

Going for broke: New Century Financial Corporation, 2004-2006¹

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Abstract:

Using loan level data, we investigate the lending behavior of a large subprime mortgage originator, New Century, prior to its bankruptcy in the beginning of 2007. We provide evidence of sudden risk-shifting in New Century's lending behavior in 2004. This change follows the sharp monetary policy tightening implemented by the Fed in the spring of 2004, which resulted in an adverse shock to the large portfolio of loans New Century was holding for investment. Most notably, New Century reacted to the shock by massively resorting to deferred amortization loan contracts ("interest-only" loans). We show that these loans were not only riskier, but also that their returns were by design more sensitive to real estate prices than standard contracts. New Century was thus financing projects with a high beta on its own survival, as predicted by a standard model of portfolio selection in financial distress. Our findings shed new light on the relationship between monetary policy and risk taking by financial institutions. They also contribute to better characterizing the type of risk taken by financially distressed firms.

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1. Introduction

Subprime mortgage originators were key players in the onset of the 2007-2009 financial crisis. The economic literature insists on their poor incentives to monitor borrower quality, as their loans were passed on to final investors through securitization (for instance, Mian and Sufi, 2009, Keys et al., 2010). In this paper, we find a different economic reason why the industry mass-produced high-risk loans: in 2004, the Fed started to sharply increase interest rates. Using detailed internal data of New Century, the second biggest subprime mortgage originator in the US, we show how the 2004 monetary tightening adversely affected the company's assets. Exactly at this moment, the firm started to originate new mortgage contracts with deferred amortization, which were much riskier. More precisely, we characterize the risk embedded in these loans: by design, these new mortgage contracts were "survival contingent", i.e. their payoffs were correlated with New Century's survival. As we argue, this is a robust - albeit rarely mentioned - prediction of standard models of corporate risk taking in financial distress.

Our data allow us to look under the microscope at the impact of monetary policy on the value of New Century's assets. These assets consisted of mortgages originated and held for investment on the firm's balance sheet. Like most of its competitors, the firm invested heavily the loans it originated (\$4.7bn at the end of 2003, about 20% of total production). When the Fed started to raise interest rates, the loan portfolio was hit by two shocks. On the one hand, fixed rate mortgages (FRMs), who were financed short term, became less profitable. On the other hand, adjustable rate mortgages (ARMs) became unaffordable for some borrowers, and therefore more likely to default. Finally, we present evidence that the loan portfolio became not only riskier, but also more correlated with housing prices.

The company, like all of its competitors, simultaneously started issuing loans that could be paid off only if the housing market remained strong over the next 2-3 years. This strategic shift was implemented through the introduction of new mortgage contracts featuring deferred amortization ("interest-only loans"). We find that the payoffs of these loans were riskier and, importantly, more sensitive to real estate prices than standard contracts. One contractual characteristic of "interest only" loans is to exhibit a strong jump in due repayment at a reset date (typically 24 months from origination). Because of this contractual feature (referred to internally in NC as a "sticker shock"²), most of these loans would eventually pay off only if the borrower could refinance at that reset date, which would require sustained real estate prices growth. If prices had ceased to grow within the 24 months following issuance, such loans would be much less likely to be repaid, either because the borrower would strategically default, or because competitors would be unwilling to refinance the loan.

Thus, the exposure of NC to real estate prices movements was substantially increased by its strategic shift. This is consistent with the view that NC was "gambling for resurrection", by investing in assets paying off only in its survival state. We provide further evidence of such risk shifting behavior by NC. In particular, a standard model of portfolio selection in distress predicts that once in distress, a firm should increase its exposure to its own default risk. In

² See Missal (2008).

line with this idea, we find that NC implemented the use of Interest-Only contracts primarily in regions with a high beta on its existing pool of loans.

Our paper puts in perspective an under-investigated aspect of monetary policy, namely that increasing interest rate may lead weak institutions to take excessive risk. It is often argued that low interest rates were the source of excess risk taking by forcing investors to reach for yield.³ The view the Fed's persistent policy of low interest rates fuelled leveraging by financial institutions is also expressed by e.g. Rajan (2005), Diamond and Rajan (2009), or Stiglitz (2010), while Greenwood and Hanson (2010), find evidence consistent with this. Without contradicting this view, the evidence we present in this paper suggests that raising rates can exacerbate risk shifting, because it weakens the balance sheet of financial intermediaries.⁴ Following a monetary shock, "zombie institutions" take more risk and might propagate rather than mitigate financial risk. During bubbles, this mechanism can have a strong reinforcing effect: it creates a reason for the more fragile institutions to "ride the bubble", potentially aggravating the consequences of a burst. It might thus be necessary when tightening monetary policy to simultaneously tighten supervision of risk-taking by financial institutions.

Our paper is directly related to several strands of the economic literature. First, our work relates to the growing literature analyzing the crisis. We highlight a shareholder value maximizing risk-shifting mechanism to explain the behavior of New Century post 2004. Our analysis suggests that risk-shifting following the 2004 monetary tightening is an important piece to decipher the behavior of mortgage originators, and potentially other financial institutions. The narrative of the crisis' onset that emerges from our analysis is different from a "*looting view*" of the crisis, whereby incentive frictions led banks' executives, salesmen and traders to engage in risk-taking, negligence or other forms of rent extraction at the detriment of shareholders (Akerlof and Romer, 1993, LaPorta et al., 2003, Kashyap et al., 2009, Biais et al., 2010). It also differs from a "*catering view*" whereby the crisis results from financial institutions producing toxic financial assets catering to the demand of "naïve" or "subsidized" investors (Shleifer and Vishny, 2010, Nadauld and Weisbach, 2010). In particular, it is often argued that the generalization of the "Originate-to-distribute" model in the mortgage industry might have led originators to issue large quantities of loans without regard to risk (Rajan et al., 2008, Purnanandam, 2010). One difficulty with that view is that originators of those assets, as we document in the case of subprime originators, actually kept much exposure to them. By contrast, this is for us a simple consequence of the mechanism at play (risk shifting), not a puzzle. Our risk-shifting narrative is highly consistent with the view developed in Hong and Scheinkman (2010), who show that the banks taking high risks pre-crisis were doing so to cater to the preferences of shareholders. In the same spirit, Minton et al., 2010, show that banks with a more financially knowledgeable board pre-crisis took higher levels of risk, suggesting risk-taking was shareholder value maximizing. Farhi and Tirole, 2010, relate systemic risk-taking by the financial industry to shareholder value maximization in the presence of bailout expectations. New Century might have expected the Fed's policies in case of crisis to provide support to real estate prices, thus increasing the benefits of risk-taking.

³ For instance, Yellen (2010) states "It is conceivable that accommodative monetary policy could provide tinder for a buildup of leverage and excessive risk-taking in the financial system"

⁴ These opposite effects of monetary policy on risk-shifting are formalized e.g. in Dell'Ariccia et al (2010).

Our work is also related to the cost of financial distress and risk-shifting literatures. Costs of financial distress incurred by firms at high leverage levels are at the core of modern corporate finance theory. A major class of such distortions is risk shifting: An institution in distress is biased toward projects that pay-off in the state of the world where it escapes bankruptcy (see e.g. Stiglitz and Weiss, 1983). Our paper provides new evidence on the impact of high financial leverage on project choice by examining the reaction of NC to a negative shock to its assets, the 2004 monetary tightening. This is related e.g. to Esty (1997) who finds compelling evidence of risk shifting during the savings and loans crisis. He does so by comparing the strategies followed by similar financial institutions differing only in organizational forms. We show in a simple model that risk shifting is characterized not only by the choice to hold more volatile assets but more specifically by the choice of new assets that have a high beta on the survival of the company. Consistent with this prediction, NC's reaction to the sharp increase in interest rates in 2004 was to issue highly "price-contingent" loans, paying off only in case of sustained real estate price growth. As a consequence, loans issued by NC after 2004 became much more likely to default should the bubble burst.

Last, our paper is related to the literature on mortgages. Demyanyk and Van Hemert, 2009, document that a sharp deterioration in loan quality post 2003 was masked by increasing real estate prices. Mayer et al., 2010, document the post-2003 spread of negative amortization mortgages and the relatively high loan-to-value ratio of subprime mortgages. We analyze the massive introduction of interest-only contracts in 2004. Barlevy and Fisher, 2010, provide an explanation for the use of interest-only loans based on borrower preferences in bubbly geographic zone. We provide a complementary explanation based on lender's preferences, explaining when and why the use of such loans is consistent with shareholder value maximization.

Section 2 provides a simple framework to explain what projects a highly levered institution should select when maximizing shareholder value. We show that together with volatility, the correlation structure between these new projects and the firm's default states appears to be a critical component of project choice. Section 3 describes the data and the business of NC, with special attention to the different types of contracts used by NC and to the trends observed in the composition of the loans it issued. Section 4 shows that the 2004 rise in interest rates was an important negative shock to NC's existing assets and to its continuation value. Section 5 investigates risk-shifting behavior by NC and tests the finer predictions of this view: NC issues loans that are more price-dependent, with a higher beta on its own survival. Section 6 concludes.

2. Portfolio choice in financial distress: a simple framework

Before moving to the empirical analysis of NC's strategic shift following the 2004 monetary shock, we present a simple model of project selection by a company as a function of its default probability. The goal is twofold: (1) to convince the reader that as the probability of default increases, a company tilts its preferences in favor of projects with a higher covariance with the company's survival and (2) to show that the probability of default of a

company does not have to be large for such distortions in project choice to be important. In other words, faced with a higher default probability, a shareholder value maximizing company will pick marginal projects that have both a high variance (the usual risk-shifting intuition) *and* a high correlation with the company's survival. Specifically, we derive the company's investment criterion and explain how it becomes different from the NPV criterion.

a. Risk-shifting and the "survival covariance" effect

We formalize project choice by a levered institution in a simple one period model. There are two periods. At time 0, the probability that the company survives at time 1 (i.e. doesn't default on its liabilities) is p . We call S the survival dummy, equal to 1 when the company survives, and zero when it defaults. The unconditional mean of S is $p=ES$.

We assume a risk-neutral pricing kernel and assume that the company keeps its preexisting assets on balance sheet (for instance, it cannot sell existing assets to buy new assets with the proceeds). Now consider a marginal dollar that the company can invest on either of two projects ($i=1,2$) that both consume one unit of capital at time zero and yield a net return R_i at time 1. For instance, this marginal dollar could be held in cash (yielding the risk-free rate rf) or lent to a borrower. How should the managers of the company evaluate such marginal projects, from the point of view of their shareholders? The following proposition shows how preferences over projects are distorted by the possibility of failure.

Proposition 1:

Noting β_i the beta of project i on the survival dummy S , project 1 is preferred to project 2

iff:

$$E(SR_1) > E(SR_2)$$

i.e.

$$ER_1 + (1 - p)\beta_1 > ER_2 + (1 - p)\beta_2$$

In particular, a sufficient condition for project 1 to be preferred to the risk-free rate is:

$$ER_1 - rf > -(1 - p)\beta_1$$

To prove this result, notice first that the project's payoff to shareholders comes entirely from the cash flows generated by the project when the company is not bankrupt. The default dummy S can be thought of as the shareholders' pricing kernel *for the company's projects*. Since projects are marginal, the survival probability of the company, p , can be taken as exogenous⁵. The time 1 value of the projects for shareholders is ⁶ $E(S(1+R_i))$. It follows

⁵ A marginal project only has, through its first-order impact on default, a second order impact on the shareholder value of the legacy asset. This is because at the default frontier, shareholder payoffs from the legacy asset equal zero, thus a first order change in the default frontier only impacts the value of the legacy asset to the second order.

that project 1 is preferred to project 2 iff: $E(SR_1) > E(SR_2)$, which rewrites directly into the proposition's first equation, once noting that $\beta_i = \text{cov}[S, R_i]/[ES(1 - ES)]$.

Project 1 has higher economic value than project 2 iff: $ER_1 > ER_2$. An economic value approach in comparing the projects, would prevail if the company never defaults: Preferences over projects would then be independent of their returns' covariances with the company's survival. When its default probability is positive, however, the company does not care only about a project's margins (ER_i) but also about whether the projects tends to pay-off in states where the company is afloat or not. As the probability of default increases (lower $p=ES$), the company tilts its preferences toward projects with higher covariances (or equivalently betas) with the survival dummy. An increase in a project's covariance (or beta) with survival can come from either its higher variance (the usual risk-shifting effect) or higher correlation with the survival dummy.

To get an illustration of the fact that the distortions in project choice can be quite substantial without the default probability being very high, assume $p=0.9$. Let's consider the tradeoff between investing a marginal dollar on the risk-free rate or investing it on a project with the following structure: conditional on the firm surviving, the project yields 8% with probability 97% and -50% otherwise (think about it as a 50% recovery rate on the dollar lent if the project is a loan); conditional on the firm not surviving, the project yields 8% with probability 20% and -50% otherwise. A simple computation based on the second inequality of Proposition 1 shows that the project is preferred by shareholders to the riskless investment if its expected return ER fulfills:

$$ER - rf > -8.5\%.$$

This implies that some negative NPV projects might be undertaken as long as they are sufficiently "survival-contingent", i.e. have a high covariance on the firm's survival.

b. Risk-shifting and the "common factor" effect

We now come to the description of a second effect, which is fairly intuitive: if the survival dummy of a company becomes more contingent on an economic factor and if the company can choose the exposure of projects to this factor, it will tilt its preferences toward projects with a higher exposure on this factor. Later, in our empirical analysis, this factor will be aggregate real estate prices. On a theoretical basis, this effect is interesting as it can give rise to risk-shifting without higher default rates.

