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Financial Black-Holes: The Interaction of Financial Regulation and Bailout Guarantees

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Financial Black-Holes: The Interaction of Financial Regulation and Bailout Guarantees*

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1 Introduction

The recent US financial crisis has shown that the financial system might occasionally go awry generating *financial black-holes,* whereby an excessive expansion of the financial sector has negative social returns that affect severely the real sector of the economy. The financial black-hole experienced by the US is different than the typical third-generation financial crises emerging markets have experienced in recent decades, where risk taking has been associated with higher mean growth.

Can we characterize circumstances under which financial deregulation leads to black-holes? Should new financial regulation be heavy-handed and aim at ensuring the financial system does not take on any kind of insolvency risk? Or should it be light-handed and limit itself to ensuring private agents abide by their bilateral financial contracts? Here, we argue that conditions under which black-holes emerge can be identified and that neither of the above mentioned extreme regulatory frameworks is desirable. While preventing financial black-holes is desirable, overregulating in order to prevent all financial crises is not, as it will drastically reduce access to credit and growth.

In the theoretical part of this paper we consider a model in which the financial system matters for production and bailout guarantees are present, and characterize the degree of financial discipline and productivity under alternative regulatory regimes. The model makes two points. First, the toxic cocktail that generates black-holes is the combination of perceived government guarantees and the ability to issue, without collateral, excessive catastrophe-bond-like liabilities that promise to repay nothing in good states and a large amount in crisis states. Under this anything-goes regulatory regime with no limits on the type of liabilities that can be issued, financial discipline breaks down, and lending conditions are not determined by the profitability of investment projects, but by the expected generosity of the bailout guarantees.

Second, in the other extreme, an overly restrictive regime that aims at eliminating all traces of financial fragility, will reduce productive investment and hence growth. Importantly, a shift to a liberalized financial regime with limits on the type of liabilities than can be issued increases production efficiency. In such regime, systemic bailout guarantees do not lead to a break-down of financial discipline: the financial system will self-regulate and fund only positive NPV projects, some of which might be risky.

There are two channels through which a shift from a liberalized to an anything-goes regime generate black-holes: (i) it activates negative NPV activities because they are funded with catastrophe-bonds and bailout guarantees are present; and (ii) it induces entrepreneurs with positive NPV technologies–that would otherwise never default–to overleverage and take on insolvency risk via catastrophe-bonds.

The empirical part investigates whether the two sets of the model's implications are consistent with the data. First, we investigate whether the channels for a black-hole can be identified in US data in the run-up and aftermath of the recent housing crisis. Our findings support the view that in the US there was an anything-goes financial regulatory regime and a black-hole developed. Second, we carry out two exercises to assess whether financially liberalized regimes–distinct from an anything-goes regime–lead to more investment and faster growth paths punctuated by rare crises. In one exercise we use BEEPS firm-level data to provide evidence of the microeconomic mechanism linking financial liberalization, risk taking and the relaxation of borrowing conditions: we estimate the effects of currency mismatch–a common way to take on insolvency risk–on firm's borrowing costs and growth. In the other exercise, we show that over the last four decades, countries that have liberalized financially–and thus have experienced subsequent financial crises–tend to grow faster than countries that have followed a smooth path.

2 Model

We consider an economy with three production technologies: a safe one, a risky one and an inferior technology. The first two have positive net present value (NPV), while the third technology has negative NPV. This menu allows us to analyze the circumstances under which the financial system performs its disciplining function of allocating resources to all productive activities, but not to unproductive activities. In the appendix we present a mortgage-origination version of this model, where we identify these production technologies with mortgages granted to three different types of homebuyers: those that will be able to repay the mortgage regardless of future house prices; those that will repay only if prices do not fall and those that will repay only if house prices increase significantly.

Our objective is to characterize conditions under which there is trade-off between regulatory restrictiveness and efficiency, and conditions under which this trade-off breaks down–i.e., less restrictiveness leads to financial-black holes in which the financial system funds negative NPV projects.

There are two states of nature next period: a good state ($\overline{s}$) and a bad state ($\underline{s}$)

$$S_{t+1} = \begin{cases} \overline{s} & \text{with probability } u \\ \underline{s} & \text{with probability } 1-u \end{cases}$$

The safe technology returns σ in both states

$$q^{\sigma}_{t+1} = \sigma I_t, \qquad \sigma > 1+r, \tag{1}$$

where $1+r$ is the return on a storage technology. The risky technology has a return θ in the good state and zero in the bad state. The return θ is high enough so that this technology has positive NPV

$$q^{\theta}_{t+1} = \begin{cases} \theta I_t, & \text{if } S_{t+1} = \overline{s} \\ 0 & \text{if } S_{t+1} = \underline{s} \end{cases}, \qquad u\theta > 1+r \tag{2}$$

The inferior technology has a negative NPV.

$$q^{\varepsilon}_{t+1} = \begin{cases} \varepsilon I_t, & \text{if } S_{t+1} = \overline{s} \\ 0 & \text{if } S_{t+1} = \underline{s} \end{cases}, \qquad 0 < u\varepsilon < 1+r \tag{3}$$

These production technologies have hard-wired insolvency risk. In a more complicated setup, systemic risk would derive from mismatches between uncontingent promised debt repayments and contingent revenues (see Ranciere and Tornell (2010)).

There are three groups of entrepreneurs, each of which has access to one of the three production technologies, as well as to a storage technology that returns $1+r$ in all states. Each group consists of two-period lived entrepreneurs of measure one. Each young entrepreneur starts with internal funds equal to w_t. If she commits to invest her internal funds in the production technology, she can borrow from risk-neutral lenders that have an opportunity cost of r. Thus, the budget constraint of a young entrepreneur is

$$I_t + s_t = w_t + b_t, \tag{4}$$

where b_t is the amount borrowed, I_t is investment in the production technology and s_t is storage.

There are two types of liabilities that entrepreneurs can issue: *standard debt* and *catastrophe bonds*. Under a standard debt contract the borrower must repay next period under all circumstances. If she is unable to repay debt, she defaults and all revenues are lost–in bankruptcy procedures. That is, under a standard debt contract the promised repayment is

$$L_{t+1}^{sd} = b_t[1 + \rho_t^{sd}] \quad \text{for all } S_{t+1}, \tag{5}$$

where b_t is the amount borrowed and ρ_t is the promised interest rate. Catastrophe bonds, in contrast, promise to repay zero in the good state and a large amount in the bad state

$$L_{t+1}^{cb} = \begin{cases} 0 & \text{if } S_{t+1} = \overline{s} \\ b_t^{cb}[1 + \rho_t^{cb}] & \text{if } S_{t+1} = \underline{s} \end{cases} \tag{6}$$

The sale of catastrophe bonds is akin to sale of out-of-the-money puts or credit default swaps.

When old the entrepreneur consumes her profits, which will equal $q_{t+1} - L_{t+1}$ if the promised debt repayment L_{t+1} is no greater than revenues q_{t+1}. If instead $q_{t+1} < L_{t+1}$, the entrepreneur defaults and all revenues are lost in bankruptcy procedures. It follows that expected profits are

$$\pi_{t+1} = E_t\left(\max\{0, q_{t+1} - L_{t+1}\}\right). \tag{7}$$

2.1 Financial Regulatory Regimes

We consider three regulatory regimes.

Restrictive regime It restricts the class of borrowers and the type of liabilities: lenders can only lend to the entrepreneurs with access to the safe production technology, and only the issuance of standard debt is allowed.

Liberalized regime It only restricts the type of liabilities that can be issued: it allows lenders to lend to any class of entrepreneur, but only allows the issuance of standard debt.

Anything-goes regime It restricts neither the class of borrowers nor the type of liabilities that can be issued.[1]

Our objective is to analyze conditions under which the financial system performs its disciplinary role, as defined below, under the three regulatory regimes.

[1] We do not refer to the anything-goes regime as *laissez-faire* because we will introduce bailout guarantees. Thus, agents do not face the consequences of the contracts they sign.

Financial Discipline The financial system performs its disciplinary role if lenders fund all entrepreneurs with positive NPV technologies, but fund neither entrepreneurs with a negative NPV technology nor diversion schemes.

2.2 Credit Market Imperfections

The economy has two imperfections: bailout guarantees and enforceability problems. The guarantees are an–implicit or explicit–government policy that insures lenders against default by borrowers in certain circumstances. To capture the stylized fact that bailouts are granted if there is a financial crisis, but not otherwise, we consider the following bailout policy.

Systemic Bailout Guarantees If a critical mass of borrowers defaults and the bad state realizes, the government pays lenders of defaulting borrowers up to an amount $G_t = gw_{t-1}$ per borrower. If isolated defaults occur, the lenders are not bailed out.

As we shall see, the disciplinary role of the financial system is achieved when lenders impose borrowing constraints. In order to understand how bailout guarantees can lead to a break-down of financial discipline, it is necessary to endogeneize borrowing constraints. Therefore, we postulate an agency problem that might endogenously give rise to borrowing constraints under some circumstances. We introduce the agency problem between lender and borrower via a contract enforceability problem.

Contract enforceability problems If a borrower implements a diversion scheme at time t, she will be able to divert all funds at $t+1$ provided she is solvent. In order to implement a diversion scheme, the borrower has to incur at time t a diversion cost, proportional to her investable funds

$$\text{diversion cost} = h[w_t + b_t]$$

The parameter h indexes the degree of contract enforceability. The greater h, the more costly for a borrower to divert. A borrower will choose not to set up a diversion scheme if and only if the expected debt repayment is less than the diversion cost

$$\text{Borrower's expected debt repayment} \;\leq\; h[w_t + b_t] \tag{8}$$

This no-diversion condition becomes a borrowing constraint only if it is binding in equilibrium for some positive b_t. This is the case only if at the margin the diversion cost is smaller than the expected interest cost. Thus, in order for the economy to be financially constrained under standard debt we impose the following condition

$$h < [1 + r]u. \tag{9}$$

Notice that requiring that a critical mass of borrowers default to trigger a bailout is necessary for the no-diversion condition to become a borrowing constraint. If a bailout were granted in the wake of any idiosyncratic default, then lenders would not find it optimal to impose borrowing limits: (8) would never become a borrowing constraint. In addition to being crucial for the argument, we consider that this "systemic" nature of the guarantees is realistic.

2.3 Financial Discipline

A restrictive regulatory regime might easily succeed in inducing financial discipline, but at a high social cost in terms of underinvestment. Here we investigate conditions under which a relaxation of the regulatory regime might increase productive investment while not breaking down the financial discipline. Our results are summarized in three propositions that characterize the financial discipline induced by each regulatory regime.

2.3.1 Restrictive Regulatory Regime

This regime directs lenders to lend only to σ-entrepreneurs with access to the safe technology with a non-stochastic return. Under such regime financial fragility would arise and bailouts would be triggered only if entrepreneurs issued excessive debt or they set up diversion schemes. The next proposition says that the are no incentives for such fragility-inducing actions.

Proposition 1 (Financial Discipline in a Repressive Regime) *Under the restrictive regulatory regime the financial system performs its disciplinary role by imposing borrowing constraints that ensure diversion schemes are not profitable. Furthermore, bailout guarantees are never triggered.*

Consider the case where no bailout guarantees are expected. Lenders are willing to lend up to an amount that ensures borrowers will be able to repay debt and have no incentives to divert borrowed funds. Suppose for a moment that such a contract is feasible. Then lenders break even if the interest rate on debt equals the storage rate

$$1 + \rho_t^{safe} = 1 + r \tag{10}$$

It follows that the no-diversion constraint (8) becomes

$$b_t[1 + r] \leq h[w_t + b_t] \tag{11}$$

This no-diversion constraint becomes a borrowing constraint because contract enforceability problems are severe enough: $h < 1 + r$ (this condition is implied by (9)). It follows that borrowing and investment are

$$b_t^s = [m^s - 1]\, w_t, \qquad I_t^s = m^s w_t, \qquad m^s \equiv \frac{1}{1 - \frac{h}{1+r}} \tag{12}$$

The first equation shows that credit is constrained by internal funds. The second equation exhibits the familiar financial accelerator: investment equals the multiplier times internal funds. As we can see, the greater the degree of contract enforceability h, the greater the investment multiplier.

To verify that borrowers will be able to repay we replace (12) in (7), and find that the borrowing constraint ensures that revenues will be sufficient to repay debt (i.e., profits are always positive (because $\sigma > h$))

$$\pi_{t+1}^{\sigma} = \sigma m^s w_t - [m^s - 1][1 + r]w_t = [\sigma - h]m^s w_t. \tag{13}$$

Furthermore, under borrowing constraint (12) the entrepreneur does not gain by setting up a diversion scheme: he would get $\pi_{t+1}^{\sigma,\mathrm{div}} = \sigma m^s w_t - h[w_t + b_t] = \sigma m^s w_t - h m^s w_t$, which is the same as his payoff under no diversion (13).

Next, notice that there are no incentives to exploit the bailout guarantees. In order to do so, entrepreneurs would have to issue high enough debt that would render them insolvent in the bad state. Under the standard debt requirement, however, this excessive debt implies that entrepreneurs would also default in the good state. Thus they would get zero profits in both states.

2.3.2 Liberalized Regime

Under the liberalized regime lenders can lend to any entrepreneur, but only standard debt can be issued. A key point, made by the following proposition, is that even in the presence of bailout guarantees, financial discipline is preserved by the requirement that debt must be repaid in *all states of nature.* Thus, on financial discipline grounds, the existence of guarantees is not sufficient to justify an overly restrictive regulatory regime that directs lending to specific type of borrowers.

Proposition 2 (Financial Discipline in a Liberalized Regime) *Under the financially liberalized regulatory regime–that restricts liabilities to standard debt contracts–the financial system performs its disciplinary role:*

- *Interest rates and borrowing constraints are such that negative NPV projects are not undertaken, while all entrepreneurs with positive NPV projects are funded and do not divert.*

- *Systemic bailout guarantees do not undermine the disciplinary role of the financial system: under standard debt, guarantees only relax the borrowing conditions of risky borrowers but induce neither the undertaking of negative NPV projects nor diversion.*

Case a. No bailout guarantees are expected

The problem of a lender lending to a σ-entrepreneur is the same problem as the one under the restrictive regime, and so borrowing and investment are as in (12). Consider a lender that lends to an θ-entrepreneur with access to the risky technology. Since she will default with probability $1-u$, lenders require an interest rate that allows them to break even

$$1+\rho_t^{risky,NG} = \frac{1+r}{u} \tag{14}$$

Since the expected debt repayment by the entrepreneur is $ub_t[1+\rho_t]$, the no-diversion constraint is

$$\begin{aligned} h[w_t+b_t] &\leq ub_t[1+\rho_t] \\ &= b_t[1+r] \end{aligned} \tag{15}$$

A comparison of borrowing constraints (11) and (15) reveals that in a liberalized regime with no guarantees, the θ-entrepreneur can borrow and invest the same amounts as the σ-entrepreneur under the restrictive regime (they are given by b_t^s and I_t^s in (12)).

How about ε-entrepreneurs with access to the inferior technology? Since their productivity is too low ($u\varepsilon < 1 + r$), they prefer to store their funds in the absence of guarantees.

To sum up, under a liberalized regime, in the absence of guarantees, the financial market will impose discipline into investment decisions: the interest rates charged to entrepreneurs and the borrowing constraints imposed on them by lenders internalize the risks taken on by entrepreneurs. Only entrepreneurs with positive NPV projects are funded.

Case b. Bailout guarantees are expected

In this case, lenders impose the same interest rate on risky entrepreneurs as that for safe entrepreneurs because from the lender's perspective loans to θ-entrepreneurs are safe: either they will be repaid by the borrower if $S_{t+1} = \overline{s}$ or by the government if $S_{t+1} = \underline{s}$. That is, the interest rate to risky borrowers reflects the guarantee

$$1 + \rho_t^{risky,G} = 1 + r.$$

Since the expected debt repayment by the entrepreneur is $ub_t[1 + \rho_t]$, the no-diversion constraint is

$$h[w_t + b_t] \leq ub_t[1 + r]. \tag{16}$$

We set the upper limit on the bailout high enough so that it is not binding in a risky equilibrium

$$G_{t+1} = gw_t, \qquad g > \frac{1}{\frac{1}{h} - \frac{1}{u}\frac{1}{1+r}}$$

It follows that with generous guarantees, borrowing and investment by θ-entrepreneurs are

$$b_t^r = [m^r - 1]\, w_t, \qquad I_t = m^r w_t, \qquad m^r \equiv \frac{1}{1 - \frac{1}{u}\frac{h}{1+r}} \tag{17}$$

Shifting from a no-guarantees' regime to a guarantee's regime has two benefits for a θ-entrepreneur: it reduces the interest rate from $\frac{1+r}{u}$ to $1 + r$, and it relaxes her borrowing constraint, which allows for greater leverage and investment (the investment multiplier increases from m^s to m^r). This relaxation of borrowing constraints comes about because lower expected interest payments reduce the incentives to divert. One can thus interpret the bailout guarantees as an implicit investment subsidy that can be cashed in only by taking on insolvency risk.

