

The Boom-Bust of Sub-prime Mortgage Market and Its Impacts: What's Old and What's New?

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1 The Credit Cycles and Real Estate Cycles

1.1 Some Episodes Recounted

- Most OECD countries (especially Japan and Scandinavia) experienced a dramatic boom-bust cycle in credit and asset prices during 1980s-early 1990s.
- In emerging economies, financial crises of this type have been particularly prevalent since the early 1980s, including Argentina, Chile, Mexico, and several East Asian countries, and more dramatically in 1997. These tremendous fluctuations in asset prices not only have a huge impact on the net worth of corporations and individuals, but also have significant and

persistent effects on real economic activities (Higgins and Osler (1997), Kaminsky and Reinhart (1996a,b))

- Studies that recount the dramatic boom-bust asset price cycle during mid-1980s and early 1990s in OECD countries and some emerging economies find that a common precursor of rapid credit expansion was financial deregulation and liberalization (Allen and Gale (2000), Browne and Rosengren (1992), Higgins and Osler (1997)).
 - Lending booms is accompanied by an extraordinary rise in asset prices such as real estate and stocks.
 - The subsequent collapse in asset markets were accompanied by surge in delinquency rates and default, banking distress, sometimes exchange

rate crisis, and then followed by persistent economic downturns (Keeton (1999), Asea and Blomberg (1998), Kaminsky and Reinhart (1999), Gourinchas et al. (2001), Tornell and Westermann (2005), and Demirgüç-Kunt and Detragiache (2002))

- No liberalization or deregulation, no pain?
 - A moral hazard explanation is that deregulation gives the market participants more power to compete and pursue higher profits, but does not require them to bear the responsibility corresponding to the risk that is involved; in particular, an appropriate incentive mechanism was not in place to curb the financial institutions from excessive risk-taking.
 - Krugman (1998) and many others argue that government guarantees led to over-lending and excessive risk-taking in Asian countries.

- Anticipated government subsidies and bailouts as major sources of moral hazard find that they lead to ex-ante over-investment and asset price “bubbles”, and ex-post regulatory forbearance (Soft Budget Constraint).

1.2 Procyclicality in Collateralized Lending and Leverage

- Collateral-based lending closely relates to the issue of bank loan procyclicality that is, lending increases significantly during business cycle expansions and then falls considerably during subsequent downturns, occasionally so drastically to be considered a “credit crunch” (e.g., Bernanke and Lown, 1991; Berger and Udell, 1994; Hancock et al., 1995).
- Kiyotaki and Moore (1997): financial contracts are imperfectly enforceable, and creditors then protect themselves from the threat of repudiation by collateralizing borrowers’ debt, thus employing the collateral-based lending technology. When the amount of borrowing is directly linked to the value of collateral value, credit cycles can be driven by the interactions of the credit constraint and asset prices (collateral value).

- Chen and Wang (2007): Using Taiwan's transaction-level data, they find that the value of collateralizable assets has positive and significant effects on the amount of loans and the leverage effect of collateral is procyclical to asset price cycles.
- Most of these studies tend to focus on commercial & industrial loans. As for mortgages, these loans are *by default* collateralized by the houses that the borrowers purchase. Still, the loan-to-value ratios for mortgages are time varying.

1.3 Asset Liquidation and Collateral Damage – Feedback Effect

- Kiyotaki and Moore (1997): Small perturbation lead to large fluctuations by way of interactions between credit constraints and asset prices.
- Chen and Chu (2004)
 - Feedback effect from asset prices to asset liquidation leads to fire sale of assets and further declines in collateral value.
 - This externality was not taken into account by each individual bank.
- Changes in bank credits have strong impacts on aggregate fluctuations via the credit channel (e.g., Bernanke and Lown, 1991; Oliner and Rudebusch,

1996; Kashyap and Stein, 2000), and the impacts are particularly amplified by movements of asset prices and collateral values (e.g., Peek and Rosengren, 2000; Chen, 2001; Iacoviello, 2005; Goyal and Yamada, 2004).

- Concerns of the potentially substantial impact from the procyclicality of bank credits have been raised by central bankers, practitioners, and researchers, most notably in the debate regarding the IRB (internal-ratings-based) approach in the **Basel II** regulatory framework (Kashyap and Stein, 2004; Gordy and Howells, 2004).
 - **Non-bank financial institutions** received less attention in Basel II.

Non-Agency MBS Outstanding

Year	Outstandings in \$ Billions						Percent of Total MBS				
	Total MBS	Agency	Total	Jumbo	Alt-A	Subprime	Agency	Total	Jumbo	Alt-A	Subprime
2000	3,003	2,625	377	252	44	81	87%	13%	8%	1%	3%
2001	3,409	2,975	434	275	50	109	87%	13%	8%	1%	3%
2002	3,802	3,313	489	256	67	167	87%	13%	7%	2%	4%
2003	4,005	3,394	611	254	102	254	85%	15%	6%	3%	6%
2004	4,481	3,467	1,014	353	230	431	77%	23%	8%	5%	10%
2005	5,201	3,608	1,593	441	510	641	69%	31%	8%	10%	12%
2006	5,829	3,905	1,924	462	730	732	67%	33%	8%	13%	13%
2007Q1	5,984	4,021	1,963	468	765	730	67%	33%	8%	13%	12%

Source: Federal Reserve Board, Inside MBS&ABS, Loan Performance, UBS.

Source: Gorton (2008)

Mortgage Originations and Subprime Securitization

	Total Mortgage Originations (Billions)	Subprime Originations (Billions)	Subprime Share in Total Originations (% of dollar value)	Subprime Mortgage Backed Securities (Billions)	Percent Subprime Securitized (% of dollar value)
2001	\$2,215	\$190	8.6%	\$95	50.4%
2002	\$2,885	\$231	8.0%	\$121	52.7%
2003	\$3,945	\$335	8.5%	\$202	60.5%
2004	\$2,920	\$540	18.5%	\$401	74.3%
2005	\$3,120	\$625	20.0%	\$507	81.2%
2006	\$2,980	\$600	20.1%	\$483	80.5%

Sources: Inside Mortgage Finance, The 2007 Mortgage Market Statistical Annual, Key Data (2006), Joint Economic Committee (October 2007).

Source: Gorton (2008)

2 Who Is To Blame for the Sub-Prime Crisis?

2.1 Loose Monetary Policy

- The federal funds rate had been 13 times lowered from 6.5% in early 2001 to 1% in mid-2003, before it reversed course and went up again.
- The Fed is accused of laying out an extremely loose monetary environment and a fertile ground for credit expansion.
 - Taylor (2007) argues that the loose monetary policy between 2002 and the end of 2004 should be mainly responsible for the subsequent turmoil. The counterfactual analysis in the paper finds that interest

rates should have risen from the low of 1.75% in 2001 to 5.25% in 2005, rather than being further pushed all the way down to 1% in 2003.