As before, we stage this effect in our simplified one period set-up, with a firm holding to a legacy asset and considering a marginal project. Assume U is a random variable (e.g. the aggregate real estate index) and assume that the survival dummy of the company can be decomposed into the product of an idiosyncratic shock, 1_{firm} , orthogonal to all random variables we will use, and a factor-dependent shock, $1_{U>U^*}$, which is one if the factor is above a threshold U^* and zero otherwise:

$$S = 1_{firm} 1_{U>U^*}$$

Assume that the firm considers investing in the risk-free rate or in a project which has a net return dependent on the factor and on its own idiosyncratic shock (orthogonal to all other variables). For instance, let's look at a project with only two possible outcomes, X or 0 , which occurrence is determined by:

$$1 + R = 1_{project} 1_{U>U^{**}} X$$

Proposition 2: The project is preferred by shareholders to the risk-free project iff:

$$\frac{E(1+R)}{1+rf} > \frac{E(1_{U>U^*})}{E(1_{U>U^*} \text{ if } U>U^{**})} = \frac{p}{E(1_{firm})E(1_{U>U^*} \text{ if } U>U^{**})}$$

To see this, we start from the fact that the project is preferred to the risk-free rate if:

$$E(S(1 + R)) > (ES)(1 + rf).$$

We then get to the result by rewriting this as:

$$E(1_{firm} 1_{U>U^*} 1_{project} 1_{U>U^{**}}) X > E(1_{firm} 1_{U>U^*})(1 + rf).$$

Proposition 2 has two distinct implications that will guide us in the empirical analysis. First, keeping the probability of default p constant, and decreasing the idiosyncratic part of risk-shifting ($E(1_{firm})$), we see that more risk-shifting occurs, in the sense that the inequality of proposition 2 becomes less tight. This is because the project is contingent on the factor, and the decrease in idiosyncratic default implies that default becomes more factor-dependent. Thus, risk-shifting through the loading on a common factor can occur as soon as default becomes more factor-sensitive, even without an increased default probability.

A second consequence of the proposition is that if U^* increases, so that the economic factor becomes more often fatal to the firm, the firm has a bias toward factors with a higher U^{**} , i.e. a stronger success sensitivity to the factor. The intuition is that the firm is willing to give up any positive cash-flows for $U < U^*$ against positive cash-flows occurring if $U > U^{**}$. Starting from $U^* < U^{**}$, the firm is willing to raise the threshold U^* (up to U^{**}) to gain any arbitrarily small increase in X , even if it means the economic value of the project deteriorates. This result turns out to be useful in the study of New Century: we will see that, as the firm became more sensitive to real estate prices, it started financing projects with success more contingent on high real estate prices.

3. Data and business description

This section presents our various data sources and some key aspects of New Century's business that are important background information to analyze its behavior post-2004.

a. New Century's business

Looking at New Century's business over 2001-2003, a striking fact is that the company has progressively moved away from a pure originate and distribute business model, where loans are only held temporarily on the balance sheet. As time passes, the company finds itself holding more and more loans for the long term, and its balance sheet expands. But let us first review the three main ways for New Century to finance loan issuance.

Whole loan sales

Table 1 reports the dollar amount of mortgages issued by New Century over 2001 - 2005. As shown in Table 1, most of the loans are sold a few months after origination to third parties (mostly investment banks that will eventually repackage them) through what is called « whole loan sales »⁷. This part of NC's activities generates off-balance sheet liabilities, but it is not obvious to quantify their extent. First, buyers can return loans that default within a few months of origination (early payment defaults). Second, NC is forced to replace or repurchase loans if buyers can prove a breach of representation or warranty.⁸

Securitization structured as sale

In this setting, NC would set up a trust, which would receive loans as assets. The trust would issue bonds that will receive principal repayment plus an interest that is lower than the interest rate actually paid by the loans. This is in exchange for seniority. NC would receive the residual and book the resulting profit as income. As shown in Table 1, securitization structured as sale is a small and intermittent share of total originations. There is none in 2003 and 2004. In 2002, it is about 10% of total originations. In 2001 and 2005, it hovers around 10-12%.

As for whole loan sales, off-balance sheet liabilities seem to be limited to breach of representation or warranty.⁹

Securitization structured as financing (loans held for investment)

This is the last category, and here, loans that are issued fully remain on NC's balance sheet (thus, the term "securitization" is not used here in its usual street meaning). In this case, New Century becomes in effect a mortgage lender. Financing of these assets is done through the issue of bonds, who rise in NC's balance sheet in parallel with the corresponding assets;

⁷ The ownership transfer takes a few months (52 days in 2002), such that New Century always holds an inventory that is financed by short term financing (credit lines).

⁸ « We sell whole loans on a non-recourse basis pursuant to a purchase agreement in which we give customary representations and warranties regarding the loan characteristics and the origination process. Therefore, we may be required to repurchase or substitute loans in the event of a breach of these representations and warranties. In addition, we generally commit to repurchase or substitute a loan if a payment default occurs within the first month or two following the date the loan is funded, unless we make other arrangements with the purchaser. » (10k form for fiscal year 2003, p13)

⁹ « The Certificates are typically sold at face value and without recourse except that the Company provides representations and warranties customary to the mortgage banking industry to the Trust. » Source: 2003 10K filing. In 2005, the 10K filing makes a somewhat more mysterious statement: «We are party to various transactions that have an off-balance sheet component. In connection with our off-balance sheet securitization transactions, there were \$6.9 billion in loans owned by the off-balance sheet trusts as of December 31, 2005. The trusts have issued bonds secured by these loans. **The bondholders generally do not have recourse to us in the event that the loans in the various trusts do not perform as expected except for specific circumstances.** »

these bonds are collateralized by the loans, but nowhere in the 10K filings could we find a sentence mentioning that these bondholders had no recourse to NC. It seems a priori reasonable to assume that these bonds were sold with recourse, so that NC's shareholders are liable for defaults on these loans.

This category of financing has dramatically increased over the period, from zero in 2001 and 2002 to \$11bn in 2005 (about 20% of overall originations, see Table 1). Looking at overall capital structure, the dramatic increase in the importance of these loans and their financing leads to a sharp increase in the gearing ratio (book value of debt to book value of equity): 5 (2002), to 11 (2005). This is apparent from Table 2, which reports the evolution of a stylized balance sheet from 2001 to 2005 (last year for which we have annual accounts).

NC was not isolated in its choice to keep loans for investment. In Table 3 we show data on the 10Ks of Newcentury's competitors as of the end of 2003. Specifically, we looked for all mortgage originators the following industries: sic = 6798 (REAL ESTATE INVESTMENT TRUSTS) and sic = 6162 (MORTGAGE BANKERS & LOAN CORRESPONDENTS). We retrieved from the 10Ks the value of loans held for investment when available, stockholder equity and total assets for the fiscal year 2003. The table provides evidence that all competitors of NC were also holding loans for investment as a significant fraction of their assets and a large multiple of their equity.

b. Data

We are using several sources of data.

New Century's loan database

We work on a 20% random extract of the exhaustive loan database used by New Century when it was in operation. This extract ("the loan database") contains 739,688 loan applications examined by NC since 1997. These data are used in the academic literature by Berndt and al., 2010, who analyze incentives of mortgage brokers. Figure 1 shows how steep NC's growth has been since 2002-2003. Until 2001, the firm was examining about 20,000 applications a year. The annual flow increases to about 100,000 in 2003 to culminate around 160,000 in 2004-2005. This corresponds to an eightfold increase in NC's volume of activity in about 3 years (from 2002 to 2004).

We use several kinds of variables from the loan database:

- **Borrower:** full documentation provided (or not), loan to value ratio, income, fico score, age
- **Property:** zip code
- **Loan:** principal, status (funded, denied by NC, withdrawn by borrower), fixed or variable rate (ARM or FRM), maturity (30 years for 92% of the applications), interest rate, amortization schedule (is there an interest only period or a balloon dimension), length of the teaser period (2 to 5 years), purpose of the loan (first purchase or refinancing), first monthly payment, etc.

The geographic dispersion of applications is not fully representative of the US real estate market, but all regions are well represented. California (22.5% of all applications), Texas (9.5%) and Florida (8.5%) together represent more than 40% of all applications. Yet, no other state weighs more than 4%.

Table 4 looks at other loan characteristics. About 65% of the applications are based on full documentation. For the observations that are not, a bias is to be expected (all our regressions are run with and without the partial documentation sample). The average monthly income of borrowers is \$6600 (about \$80,000 annual) and the average fico is 617, short of the 620 threshold under which most lenders used to consider a borrower as « subprime ». The mean loan to value ratio is 80%. All in all, borrowers have relatively high income but are also heavily indebted. Approximately 70% of the applications correspond to refinancing of existing home loans.

In this overall sample, the fraction of loans actually funded is 42.7%. Most of the non-funded applications are actually withdrawn by the borrower (42.2%). New Century denies a smaller fraction of applications (14.5%).¹⁰

New Century's servicing database

The servicing database gives us access to the history of a fraction of the loans issued by New Century. Next to its origination business, NC had a « servicing » business whose role was to make sure the eventual owners of the loans would receive the agreed upon monthly repayment. The servicer would also launch a recovery procedure as soon as a default event would arise. The servicer would receive a fee on all these operations and therefore had strong incentives to maintain a precise payment record for each borrower.

The raw servicing database is a panel dataset that tracks each individual loan over time. It can be matched with the loan database through a unique loan identifying number. It provides information on loan repayment history & fees. In this paper we focus on delinquency events.

NC did not service all the loans that it originated. It was the servicer of the loans that it held on balance sheet for investment and of a fraction of the loans sold to third parties (once a loan was sold, the buyer could opt for a competing servicing company). We remove all observations corresponding to dates less than 12 months after loan origination. This has the drawback of removing early payment defaults (less than 3 months after origination) from the analysis, but the advantage is that we are certain to focus on loans permanently serviced by NC, as opposed to loans that are temporarily in inventory before being serviced by another company. This guarantees that such servicing migrations won't be confused with refinancing events. For loans issued in 2004, the vintage for which servicing data are being used, the vast majority of the serviced loans were held for investment (11,6bn compared to 1,2bn sold on a servicing retained basis). These are loans that NC either chose not to sell, or could not sell, immediately after producing them. This selection issue could bias our estimated levels of delinquencies up or down compared to the rest of NC's loan production.

¹⁰ These fractions don't exactly add up to 100%, as there are residual categories in the status variable that are hard to interpret. In the analysis, we will focus on loans that belong to one of the above three categories.

However, we focus on NC's own level of risk-taking (not the risk it was making other institutions take).

Real estate price database

We obtain house price indices (HPI) from the OFHEO website. HPIs are defined at the MSA level since 1973. They correspond to prices of observed transactions of single-family houses, whose characteristics (number of rooms etc.) are controlled for using hedonic regression techniques. Geographic information in NC datasets does not have the MSA code but only the zipcode. Hence, home price information is matched with both New Century datasets using a MSA – zipcode correspondence table retrieved from the Missouri Data Research Center.¹¹

Census database

Some borrower specific information such as education, are not available from NC's loan database. To fill this gap, we retrieve average education in 2000 by census tract using a 5% extract of the 2000 census (itself obtained from the PUMS website¹²). We then match this information with NC datasets using a correspondence table between zip codes and census tract identifiers retrieved from the Missouri Data Center. A complication arises from the fact that some zip codes overlap several census tracts and some census tracts overlap several zip codes. Fortunately, the MDC provides us with the population in each tract x zip region, so that we end up taking, for each zip code, the average education level across tracts in this zip code, weighted by the population of each tract in this zip code.

c. Types of loans used before 2004

As of December 2003, 98.9% of the loans issued by NC belong to one of the following two types of contracts:¹³

1. Standard fixed rate mortgages (FRMs): the interest rate is fixed for the lifetime of the loan. Amortization is progressive so as to keep the monthly payment fixed over the full duration of the loan. Maturity is typically 30 years. These loans account for about 30% of total originations.
2. Hybrid Adjustable rate mortgages (ARMs): the interest rate tracks the 3 months LIBOR. Every six months (for 95% of the ARMs in the sample), the interest rate is reset to being equal to LIBOR plus a pre-specified "ARM margin", unless it reaches a pre-specified cap or floor. NC's ARMs are "hybrid" in that they systematically come with an initial "teaser" period of about 24 months (90% of the observations) where the interest rate is fixed. Most of the loans in our data have a 30-year maturity. In this case, they are called 2/28 ARMs.

4. The 2004 monetary policy shock

¹¹ <http://mcdc2.missouri.edu/websas/geocorr2k.html>

¹² <http://www.census.gov/main/www/pums.html>

¹³ See for instance Mayer et al (2009) for a more exhaustive description of mortgage contracts used in the industry.

The Federal Reserve has increased its baseline interest rates very strongly, from 1.5% to more than 5% in mid 2006. This turning point was anticipated by professional forecasters in the second half of 2003 (see figure 2). It therefore seems reasonable to assume that upcoming interest rates hikes were anticipated by NC in 2003.

This Section investigates the consequences of this interest rate increase on NC's assets. We will show that the monetary policy tightening had the effect of (1) making these assets riskier, thereby increasing the probability of financial distress, and (2) increasing the exposure of NC's assets to the risk of real estate price decrease.

a. NC's assets became riskier

Financing fixed rate mortgages became more costly

The first impact of the 2004 interest rate increase comes from the fact that many loans issued by New Century were paying fixed interest rates (either because they were FRMs or relatively new ARMs in the teaser period¹⁴), while New Century inventories and investment were financed using variable rate debt.

