Anticipating market model failure: Competitive pressure and the mortgage backed securities market

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Abstract Market models that have worked well for years can suddenly fail dramatically, such as during the financial crisis of the late-2000s. For example, models that assigned credit ratings to mortgage-backed securities (MBS) predicted relative default rates well for decades. It was only in the late-2000s that these models under-predicted defaults by orders of magnitude. Why then? This paper argues that high competitive pressure spurs market participants to change strategies, which can break models. Behavioural research has demonstrated the powerful effect of competition on people's strategies. Indeed, it was in the mid-2000s that competitive pressure spiked among mortgage originators and securitisers, as measured by indicators such as changing market share. Originators and securitisers reacted with a variety of new strategies: creating new mortgage types like no-documentation loans, improving the efficiency of back office processing of mortgages, reducing quality control and, in some cases, committing fraud. Unfortunately, credit rating agencies, secure in their dominant market positions, had no spur to update their models to keep up with the changes. Thus, risk managers could anticipate model failure by monitoring competitive pressure in the relevant markets.

Keywords: *risk management, model failure, competition, behavioural finance*

THE GOAL: IDENTIFYING HIGH-CHANGE MARKETS

Models that work well for years can suddenly fail dramatically, such as during the financial crisis of the late-2000s. For example, models that assigned credit ratings to mortgage-backed securities (MBS) predicted relative default rates well for decades. It was only in the late-2000s that these models under-predicted defaults by orders of magnitude. Specifically, 83 per cent of the MBS awarded Moody's highest credit rating in 2006 were later downgraded.[1] Furthermore, the size of ratings downgrades was also unusually large in the post-2005 period, with ratings dropping an average of 10 notches for some vintages, on ratings scale that had 21–22 notches.[2]

Now, if an earthquake had caused the models to fail, there would be little that risk managers could do to anticipate failure, but this failure had an endogenous source: changes in the mortgage market. It was the increased competitive pressure among mortgage originators and securitisers in the mid-2000s that spurred changes and pressured all market participants to copy them. Originators and securitisers created new mortgage types such as no-documentation loans, improved the efficiency of back office processing of mortgages, reduced quality control and, in some cases, committed fraud.

Meanwhile, the credit agencies that rated the products, secure in their dominant market positions, had no spur to update their models to keep up with the changes. For example, testimony to the US Congress in 2008 revealed that the residential mortgage rating group at Standard & Poor's (S&P) already had a market share of 92 per cent 'and improving the model would not add to S&P's revenues'.[3]

Competition spurs new strategies, but this paper will *not* try to predict exactly what the new strategies will be. To make such exact predictions, credit agencies would have to ask, 'Given a credit model, how will securitisers change the kinds of mortgages they submit for rating when competition heats up?' The financiers creating the securities are innovative. Predicting their new strategy would be like guessing a chess player's next move or an enemy's next war tactic. This paper has a more modest goal: making a binary assessment of a market as a low-change or high-change environment.

This goal is similar to biologists' attempts to characterise evolutionary 'hot spots', where species evolve new traits quickly. To illustrate, consider the mud snails (*Potamopyrgus antipodarum*) that live in lakes in New Zealand. Some of the snails live in shallow water near the shore. Because wading birds transmit parasites (Microphallus), these snails suffer from high rates of infection, which triggers a high rate of evolutionary change that can help escape susceptibility. In contrast, the snails that live in deep water are rarely infected by parasites; they evolve slowly, reproducing asexually, where each offspring is a clone of its one parent.[4] Analogously, this paper aims to help risk managers identify 'hot spots' where market participants are highly likely to change strategies, breaking existing models of those markets.

SPURRING CHANGE

Behavioural research on competitive pressure

So what pushes *Homo sapiens* to change? Behavioural game theory has found that competition can have a sizeable effect on people's strategies.

Consider the 'ultimatum game'. The experimenter offers a sum of money to two participants, a proposer and a responder. The proposer suggests how to split the money: 'You get X%, I get the rest'. If the responder accepts the offer, they each get the proposed amounts. If the responder rejects the offer, they both go home empty-handed. Proposers are like sellers, suggesting a price for an exchange and responders are like buyers who can either accept the proposal or walk away.

