Jump and Cojump Risk in Subprime Home Equity Derivatives

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Outline

1. Housing Market Fundamentals

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2. Overview of Markets and Instruments
3. The ABX Indices

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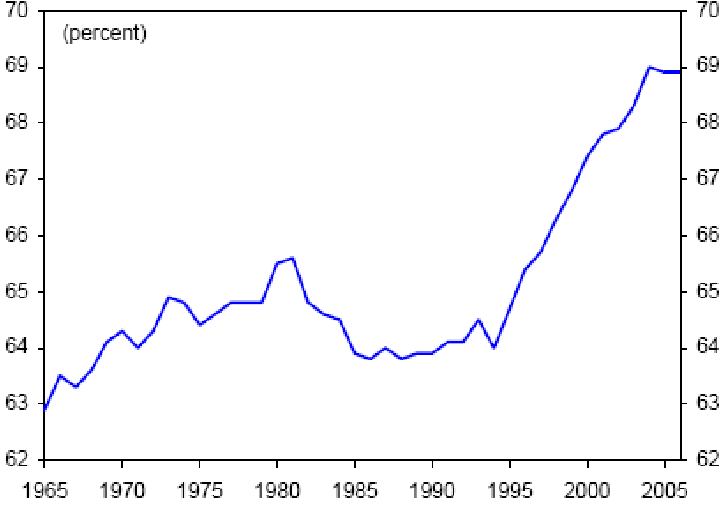
3. The ABX Indices
4. Jump Processes
5. Finite Sample Properties: Daily Returns of Intradaily Data
6. ABX Jump Risk Estimates
7. Linking Jump Risk to the Headlines
8. Housing Futures
9. Cojumps and a Predictive Model
10. Will the Crisis Spread?

Housing Market Fundamentals

Home ownership

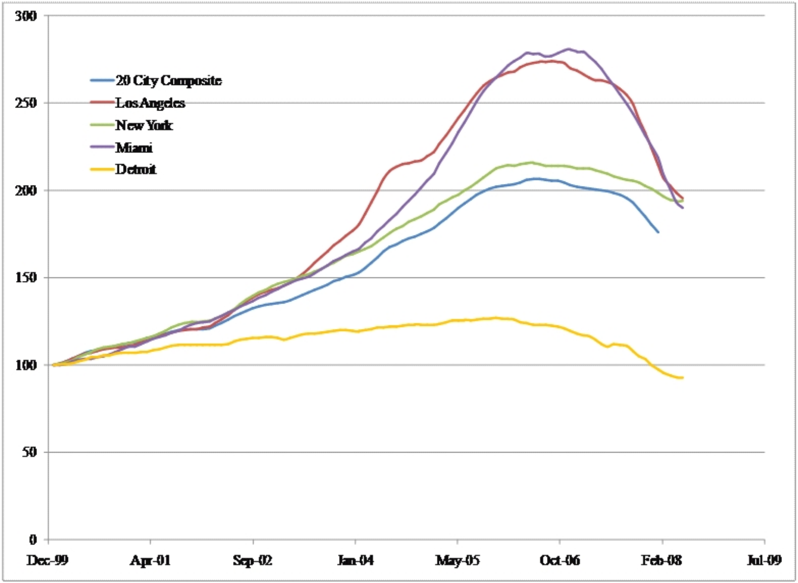
Figure 1. Homeownership Rate



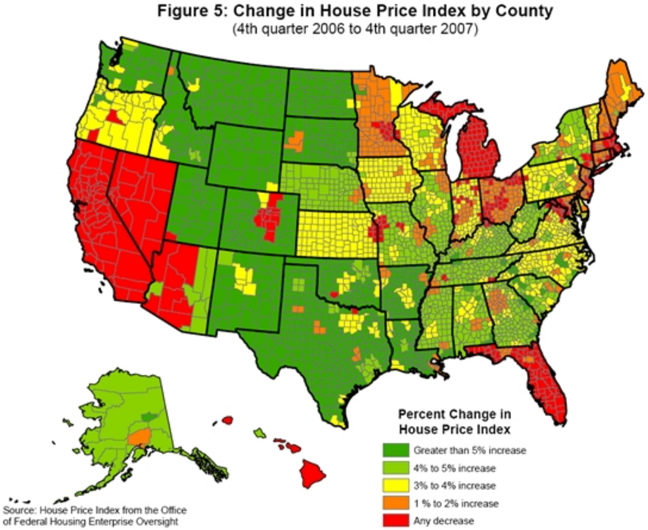
Housing indices

The Case-Shiller indices (CSI) use a repeat sale methodology. The index computes a three-month moving average of the repeat sales of single family houses in 20 metropolitan areas. The use of repeat sales is preferable to using a hedonic index to compensate for changes in quality, but obviously does not avoid it due to home improvements (or lack thereof). The method produces a cap-weighted index for residential real estate in a particular region. A national composite in then produced from the regional indices using census weights.

Case-Shiller house price indices (2000=100)



Regional variation in price changes



Delinquencies and foreclosures

Mortgage Bankers Association National Delinquency Survey 2008Q2:
More than 9% of mortgage loans are either delinquent or somewhere in the foreclosure process. California and Florida alone accounted for 39% of all of the foreclosures started nationally during the second quarter.

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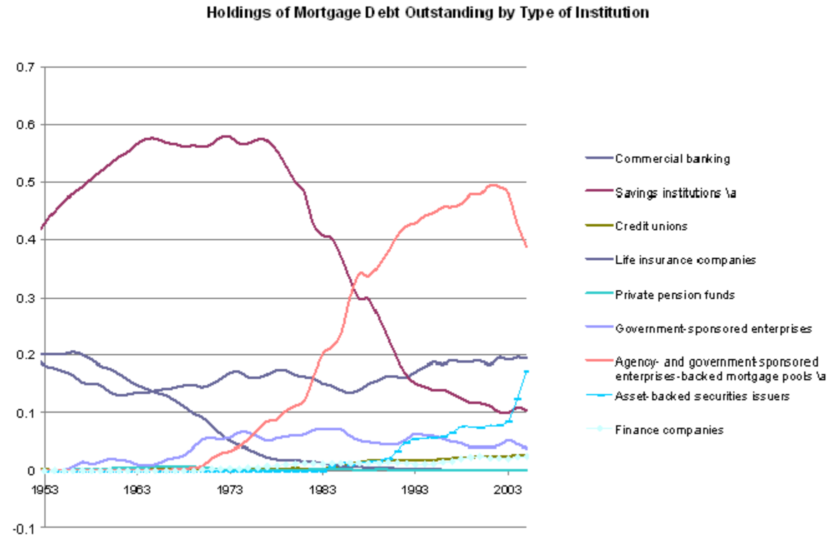
The percentage of loans that went into foreclosure in the second quarter was 1.08%, up from 1.01% in the first quarter and 0.59% a year ago. Meanwhile, 2.75% of loans in the survey were somewhere in the foreclosure process, up from 2.47% last quarter and 1.4% in the second quarter of 2007.

Foreclosures concentrated in subprime

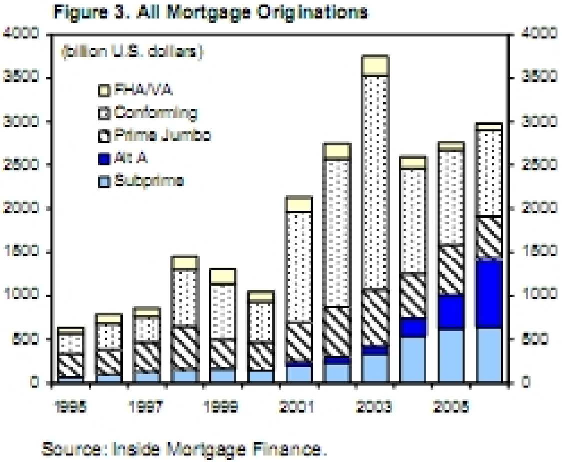
MBA 2007Q3	Loans	% of Foreclosures
Prime Fixed	65%	18%
Prime ARM	15%	20%
Subprime Fixed	6%	12%
Subprime ARM	7%	42%
FHA	7%	8%

Overview of Markets and Instruments

Holdings of mortgage debt



Mortgage originations



Source: Kiff and Mills (2007).