This effect is likely to be big. To obtain an order of magnitude, let us make several simplifying assumptions. First, about 30% of NC's originations are fixed rate mortgages: in December 2003, since NC held \$8bn in assets, it is therefore reasonable to assume that NC held about \$2.4bn in FRMs on its balance sheet. Furthermore, let's assume that these loans behave like assets that yield a nominal risk-free constant amount C (interest + principal repayment) for 4 consecutive years, after which the loan is refinanced and therefore repaid. The value of the asset is thus $V(A) = (1 - 1/(1+r)^4)(C/r)$, where r is the current risk-free rate. When r increases from 1% to 5.5%, corresponding to the change of the LIBOR rate between mid 2004 and mid 2006, the value of the asset drops by 11.3%. For holdings of \$2.4bn, this generates a capital loss of about \$270m. Thirdly, let us assume that NC's debt is short-term, so that its value is unaffected by changes in r : at the end of 2003, liabilities amount to \$8.4bn and will not change. According to this rough calibration, the direct effect of monetary policy is to reduce NC's equity by about \$300m, and to increase NC's debt to equity ratio from 6.5 to 8.5, an increase of about 30%. For comparison, notice that NC's market value of equity at the end of 2003 was \$1.3bn, and its book equity was \$500m.

The negative sensitivity of income to interest rate hikes was explicitly acknowledged in NC's 2004 10k filing.¹⁵ It is also visible from accounting information. As predicted, when interest rates were lifted by the federal reserve in 2004, the interest income to interest expense ratio

¹⁴ In the data the average time of a typical NC loan before refinancing or final repayment was no more than 3 years.

¹⁵ "Our profitability may be directly affected by changes in interest rates. The following are some of the risks we face as a result of interest rate increases: [...] the income we receive and the value of the residual interests we retain from the securitizations structured as financings are based primarily on the London Inter-Bank Offered Rate, or LIBOR. This is because the interest on the underlying mortgage loans is based on fixed rates payable on the underlying mortgage loans for the first two or three years from origination while the holders of the applicable securities are generally paid based on an adjustable LIBOR-based yield. Therefore, an increase in LIBOR reduces the net income we receive from, and the value of, these mortgage loans and residual interests."

reported by New Century started to decline sharply: this ratio is equal to 3.02 in 2003, 2.45 in 2004 and 1.78 in 2005. New Century reports hedging some of its interest rate exposure by using derivative contracts such as Euro Dollar futures or interest rate caps contracts. While the details of NC's hedging policy are not easy to assess, it is possible to infer from its 10K statements that they were only very limited in size.¹⁶

Adjustable rate mortgages became riskier

ARMs in NC's balance sheet as of January 2004 were partly immune¹⁷ to interest rate risk but became more exposed to borrower default. For ARM borrowers whose monthly payment was a high fraction of income, the expected future increase in interest rates would make the loan unaffordable. In this case, the borrower would be left with two choices: (1) refinance the loan at a lower interest rate, using capital gains to lower interest rates or (2) default on the mortgage if the real estate market does badly and there is no capital gain to lower interest payments.

The increase in monthly payments of existing ARMs responded sharply to the 2004 monetary policy tightening. For each ARM in the servicing data and originated before January 2004, we calculate, each month, the cumulative growth in monthly payment since origination. We then calculate the average monthly payment growth of these ARMs for each month starting in January 2003, and report this in Figure 3. The monthly payment of these loans remains stable until mid 2005, and then sharply rises; by the beginning of 2007, monthly payment of these loans (remember they have been originated before January 2004) has increased by more than 20%. This evolution is probably underestimated by servicing data since loans that became unaffordable were more likely to default or be refinanced. All in all, Figure 3 also shows that the impact of monetary policy is delayed by about one year. This is due to the fact that New Century issued hybrid ARMs who came with a two-year period of fixed interest rates. Hence, rates of ARMs issued in February 2003, for instance, only became variable in February 2005. But this evolution was clearly anticipated by NC as soon as the end of 2003, when it became clear the Fed would raise interest rates.

Such a monthly payment increase ultimately led to an increase in repayment risk for ARMs issued prior to 2004. For each of these ARMs in our servicing data, we define, each month, a "delinquent" dummy equal to one if payment is more than 60 days late. We then calculate, each quarter, the average of this dummy, i.e. the fraction of month-loan observations in the quarter that correspond to a delinquency event. We then repeat the procedure for FRMs, and report the two evolutions in Figure 4. While the delinquency rate of FRMs remained around 10-15% until the demise of NC, the delinquency rate of ARMs increased from about 15% to 35% in the beginning of 2007. From Figure 4, we can see that repayment risk increase for ARMs in mid 2005, which is the precise date when monthly payments for these loans started to increase.

¹⁶ For instance, the 2004 10K filing reports that the fair value of Eurodollar contracts was a \$26.1 million asset in December 31, 2004. The fair value of interest cap contracts was \$7.4 million at December 31, 2004. To put these numbers in perspective, NC's interest income was 1.7 Billion in 2005 and 0.9 Billion in 2004. The hedges reported by NC are thus not likely to protect it fully from permanent increases in the interest rate.

¹⁷ Typically, rates in ARM contracts are fixed for the first 24 months and then adjust to the LIBOR every six months.

New Century's business opportunities deteriorated

In addition to the risk on NC's assets in place, higher interest rates generated concerns about the sustainability of NC's business. First, higher interest rates meant higher initial monthly payments, which made borrowing less attractive for prospective customers. The impact of interest rates on monthly payment is big. Looking at loan data, the interest rate on loans granted by NC increased from 7.5% to 9% between 2004 and 2006. For a given loan principal, this would lead to an increase in monthly payment by about 20% in the first years. Second, helping FRM holders to refinance at a lower rate was until 2004 a big part of NC's business. As interest rates increased, demand for refinancing decreased strongly. Looking at loan data, we see that the fraction of applications corresponding to refinancing fell from about 75% to about 55% around 2004.

b. NC's assets became more exposed a negative shock to housing prices

The 2004 monetary policy turning point also made New Century's assets more exposed to the risk of a slowdown in real estate prices. We have seen above that ARMs held by New Century became riskier as the monthly payment asked to borrowers increased. Constrained borrowers who could not afford the new payments could, however, refinance their loans into lower interest rates mortgages as long as real estate prices increase. This is the principle behind lenders' "points": a borrower can increase the face value of his debt - hence reduce his home equity - in exchange for a lower interest rate (Hall and Woodward, 2010). Hence, if real estate prices go up, it is possible for borrowers to refinance loans before the monthly payment explodes. But in the absence of house price appreciation, constrained borrowers may have to default. Conditional on the information available in January 2004, it became likely that returns of ARMs in NC's portfolio would be tied to real estate prices.

To verify that this ended up being the case, we ask if ARMs became more likely to be delinquent in areas where house price growth was slower. To run this test, we restrict the analysis on the sample of ARMs and FRMs issued prior to January 2004, and run the following regression:

$$Everdelinquent_{ia} = \beta.ARM_i + \gamma.Slowgrowth_{ia} + \delta.Slowgrowth_{ia} \times ARM_i + X_i + \varepsilon_{ia}$$

for loan i , granted in area a (ZIP code). $Everdelinquent_{ia}$ is a dummy variable equal to 1 if, at any point until the 36th month of the loan, the borrower is more than 60 days late on one monthly payment. ARM_i is a dummy equal to one if the loan is an ARM. $slowgrowth_{ia}$ is a dummy equal to 1 if the cumulative house price growth in area a over the first 36 months of the loan's life is less than 15%. X_i is the set of controls: log of borrower income, borrower's FICO, loan to value ratio and a date of origination fixed effect. ε_{ia} are clustered at the area level. If ARM returns are more sensitive than FRMs to slow house price growth, we would expect that $\delta > 0$.

In Table 5, we look at estimates of the above regression for three vintages: 2001, 2002 and 2003. For vintage 2001, we do not expect a big difference in delinquency between ARMs and FRMs over the first 36 months of their lives, since interest rates barely changed over the

period. As expected, even though the delinquency rates of ARMs and FRMs were both significantly higher in slower growing regions, they are not statistically different (columns 1 and 2). For vintage 2003 however, the difference in behavior between ARMs and FRMs is statistically significant: all things equal, 2003 ARMs were 14 ppt more likely to become delinquent in slowing regions than in non slowing regions; FRMs were only 6 ppt more likely to become delinquent. The 8 ppt difference is significant. Such evidence suggests that ARMs in New Century's assets became exposed to a slowdown in price growth once interest rates started to increase.

5. Evidence of risk shifting

We have just shown that the 2004 monetary policy tightening would tilt NC's shareholders' loan selection in the direction of risk shifting. In this section, we document that New Century's risk shifting behavior was consistent with our stylized model, i.e. that loans originated and kept were more likely to have a high beta with NC's survival prospects. First, in 2004, NC started to massively issue loans with deferred amortization. These loans were not, in the long run, affordable to borrowers unless home prices kept rising. Second, these loans were primarily directed to regions that were "bubbly", i.e. whose home prices would be more likely to drop if the bubble burst. Third, NC would issue more loans in regions whose past price increases were correlated with regions in NC's own loan portfolio.

a. The rise of deferred amortization lending

Interest-only and balloon loans: the 2004 shock

In early 2004, New Century, started to massively issue loans whose first payments entailed little amortization. These loans were of two types:

- Interest only ARMs: These are hybrid ARMs, with the added feature that during the teaser period the principal is NOT amortized. This period lasts 24 month in 2004, but then gradually increases to 60 months towards the end of 2006.
- Balloon loans: These are also ARMs whose principal is amortized over 40 years while holding maturity at 30 years. Hence, a substantial fraction of the principal has to be repaid at maturity. Balloon loans also feature a teaser period where the interest rate is fixed.

In figure 5, we plot the fraction originated in the form of deferred amortization loans. They were a negligible fraction of total originations until February 2004. Interest-only loans are first introduced, and rise to nearly 40% of all originations in mid 2005. Then, they decline somewhat, but balloon loans are introduced and rise very rapidly. By the end of 2006, the two types of deferred amortization loans account for about 60% of all origination.

The sudden diffusion of deferred amortization loans is not restricted to New Century. We looked at the 10k filings of New Century's competitors in two industries: REAL ESTATE INVESTMENT TRUSTS (sic = 6798) and MORTGAGE BANKERS & LOAN CORRESPONDENTS (sic = 6162). In figure 6, we report, for each competitor for whom the information was available, the fraction of (dollar) originations that are accounted for by the issuance of interest-only loans. There is a clear turning point in 2004 for most competitors. There is also evidence that that the adoption of balloon loans was pervasive in the industry as of 2005. Demyanyk and

Van Hemert (2009) for instance report, using a representative sample of securitized loans that balloon originations went from 0% in 2003 to 4% in 2005 and 25% of all originations in 2006). Because we only have servicing data until the beginning of 2007, in the following we will focus on the first large vintage (2004) of deferred amortization loans, and therefore on interest-only loans only.

The payoff structure of interest-only loans: evidence from the "sticker" shock

We now document that these interest-only loans implement the risk shifting strategy that we described in Section 2. Given the 2004 monetary tightening, New Century's assets became both riskier and more correlated to future home price appreciation. The model sketched in Section 2 suggests that, in these circumstances, New Century's portfolio allocation should be tilted towards assets that are correlated with NC's own legacy asset, i.e. loans whose returns are correlated with real estate returns.

We demonstrate here that interest-only loans are such assets, because they force borrowers to refinance them, which can only happen if real estate prices appreciate. These loans feature no amortization of the principal during the interest-only period: hence, at the end of this period, monthly payments increase (1) because interest rates increase (like for hybrid ARMs, as discussed above) and (2) because the borrower starts amortizing the principal. Figure 7 provides visual evidence that this monthly payment shock for interest-only loans is much larger than for ARMs. Using servicing data, we plot the observed cumulative increase in monthly payment since origination, starting 12 month prior to the end of the teaser period until 12 month after this date. We do this both for interest-only loans issued in 2004, and for ARMs for comparison. For ARMs issued in 2004, the end of the teaser period occurred in 2006. Since interest rates increased a lot during this period, borrowers face a monthly payment shock of about 10-20%. For interest-only loans, monthly payments increase by more than 50%.

Looking at payment to income ratios, it is likely that a significant fraction of borrowers could not withstand such a shock. Figure 8 reports the average monthly payment to income *at origination* for the three main categories of loans. In 2004, monthly payments for interest-only loans started at about 21% of income (compared to 23% for ARMs). Once the interest-only period ends, payments increase by about 50% for interest-only loans (compared to only 20% for ARMs): thus interest-only payments end up being a much larger fraction of income once the borrower starts amortizing the principal.

Therefore, the monthly payment shock coincides with an increase in delinquency. To check this, we run the following regression:

$$Delinquent_{it} = \alpha + \beta.POST_{it} + X_i + \varepsilon_{it}$$

where the LHS variable is a dummy equal to 1 if loan i is delinquent at date t (i.e. payment is more than 60 days late). The X 's are loan-level controls: LTV, fico and year-of-origination dummy. $POST$ is a dummy equal to 1 once the loan has passed the end of the teaser / interest-only period. We report results for interest-only and ARMs in Table 6 (columns 1 and 3, respectively). We find that the monthly probability of delinquency increases by a

significant 7.5 percentage points after the end of the teaser period for ARMs. The increase is larger for interest-only loans (9%), consistently with the idea that interest only loans trigger a much stronger payment shock around the first reset date. The differential increase between both types of loans is, however, insignificant.