- Iacoviello and Neri (2008) find that monetary factors explain about 20 percent of the cyclical volatility of housing investment and housing prices for longer time series, but they played a bigger role in the housing cycle in early 2000s.
- A similar episode occurred two decades earlier in Japan. Bernanke and Gertler (1999) find that the loose monetary policy in the second half of 1980s maintained by the Bank of Japan was responsible for the fast growth in bank credit and extraordinary booms in stock and real estate markets in the late 1980s. They further argue that the Bank of Japan should have substantially raised interest rates in around 1987.

- This indicates it is a widely-held view that monetary policy is important in determining the growth of bank credit and asset price booms.

2.2 Preference Shock

- The demand side factors, reflecting changes in demographics and preferences have also received attention as explanations for the increase in mortgages and house prices.
- Mankiw and Weil (1989) argued that population demographics were the prime determinant for driving house prices. But they predicted that house prices would fall with the maturation of the baby boom generation. Recently, Martin (2005) and Krainer (2005) argue that the relationship between house prices and demographics remains important.

- Iacoviello and Neri (2008) find that The Housing Boom of the late 1990s-early 2000s was mostly driven by demand-side factors in the housing market. Technological progress in the non-housing sector and Monetary policy each contributed for about 15%-20%. Thus, changes in preferences towards housing is the main source of house price fluctuations in the last 25 years.

2.3 Credit Standards

- An alternative view that causes boom-bust cycle in banking lending and asset prices is inherent in the cyclical behavior of credit standards by intermediaries.

- Asea and Blomberg (1998): Use a panel dataset on the contract terms of commercial and industrial loans in US during 1977-1993, and a constructed measure of lending standards (based on interest rates, size and duration of loans, percentage of total loans collateralized). They find a systematic tendency for lending standards to vary from tightness to laxity over the business cycle.
- Keeton (1999), using the “credit standards” from the Federal Reserve’s survey, shows that loan growth moved inversely with credit standards in the 1990s.
- A. Greenspan noted, “the worst loans are made at the top of the business cycle” and that at the bottom of the cycle, “the problem is not making bad loans. . . it is not making any loans, whether good or bad, to credit-worthy customers.” (Chicago Bank Structure Conference, May 10, 2001).

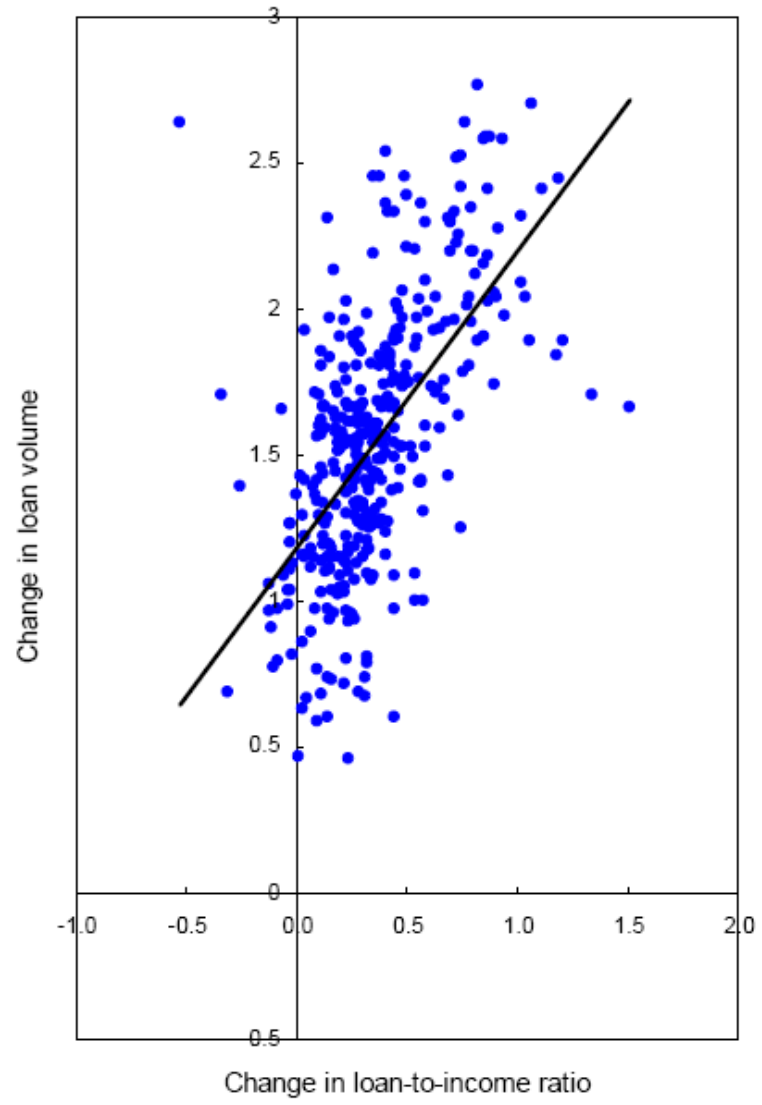
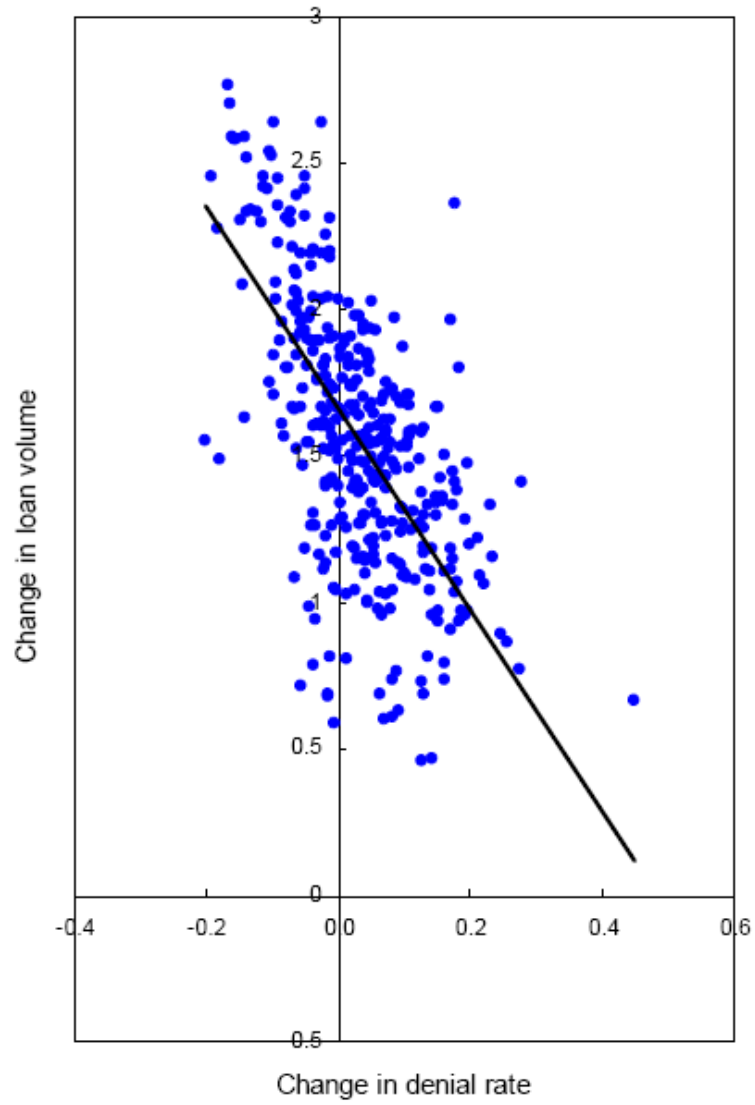
- The behavior of cyclical lending standards by intermediaries bears important implications for the dynamics of aggregate fluctuations.
 - It generates an **inherent cycle** for the financial sector. The cyclical lending standards leads to the **procyclicality of bank credit**, that is, lending increases significantly during business cycle expansions, and then falls considerably during subsequent downturns.
 - The procyclical bank credit resulting from cyclical lending standards is found to **exert considerable influence on the dynamics of aggregate fluctuations** (Asea and Blomberg (1998)). This is because the **easing of bank credit standards in good times raises the proportion of potentially problem loans in the future, which tends to pave the way for a downturn in the economy.**