Subprime, Alt. A, Jumbo

Subprime borrowers who have Fair Isaac & Co. (FICO) credit scores in the low 600s, high loan to value (LTV) ratios, and they may lack documentation of their income or assets. Schloemer, Li, Ernst, and Keist (2006) estimate that the subprime share of mortgage originations reached 23% in 2006, up from only 10% in 1998

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A *jumbo loan* exceeds the borrowing limits of Federal Housing Aministration (FHA) conforming mortgates. Until recently, the limit was $417,000, but it was raised in March 2008 to $729,750.

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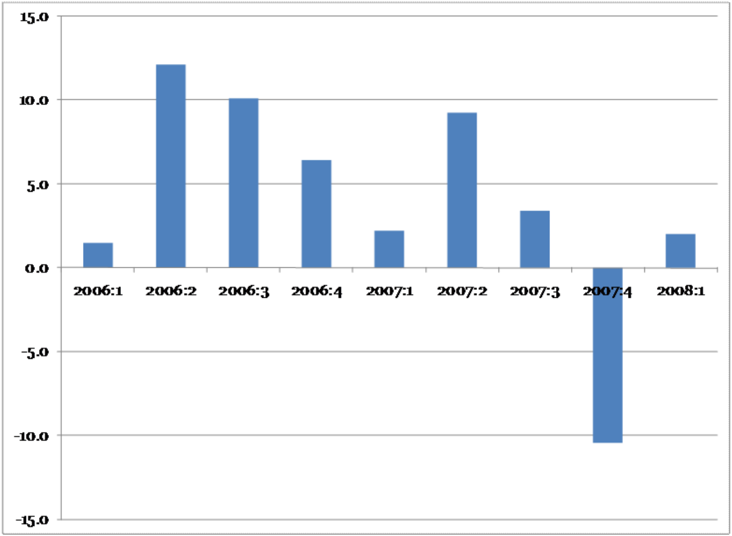
Other non-conventional mortgages, including Alt-A and Jumbo loans, are classified as RMBS.

Change in home equity loans outstanding



Source: SIFMA

Subprime HEL

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As the credit crunch unfolded in 2007, HEL securities faced growing credit spreads, deteriorating collateral, and the inevitable ratings downgrades from the credit rating agencies. According to SIFMA, "in excess of 95 percent of ABS downgrades in the 2005-2007 vintages sector were HEL."

Credit default swaps

Credit default swaps are derivative securities that pay security holders contingent upon a credit event. Typically, these are triggered by some failure to deliver the underlying cash flows promised to the security pool. There are now very liquid markets in credit default swaps on corporate and sovereign bonds.

ABS credit default swaps

Credit default swaps on ABS reference individual tranches from a *special purpose vehicle* (SPV) because they are likely to have a wide range of default probabilities. Other unique features of asset backed securities are: (1) the amortization of principal; (2) adjustment of security values in light of partial interest shortfalls or principal writedown.

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With home equity securities, credit default swaps provide a sequence of payments to the protection buyer. For this reason, the contracts are often referred to as *pay-as-you-go*. The protection seller will compensate for losses in principal and any interest shortfall. These differ from corporate credit default swaps which usually involve a single payment after a credit event. Because the maturity of the ABS contract is usually the same as the underlying mortgage securities, ABS credit default swaps can have long maturities. Corporate bond contracts typically last only 5 years.

The ABX Indices

Construction of ABX

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This paper studies the ABX.HE indices which track home equity loans.

MarkIt criteria

1. Deals from the largest 25 issuers (by sub-prime home equity issuance)
2. Issued within the last six months
3. Offering size of at least $500M;
4. At least 90% 1st lien mortgages;
5. Weighted average FICO credit score < 660;
6. Deals must pay on the 25th of the month;
7. Referenced tranches must bear interest at a floating rate benchmark of one-month LIBOR;
8. A issuance, each deal must have tranches of the required ratings with a weighted average life greater than 4 years, except the AAA which must have an average life of longer than 5 years.for inclusion.

Issuers and entities in the ABX 1/2

	Issuer	Entities
1	ACE Securities Corp. (DeutscheBank)	2005-HE7
2	Ameriquest Mortgage Securities	2005-R11
3	Argent Securities Inc.	2005-W2
4	Bear Stearns Asset Backed Securities, Inc.	2005-HE11
5	Countrywide Asset-backed Certificates	2005-BC5
6	First Franklin MTG Loan Asset Backed	2005-FF12
7	GSAMP Trust (GoldmanSachs)	2005-HE4
8	Home Equity Asset Trust (CSFB)	2005-8
9	JP Morgan Mortgage Acquisition Corp.	2005-OPT1
10	Long Beach Mortgage Loan Trust	2005-WL2

Issuers and entities in the ABX 2/2

	Issuer	Entities
11	MASTR Asset Backed Securities Trust (UBS)	2005-NC2
12	Merrill Lynch Mortgage Investors Trust	2005-AR1
13	Morgan Stanley ABS Capital	2005-HE5
14	New Century Home Equity Loan Trust	2005-4
15	Residential Asset Mortgage Prdct Ser. (RFC/GMAC)	2005-EFC4
16	Residential Asset Securities Corp. (RFC/GMAC)	2005-KS11
17	Securitized Asset Backed Receivables (Barclays)	2005-HE1
18	Soundview Home Equity Loan Trust (Greenwich)	2005-4
19	Structured Asset Investment Loan Trust (Lehman)	2005-HE3
20	Structured Asset Securities Corp. (Lehman)	2005-WF4

Observations about the issuers

Nearly every major investment bank is represented including Barclays, Goldman Sachs, JP Morgan, Merrill Lynch, Morgan Stanley and UBS.

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Non-bank financial intermediaries include GMAC.

There are also mortgage originators like Ameriquest, Countrywide, First Franklin, and New Century.

ABX rolls and tranches

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There are 5 credit tranches to each of the underlying exposures, AAA, AA, A, BBB and BBB-. Ratings are determined by the lower of the Moody's or Standard & Poor's grades.

Deal characteristics

ABX	60+	FICO	LTV	ARM	IO	Full Doc
2006-01	11.94	634	80.36	81.75	32.13	58.71
2006-02	11.94	627	77.76	80.78	22.52	56.90
2007-01	5.48	626	79.21	76.84	15.64	57.57

Source: Nomura Fixed Income Research (April 2007)

Cash flows: coupons

Index	AAA	AA	A	BBB	BBB-
ABX.HE-061	18	32	54	154	267
ABX.HE-062	11	17	44	133	242
ABX.HE-071	9	15	64	224	389

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A purchaser of default protection with the security trading at par will pay the coupon rate. To protect \$1 million in security value in the AAA tranche of the 06-1 index, you will pay $\$1,800$ per year, usually in monthly installments. For the riskier triple BBB- security from the first half of 2006, protection buyers must pay a 2.67% coupon, or $\$26,700$ per year. Note that for the high credit quality tranches, AAA and AA, coupon rates have actually fallen in the first half of 2007. For riskier BBB and BBB- securities, the coupon rates have risen to up to 389 basis points.

Cash flows: up front payments

The ABX.HE 061 AAA security has traded in a range of 100.32 and 79.97 during its life, with 100 representing par. With the index trading at a discount, purchasing credit protection becomes much more costly.

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The buyer must not only pay the coupon, but also make payments up front based on the distance from par. With the index at 79.97, a protection buyer would pay

$$\$1mn \times (100 - 79.97)\% + \$1,800 = \$202,100.$$

ABX as benchmark

While the deals have progressively lower FICO scores, and less documentation, the loan to value ratio also falls slightly to offset these risks. The characteristics clearly indicate a very clean exposure to high risk borrowers.

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While liquidity has certainly fallen off recently, the ABX indices constitute the best available aggregate indicator of subprime borrowing and are now widely used to mark to market institutional portfolios. Motivated by the new accounting rule FASB 157, banks are being prompted to mark their securities to market prices rather than models. The ABX, according to Reuters, is being used to price up to $1 trillion dollars in subprime mortgage securities.