The impact of the payment shock should, however, be smaller if home prices appreciate. For constrained borrowers, once the reset date approaches, there are two options: either default, or refinance. Refinancing is a feasible option if the house price has increased enough, since in this case the borrower can exchange some of his capital gains to lower the interest rate (this is the principle behind lender's points, as we discussed above). Refinancing is an interesting option if the borrower's equity in the house remains positive, i.e. if the real estate market is in good shape. For both reasons, we expect the payment shock to increase delinquency when home prices decelerate. To check this, we report in table 6, columns 2 (for ARMs) and 4 (for interest-only), the following estimates:

$$Delinquent_{it} = \alpha + \beta \cdot POST_{it} \times LOWGROWTH_{it} + POST_{it} + LOWGROWTH_{it} + X_i + \varepsilon_{it}$$

where LOWGROWTH is equal to 1 if home prices in the property's zipcode have grown by less than 10% between months t-12 and t. From this table, it appears that the increase in default rates for both ARMs and interest-only loans around reset are sensitive to real estate returns. This is consistent with the idea that these loans are risky and that their returns are low in states of nature where house prices grow little. Home price sensitivity is almost twice larger for interest only loans, which is consistent with the idea that the monthly payment shock around reset makes interest-only more likely to default when capital gains are too low to permit refinancing.

Such behavior is consistent with our model sketch, which suggests that NC should tilt its portfolio towards assets that are more sensitive to its current portfolio's return. For a given loan granted, assuming New Century managers were maximizing equity value, they are indifferent to the payoffs of the loan in the scenario of bankruptcy (the bad state), while trying to maximize payoffs in the good state. Thus, as the occurrence of the bad state was highly related to the burst of the real estate bubble, New Century must have been prone to adopt contractual features leading to high bankruptcy rates in the burst scenario, while yielding high payoffs in case of persistence of strong real estate prices. The contractual form of Interest Only loans was granting precisely that feature: when using such loans, borrowers are unlikely to be able to refinance unless prices keep growing, as the due payment jumps sharply at the reset date, where principal amortization starts.

The payoff structure of interest-only loans: evidence from unconditional defaults

To generalize the above "clean" analysis, we check whether unconditional delinquencies of interest-only loans were indeed more elastic to home prices than other classes of loans. In order to do this, we focus on the 2004 vintage of loans granted by New Century, a vintage for which we can observe up to 36 months of servicing history post origination. For each category of loan, we define a cumulative default dummy equal to one if the loan is ever observed to be more than sixty days delinquent over its lifecycle. We construct aggregate price measures at the zip code level (using MSA level information) and merge them to our

servicing data. For each zip code where the price data are available, we construct each month the growth rate of prices over the two years following that month's end. We defined quartiles of this growth rate using data for all available data over 1999 to 2005, which provides a discrete measure of relative price growth in a given zip code (the corresponding dummies are called "growth1", "growth2", "growth3", "growth4"). We construct a second discrete measure of price growth: we say that there is slow growth in zip code i at month t if price growth in zip code i is lower than 10% for the 24 months following month t . We merge the zip code level data with our servicing data so that we have for each loan the measures of the growth of prices in the two years following the start of that loan's life. There is a total of 21,828 loans for which we are able to get information on aggregate prices in their zipcode. 24% of these 2004 loans exhibit "slow growth" in local real estate prices during the 2 years following their start date. We then regress the cumulative default dummy defined above in loan level regressions (one observation per loan) where the right hand side variables is loan type ("FRM", "ARM" and "IO") interacted with the measures of price growth. The reference is "FRM" and in the quartile growth specification, the reference is "growth 1", which corresponds to the lowest price growth quartile. We also control for the month of the loan's start and in some specifications for FICO and the Loan-to-Value ratio (LTV). Error terms are clustered at the date level (year and month of origination).

The results, reported in table 7, show that IO loans exhibit a higher sensitivity of default to price growth: If prices stop growing fast, the implied increase in the probability of default is higher for an IO loan than for the two other types of loans. ARM loans also exhibit higher sensitivity of default to prices than ARM loans, but to a lesser extent than IO loans. The difference in sensitivity between IO and ARM loans is significant: for instance, in the first specification (column I), we can reject that the coefficient on "Slow Growth X IO" is equal to that on "Slow Growth X ARM" with a p-value of 2.1%. An IO loan is more likely to default when it is in a low growth zone by 8.5%, an economically significant amount (for IO loans, the average cumulative default probability is 12,8%).

b. Levering up exposure to survival risk: lending to bubbly zones

Bubbly zones are riskier

In this Section, we first document that NC was taking large positions in the riskiest areas of the country. The riskiest areas to invest in were presumably those where prices had gone up the most. To verify this, we first check that the most expensive areas are the ones who experienced the sharpest price drop since the beginning of the crisis. To proxy for "expensive", we use two proxies inspired by the asset pricing literature. First, we compute, for each "core based statistical area" (CBSA, designed to cover urban centers of more than 10,000 inhabitants), the cumulative price increase between the first quarter of 2000 and the first quarter of 2006. To do this, we use data from the OFHEO, which reports house price indices at the CBSA level. As a second proxy for "expensive area", we also compute the mean property value to household income using the 2005 American Community Survey. To compute this mean, we use weights from the ACS and take out the top 1% of the distribution to limit the influence of outliers. The zoning information from the ACS differs somewhat from that of the OFHEO data, so we have to compute mean value to income at the PUMA level (Public Use Microdata Area). PUMAs are larger than CBSAs but smaller than states, to

go from one to the other we use correspondence tables from the Missouri Census Data Center. After gathering such information, we end up with 351 CBSA for which we have quarterly prices from 2000 to 2010, as well as cumulative price growth between 2000 and 2006, and mean home price to income in 2005. Average mean home price to income in 2005 is 2.9 in the sample, from a minimum of 1.6 (Texas) to a maximum of 8.4 (California). Average cumulative price increase from 2000 to 2006 is 38%, from 10% (Indiana) to 175% (California). The correlation between the two measures is high (64%).

Whether we use the first or second proxy, it is apparent - and not surprising - that the most expensive areas are the ones that experienced the sharpest drops during the crisis of 2007-2010. As we report in Figure 9, areas in the top quartile of house price to income display a 20% price drop over 2007-2010, while home prices are essentially flat in the other areas.¹⁸ It is therefore reasonable to assume that mortgages in these areas in 2004 were presumably more exposed to aggregate risk.

New Century issued interest-only loans in bubbly areas

We have seen in the previous section that New Century increased its exposure to the risk of house price drop by issuing more interest-only loans. We will now show that this increased exposure was magnified by an overexposure to bubbly areas.

In Figure 10, we check graphically that interest-only products were aimed at expensive areas. To do this, we first sort zip codes by quartile average property value to income ratio (from 2000 census data). We then calculate the fraction of loans funded by New Century that are interest-only, or balloon loans, by month of application. We then plot the four lines, one per quartile of 2000 bubblieness. In the bottom quartile (highly affordable zip codes), the fraction of deferred amortization loans never reaches 20%. In the top quartile (highly expensive zip codes), the fraction of low amortization loans reaches 60% in 2006. Hence, deferred amortization loans (until 2005, these loans are interest-only loans only, balloons only appear in mid 2005) are aimed, in priority, at lending in expensive areas.

We report the corresponding regression in Table 9. There, we regress the local fraction of interest only loans issued on our measure of bubblieness and other controls. It appears that bubblieness is a very strong correlate of interest-only diffusion. A 1 standard deviation increase in bubblieness (price to income ratio increase by 3) leads to an increase in the fraction of interest-only loans issued by about 10 ppt. It is highly significant and unaffected by controls. These results are unchanged in magnitude and significance when excluding California

c. Testing the model: the determinants of loan selection

In this last section, we test the predictions of our risk-shifting framework more directly. We expect New Century to issue more IO loans in the areas that have a high beta with its own liabilities: high beta loans have high returns in states of nature where New Century is afloat (at the expense of low returns in states where New Century is bankrupt, and thus insensitive

¹⁸ In non-reported regressions we have checked that this difference is also statistically significant, and robust to excluding the three largest states in NC's activities: California, Texas and Florida.

to). To compute this beta, we retrieve, for each MSA, the real estate annual price index starting in 1980 from OFHEO. We then call NCindex the aggregate index of MSA prices weighted by the amounts lent by NC in 2003. We see this index as a proxy for returns of New Century's legacy asset and consider that New Century's bankruptcy probability is largely determined by the performance of this asset. For each MSA, we compute the beta of local real estate prices with this NC index, using prices from 1980 till 2003.

To test this specific risk-shifting hypothesis against alternatives, we also construct the betas of MSA level real estate prices on an equal-weighted real estate index ("beta_ewindex") and on the growth of aggregate personal income ("beta_gincome"), which proxies for the returns of human capital (Source: Bureau of Economic Analysis, Table 2.1. Personal Income and Its Disposition). The betas are computed using yearly data between 1980 and 2003 (we stop in 2003 to eliminate any concern about a look-ahead bias). These betas have no particular reason (at least that we could think of) to affect portfolio selection; we view them more as placebos rather than as theoretically grounded controls.

Because price indices are defined at the MSA level, we collapse the data by MSA-year and regress the percentage of each loan type (in each MSA-year) on the betas for loans originated in or after 2004. We have a total of 89 MSAs for which all our variables are defined. Results are reported in table 10, with t-stats clustered at the MSA level. We find, in line with our hypothesis, a strong and significant relationship between betas on the "legacy asset" and the propensity of New Century to issue Interest Only loans in a given MSA. This suggests that the accumulation of "bubble-riding" loans was primarily located in the MSAs NC was highly sensitive to. We control for the MSA-level log of total amount lent in 2003, to be sure our results do not simply reflect that NC issues IO loans in zones where it has a higher presence. We also control for the local affordability, education and poverty measures based on the Census 2000, as well as the MSA-level total amount of loans originated in 2003. These results are robust to restricting the sample to non-Californian MSAs.

d. Alternative Hypothesis, bad governance?

The managerial team at NC had significant ownership stakes in the company. In 2001, Robert Cole, Brad Morrice and Edward Gotschall owned, according to EXECUCOMP, namely 15% of the company. With a market capitalization of around \$277 Millions, this represented a \$42 Million stake for the founding team. In 2005, because of multiple equity offerings, the ownership stake of the three founders went down to 7%. However, thanks to a striking increase in market capitalization (from \$277M to \$2B), their dollar stake did actually go up from \$42M to \$147M. As a consequence, we remark that during the entire period our sample covers, the top executives of New Century had significant incentives to maximize shareholder value. This evidence brings strong support to the risk-shifting view we develop in the remaining of the paper relative to explanations that would be based on "looting".¹⁹

¹⁹ Besides, we have checked the insider filings on the SEC's EDGAR website. Between 2003 and the default of NC, the founder-managers have sold less stocks than they were granted, in particular through stock-option exercise.

e. Cross-sectional evidence from other originators' behavior

Our economic interpretation of the strategic shift of NC post 2004 naturally begs the question of its coherence with what happened to other originators. We do not have micro loan data for other originators similar to what we have concerning NC. However, based on their 10ks retrieved on the SEC Edgar website, we can ask a simple question: is it the case that subprime originators that had larger fractions of their assets consisting of loans held for investment at the end of 2003 are also those that engaged in higher originations of deferred amortization loans? Our interpretation of NC's risk-shifting implies a positive answer to this question. Figure 11 directly tests this prediction, by plotting the fraction of deferred amortization loans in 2005 (fraction of total loan production) as a function of the fraction of assets consisting in loans held for investment at the end of 2003, before the monetary shock. The picture shows a strong correlation between both numbers, conform to our risk-shifting assumption. Of course, while appealing, this picture should be taken with a grain of salt: there are only seven points, and observing such correlation is in no way a direct proof of causality.

7. Conclusion

This paper has provided forensic evidence on the risk-shifting behavior of a large mortgage originator. The sharp rise in interest rate in 2004 destroyed a large fraction of New Century's net present value. In reaction, New Century drastically modified its business model. It introduced a new, more price sensitive product: the interest-only loan. It changed its customer base, selling this new product to more credit-worthy, wealthier households, whose repayment decisions are also more sensitive to real estate prices. Finally, it changed the geography of its operations – selling more and more of these new loans in cities with real estate prices correlated with its legacy assets. This new business strategy is consistent with that of a financially distressed company that starts taking long bets on its own survival.

Our paper has important implication for monetary policy. In response to a heating real estate market, policy makers thought in 2004 that increasing interest rates was the appropriate response. Our paper suggests this decision had dramatic consequences that were opposite to the effect sought out by the policy. By pushing mortgage originators closer to financial distress, the monetary policy tightening led mortgage originators to increase risk. In the case of New Century, risk taking took the form of a business that became much more sensitive to the continuation of the real estate bubble. All in all, this may well have fuelled the real estate bubble and eventually accentuate the burst of this bubble.

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Figure 1: Number of loans in NC’s loan database by year of application and funding status

Source: Loan Database. 739,655 observations by year of application (Funding, if it occurs, typically arrives about 1 month after application). «Withdrawn» correspond to the number of loan applications that were accepted by NC, but finally withdrawn by the borrower. « Declined » corresponds to the loan application whose funding was denied by NC. « Funded » corresponds to the number of loans actually funded (i.e. neither declined nor withdrawn) by NC. « Other » is a residual category.