Experiments have shown that the median proposer offers the responder 40–50 per cent in a surprisingly wide range of experimental conditions.[8] (For example, results were similar when the total amount being split was US$400 rather than US$10.[8]) The nearly equal split in itself fascinates many economists,[5] but for this paper, consider it a 'baseline' strategy. The important point is that there is a condition that did dramatically alter proposals: competition.

For example, one experiment had nine proposers make simultaneous offers to a single responder, who could choose to accept at most one offer. In this case, the winning proposal was large, on average around 95 per cent.[6] In the opposite experiment, one proposer made an offer that at most one of five responders could get. If multiple responders accepted, one was randomly chosen as the winner. This condition led most proposers to offer nearly zero to responders.[7]

When there is no competitive pressure, people are free to keep doing what they are doing, like deep-water snails, but under competitive pressure, they change toward maximising whatever is being competed over. Colin Camerer, an expert on behavioural game theory, summarised the findings of adding competition to the ultimatum game: 'A competitive market is simply a place in which it is hard to express your concern for fairness' — or any non-economic concern — 'because buying or selling (or refusing to do so) will not generally change your inequality much'.[8] Competition creates *Homo economicus*.

Stable and dynamic competition

Competition pushes people to strive for economic goals. By what means will they achieve those goals? In the constrained market of the laboratory, the only free parameter available to a proposer is the offer

price. (In fact, if the proposer tried to do anything else, such as offering a beer, the data would be discarded.) This is similar to the idealisation of perfect competition, where a large number of price-taking buyers and sellers exchange a commoditised product: competition drives the price to the marginal cost and there it stops. This is 'stable competition'.

In many real world markets, strategic changes are *not* restricted to the traditional economic categories of price and quantity. Participants can change other aspects of strategy, from investing in better technology to creating clever advertisements to committing fraud. The vast range of possible strategies — orders of magnitude more than in a chess game — makes calculating an optimal strategy impossible in practice. Furthermore, there is no common limiting factor for all the various changes, in the way that marginal cost is a limit for price, so the changes could just keep going. Adding competitive pressure in real markets can lead to continued dynamics rather than equilibrium. This is 'dynamic competition'.

The idea that competition can lead to continual change has also been given theoretical underpinnings by economist Andrew Lo's 'adaptive market hypothesis', an alternative to the traditional 'efficient market hypothesis'. The adaptive market hypothesis proposes that 'the dynamics of evolution — competition, mutation, reproduction, and natural selection — determine the efficiency of markets and the waxing and waning of financial institutions, investment products, and ultimately, institutional and individual fortunes'.[9]

Determining exactly which market conditions lead to which changes is complicated. For example, economists have debated for decades whether there is a positive or negative relationship between competition and innovation, where innovation is measured by the amount of investment in research and development (R&D) or number of patents.[10] Investigations of the relationship between competition and fraud are in an earlier stage but are also proving to have many interaction effects.[11,13]

Fortunately, the goal of this paper is modest. What breaks models is dynamic competition. So anticipating model failure only requires distinguishing among:

- no competition (low change);
- stable competition (low change);
- dynamic competition (high change).

Some of the traditional measures for competition are not appropriate for dynamic competition. For example, if intense competition drove several firms out of business, the industry's market concentration (or Herfindahl index) would be higher, incorrectly indicating lower competition. Similarly, if high competition drove some firm to innovate to lower marginal costs, the price cost margin (or Lerner index) would increase, also incorrectly indicating lower competition.[12]

Thus, other measures are better for assessing dynamic competition. These include changes in market size (especially rapid growth), changes in the market share of various participants, and increases in spending on attracting customers. This paper uses these measures for assessing 'competitive pressure' in the MBS market. The differences among the kinds of competition are summarised in Table 1.