Jump Processes

Stochastic volatility with jumps

Consider a stochastic volatility model with jumps,

$$dp_t = \mu_t dt + \sigma_t dw_{1,t} + J_t dq_t,$$

$$d\sigma_t^2 = \beta(\theta - \sigma_t^2)dt + \gamma\sqrt{\sigma_t^2}dw_{2,t},$$

where p_t is the log price of the underlying asset, μ_t is its drift, σ_t is the local volatility, $w_{1,t}$ and $w_{2,t}$ are standard Brownian motions with correlation ρ, q_t is a Poisson process with intensity λ_t, and J_t is a normally distributed jump process with mean μ_J and and standard deviation σ_J.

Quadratic variation

The *quadratic variation* for the return process is then

$$[r, r]_t = \int_{t-1}^{t} \sigma^2(s)ds + \sum_{t-1<s\leq t} J^2(s).$$

Estimation of the quadratic variation proceeds with discrete sampling from the log price process.

Realized volatility

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In the case of discontinuous price paths, Barndorff-Nielsen and Shephard (2006) show that the realized volatility will also include the jump component, and that, in the limit, realized volatility will capture the entire quadratic variation,

$$\lim_{M \longrightarrow \infty} RV_t = [r, r]_t$$

Bipower variation

To extract the integrated volatility, Barndorff-Nielsen and Shephard have also introduced the *realized bi-power variation*,

$$BV_t = \mu_1^{-2} \sum_{j=1}^{M} |r_{t,j}| \, |r_{t,j-1}|$$

where $\mu_1 = \sqrt{2/\pi}$.

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It is then possible to show

$$\lim_{M \longrightarrow \infty} BV_t = \int_{t-1}^{t} \sigma^2(s) ds.$$

Extracting the jump component

By comparing realized volatility and bipower variation we have the estimate of just the jump portion of the process,

$$\lim_{M \longrightarrow \infty} (RV_t - BV_t) = \sum_{t-1<s\leq t} J^2(s).$$

Joint distribution

We follow Bollerslev, Law and Tauchen (2007) to analyze the statistical significance of the jump risk. Barndorff-Nielsen and Shephard (2006) show that the joint distribution of RV_t and BV_t is asymptotically normal,

$$M^{1/2}\left[\int_{t-1}^{t}\sigma^4(s)ds\right]^{-1/2}\begin{pmatrix} RV_t-\int_{t-1}^{t}\sigma^2(s)ds \\ BV_t-\int_{t-1}^{t}\sigma^2(s)ds \end{pmatrix}\longrightarrow N\left(0,\begin{matrix} v_{qq} & v_{qb} \\ v_{qb} & v_{bb} \end{matrix}\right)$$

where $v_{qq}=2$, $v_{qb}=2$, and $v_{bb}=(\pi/2)^2+\pi-3$.

Tripower quarticity

Approximating this distribution requires an estimate of the *integrated quarticity* $\int_{t-1}^{t} \sigma^4(s)ds$. In computing our test statistics, we utilize a consistent estimator called the *tripower quarticity*,

$$TP_t = 2^{2/3}\frac{\Gamma(7/6)}{\Gamma(1/2)}\left(\frac{M}{M-2}\right)\sum_{j=3}^{M}\left|r_{t,j}\right|^{4/3}\left|r_{t,j-1}\right|^{4/3}\left|r_{t,j-2}\right|^{4/3}.$$

Significant jumps

Relying on the analysis of Huang and Tauchen (2005), I utilize their relative jump measure

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I assess statistical significance using

$$z_t = \frac{RJ_t}{\left[\left(v_{bb} - v_{qq}\right)\frac{1}{M}\max(1, \frac{TP_t}{BV_t^2})\right]},$$

which has a standard normal distribution as $M \longrightarrow \infty$ if $J(t) = 0$. Monte Carlo evidence in Huang and Tauchen shows that this statistic has good size and power properties in high frequency data.

Daily Return Analysis

Daily returns

I set the sampling interval to be daily changes, $M = 1$, and compute n-day rolling sample estimates of realized volatility,

$$RV_t = \sum_{k=0}^{n-1} r_{t-k}^2$$

and bipower variation,

$$BV_t = (\pi/2) \sum_{k=0}^{n-1} |r_{t-k}| \, |r_{t-k-1}| \, .$$

Daily relative jump statistic

I adapt the tripower quarticity for daily changes,

$$TP_t = [2^{2/3}\frac{\Gamma(7/6)}{\Gamma(1/2)}]^{-3}\frac{n}{n-2}\sum_{k=0}^{n-1}|r_{t-k}|^{4/3}|r_{t-k-1}|^{4/3}|r_{t-k-2}|^{4/3},$$

and construct the statistic

$$z_t = \frac{RJ_t}{\left[((\pi/2)^2+\pi-5)\frac{1}{n}\max(1,\frac{TP_t}{BV_t^2})\right]}.$$

Significant jumps

I constrain the jump risk to be positive,

$$J_t^2 = (\max[RV_t - BV_t, 0]) / n,$$

and then compute what Andersen, Bollerslev and Diebold (2006) call the *significant jumps* using an $\alpha\%$ confidence level,

$$J_{z,t}^2 = J_t^2 I(z_t > \Phi_\alpha^{-1}),$$

where Φ is the cumulative normal distribution.

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Empiricists typically find "too many" jumps in intradaily data which they compensate for by adjusting α.

Monte Carlo: DGP

- Drift: $\mu(t) = 0$
- Volatility mean reversion: $\beta = 0.10$
- Volatility of volatility $\gamma = 0.05$.
- Jump frequency $\lambda dt = 0.05dt$.
- Average jump size $\mu_J = 0.20$ with a standard deviation of $\sigma_J = 1.40$.
- The return and volatility shocks have a correlation of $\rho = -0.5$.

Implications for relative jumps

Tauchen and Zhou (2007) note that as you raise the long run mean of volatility θ, you lower the jump contribution to the total variance. At $\theta = 0.9$, the jump contributes only 10%, but at $\theta = 0.025$, the jump contribution rises to 76%. I also consider an intermediate case with $\theta = 0.2$ where the jump contributes 33%.

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I use 400 days of simulated 1-minute data which are sampled at 5-minute and daily intervals. For the daily estimator, I set the moving average to $n = 50$. The tick frequency and sample length approximate those of the ABX sample.

Size

		5-min		Daily	
θ	RJ	5%	1%	5%	1%
0.9	0.00	0.292	0.058	0.000	0.000
		(0.51)	(0.23)	(0.00)	(0.00)
0.2	0.00	0.870	0.200	0.000	0.000
		(0.97)	(0.43)	(0.00)	(0.00)
0.025	0.00	0.328	0.052	0.000	0.000
		(0.57)	(0.23)	(0.00)	(0.00)

Power 5-min

			5-min			
θ	$E[J^2]$	$E[RJ]$	J^2	RJ	5%	1%
0.9	0.1	0.10	0.086	0.087	64.311%	53.414%
			(0.03)	(0.03)	(13.61)%	(12.34)%
0.2	0.1	0.33	0.085	0.284	75.814%	69.932%
			(0.04)	(0.08)	(11.27)%	(10.12)%
0.025	0.1	0.76	0.092	0.746	84.427%	82.400%
			(0.04)	(0.08)	(9.10)%	(8.97)%