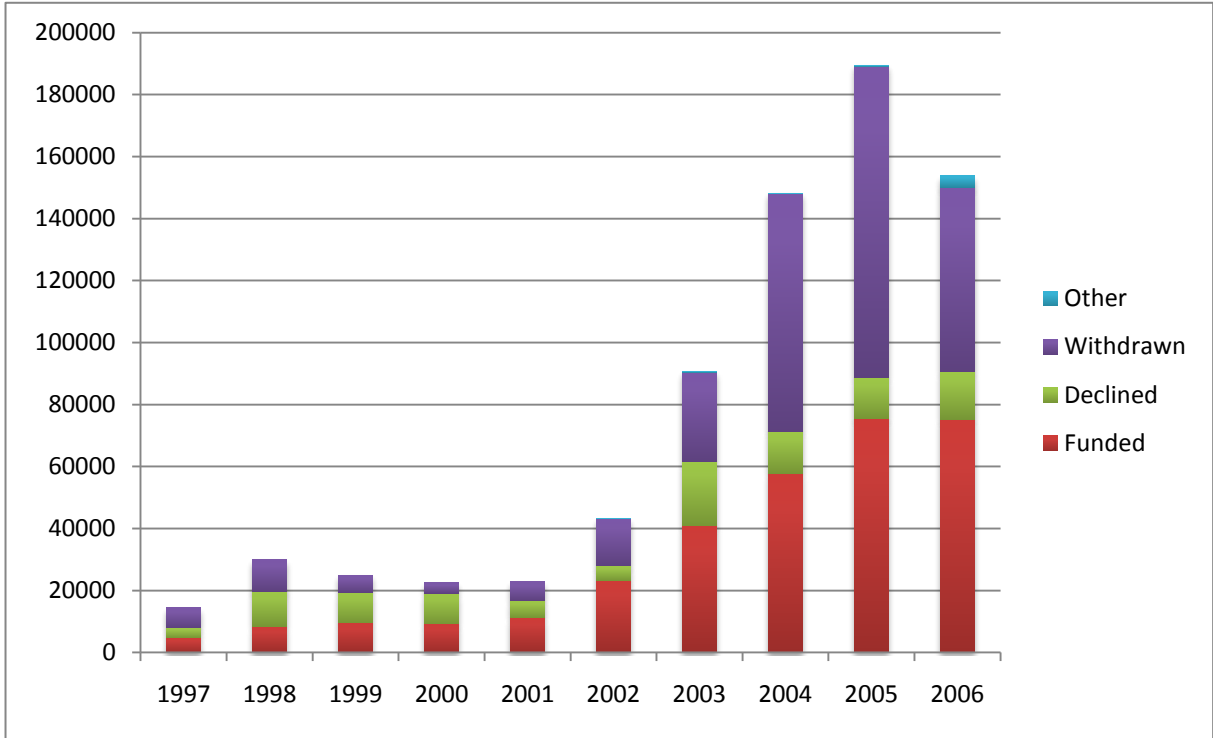
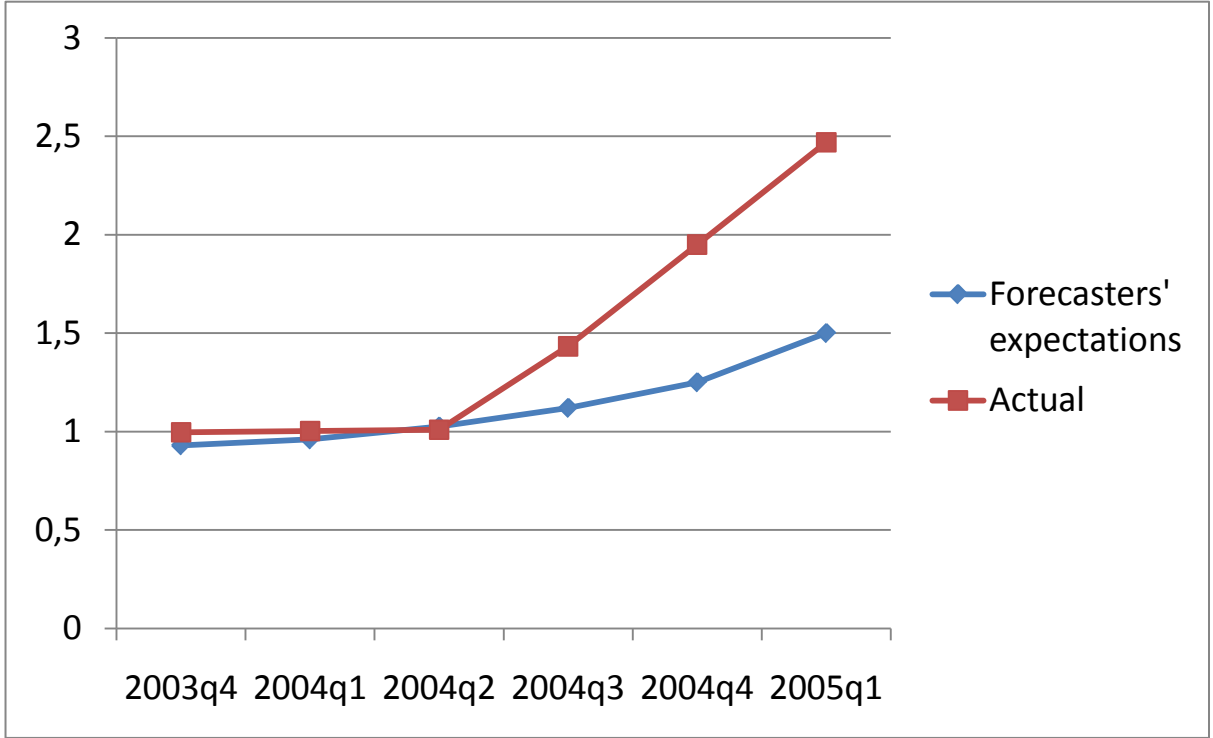


Figure 2: Actual and expected shift in monetary policy

Note: Mean forecasters expectations about the 3m Tbill rates are from the Federal Reserve Bank of Cleveland website. Data on actual 3m Tbill rates are from the Federal Reserve website.

Panel A: Expectations as of 2003Q4



Panel B: Expectations as of 2004Q1

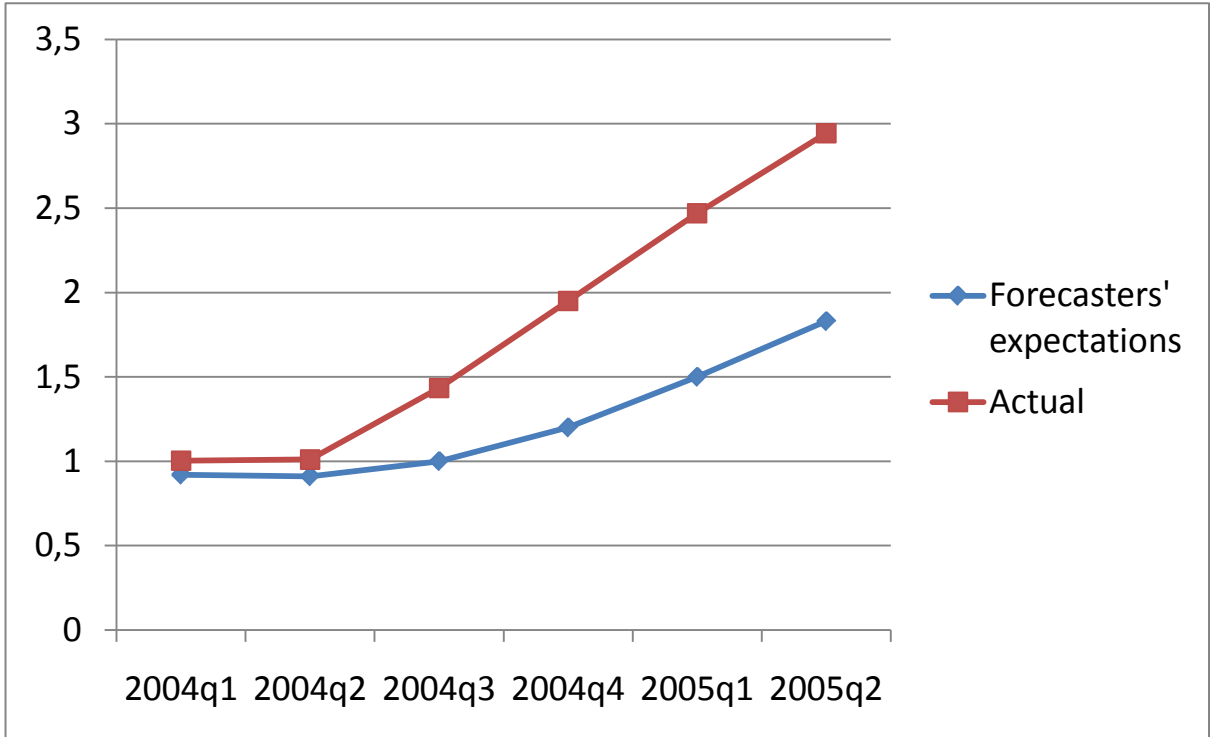


Figure 3: Cumulative growth in monthly payment since origination for ARMs issued prior to January 2004

Source: Servicing data, Hybrid ARMs only. For each ARM originated and serviced by New Century beyond its 12th month, we compute, each month, the cumulative growth in monthly payment since origination. We then compute the average of this cumulative growth for all ARMs still serviced for each month.

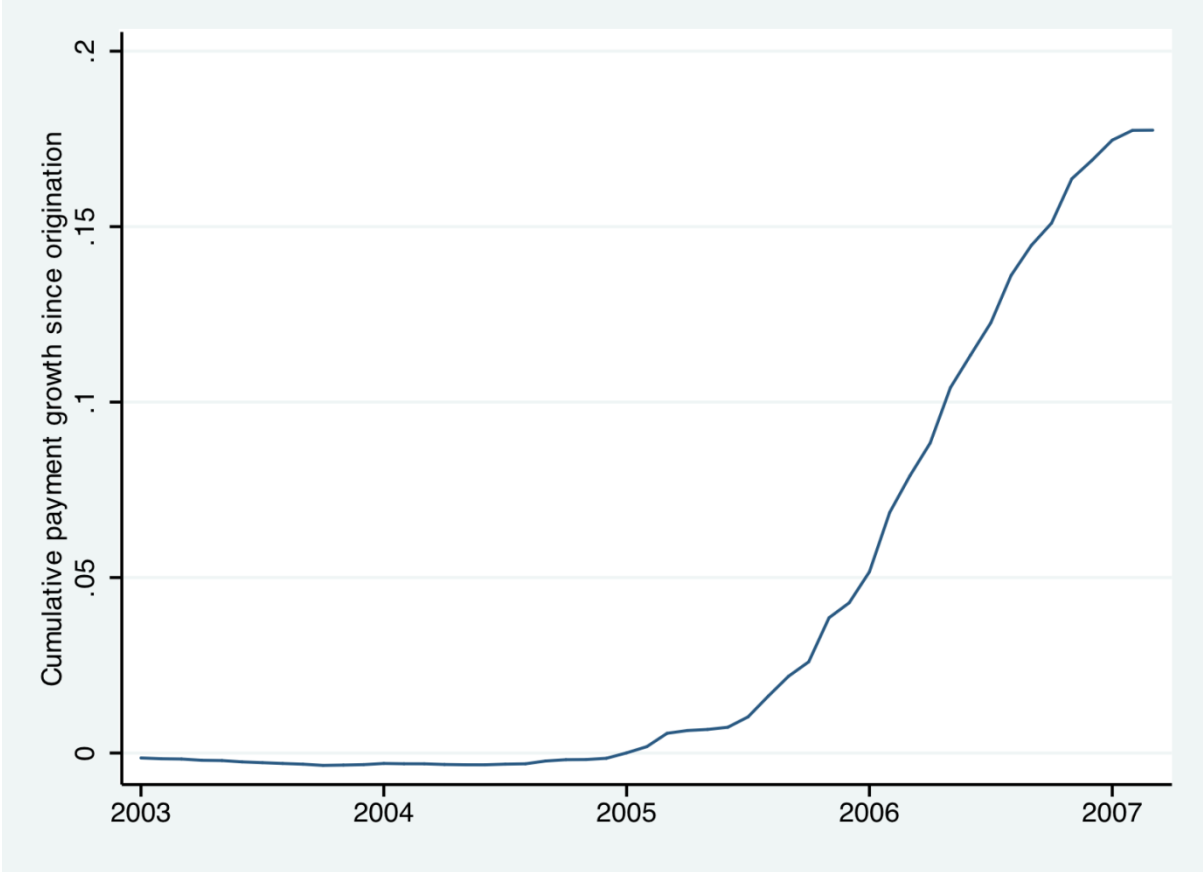


Figure 4: Delinquency rates for ARMs and FRMs issued before 2004

Source: servicing data for all hybrid ARMs & FRMs. We restrict ourselves to loans issued before January 2004. Each quarter, for each of the two categories of loans, we compute the fraction of loan-month observations that correspond to payments that are more than 60 days late.