A θ-entrepreneur can choose to store her equity w_t rather than invest in the risky technology. In the former case she will get $w_t[1+r]$ for sure, while in the latter case the entrepreneur might default and loose her equity w_t. Thus, she will take on risk only if the benefits are high enough so that $w_t[1+r]$ is lower than expected profits, which are

$$\pi_{t+1}^{risky,BG} = u\left\{\theta m^r w_t - [m^r - 1][1+r]w_t\right\} = [u\theta - h]m^r w_t.$$

The benefits of taking on risk outweigh the default costs $\pi_{t+1}^{risky,BG} > w_t[1+r]$ if and only if $h > [1 + r - u\theta]\frac{u}{1-u}$. This inequality holds for all $h > 0$ because the risky technology has positive NPV ($1 + r < u\theta$).

Will bailouts induce the adoption of the inferior technology in a liberalized regime? No. To see why, suppose that an ε-entrepreneur issues standard debt and invests in the ε-technology. A lender would charge the ε-entrepreneur an interest rate r, and lend her an amount that satisfies both the no-diversion constraint $ub[1 + r] \leq h[w + b]$ and allows the borrower to repay in full in the good state $q^{\varepsilon} - b[1+r] \geq 0$. Even though lenders are willing to lend to an ε-entrepreneur, she has no incentives to risk her funds w_t because her cost of funds $u[1 + r]$ is greater than the expected return $u\varepsilon$. Thus, bailouts do not activate the inferior technology when financial regulation restricts liabilities to standard debt contracts.

2.3.3 Anything-Goes Regime

Under this regime lenders are allowed to fund any class of entrepreneurs, as in the liberalized regime. In addition, regulation allows not only for the issuance of standard debt, but also permits catastrophe bonds. The key implication is that the disciplining role of the financial system *might* break down. However, as detailed in the next proposition, discipline *need not* always **to** break down. It is only the toxic combination of the anything-goes regulatory regime with generous systemic bailout guarantees that breaks financial discipline and generates financial black holes. If only systemic bailout guarantees were present, the financial system would perform its disciplinary role and weed out negative NPV investment projects via interest rates and borrowing constraints. If the regulatory regime were of an anything-goes type but systemic bailout guarantees were absent, lenders would internalize the consequences of their lending decisions and only positive NPV project would be funded. That is, there would be no need for financial regulation in a truly *laissez-faire regime.*

Proposition 3 (Anything-Goes Regime) *In an anything-goes regulatory regime, where catastrophe bonds can be issued, the disciplining role of the financial system is determined by the generosity of bailout guarantees:*

- *Financial discipline breaks down if bailout guarantees are generous: (i)negative NPV production technologies are funded; and (ii) entrepreneurs that would otherwise have zero likelihood of default, take on insolvency risk via an excessive issuance of catastrophe bonds.*

- *In the absence of generous bailout guarantees there is financial discipline: (i)only positive NPV technologies are funded; (ii) there is no diversion; and (iii)all catastrophe bonds issued are repaid for sure by the issuer.*

Case a. No bailout guarantees are expected

Recall that with a catastrophe bond an entrepreneur receives b_t^{cb} at time t from a lender for a promise to repay zero in the good state, and $L_{t+1}^{cb} = b_t^{cb}[1+\rho_t^{cb}]$ in the bad state. In the absence of guarantees, no lender is willing to buy catastrophe bonds issued by either θ-entrepreneurs or ε-entrepreneurs because it is known that they will default in the bad state. Therefore, the lender will be paid zero in both states for sure. A lender, however, is willing to buy a catastrophe bond issued by safe σ-entrepreneurs up to an amount that satisfies the no-diversion condition $[1-u]b_t^{cb}[1+\rho_t^{cb}] \leq h[w_t + b_t^{cb}]$. Since the interest rate that allows the lender to break even is $\rho_t^{cb} = \frac{1+r}{1-u}$, the no-diversion condition implies that the largest loan amount consistent with no diversion is $b_t^{cb} = m^s w_t$. Notice that this amount coincides with the amount of standard debt that the σ-entrepreneur can issue (see (12)). Furthermore, her expected profits are the same under both types of liabilities. Thus, in the absence of guarantees, the σ-entrepreneur is indifferent between issuing catastrophe bonds and standard debt.

In sum, in the absence of guarantees a shift from a liberalized regime to an anything-goes regulatory regime does not undermine the disciplinary role of the financial system. In fact, if the relaxation of regulation leads to the issuance of catastrophe bonds, they will be repaid for sure by the issuer. If we refer to Laissez-faire as a situation with an anything-goes regulatory regime and absence of guarantees, we can say that laissez-faire does not undermine the disciplinary role of the financial system.[2]

Case b. Bailout guarantees are expected

The main difference with respect to the other regimes is that now lenders are willing to buy catastrophe bonds issued by ε-entrepreneurs, and that the inferior ε-technology is activated. With a catastrophe bond the promised repayment is concentrated in the bad state, while it is zero in the good state. In the bad state, although an ε-entrepreneur will default, the lender expects to be repaid by the government. A key implication is that the disciplinary role of the financial system breaks down: the lender does not care whether the investment project is profitable or the borrower will set up a diversion scheme. Thus, contract enforceability problems do not give rise to borrowing constraints. Rather, if the bailout generosity is high enough ($g > g^*$), the lender and the entrepreneur will enter a catastrophe debt contract that *fully exploits the bailout guarantee*: since the maximum bailout is $G_{t+1} = gw_t$, the lender lends up to

$$b_t^{cb} = \frac{1-u}{1+r} g w_t, \tag{18}$$

and the ε-entrepreneur invests all her funds in the ε-technology

$$I_t^{\varepsilon} = \left[1 + \frac{1-u}{1+r} g\right] w_t \qquad \text{if } g > g^* \equiv \left[\frac{1+r}{u\varepsilon} - 1\right] \frac{1+r}{1-u}$$

Condition $g > g^*$ ensures that the expected profits of investing in the ε-technology ($\pi_{t+1}^{\varepsilon,cb} = u\varepsilon[1 + \frac{1-u}{1+r} g]w_t$) are greater than the storage return $[1+r]w_t$.

Will θ-entrepreneurs issue standard debt or catastrophe bonds? If she issued catastrophe bonds, the borrowing constraint would be determined by the bailout guarantee not by the no-diversion condition. Thus, the θ-entrepreneur could borrow up to (18) and her expected profits would be $\pi_{t+1}^{\theta,cb} = u\theta[1 + \frac{1-u}{1+r} g]w_t$. If instead she issues standard debt, the borrowing constraint is determined by the no-diversion condition–as in the liberalized regime–and so her expected profits are $\pi_{t+1}^{risky,BG} = [u\theta - h]m^r w_t$, which were derived above. A comparison of these expected profits reveals that θ-entrepreneurs prefer to issue catastrophe bonds over standard debt if the bailout generosity is high enough ($g > g^{**}$)

$$g^{**} \equiv \left[\frac{[u\theta - h]\, m^r}{u\theta} - 1\right] \frac{1+r}{1-u}.$$

[2] Opponents of restrictions on OTC derivatives trading have this laissez-faire regime in mind.

Lastly, σ-entrepreneurs also prefer to issue catastrophe bonds over standard debt if the bailout generosity is high enough ($g > g^{***}$)

$$g^{***} \equiv \left[\frac{[\sigma - h]\, m^s}{u\theta} - 1 \right] \frac{1+r}{1-u}.$$

If g is high enough, it behooves a σ-entrepreneur to shift from a strategy that never defaults–and yields $\pi_{t+1}^{\sigma,safe} = [\sigma - h] m^s w_t$–into a strategy that leads to default in the bad state by issuing an excessive amount of catastrophe bonds, so that promised debt repayments in the bad state surpass revenues. The latter strategy yields an expected profit of $\pi_{t+1}^{\theta,cb} = u\sigma[1 + \frac{1-u}{1+r} g] w_t$.

The essential reason for the breakdown of discipline across safe entrepreneurs is that the σ-entrepreneur can increase her bad state debt repayment without being forced to increase her good state repayment.

2.4 Social Efficiency

In the financially constrained economy we have characterized, an increase in expected output comes about with the undertaking of insolvency risk and the consequent bailouts during default episodes. Thus, an appropriate criterion of social efficiency should consider the implicit bailout costs that are born out by the taxpayer. To this end, we define the "social profits" generated by a j-entrepreneur as her expected private profits net of expected bailout costs.[3]

$$W^j \equiv E(\pi^j - BG^j) \tag{19}$$

Using (19) we define the "social efficiency" of a regulatory regime as the sum of social profits over all entrepreneurs: $W = \sum_j w^j$, and we define a black-hole as follows.

Financial Black Hole Is a situation where an increase in credit to a group of entrepreneurs is associated with a reduction in their social profits (i.e., a fall in expected private profits net of bailout costs).

[3] In a dynamic setup the government could finance the bailout scheme by issuing debt and repaying it via taxes during good times. In the two-period setup we consider here, we can think of an insurance contract between the government and an international organization by which the government pays the agency in the good state and receives a payment to finance the bailout in the bad state. The government would then impose lump-sum taxes.

Here, we ask whether social efficiency is greater in a restrictive regime, in a liberalized regime or in an anything-goes regime. The economy's original sin is the credit market imperfection that generates borrowing constraints and underinvestment. Thus, the economy would benefit from more investment. The first best policy is for a central planner to allocate all investable resources to the most productive entrepreneurs. A second best policy is to implement a *judicial reform* that improves contract enforceability (h) and in this way relaxes borrowing constraints. Here we ask whether, in the absence of such policies, a relaxation of financial regulation helps to bring greater social efficiency.

We address two issues. First, can there be an increase in social efficiency by shifting from a restrictive regime–that only allows lending to agents that will never default–to a liberalized regime that allows lenders to lend to whomever they choose, but that only permits the issuance of standard debt? Second, what is the effect on social efficiency of a shift from a liberalized to an anything-goes regime–that eliminates the restriction to issue only standard debt. The following proposition states that, in the presence of generous guarantees, some deregulation increases productive investment, but excessive deregulation generates *financial black holes.*

Proposition 4 (Social Efficiency and Financial Black-holes) *1. A shift from a restrictive to a liberalized regime increases the incidence of financial crises, but it also increases social efficiency.*

2. *A shift from a liberalized to an anything-goes regime with generous bailout guarantees generates* financial black holes *as the financial system stops imposing discipline into investment decisions: (i) production technologies with negative NPV become funded; and (ii) entrepreneurs with access to positive NPV technologies–even those that would have never defaulted under other regimes–choose to take on insolvency risk by issuing excessive catastrophe bonds as a means to exploit the bailout guarantee.*

To show the first point we compare expected social profits across the restrictive and the liberalized regimes. Recall that in both regimes σ-entrepreneurs have the same investment level, and that ε-entrepreneurs cannot obtain external funds. The only effect of the regime shift is to allow θ-entrepreneurs to receive external funds. Thus, in a restrictive regime θ-entrepreneurs' contribution to social profits equal their private expected profits $E_t\left(\pi_{t+1}^{\theta,restrictive}\right) = u\theta w_t$, while in the liberalized regime their social profits must subtract the bailout costs: $E_t\left(q_{t+1}^{\theta,BG} - BG_{t+1}\right) = u\theta m^r w_t - [1-u][m^r - 1][1+r]w_t$. The right hand side of this equation equals $u\theta m^r w_t - [1-u]hm^r w_t$, which is unambiguously positive because the θ-technology has positive NPV ($u\theta > 1+r$) and borrowing constraints bind ($h < u[1+r]$). Furthermore, the regime shift generates an increase in the social net contribution of θ-entrepreneurs:

$$W^{\theta,Liberalized} - W^{\theta,restrictive} = \left[\frac{u\theta}{1+r} - [1-u]\right] hm^r w_t.$$

This expression is positive for all positive probabilities of the good state u because the θ-technology has positive NPV ($u\theta > 1+r$). A shift to a liberalized regime has two effects. First, it allows the funding of a new class of entrepreneurs with risky but positive NPV production technologies. Second, it activates the bailout guarantees, which act as an implicit investment subsidy that allows entrepreneurs to leverage up more and invest more, but entail fiscal costs. Importantly, since the financial system performs its discipline role under a liberalized regime, only positive expected NPV projects are undertaken–θ-entrepreneurs are funded but ε-entrepreneurs are not–and so the increased expected output more than compensates for the expected bailout costs.[4]

To establish the second point of the proposition recall that a financial black hole is a situation where more financial intermediation is associated with less net expected output. There are two channels by which financial black holes are generated by a shift from a liberalized to an anything-goes regime if guarantees are generous: (i) it activates negative NPV production technologies; and (ii) it induces entrepreneurs with positive NPV technologies–that would otherwise never default–to overleverage and take on insolvency risk.

For (i) consider the case $g > g^*$, so that ε-entrepreneurs choose to invest in the ε-technology in an anything-goes regime. The social profits of ε-entrepreneurs in an anything-goes regime are $u\varepsilon\left[1 + \frac{1-u}{1+r}g\right] w_t - [1-u]gw_t$. Comparing this expression with the storage return $[1+r]w_t$ obtained by ε-entrepreneurs in alternative regimes, it follows that the change in the ε-entrepreneurs' social profits brought about by the shift from a liberalized to an

[4] One could ask whether a shift to the liberalized regime but with no guarantees generates more expected net output than a regime with guarantees. Recall that in the abscence of guarantees θ-entrepreneurs' investment is $I_t^{\theta,noBG} = m^s w_t$, while in the presence of guarantees it is $I_t^{\theta,BG} = m^r w_t$. Thus, expected net output is greater in a liberalized economy with bailout guarantees if $E_t\left(q_{t+1}^{\theta,BG} - BG_{t+1}\right) > E_t\left(q_{t+1}^{\theta,noBG}\right) = u\theta m^r w_t - [1-u][m^r - 1][1+r]w_t > u\theta m^s w_t$.

anything-goes regime is

$$W^{\varepsilon,AnythingGoes} - W^{\varepsilon,Liberalized} = g[1-u]\left[\frac{u\varepsilon}{1+r} - 1\right] w_t + [u\varepsilon - (1+r)]\, w_t,$$

which is unambiguously negative because the ε-technology has negative NPV. The shift to an anything-goes regime brings about not only the activation of a negative NPV production technology, but also the social cost associated with the bailout.

For (ii) recall that the shift to an anything-goes regime induces safe σ-entrepreneurs to issue an excessive amount of catastrophe bonds and default in the bad state if $g > g^{***}$. This is because the increase in leverage and profits in the good state dominates the potential losses associated with default in the bad state. This strategy shift might or might not reduce expected social profits as more leverage is traded off against bankruptcy costs: under a safe strategy social profits are $\sigma m^s w_t$, while under the insolvency risk strategy they are $u\sigma\left[1 + \frac{1-u}{1+r} g\right] w_t - [1-u] g w_t$. The difference is

$$W^{\sigma,AnythingGoes} - W^{\sigma,Liberalized} = \sigma\left(\left[1 + \frac{1-u}{1+r} g\right] u - m^s\right) w_t - g[1-u] w_t$$

This expression has an ambiguous sign. On the one hand the regime shift allows for greater investment in a positive NPV technology. On the other hand it generates insolvency risk, and so with probability $1-u$ the economy incurs bailout costs and bankruptcy costs–all output is lost in bankruptcy procedures. The first term captures the change in expected output and the second term captures bailout costs. If the likelihood of the bad state $1-u$ is high enough or the degree of contract enforceability h is high enough, so that borrowing constraints are not very restrictive, then a regime shift generates a *financial black hole* in the otherwise safe σ-sector. Notice that $\lim_{h \to 1+r} m^s = \infty$.[5]

Lastly, if the guarantees are very generous ($g > g^{**}$), θ-entrepreneurs will also issue catastrophe bonds. The change in their contribution to social profits is

$$W^{\theta,AnythingGoes} - W^{\theta,Liberalized} = hm^r\left[1 - \frac{\theta}{1+r}\right] w_t - g[1-u]\left[\frac{u\theta}{1+r} - 1\right] w_t$$

We can see that a regime shift unambiguously generates a *financial black hole* in the θ-sector because $\theta > u\theta > 1+r$.

[5] This strategy shift is not simply a theoretical curiosity. It captures the excessive issuace of currency puts by AAA-rated companies in the boom preceding the 2008 crisis, such as Comercial Mexicana and Cemex in Mexico, and Aracruz in Brazil.

To sum up, a shift to an anything-goes regulatory regime combined with generous bailout guarantees generates *financial black holes* across the three groups of entrepreneurs because the financial system stops imposing discipline into investment decisions. Thus, (i) production technologies with negative NPV become funded; and (ii) entrepreneurs with access to positive NPV technologies–even those that would have never defaulted under other regimes–choose to take on insolvency risk by issuing excessive catastrophe bonds as a means to exploit the bailout guarantee.

2.4.1 Bailout Expectations

Notice that coordination–implicit or explicit–among agents is necessary for bailout expectations to arise in equilibrium. If a majority of agents believe that no bailout will be granted under any circumstances, and this is common knowledge, there are no incentives for any type of entrepreneur to unilaterally undertake insolvency risk.

