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The Credit Crisis as a Problem in the Sociology of Knowledge¹

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Abstract This article analyzes the role played in the credit crisis of the processes by which different groups of market participants produce knowledge about financial instruments. Employing documentary sources and a set of 87 predominantly oral-history interviews, the article presents a historical sociology of the clusters of evaluation practices surrounding ABSs (asset-backed securities, most importantly mortgage-backed securities) and CDOs (collateralized debt obligations). Despite the close structural similarity between ABSs and CDOs, these practices came to differ substantially, and became the province (e.g. in the rating agencies) of organizationally separate groups. In consequence, when ABS CDOs (CDOs in which the underlying assets are ABSs) emerged, they were evaluated in two separate stages. This created a fatally attractive arbitrage opportunity, large-scale exploitation of which sidelined a previously important set of gatekeepers (risk-sensitive investors in

¹ I am extremely grateful to my interviewees, without whose generosity with their time and insights this article could not have been written. Several also provided helpful comments on early drafts, as did Patrick Aspers, David Bloor, Michel Callon, Neil Fligstein, Iain Hardie, Gavin Kretschmar, Horacio Ortiz, Martha Poon, Arthur Stinchcombe, and five anonymous *AJS* referees. As always, however, responsibility for errors remains mine alone. The research reported here was supported primarily by a grant (RES-062-23-1958) from the UK Economic and Social Research Council (ESRC), although funding for earlier relevant fieldwork also came from another ESRC grant (RES-051-27-0062), from the UK Engineering and Physical Sciences Research Council (EP/E001297/1), and from the Strategic Research Support Fund of the University of Edinburgh's School of Social and Political Science.

the lower tranches of mortgage-backed securities) and eventually magnified and concentrated the banking system's calamitous mortgage-related losses.

Introduction

At the heart of the credit crisis that erupted in summer 2007 and culminated in the near-collapse of the global banking system in the fall of 2008 were complex, esoteric financial instruments. At the peak of the crisis, in October 2008, the IMF categorized the estimated \$1.4 trillion losses that, were it not for massive international government intervention, would most likely have caused an economic catastrophe on the scale of the Great Depression. More than half the total, \$770 billion, was in mortgage-backed securities and asset-backed securities (ABSs) of other kinds, and collateralized debt obligations (CDOs).² The largest single category of loss, \$290 billion, was in a class of instruments of which many outside the financial sector had simply been unaware prior to the crisis: ABS CDOs, in other words collateralized debt obligations whose underlying assets are tranches of asset-backed securities, most commonly mortgage-backed securities (IMF 2008, table 1.1, p. 9).

Not only were the sums lost on ABS CDOs very large, but (as discussed in this article's fifth section) the losses were concentrated at the very core of the global financial system. ABS CDOs also had wider effects. The "assembly lines" via which they were constructed reshaped the underlying market for mortgage-backed securities in ways that facilitated ever-looser mortgage underwriting. Those losses and these

² ABSs and CDOs will be explained in more detail in the second and third sections of this article. For now, it is adequate to think of them as sets of claims on the cash flow from a pool of underlying assets such as mortgages (in the case of ABSs) or corporate debt (in "corporate" CDOs.)

processes were by no means the only causes of the credit crisis, but to understand it fully we need to understand ABS CDOs, to grasp how they emerged from the world of mortgage-backed securities and the (cognitively quite different and organizationally largely separate) world of CDOs, and above all develop a sociological analysis of how these complex financial instruments were evaluated by market participants. For example, differences between how market participants evaluated ABSs and evaluated CDOs, and the location of those evaluations in different groups or departments of credit rating agencies and banks, had a double effect. In a situation in which investment behavior was largely governed by credit ratings, they made the construction of ABS CDOs highly profitable. Simultaneously, however, they left the ABS CDO a kind of epistemic orphan, cognitively peripheral to both its parent worlds, ABSs and corporate CDOs.

In its emphasis on evaluation,³ this article contributes to a growing body of work in economic sociology that shows the importance and richness of what Beckert (2009, pp. 253-54) calls “the value problem,” in other words “the processes of classification and commensuration with which actors assign value to goods.” As Carruthers and Stinchcombe (1999, p. 353) point out, “buyers and sellers” need “to know the commodities they transact in,” and the ease with which those commodities are bought and sold is, therefore, “among other things, an issue in the sociology of knowledge.”

³ I write “evaluation,” not “valuation,” because I want to encompass practices such as credit rating that contribute to knowledge of economic value but do not themselves generate a monetary valuation.

Carruthers and Stinchcombe focus on a particular set of knowledge-generating arrangements, to be found for example in the trading of the shares of large corporations, that one might call the “canonical mechanism.” It involves the standardization of the financial claims or other commodities being traded, continuous auctions coordinated either by an exchange or by dealers who act as “market makers,” and wide dissemination of the resultant prices.⁴ These arrangements are, as Carruthers and Stinchcombe show, powerful generators of public knowledge, but they are also limited in their scope, even in their primary domain, the financial markets. The ABS and CDO tranches discussed here were not, in general, traded in canonical-mechanism markets. They were usually bought directly from those who had constructed them, who frequently were dealers based at major international banks, and in many cases then simply retained by the purchasers. Secondary trading of them was on a limited scale, and was always “over-the-counter” (conducted by direct institution-to-institution negotiation) rather than on an organized exchange. Even in the limited cases in which some of these instruments were made sufficiently standard that canonical-mechanism trading was possible, there was an undercurrent of dissent, touched on in the penultimate section below, about whether the publicly-quoted prices of them were fully reliable and legitimate.

In consequence, this is a case in which the analysis of the “social processes behind the constitution of value” (Beckert 2009, p. 254) needs to look beyond the canonical mechanism. There is a substantial body of work by economic sociologists

⁴ On market-making, see Abolafia (1996); on the way auctions can produce legitimacy and shared knowledge of value, see Smith (1989); on the varying “quality” of prices, see Muniesa (2007). The “efficient market hypothesis” of financial economics (Fama 1970) is, in effect, the hypothesis that the price of a financial instrument in a canonical-mechanism market is the best guide to its value.

on these processes, mainly concerning contexts outside the financial markets and often – though not always – goods and services that are “singular” (Karpik 2010): not straightforwardly commensurable. The situations on which this literature has focused include: those in which the legitimacy of a product or of monetary valuation is contested (see, e.g., Zelizer 1979 on life insurance and Zelizer 1994 on children); where incommensurable forms of evaluation or “orders of worth” contend (Boltanski and Thévenot 2006, Stark 2009); perceptions of value interact with aesthetic judgments (e.g., Velthuis 2005 and Aspers 2005); the quality of a product is inferred from the status of its producer (e.g., Podolny 1993, 2005; see Aspers 2009); or the value of a commodity to one buyer depends directly on anticipation of its value to other buyers (as in the case of dot.com stocks or houses bought in the anticipation of selling them to others at a higher price).⁵

ABSs and CDOs are not valued for their aesthetic properties, and the moral legitimacy of monetary valuation of them has never been challenged. With those exceptions, however, all the phenomena listed in the previous paragraph can be found in respect to ABS and CDOs, and I return to two of them in the conclusion. However, the main way in which the evaluation of ABSs, CDOs, and ABS CDOs contributed to the crisis concerns the apparently “technical” core of evaluation. ABSs, CDOs, and

⁵ This last situation, famously formulated by Keynes (1936, p. 156), is amongst those emphasized by the “economics of convention”: see Eymard-Duvernay, Favereau, Orléan, Salais, and Thévenot (2005), and more generally Eymard-Duvernay (1989) and Favereau and Lazega (2002). Clearly the process is an important contributor to bubbles in both the stockmarket and housing market. It is, however, not at the center of my analysis because the instruments discussed were usually held for the “spread” they offered (see below), rather than purchased primarily because it was anticipated that they could be resold at a higher price.

ABS CDOs are debt instruments. They normally entitle investors (a) to defined “coupons” (interest payments), set either as a fixed percentage or as a fixed margin or “spread” over a benchmark interest rate such as Libor (London Interbank Offered Rate), and (b) to eventual repayment of principal (their initial capital investment). The monetary worth of an investment in an ABS or CDO is thus the aggregate present value of those future payments. If the payments were entirely certain, the valuation of an ABS or CDO would be a matter simply of arithmetic, but they are not. There are two main risks: default (in other words that the payments are not made, or not made in full) and prepayment (i.e. principal is repaid earlier than anticipated, in a situation in which it can be reinvested only at a lower rate of interest). This article’s focus is on whether and how those risks were taken into account in the evaluation of ABSs, CDOs, and ABS CDOs.

How might “technical” processes of evaluation of this kind be analyzed sociologically? This article draws its inspiration from studies of scientific practice. Historians and sociologists have found that practice to be far less uniform than traditional notions of a unitary “scientific method” might suggest (see, for example, Galison and Stamp 1996), and have sought to capture distinctive clusters of practice in notions such as the “local scientific cultures” of Barnes, Bloor, and Henry (1996), the “subcultures” and “competing traditions” of Galison (1997), the “experimental cultures” of Rheinberger (1997), “epistemic cultures” of Knorr Cetina (1999), “epistemological cultures” of Fox Keller (2002), and “evidential cultures” of Collins (2004).

Can similar patterned differences in evaluation practices be found in financial markets?⁶ This article suggests that they can,⁷ using as its main evidence differences between the evaluation of ABSs and of CDOs, which are structurally very similar instruments (indeed sometimes simply lumped together, as for example by McDonald and Robinson 2009). In evaluation, as in scientific practices, one can find “aggregate patterns and dynamics that are on display in expert practice and that vary in different settings of expertise ... patterns on which various actions converge and which they instantiate and dynamically extend” (Knorr Cetina 1999, pp. 8-9). Let me call these patterns “clusters of evaluation practices.” (Following the literature on science and calling them “evaluation cultures” might be taken to imply greater homogeneity and “bounded-offness” of their practitioners than is the case.⁸ It could also be taken wrongly as implying a theory of action as based solely on “belief” and “habit” – for which see Camic 1986 – rather than self-interested, reflexive rational choice. As

⁶ For an analysis of differences amongst evaluation practices in a different sphere, see Fourcade (2009).