- Weinberg (1995) and Keeton (1999) find that those periods in which exhibited unusual strong loan growth tend to precede rising delinquencies and charge-offs.
- Lown et al. (2000) and Lown and Morgan (2002): Changes in lending standards appear to be largely exogenous to the monetary policy actions. This suggests that the intermediaries' behavior of cyclical lending standard is an independent channel that drives the financial cycle.
- Mian and Sufi (2008)
 - Use zip code level data set during 1991-2007 that includes outstanding consumer debt, defaults, house prices, mortgage characteristics, income data, and demographic variables.

- Controlling for the demand factor, zip codes with high latent demand for mortgages (or unfulfilled demand for mortgages, measured by the percentage of applicants in the zip code denied mortgage credit in 1996) experience a sharp relative decrease in denial rates, a sharp relative increase in mortgage debt-to-income ratios, and a decline in the price of mortgage credit risk (the spread between sub-prime and prime mortgages) to historical lows from 2001 to 2005.
 - High latent demand zip codes experience sharp relative growth in mortgage originations and house prices during this period.
 - Finally, the supply-driven expansion in mortgage credit and house price appreciation respectively during 2001-2005 in high latent demand zip codes leads to an increase in mortgage default rates during 2005-2007.
- Dell’Ariccia et al. (2008)

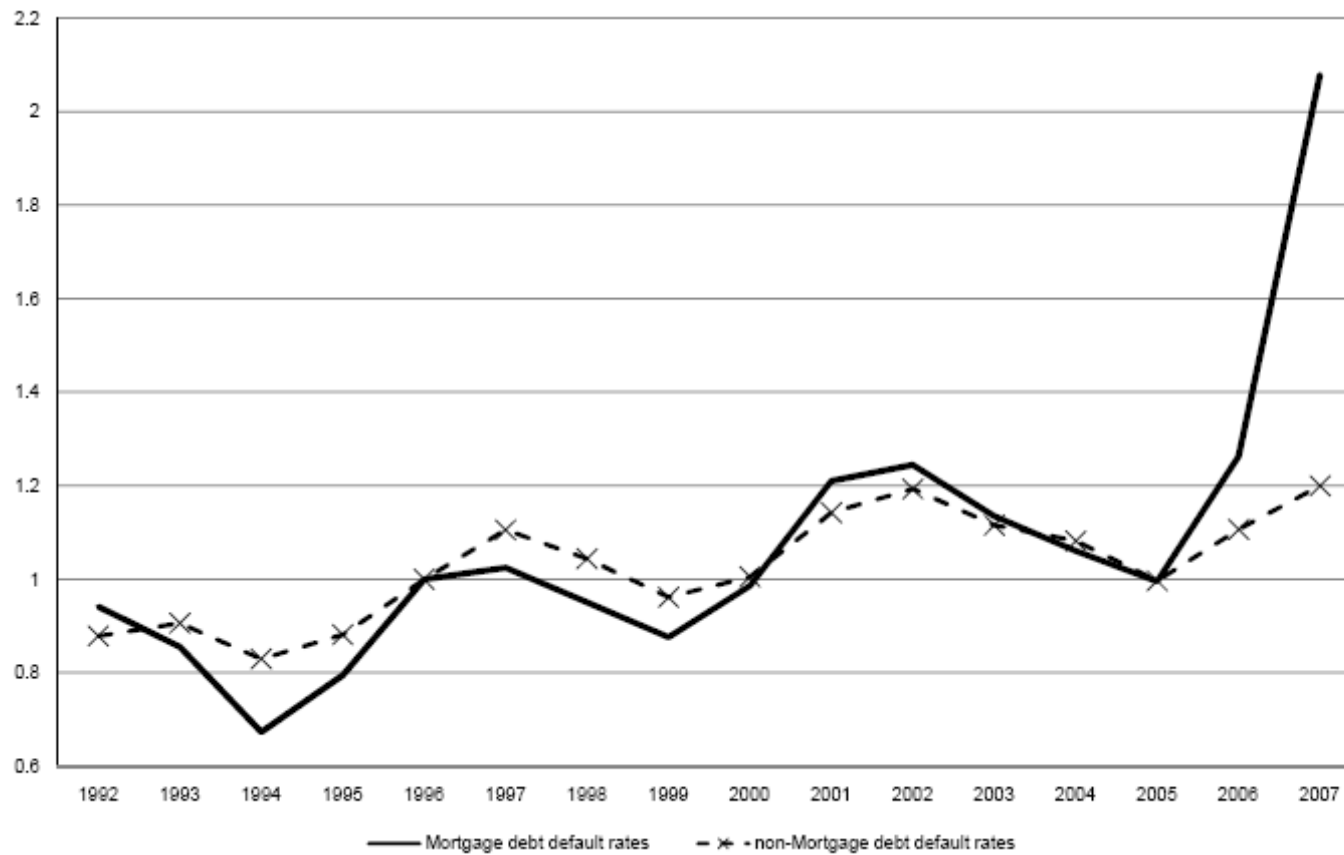
- Use disaggregate data and aggregate up to the metropolitan statistical area (MSA) during 2000-2006.
 - The sub-prime mortgage delinquency rates rose more sharply in areas that experienced larger credit booms and larger house price appreciation, and higher mortgage securitization rates.
 - This relationship is linked to a decrease in lending standards (higher loan-to-income ratios and lower loan denial rates compared to the year 2000), but not explained by changes in the underlying economic fundamentals.
- Jimenez et al. (2006): during booms collateral requirements (lending standards) decrease and riskier borrowers are able obtain credit (transaction-level data, collateral dummy = 1 if collateralized, 0 if otherwise).