If a few entrepreneurs issue catastrophe bonds and bailout guarantees are absent, the financial system will play its disciplinary role and ensure the issuers of these catastrophe bonds have the ability and incentives to repay them. However, as more entrepreneurs start to issue catastrophe bonds, there is a tipping point beyond which a perception of bailout guarantees arises. Beyond this tipping point, there is a break-down of financial discipline in an anything-goes regulatory regime and financial black holes arise.

3 Opening the Box: Mortgage Origination

Here, we open the box by replacing the entrepreneurs and lenders with mortgage originators, securitizers, insurers and pension funds. This exercise will not add any new insights, but will allow us to link the abstract concepts–such as catastrophe bonds–to financial instruments used in the real world, and connect the financial black-hole concept to the recent US housing boom-bust cycle.

Consider a set up where *mortgage originators* extend one-period mortgages to homebuyers. A homebuyer will repay the mortgage next period by using two sources of funds: a refinancing loan and his disposable income y^i. Thus, a homebuyer will be able to repay the mortgage only if his disposable income plus the amount he will obtain in mortgage refinancing are greater than his committed mortgage repayment. Otherwise, the house will be foreclosed and the entire value of the mortgage will be lost in bankruptcy procedures.

The refinancing amount will equal the house price at $t+1$. The house price equals 1 at time t, and might go up or fall at $t+1$.

$$p_{t+1} = \begin{cases} \overline{p} > 1 & \text{with probability } u \\ \underline{p} < 1 & \text{with probability } 1-u \end{cases}$$

Mortgages have a zero down payment and require the homebuyer to repay next period the loan plus a mortgage rate μ, which includes a markup over the riskless rate (i.e., $\mu > r$). Since house prices equal 1 at time t, the mortgage repayment amount at $t+1$ is $[1+\mu]$.

There are three groups of homebuyers: safe, risky and no-doc. The safe homebuyers have a high and steady disposable income (y^{σ}) that will allow them to repay the mortgage in full even if house prices fall: $y^{\sigma} > 1+\mu$. The risky and the no-doc homebuyers have a low and random disposable income: it is $\widetilde{y} < 1+\mu-\underline{p}$ with some probability and 0 otherwise. Thus, they can repay the mortgage only if their income is positive and the home price goes up. That is,

$$\widetilde{y} + \overline{p} > 1+\mu > \widetilde{y} + \underline{p}.$$

The risky and no-doc homebuyers' income are positive with probability θ and ε, respectively, with $\theta < \varepsilon$. We can think of the risky homebuyers as workers with steady jobs that will be employed with a high probability θ, while the no-doc homebuyers have transitory jobs that will be employed with low probability ε. Safe homebuyers can be thought of as wealthy individuals that can always repay their mortgages.

The repayment probabilities of the three homebuyers' types are

$$P^{\sigma} = [1+\mu], \qquad P^{\theta} = \theta u[1+\mu], \qquad P^{\varepsilon} = \varepsilon u[1+\mu]$$

In order to have the same ranking of expected returns as in the original model we set

$$\varepsilon u[1+\mu] < 1+r < \theta u[1+\mu]$$

The upshot is that mortgages to σ- and θ- homebuyers have positive NPV, while ε-mortgages have negative NPV. Notice that we can interpret ε-mortgages as Alt-A mortgages in which the required repayment is low during the first few years of the loan, but then might jump up. As long as house prices will increase fast enough, the borrower will be able at that future date to get a new Alt-A mortgage. This process can go on and on until house prices stop rising, at which point the borrower will default.

There are three types of mortgage *originators* $\{\sigma, \theta, \varepsilon\}$, each specializing in extending mortgages to one of the three homebuyers' types. These originators also act as *securitizers* that package mortgages into bonds and sell them.

At time t, a representative j-type mortgage originator lends 1 to a j-type homebuyer. At $t+1$ the j-homebuyer will repay $1+\mu$ if he is solvent or 0 otherwise. In order to link the originators' payoff to the entrepreneurs in the original model denote by I^j the number of mortgages originated by a j-originator. It follows that the repayments next period are:

σ-originator: $\quad q^{\sigma}_{t+1} = I^{\sigma}[1+\mu]$

$$\rho\text{-originator:} \quad q^{\theta}_{t+1} = \begin{cases} I^{\theta}[1+\mu] & \text{if } p_{t+1} = \overline{p} \text{ and } y^{\theta}_{t+1} = y^{\theta} \\ 0 & \text{if } p_{t+1} = \underline{p} \text{ or } y^{\theta}_{t+1} = y^{\theta} \end{cases}$$

$$\varepsilon\text{-originator:} \quad q^{\varepsilon}_{t+1} = \begin{cases} I^{\varepsilon}[1+\mu] & \text{if } p_{t+1} = \overline{p} \text{ and } y^{\varepsilon}_{t+1} = y^{\varepsilon} \\ 0 & \text{if } p_{t+1} = \underline{p} \text{ or } y^{\varepsilon}_{t+1} = 0 \end{cases}$$

Mortgage Financing

We introduce two additional risk neutral agents with an opportunity cost of capital r: *funds* and *insurers.* Funds are required by regulation to hold safe net positions in their balance sheets (i.e., they should be rated AAA by rating agencies). Insurers specialize in trading put-like instruments. In particular, insurers trade *put contracts* that have a promised repayment of the form

$$L^{cb}_{t+1} = \begin{cases} 0 & \text{if } p_{t+1} = \overline{p} \\ x & \text{if } p_{t+1} = \underline{p} \end{cases}$$

Mortgage originators fund themselves by repackaging mortgages into *CDOs.* A CDO has two tranches: a junior tranche and a senior tranche that promises an interest rate ρ. If some mortgages in the CDO default, the junior tranche absorbs the losses, and the senior tranche gets paid in full until the junior tranche has lost all its value. Originators sell to the funds the senior tranches of the CDOs (b_t) and keep the junior tranches (w_t).

In particular, a $\theta-$mortgage originator with internal funds w_t that sells b_t senior CDO tranches to the funds, is able to originate $w_t + b_t$ θ-mortgages at time t. Next period, if $p_{t+1} = \overline{p}$, a share θ of the mortgages will repay $1+\mu$, while a share $1-\theta$ will default. In this case the fund (that holds the senior CDO tranche) will receive $b_t[1+\rho]$, while the originator (that holds the junior CDO tranche) absorbs the losses and receives only $\theta[w_t + b_t][1+\mu]$. If instead the bad state realizes ($p_{t+1} = \underline{p}$) then all θ-mortgages default and both CDO tranches get zero.[6]

In order to generate a AAA security that pays for sure $b_t[1+\rho]$ in all states next period, the funds buy from insurers a put that pays 0 if $p_{t+1} = \overline{p}$ and $b_t[1+\rho]$ if $p_{t+1} = \underline{p}$.[7] It follows that, from the funds' and the regulator's perspectives, the senior tranche of the CDO plus the put constitute a AAA security that will pay $b_t[1+\rho]$ in every state. Of course, such AAA security might have a very low expected return because of the cost of insurance. As we shall see, here is where systemic bailout guarantees kick in.

Whether originators can replicate the catastrophe bonds of the original model or only issue standard debt is determined by the regulations on derivatives trading.[8] Analogous to the original model, we consider three regulatory regimes.

Restrictive regime. Pension funds must hold AAA securities and cannot buy puts from insurers.

Liberalized regime. Pension funds must hold AAA securities, but can buy protective puts. Insurers can only sell puts that pay-off if $p_{t+1} = \underline{p}$.

Anything-goes regime. Pension funds must hold AAA securities, but can buy protective puts. Insurers can enter into any option contract with no collateral.

The rest of the setup is as in the original model: there are contract enforceability problems and systemic bailout guarantees. In particular, a mortgage originator cannot commit to repay debt: by incurring a cost $h[w_t + b_t]$ she can set up a diversion scheme and divert all funds next period. Furthermore, if a majority of mortgages defaults, the government pays out all the obligations up to $G = gw_t$ per creditor.

We can now see that both models are isomorphic: the mortgage repayments have the same form as production technologies (1)-(3), and the originators' borrowing costs have

[6] Notice that buying a senior CDO tranche is like buying a call option that will pay only in the good state.

[7] In the literature catastrophe bonds are sometimes assumed to be call-like instrument: they pay 0 in the bad state and a positive amount in the good state. In this paper catastrophe bonds are puts.

[8] Under a standard debt contract the originator must repay next period under all circumstances, regardless of the house price realization. A catastrophe bond, in contrast, promises to repay zero if house prices rise ($p_{t+1} = \overline{p}$), and a large amount if house prices fall ($p_{t+1} = \underline{p}$). Thus, the promised repayments under these two liabilities are as in the original model substituting the realization of the price p_{t+1} for the realization of the state S_{t+1} (given by (5) and (6)).

the same form in both models. In particular, notice that the mortgages to safe and risky homebuyers have positive NPV and correspond to the σ- and θ-technologies of the original model. Meanwhile, the no-doc mortgages have ex-ante negative NPV and correspond to the inferior ε-technology. Furthermore, notice that since a bailout is granted only if a majority of originators defaults, a bailout occurs in the original model only in the bad state ($S_{t+1} = \underline{s}$), and only if the house price are low ($p_{t+1} = \underline{p}$) in this model. In particular, a bailout would not be granted if $p_{t+1} = \overline{p}$ and $y^{\varepsilon} = 0$ even if all ε-originators defaulted. It follows that the propositions derived in the original model apply to this mortgage origination setup if we replace the state (S_{t+1}) by house prices (p_{t+1}).[9]

From the propositions in the original model we have that in the restrictive regime only σ-homebuyers get mortgages and originators never default. In the liberalized regime both σ- and θ-homebuyers get mortgages and originators default with probability $1 - u$. In an anything goes regime all homebuyers get mortgages including those that are not expected to repay.

To analyze the liberalized regime consider θ-mortgages. As we described above, funds can create a synthetic riskless bond that will repay $b_t[1 + \rho]$ in all states at $t + 1$ by buying a senior CDO tranche and a put that will pay-off $b_t[1 + \rho]$ if $p_{t+1} = \underline{p}$.

To determine the price of this put notice that since the systemic bailout guarantee is activated if $p_{t+1} = \underline{p}$, the taxpayer ends up paying the promised put repayment. Since insurers are risk neutral and competitive, the guarantee makes the time t price of the protective put go to zero. It then follows that the funds will accept an interest rate ρ equal to the riskless rate r. The results in the model imply that a fund will buy from a θ-originator up to an amount of CDOs that makes diversion non-optimal: $b_t = [m^r - 1]w_t$. Lastly, θ-originators' expected returns on their equity (w_t) are greater than the riskless return because mortgage repayments in the good state are high enough: $\theta u[1 + \mu] > 1 + r$. Thus, θ-originators find it optimal to originate θ-mortgages.

Notice that, as in the original model, under a liberalized regime ε-mortgages are not originated because the ε-originators' expected returns on their equity are lower than the

[9] Notice that there is a difference with respect to the original model because here there are three states rather than two states. This difference is inessential. In the original model payoffs depend only on the realization of S_{t+1}. Similarly, in this model, payoffs depend only on the realization of p_{t+1}. It is payoff-irrelevant whether we have $\{p_{t+1} = \overline{p}$ and $y^{\varepsilon} = 0\}$ or $\{p_{t+1} = \overline{p}$ and $y^{\varepsilon} > 0\}$. Furthermore, both models have the same binary structure of payoffs and the same ranking of expected returns.

riskless return: the financial system performs its disciplinary role.

Next, to illustrate how an anything-goes regime can generate financial black-holes, we describe an array of derivatives contracts that support the issuance of ε-mortgages with a negative NPV. Because there are no restrictions on the option contracts that can be issued, originators-securitizers are able to de-facto shift all their promised repayments from the good state to the catastrophic state, and in this way manufacture synthetic catastrophe bonds. Recall that with catastrophe bonds originators promise to repay zero if $p_{t+1} = \overline{p}$, and promise a high amount if $p_{t+1} = \underline{p}$. These repayment profiles will be passed on to the homebuyer, and thus support the issuance of interest-only mortgages.

The following array of CDOs and put contracts supports the issuance of ε-mortgages: (i) the ε-originator purchases from an insurer put contracts that pay $b_t[1+r]$ if $p_{t+1} = \overline{p}$ and 0 otherwise; (ii) the ε-originator pays the insurer with a put that pays $b_t[1+r][\frac{1-u}{u}]$ if $p_{t+1} = \underline{p}$ and 0 otherwise; (iii) funds pay b_t to ε-originators for a CDO that promises $b_t[1+r]$ and has attached the right to the payments in the put contract in (ii); lastly, (iv) funds buy from insurers put contracts that promise to pay $b_t[1+r]$ if $p_{t+1} = \underline{p}$ and 0 otherwise; At time $t+1$, if $p_{t+1} = \overline{p}$, originators will get $\varepsilon[1+\mu]$ in mortgage repayments, and funds will receive $b_t[1+r]$ from the put attached to the CDO. If instead $p_{t+1} = \underline{p}$, funds will get the put payment gw_t, and insurers will get a bailout payment associated with their put contract with originators.

The upshot is that the above array of payoffs allows ε-originators to not make any payment to the funds if $p_{t+1} = \overline{p}$. Thus, the diversion constraint is not binding (because $0 < h(w_t + b_t)$). As a consequence, funds set b_t so as to maximize the bailout payment they will extract, disregarding the no-diversion constraint. Furthermore, notice that originators have incentives to originate ε-mortgages because they do not need to risk their own equity.

We sum-up in the next Corollary

Corollary 5 *A financial black-hole in the real estate sector develops if and only if (i) there are systemic bailout guarantees; and (ii) catastrophe-bond-like securities can be issued. If there is a shift to a black-hole equilibrium:*

1. *There is an increase in the origination of mortgages with very low required repayments during the first years, followed by a jump in repayments latter on (i.e., the so called Alt-A mortgages: interest-only, negative amortization, option ARM, etc).*

2. *There is an increase in the share of subprime and Alt-A mortgages issued to borrowers with a low ability–or none–to repay in the absence of house-price increases.*

3. *There is a massive increase in securitization vehicles–such as CDOs–and financial insurance instruments–such as CDSs.*

4. *Financial insurance is underpriced and is insensitive to mortgage default rates.*

Implication 1 reflects the existence of catastrophe bonds. In the empirical section we provide evidence for these facts. Implication 2 reflects the issuance of negative NPV mortgages. Implication 3 reflects the fact that origination of negative NPV mortgages requires funding instruments with catastrophe-bonds payoff characteristics. Implication 4 reflects the expectation that creditors will be bailed out in case of massive defaults. Notice that in equilibrium it is a necessary condition that a critical mass of borrowers is at the brink of default in order to induce a systemic bailout guarantee–i.e., force the government to grant a bailout.

3.1 Efficiency and Fragility

Notice that allowing trade in puts that pay in the bad state is not necessarily bad in our model economy. In a liberalized regime–where some type of puts can be traded–there is a trade-off between efficiency and financial fragility. That is, issuance of puts that pay-off when $p_{t+1} = \underline{p}$ increases efficiency. This is because the ability to buy CDS(puts) allows pension funds (that can only invest in AAA securities) to buy the senior tranches of CDOs formed by packaging together mortgages to risky θ-homebuyers. This in turn allows for the origination of θ-mortgages.

In an anything-goes regime–where there is no restriction on the type of puts that can be traded–there is no trade-off between efficiency and fragility.

4 Empirics

Here, we present evidence that addresses the three key conclusions of our model. First, we present recent US data that indicates the existence of a financial black hole. Second, we use firm-level data to determine whether there is evidence for the mechanism that links insolvency risk taking and investment in the presence of bailout guarantees. Lastly, we use cross-country data to see whether, relative to a restrictive financial regime, liberalization–and the subsequent greater incidence of crises–is associated with higher long-term average growth in a cross section of countries.

4.1 A Financial Black-Hole in the US

Here, we provide evidence that supports the view that the recent US crisis reflects a financial black-hole rather than a typical third-generation banking crisis. We have argued that under a black-hole, financial deepening is associated with more funding of unproductive activities, while under the latter it is associated with productive activities and so financial fragility leads to more growth.

Recall that the toxic cocktail necessary for the emergence of black-holes is the combination of systemic bailout guarantees and the ability to issue catastrophe-bonds that promise to repay zero in good states and a large amount in bad states.[10] Unfortunately, no direct evidence exists on either guarantees or catastrophe bonds. Thus, our empirical strategy is to bring indirect evidence for the implications of a black-hole equilibrium, which are listed in the Corollary in the "opening the box" Section.

First, we document the development of financing instruments–such as interest-only mortgages–whose payoffs resemble those of catastrophe bonds. Second, we show that the issuance of interest-only mortgages was strongly correlated with (i)the increase in the market share of private securitizers and the reduction in the share of Government Sponsored Enterprises (Fannie Mae, Freddie Mac), and (ii)the issuance of securities (such as CDOs and ABSs) that could be purchased by pension funds and other regulated investors. Third, we ask whether the pricing of financial instruments loaded with catastrophic risk reflected the presence of systemic bailout guarantees. Fourth, we provide evidence that the share of mortgages that were likely to have ex-ante negative NPV was increasing in the years 2003-2007. Fifth, we provide an ex-post perspective on the funding of negative NPV mortgages by assessing the abnormally high default rate during the crisis.