⁷ Although the article focuses on evaluation practices relevant to the credit crisis, other sociological work on financial markets also suggests the existence of distinct clusters of practice. See, especially, the characterization of different approaches to assessing the value of stocks in Smith (1999).

⁸ The literature on science also employs a broader understanding of the “symbolic” than is sometimes found when “culture” is invoked in the wider social sciences. As Knorr-Cetina (1999, p. 11) puts it, “symbolic structurings ... come into view through the definition of entities, through systems of classification, through the ways in which epistemic strategy, empirical procedure, and social collaboration are understood in the ... fields investigated.” It should be noted, however, that symbolism in the ordinary sense is not entirely absent from the evaluation practices discussed here. In particular, AAA was a rating that had a real symbolic cachet, frequently being understood to mean effectively free of any risk of default.

discussed in the conclusion, belief and habit *were* present, but by no means exclusively so.)⁹

The research on which this article is based, which is outlined at the end of this introduction, supports six postulates about these clusters.¹⁰ First, *clusters of evaluation practices are the path-dependent outcomes of historical contingencies*.¹¹ For example, while the evaluation practices surrounding CDOs always had default risk as their primary object, those surrounding mortgage-backed securities were concerned primarily with prepayment. As the following section will show, that latter focus originally arose because of features of the political economy of mortgage lending in the US that can be traced back to the 1930s. The focus on prepayment remained in place even in the very different circumstances of the past decade: it formed a criterion on which that decade's subprime mortgage-backed securities were judged superior to their prime counterparts. In emphasizing long-lasting effects such as this, I do not want to suggest that evaluation practices never change. They do – change in them is a major focus of this article – but the way in which they change is path-dependent: it is easier, for example, to modify an existing practice than to develop an entirely new one.

⁹ Conceiving of clusters of evaluation practices as “communities of practice” (Lave and Wenger 1991) would involve a similar risk: the term might be taken to imply higher levels of interaction amongst practitioners than often was the case, especially in what appear to have been the rather fragmented practices surrounding ABSs.

¹⁰ While these postulates are presented here simply as summarizing the findings of this research, some (notably 1 and 6) are also hypotheses that could be explored elsewhere. For reasons of space, I concentrate in this article on the evidence for the first, second, third, and sixth postulates.

¹¹ On path-dependency more generally, see, e.g., Arthur (1984), David (1992), and Nunn (2009).

Second, *the more elaborate of evaluation practices give rise to, and are informed by, distinctive ontologies: distinctive presuppositions about the nature and properties of the features and processes of the economic world.* Thus the third section of the article will show that the evaluation practices surrounding CDOs came to be oriented heavily to one such feature, “credit correlation” (a term that will be explained in that section), which was a notion entirely absent, at least in any explicit form, in the evaluation of ABSs. Like many scientific objects, correlation was neither simply “real” nor simply “fictional” (Knorr Cetina 1999, pp. 248-52). It was not observable in any straightforward sense: to invoke it was to invoke the unseen. Yet, like the scientific objects analyzed by Daston (2000), it had the potential to become “more real,” as specific markets (the tradable credit indices described below) were created in which its effects were more easily traced. Indeed, some of those involved with CDOs came to hold that in those markets correlation was not just real but tradable. For others, though, the frustrating difficulties of measuring correlation indicated it was a misconception, an artifact of inadequate models.

Third, *evaluation practices become organizational routines, and when different practices are pursued in the same organization, they frequently are the province of separate parts of it.*¹² For instance, the evaluation of ABSs on the one hand and CDOs on the other typically became the responsibility of different sections of banks, of the specialist “monoline” insurers, and of credit rating agencies. In the case of the rating agencies, for example, both ABSs and CDOs fell within the remit of

¹² See also Beunza and Stark (2004), who demonstrate the spatial distribution of different evaluation practices across the different “desks” (subgroups) of the trading room they study.

their structured finance departments, but the latter had separate groups dealing with each. When ABS CDOs (which are CDOs with ABSs nested within them, so to speak) came into being, the decision as to how to evaluate them was thus also a decision about how their evaluation should be mapped onto the organizational structure of rating agencies. All the three main agencies – Moody’s, Standard & Poor’s (S&P), and Fitch – found the same solution: they relied on the existing ratings, by ABS groups, of the component ABSs, and assigned the analysis of the higher-level structure to their CDO groups. Those groups analyzed that structure largely as if it was simply another variant of a CDO, for which their existing practices were therefore appropriate, rather than treating an ABS CDO as a radically different instrument that demanded new evaluation techniques.

Fourth, *in modern debt markets* (in which I include the markets for bonds, tradable loans, and structured instruments such as ABSs and CDOs) *evaluation practices regulate actions and become means of governance via the process of credit rating*.¹³ Ratings (see figure 1) encode rating agencies’ conclusions about either the likelihood of default on debt instruments (in the case of S&P and Fitch) or, in the case of Moody’s, the expected loss on them (the likelihood of loss multiplied by its severity). For institutional investors such as banks, insurance companies, and pension funds (private individuals were never major participants in the ABS and CDO markets discussed here), ratings frequently become rules. Cantor, ap Gwilym, and Thomas (2007, p. 14) note that in the US “there are currently over 100 federal laws and 50 regulations incorporating credit ratings,” and they report that the purchases of

¹³ For all their importance, the credit rating agencies have been the object of surprisingly little social-science attention. The single best study of them is Sinclair (2005).

74 percent of their sample of US investment fund managers (and 78 percent of European managers) were subject to a minimum-rating requirement: if an instrument's rating was below the minimum, they were not allowed to buy it. Especially towards the end of the period discussed here, banking regulation in particular relied heavily on ratings, with banks able to hold much smaller capital reserves in respect to instruments with high ratings, a factor that greatly enhanced the attractiveness of the most senior tranches of the instruments discussed here.

- FIGURE ONE AROUND HERE -

Fifth, *evaluation practices crystallized in ratings reduce a difficult problem of evaluation* (assessing complex, novel financial instruments that involve potentially uncertain payments stretching years into the future) *to a simple one, by establishing a rough equivalence amongst debt instruments of different kinds and with different particularities*. Though some buyers of ABSs and CDOs had a good understanding of the detail of evaluation practices (such as the Gaussian copula models discussed below), many did not, and the market for these instruments would have been quite limited if participation in the market required that understanding. Ratings “black boxed” these complexities. They permitted the economic value of different ABSs and CDOs to be compared, both with each other and with more familiar, less complex instruments such as corporate bonds, by comparing the “spread” (increment over Libor or other benchmark interest rate) offered by a given instrument to that offered by others *with the same rating*. In consequence, as one dealer put it, “You knew that if you hit a certain spread for a given rating, that the deal was sold” (quoted in Securities Industry and Financial Markets Association 2008, p. 22). This spreads-

ratings nexus was thus a convention in the sense of the French “economics of convention”: a way of turning what might otherwise be radical uncertainty into a form of order that – while never unchanging – is stable and predictable enough to permit coordination and rational action, thus solving the wider problem of social order in markets on which Beckert (2009) and others (e.g. White 1981 and 2002) focus. A bank producing a novel instrument could anticipate the most important metric (spread for a given rating) by which it would be judged, and – by discovering the spreads offered by the instruments with the same rating that others had recently sold¹⁴ – could know the combinations of ratings and spreads that were needed for the instrument to be “competitive.” The detailed design of both ABSs and CDOs was always informed by how they would be evaluated by the rating agencies, in a clear manifestation of what Espeland and Sauder (2007) call “reactivity”: the effects of evaluation or ranking on what is being evaluated and ranked.

Sixth, *when they bear upon the same instrument, or same risk, evaluation practices that differ permit a specific form of profit-making: arbitrage.*¹⁵ At least some of the time, different practices will lead to the same instrument or same risk being valued differently. In consequence, it may be possible to sell the instrument or risk to one market participant while buying it more cheaply from another, with the difference in prices being riskless profit – in other words, arbitrage profit. Many CDOs and nearly all ABS CDOs were constructed in order to perform arbitrage, and this also became increasingly the motivation for constructing ABSs. The evaluation

¹⁴ These spreads were never fully public knowledge, but knowledge of them circulated reasonably widely amongst both constructors of ABSs and CDOs and regular buyers of them.

¹⁵ For sociological discussion of arbitrage, see e.g. Beunza and Stark (2004).

practices employed by the rating agencies had the consequence that assets that had high spreads and that were only modestly creditworthy could be packaged into instruments with high ratings, which could therefore be sold to investors at lower spreads, with the constructor of the instrument capturing most of the difference as arbitrage profit. As an interviewee put it in June 2006:

the whole [CDO] market is rating-agency-driven at some level ... the game is basically to create ... tranches of portfolios which are A, AA, or AAA-rated and yield significantly more than a correspondingly-rated tranche of a corporate or an asset-backed derivative, commercial mortgage-backed security would yield ... it's just that there are investors who are constrained by ratings ... and that creates value for everyone else and we're in the business of exploiting that.