Lending Standards and Subprime Credit Boom



Source: Dell'Ariccia et al. (2008)

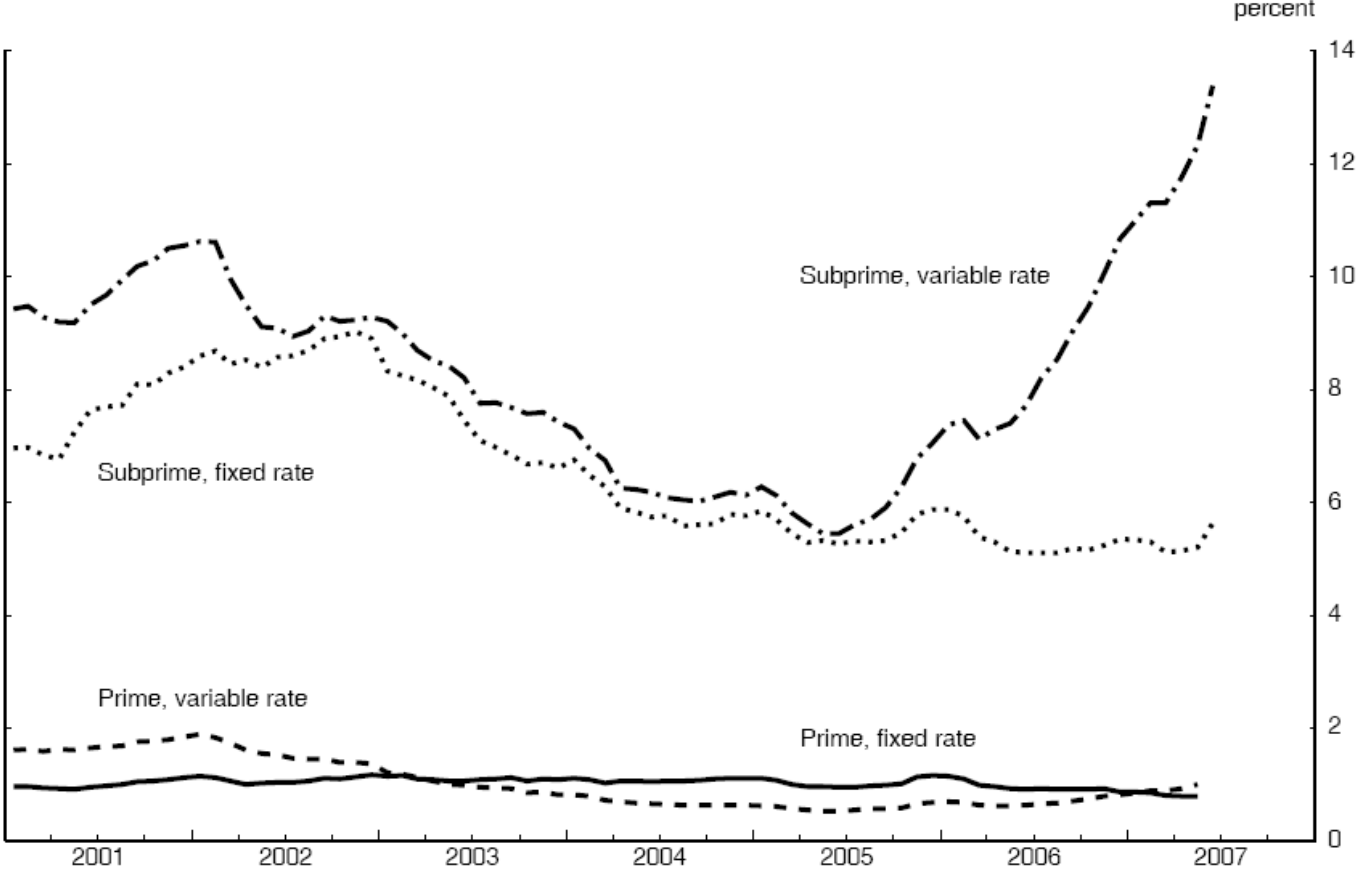
Default Rates for Mortgage and non-Mortgage Debt , Indexed to 1996



Note: The default rate for consumer debt outstanding for the U.S. from 1992 to 2007, indexed to 1996. The total non-mortgage default rate is calculated using non-mortgage debt which includes student loans, auto loans, consumer loans, and outstanding credit card balances. Data are from Equifax Predictive Services.

Source: Mian and Sufi (2008)

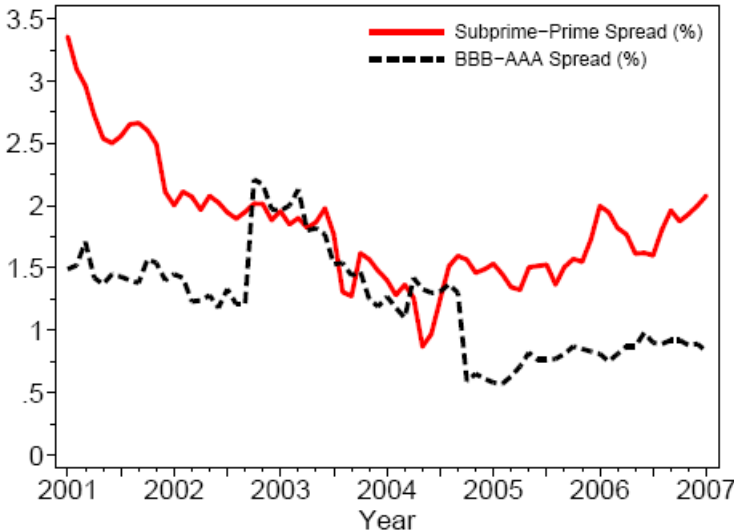
Default Rates for Mortgage Debts



Source. First American LoanPerformance

Note: From Mishkin (2008)

Fixed Rate Mortgages Subprime-Prime Rate Spread and Corporate Bond Yield Spread



Demyanyk and Hemert (2007)