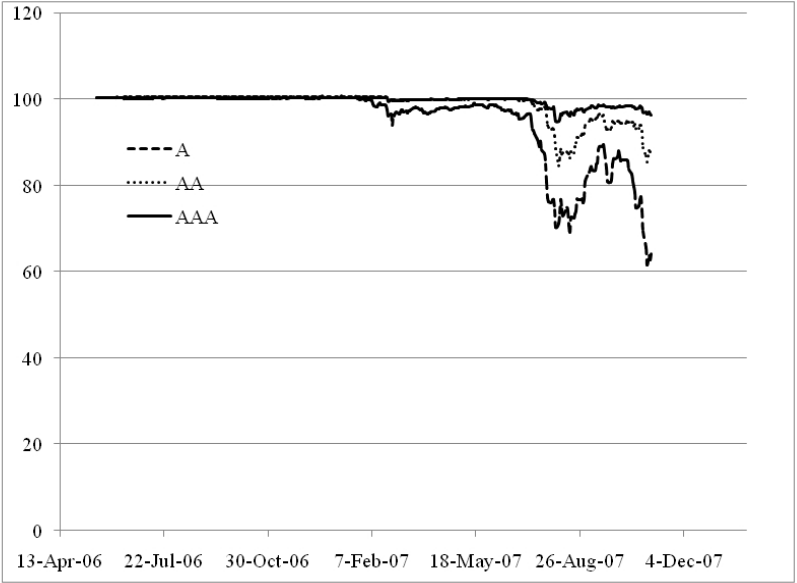
Power Daily

			Daily			
θ	$E[J^2]$	$E[RJ]$	J^2	RJ	5%	1%
0.9	0.1	0.10	0.054	0.053	7.285%	2.726%
			(0.03)	(0.03)	(10.13)%	(6.13)%
0.2	0.1	0.33	0.053	0.169	36.817%	25.420%
			(0.03)	(0.08)	(19.47)%	(18.21)%
0.025	0.1	0.76	0.078	0.598	84.662%	79.917%
			(0.04)	(0.10)	(12.16)%	(14.37)%

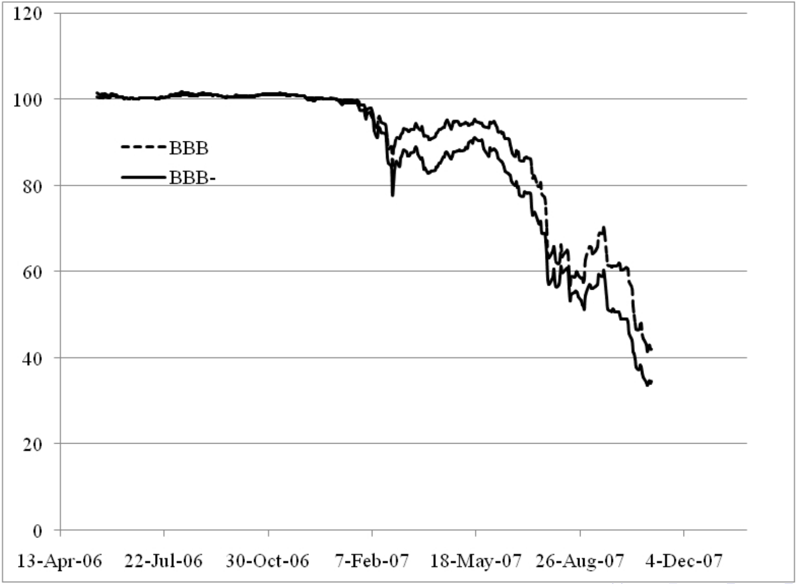
When the jump contributes only 10%, the power is quite weak.

ABX Daily Jump Risk Estimates

ABX prices 2006-1 A tranches



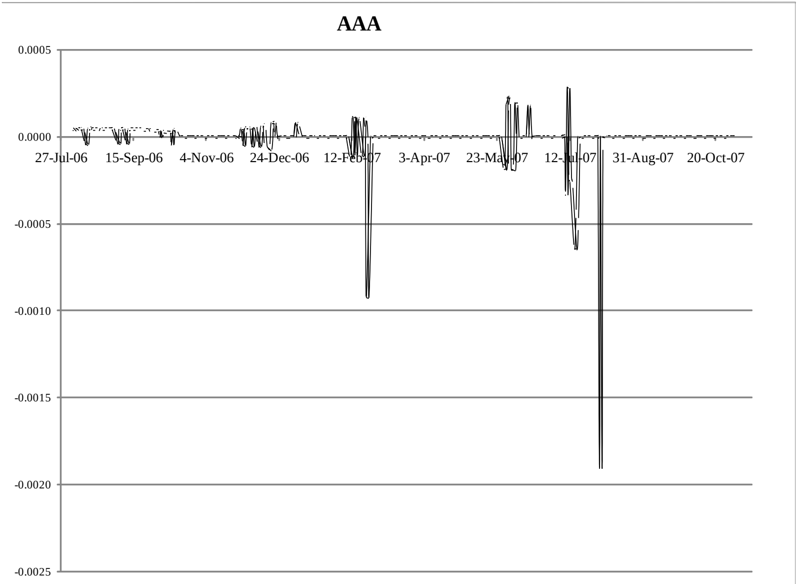
ABX prices 2006-1 B tranches



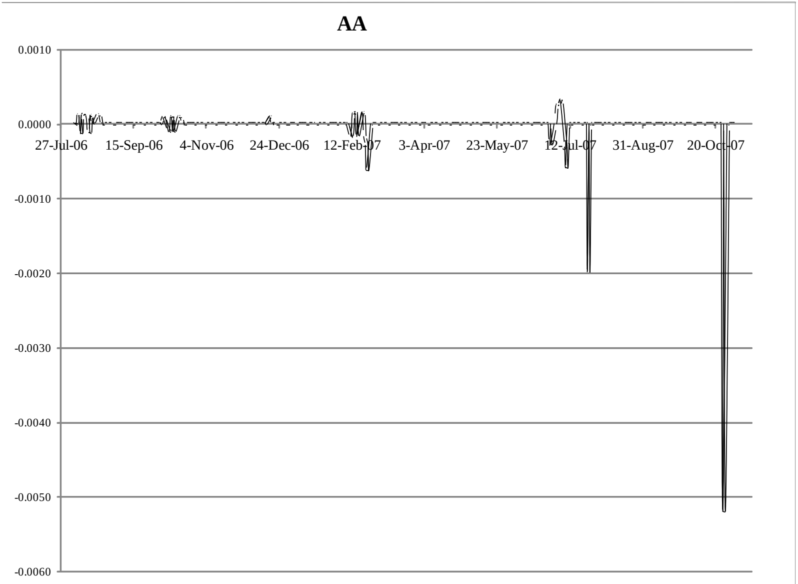
Jump risk parameter estimates 2006-1

	RJ				
ABX-061	Avg.	Max	μ_J^*	N^*	λ^*
AAA	0.2381	0.8117	-0.0000	91	0.2880
AA	0.0991	0.5561	-0.0018	38	0.1203
A	0.0910	0.6725	-0.0001	59	0.1867
BBB	0.0487	0.3823	-0.0001	11	0.0348
BBB-	0.0852	0.4303	-0.0012	26	0.0823