Fact 1: Catastrophe-Bond-like Mortgage Instruments.

[10] In a black-hole there is a breakdown of financial discipline and projects with negative NPV are funded.

Catastrophe bonds are not directly observable. However, some mortgages, such as interest-only and negative amortization loans, have a payoff structure that is similar to the payoff of catastrophe bonds. Pooling and securitizing those mortgages implies the existence of catastrophe-bond-like financing instruments. Interest-only mortgages carry low interest rates for an initial period of 24, 36 or 60 months followed by a sharp increase afterwards as amortization starts. However, because agents are able to continuously refinance when house prices are going up, they can avoid amortizing in the good state of the world and keep rolling with low mortgage payments. Therefore, large net repayments are triggered only in the bad state of the world where house prices stop rising. In this case, the borrower is likely to default.

Figure 1 plots the market share of interest only mortgages in the US, as a whole, and in the portfolio of New Century, one of the largest mortgage originators that went bust in 2007. From 0% in 2002, the share of interest-only loans in the total number of originated mortgages went up to 15% in 2005 and 18% in 2007. The rise of was even more dramatic for New Century originations where it went from 0% in 2002 to 30% in 2006.[11]

Fact 2: Securitization of Catastrophe-bond-like instruments and Subprime Loans

As we explained above, the origination of subprime and interest-only mortgages requires the issuance of financial instruments such as CDOs and CDSs that allow catastrophe-loan-like instruments to be securitized.

Until 2003, the securitization market was dominated by the Government Sponsored Enterprises (GSEs) Fannie Mae, Freddie Mac and Government Enterprise Ginnie Mae. These agencies had very strict standards on the loans they accepted for securitization: loans needed to be conventional (standard amortizing loans), and conforming (below a maximum loan amount limit). In addition, they mostly funded prime loans. The domination of GSEs imposed discipline in the underlying mortgage origination process. However, starting in 2004 there was a sharp shift in the securitization market from GSEs to private securitizers ("private label") that accepted subprime and non-conventional mortgages.[12] Figure 2 plots the market share in the issuance of Mortgage Backed Securities (MBS) and Collateralized

[11] See Landier, Saez and Thesmar (2010) for an analysis of the role of Interest-Only mortgages in New Century's fall.

[12] See Farber (2010) for a description of why GSEs were forced to retreat from the market, and how "Private Label" securitizers benefitted from this retreat.

Mortgage Obligations (CMOs) of the GSEs+Ginnie Mae and the private label securitizers between 1996 and 2009. Until 2003, the market share of GSEs+Ginnie Mae was relatively stable between 90% and 85%. However, between 2004 and 2006 this share dropped dramatically from 86% to 56%.

Most of the MBS issued by private label securitizers found their way into capital markets through Collateralized Debt Obligations (CDOs) for mortgages, and Asset Backed Securities (ABSs) for home equity loans. As we explain in the model, CDOs and ABSs where sliced in tranches with different seniorities before being sold to investors (pension funds, etc.).

Figure 3 exhibits a stark correspondence between the share of interest-only mortgages and the financial instruments that supported the origination of these catastrophe-bond like mortgages. As we can see there is an almost perfect correspondence between the share of interest-only mortgages, private label mortgage-related securities issuance, and ultimately to CDOs and ABSs. Figure 4 exhibits a similar correspondence with the number of subprime and Alt-A mortgages originated.

Fact 3: Catastrophic Risk underpricing and Systemic Bailout Guarantees.

Systemic bailout guarantees are unobservable. However, as the model implies, in the presence of guarantees, puts against catastrophic risk will be underpriced and will be insensitive to an increase in the mortgage defaults and credit quality. This underpricing in turn will support the issuance of CDOs.

We documented above that CDO issuances peaked in 2006 and remained near to the peak in 2007 while at the same time, the rate of default was increasing especially for subprime mortgages and adjustable-rate mortgages. To see this more clearly, Figure 5 plots the issuance of CDOs and the rate of subprime mortgages past due. As we can see, the period of booming issuance of CDOs (2005-2007) corresponds to a period where delinquencies on subprime mortgages were trending up significantly (from 10% in 2004 to 17% in 2007). This fact suggest that the issuance of catastrophe-bonds was largely insensitive to early warning signals of abnormal default rates in the mortgage market.

Figure 6 plots the delinquency rate of subprime mortgages along with the spread–the insurance premium–implied by the CMBX.AAA index. This index corresponds to CDS contracts on either "AAA" CMBS bonds or on "AAA" tranches of CMOs.[13] As we can see,

[13] These indexes are associated with commercial and multi-familty mortgage-backed securities.

until July 2007, the insurance premium was below 10 basis points (a tenth of a percent), which means that these securities were considered almost as safe as US Treasuries in the very same period where default on subprime loans started to increase sharply. In fact, during 2006 and the first half of 2007, the spread actually declined from 10 bps to around 5 bps. During the second half of 2007 the spread increased significantly but was only at around 100 bps in early November 2008 (after the failure of Lehman Brothers and the government take-over of AIG). It actually declined between August 2008 (150 bps) and the end of October 2008 (100bs) before jumping up in the last two months of 2008.

Figure 7 plots the ABX indexes corresponding to three tranches ranging in seniority from AAA to BBB-. These indexes allow investors to take positions on residential subprime mortgage-backed securities via CDS contracts. Until January 2007, the indexes remained flat for all the tranches. Around March 2007, the index corresponding to the most junior tranche started to decline (a decrease in the index correspond to an increase in the cost of credit protection). However, the index for the two senior tranches did not decrease until November 2007. In a world without bailout guarantees an increase in the default rate on junior tranches should have mechanically lead to a repricing of the default risk on now riskier senior tranches. The lack of such repricing provides evidence of bailout expectations. After 2007, all the indexes plummeted as the cost of insuring against default became prominently large.[14]

Fact 4: Ex-ante Funding of Negative Net-Present Value Mortgages.

Indirect evidence of the funding of negative net present value mortgages is provided by the shift of mortgage origination towards borrowers with unverified income and little initial equity. These borrowers' repayment capacity depended critically on the continuous increase of home prices, like the $\varepsilon-$borrowers of our model. The portfolio of New Century, the second US mortgage originator that went broke in 2007, offers ample evidence of the shift towards borrowers with low probability of repayment. Figure 8 presents the characteristics

[14] Senior tranches of mortgage-based structured securities were protected from tranquil times losses by the equity and the junior tranches of those securities. Therefore the underpricing of credit risk in senior tranches concerns specifically crisis related risk and provide evidence of systemic bailout guarantees. Cowal, Jurek and Stafford (2009a) provides further evidence of the underpricing by comparing the relative of investing in senior tranches in CDOs vs. investing in out-of-money put on stocks indexes. Ex-post the former investment was strongly outperformed by the later.

of New Century borrowers between 2002 and 2006. The share of borrowers with unverified–stated–income increased from 25% in 2000 to 47.2 % in 2006 The share of borrowers with no downpayment increased from 9% to 34.8%.

At the macroeconomic level, the trend towards borrowers with low repayment capacity can be measured by the increasing share of subprime loans, and the rise in the mortgage-related leverage ratio for low net worth borrowers. Figure 9 plots the number of prime and subprime mortgages serviced (left scale) and the relative share of subprime mortgage (right scale). Between 2001 and 2006, the share of subprime mortgages increased from 3.4% to 15.1% of the total number of mortgage serviced. Using data from the Survey of Consumer Finances, Figure 10 plots the ratio of mortgage debt to income and mortgage debt to net worth for this household group (the poor and the lower middle-class). From 2004 to 2007, the mortgage debt-to-income ratio increases from 47% to 97% and the mortgage debt-to-net worth ratio from 85% to 132%. These patterns offer clear evidence of excess mortgage lending to a financially fragile population whose repayment ability was dependent on a continuing increase in house prices.

Fact 5: Abnormally high defaults

After 2006, the foreclosure rate increases significantly and appears to be driven by an entirely different data generating process than the pre-2006 process. As we can see in Figure 11 total mortgage foreclosures exploded starting in 2006 and brought the foreclosure rate from 1.8% to 5.4%. This increase is unprecedented in the last 40 years of history.

Figure 12 plots the rate of mortgage foreclosures for different categories of mortgage products. The graph makes clear that even before 2002–the onset of the pre-crisis wave of subprime mortgage origination–subprime loans exhibited a rate of foreclosure 5 to 10 times higher than prime loans.[15] Note also that foreclosure rates were already up in 2006 for adjustable-rate prime and subprime mortgages.

Another way to assess the trend towards mortgages more likely to default is to look at cumulative default rates across yearly vintages of originated mortgages. Figure 13 plots those default rates for the pool of mortgages bought by Fannie Mae. From 2003 to 2007, each subsequent yearly vintage exhibits higher cumulative default rate than the previous year vintage at all time horizons since origination. In particular, the more recent vintages

[15] See Figure 3.

were experiencing higher rates of delinquency even before the financial crisis.[16]

4.2 Bailout Guarantees and Borrowing Conditions

In emerging markets, systemic risk takes often the form of currency mismatches in banks' and firms' balance sheets. At the individual level, a firm is said to have a currency mismatch if it has debt denominated in foreign currency that is not backed by foreign assets or revenues. Our theoretical mechanism predicts that in presence of systemic bailout guarantee firms with currency mismatch should: (i) face lower interest rates; and (ii) invest more and grow faster in tranquil times than similar firms with no currency mismatch. We test these predictions using a sample of around 10,000 firms in Central and Eastern Europe and in former Soviet republics, surveyed by the EBRD in 2005 and 2008 through the Business Environment and Enterprise Performance Survey (BEEPS).[17] An advantage of the BEEPS survey over existing stock-market based data sets is that it is representative of all sectors in the economy and covers stock-market listed as well as non-listed firms. The 2005 EBRD survey reports only the currency denomination of the last loan for firms that have at least one loan on their books. We therefore assume that the denomination of the last loan reflects the denomination of the debt stock.

We restrict the sample to firms with debt on their books and consider two subsamples of those firms: (i) firms with all sales revenues coming from the non-tradables sectors and (ii) firms with all sales revenues coming from the tradable sector. Firms exhibit a currency mismatch if they belong to the non-tradables sample and have foreign currency debt on their books.

We first test whether currency mismatch helps reduce interest costs (as implied by Proposition 2).[18] We do so by regressing the interest rate on a dummy variable equal to 1 if the

[16] Note that Fannie Mae's cumulative default rates actually understate the severity of the deterioration of the mortgage portfolio between 2003 and 2006. Following accounting fraud, Fannie Mae and Freddie Mac were forced by OFHEO to reduce substantially their purchasing share of newly issued mortgages. The decline of the GSEs was partly compensated by the Private Label MBS Issuers which typically had much lower standards to admit mortgage loans in their securitized pool. See Farber (2010) for description of this market structure shift and Fannie Mae (2008) for evidence that Private Label mortgage pool experience much larger cumulative default rate.

[17] In 2004, the countries in the survey are classified as financially liberalized.

[18] For the firm-level regressions to be consistent with the model, it is necessary that in equilibrium firms

firm's last loan is denominated in foreign currency, and a set of firm-specific and loan-specific variables. The regressions are performed using two sets of control variables. The simple set include firm's age and size and loan maturity. The more comprehensive set contains also a set of variables related to the collateralization of the loans. In addition, we control alternatively for country-specific fixed effects, industry-specific fixed effects and, in the most stringent configuration, for country-industry fixed effects. The latter fixed effects control for the demand for goods and services in a specific industry and in a specific country.

Table 1 presents the result of the interest rate regressions for the set of non-tradable firms. Our estimates indicate that non-tradables firms borrowing in foreign currency face an interest rate around 2 percentage points lower than similar firms borrowing in domestic currency. These estimates are significant at the one percent level in the three fixed-effects configurations. The control variables have the expected sign, with larger and older firms paying a lower interest rate, and shorter maturity loan carrying a lower (but not significantly so) interest rate. Additional controls capturing the effect of collateral reduce the estimated difference between foreign and domestic currency interest rates by only 0.3 percentage points.

Table 2 presents the result of the interest rate regressions performed on the set of tradable firms. The estimates show that tradables firms borrowing in foreign currency enjoyed a interest rate around 2.5 percent lower than those borrowing in domestic currency. In order to compare the estimates across the sample of non-tradable and tradable firms, we run a series of chow tests under the null hypothesis that the estimated spread between domestic and foreign interest is the same across the two samples of firms . Results are presented in Table 3 and indicate that the null hypothesis of equal spread can never be rejected. This finding implies that while currency risk associated with domestic debt denomination seems

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with similar characteristics chose different levels of currency mismatch. This dichotomy emerges in the risky equilibrium of our model because in such equilibrium there can exist a small subset of borrowers that choose not to take on currency mismatch. This is because while a majority of borrowers expect a bailout in case of crisis, this minority set does not expect a bailout. As long as this subset is small enough, a risky equilibrium exists because a bailout will indeed be granted during a crisis—as a critical mass of borrowers will default. It follows that in a risky equilibrium there can be two firms with the same observable characteristics, but with different bailout expectations. One firm will take on currency-mismatch and enjoy lower interest rates than the other firm that does not take on currency mismatch, and so will be able to grow faster during no-crisis times. The firm-level regressions in this section assess whether this difference in interest rates and growth is present in the data, after controlling for a large number of observable firm characteristics.

to be priced in the interest rate, risk-taking through currency mismatch seems not. This is strong evidence of the presence–at least implicit–of systemic bailout guarantees, which results in an implicit subsidy for firms with currency mismatch.

In order to test whether currency mismatch allows firms to borrow and grow more (Proposition 2), we run a series of standard growth regressions. We regress the three year average growth in firm's sales between 2001 and 2004 on a dummy variable equal to 1 if the firm's last loan is denominated in foreign currency, and two sets of alternative controls under the three fixed effects configurations alluded to above. The simple control set includes firm's years of operations and initial sales. The comprehensive control set includes also initial productivity, the share of foreign inputs in total production inputs and two measures of the quality of the workforce: the share of skilled workers and the share of workers with a university degree.

Table 4 presents the results of the growth regressions for the set of tradable firms. The estimates indicate that firms with currency mismatch exhibit an annualized growth in sales between 1.9 and 2.8 percentage points higher than firms without currency mismatch on their books. The estimates are significant at one percent (five percent) confidence interval in the regression using the simple (comprehensive) set of controls. Table 5 presents the results of similar regressions for the set of tradable firms. In sharp contrast with non-tradable firms, we cannot reject that tradable firms borrowing in foreign currency grow at the same rate than tradable firms borrowing in domestic currency. This result indicates that while undertaking risk through currency mismatch does yield growth benefits, simply borrowing in foreign currency does not.

To sum up, the tests performed on the sample of Eastern European firms confirms the mechanism at work in our model. Under a financially liberalized regime with systemic bailout guarantees, firms loading on systemic risk benefit from an implicit interest rate subsidy and grow faster in tranquil times than similar firms unexposed to systemic risk.

4.3 Financial Liberalization, Crises and Growth

Proposition 4 states that a shift from a restrictive to a liberalized regime increases expected output net of social bailout costs even if it leads to occasional financial crises. This increase in social efficiency occurs because the regime shift allows for the funding of a new set of risky entrepreneurs with positive NPV projects, but does not destroy financial discipline. Starting in the 1970s there has been a wave of financial liberalization, specially among middle income countries. Such liberalization episodes have allowed agents to freely direct funding and to take on risk. Among emerging markets, a big portion of the resulting financial flows took the form of bank lending, equity investment and FDI, not the form of instruments akin to the catastrophe bonds of our model. We can thus consider the liberalization policies during the period 1970-2000 as a shift from what our model calls a restrictive regime to a liberalized regime. We must add the caveat that these are analytic categories and aren't watertight.

We investigate whether countries that have liberalized and experienced the consequent financial crises, have grown faster than other countries over the period 1970-2008. We consider all countries with available data and exclude those that have experienced either a severe war or a large terms of trade deterioration, reducing the sample from 83 to 58 countries. To measure the incidence of financial crises we use the negative skewness of credit growth rather than the variance. This measure captures rare and sharp declines in credit growth, which is a key characteristic of financial crises: they occur rarely and have severe effects on new credit. The variance, in contrast, captures both rare-severe falls in credit as well as garden variety bussines-cycle frequency credit growth fluctuations. Thus, unlike negative skewness, high variance does not isolate the volatility generated by financial crises.

We run cross-country growth regressions where we add the three first moments of credit growth to the standard controls in the literature.

$$\ln(y_{i,1}) - \ln(y_{i,0}) = \sum_{k=1}^{3} \boldsymbol{\alpha}_k \mu_k(\gamma r_i) + \boldsymbol{\beta} * \mathbf{Z}_{i,0} + \varepsilon_i$$

where $y_{i,0}$ and $y_{i,1}$ are GDP per-capita at the beginning and the end of the sample period, $\mu_k(\gamma r_i)$ denotes the first three of moments of each country's sample distribution of real credit growth (mean, variance and skewness), $Z_{i,0}$ is a vector of predetermined variables including initial per-capita GDP and initial average number of year of secondary schooling to proxy for initial physical and human capital, and ε_i is an error term. Our preferred sample period is 1970-2008. The period is long enough to encompass the transition to financial liberalization and most of the financial crises. As a robustness check, we repeat the regression on two alternative sample periods: 1960-2008 and 1980-2008, as well as on the full set of 83 countries.