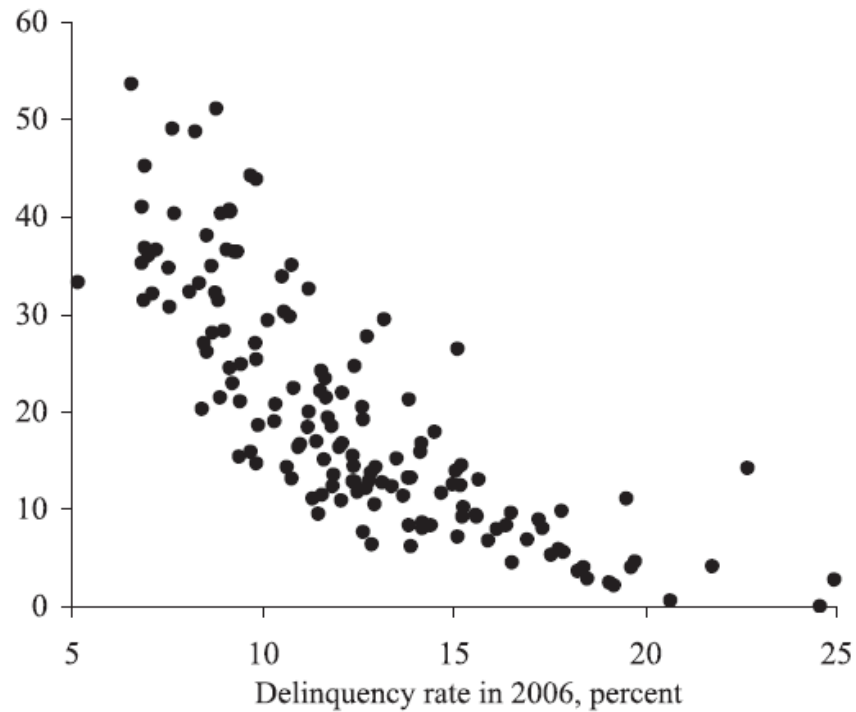
- Gerdrdi et al. (2007) attribute most of the dramatic rise in foreclosures in 2006 and 2007 in Massachusetts to the decline in house prices that began in the summer of 2005. Sub-prime mortgages are more sensitive to changes in house prices and to the initial loan-to-value ratio at origination, and far more likely to end up in foreclosure than prime mortgages.
- Hemyanyk and Hemeret (2008): Using loan-level data, they find that the quality of loans deteriorated for six consecutive years before the crisis.

2.4 Why Lowering Credit Standards?

- Strategic interactions between competing lenders (Rajan (1994), Ruckles (2004), and Dell'Ariccia and Marquez (2006)): Strategic interactions between competing lenders lead to changes in the intensity of screening (lending standards) over the lending cycles.
- Changes in the composition of financiers (Iacoviello and Minetti (2005)): Changes in the composition of financiers, from informed domestic financial institutions to uninformed foreign investors, that drives credit cycles.
- Collateral value (Rise and Fall of House Prices)
 - loan-to-value ratios for mortgages increased in the last few years (Dell'Ariccia et al. (2008), Mian and Sufi (2008), Gerdrdi et al. (2007))

- Doms et al. (2007): The delinquency rates of sub-prime mortgages at the end of 2006 and the changes in house prices, as measured by OFHEO indexes, from 2004 through 2006 are negatively correlated. The negative relationship remains robust after controlling for local economic conditions.
- The change of banking: Securitization (“Originate-to-Distribute” or Credit Risk Transfer) or loan sales.
 - From “buying and holding” to “buying and selling”
 - Mortgage lenders lowered lending standards because loan originators transfer credit-risk to market participants by way of securitization (and various structured products). This originate-to-distribute model fosters moral hazard amongst mortgage originators, leading them to expand

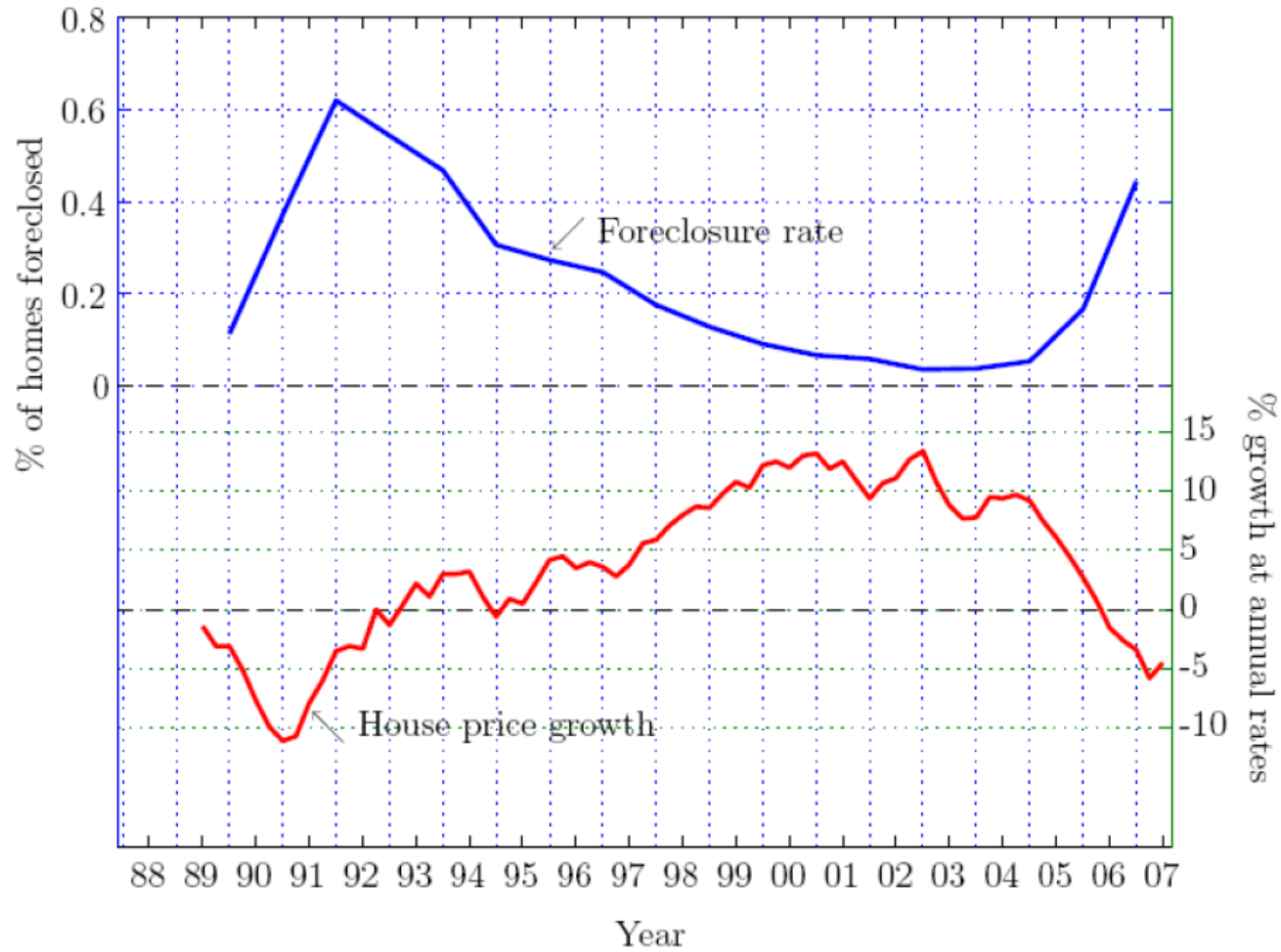
Change in house prices, 2004-2006, percent



All data at the MSA level. Sources: First American LoanPerformance and OFHEO.