In summary, behavioural research shows that competition spurs people to strive for economic goals, but market conditions affect the options available for achieving those goals. Markets that constrain participants to manipulating traditional economic variables like price lead to the stable equilibrium of introductory economic textbooks, but markets that offer a wide range of strategy options can sustain ongoing dynamics. Economist Andrei Shleifer has summarised how this form of competition can be associated both with good changes that increase social welfare and with bad changes that decrease social welfare:

> 'Competition is the fundamental source of technological progress and wealth creation around the world. The very same market forces that might encourage unethical conduct also motivate firms to innovate and create new products, leading to economic growth.'[13]

Table 1: Summary of characteristics of stable and dynamic competition

	Stable competition	Dynamic competition
Associated with	• Few strategic options • Equilibrium • Commoditised products • Low profits	• Many strategic options • Disequilibrium • Differentiated products • Volatile profits
Measured by	• Concentration ratio • Herfindahl index • Price cost margin • Lerner index	• Changes in market size • Changes in market share • Increases in spending on attracting customers

That is exactly what can be observed in the MBS market beginning in the mid-2000s — innovations good and bad, spurred by competitive pressure.

CASE STUDY OF THE MBS MARKET

Participants in the MBS market

The MBS market in the USA provides an excellent case study of the effects of competition. As will be shown, competitive pressure among mortgage originators and securitisers spiked in the mid-2000s, as indicated by a surge in market size, changes in relative market share and increased spending on advertising. That was the same period in which many changes occurred, including more efficient back office processing, new mortgage types and fraud. Furthermore, because the MBS industry was heavily studied after the crash, the details of the changes are in published emails and interviews. They show many cases where market participants explicitly cited competitive pressure as a motivator for changes, which they felt compelled to undertake even when they had misgivings. (This review is *not* meant to imply that competitive pressure was the only factor in the mortgage crisis, only that modellers can gain predictive mileage from observing competitive pressure.)

The process for an MBS began after a mortgage originator arranged a mortgage for a homebuyer. The originator had two paths for selling the mortgage (to gain funds to originate more mortgages). The traditional path was to sell the mortgage to a government-sponsored entity (GSE), an agency such as Fannie Mae. The agencies pooled loans into MBS that carried the highest credit rating because the US government implicitly guaranteed them, but in the 2000s an alternative to the GSEs became increasingly popular: selling the mortgage to a private securitiser. The private securitisers also pooled loans into MBS, generally with a wider range of loan types and payment structures than GSEs offered. The government did not back the privately created MBS, so they had to be rated by a credit agency, such as S&P. In both cases, investors like mutual funds, pension funds and banks purchased the MBS.

The first indicator of high competitive pressure in the mid-2000s was the exponential growth of the MBS market. Overall mortgage indebtedness in the USA climbed from US$5.3tn in 2001 to US$10.5tn in 2007, rising almost as much in those 6 years as it had over the course of the country's 200-year history.[1] The amount of mortgage debt per household rose from US$91,500 in 2001 to US$149,500 in 2007.[1] Meanwhile, total MBS issuance soared from US$1bn in 2000 to US$3.5bn in 2003.[14] Such extreme growth in the market was a clear indicator that participants would be under competitive pressure to obtain a share of this lucrative new business.

Originators: High competitive pressure, high change

The first link in the chain was originating a mortgage. As the mortgage market grew in the mid-2000s, mortgage originators jockeyed for market share. Ameriquest in particular aggressively pushed into the market, putting a lot of pressure on other firms. In 2000, it originated US$4bn in loans annually, making it the 11th largest originator. By

2003, it originated US$39bn in loans, vaulting it to first place.[1] These large changes in market position were an indicator of fierce competition. Another sign of high competition was increased spending on advertising — and Ameriquest ramped up advertising spending from US$65m in 2002 to US$365m in 2004.[15] Their ads were widely known on television and the internet.