Table 6 contains our estimation results. In regression 6.1, performed on 1970-2008, skewness enters with a negative sign and statistically significant at the 1% level. Consistent with the literature, the mean of credit growth enters positively and significantly, while the variance enters negatively although not significantly. The initial controls have the expected sign but are not significant. To give an economic interpretation consider two countries one with zero skewness and the other with skewness of minus one. Our point estimate of -0.654 means that the negatively skewed country will grow 0.654 per year more than the country on a safe path with no financial crises. Over the course of 38 years this growth differential leads to a difference in GDP per capita of around 25 percent between the "risky" and the "safe" countries. Figure 14 presents the partial correlation plots for each of the three moment of credit growth. Regression 6.2 and regression 6.3 present robustness results for alternative sample periods. They confirm our findings, but the coefficients on skewness are lower and only significant at 5% and 10% confidence interval. Regression 6.4 replicates the regression on the full sample of countries. In this case, the effect of skewness persists but its coefficient is a bit smaller.

5 Literature Review

[to be added]

6 Conclusion

[to be added]

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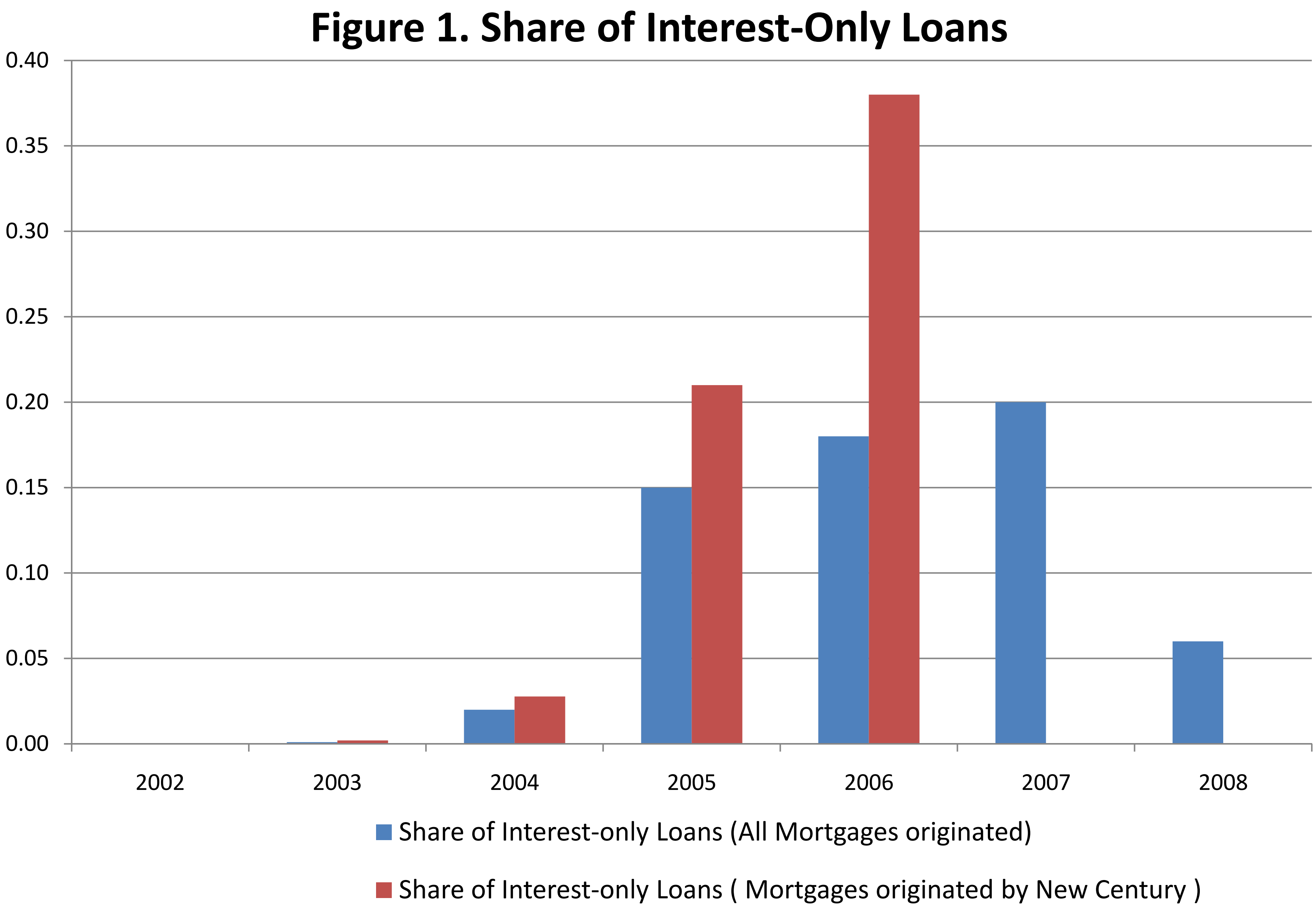
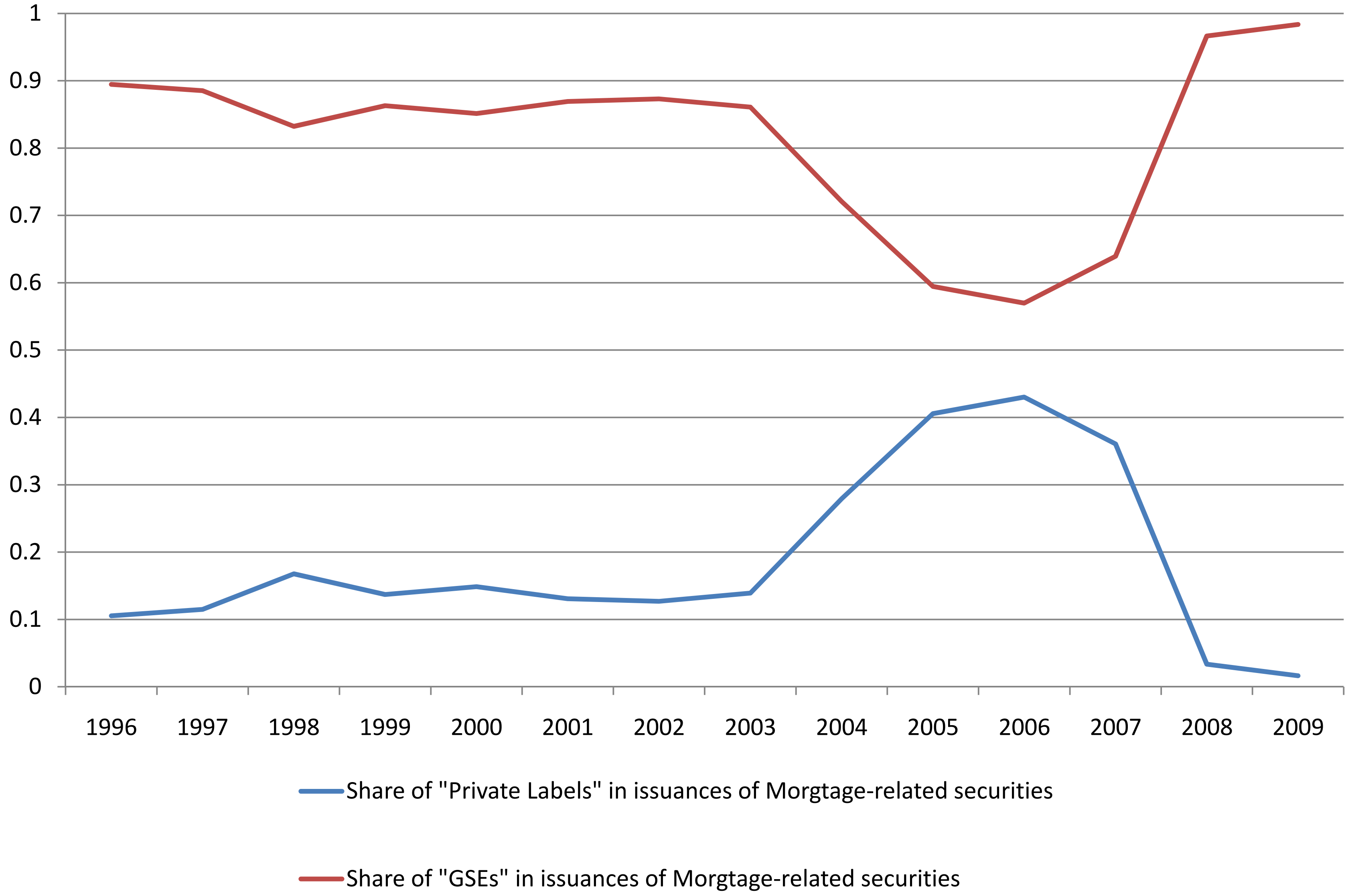


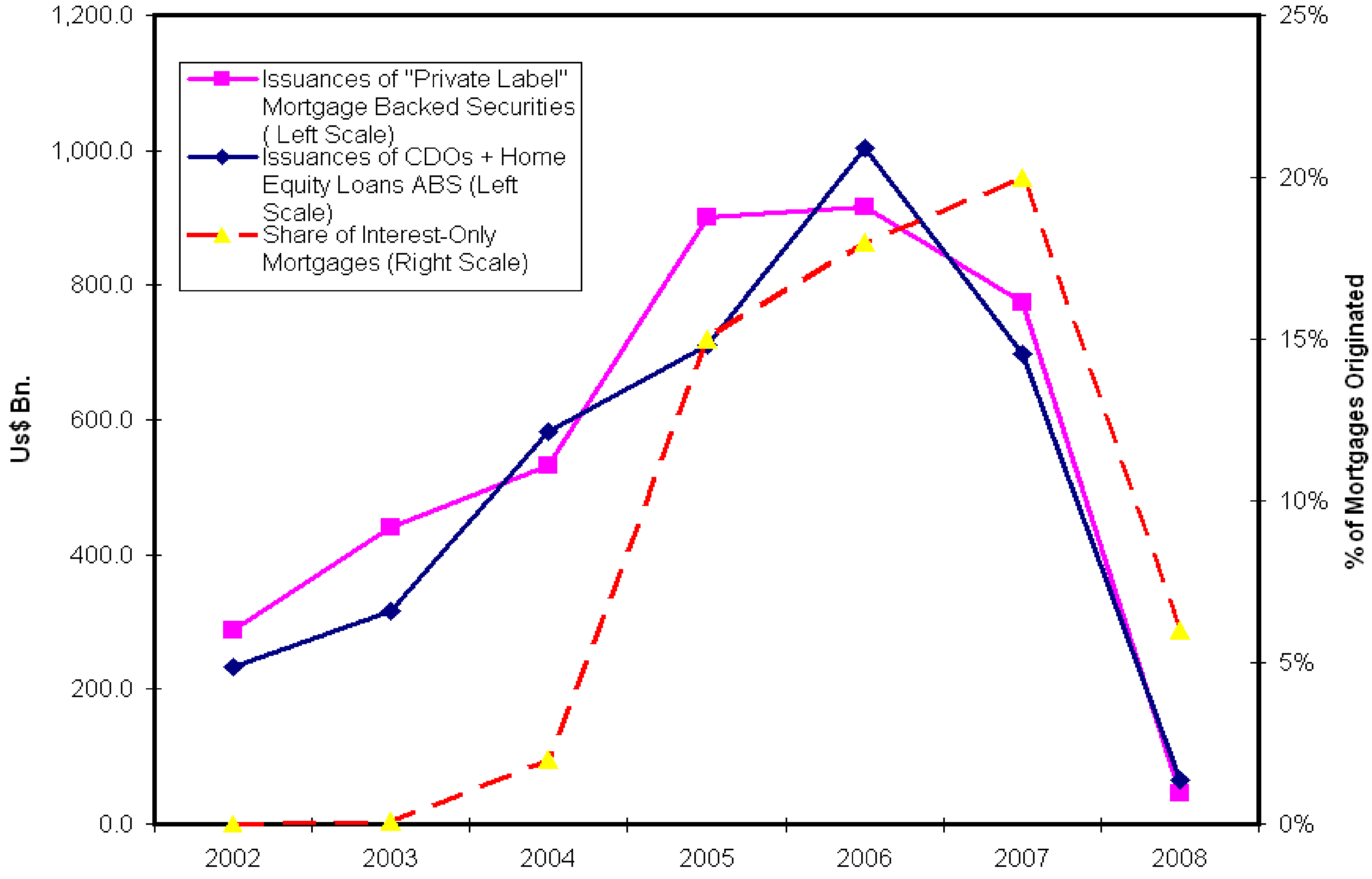
Source: Inside Mortgage Finance and New Century Bankruptcy Report

Figure 2. Issuances of Mortgage-Related Securities
“Private Labels” vs. GSEs.



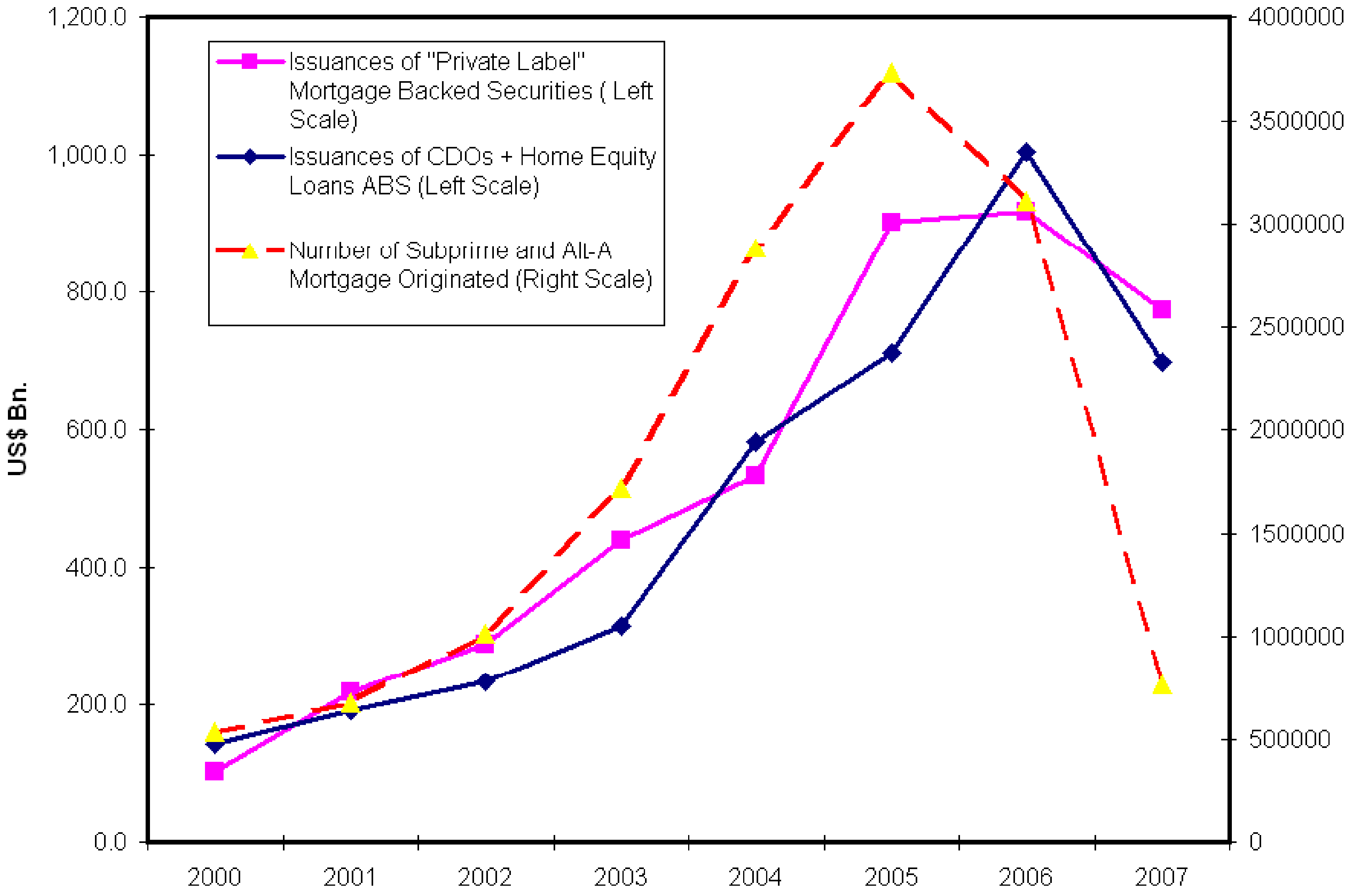
Source: Securities Industry and Financial Markets Association (SIFMA)

Figure 3. Share of Interest-Only Loans, "Private Label" MBS Issuances, CDOs+ Home Equity Loan ABS Issuances.