Note: Compiled by First American LoanPerformance (FALP), the delinquency rate is defined as the percent of subprime loans that are delinquent 60 days or more. The data, from 2005 and 2006, contain observations on 309 metropolitan statistical areas (MSAs). The FALP data show considerable regional variation in the delinquency rates and in the changes in the delinquency rates. For the sample of 309 MSAs, appreciation rates ranged from -2% in Kokomo, Indiana, to almost 54% in the Phoenix, Arizona, area (Doms et al. (2007)).

Massachusetts House Price Growth, Foreclosures and Delinquencies, 1989:01-2007:8
(Gerardi et al. (2007))



credit to credit-unworthy borrowers (Keys et al. (2008), Mian and Sufi (2008)).

- But still, this moral hazard problem is not unique to this episode. Furthermore, Originators and underwriters do take part of the risk. For example, Citi Corp. (sponsoring banks of some SIVs) took the off-balance sheet SIVs back onto its balance sheet, even though it is not obligated to do so.

3 The Sub-Prime Mortgage Market

- Sub-Prime Mortgage: mortgage lending that do not meet Fannie Mae or Freddie Mac guidelines (FICO score < 620 , who has become delinquent on some form of debt repayment in the previous 12 to 24 months, or who has even filed for bankruptcy in the last few years). These mortgages tend to be initiated by sub-prime originators (mortgage companies or brokers) that are owned or controlled by major financial institutions
- The adjustable rate sub-prime mortgages are designed so that (Gorton (2008))
 - Both borrowers and lenders can benefit IF house prices are appreciating over short horizon.

- After the initial 2-3 years of paying a lower fixed interest rate, homeowners must **refinance** with the same lender and pay a higher floating interest rate (LIBOR+markup) and the lender has the option to provide a new mortgage, depending on the current value of the house.
- Particularly **sensitive to changes in house prices.**
- With the rapid increase in mortgage securitization and the continuing rise in house prices, the sub-prime lending soon **expanded its credit to borrowers with heterogeneous characteristics** (high loan-to-value ratios or zero-downpayment, unwilling to disclose financial status, high loan-to-income ratio): the sub-prime lending no longer focused on only poor credit borrowers, but also on borrowers who would have been considered prime based on their FICO score, but are perceived to have higher credit risk because of other characteristics (Gerardi (2007)).

- Mortgage loans are pooled in Real Estate Mortgage Investment Conduits (REMICs) which are a type of special purpose vehicles (SPVs), and repackaged by underwriters (dealer banks or investment banks) for issuing residential mortgage-backed securities (RMBSs).

3.1 The Role of Investment Banks

- Glass-Steagall Act 1933 separated commercial banking and investment banking, because underwriting (by investment banks) was considered to have conflict of interests with commercial banking and was held liable for the 1929 bank panic. The separation was then weakened by bank holding Co. (BHC) and now considered against the economy of scope. It was repealed by GLB Act 1999.

- Less regulated than commercial banks (e.g., no capital adequacy requirement), highly leveraged.
- Security underwriters, dealers, and brokers; consultants on transactions such as mergers and acquisitions.
- Underwriting (also lending): securitization (ABSs, MBSs, structured notes, ...) and all types of off-balance sheet activities and financial derivatives.
- Invest in MBSs, derivatives, and other structured products.

3.2 CDOs

- A collateralized debt obligation (CDOs, a certain type of Special Purpose Vehicle (SPV)) can be considered a financial intermediary which issues different classes (tranches) of bonds and equities to acquire MBSs (mortgage-backed securities), corporate loans, and other ABSs (asset-backed securities). CDOs are typically issued by investment banks.
- Sub-prime MBSs were repackaged into tranches of securities (with custom-built exposure) that were purchased by banks, mutual funds, investment trusts, investment banks, hedge funds, Insurance Co., pension funds, private banking organizations, asset-backed commercial papers conduits (ABCPs), SIVs, other CDOs ($CDO^n, n \geq 2$), etc.. all over the US, European and Asian markets.

- A structured investment vehicle (SIV) can be thought of as a virtual bank. It borrows money using short-term commercial paper (CP) and invests in MBSs, ABSs, ...
- Re-Securitization: A series of primary markets
 - The losses of information to investors are more and more as the chain of structure – securities and special purpose vehicles – stretches longer and longer (Gorton (2008)).
 - This is different from the “originate-to-distribute” view.
 - Failure of credit rating agencies to precisely assess the risk of CDOs and SIVs products.
 - Lack of secondary markets (liquidity is low)

- Typically a financial institution may purchase a CDO-issued bond and at the same time purchase protection on the bond with a **credit default swap** (CDS).

3.3 Impacts and Spillover Effect

- **Financial integration** makes easier for these structured products to be sold across borders.
- When house prices were rising, homeowners were building up **home equities** and they were able to lower their outstanding debts by refinancing. Thus, they had an incentive to keep their houses even though interest rates became higher. But when house prices are falling in 2006–2007, their home

equities were declining and refinancing became more difficult. When their outstanding debts are larger than their accumulated home equities, they have an **incentive to default**. Defaults and foreclosure rose dramatically. This includes all categories of mortgages.