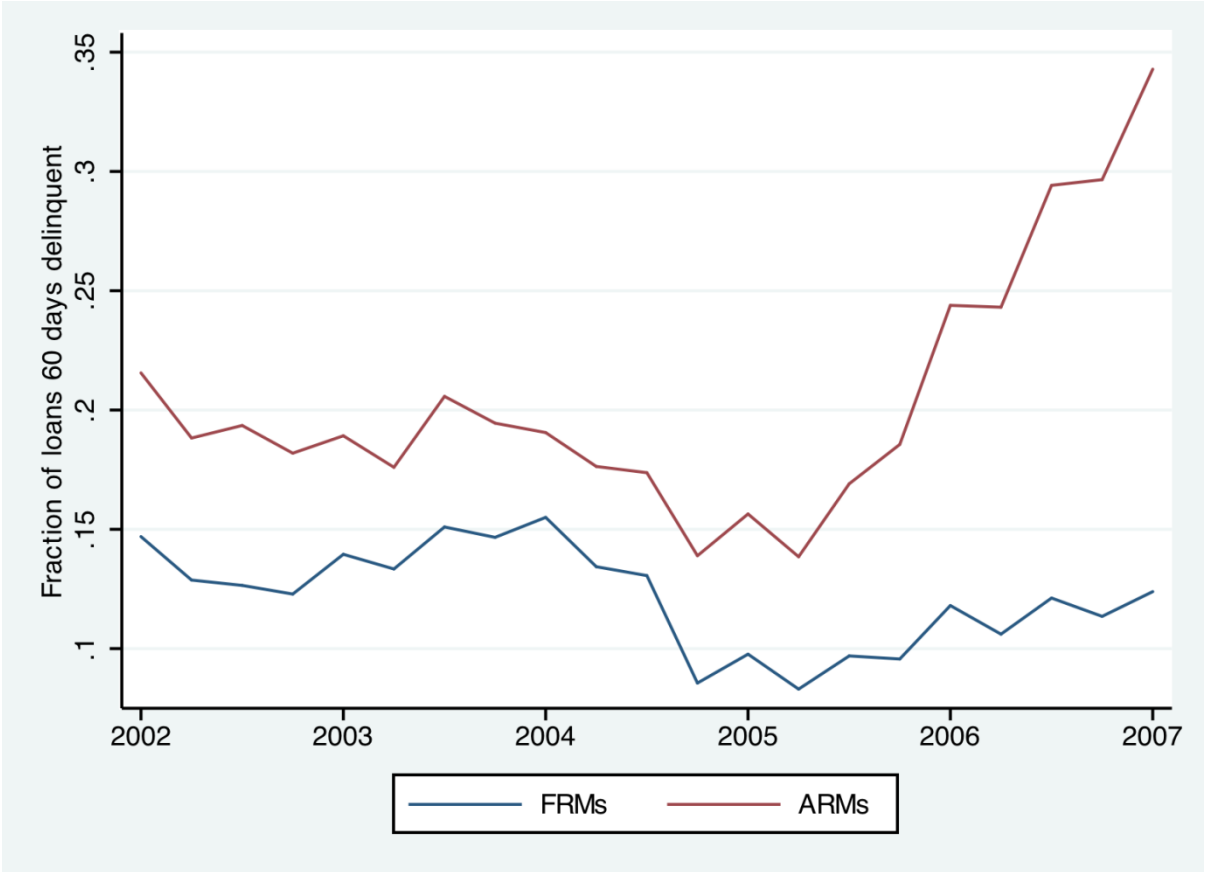


Figure 5: Fraction of deferred amortization loans funded

Note: Loan data, restricted to funded loans. In this figure, we plot the fraction of dollars originated as interest-only and balloon loans. Reading: in January 2006, interest-only loans accounted for about 12% of the overall amount originated. Balloon and interest-only loans together accounted for about 53% of total originations.

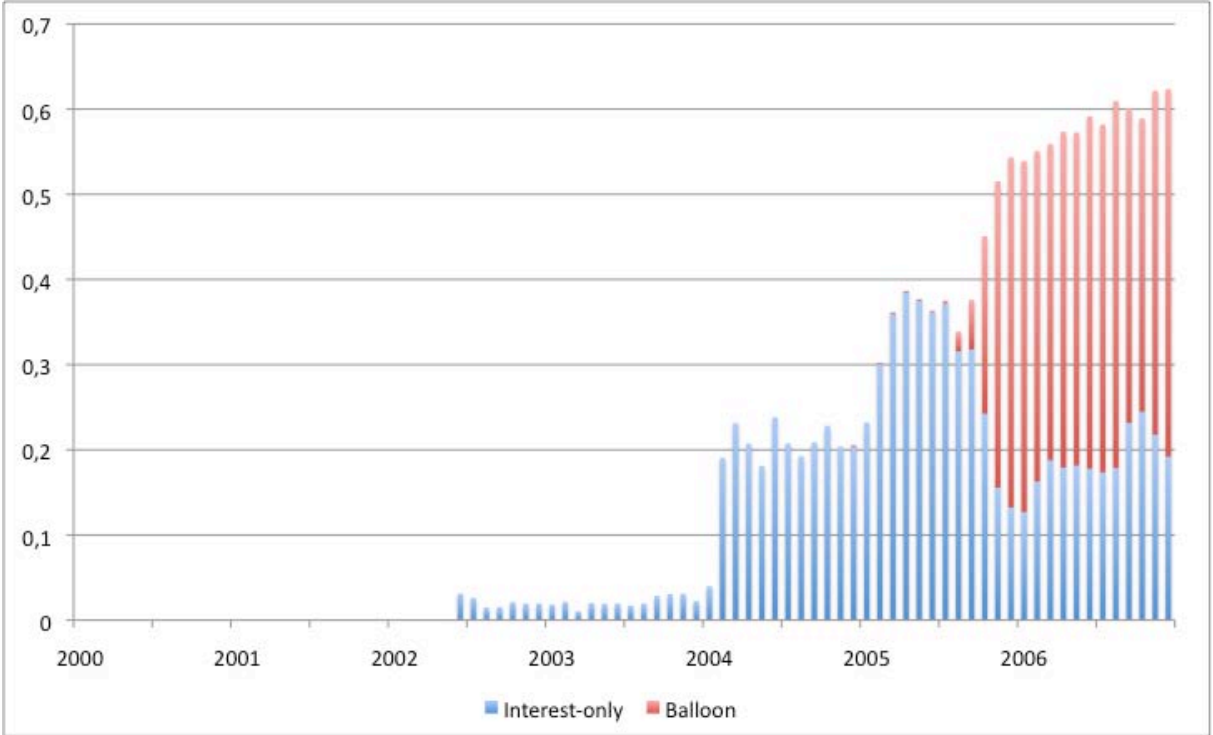


Figure 6: The fraction of interest-only loans for publicly listed subprime mortgage originators

Source: 10k filings. Note: We looked for all publically traded companies who are pure or quasi-pure plays in the following industries: sic = 6798 (REAL ESTATE INVESTMENT TRUSTS) and sic = 6162 (MORTGAGE BANKERS & LOAN CORRESPONDENTS). We looked for their 10Ks on Edgar and retrieved from them total originations and interest-only origination (when this information was available). This figure reports the fraction of total (dollar) origination accounted for by issuance of interest-only loans.

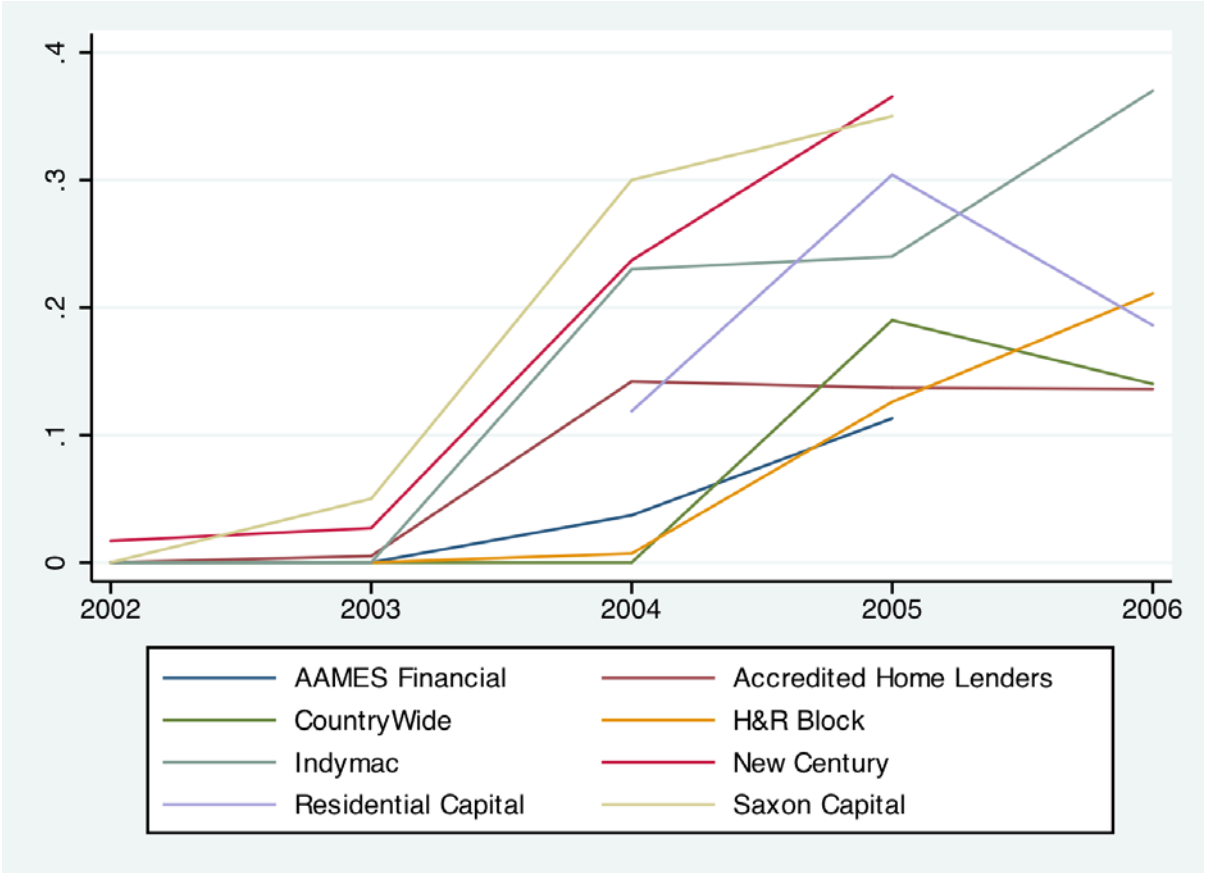


Figure 7: Monthly payment growth after the reset date

Source: Servicing data. For each loan-month that is present in the servicing data, we compute the growth rate in monthly payment due since 6 months before the end of the "teaser" period. Time is reported in months on the horizontal axis, where date zero corresponds to the first reset date (end of teaser period). For all loans originated a given year, we compute the average of this growth rate (vintage effect). From this graph, we can see that, for ARMs originated in 2000, the monthly payment was stable until 12 months after the reset date. For ARMs originated in 2004, the monthly payment grew on average by almost 25% between 6 months before reset and 12 months after reset.

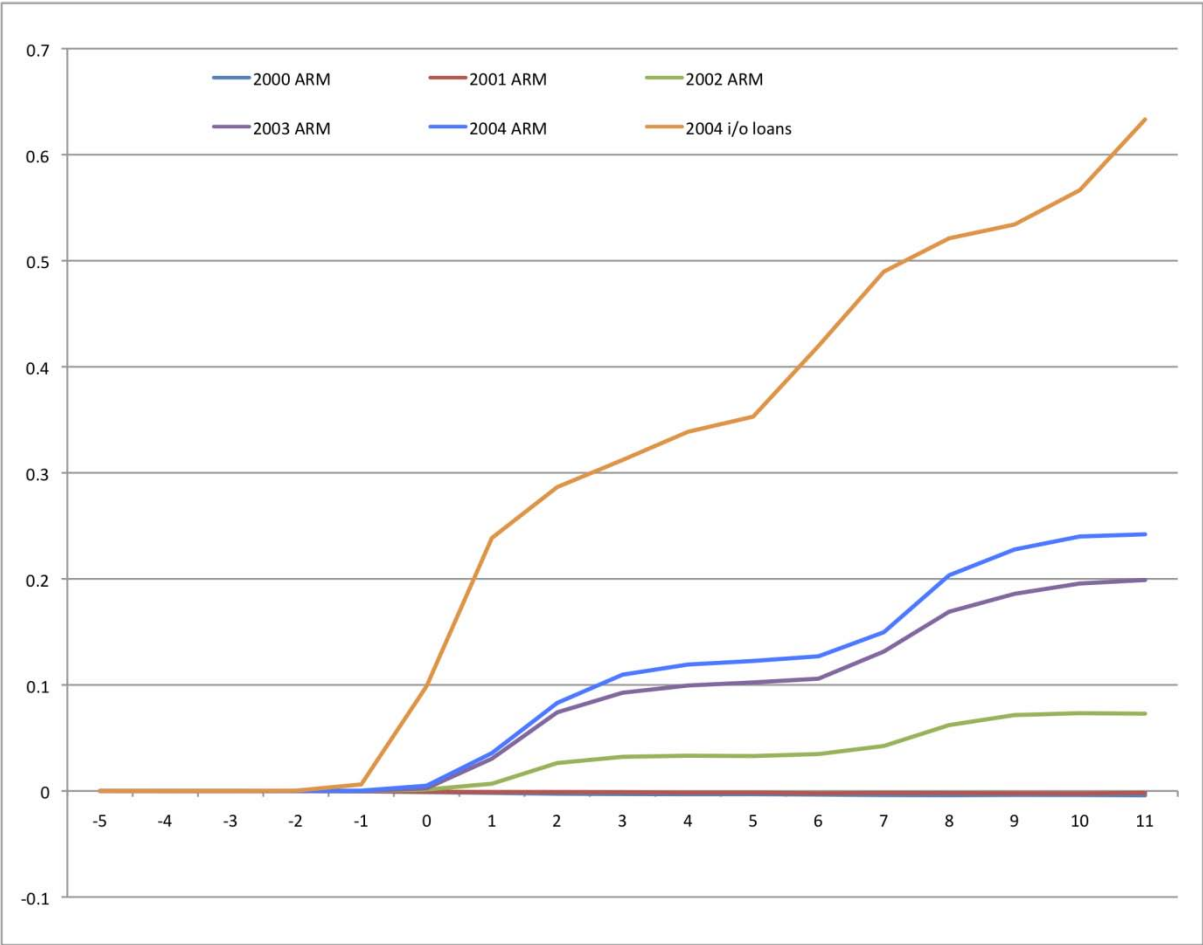


Figure 8: Average first monthly payment / monthly income ratio, by loan type

Source: Loan data, restricted to funded and "full documentation" loans. For each loan, we divide the FIRST monthly payment through the combined monthly income. We then compute the average of this ratio for all loans of a given type (ARM, FRM or IO: we exclude balloon loans) in a given month of origination. Reading: in January 2005, monthly payment at origination was approximately 22% of household income for interest-only loans, and about 16% for FRMs.