Ameriquest's striving led it into multiple new strategies. Some were clearly good for social welfare, such as more efficient back office operations. Ameriquest turned mortgage processing into an assembly line of data entry, underwriting, customer service, account management and funding.[16] However, Ameriquest also created the first 'stated income loan', which did not require documentation of a borrower's income if their FICO score was high enough.[16] Initially some argued for the benefits of these loans, but they later earned the nickname 'liar loans'. Ameriquest was also later accused in many suits of being at the forefront of mortgage fraud, ranging from inflating home appraisals to switching loans from fixed to adjustable interest rates at closing.[1] With the help of these tactics, Ameriquest was ultimately able to lower prices, charging securitisers 0.55 per cent less than what competing originators charged.[1]

This of course put pressure on other originators to match Ameriquest's prices, copying innovations just to stay in the game. Countrywide, which had 12 per cent of the origination market in 2004, was an example.[1] Although Countrywide had begun its business with standard mortgages, by mid-2005, 59 per cent of their loans were non-traditional.[1] Senior executives at Countrywide privately discussed concerns about the new types of loans. Chief Executive Officer (CEO) Angelo Mozilo wrote in an internal email in 2006, 'In all my years in the business I have never seen a more toxic [product]', referring to the 100 per cent loan-to-value subprime loan (also known as 80/20). Another executive, David Sambol, responded that such products were 'pervasively offered in the marketplace by virtually every relevant competitor of ours'. Mozilo rather presciently answered, 'There was a time when savings and loans were doing things because their competitors were doing it. They all went broke.'[1] Countrywide continued offering the product.

Even big banks that originated mortgages were not immune to competitive pressure. Former Federal Deposit Insurance Corporation (FDIC) Chairman Sheila Bair explained in a later interview that the many nonbanks originating subprime loans 'created negative competitive pressure for the banks and thrifts to start following suit'.[1] Banks that did not play copycat paid a price. John Stumpf, the CEO, chairman and president of Wells Fargo, recalled that Wells decided *not* to offer a type of subprime mortgage called an option ARM. He noted, 'We did lose revenue, and we did lose volume'.[1]

Underwriting standards suffered in this period, too. The Office of the Comptroller of the Currency (OCC) Survey of Credit Underwriting Practices found a large decline in underwriting standards in the years 2004–2007.[14] The underwriting decline was not just coincidental timing. Using data from 2000 to 2006 covering 50 million mortgages across 387 Metropolitan Statistical Areas in the USA, a recent study found that underwriting standards declined more in areas with more lenders and more new entrants. For example, a one-standard deviation increase in the number of competitors in a metropolitan statistical area reduced subprime denial rates by three percentage points.[17]

Furthermore, several originators — including New Century Financial, the second-largest originator by volume in 2006, and Fremont Investment & Loan — were later found to have gamed the quality-control procedures of the securitisers who bought their loans. Securitisers did not have the means to confirm that every loan was good, so they checked a random sample of loans. Originators realised that only a sample of loans were checked, so when a loan was rejected in one submission, they would simply resubmit it, hoping it would not be one of the sampled loans the next time around.[1]

Originators jockeyed heavily for market share in the expanding mortgage market of the 2000s, which spurred many changes. These included changes that clearly improved welfare, such as more efficient back office processing, but they also included questionable changes like more kinds of non-traditional mortgages and lower underwriting standards. Clear negatives for social welfare were the fraud and gaming of quality control.

Private securitisers: High competitive pressure, high change

Private securitisers, the next link in the chain, were not just innocent victims of originators. Pulled by the carrot of profits and pushed by the stick of competitive pressure, they rushed into changes, too. Private securitisers went from 20 per cent of the market in 2003 — with the remaining 80 per cent still securitised by GSEs — to 50 per cent of the market in 2005.[1] Such growth indicated high competition. Although the private securitisers grew in overall market share, they remained fractured. No single private securitiser had market share even close to Fannie Mae's.[1]

One of the biggest changes was a decreased concern with mortgage quality. For example, Richard Bowen, a manager at Citigroup, discovered in 2006 that 60 per cent of the loans Citi was buying were defective. Senior managers expressed concern but, instead of addressing quality, made 'a considerable push to build volumes, to increase market share'.[1] For example, Citi began to purchase stated-income loans, which lacked documentation of borrower income.[1]

Securitisers that outsourced their due diligence had a similar story. Clayton, one of the companies they outsourced to, found that only half (54 per cent) of the nearly one million loans they reviewed for securitisers actually met the originators' stated underwriting guidelines, over the 18 months ending in June 2007.[1] Nevertheless, securitisers accepted almost 40 per cent of the loans Clayton had rejected. Keith Johnson, president of Clayton, speculated that securitisers accepted the bad loans to preserve their business relationship with loan originators, lest the originators switch to selling loans to competitors.[1]