Hence, in brief summary, the connection between the evaluation practices surrounding ABSs and CDOs and the credit crisis. Ratings-governed investors, the ratings-spreads nexus, differences in evaluation practices, and the way those practices mapped on to the organizational structures of rating agencies created arbitrage opportunities that persisted. One such opportunity was created by the *separate* evaluation of ABSs and CDOs, following different practices and (in the rating agencies) by different groups. ABS CDOs were created primarily to exploit that arbitrage, and the huge scale on which this was done was amongst the causes of the crisis. By changing the composition of the underlying market for ABSs, ABS CDOs removed previously influential gatekeepers (the traditional buyers of the lower tranches of ABSs: see Adelson and Jacob 2008a), and in so doing very likely helped clear the way for increasingly reckless mortgage lending. ABS CDOs also magnified

the resultant mortgage-related losses in the way discussed in the article's fifth section, and a specific aspect of them – their large, apparently ultra-safe, but low-spread “super-senior” tranches – fatally concentrated those losses at the heart of the global banking system.

In showing, in this way, the role of the clusters of evaluation practices surrounding ABSs and CDOs in the genesis of the credit crisis, this article is intended to complement, not contradict, existing explanations, both those that focus on macroeconomic factors¹⁶ and those offered by the emerging sociological literature on the crisis (to which the single most important contribution is the collection edited by Lounsbury and Hirsch 2010). Closest in this latter literature to this article are the analyses of mortgage securitization and the role of credit rating agencies in Carruthers (2010), Fligstein and Goldstein (2010), Pozner, Stimmler, and Hirsch (2010), and Rona-Tas and Hiss (2010), along with the discussion of credit default swaps in Morgan (2010).¹⁷ I share, for example, Fligstein and Goldstein's emphasis in the role played by government in modern US mortgage securitization and their sense – also to be found in other sociological contributions such as Guillén and Suárez (2010) and Schneiberg and Bartley (2010) – that an entirely rational-choice, agency-theoretic

¹⁶ These factors include global economic imbalances – notably the “savings glut” in countries such as China with big trade surpluses – and an extended period of low interest rates, which prompted a “search for yield”: widespread hunger for even fractionally higher interest rates (see, e.g., Turner 2009).

¹⁷ Also relevant, though they do not discuss the crisis, are the sociological discussion of the development of credit derivatives in Huault and Rainelli-Le Montagner (2009) and the excellent ethnography of ABS purchases and ABS CDO construction at a French fund management company in Ortiz (2008).

explanation of the crisis is unsatisfactory. What this article adds to this existing work is (a) extensive primary-source analysis of the practices of credit rating and other forms of evaluation; (b) an interpretation of the consequences of those evaluation practices that focuses not on fees-driven rating-agency wrongdoing and other forms of “amoral calculation” (Vaughan 1996) but on the content of those practices, on their mapping onto the organizational structures of the agencies, and on the arbitrage opportunity to which it gave rise;¹⁸ and (c) a focus, almost entirely missing in the existing sociological literature, on ABS CDOs, on the change they brought about in the structure of the ABS market, on the way in which they magnified and concentrated losses on ABSs, and on the crucial interaction between them and credit default swaps.

There are few reliable secondary sources on the history of ABSs and CDOs to draw on: the best are the insightful, archivally-based, analysis of the modern origins of US mortgage-backed securities in Quinn (2009); Tett’s (2009a) lively, interview-based account of the J.P. Morgan credit-derivatives group; and two other interview-based books (Zuckerman 2009 and Lewis 2010) focused mainly on those who successfully bet against mortgage-backed securities. The research reported here has thus involved the construction of a historical narrative largely afresh, drawing on two main sets of primary sources. The first is 87 interviews, mainly in London and New York, with 77 market participants,¹⁹ including 36 who are or were constructors,

¹⁸ Empirically determining the relative weight of amoral calculation versus other cognitive/organizational factors is very difficult. I return to this issue in the conclusion.

¹⁹ Six interviews were with two market participants, and two involved three interviewees. Three participants were interviewed three times, and 14 were interviewed twice.

managers, brokers, or traders of the financial instruments discussed in this article; 14 who are “quants” (specialists in quantitative modeling); 16 who are or have been rating-agency employees; and four who are or were market regulators.²⁰ The interviews took place in two phases, before and after the onset of the credit crisis in the early summer of 2007. The earlier phase, which consisted of 29 interviews, was a pilot study focusing on what I describe below as “corporate CDOs.” The 58 more recent interviews cover the full range of instruments discussed here.

The interviews took a loosely oral history form, in which interviewees were led through those parts of their careers in which they had been involved with the financial instruments examined here. Questioning was semi-structured, and was designed to elucidate the evolution of the relevant market and the main innovations and forms of evaluation in it (sometimes specific issues were dealt with by follow-up email questions or repeat interviews). No claim of statistical representativeness can be made: there is no list of individuals involved in the ABS or CDO markets that can be sampled, so the sample was constructed by “snowballing” from an initial set of interviewees identified via documentary sources.

Oral-history interviewing has notorious pitfalls: interviewees may have fallible memories, and may wish to promulgate particular views of episodes in which they were involved, especially in the aftermath of a disaster such as the credit crisis. The sensitivity of the topic adds other difficulties. Several banks, for example, now insist that all

²⁰ The remaining interviewees were two who provide hardware on which computationally intensive models are run, four who work for firms specializing in provision of price data, and an accountant with specialist knowledge of accounting for financial instruments.

contacts with the press (a category that currently includes research of this kind) must be through their communications department, often rendering direct interview access impossible. (Many banks face multiple lawsuits, and their fear may be that interviewing might produce information helpful to hostile litigants.) Occasionally, interviews had to be conducted in the presence of public relations staff. At other times, perhaps to avoid this kind of problem, interviewees would ask me to ring them from my mobile telephone from outside their building or in its lobby. They would then leave the building and I would interview them in a cafe or restaurant. The need for anonymity is therefore even greater than normal. In order to ensure it, I sometimes use phrases such as “a rating agency” or “a bank,” rather than naming the organization in question.

These drawbacks and difficulties of interviewing rendered a second source of primary data, contemporaneous documents, equally valuable, both in its own right and as a means of triangulation. These documents included the specialist trade press, such as *Credit* and *Creditflux* (and, for more recent years in which the ABS and CDO markets have become much more prominent, also the *Financial Times* and *Wall Street Journal*), and the technical literature on the evaluation of ABSs and CDOs, including textbooks, manuals, and the technical reports in which the credit rating agencies described the procedures and models used to rate these instruments. Of course, such documents also have their limitations as historical evidence (textbooks, for example, portray idealized versions of evaluation practices), but they are useful nonetheless. For example, Fabozzi, Bhattacharya, and Berliner’s 2007 textbook or Adelson’s informal “trip reports” after ABS conferences (e.g., Adelson 2006d) are now windows into a lost world, mortgage-backed securities before the disaster that became apparent only a few months after they were written.

Because of the need to reconstruct an often-intricate historical process in which apparently small choices had large, lasting consequences, this article is inevitably lengthy. It has six sections. After this introduction comes a section on the historical shaping of the evaluation practices surrounding securitizations of pools of residential mortgages. The third section deals with the original “corporate” CDOs, in which the underlying assets were bonds issued by corporations or loans made to them. The section shows that although they too emerged from the world of securitization, the evaluation practices of the world of “credit derivatives” that they came to inhabit differed radically. The fourth section deals with the somewhat later ABS CDOs (CDOs in which the underlying assets were ABSs, mainly mortgage-backed securities, not corporate debt), and shows how an alluring arbitrage opportunity was created by the way in which they were evaluated, particularly by how this evaluation was mapped onto the organizational structures of the rating agencies. The fifth section examines the contribution of ABS CDOs to the crisis. It discusses how ABS CDOs changed the ABS market and (via their super-senior tranches) concentrated the resultant losses, and how default swaps both magnified the crisis and – via a new canonical-mechanism market, the ABX – rendered it visible. The sixth section is the article’s conclusion.

Mortgage-Backed Securities and the Emphasis on Prepayment Risk

Mortgage lending in the US was shaped for decades by government responses to the effects of the Great Depression on the housing market. The form of mortgage prevalent prior to the 1930s – a five-to-ten year variable-interest loan, which did not fully amortize, leaving borrowers needing to make large repayments of principal at its maturity – greatly exacerbated the Depression’s effects, and at its peak “nearly 10 percent of homes were in

foreclosure” (Green and Wachter 2005, pp. 94-95). In response, the Roosevelt administration created three organizations that radically changed mortgage lending. The Home Owner’s Loan Corporation used funds raised from bond sales to buy mortgages which borrowers could not repay, and replaced them with new long-term (twenty-year maturity) fixed rate loans that amortized in full. The Federal Housing Administration (FHA) insured mortgages of this new form against default (in return for insurance premiums paid by the borrower), thus helping to restart large-scale private mortgage lending. The Federal National Mortgage Association (Fannie Mae), set up in 1938, tried to foster a secondary market in mortgages insured by the FHA, though in practice it itself and the Federal Home Loan Banks were the main purchasers (Snowden 1995, p. 262).

Deliberate government action thus brought about the dominance of what Green and Wachter (2005) call simply “the American mortgage”: its interest rate was fixed, typically at around 5 to 6 percent, even over the long-term (in 1948, the FHA started to insure thirty-year mortgages), thus protecting borrowers from interest-rate rises; and borrowers had the right to prepay (redeem) mortgages at any point, with no penalty. “The American mortgage” helped change the US “from a nation of urban renters to suburban homeowners” (Green and Wachter 2005, p. 97). However, it always had drawbacks – it was, for example, often not available to ethnic minorities (see Stuart 2003) – and providing it became ever more difficult in the 1960s, as the low-interest savings accounts that traditionally had funded it were drained by the growing availability of higher rates elsewhere.