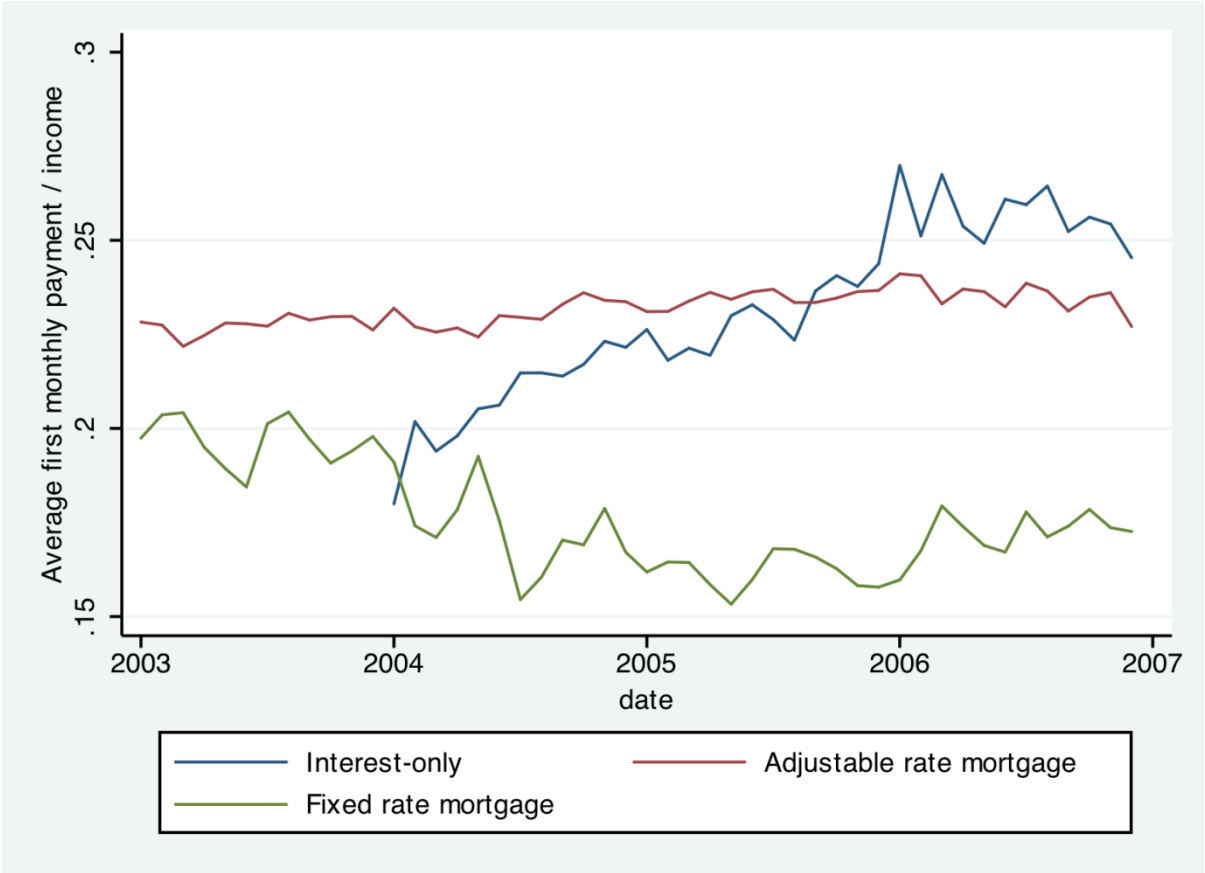


Figure 9: Cumulative price drop over 2007-2010, by quartile of house price to income.

Sources: Price to income in 2005 at the PUMA level is from the 2005 CBSA survey. Home prices at the MSA level are from OFHEO. In 2005, we sort PUMAs by their average price to income ratio, and then compute the cumulative real estate price change every quarter until 2010q1.

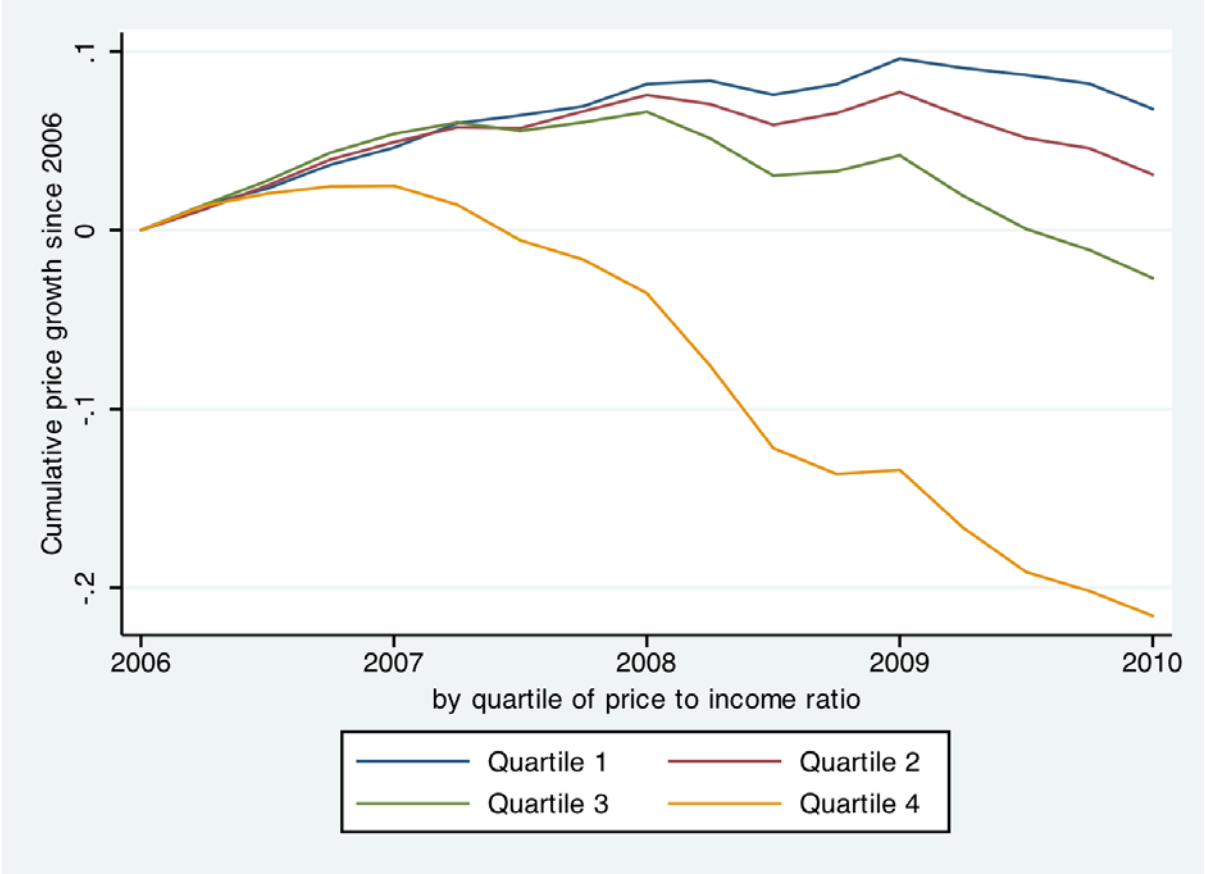


Figure 10: Fraction of interest-only & balloon loans in total issuances, by mean price to income in 2000

Source: NC's loan data and 2000 census.

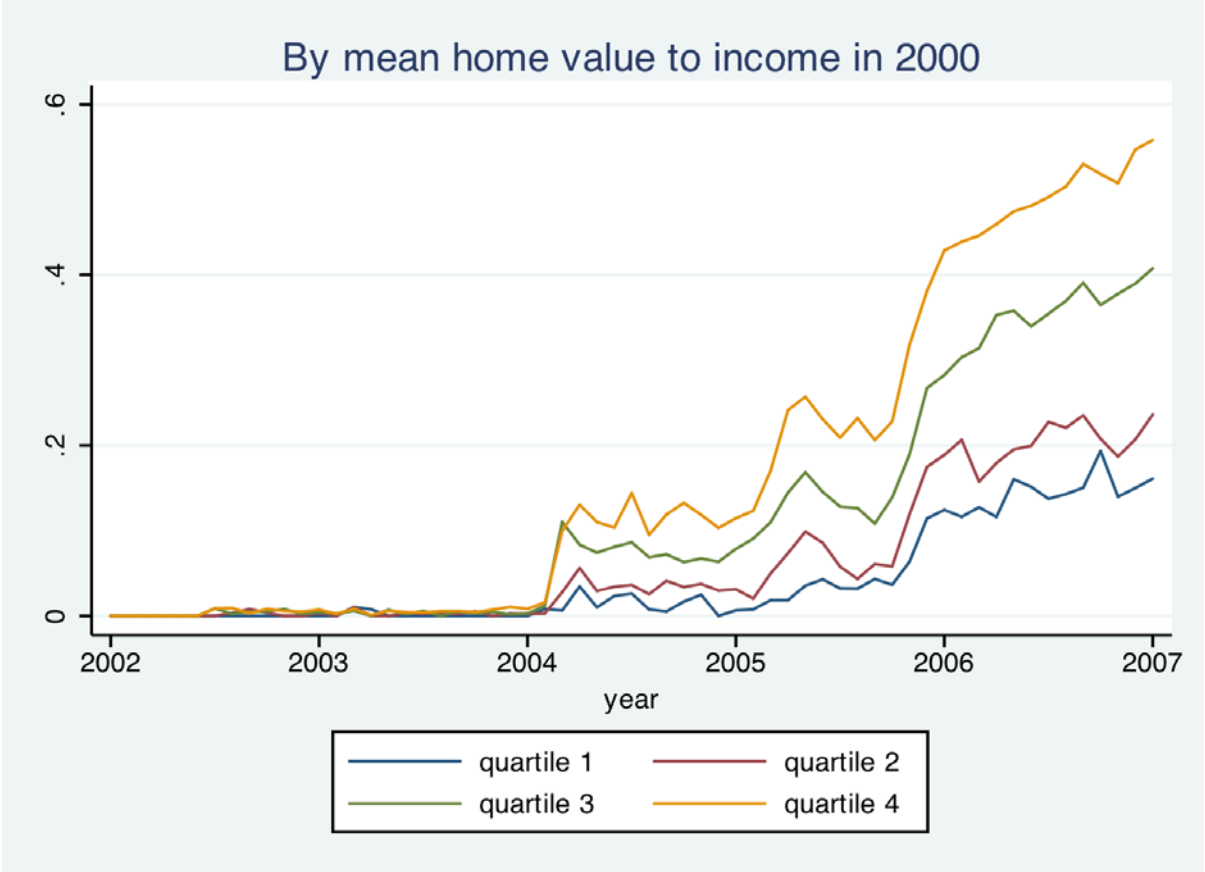


Figure 11: The fraction of deferred amortization loans for publicly listed subprime mortgage originators as a function of loans held for investment

Source: 10k filings. Note: We looked for all publically traded companies who are pure or quasi-pure plays in the following industries: sic = 6798 (REAL ESTATE INVESTMENT TRUSTS) and sic = 6162 (MORTGAGE BANKERS & LOAN CORRESPONDENTS). We looked for their 10Ks on Edgar and retrieved from them total originations and interest-only origination (when this information was available). This figure reports the fraction of total (dollar) origination accounted for by issuance of deferred amortization loans in 2005 as a function of Loans held for investment as a fraction of total assets at the end of 2003.



Table 1: New Century origination by category of revenue

Source: 10K filings. Numbers are in billion dollars. "Whole loan sales" are loans directly auctioned to outside investors. "Securitization structured as sales" is actual securitization by New Century itself. "Securitization structured as financing" corresponds to loans that remain on New Century's balance sheet and are financed through collateralized bond issues.

	Off balance sheet Whole sales	loan Securitization structured sales	as structured financing	On balance sheet Securitization structured as	Total
2001	4,7	0,9		0	5,6
2002	12,4	0,8		0	13,2
2003	20,6	0		4,9	25,5
2004	30,1	0		10,1	40,2
2005	35,1	6,4		10,9	52,4

Table 2: New Century's consolidated balance sheet : 2001 – 2005

Source : 10k filings. All numbers are in billion dollars. Mortgages held for sales correspond mostly to loans that will be sold through « whole loan sales ». This inventory is typically financed through credit lines. Mortgages held for investment are loans that remain on the balance sheet and are typically financed through bond issues. Residual interest in securitization corresponds to the estimated present value of equity tranches held in trusts who received actually securitized loans.