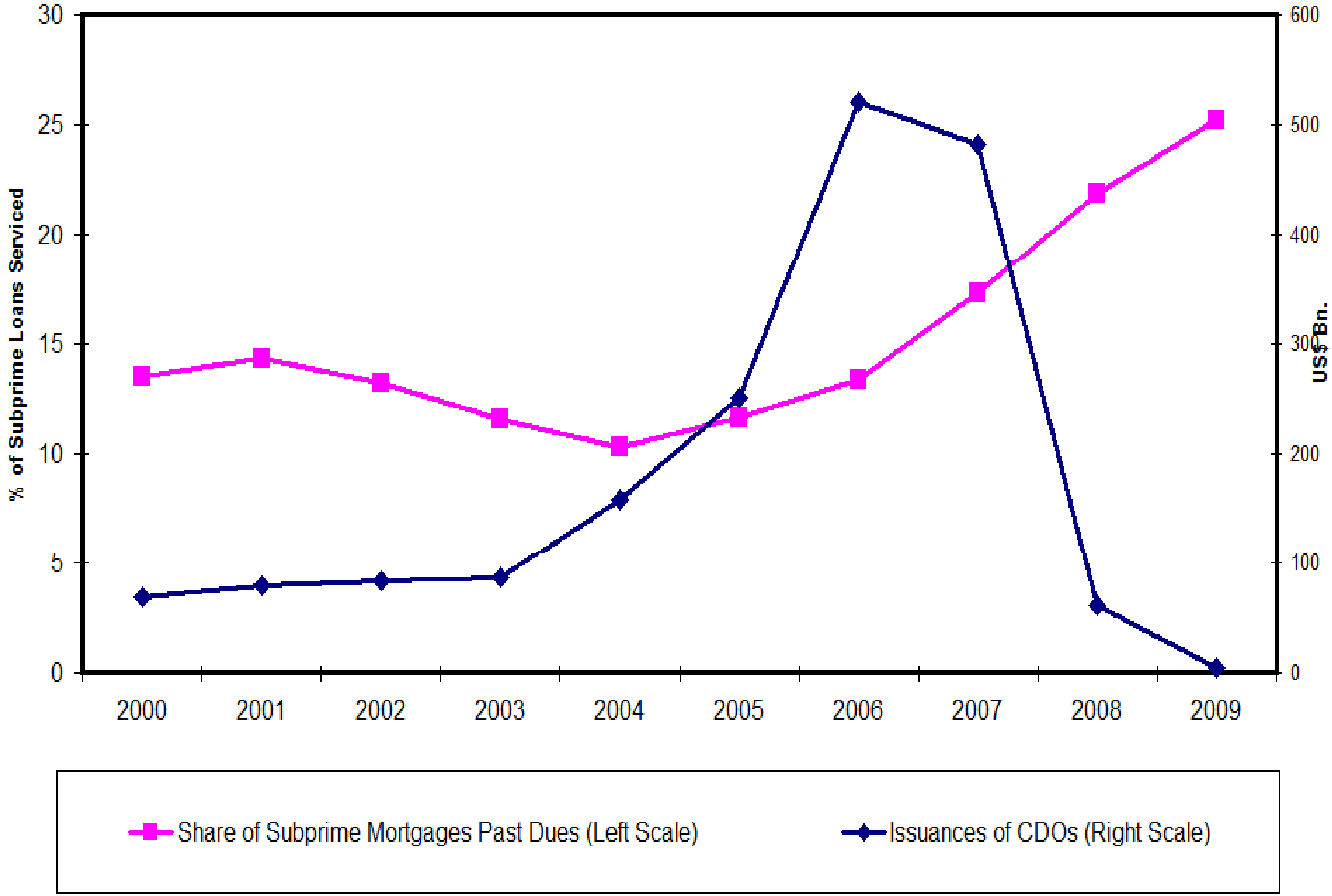
Source: Securities Industry and Financial Markets Association (SIFMA) and Inside Mortgage Finance.

Figure 4. Issuances of Subprime Loans + Alt-A loans. "Private Label" MBS Issuance, CDOs+Home Equity ABS Issuances



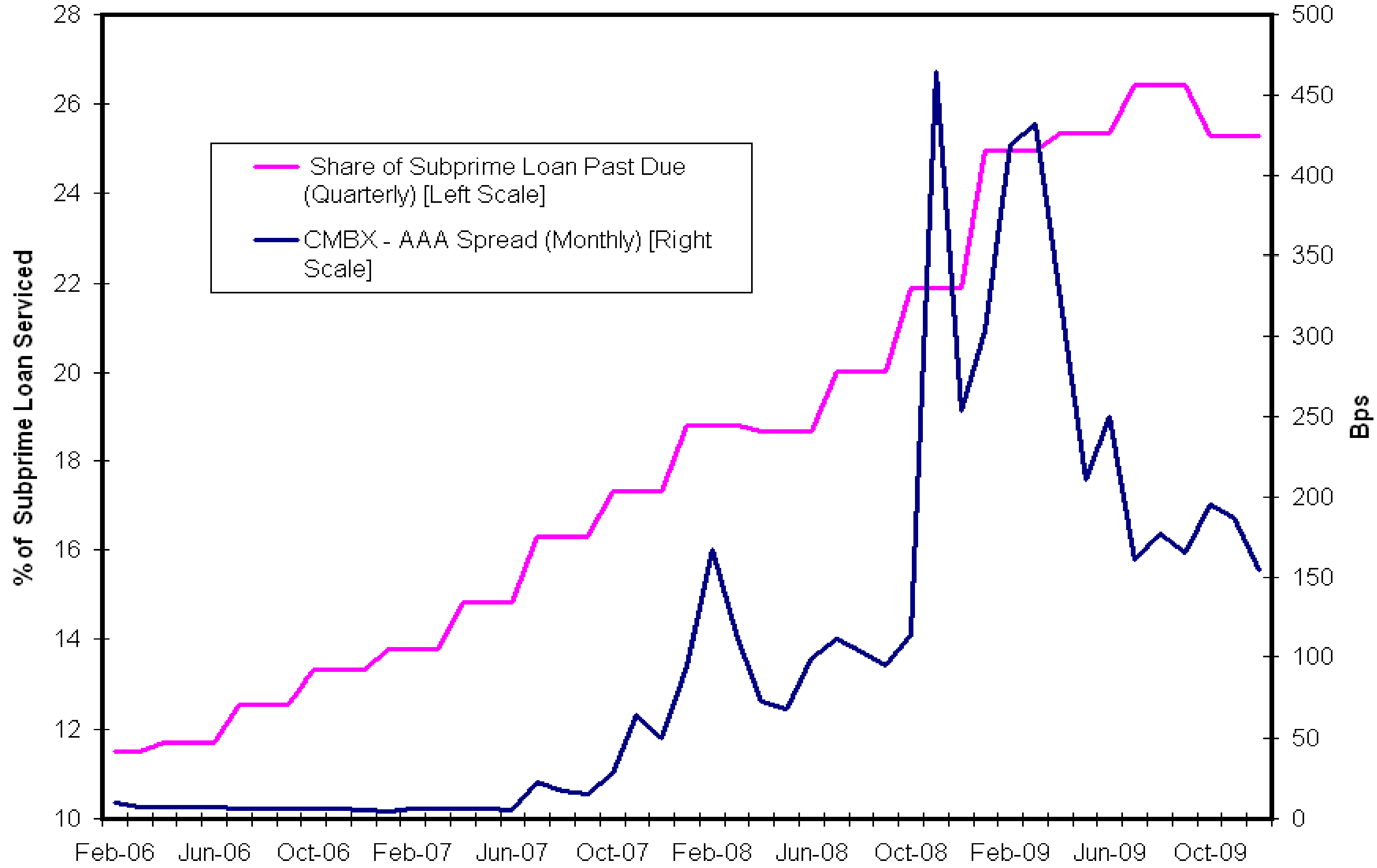
Source: Securities Industry and Financial Markets Association (SIFMA) and Loan Peformance.

Figure 5. Subprime Loans Delinquency and CDOs Issuances



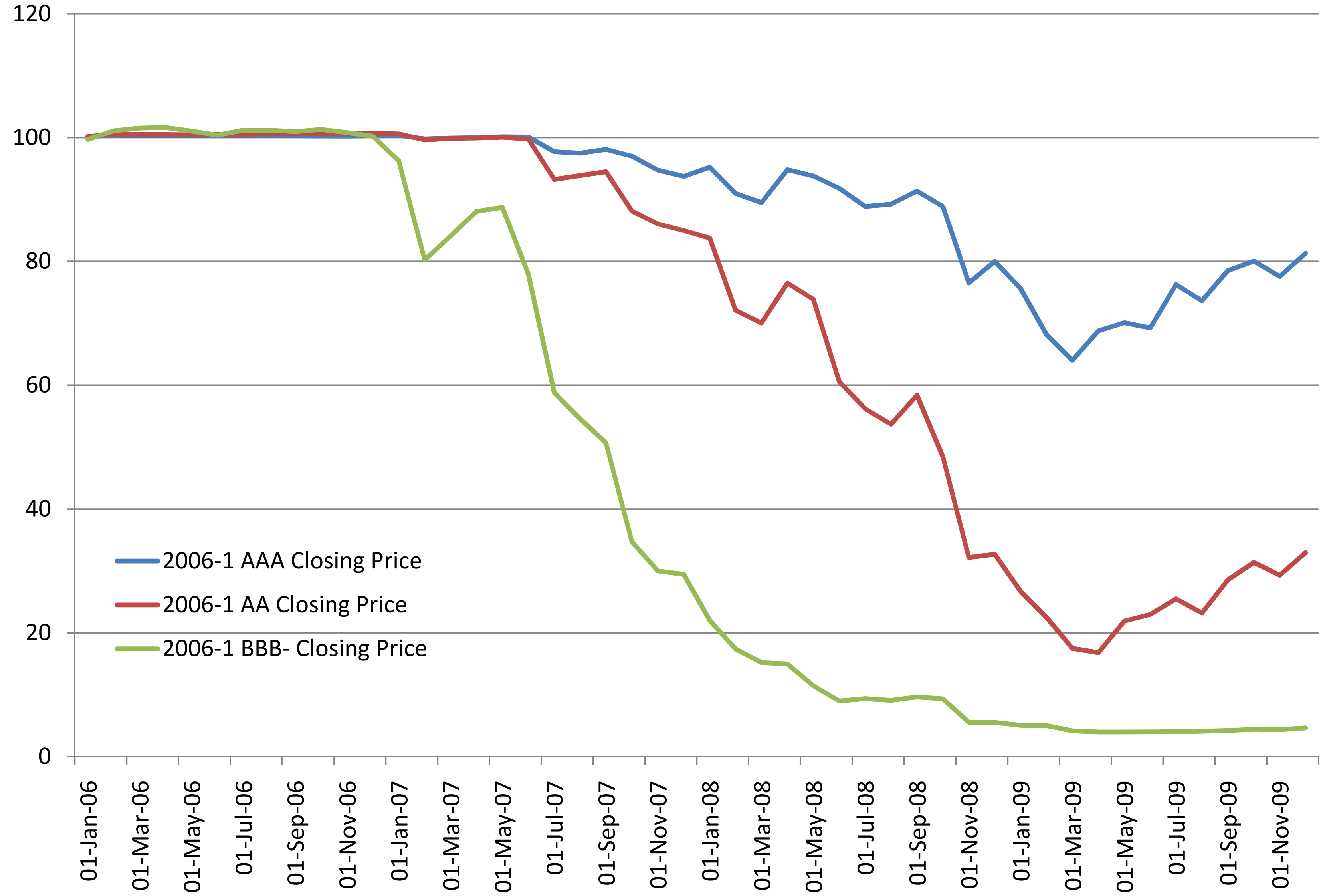
Source: Securities Industry and Financial Markets Association (SIFMA) and Mortgage Banker Association.

Figure 6. Subprime Loans Delinquency and CMBX Spread



Note: The Markit ABX index is a synthetic tradeable index referencing a basket of 20 commercial and multi-family mortgage-backed securities allowing investors to take positions on commerical and multi-family mortgage-backed securities via CDS contracts. The CMBX spread is the Credit Default Swap protection premium implied by the CMBX index.

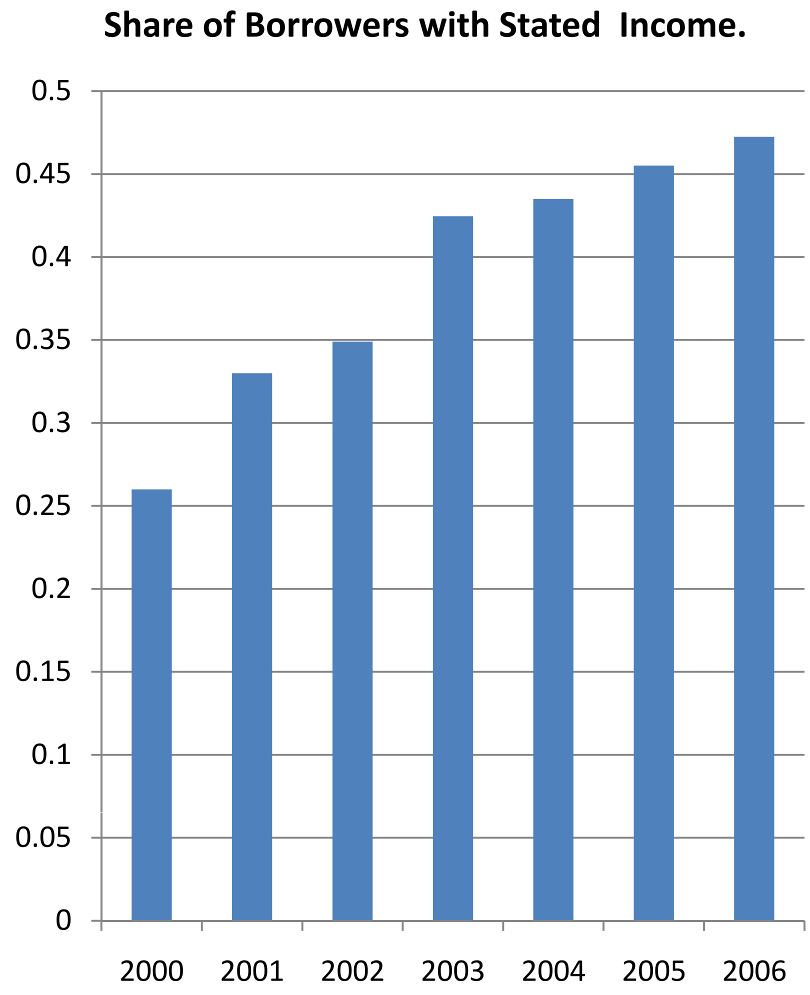
Figure 7. ABX: Mortgages Credit Default Swap Index for Subprime Residential Mortgages

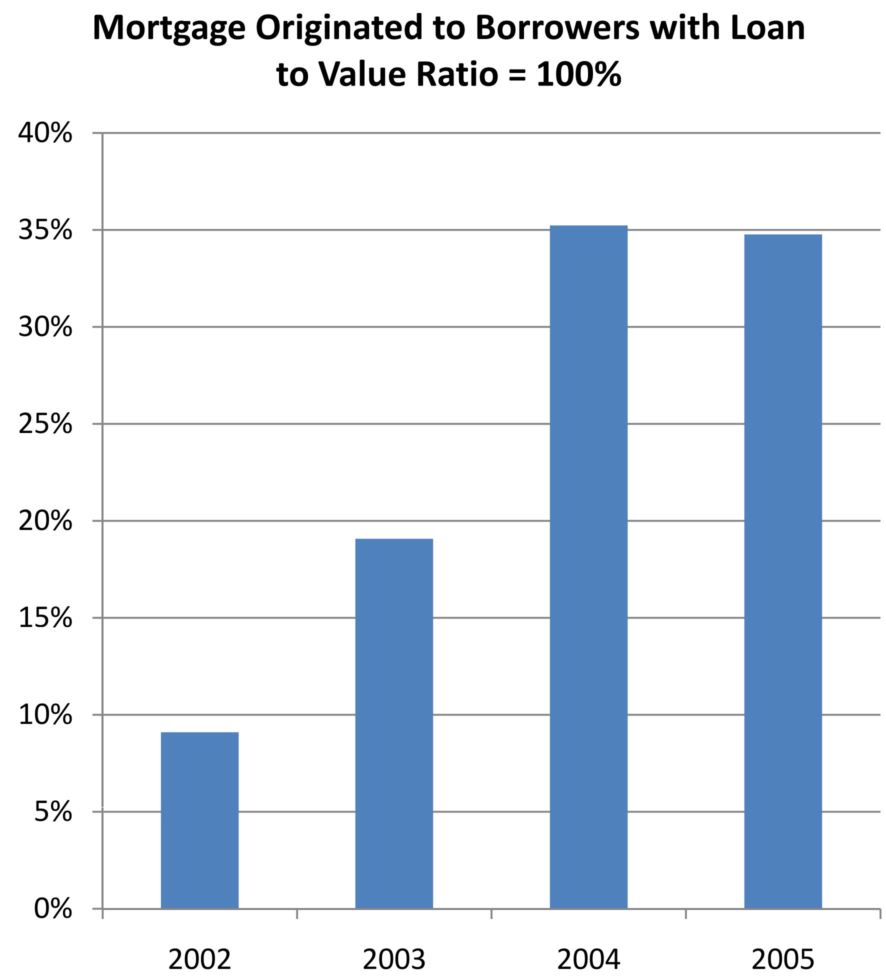


Source: JP Morgan

Note: The Markit ABX index is a synthetic tradeable index referencing a basket of 20 subprime mortgage-backed securities allowing investors to take positions on subprime mortgage-backed securities via CDS contracts.