With renewed direct government borrowing to fund mortgage lending rendered unattractive by the Johnson Administration’s growing budgetary problems (Quinn 2009),

a solution was found in selling to private investors government-backed securities based on pools of mortgages. Fannie Mae was partly privatized. Its remaining Federal sections, renamed the Government National Mortgage Association (Ginnie Mae), gave a government guarantee to securities backed by pools of mortgages, starting with Ginnie Mae Pool No. 1, issued in February 1970. In 1971, the newly-created Federal Home Loan Mortgage Corporation (Freddie Mac) started to sell securities based on pools of mortgages it had itself purchased; Fannie Mae began to do so in 1981. By 1991, Ginnie Mae had guaranteed, and Freddie Mac and Fannie Mae had issued, a total of just over a trillion dollars of mortgage-backed securities (Carron 1990; Fabozzi and Modigliani 1992, pp. 18-24; Carruthers and Stinchcombe 1999; Tower 1999).

That securitization (the packaging of income-generating assets into pools and the sale of securities that are claims on that income) began its modern history²¹ in the US as a government program, and that what were securitized were “American mortgages” – fixed-interest loans with no prepayment penalties – had lasting effects on how mortgage-backed securities were evaluated. The three government-sponsored enterprises – Ginnie Mae, Fannie Mae, and Freddie Mac – set quality criteria for the mortgages they would guarantee or buy, thus defining “conforming” or “prime” mortgages. They guaranteed investors in mortgage-backed securities against defaults on the underlying mortgages, and the full credit of the US government was seen as backing the three enterprises, so investors could treat those securities as involving no risk of default. (Only Ginnie Mae guarantees were legal obligations of the Federal government, but investors generally took the government implicitly to stand behind Fannie Mae and Freddie Mac as well.)

²¹ For earlier developments, in the US and elsewhere, see Snowden (1995), Bogue (1955), and Goetzmann and Newman (2010).

Prepayment, though, was a quite different matter. Originally, the absence in “the American mortgage” of a prepayment penalty was of no great consequence, since the costs of refinancing were considerable – fees and loan points (up-front interest payments) could amount to 2 percent of the new loan (Ranieri 1996, p. 43) – creating a *de facto* penalty. However, as competition reduced those costs, the option enjoyed by borrowers to refinance without penalty when interest rates fell became more valuable and much more frequently exercised. As one interviewee put it to me, if you held a mortgage-backed security yielding 5 ½ percent, and you noticed that new securities were offering only 4 ½ percent because interest rates had fallen, you could be certain that the mortgages underpinning the security you owned were “all going to prepay,” and you would therefore quickly stop enjoying the higher yield. While most bonds rise in price when interest rates fall (because the fixed “coupons” they offer become relatively more valuable), this effect is therefore much attenuated for mortgage-backed securities: as this interviewee told me, their price seldom rises above 110 (i.e. 10 percent more than their “par” or face value).

As Lewis Ranieri, Salomon Brothers’ famous trader of mortgage-backed securities, complained, the absence of a prepayment penalty meant that “the mortgage instrument becomes so perfect for the borrower that a large economic benefit is taken away from the other participants, including the long-term investor” (1996, p. 43). What came into being, therefore, were evaluation practices amongst investors in mortgage-backed securities that focused not on default but on prepayment risk. (Indeed, the government-sponsored enterprises transformed defaults into prepayments: if a borrower

defaulted, the enterprises paid investors in the corresponding pool of mortgages the sum they would have received if the mortgage had been prepaid at that point.)

Assessing the exact extent to which the prepayment option reduces the value of mortgage-backed securities is a notoriously difficult matter (neither interest-rate changes themselves nor their precise effects on prepayment rates are fully predictable) and assessing it was traditionally seen as *the* crucial skill in evaluating mortgage-backed securities. Prepayment was, for example, the primary risk that Ranieri and the other Salomon Brothers' traders of these securities described in Lewis's *Liar's Poker* (1990) were slicing, dicing, buying, and selling, and it was for their excellent grasp of prepayment risk that the Salomon Brothers' modelers who helped form the famous hedge fund Long-Term Capital Management were known. Prepayment "was a dominant issue," an interviewee told me: "it drove everything in what people would think about."

Government-sponsored mortgage securitization had, however, been successful despite the prepayment problem, which made it an attractive model for banks and finance companies seeking new ways of funding their lending. In 1977, the first modern "private label" (not government-sponsored) US mortgage-backed securities were issued by the Bank of America, in collaboration with Salomon – an event that prompted Ranieri to coin the term "securitization" (see Ranieri 1996, p. 31) – and from 1985 onwards banks also began securitizing auto loans, truck loans, equipment leases, and credit-card receivables (Rosenthal and Ocampo 1988, table B.1). The generic term "ABS" (asset-backed security) came into use to describe the products of these and other securitizations.²²

²² Usage of the term "ABS" is not consistent through time. Only once subprime mortgage securitizations became popular did it start to include mortgage-backed securities, and even then

These new private-label securitizations typically involved the parent bank or finance company setting up a special-purpose vehicle (such as a trust) that was legally separate from its parent, so that the creditors of the one had no claim on the assets of the other. The vehicle then bought pools of loans from the bank, raising the money to do so by selling securities that were claims on the interest payments and principal repayments on those loans. Since those securities had no government backing, the risk of default on those loans could no longer be ignored entirely. The early government-backed securities (known as “pass-through certificates”) offered identical, equal shares of the cash flow from the underlying mortgages, but increasingly what was created in private securitizations was not a single class of pass-through certificates, but two, three, or more classes or “tranches” of claims differentiated by credit risk, as in figure 2. The lowest tranche – the “first-loss piece” – bore the first losses caused by default on the pool of mortgages or other assets underpinning the securitization. In early deals, this tranche was typically retained by the bank or finance company that arranged the securitization; later, first-loss securities were sometimes sold by private arrangement to outside investors – often hedge funds – who received a large spread (increment over Libor or other benchmark interest rate) for taking on the risk of loss.

- FIGURE 2 AROUND HERE -

Only if defaults rose to such a level that losses entirely exhausted the lowest tranche were the investors in the next tranche, which came to be called “mezzanine,” at

securitizations of prime mortgages were not generally referred to as ABSs. In this article, however, the term “ABS” always includes mortgage securitizations.

risk. In early securitizations this tranche was also often retained by the parent bank or finance company. It would typically be bigger than the lowest tranche – perhaps as much as eight times as big (Rosenthal and Ocampo 1988, p. 10) – which meant that losses on it could in aggregate be large. However, because the cushion provided by the lowest tranche made the probability of mezzanine losses modest, the bank arranging the securitization could buy insurance against them from the specialist insurers known as “monolines,” whose original business had been insuring US municipal bonds. At the top of the hierarchy of tranches was the “senior” tranche, by far the largest, which was always sold to outside investors. With both lower tranches as buffers, the risk of loss on it was seen as very low. Accordingly, only relatively modest “spreads” were thought necessary to compensate for this small risk.

The most prominent of the actors who had to concern themselves with default risk were the rating agencies, whose services had not been needed when securitization was a government program. S&P began to rate securitizations in 1978 and Moody’s in 1983.²³ The evaluation practices they employed had three characteristics. First, they were heavily influenced by past episodes of large-scale mortgage defaults. S&P, for example, used the default rates in the US during the Great Depression as the “stress scenario” for a AAA rating: if a tranche was to be rated AAA, the structure of the security had to protect the tranche from loss even if defaults again rose to Great Depression levels (interview data; Khadem and Parisi 2007, pp. 546-47). Second, analysis was originally of pools of mortgages, not individual loans. The rating agencies defined the characteristics (such as loan-to-value ratios) of a “benchmark” pool or set of pools, and then compared the characteristics of the actual pool of mortgages underlying a mortgage-backed security to

²³ See the data tables in Roy and McDermott (2007); q.v. Cantor and Packer (1994, p. 20).

the benchmark. Deviations between the two were then translated into set “penalties” (or set “rewards”) in the rating processes.²⁴

Third, both the rating process and the construction of mortgage-backed securities and other ABSs hinged around the same parameter: the “credit enhancement” or “credit support” level needed for each tranche to achieve the rating that the constructors of the ABS desired. (This level is the total size of the lower tranches, guarantees, reserve funds, etc., that protect a tranche from losses. From the constructor’s viewpoint, all these mechanisms are expensive: e.g., if lower tranches are sold to outside investors, the higher spreads required to attract them limit the spread that can be offered on the senior tranche.) For instance, the “penalties” or “rewards” referred to in the previous paragraph took the form of the rating agencies demanding set increases or allowing set decreases in a security’s credit support levels to the extent that the pool of mortgages underpinning it was judged riskier or less risky than the benchmark pool. The securities themselves and knowledge of the securities were thus co-produced: credit support levels, the crucial parameters in the design of a tranching security, were determined by the ratings agencies’ procedures for evaluating those securities.

From the mid-1990s onwards, evaluation techniques based on the analysis of pools were complemented by techniques that did involve estimating the default probabilities of individual mortgages, as least relative to the benchmark of prime lending. The rating agencies developed logistic regression or hazard rate models (S&P’s *Levels*, Moody’s *Mortgage Metrics*, and Fitch’s *Resilogic*), which incorporated characteristics both of the mortgage, such as loan-to-value ratio, and of the borrower, notably his or her

²⁴ See, especially, Bhattacharya and Cannon (1989), in particular their worked example (pp. 482-83).

FICO score, a measure of creditworthiness developed by Fair, Isaac & Company, originally for forms of consumer credit other than mortgages (see Poon 2007). The parameters of these models were estimated using large datasets containing both this information and the payment histories of the resultant mortgages, such as those built up since 1991 by the San Francisco-based firm, Loan Performance. The growing use of FICO scores and of models incorporating them both facilitated and was encouraged by increasing volumes of “subprime” lending to people whose impaired credit histories made them ineligible for prime mortgages (Poon 2009).