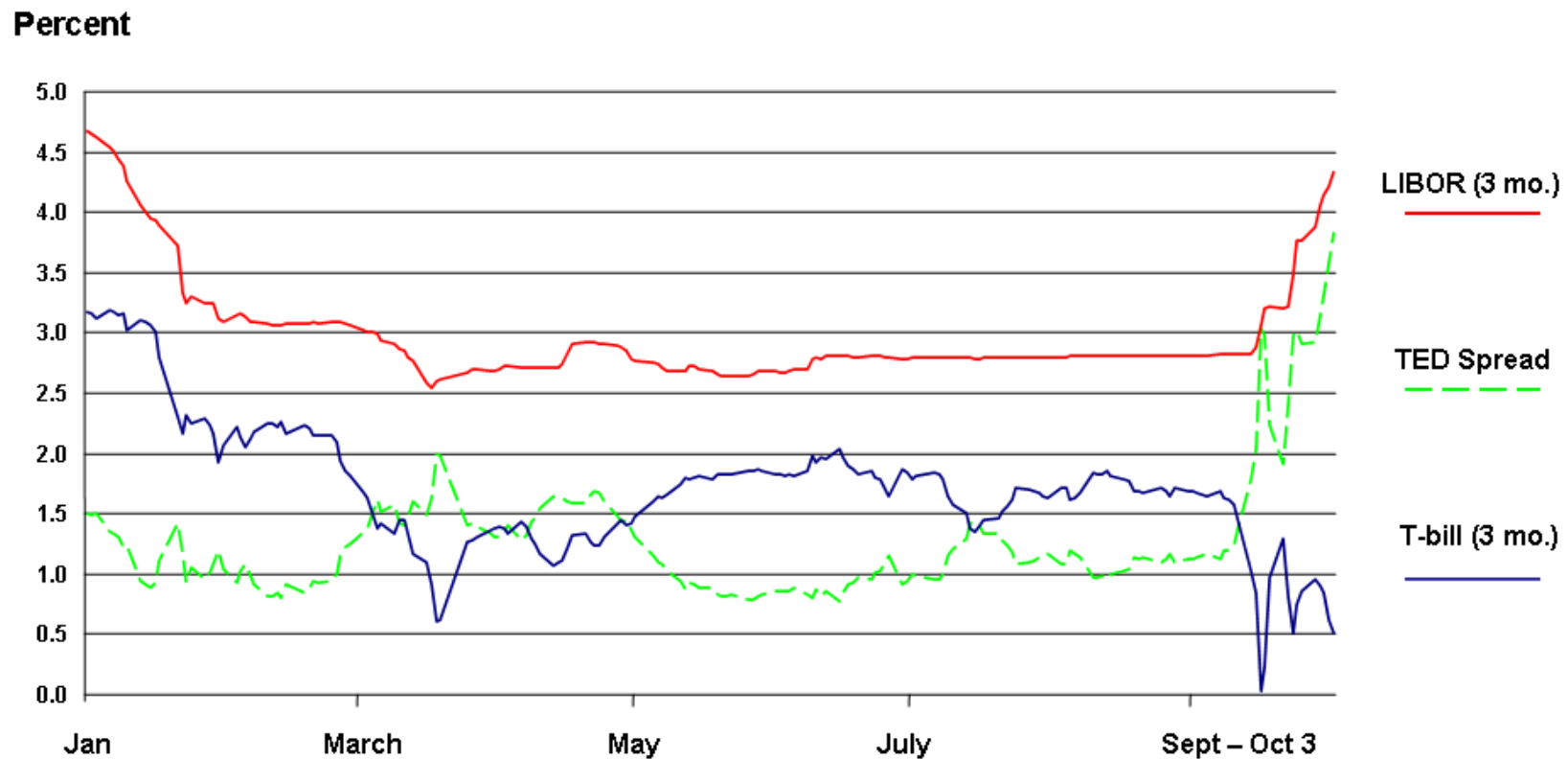
- Liquidity drying up is exacerbated by **fire sale** of assets in order to meet **col-lateral call** in derivative trading. The **TED** (3-month T-bill rate - LIBOR) spread surged.
 - Runs on SIVs and ABCPs by not rolling over their commercial papers and repos (Repurchase Agreements).
 - Liquidity crunch spills over to **commercial papers** and **repos** collateralized by other real estate related assets.

TED Spread

The TED spread is the difference between the three-month T-bill interest rate and three-month Eurodollars contract as represented by the three-month London Interbank Offered Rate (LIBOR), where LIBOR is a daily reference rate in the London interbank market.

TED Spread & Components - 2008

The "TED Spread" is a measure of credit risk for inter-bank lending. It is the difference between: 1) the risk-free three-month U.S. treasury bill rate; and 2) the three-month LIBOR rate, which represents the rate at which banks typically lend to each other. A higher spread indicates banks perceive each other as riskier counterparties.



TED spread during the subprime mortgage crisis



- A cascade of runs for liquidity: healthy financial institutions and businesses across the world with no direct connection to US sub-prime mortgage problem started facing financial distress due to perceived rising risk and liquidity shortage.
- Buyers of credit protection, such as **credit default swap** (CDS), can **make collateral calls** when interest rate spreads rise (e.g., AIG collapsed due to collateral calls under CDS, rather than actual defaults occurred).
- JP Morgan Chase was accused of pushing Lehman Brothers into bankruptcy and Merrill Lynch into Bank of America merger by exercising collateral calls.
- **Feedback effect** (externalities) of asset prices was not taken into account by originators, underwriters and security investors.

- US and West European countries
 - Those sub-prime mortgages issued before mid-2007 need to be refinanced. Soon they will find that they are not able to refinance because they cannot find a lender, or because house prices are falling and these homeowners have an incentive to default.
 - Expenditures (consumption, college tuitions, ...) that rely on home equity withdraw (HEW) no longer exist. The home equities of many US families decline, i.e., their mortgage debts rise.
 - Spillovers to all mortgages, credit cards loans, auto loans, ... and therefore those ABSs and financial derivatives based on these assets.

- South Korea, Iceland, Eastern European, and Latin American countries

- Relying on foreign debt (denominated in Dollars)
- Capital outflow and banking distress may lead to currency crisis which then feeds back to banking crisis: foreign debt in terms of domestic currency surges when domestic currency depreciates. This is reminiscent of the Asian financial crisis in 1997.

3.4 Evaluation and Policy Implications

- Kiyotaki and Moore (1997): Small perturbations lead to large fluctuations by way of interactions between credit constraints and asset prices. The feedback from asset prices to the economic activity is large and persistent.

- The sub-prime mortgage market basically follows a classic scenario of boom-bust cycle in credit and real estate markets.
- Financial Innovations: basically sub-prime mortgages are a financial innovation that allows poorer (and minority) and risky borrowers to obtain finance and become homeowners. A welfare analysis is warranted.
- Securitization = Diversification?
- Re-regulation?
- Financial supervision: Too-Big-To-Fail (consolidation and merger)

- Zero-Probability event
- systemic risk vs. moral hazard problem
- Injection of public capital
- Spillovers across borders – Do central banks perform better than private co-insurance club (clearing house or Super SIV)?