2002

Mortgages held for sale	1,9	Credit facilities	1,8
Mortgages held for investment		Bonds (aka "securitization structured as financing")	0
Residual interest in securitization	0,2	Other	0,2
Other	0,3	Equity	0,4
Total	2,4	Total	2,4

2003

Mortgages held for sale	3,4	Credit facilities	3,3
Mortgages held for investment		Bonds (aka "securitization structured as financing")	4,7
Residual interest in securitization	0,2	Other	0,4
Other	0,6	Equity	0,5
Total	8,9	Total	8,9

2004

Mortgages held for sale	3,9	Credit facilities	3,7
Mortgages held for investment		Bonds (aka "securitization structured as financing")	13,1
Residual interest in securitization	13,2	Other	0,3
Other	0,1	Equity	1,9
Total	19,0	Total	19,0

2005

Mortgages held for sale	7,8	Credit facilities	7,4
Mortgages held for investment		Bonds (aka "securitization structured as financing")	16
Residual interest in securitization	16,1	Other	0,6
Other	0,2	Equity	2,1
Total	26,1	Total	26,1

Table 3: Loans kept on balance sheet by NC's competitors

Note: We looked for all publically traded companies who are pure or quasi-pure plays in the following industries: sic = 6798 (REAL ESTATE INVESTMENT TRUSTS) and sic = 6162 (MORTGAGE BANKERS & LOAN CORRESPONDENTS). We looked for their 10Ks on Edgar and retrieved from them the value of loans held for investment, stockholder equity and total assets as of the end of 2003 (except for Residential Capital LLC, whose 10k are not available before 2004). The table above provides the ratio of the first variable (loans held for investment) on the other two (stockholder equity and total assets). The table shows that New Century's policy of keeping a portfolio of loans for investment was no exception vis-à-vis competitors.

Originator	Mostly subprime	Loans held for investment /equity	Loans held for investment /assets
Accredited Home Lenders	Yes	9.83	0.60
Country Wide	No	3.26	0.27
Greenpoint Financial Corp	Yes	5.39	0.43
Residential capital LLC	Yes	13.02	0.59
Saxon Capital	Yes	12.28	0.83
American Home Mortgage	Yes	44.32	0,52
Indymac Bank Corp	Yes	4.60	0.41
New Century	Yes	8.76	0.53

Table 4: Summary statistics*Source: Loan database*

Variable	Obs	Mean	Std. Dev.
<i>Panel A: Borrower level information</i>			
Full documentation ?	710209	0,65	0,48
Loan to Value ratio	716119	81	19
Monthly income	731577	6672	92428
FICO score	513763	617	67
Age in years	685395	43	12
<i>Panel B: Loan information</i>			
Principal	738744	162732	131222
Initial monthly payment	707351	1170	1377
Adjustable rate?	738135	0,60	0,49
Length of fixed rate period (ARMs only)	192746	32	7
Maturity in months	316415	349	41
Initial interest rate	724207	8,35	1,93
Has an interest only period?	739079	0,07	0,26
Length of interest only period in months	45871	41,30	18,54
Balloon?	738265	0,07	0,26
Refinancing?	738813	0,69	0,46

Table 5: New Century's assets' exposure to a negative shock on real estate

Sources: Servicing data and loan data for ARMs and FRMs. This table uses loan level data. The left hand side variable is a dummy equal to 1 if the loan is ever delinquent (the borrower is at some point 60 days late), over the first 36 months of its life. Columns 1 and 2 restrict the sample to loans issued in 2001, columns 3 and 4, to loans issued in 2002, and columns 5 and 6, to loans originated in 2003. "Slow growth" is a dummy equal to one if local real estate price growth is less than 15% over the 36 months following the loan origination. ARM is a dummy equal to 1 for ARM loans. All regressions include date of origination fixed effects. We report OLS regression results of a linear probability model. Error terms are clustered at the zip code level. T-stats are reported between brackets.

	2001 vintage		2002 vintage		2003 vintage	
Slow growth	0.118	0.088	0.113	0.088	0.090	0.051
	[3.79]	[2.96]	[3.33]	[2.63]	[5.51]	[3.27]
ARM	0.052	0.000	0.060	0.021	0.053	-0.001
	[2.19]	[0.01]	[2.92]	[1.03]	[5.44]	[-0.12]
Slow growth x ARM	0.015	0.028	0.032	0.026	0.054	0.073
	[0.41]	[0.81]	[0.79]	[0.65]	[2.42]	[3.41]
LTV		0.003		0.004		0.002
		[6.27]		[7.00]		[6.91]
Log (income)		-0.018		-0.058		-0.053
		[-1.39]		[-3.81]		[-6.39]
FICO		-0.002		-0.002		-0.001
		[-15.39]		[-11.80]		[-20.69]
Constant	0.251	1.409	0.153	1.292	0.143	1.320
	[11.88]	[11.07]	[8.91]	[9.24]	[20.93]	[16.79]
Observations	3,583	3,583	2,774	2,774	8,466	8,465
R-squared	0.031	0.090	0.055	0.110	0.038	0.096

Table 6: Default around end of the monthly payment shock

Source: Servicing data, ARMs & Interest-only. We restrict ourselves to loan-months observations that are situated no more than 6 months away from the end of the first interest rate reset date. We present here OLS regression results. The LHS variable is a dummy equal to 1 if loan payment is more than 60 days late. Post=1 if the loan has passed the end of the teaser/interest-only period. " Price growth <10%" is a dummy equal to one if real estate price growth over the past 12 months is less than 10%.

	Probability of default			
	ARM	ARM	I/O	I/O
Post	.075*** (.0039)	.048*** (.0064)	.09*** (.0066)	.083*** (.0093)
Post x Price growth <10%		.039*** (.011)		.073*** (.022)
Price growth <10%		-0,039 (.084)		-0,041 (.13)
LTV	.0022*** (.00016)	.0026*** (.00041)	.0014*** (.00021)	.0016*** (.00037)
LTV x Price growth <10%		-0,00043 (.0006)		0,00037 (.00077)
FICO	-.00082*** (.00004)	-.00098*** (.000093)	-.00043*** (.000059)	-.00041*** (.00011)
FICO x Price growth <10%		0,00016 (.00014)		0,000023 (.00019)
Constant	.4*** (.024)	.46*** (.055)	.19*** (.037)	.15** (.068)
Month of origination FE	Yes	Yes	Yes	Yes
Observations	153 900	58 633	49 798	22 429
R2	0,035	0,038	0,032	0,053

Table 7: The price sensitivity of unconditional default rates

Source: Servicing data, 2004 vintage. We consider loans present in the database for more than 12 months and define “Cumulative Default” as a dummy equal to one if the loan is at some point more than 60 days delinquent. We regress this cumulative default dummy on measures of price growth interacted with loan type (Interest Only, ARM or FRM). The default value of loan type is FRM. The dummies “growthi” define quartiles of the distribution of real estate growth rate in the two years preceding the loans’ origination (we use MSA level real estate price data). “slow growth” is another discrete measure of price growth equal to 1 if local price growth is lower than 10% for the 24 months preceding month t. Results are clustered at the origination’s (year, month) level.

VARIABLES	Cumulative Default			
	I	II	III	IV
ARM	0.024	0.063	0.050	0.077
	[2.27]	[6.41]	[2.38]	[3.41]
IO	-0.027	-0.036	0.053	0.040
	[-2.67]	[-3.71]	[3.34]	[2.61]
Slow Growth	0.066	0.087		
	[6.33]	[6.09]		
growth2			-0.032	-0.037
			[-1.73]	[-1.96]
growth3			-0.035	-0.040
			[-2.58]	[-2.88]
growth4			-0.106	-0.137
			[-6.68]	[-7.02]
Slow Growth X ARM	0.030	0.022		
	[2.63]	[1.59]		
Slow Growth X IO	0.085	0.083		
	[4.18]	[4.23]		
growth2 X ARM			0.011	0.016
			[0.53]	[0.79]
growth3 X ARM			-0.018	-0.011
			[-1.17]	[-0.66]
growth4 X ARM			-0.027	-0.013
			[-1.45]	[-0.60]
growth2 X IO			-0.006	-0.006
			[-0.26]	[-0.26]
growth3 X IO			-0.068	-0.070
			[-2.73]	[-2.50]
growth4 X IO			-0.071	-0.058
			[-3.58]	[-3.23]
fico	-0.002		-0.002	
	[-27.04]		[-27.33]	
ltv	0.003		0.003	
	[13.07]		[12.60]	
Start Date Control	YES	YES	YES	YES
Constant	0.866	0.161	0.929	0.275
	[31.48]	[37.95]	[30.91]	[15.54]
Observations	21,802	21,828	21,802	21,828
R-squared	0.073	0.028	0.079	0.038

Table 9: Housing affordability and loan issues post-2004

Source: Loan database collapsed at the MSA-year level. Funded loans only, years 2004-2006. INTONLY stands for "Interest only". There are 89 MSAs followed. "Cost2000" is an affordability measure computed from a 5% extract of the 2000 Census, equal to the average ratio of 'property value' to 'family income'. "Poor" and "Educ" are local measures of wealth and education computed as fractions of poor and highly educated individuals. They are computed using the 5% extract of the 2000 Census. "log total 2003" and "frac high inc 2003" are respectively the MSA-level log of amount lent and fraction of high income (top 25% of sample) among 2003 borrowers. Elasticity measures the amount of developable land in a given area (we use data from Saiz (2009), defined at the MSA level), providing an exogenous source of variation to local housing supply. Geographic localization variables are linked together using the Missouri Data Research Center tables. Error terms are clustered at the MSA level, robust t-stats are reported in brackets.

VARIABLES	FRAC INTONLY		
cost2000	0.035	0.037	0.038
	[8.46]	[8.68]	[5.12]
poor		-0.683	-0.665
		[-2.18]	[-1.69]
educ		-0.306	0.121
		[-1.63]	[0.47]
log total 2003		-0.003	0.014
		[-0.87]	[2.01]
% high income people			
elasticity			0.014
			[1.74]
Constant	-0.015	0.249	-0.263
	[-0.94]	[2.04]	[-1.49]
Year Dummies	YES	YES	YES
Observations	489	485	258
R-squared	0.417	0.430	0.583

Table 10: New Century loan selection by MSA

Source: Loan database, years 2004-2006. Funded loans only. FRM stands for fixed rate mortgages. ARM stands for adjustable rate mortgages, INTONLY for "Interest only". There are 89 MSAs followed. "FRAC_X" is the fraction of loans funded of type "X" at the MSA-Year level. Betas are computed for each MSA using local real estate indices between 1980 and 2003. "beta_ewindex" is the beta on an equal-weighted (across MSAs) real estate index; "beta_ncindex" is the beta on a real estate index weighted by the amounts originated in each MSA in 2003 (proxy for NC's legacy asset); "beta_gincome" is the beta on the growth of aggregate personal income (Source: Bureau of Economic Analysis, Table 2.1. Personal Income and Its Disposition). "Cost2000" is an affordability measure computed from a 5% extract of the 2000 Census, equal to the average ratio of 'property value' to 'family income'. "Poor" and "Educ" are local measures of wealth and education computed as fractions of poor and highly educated individuals based on the 5% extract of the 2000 Census. "log total 2003" is the MSA-level log of amount lent in 2003. Geographic localization variables are linked together using the Missouri Data Research Center tables. Error terms are clustered at the MSA level.

VARIABLES	FRAC INTONLY			FRAC ARM			FRAC FRM		
beta_ncindex	0.288 [3.66]	0.249 [3.25]	0.249 [3.25]	-0.057 [-0.70]	-0.010 [-0.12]	-0.010 [-0.12]	-0.216 [-2.78]	-0.173 [-2.39]	-0.173 [-2.39]
beta_ewindex	-0.093 [-2.72]	-0.082 [-2.51]	-0.082 [-2.51]	0.088 [2.59]	0.073 [2.31]	0.073 [2.31]	-0.025 [-1.06]	-0.034 [-1.58]	-0.034 [-1.58]
beta_gincome	-0.012 [-0.68]	-0.012 [-0.71]	-0.012 [-0.71]	-0.032 [-1.48]	-0.026 [-1.26]	-0.026 [-1.26]	0.065 [3.29]	0.055 [3.08]	0.055 [3.08]
cost2000	0.036 [5.18]	0.033 [4.68]	0.033 [4.68]	-0.044 [-6.78]	-0.048 [-7.11]	-0.048 [-7.11]	-0.012 [-1.86]	-0.008 [-1.23]	-0.008 [-1.23]
poor		-0.275 [-0.70]	-0.275 [-0.70]		-0.368 [-0.67]	-0.368 [-0.67]		1.525 [4.10]	1.525 [4.10]
educ		0.119 [0.50]	0.119 [0.50]		-0.950 [-2.76]	-0.950 [-2.76]		1.008 [2.99]	1.008 [2.99]
Log total 2003		0.010 [1.42]	0.010 [1.42]		0.001 [0.20]	0.001 [0.20]		-0.011 [-1.28]	-0.011 [-1.28]
Year Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	258 0.610	258 0.624	258 0.624	267 0.647	267 0.663	267 0.663	267 0.484	267 0.546	267 0.546
Observations	258	258	258	267	267	267	267	267	267
R-squared	0.611	0.619	0.621	0.648	0.663	0.667	0.483	0.539	0.563