From the viewpoint of the quite different evaluation practices that eventually developed around CDOs (discussed in the next section), there remained a striking silence in the evaluation of mortgage-backed securities. There was almost no explicit modeling of statistical dependence amongst mortgage defaults, in other words no modeling of what CDO specialists came to call “correlation.”²⁵ Defaults were treated mathematically as statistically independent events, with “correlation” handled implicitly. For instance, in the rating of mortgage-backed securities at Standard & Poor’s, correlation amongst defaults induced by macroeconomic variables such as the unemployment rate was handled by continuing to use stress scenarios, even after the regression or hazard-rate models were developed. The latter were used not to estimate absolute default probabilities, but to determine the amounts by which the stress-scenario default rates of the benchmark prime pool should be modified for the particular pool being evaluated. (If, for example, the Great-Depression-based AAA-stress default rate of the benchmark pool was 10 percent, then the equivalent rate for a

²⁵ The rating agencies were not unique in this. Thus Fabozzi, Bhattacharya, and Berliner’s (2007) textbook of mortgage-backed securities makes effectively no mention of correlation.

pool of subprime, high loan-to-value, low-documentation loans might be 40 percent. In other words, to achieve a AAA rating a tranche based on this pool would have to be able to survive the default of 40 percent of the mortgages in the pool.) So the apparently assumed independence of mortgage defaults was, to quote an interviewee, only “conditional independence”: independence conditional on the macroeconomic variables condensed in the historical experiences that had given rise to the stress scenarios.²⁶

Another potential source of correlation amongst mortgage defaults – the vulnerability of a pool of mortgages to *local* economic conditions – was also handled primarily by organizational procedures rather than mathematical modeling. Geographically concentrated pools were discouraged by applying ratings penalties (again expressed as increases to required credit support levels) to them. With the main mortgage lenders – especially subprime lenders – increasingly operating across the US, there was no need for them to incur these penalties, and the mortgage pools they presented for rating were typically as diversified as possible geographically. (This unsurprising outcome had significant consequences, as we shall see later, in the evaluation of ABS CDOs.)

With the rating agencies analyzing the risk of default, prepayment remained the dominant concern of most investors in mortgage-backed securities. For example,

²⁶ S&P’s stress scenarios also differed in the assumptions made about the severity of losses following default, with higher severities assumed in the stress scenarios for higher ratings, the rationale being that the house price declines in high-stress scenarios would imply lower proceeds following foreclosure. See Securities and Exchange Commission (2008, pp. 32-34) for the practices at Moody’s and Fitch.

the 2007 textbook on those securities mentioned in the introduction devoted its section on “valuation and analysis” almost exclusively to prepayment and other matters concerning changes in interest rates, with default scarcely mentioned in that section. As the textbook put it, investors in “senior private label MBS” (in other words, in the upper tranches of private mortgage-backed securities) “typically assume that principal will be returned with 100% certainty ... The driver of performance of these securities is thus not *if*, but *when* principal is paid to the bondholder” (Fabozzi, Bhattacharya, and Berliner 2007, p. 241, emphases in original).

The “100% certainty” was understandable. The move into subprime was accompanied by considerably increased credit support levels, achieved not just by tranching but by two other safety mechanisms, “excess spread” and “over-collateralization.”²⁷ The resultant typical structure of a subprime ABS is shown in figure 3. As is shown there, around four-fifths of a typical subprime ABS was rated AAA, the same rating as enjoyed by the sovereign bonds of the US and other leading nations. Although it was universally understood that the default rate on the underlying subprime mortgages would be much higher than on prime, it would have taken what seemed an unimaginably high default rate to eat through all the excess spread, all the over-collateralization, and all the lower tranches to reach the AAA tranches.

²⁷ “Excess spread” is the difference between the aggregate interest payments received from borrowers (net of fees and other payments) and the interest payments to investors; it creates what is in essence a reserve. Overcollateralization means that the total principal sum of the loans in the pool is greater than that of the securities held by investors, either because the deal was structured that way initially or because of “turboing,” the use of excess spread to repay some investors and thus reduce the amount of securities still outstanding (Fabozzi, Bhattacharya, and Berliner 2007, pp. 102 and 188).

- INSERT FIGURE 3 AROUND HERE -

Indeed, in practice excess spread and over-collateralization were in general sufficient to protect even the lowest of the investment-grade tranches (the “mezzanine” tranches, usually rated BBB), even when a mild recession caused the delinquency rate on subprime mortgages to double in six months in 2000 and remain high for the next two years (Sanders 2008, p. 256, chart 2). Although there were some defaults (Erturk and Gillis 2005), they were concentrated mainly in a limited number of troubled deals, and left the majority of investors unscathed. In retrospect, it is clear that historical contingency played a part in muting the losses in this episode, the first experience of recession since subprime mortgage lending had reached a large scale. House prices continued to rise during it, giving some homeowners the option of selling rather than being foreclosed on, and in particular limiting lenders’ losses if foreclosure did take place (Calomiris 2009). Indeed, ABS defaults of all kinds (not just of mortgage-backed securities) had been rare until that recession hit. A February 2001 Moody’s report noted that “we often hear that no ABS security has ever defaulted” (Harris 2001, p. 13). While not entirely consistent with the detailed default data in Erturk and Gillis (2005), the belief is indicative of widespread conviction in the safety of ABSs.

With default still not a major concern of most investors in subprime mortgage-backed securities, the latter offered an advantage compared to prime securities in terms of the traditional evaluation focus, prepayment. Although prepayment rates on subprime were usually higher than on prime mortgages, they were less sensitive to interest-rate changes, thus reducing what was from the investor’s viewpoint the traditional main drawback of mortgage-backed securities. As lenders moved into subprime they were

able to weaken the entrenched features of “the American Mortgage.” Floating-rate loans became much more common, as did prepayment penalties, especially penalties for prepaying during the increasingly-common period of relatively low – but still, in absolute terms, quite high – “teaser” rates (Bhardwaj and Sengupta 2008). In consequence, as a chapter in another textbook put it, “the average lives of the residential [subprime] ABS are likely to be more stable for a given change in interest rates than the average lives of securities created from conforming [i.e. prime] loans” (McElravey 2006, p.371). “No income verification” loans were particularly prized from the viewpoint of prepayment: “The capital markets pay a premium” for them, reported Adelson (2006c, p.14), “because such loans display slower prepayments (and despite the fact that the loans have greater credit risk).”

It would, however, be misleading to suggest that *no* investors in subprime mortgage-backed securities were concerned with default. While those who bought the higher tranches did largely set it aside, those who bought the lowest externally-sold tranches (usually the “mezzanine” tranches, typically with a rating of around BBB, close to the bottom of investment grade) frequently performed their own evaluations of default risk, and they were in quite a powerful position. Those tranches were “historically harder to sell,” an interviewee told me, but they usually *had* to be sold. While the constructor of an ABS might be prepared if necessary to keep the very lowest tranche, retaining the larger mezzanine tranches as well was unattractive. Many deals would simply not have been viable from their constructors’ viewpoint if no buyers for those tranches could be found, because those constructors would have needed too much capital of their own (many subprime lenders were quite thinly capitalized).

When constructing a subprime ABS, therefore, those arranging it would often “try to place the BBBs first,” secure in the knowledge that the AAA tranches could easily be sold “to people who don’t want to think,” as another interviewee put it. Mezzanine buyers were often sophisticated: they were “willing to spend the time to understand the collateral and the structure.” Some, for example, had developed their own models of mortgage default rather than relying by proxy on the rating agencies’ models. These buyers could, and not infrequently did, demand to see the “loan tapes” (the electronic records of the underlying mortgages), which the buyers of higher tranches almost never did, and they had to be allowed a reasonable time (even as late as 2001-3, as much as a week, one such buyer told me) to analyze the contents of the tapes. If they didn’t approve of what they found – for instance, over-large pockets of particularly risky mortgages hidden beneath the aggregate data in the offering documents – they might say “I don’t like the collateral,” and demand that the mortgage pool be changed before they would buy securities based on it.

All that was soon to change utterly. However, before we can understand fully why it did so we need to follow an apparent historical detour. At the end of the 1980s, the securitization of mortgages and other forms of consumer debt was joined by the securitization of corporate debt. On the face of it, it was a small change: the structures of the new instruments, CDOs, were initially almost identical to those of ABSs. Around them, however, a quite different cluster of evaluation practices was to develop.

Corporate CDOs and the Emphasis on “Correlation”

CDOs were originally a simple extension of the techniques employed in the “private label” securitization of mortgages and other forms of consumer debt. Firms

constructing CDOs again set up special-purpose legal vehicles, and used the capital raised by the sale of securities to investors to buy pools of corporate debt: at first, bonds issued by corporations but soon also loans made to them. The securities sold by CDOs were tranching in a way similar to a private-label mortgage-backed security (see figure 2).

CDOs began in the exciting but risky fringes of the late-1980s bond market, which traded “junk” (speculative-grade) bonds, typically those issued by corporate raiders as a means of funding their take-over bids. Although they differed in structure from most later deals,²⁸ what appear to be the first CDOs were issued in 1987 by the San Diego-based Imperial Savings Association, in conjunction with the investment bank Drexel, Burnham, Lambert, whose heavy involvement in the junk-bond market was famously led by Michael Milken. Sharply increased junk-bond default rates, the February 1990 bankruptcy of Drexel, and the imprisonment of Milken for securities violations temporarily returned junk bonds to the margins of finance. However, from 1996 on CDOs started being used on a large scale by banks to shed credit risk from their portfolios of loans to corporations and to reduce the capital reserves that regulators insisted they hold in respect to that lending. In November 1996, the UK’s National Westminster Bank completed a \$5 billion securitization of its loan book known as Rose Funding (previous CDOs had typically been a tenth of that size or smaller). In 1997, further large CDOs were created by, amongst others, Swiss Bank,

²⁸ They were what would later be called “market-value CDOs”: the pool of junk bonds was revalued fortnightly, and if its value fell below a set threshold for more than two weeks investors could require that the pool be sold and their capital returned to them (Hourican 1990, p. 333).