4 Implications for Taiwan

4.1 The Impact on Taiwan's Banking Sector

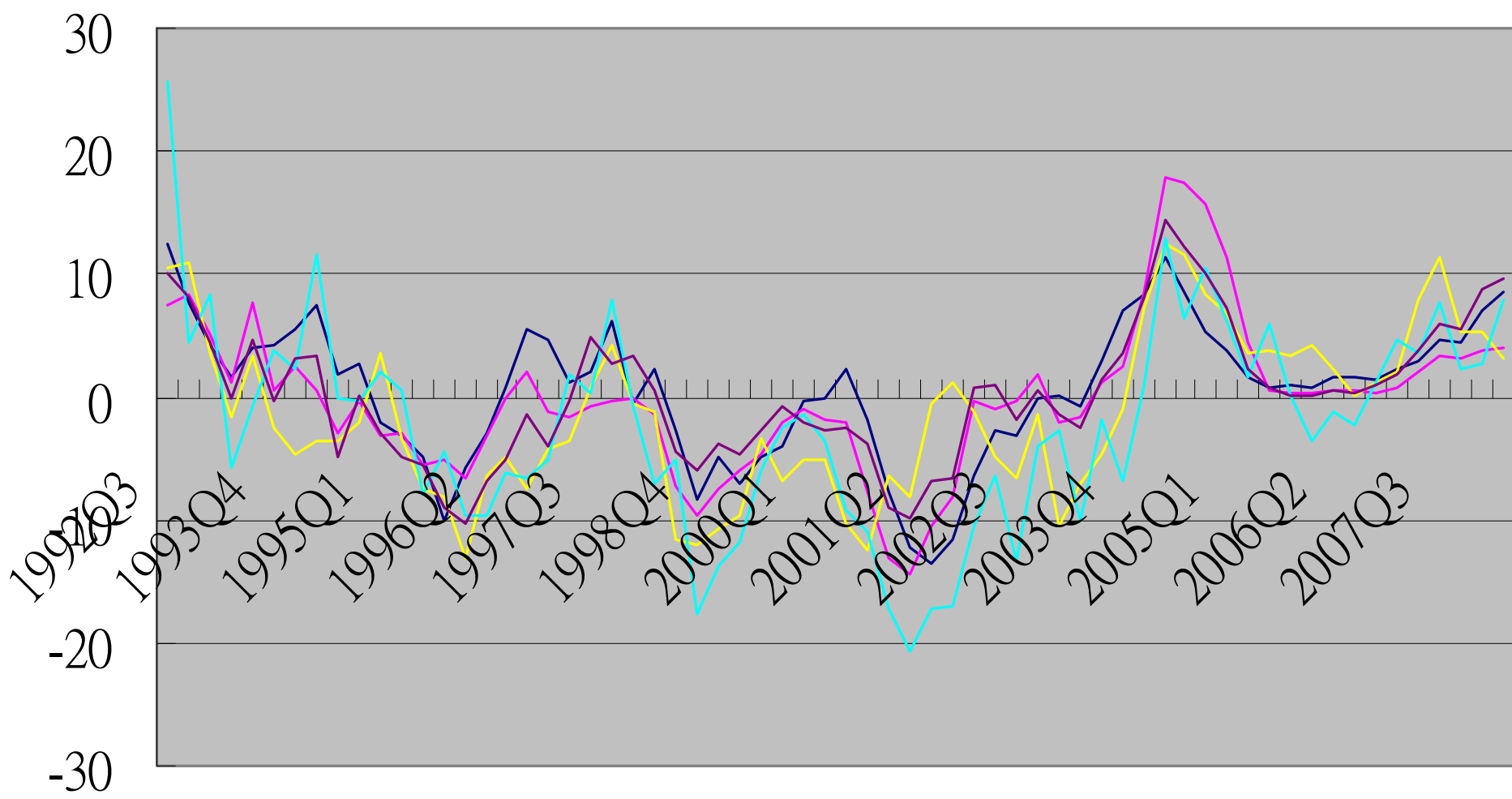
- Direct impact on the banking system is not large
 - Excess reserves of the banking system was already extremely high, plus a big cut of reserve requirement ratio by the central bank – no liquidity crunch.
 - Foreign debts are relatively low.
 - Internationalization is lower relative to other countries of comparable income levels.

- A curse or a blessing?
- Furthermore, banking sector problems in Taiwan were typically driven by fraudulent lending and hollowing-out (2000-2001).

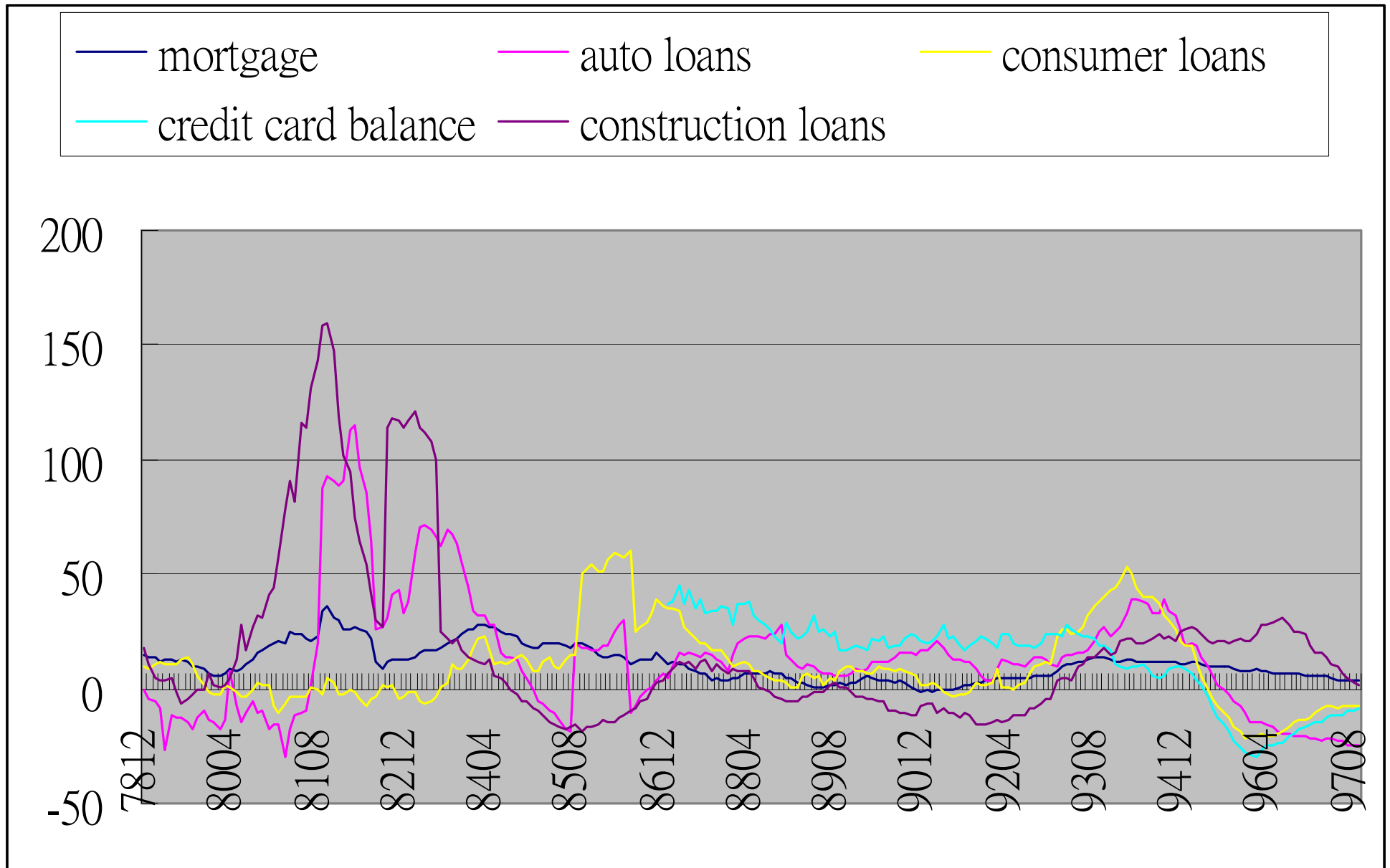
4.2 The Impact on Taiwan's Economy As a Whole

- Decline in real estate markets, consumption, and investment
- Decline in global aggregate demand

— 台北市 — 台北縣 — 台中 — 高雄 — 台灣



Growth Rates of Bank Credit in Taiwan



4.3 Regulatory Forbearance

- Expanding deposit insurance coverage, requiring banks to roll over loans, pumping up stock market, ...
- Cargill et al. (1997): the “buy time” policy by Japan’s government in early 1990s prolonged the recession enduring throughout 1990s.