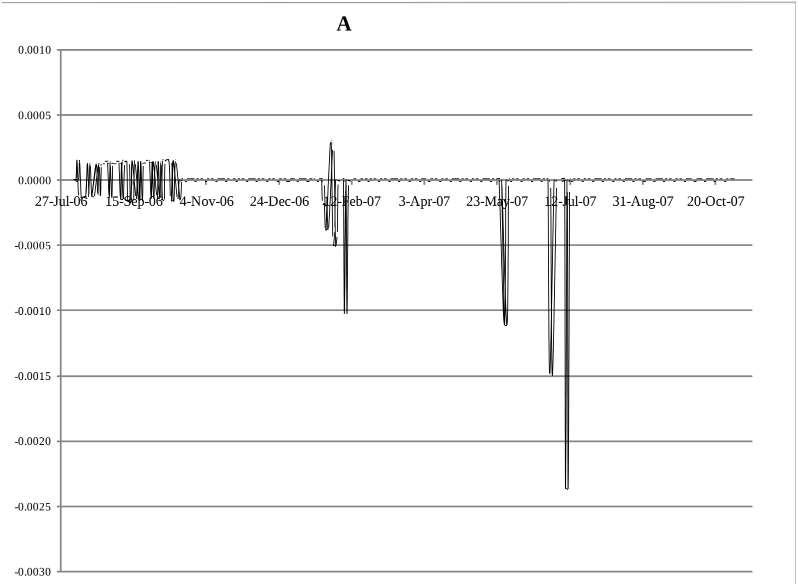
Jump risk 2006-1 AAA



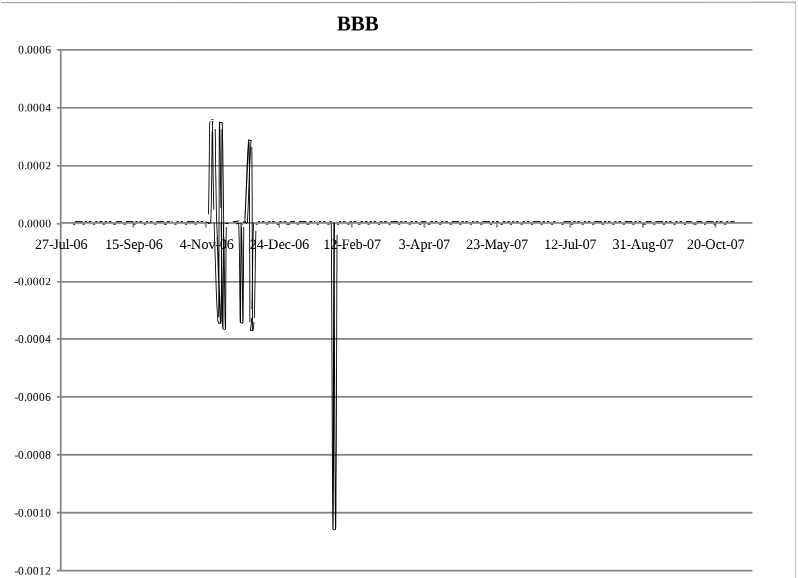
Jump risk 2006-1 AA



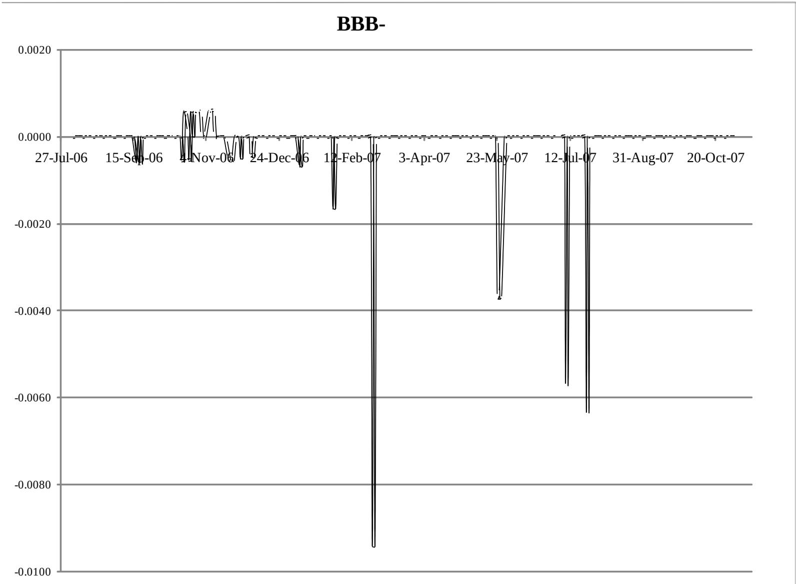
Jump risk 2006-1 A



Jump risk 2006-1 BBB



Jump risk 2006-1 BBB-



Linking Jump Risk to the Headlines

Early warnings

Edward Gramlich in testimonry before the House Committee on Banking and Financial Services on May 24, 2000: "Most predatory lending seems to occur in the subprime mortgage market, a market that has grown recently. In this market, the premiums paid by borrowers typically range from about 1 percentage point to about 6 percentage points over the rate charged for prime mortgage loans, depending on the credit risk involved."

Subprime comes onto the radar

The Wall Street Journal noted in January 8, 2008, that in the newspaper, there were 75 mentions of the word subprime in the second half of 2006. In the second half of 2007, there were $1,561$. The question before us here is whether jump risk did any better anticipating it.

News timelines

I utilize three time lines that have been published since the subprime crisis hit. (1) BBC; (2) JEC; (3) PIMCO;

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I gathered news stories from the three timelines about (1) Federal Reserve actions; (2) Materials news from subprime lenders like Countrywide and investment banks like Merrill Lynch; (3) I excluded macroeconomic news unless it appeared on at least 2 of 3 timelines. The stories caught by these filters are listed in Table 6.

Measuring news flow

I consider two measures of news. The first is simply the message count which I denote $\#M_t$. This variable counts stories that appeared in any of the three timelines on a given event day. For example, on August 9, 2007, there was; (1) a coordinated intervention by ECB, Fed and Bank of Japan; (2) the French bank BNP Paribas suspended redemption in three hedge funds; and (3) AIG warned that defaults were spreading beyond subprime. This would set the count variable to 3. There are several other days with three stories including June 14, 2007 and August 13, 2007.

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My second measure was one of intensity. If a story appeared in all three timelines, this variable, which I denote $\#nM_t$, would be set to 3. For example, the Bear Stearns' announcement on August 18, 2007 that it would be returning little or nothing to investors in two of its' mortgage backed hedge funds appears in the BBC, JEC and PIMCO timelines, so $\#nM_t = 3$. If there are multiple stories for a given day, the story that appears the most determines the counter for this variable.

Triple XXX news flow

Date	News	BBC	JEC	PIMCO
20070402	New Century files for bankruptcy	X	X	X
20070622	Bear Stearns $3.2bn hedge fund bail out	X	X	X
20070718	Bear: investors will get little money back	X	X	X
20070816	CFC draws entire 11.5bn credit line	X	X	X
20070817	Fed cuts discount rate by 50 basis points	X	X	X
20071031	Fed delivers second rate cut	X	X	X

News flow regressions

To smooth over possible difficulties in timing with stories being released in Europe and the U.S. and the possibility that action might take effect with some lag, I construct a 5-day sum of both variables,

$$D_{1,t} = \sum_{j=1}^{5} \# M_{t+1-j},\ D_{2,t} = \sum_{j=1}^{5} \# M_{t+1-j}$$

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I then regress the statistically significant jumps at time t on the lagged values of the two moving sums,

$$J^{*}_{t,z} = b_0 + b_1 D_{i,t-1},\ i = 1, 2.$$

Regressions results for all 5 credit quality tranches for the 2006-1 roll are in Table 9.

News explains jump risk

News explains the jumps best in the AAA and BBB- tranches. The best fit is with the D_2 variable for the AAA, where news explains 56% of the jump risk. For the BBB-, the same variable explains nearly 53%.

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In the middle tranches, the fits are respectable to poor. For the A and AA, news explains between 9% and 23% of the jumps. The BBB tranche, which has only 11 jumps, is uncorrelated with the news flow.

Housing Futures

CME residential real estate futures

In May 2006, the Chicago Mercantile exchange began trading futures on the CSI indices for 10 metropolitan areas: Boston; Chicago; Denver; Las Vegas; Los Angeles; Miami; New York; San Diego; San Francisco; and Washington, D.C. There are also options on the futures.

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The contracts trade at \$250 per index point and are cash settled. For example on January 25, 2008, the February 26, 2008 expiry of the composite index closed at 203. The November 2010 expiry was trading at 178.80. If the February 2008 contract were to fall to the November 2010 level, an investor who was long the contract would lose

$$\$250 \times (178.80 - 203.00) = -\$6,050.00.$$

. The contracts trade in ticks of 0.20.