NationsBank, Bank of Tokyo/Mitsubishi, Credit Suisse, ABN Amro, Rabobank, J.P. Morgan, and Sumitomo (First Union Securities, Inc. 2000).

Success in selling these huge “balance-sheet CDOs” revealed that they were profitable in their own right, quite apart from their effects on the loan books and capital reserves of their parent banks: investors would buy their tranches at spreads that were sufficiently low that the aggregate flow of cash to those investors was less than the income generated by the loans in the CDO’s pool, so generating an arbitrage: a risk-free profit. Balance-sheet CDOs were therefore quickly joined by what insiders explicitly called “arbitrage CDOs,” which would buy corporate bonds or loans on the open market and capture this arbitrage.

As described above, the political economy of US mortgage lending led to evaluation practices focused primarily on prepayment. The latter was a peripheral concern in the evaluation of CDOs (with no equivalent of government action on behalf of mortgagors, prepayment of corporate loans was generally either prohibited or subject to stringent penalties), and default was always the focus, with the rating agencies playing an essential role right from the start. In the early balance-sheet CDOs, banks often did not let investors know the names of the corporations whose loans had been packaged and sold, fearing loss of those corporations’ business if they discovered that their bankers had publicly divested themselves of exposure to them. In that situation, investors had little but ratings to go on.

Rating agencies *were* told the composition of a CDO’s pool, and – at least in the US – the corporate debts that formed the pool would typically already have been

rated. By the early 1990s the rating agencies had accumulated datasets of corporate defaults from which what they called the “idealized” default rates corresponding to a particular rating could be inferred. (For example, Moody’s early 1990s’ estimate of the ten-year default rate of companies rated Aaa was 1.0 percent; for Baa companies, it was 4.4 percent. See Lucas et al. 1991, p. 6.) These databases could also be used to estimate recovery rates: the typical extent to which the loss following default was less than total. For example, Hourican (1990, p. 338) noted that “Studies indicate that defaulted bonds trade at an average price of 40 percent of par [face value] one month after default.”

Default probabilities and recovery rates thus seemed knowable. But how could they be combined to estimate the probability of different levels of loss in a CDO’s pool? If corporate defaults were statistically independent events, then those probabilities could be calculated using only elementary probability theory.²⁹ However, it was also clear that the assumption of statistical independence was untenable:

For example, among companies rated Ba at the beginning of 1974, 6.1% defaulted over the next 10 years, compared with 21.2% over the 10-year period beginning in 1981. The magnitude of variations in these default rates suggest the presence of correlation, meaning that if one company defaults, there is a greater likelihood that others will default (Lucas et al. 1991, p. 2).

²⁹ Thus, for example, if both company A and company B have a default probability of 0.1, and their defaults are independent events, then the probability of them both defaulting is simply $0.1 \times 0.1 = 0.01$.

As with mortgages, some of this correlation would be common exposure to the same macroeconomic conditions. With no publicly-available model of correlated corporate defaults to draw on in the late 1980s and early 1990s, the rating agencies initially handled that issue using a “conditional independence” approach closely analogous to that used in rating mortgage-backed securities. In evaluating CDOs, both S&P and Moody’s again “stressed” historically average corporate default probabilities by greater amounts for higher targeted ratings, and then used those stressed probabilities in a calculation that assumed defaults to be independent events. The additional correlation that would come from poorly diversified pools of assets (for example, loans heavily concentrated in a particular industry) was again handled procedurally, just as it had been for mortgages. Thus S&P “notched” (reduced by one or more ratings grades) the ratings of all the debt instruments in any industrial sector that formed more than 8 percent of a CDO’s pool (interview data; Standard & Poor’s n.d., p. 36).³⁰

These relatively simple ways of evaluating CDOs, in which correlation was not modeled explicitly but handled procedurally, changed more quickly than their counterparts for mortgage-backed securities and in quite a different direction. The impetus for change was external to the rating agencies: the growing influence within banking of derivatives, notably options and interest-rate swaps.³¹ By the 1980s,

³⁰ Moody’s explicitly calculated a “diversity score” for CDO’s pool. Fitch appears not to have had an explicit concentration penalty in this period.

³¹ Options are contracts or securities that grant a right but not an obligation. For example a “call” option gives the right to buy a block of shares at a set price – the “exercise price” – on, or up to, a given future date. An interest-rate swap involves one party paying the other a fixed rate of interest on an agreed notional principal sum, while the second party pays a floating rate (usually Libor) on the same

professional traders of these derivatives did not simply evaluate them by following set procedures akin to those then used by the rating agencies, but employed explicit, sophisticated mathematical or economic models, many based on the eventually Nobel-prize-winning Black-Scholes-Merton option model (Black and Scholes 1973, Merton 1973). These models had an impact on the evaluation practices surrounding mortgage-backed securities – since prepayment is an option, one can apply option theory to calculate by how much it reduces a security’s value, and the Salomon team were known for their skill in this – but they brought about a far more radical change in the evaluation of CDOs.

Black, Scholes, and Merton had also applied their options work to modeling the value of a corporation’s debt.³² Oldrich Vasicek (a Czech-born probability theorist who had worked at Wells Fargo, where Black and Scholes were consultants) then showed how this approach could be extended to value a large, homogeneous, highly granular portfolio of corporate loans (Vasicek 1991). Vasicek’s model was commercially confidential, but a more general computerized simulation version of it was incorporated into

sum. Introduced in 1981 (Beckstrom 1988, p. 43), interest-rate swaps quickly became widely used by banks and other market participants to manage the risks of interest-rate fluctuations.

³² Because of their limited liability, the owners of a corporation’s shares possess what is in effect a call option on its assets. If the market value of those assets is below the total amount of the corporation’s debt when the latter falls due, shareholders rationally should simply allow the corporation to default (leaving their shares worth nothing). If the corporation’s assets are at that point worth more than its debt, their shares are in aggregate worth the difference. Those outcomes are precisely the pay-off of a call option with an exercise price equal to the total amount of the corporation’s debt, and this allows option theory to be used in what has become known as the “Merton model” of default: see Merton (1974).

CreditMetrics, a system for measuring credit risk developed by J.P. Morgan. The bank, which was a particularly active proponent of the credit default swaps discussed below, made both *CreditMetrics* itself and a detailed description of it (Gupton, Finger, and Bhatia 1997) available to other market participants, because (as an interviewee involved told me) it wanted to promote the market for these swaps by giving other banks a way of measuring how they could use them to reduce credit risk. In these “Gaussian copula” models,³³ correlation – previously handled procedurally and almost entirely implicitly – was modeled explicitly.

The creators of the big “balance-sheet” deals that made CDOs mainstream were typically not in banks’ securitization or junk bond departments but in their derivatives teams, especially those specializing in interest-rate swaps. In consequence, despite the similarity in structure of ABSs and CDOs, the creators of the new wave of the latter thought of them not as securitizations but as “credit derivatives,” a term that first came into use in the early 1990s at Bankers Trust (see Sanford 1993, p. 239), a bank that was prominent in developing new derivatives to disaggregate and make tradable the different aspects of what an interviewee then employed there called the “bucket of risks” involved

³³ A copula function (a formulation introduced to mathematical statistics by Sklar 1959) “joins together” the distribution functions of uniformly-distributed variables in such a way as to yield a specific multivariate joint distribution function. (A “Gaussian copula” yields a multivariate normal distribution function.) Copula functions were brought to the study of credit risk by Li (1999 and 2000), who used them to specify the dependence amongst the survival or hazard-rate functions that model the time at which a corporation defaults. When referring to “Gaussian copulas,” I also include models such as *CreditMetrics* and the original 2001 version of *CDO Evaluator* (discussed below), which are single-period (all that is modeled is whether a corporation defaults during the period in question, not when), but in which what is in Li’s terms the copula function is Gaussian.

in lending. Sometimes the derivatives teams discovered only accidentally that others in a different department of the same bank had long experience of similar structures:

... one of the salespeople in Bank of America was in our Chicago office [in 1997], getting a cup of coffee, showing it [a planned CDO-like instrument] to a colleague. The guy behind [an ABS specialist] leans over and says, “that’s a really neat idea.” He’s been doing that for years ... securitizing ... putting diversified pools of assets into a vehicle and tranching off the risk ...

By the mid-1990s, the derivatives teams already inhabited a world in which sophisticated mathematical models were central, and they were quick to adopt Gaussian copula models of CDOs (interview data; Tett 2009a). That then made purely procedural ratings techniques such as notching begin to seem outdated: as one interviewee employed at a rating agency in this period told me, notching was “not a proper correlation method.” All three main agencies largely switched to evaluating CDOs using Gaussian-copula software systems: S&P with its November 2001 *CDO Evaluator*, Fitch with its July 2003 *Vector*, and Moody’s with its May 2004 *CDOROM*.³⁴

³⁴ See, e.g., Chen et al. (2005, p. 7, exhibit 3). Moody’s had developed a distinctive approach in which a CDO’s “diversity score” (see note 30) was used to map its asset pool onto a hypothetical pool of homogeneous assets whose defaults were independent events and to which, therefore, the binomial formula from elementary probability theory could be applied (Cifuentes and O’Connor 1996). Its commitment to this “binomial expansion technique,” which is much simpler than Gaussian copula formulations, meant it embraced Gaussian copula models more slowly and more partially than S&P and Fitch.