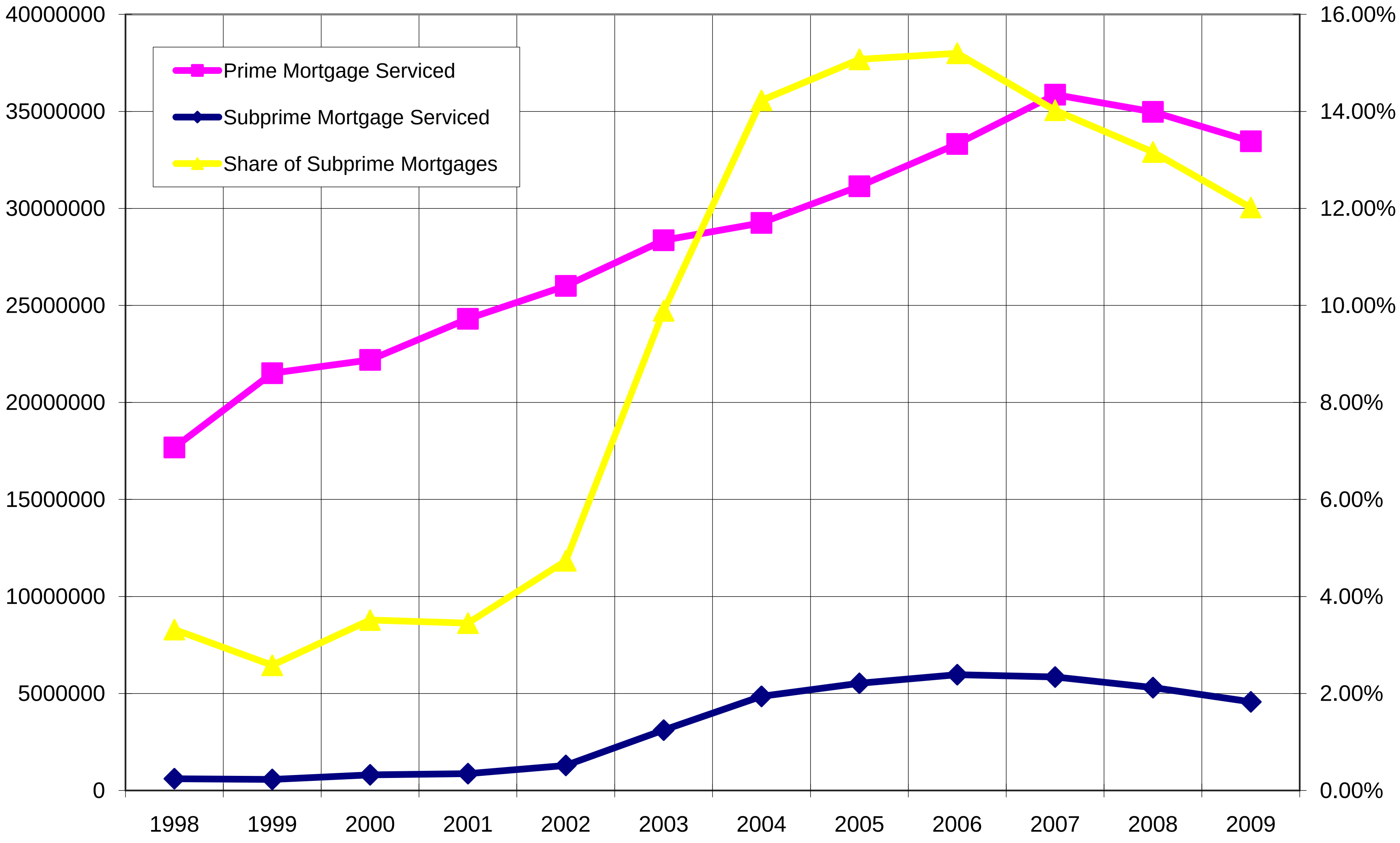
Figure 8. New Century Borrowers





Source: New Century Bankruptcy Report

Figure 9. Number of Prime and Subprime Mortgage Serviced



source: Mortgage Banker Association

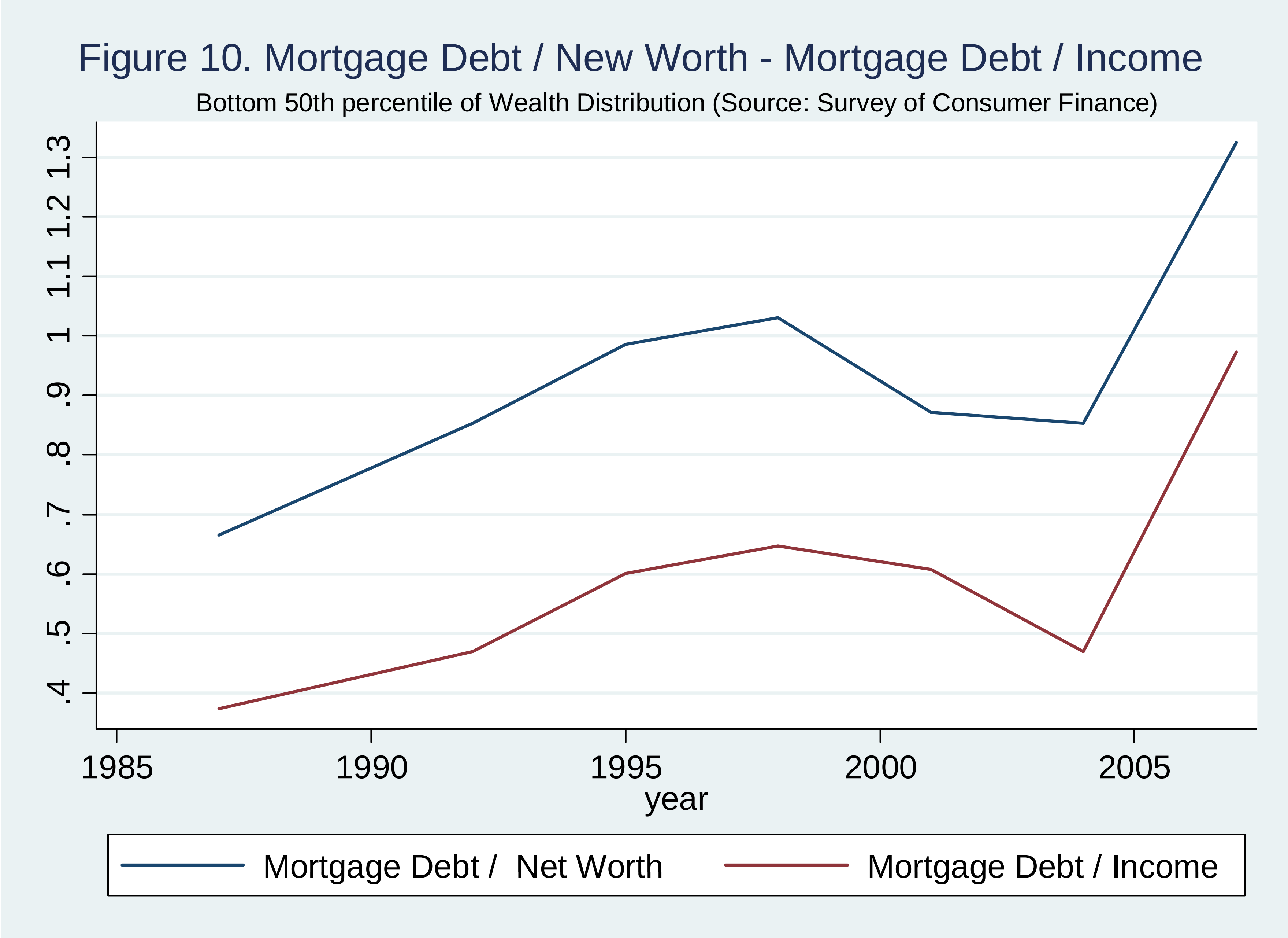
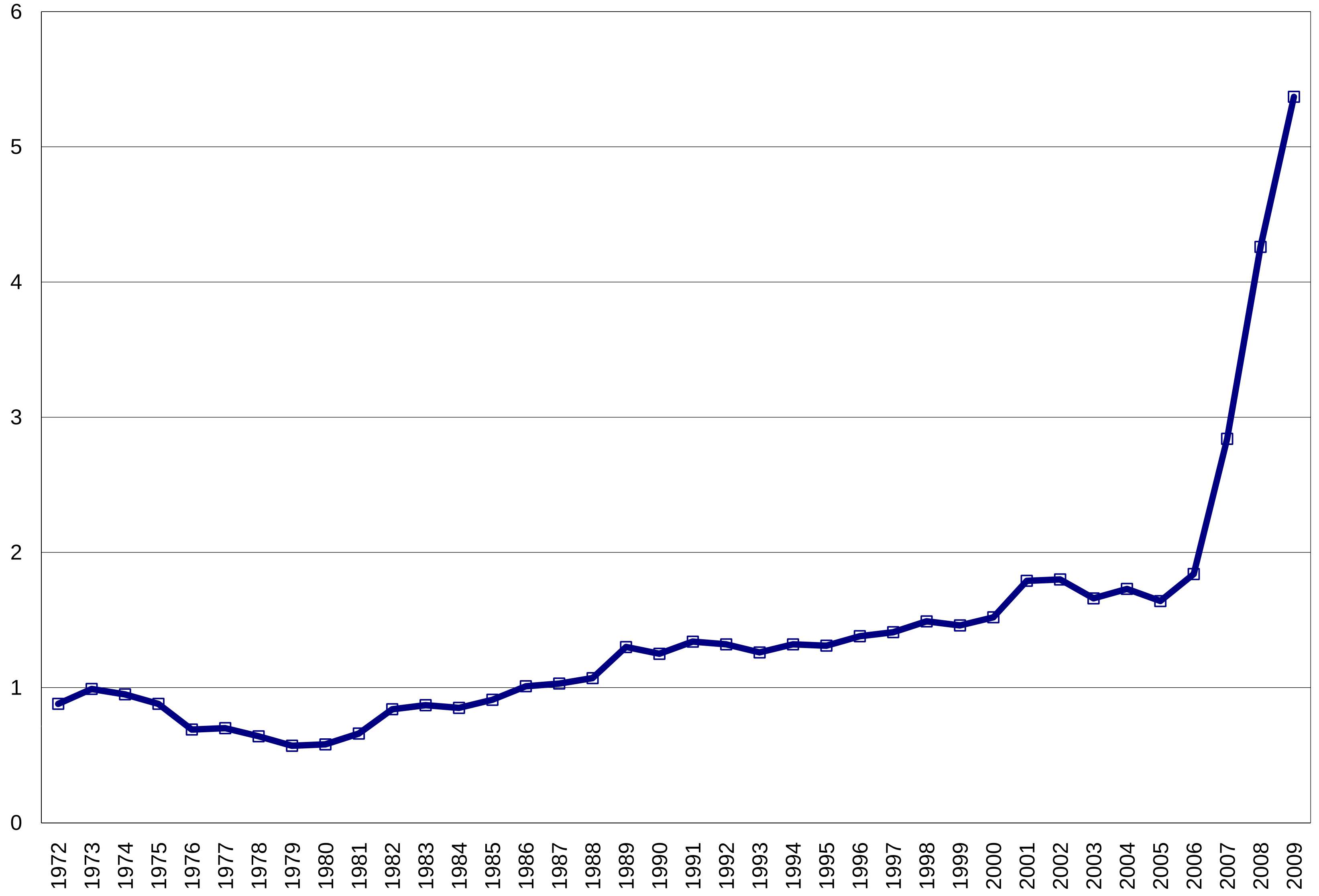


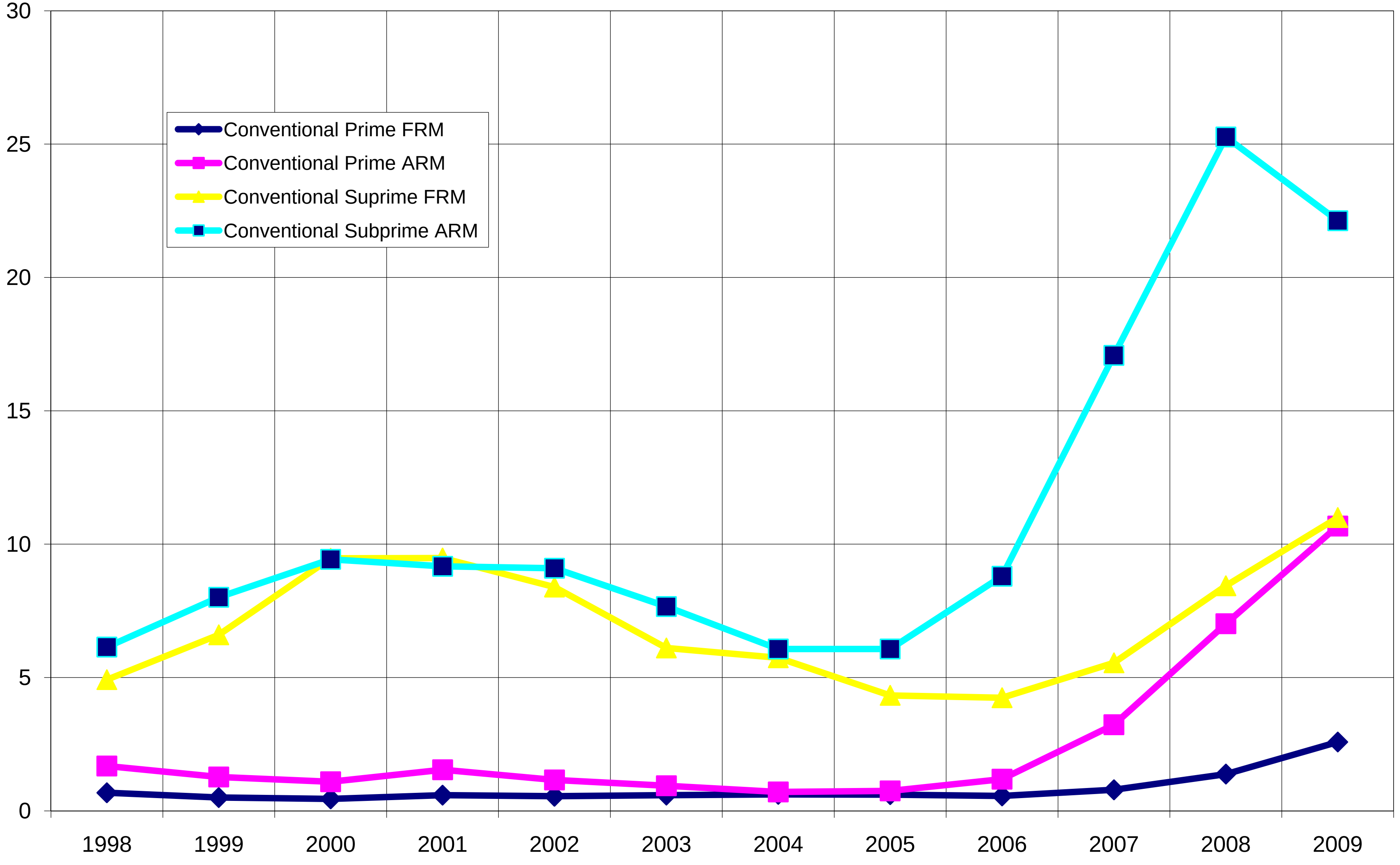
Figure 10. Mortgage Debt / New Worth - Mortgage Debt / Income
Bottom 50th percentile of Wealth Distribution (Source: Survey of Consumer Finance)
.4
.5
.6
.7
.8
.9
1
1.1
1.2
1.3
1985
1990
1995
2000
2005
year
Mortgage Debt / Net Worth
Mortgage Debt / Income

Figure 11. Foreclosure Rate for All Mortgages.