Daily jump risk estimates

	RJ				
Contract	Avg.	Max	μ_J^*	N^*	λ^*
f^1	0.4071	1.0000	0.0013	212	0.6709
f^{12}	0.4617	1.0000	0.0012	221	0.6994

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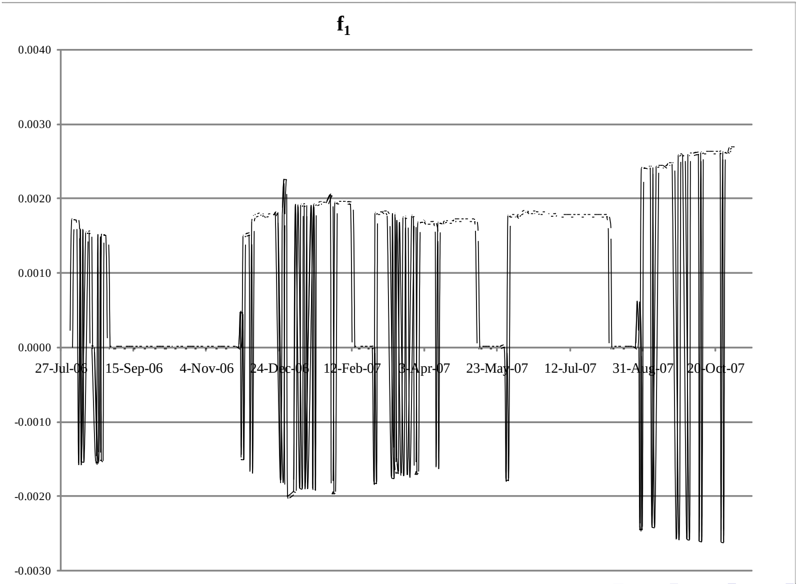
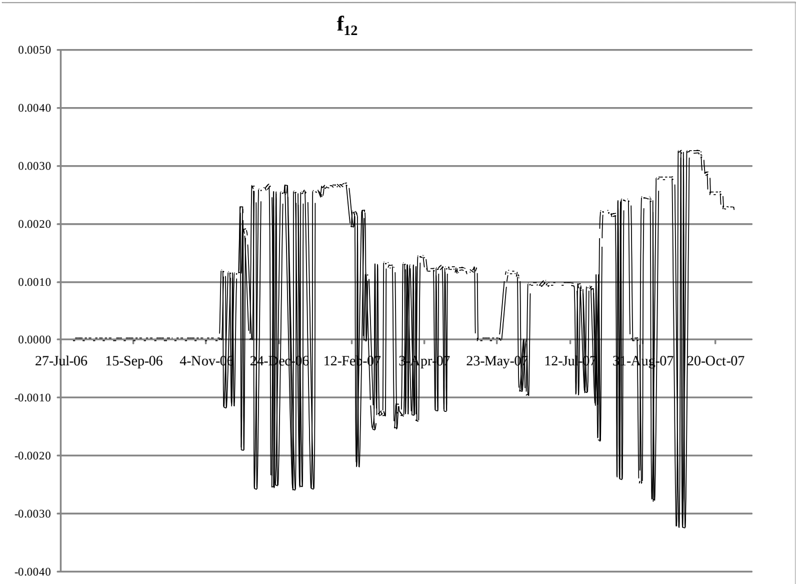
I report estimates of the jump contribution to total variation and the number of statistically significant jumps in Table 10. Jumps are, on average small, but they contribute 40.7% of the total return variation in the 1-month futures and 46.2% in the 12-month. Both series jump over 200 times, with the probability of a jump occurring around 2/3.

Jump risk in near-month contract



Jump risk in 12-month expiry



Smaller impact of news

Contract	$D_{1,t-1}$	$D_{2,t-1}$	Stat.
f^1	1.5669	1.3200	Coeff
	(-2.57)	(-2.07)	(t-stat)
	0.0259	0.0153	$\overline{R}^2$
f^{12}	0.2271	-0.1547	Coeff
	(-0.36)	(-0.27)	(t-stat)
	-0.0040	-0.0042	$\overline{R}^2$

Cojumps

Jumps in multiple markets

Bollerslev, Law and Tauchen (BLT, 2007) have proposed a measure of the cross correlation of markets to look at jumps occurring simultaneously in more than one market, called *cojumps*. I restrict the analysis here to the contemporaneous daily correlation,

$$cp_t = \sum_{k=0}^{n-1} r_{1,t-k} r_{2,t-k},$$

where $r_{1,t}$ and $r_{2,t}$ are the returns in markets 1 and 2.

Studentized statistic

There is, as of this writing, no formal asymptotic theory for cojumps, so I follow BLT and use the studentized statistic,

$$z_{cp,t} = \frac{cp_t - \overline{cp}}{s_{cp}},$$

where

$$\overline{cp} = \frac{1}{T} \sum_{t=1}^{T} cp_t,$$

and

$$s_{cp} = \left[\frac{1}{T-1} \sum_{t=1}^{T} (cp_t - \overline{cp})^2 \right]^{1/2}.$$

I will designate the significant cojumps as

$$cp_{t,z}^{*} = sign(r_{1,t} r_{2,t}) \times cp_t I(|z_t| > \Phi_{\alpha}^{-1}).$$

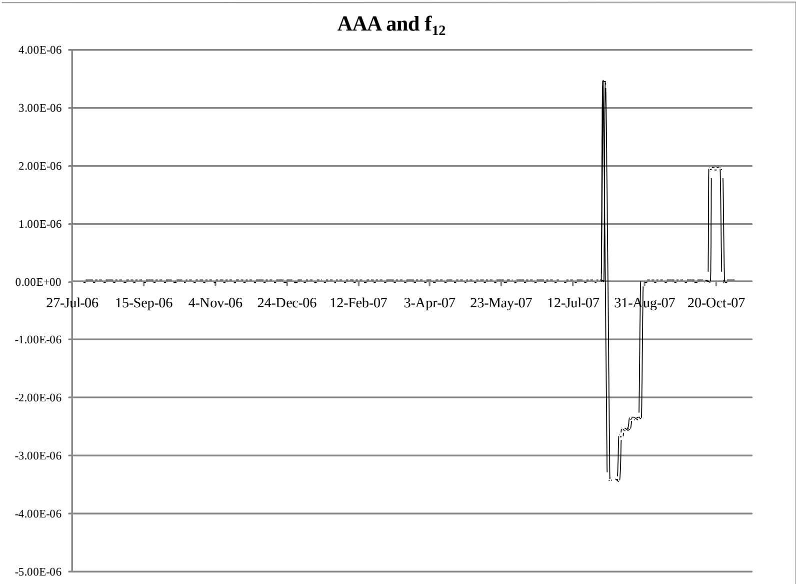
I use the absolute value because the cojump test is two-sided. I explore the finite sample performance in the next section.

Cojump power simulation

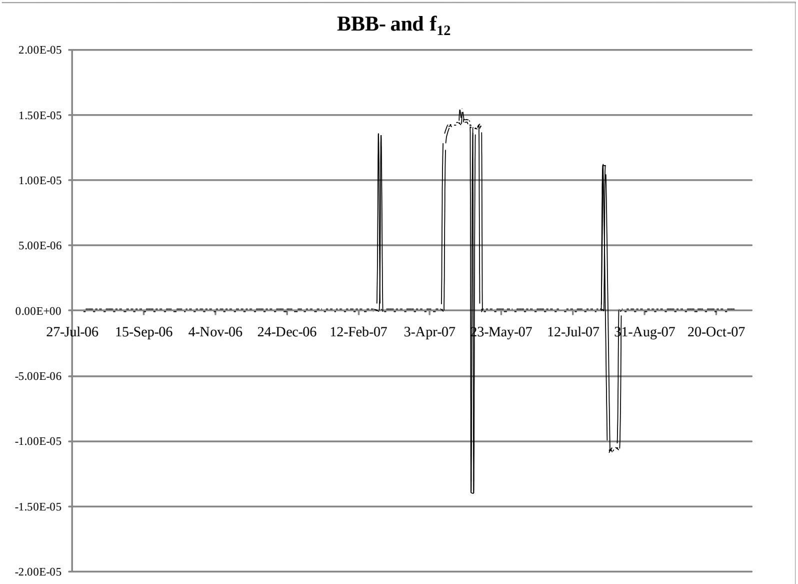
	$\theta = 0.1$		$\theta = 0.5$	
ρ_J	5%	1%	5%	1%
0.50	92.532%	90.442%	90.103%	88.502%
	(19.68)%	(23.25)%	(22.73)%	(25.13)%
0.75	88.810%	87.088%	87.710%	86.118%
	(17.99)%	(19.54)%	(20.15)%	(21.24)%

At $\rho_J = 0.5$. The test is quite powerful and seems unaffected by the jump contribution to the variance. We reject between 90 and 92.5% at the 5% significance level. As we increase the number of cojumps by setting $\rho_J = 0.75$, the detection rate falls off just a little, to 87.7% at the 5% level for the case $\theta = 0.5$

Cojump estimates AAA



Cojump estimates BBB-



Cojump news regressions

Tranche	$D_{1,t-1}$	$D_{2,t-1}$	Stat.
AAA	-4.0632	-3.1544	Coeff
	-(4.42)	-(3.99)	(t-stat)
	0.4263	0.3736	$\overline{R}^2$
BBB-	-0.4364	-0.3558	Coeff
	-(1.55)	-(2.33)	(t-stat)
	0.0549	0.1553	$\overline{R}^2$

Discussion of cojump risk

There are 25 significant cojumps in the AAA tranche/12-month futures pair. All of these episodes occur in the summer of 2007 once the subprime crisis was well under way. There is a significant negative period in August 2007 followed by a shorter positive episode in mid-to-late October.