By making credit correlation explicit for the first time, these and other copula models raised the issue of how to measure it. It was a crucial issue: the assumption of low levels of correlation was at the very core of the rationale for CDOs, especially arbitrage CDOs. They depended on being able to take a diversified pool of corporate bonds or loans with relatively modest ratings (and the high spreads that went with those ratings), and package them into a structure that would have large tranches with higher ratings. Those tranches could then be sold at lower spreads, and the difference could be pocketed as arbitrage profits. Low correlation was what made the high ratings justifiable and the arbitrage feasible, in effect making relevant the analogy with coins tossed independently. (One coin can easily turn up tails; twenty independently-tossed coins are most unlikely to.) If the correlations amongst them were low, a large portfolio of corporate bonds or loans was most unlikely to suffer the large number of defaults that would endanger a CDO's AAA tranche, even if each of those individual bonds or loans was rated BBB or even BB.

In the way Gaussian copula models were formulated in the late 1990s at banks such as J.P. Morgan, which had overtaken Bankers Trust as the leading player in the credit derivatives market (Tett 2009a), the correlation between two corporations was the correlation between the changing market values of their assets. However, this market value is not directly observable (it can diverge radically from the "book" value of those assets on a corporation's balance sheet). So, as a former J.P. Morgan trader told me, they – and also others in banks using Gaussian copula models – simply took the readily measurable correlation of two corporations' stock prices as a proxy for their unobservable asset-value correlations, even if doing so had, as one textbook put it, "no theoretical justification" (Chaplin 2005, p. 260).

With the exception of Fitch, which adopted a modified version of this way of estimating correlation, the rating agencies took other approaches more deeply rooted in their organizational practices. When Moody's started using Gaussian copula models, its modelers either used estimates based on the judgments of experienced ratings staff or values implied by patterns in the records of their actions in downgrading or upgrading corporations (Fu et al. 2004).³⁵ When Standard & Poor's was designing its new Gaussian copula system, *CDO Evaluator*, released in November 2001, it did seek econometrically to estimate the correlation values that would yield the degree of clustering of corporate defaults that had historically been encountered (Parisi 2004, p. 2). However, the limited number of cases in its default database as it stood then made that estimation hard (only with version 3.0 of *Evaluator* released in December 2005, when the default database was much larger, did S&P fully embrace these estimates), so consistency with previous organizational practice was also a criterion that shaped the original choice of correlation parameters. In line with the "conditional independence" approach used prior to the Gaussian copula, the correlation between firms in different industries in the original version of *Evaluator* was set at zero (Bergman 2001), with dependence on common macroeconomic conditions captured by continuing to "stress" default probabilities, raising them most if a AAA rating was sought. The choice in that original version of 0.3 for the correlation between corporations in the same industry similarly reflected

³⁵ Moody's also used correlations produced from analysis of market prices by KMV, a firm co-founded by Vasicek, which it bought in 2002. KMV employed an elaborated version of the option-theoretic model outlined in note 32 to estimate corporations' asset values and default probabilities. In their choice of correlation assumptions, however, the CDO specialists at Moody's "tilt towards the ratings-based results" (Fu et al. 2004, p. 10).

previous practice, an interviewee told me. 0.3 was chosen “partly to maintain consistency with the previous notching scheme”: when applied to similar asset pools it tended to generate similar results, i.e. similar ratings and credit support levels.

Although no-one at the time could have foreseen it, this apparently small, technical decision in late 2001 (the choice of an intra-industry correlation of 0.3) was pivotal to the chain of events that I will turn to in the next section. First, though, other ways in which the arrival of derivatives specialists transformed securitization need considered. They brought with them a new instrument originally developed in the early 1990s at Bankers Trust (Tett 2009a, p. 24): the credit default swap. It is a bilateral contract in which one party, the “protection buyer,” pays regular premiums to the other party for “protection” against default by a third party (Ford Motor Company, for instance) on bonds issued by it and/or loans made to it. Should Ford default, the protection buyer has the right to deliver Ford’s bonds or loans to the protection seller, and receive their full face value. The protection buyer does not need to hold Ford’s bonds or loans: it can simply purchase them at the point at which they have to be delivered (following default they will be trading at a fraction of their face value).

As the former Bank of America credit derivatives specialist put it to me, credit default swaps gave him and his colleagues a capacity the ABS world of the sarcastic coffee-queue interlocutor quoted above did not have, for all its much longer experience of securitization: “what he couldn’t do ... was synthetically transfer” credit risk. Swaps made “synthetic” CDOs possible. Instead of the special-purpose legal vehicle having to buy loans or bonds for its asset pool, it could simply sell protection on them via credit

default swaps, using the premiums it received from the swaps to pay the investors in the CDO. Those investors faced a broadly similar pattern of risks and returns (again, for example, investors in the lowest tranche were first to lose their capital, in this case if one or more of the swaps was triggered by default on the bonds and/or loan it covered), but a synthetic CDO was quicker and easier to construct than a cash CDO, as the CDOs involving the actual purchase of assets were called. Credit default swaps also made single-tranche CDOs possible. Such a CDO does not involve a separate legal vehicle: it is simply a bilateral contract between an external investor and a dealer (typically a credit-derivatives trading desk at a major bank), in which the investor earns regular fees by selling the dealer protection on a particular tranche of losses on a mutually-agreed pool of corporate bonds and/or loans. Introduced in around 2001, by 2003 single-tranche deals dominated the corporate CDO market (Reoch 2003, p. 8). Because they too were synthetic (the corporate loans or bonds in question served simply as a reference pool, a way of defining the deal; they didn't have to be bought), single-tranche CDOs could be set up almost immediately: "single-tranche technology is all over in a week," said the above interviewee. "You dream up the portfolio on a Monday, structure on the Wednesday, Thursday, and Friday."

Single-tranche CDOs greatly increased the salience of "correlation." Even once it has been completed, a single-tranche CDO leaves a dealer with a position that needs hedged. (The dealer has bought protection, and thus the hedges will consist predominantly of sales of protection. Since these are income-generating, they earn the dealer the money to pay the investor and earn a profit from the deal.) This hedging was not a simple task, because the fluctuating value of a tranche reflects not just changes in the perceived individual creditworthiness of the corporations in the CDO's reference pool

but also changing beliefs about the likely clustering of defaults – in other words, about “correlation.” To help them hedge the latter, in 2003-4, the main credit-derivatives dealers set up markets in tranches, tradable credit “indices,” which they could use to trade correlation. (That realist phrasing is deliberate: “correlation” was increasingly talked about, for example in the trade press, not as a parameter of a model but as a real phenomenon with real implications.) Such an index resembles a standardized synthetic CDO – in most cases with a fixed list of 125 corporations each making up 0.8 percent of its reference pool – and protection can be bought or sold on either the index as a whole or on standard tranches of it. The indices (which quickly became liquid, high-volume markets) provided a new way of estimating correlation. A Gaussian copula or similar model could be applied “backwards” to infer the correlation levels consistent with the prices of protection on index tranches. (E.g. if the cost of protection on higher tranches has increased, but the cost of buying protection via credit default swaps on the individual corporations making up the index is unchanged, it can be inferred that participants’ estimates of correlation have increased, or indeed, if one wants to be fully realist, “correlation itself” has increased.)

Along with broadly canonical-mechanism markets in credit default swaps that had also emerged (see, e.g., Rule 2001), the tranches index markets were the foundation of a wider epistemic change that seemed well underway at the time of the first interviews for this research, in 2006-7. The models used by the rating agencies to evaluate CDOs and ABSs such as mortgage-backed securities were explicitly backward-looking: their parameters were mainly either crystallizations of previous organizational practices or estimated using data from recent or (in the case of the Great Depression) distant historical experience. The new canonical-mechanism

markets freed CDO modeling from these organizational and statistical traces of the past: for example, both correlation and default probability could be inferred from today's market prices, not past experience.³⁶

The change sharpened already-existing differences between the evaluation practices surrounding ABSs and CDOs, but it was never complete: amongst the rating agencies, only Moody's made much use of this approach, and even there it was only as a complement to more traditional techniques. It did however seem a harbinger of the eventual complete integration of CDOs into the full cognitive world of modern derivatives modeling. The "quants" who populated that world – who often had PhDs in mathematics, physics, or engineering – could seem very alien to ABS specialists who prided themselves on understanding the everyday material and legal realities of lending. As one of the latter complained to me, those quants had "never gone out to collect any money," whether "with lawsuit or baseball bat." In consequence, they "didn't have to be very intimate with the underlying," in other words with the debts that ultimately underpinned the instruments whose prices they modeled: they "could treat it as an abstraction." For a brief moment, nonetheless, it seemed as if the future might be theirs.

The Evaluation of ABS CDOs and the Arbitrage Opportunity it Created

However, alongside the world of corporate CDOs, with its increasingly sophisticated products and models, another world of CDOs had developed: CDOs in which the underlying assets were tranches of ABSs, residential mortgage-backed securities in

³⁶ To be more precise, what can be inferred is the "risk-neutral" probability of default (see Baxter and Rennie 1996).

particular. Viewed from the corporate CDO world I have just described, ABS CDOs could seem laggards: a “very boring part” of the market, as one interviewee put it, in which profit came only from “originating transactions; it didn’t come from risk-taking, it didn’t come from like good credit assessment. It was purely, you know, in structuring fees.” The main industry body, the International Swaps and Derivatives Association, standardized the terms of credit default swaps on ABSs only in June and December 2005 (Damouni 2005), six years later than it had done so for their corporate equivalents. The single-tranche CDOs that reshaped the corporate CDO world were relatively rare in the world of ABSs. A set of tradable ABS indices (the ABX) was launched only in January 2006, and a tranching ABS index (TABX) only in February 2007. As innovations of this kind, originating in corporate CDOs, were replicated for ABS CDOs, the latter nevertheless would catch up, an interviewee told me in January 2007: “the asset-backed arena ... is going to ape, I think, the corporate ... [The] ABS market will get there in half the time it took the corporate market.” Before that could happen, however, ABS CDOs, that “boring part” of the market, were to be at the core of the greatest financial crisis for the best part of a century.