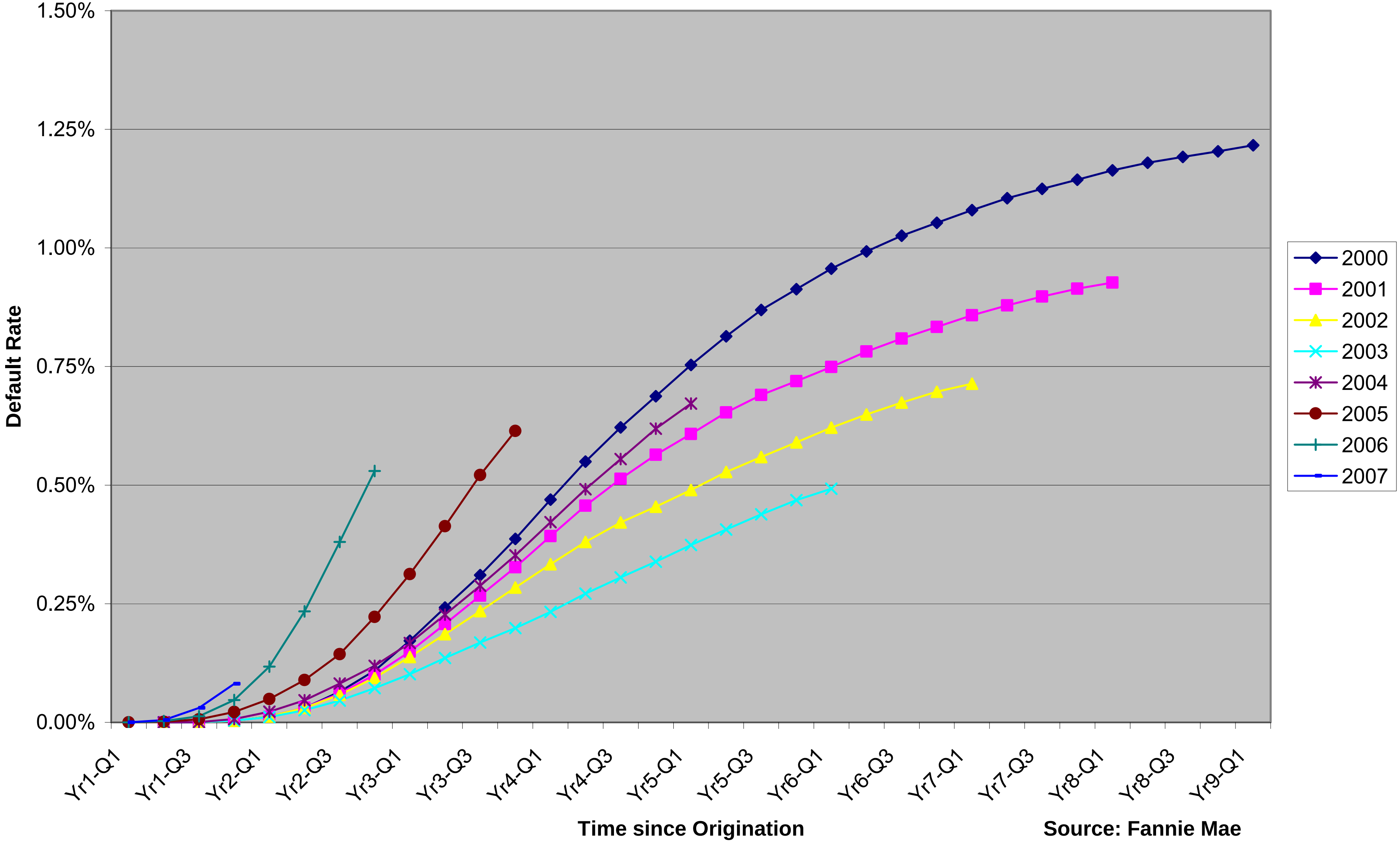
source: Mortgage Banker Association

Figure 12. Foreclosure Rates by Mortgage Instruments



source: Mortgage Banker Association

Figure 13. Cumulative Default Rates Overall Originations from 2000 through 2007



Source: Fannie Mae

Figure 14. Moments of Real Credit Growth and Per Capita Growth (1970-2008)
Partial Regression Plots corresponding to Table 5. Col 1

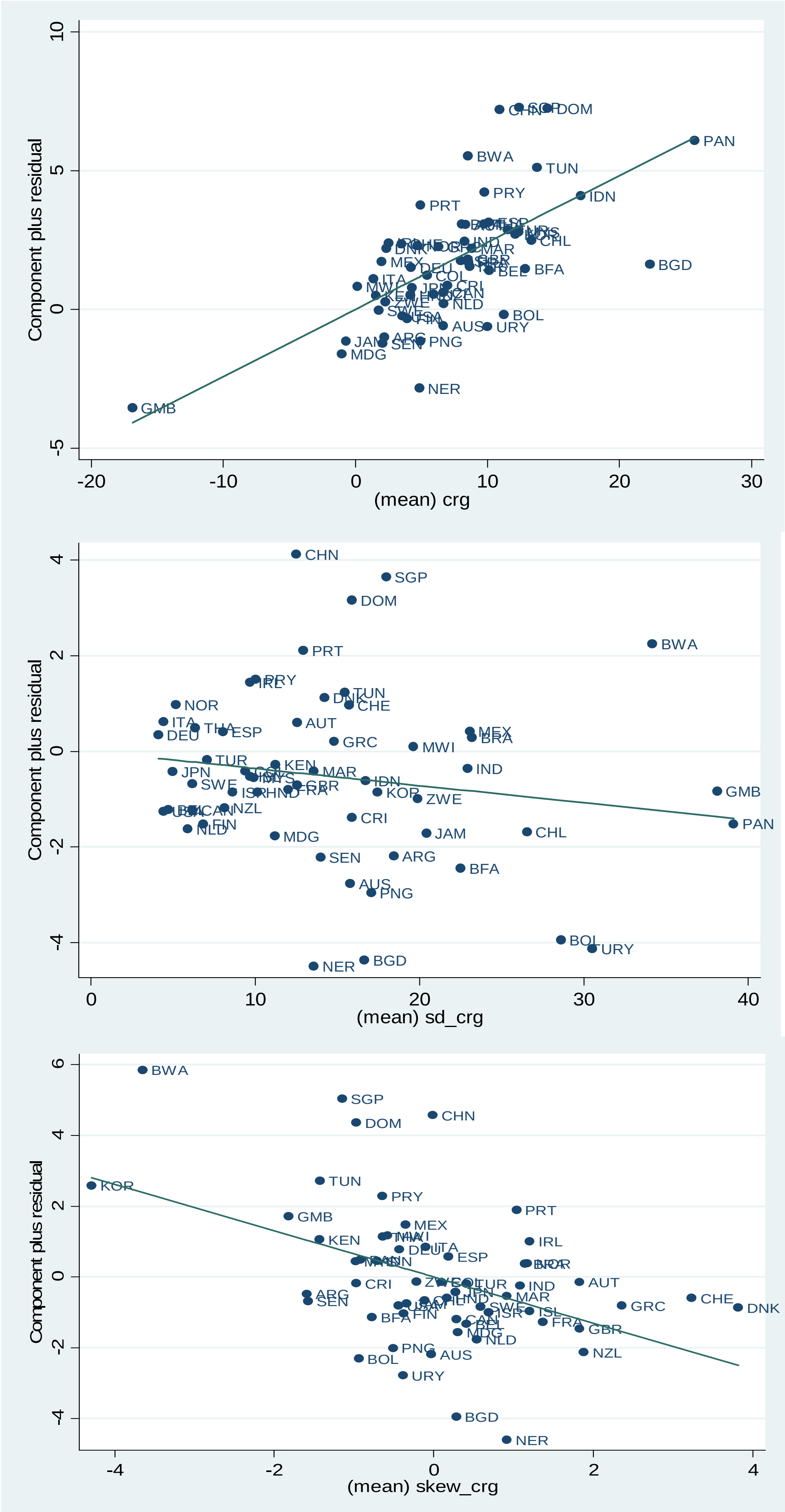


Table 1. Loan Interest Rate and Foreign Currency Borrowing.

Dependant Variable	Interest Rate on Last Loan Reported in 2005 BEEPS Survey					
Sample	Firms in Non-Tradables Sectors					
Estimation	OLS					
Foreign Currency Borrowing Dummy	-1.97***	-1.96***	-1.92***	-1.75***	-1.73***	-1.71***
	(0.37)	(0.37)	(0.41)	(0.40)	(0.41)	(0.45)
Log of Sales (2004)	-0.27***	-0.29***	-0.32***	-0.28**	-0.29**	-0.33**
	(0.10)	(0.10)	(0.11)	(0.12)	(0.12)	(0.13)
Log of Years in Operation	-0.65***	-0.63***	-0.49*	-0.52*	-0.50*	-0.28
	(0.24)	(0.24)	(0.26)	(0.27)	(0.27)	(0.30)
Maturity (in Months)	-0.0033	-0.0021	-0.00093	-0.0035	-0.0025	-0.000023
	-0.0037	-0.0037	-0.0037	-0.0039	-0.0039	-0.0039
Collateral Dummy for:						
Land or Building				0.43	0.42	0.62
				(0.34)	(0.34)	(0.38)
Equipment				-0.14	-0.16	-0.078
				(0.45)	(0.45)	(0.48)
Accounts Receivable				-0.3	-0.26	-0.36
				(1.45)	(1.45)	(1.62)
Personal Assets				-0.83	-0.82	-0.53
				(0.65)	(0.67)	(0.57)
Other Collateral				-0.08	-0.083	0.23
				(0.56)	(0.55)	(0.62)
Number of Firms	1184	1182	1182	997	995	995
Adjusted R-squared	0.597	0.596	0.605	0.586	0.584	0.595
Country Fixed Effects	Yes	Yes	No	Yes	Yes	No
Industry Fixed Effects	No	Yes	No	No	Yes	No
Country-Industry Fixed Effects	No	No	Yes	No	No	Yes

* significant at 10%; ** significant at 5%; *** significant at 1%

Notes: the foreign currency borrowing dummy is equal to 1 if last loan is denominated in foreign currency and 0 if last loan is denominated in domestic currency. The list of non-tradables sector is presented in Table A.1 in the unpublished appendix. Heteroskedasticity robust standard errors are reported.

Table 2. Loan Interest Rate and Foreign Currency Borrowing

Dependant Variable	Interest Rate on Last Loan Reported in 2005 BEEPS Survey					
Sample	Firms in Tradables Sectors					
Estimation	OLS					
Foreign Currency Borrowing Dummy	-2.52***	-2.51***	-2.50***	-2.53***	-2.55***	-2.52***
	(0.37)	(0.37)	(0.38)	(0.41)	(0.41)	(0.42)
Log of Sales (2004)	-0.38***	-0.41***	-0.42***	-0.47***	-0.47***	-0.48***
	(0.09)	(0.10)	(0.10)	(0.10)	(0.11)	(0.11)
Log of Years in Operation	0.11	0.095	0.091	0.26	0.26	0.23
	(0.21)	(0.21)	(0.21)	(0.22)	(0.22)	(0.22)
Maturity (in Months)	-0.0042	-0.0043	-0.004	-0.0018	-0.002	-0.0023
	-0.0048	-0.0049	-0.005	-0.005	-0.005	-0.0053
Collateral Dummy for:						
Land or Building				0.5	0.5	0.56
				(0.41)	(0.41)	(0.42)
Equipment				-0.8	-0.81	-0.87*
				(0.50)	(0.50)	(0.53)
Accounts Receivable				1.99**	1.97**	1.92**
				(0.88)	(0.88)	(0.91)
Personal Assets				0.93	0.95	0.94
				(0.75)	(0.75)	(0.77)
Other Collateral				-0.063	-0.1	-0.043
				(0.83)	(0.83)	(0.91)
Number of Firms	987	987	987	866	866	866
Adjusted R-squared	0.47	0.47	0.469	0.461	0.46	0.45
Country Fixed Effects	Yes	Yes	No	Yes	Yes	No
Industry Fixed Effects	No	Yes	No	No	Yes	No
Country-Industry Fixed Effects	No	No	Yes	No	No	Yes

* significant at 10%; ** significant at 5%; *** significant at 1%

Notes: the foreign currency borrowing dummy is equal to 1 if last loan is denominated in foreign currency and 0 if last loan is denominated in domestic currency. The list of tradables sector is presented in Table A.1 in the unpublished appendix. Heteroskedasticity robust standard errors are reported.

Table 3. Testing the Difference in the Effect of Foreign Borrowing on Interest Rate between the Tradable and Non-Tradable Sample

	H0 Foreign Currency Borrowing Coef (NT Firms)=Foreign Currency Borrowing Coef (T Firms)					
Difference in Foreign Borrowing Coefficients (T minus NT)	0.55	0.55	0.58	0.78	0.81	0.82
Chow Statistics	1.14	1.2	1.97	2.05	2.17	2.17
P_value	0.28	0.27	0.16	0.15	0.14	0.14
Set Control	Simple	Simple	Simple	Full	Full	Full
Country Fixed Effects	Yes	Yes	No	Yes	Yes	No
Industry Fixed Effects	No	Yes	No	No	Yes	No
Country-Industry Fixed Effects	No	No	Yes	No	No	Yes

Table 4. Growth in Sales and Foreign Currency Borrowing.

Dependant Variable	Growth in Sales between 2001 and 2004					
Sample	Firms in Non-Tradables Sectors					
Estimation	OLS					
Foreign Currency Borrowing	0.026***	0.025***	0.028***	0.019**	0.020**	0.022**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Initial Log of Sales (2001)	-0.0062***	-0.0066***	-0.0075***	0.0014	0.00045	-0.00047
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Log of Years in Operation	-0.011*	-0.012*	-0.012*	-0.022***	-0.022***	-0.020**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Initial Labor Productivity				-0.027***	-0.026***	-0.026***
Log(Sales/Employement) in 2001				(0.01)	(0.01)	(0.01)
Share of Foreign Input in Production				0.00036***	0.00038***	0.00039***
				(0.00)	(0.00)	(0.00)
Share of Employees with a University Degree				0.00042***	0.00040***	0.00033**
				(0.00)	(0.00)	(0.00)
Share of Skilled Workers				0.0054	0.0038	-0.0039
				(0.01)	(0.01)	(0.02)
Number of Firms	1243	1241	1241	1174	1172	1172
Adjusted R-squared	0.047	0.05	0.055	0.084	0.083	0.083
Country Fixed Effects	Yes	Yes	No	Yes	Yes	No
Industry Fixed Effectd	No	Yes	No	No	Yes	No
Country-Industry Fixed Effects	No	No	Yes	No	No	Yes

* significant at 10%; ** significant at 5%; *** significant at 1%

Notes: growth in sales is defined as log difference in sales between 2004 and 2001. the currency mismatch dummy is equal to 1 if last loan is denominated in foreign currency and 0 if last loan is denominated in domestic currency. The list of non-tradables sectors is presented in Table A.1 in the unpublished appendix. Heteroskedasticity robust standard errors are reported.

Table 5 Growth in Sales and Foreign Currency Borrowing

Dependant Variable	Growth in Sales between 2001 and 2004					
Sample	Firms in Tradables Sectors					
Estimation	OLS					
Foreign Currency Borrowing	0.011	0.011	0.0094	0.0076	0.0073	0.0058
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Initial Log of Sales (2001)	-0.0025	-0.003	-0.0027	0.0041	0.0041	0.0046*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Log of Years in Operation	-0.010**	-0.010**	-0.0098*	-0.018***	-0.018***	-0.018***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Initial Labor Productivity				-0.026***	-0.026***	-0.027***
Log(Sales/Employement) in 2001				(0.01)	(0.01)	(0.01)
Share of Foreign Input in Production				0.00024**	0.00023**	0.00021*
				(0.00)	(0.00)	(0.00)
Share of Employees with a University Degree				-0.00036	-0.00035	-0.00033
				(0.00)	(0.00)	(0.00)
Share of Skilled Workers				0.0027	0.0037	0.0083
				(0.02)	(0.02)	(0.02)
Number of Firms	1033	1033	1033	978	978	978
Adjusted R-squared	0.033	0.034	0.042	0.069	0.069	0.076
Country Fixed Effects	Yes	Yes	No	Yes	Yes	No
Industry Fixed Effectd	No	Yes	No	No	Yes	No
Country-Industry Fixed Effects	No	No	Yes	No	No	Yes

* significant at 10%; ** significant at 5%; *** significant at 1%

Notes: growth in sales is defined as log difference in sales between 2004 and 2001. the currency mismatch dummy is equal to 1 if last loan is denominated in foreign currency and 0 if last loan is denominated in domestic currency. The list of non-tradables sectors is presented in Table A.1 in the unpublished appendix. Heteroskedasticity robust standard errors are reported.

Table 6. Skewness and Growth in Cross-Country Regressions

	6.1	6.2	6.3	6.4
Dependent Variable	Real Per Capita Growth			
Time Period	1970-2008	1980-2008	1960-2008	1970-2008
Country Sample	58	58	58	83
Estimation	OLS	OLS	OLS	OLS
Initial Number of Years of Secondary Schooling	0.0336	0.0325	0.0416*	0.0476**
	[0.0224]	[0.0223]	[0.0216]	[0.0191]
Initial GDP per Capita	-0.218	-0.455	-0.291	-0.541
	[0.475]	[0.435]	[0.420]	[0.397]
Real Credit Growth, Mean	0.241***	0.269***	0.141***	0.206***
	[0.0380]	[0.0384]	[0.0349]	[0.0312]
Real Credit Growth, Standard Deviation	-0.0358	0.0165	-0.0556**	-0.0613**
	[0.0324]	[0.0221]	[0.0267]	[0.0244]
Real Credit Growth, Skewness	-0.654***	-0.311**	-0.281*	-0.565***
	[0.206]	[0.127]	[0.165]	[0.206]
Constant	1.528	1.941	2.93	4.095
	[3.167]	[2.499]	[2.829]	[2.662]
R-squared	0.495	0.59	0.454	0.429

Robust standard errors in brackets below estimaties. *** p<0.01, ** p<0.05, * p<0.1