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I identify 27 significant cojumps in the BBB- pairing. There is a strong positive spike on February 27, 2007 which is the day that jump risk spikes in the BBB- ABX tranche. There are some positive moves in the ABX index in late May and early June 2007. Cojump risk is negative again in the first part of August. The BBB- remains insignificant for the rest of the sample after August 13.

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News does appear to explain much of the cojumps risk for the AAA tranche. Both news dummies are highly significant and the $\overline{R}^2$ reaches 0.43. The story is less clear with the BBB- where only the D_2 dummy is significant and news explains, at most, 15% of the risk.

Predictive model of jump risk

To capture jump risk persistence, I will include lagged jumps $J^*_{1,t-1,z}$ in the empirical model. Extreme events are modeled using lagged squared values of the ABX jumps, $J^{2*}_{1,t-1,z}$.

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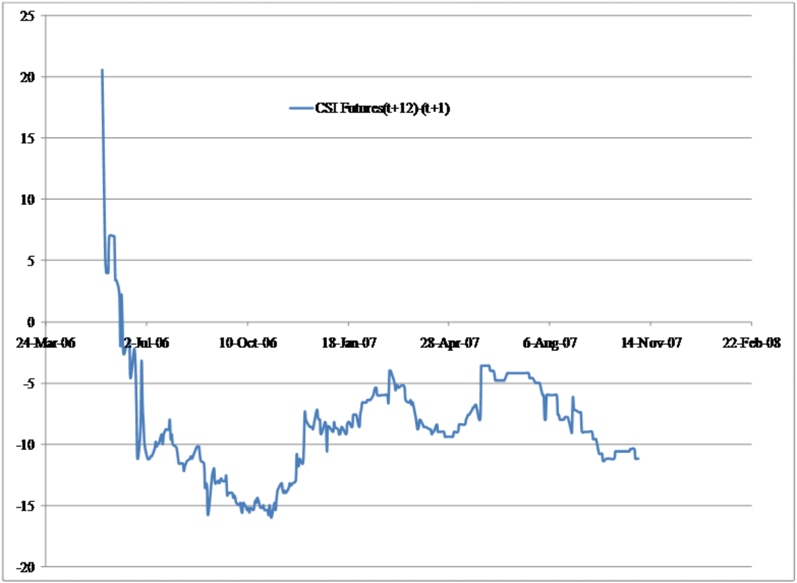
Finally, there may be risks to the ABX index from changes in home prices in the near future. I include the slope of the housing futures curve $(f^{12}_{t-1} - f^{1}_{t-1})$ as the final explanatory variable.

$$J^*_{1,t,z} = b_0 + b_1 J^*_{1,t-1,z} + b_2 J^{2*}_{1,t-1,z} + b_3 J^*_{2,t-1,z} + b_4 (f^{12}_{t-1} - f^{1}_{t-1}),$$

Futures futures curve



Empirical model estimates

Tranche	Constant	$J^*_{1,z,t-1}$	$J^{2*}_{1,z,t-1}$	$J^*_{2,z,t-1}$	$(f^{12}_{t-1} - f^1_{t-1})$	$\overline{R}^2$
AAA	-0.2446	0.1112	-441.6708	0.0508	-0.0199	0.0756
	-(2.41)	(0.34)	-(0.54)	(2.13)	-(2.29)	
AA	-0.2476	0.6340	-468.7428	-0.0142	-0.0214	0.8483
	-(1.28)	(1.52)	-(13.40)	-(0.20)	-(1.27)	
A	-0.8450	-0.2187	-1,156.9378	0.0363	-0.0670	0.5884
	-(2.99)	-(0.95)	-(4.87)	(0.61)	-(3.14)	
BBB	-1.1830	-0.0927	-1,595.0460	-0.0267	-0.1030	0.3103
	-(0.94)	-(0.16)	-(0.88)	-(0.15)	-(1.20)	
BBB-	-9.9029	-0.1508	57.5454	1.0907	-0.6873	0.8393
	-(9.91)	-(0.56)	(1.21)	(4.27)	-(9.42)	

Discussion of model estimates 1/2

The model fits the data quite well, explaining 31% to 85% of the jumps.

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b_1, the coefficient on lagged jumps, is statistically insignificant in each specification, but the lagged squared jump risk, b_2, is significant for the AA and A tranches. The extreme jumps appear to be climatic for the market and lower the jump risk the next day, $b_2 < 0$.

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Jump risk from the housing futures appears to matter only for the highest and lowest rated tranches, and it tends to increase the jump size, $b_3 > 0$.

Discussion of model estimates 2/2

The slope of the housing futures yield curve matters for jumps in 3 of the 5 tranches. A steeply sloping yield curve like we had in the housing bubble contributes to negative jumps, $b_4 < 0$.

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Consider May 19, 2006, the 1-month composite futures price was at 235.20 and the 12-month ahead price was 255.80. This spread of 20.60 leads to an expected jump of -1.42% in the BBB- tranche.

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A possibly hopeful sign is that the inversion of the futures curve since June 19, 2006 makes jumps *up* more likely.

Will the Crisis Spread?

Market losers

The mortgage originators have experienced large declines in shareholder equity, with Countrywide and First Franklin experiencing declines in their stock prices of -78.7% and -32.2% in 2007. New Century, a California based lender specializing in the subprime market, declared bankruptcy on April 1, 2007.

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Lehman Brothers may soon follow Bear Stearns? Lehman's share price has fallen below the Bear takover price of \$10.

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John Paulson's Credit Opportunities hedge fund returned 589.9% in 2007 betting on a decline in subprime mortgages, generating Paulson \$3.7*bn*.

Subprime issuance drops off

With the recent turmoil in the credit markets, particularly in home equity, MarkIt was unable to constitute an index for 2008. On December 19, 2007, they released a statement that they would postpone the launch of HE 08-1: "Under current index rules, only five deals qualified for inclusion in the MarkIt ABX.HE 08-1. MarkIt and the dealer community considered amending the index rules to include deals which failed to qualify initially but decided against this approach at this time."