Securitisers also initiated changes of their own, gaming the models that generated credit ratings for MBS. For example, top credit ratings were associated with a high average FICO (originally Fair, Isaac and Company) credit score among the mortgagors. In the 2000s the securitisers realised they could raise the average FICO score in a security by including mortgages from new immigrants, who had a high FICO because they had never taken out a loan, and thus had never made a late payment or defaulted.[18] The credit rating model did not take length of loan history into account. Financiers aggressively pursued immigrant mortgages to pool in their securities. By the 2000s, the foreign born made up a whopping 39 per cent of homeowner growth in the USA, compared with 21 per cent in the 1990s and 11 per cent in the 1980s.[19] Using immigrant loans allowed financiers to create many more highly rated MBS than in the past — but resulted in much higher default rates when the crisis hit.

Credit agencies: Low competitive pressure, low change

In contrast to the intense competitive pressure upstream, the credit agencies had fairly secure market positions, with little chance that a new entrant could steal their business. They had the market power to be effective gatekeepers — if they wanted to be — but low competition can lead to complacency, as it did at S&P.

Frank L. Raiter, who had been head of mortgage ratings at S&P for 10 years, testified before Congress in 2008. He said that in 2001, a new model had been developed that could take individual loan-level data into account. This could have given S&P a chance to keep up with the changes in the mortgage market, but the model had not been adopted, he explained, 'due to budgetary concerns'. The residential mortgage rating group at S&P already had a market share of 92 per cent 'and improving the model would not add to S&P's revenues'.[3]

There was no pressure on the credit agencies to make the costly move to the newer models that their quants had developed. The credit agencies were like the asexual snails in the deep end of the lake. Why change if the going is good?

GENERALISABILITY

More examples of model failure

The credit default swap (CDS) market grew explosively in the mid-2000s. A CDS is structured somewhat like insurance: the seller agrees to compensate the buyer if certain default conditions were met in a reference pool of loans. In the early 2000s, one of the major sellers was the giant insurance and re-insurance company, American

International Group (AIG), operating through its financial products division, AIG FP. In late 2005, Gene Park became the new manager of AIG's CDS business and he worried that the CDS model had fallen behind changes in the market. He asked others to guess how much subprime debt was in the reference pool of loans in a typical CDS. Gary Gorton, the Yale professor who built AIG's model, guessed 10 per cent subprime. A risk analyst in London guessed 20 per cent. The real value was 95 per cent. Armed with such statistics, Park worked to convince AIG management to stop selling CDS, which they finally did in 2006.[20] AIG's model had fallen well behind market changes spurred by competition in the rest of the mortgage market.

A second example comes from the Irish banking crisis of the mid-2000s. The government-commissioned report, written by Peter Nyberg, clearly regarded competition as a major contributing factor to the crisis. Nyberg wrote:

> 'Bank management and boards in some of the other covered banks feared that, if they did not yield to the pressure to be as profitable as Anglo [Irish Bank], in particular, they would face loss of long-standing customers, declining bank value, potential takeover and a loss of professional respect. The few that admitted to feeling any degree of concern at the change of strategy often added that consistent opposition would probably have meant formal or informal sanctioning.'[21]

Nyberg's report also made a more theoretical argument: 'The paradigm of efficient financial markets provided the intellectual basis for the assumption that financial markets, left essentially to themselves, would tend to be both stable and efficient.'[21] Perhaps the greatest danger, then, is failing to distinguish stable competition from dynamic competition.

CONCLUSION

When market participants change their strategies, they can wreak havoc on models of those markets. So if risk managers could find indicators of a high-change market, they could anticipate model failure. This paper has argued that competitive pressure is a major factor in spurring strategy changes. High-change markets can be detected with measures appropriate to dynamic competition, such as changes in market size, changes in market share and increases in advertising. These can spur market participants to explore a variety of new strategies, from more efficient processes to fraud. In any case, the deep-water snails are not prepared to keep up.

Author's note

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