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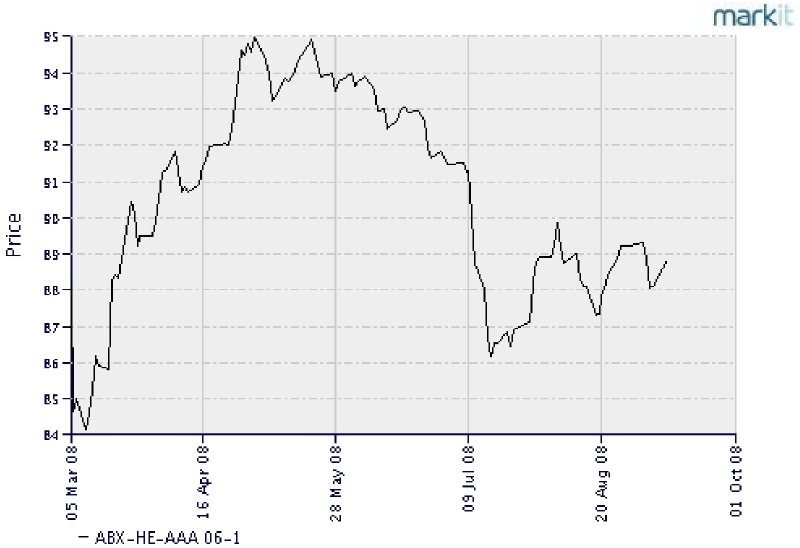
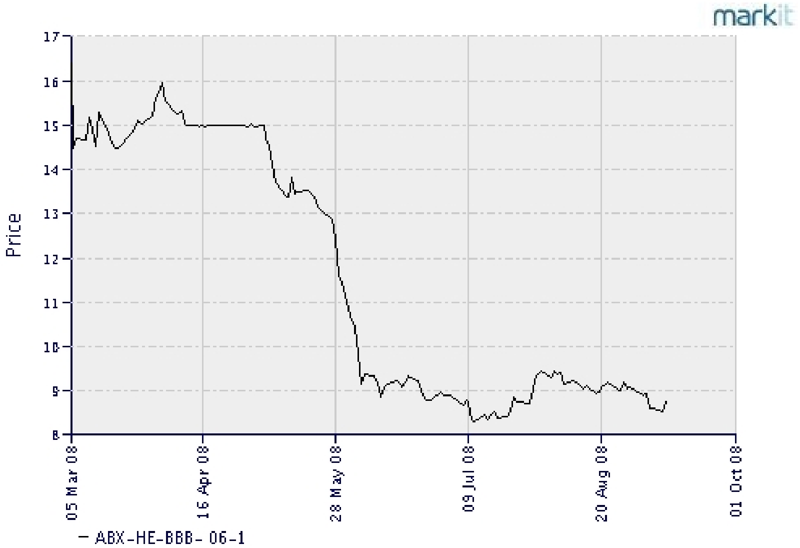
According to Inside Mortgage Finance, only $10 billion of subprime loans were issued in the 2008Q1.

The ABX rallies and falters - AAA tranches

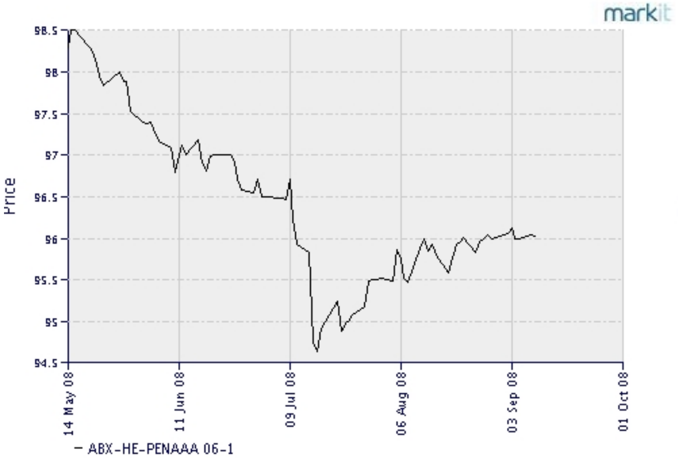


ABX BBB- No Rally



Penultimate AAA ABX

On May 14, 2008, MarkIt introduced the "penultimate ABX," a new more senior slice of the AAA tranche for the 07-2 roll. It currently trades about 15% above the AAA.



Foreclosures spread beyond subprime

Mortgage Bankers Association Report 2008Q2: "Subprime ARM loans accounted for 36 percent of all foreclosures started and prime ARMs, which include option ARMs, represented 23 percent. However, the increase in prime ARMs foreclosure starts was greater than the combined increase in fixed-rate and ARM subprime loans. Thus the foreclosure start numbers will likely be increasingly dominated increasingly by *prime ARM loans*."

Fannie and Freddie

On September 7, 2008, the federal government took control of the two GSEs.

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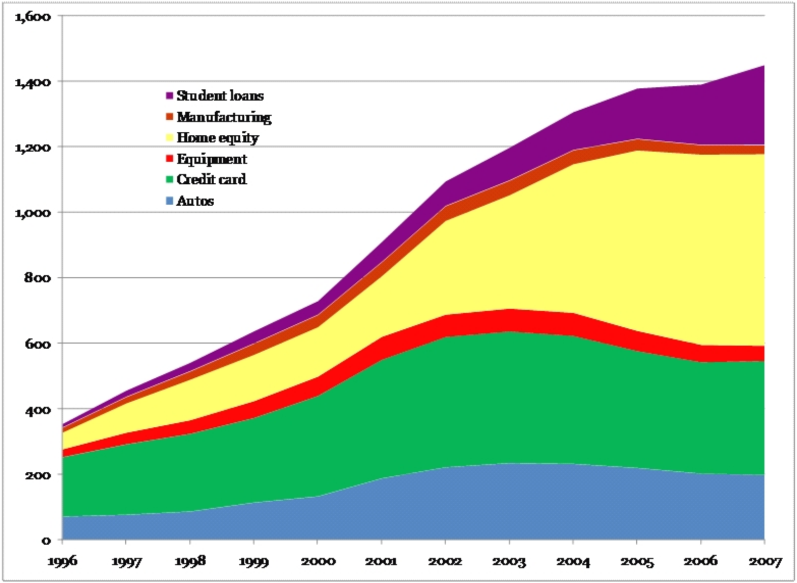
In July 2008, the Congressional Budget Office gave a rough estimate of $25 billion. Other estimates run as a high as $200 billion (still smaller in real terms than the S&L bailout).

Asset backed securities outstanding



ABS outstanding

	Automobile Loans	Credit Card Receivables	Home Equity Loans	Student Loans
1996	71.4	180.7	51.6	10.1
1997	77.0	214.5	90.2	18.3
1998	86.9	236.7	124.2	25.0
1999	114.1	257.9	141.9	36.4
2000	133.1	306.3	151.5	41.1
2001	187.9	361.9	185.1	60.2
2002	221.7	397.9	286.5	74.4
2003	234.5	401.9	346.0	99.2
2004	232.1	390.7	454.0	115.2
2005	219.7	356.7	551.1	153.2
2006	202.4	339.9	581.2	183.6
2007	198.5	347.8	585.6	243.9

Asset backed issuance

ABS ISSUANCE[1]

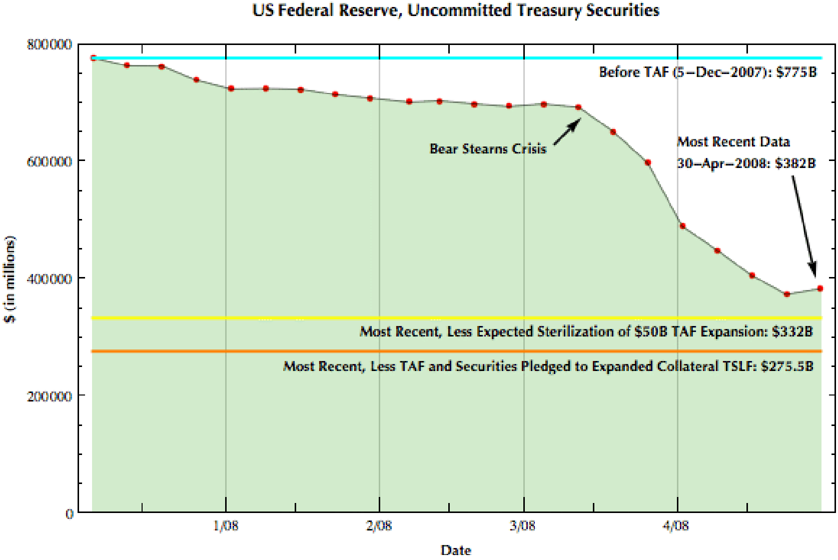
$ Billions

	2007	2008	% Change
Home Equity	222	63	-71.7
Credit Cards	95	90	-4.9
Auto Loans	67	75	11.3
Student Loans	61	55	-10.4
Other	61	42	-31.3
Total	507	325	-35.9

[1] Excludes CDOs and Mortgages
Source: Thomson Financial

Source: SIFMA Market Outlook (2008).

Fed lending


US Federal Reserve, Uncommitted Treasury Securities
800000
600000
400000
200000
0
$ (in millions)
Before TAF (5–Dec–2007): $775B
Bear Stearns Crisis
Most Recent Data
30–Apr–2008: $382B
Most Recent, Less Expected Sterilization of $50B TAF Expansion: $332B
Most Recent, Less TAF and Securities Pledged to Expanded Collateral TSLF: $275.5B
1/08
2/08
3/08
4/08
Date