ABS CDOs emerged in the second half of the 1990s, though they formed only a small market (of the 283 CDOs issued in 1997-99, only eight were ABS CDOs: Newman, Fabozzi, Lucas and Goodman 2008, p. 34, exhibit 1), and originally had structures quite different from those of the decade to come.³⁷ What is to my knowledge the first with that structure was issued in 1999 by a team at Prudential

³⁷ As far as I can tell, deals prior to 1999, such as what seems to be the first ABS CDO, the Alliance Capital/Paine Webber “Pegasus One Ltd,” issued in June 1995, were mostly market-value CDOs (see note 28 above).

Securities involving Chris Ricciardi, who was later to help make Merrill Lynch into a giant-scale constructor of ABS CDOs. The team found themselves at a disadvantage in corporate CDOs, because Prudential had little involvement in the forms of corporate lending then popular as asset pools. However, as Ricciardi told the trade magazine *Credit*, “Once you have CDOs, people ask, ‘what else can I do with CDOs?’” (Fahmy 2005). Prudential had a large ABS business, and Ricciardi noticed that some classes of ABS – such as the subordinate tranches of ABSs whose pools were second-lien mortgages – offered higher spreads than equivalently-rated corporate debt. So the arbitrage that could be achieved by packaging corporate debt into a CDO could be done even more profitably with ABSs.

The attractiveness of ABS CDOs similar to the Prudential deal was greatly enhanced by the 2000-2002 downturn, which led to defaults and bankruptcies (e.g. of over-ambitious telecoms providers) that caused substantial losses to investors in the lower tranches of many corporate CDOs. In that context, the excellent performance record of mortgage-backed securities made them seem an attractive substitute for corporate debt. In a single year, ABS CDO issuance more than doubled (to in excess of \$20 billion in 2001) and the ABS share of the CDO market roughly tripled (Hu 2007), and issuance continued to grow sharply thereafter: in 2006 alone, ABS CDOs totaling \$307.7 billion were issued.³⁸ While the pools of the early ABS CDOs often contained ABSs from a wide variety of sectors – such as securitizations of aircraft and equipment leases, auto loans, and credit-card receivables (Roy and McDermott 2007) – several of those sectors also suffered badly in the downturn (Adelson 2003, Perraudin and van

³⁸ Data from the Securities Industry and Financial Markets Association (<http://www.sifma.org>, accessed July 21, 2009).

Landschoot 2004). Accordingly, ABS CDOs increasingly replicated Prudential's design. By 2004, it was common for three quarters or more of the pool to consist of subprime mortgage-backed securities (Whetten and Adelson 2005, p. 2).

By the end of the 1990s, CDOs had largely split off organizationally from the world of securitization and ABSs from which they had sprung: they were the province of different teams or even different departments of banks. There were therefore often fierce battles over which team or department should have responsibility for the new and highly profitable ABS CDOs. An interviewee at one leading investment bank, for example, described how there had previously been a clear division of labor between its Structured Transactions team, which handled corporate CDOs, and its Securitized Products Group, which had responsibility for ABSs. The influential head of the latter told the former that they “can’t do that [ABS CDOs] without us,” and eventually a compromise was reached to conduct the activity jointly with a “50:50 split on revenue.”

The arbitrage that was the basis of the profitability of ABS CDOs depended entirely on the ratings of their tranches, and by the late 1990s the rating agencies also had evolved a division of labor, at least in their large head offices in New York (analysts were sometimes less specialized in smaller offices such as those in London). Unlike in the banks, though, there seems to have been little conflict over who should have responsibility for rating ABS CDOs: in all three agencies, the CDO team took on the new ABS CDOs, using the ratings of the underlying mortgage-backed securities or other ABSs that their ABS colleagues had already produced. That organizational division of labor mirrored the existing division for corporate CDOs, in which the

CDO teams reused ratings of the underlying corporate debt produced by their colleagues in the department that rated corporate bonds. (Such conflict as did take place seems mainly to have concerned ABS CDOs in which the underlying ABSs had not been rated by the agency in question, but only by others. At least one Moody's analyst took the view that it was improper to rate an ABS CDO under these circumstances.³⁹ In general, though, it was regarded as acceptable when rating an ABS CDO to use another agency's ratings of the ABSs, at least so long as one "notched" them – i.e. slightly reduced these ratings – if the other agency could be viewed as less rigorous.)

Mapping the evaluation of ABS CDOs onto the organizational structure of rating agencies in this way had the additional advantage of minimizing the additional work that needed done. By in effect treating ABSs as if they were corporate bonds or loans, existing CDO models could be used with little or no modification. Of the three necessary sets of parameters, the first two – the default probabilities of the ABSs in a CDO's pool, and their recovery rates in the event of default – could again be estimated relatively easily: the former from ABSs' ratings, with corrections increasingly made for the growing evidence that ABSs were less likely to default than corporate bonds with the same rating (see, e.g., Roy and McDermott 2007); and the latter from data on the limited number of ABS defaults that had taken place (Erturk and Gillis 2005; Tung, Hu, and Cantor 2006). Again, though, correlation posed the rating agencies the most challenging problems. (Recall that if correlation is high it is impossible to form large highly-rated

³⁹ See the Moody's email correspondence made public by the House of Representatives Committee on Oversight and Government Reform at <http://oversight.house.gov/documents/20081022112230.pdf>, accessed March 30, 2009.

tranches from a pool of assets with only modest ratings.) All three of the routes, discussed in the previous section, by which knowledge of corporate credit correlation was generated were largely blocked when it came to ABS correlation. First, there was no full equivalent of corporations' stock prices to use, because ABSs did not trade in a canonical-mechanism market. Second, the very advantage of ABSs – the rarity of ABS defaults – made extracting a reliable correlation estimate by analysis of the clustering of defaults even harder than in the corporate case. Third, until February 2007 (at which point the TABX index touched on in the next section was introduced) there was no tranced ABS index market from which beliefs about correlation could be inferred.

That left essentially two choices: either estimating correlations from the performance record of ABSs as crystallized in an agency's own previous actions in upgrading or downgrading ABS tranches (these ratings transitions are more plentiful than defaults, thus easing the estimation problem), or directly employing human judgment. Moody's used baseline estimates based on ratings transitions, with judgmental additions (Toutain et al., 2005). Fitch's correlation estimates were based on "expert assumptions" (Zelter 2003, slide 5; see also Gill et al. 2004, p. 10). Standard & Poor's attempted to estimate ABS correlation econometrically, and my sources conflict on the success of the effort. Parisi (2004, p. 2) suggests that correlations were estimated in this way, while an interviewee reports: "We did try to estimate ABS correlations, but the data was too limited to derive reliable/stable estimates, given the relative stability of ratings, paucity of defaults and the number of different asset classes with different dynamics resulting from different transaction structures and underlying assets." According to this interviewee, consistency with previous practice again played a role, in particular in the choice of the

same correlation, 0.3, between ABSs in the same sector (i.e. same type of lending) as was used for corporations in the same industry.

Moody's estimates of the correlation between ABSs in the same sector (such as subprime mortgages) were also around 0.3.⁴⁰ Fitch's explicitly judgment-based ABS correlations were higher than S&P's and Moody's: Whetten and Adelson (2005, p. 2) report the use at Fitch of intrasectoral ABS correlations in the range 0.3 to 0.55, and 0.55 seems to have been the figure used for subprime residential mortgage-backed securities. However, for reasons to do with how Fitch implemented its Gaussian copula model, its 0.55 may not in practice have been more onerous in its effects on ratings than S&P's 0.3.⁴¹ In addition, Fitch was in relative terms an increasingly marginal player. S&P and Moody's each rated between 85 and 95 percent of all CDOs (ABS and CDO investors

⁴⁰ For example, the baseline correlation between US subprime residential mortgage securities assumed by Moody's was 0.22. That would be increased to take into account factors such as the closeness of the vintage (year of issuance) of the ABSs: e.g. by 0.1 for the commonly encountered case of pairs of mortgage ABSs of the same vintage (Toutain et al. 2005).

⁴¹ S&P's *Evaluator* was, at least originally, a single-period model that (in the case, say, of a pool of assets all with a five-year maturity) would encompass the entire five years in a single simulation run. Fitch's *Vector* was a multi-period model that was run in annual steps: "At every annual step [in a simulation] an asset portfolio is updated by removing defaulted assets and recording amounts and recoveries upon default" (Gill et al., 2004, p. 9). As far as I am aware, the annual steps were serially independent, so as an interviewee put it, an asset "that survives the first period will start the second period with a 'clean slate.'" Since the probability of default of any asset in a single year will normally be assumed to be much lower than default of the same asset over five years, this tends to have the effect of generating fewer cases with large numbers of defaults in a multi-step model than in a single-step model with the same correlation parameters. In consequence, "we need to increase correlation [in a multi-step model] to 'match' the cumulative distribution of the single-step model" in this respect.

typically expect instruments to have ratings from at least two agencies), while Fitch's share of CDO ratings slipped from around 65 percent before 2004 to around 15 percent in 2006-7 (Barnett-Hart 2009, p. 18, figure 8). In consequence, the rating of ABS CDOs was in practice done by assuming a correlation of 0.3 (in the case of S&P) or close to 0.3 (in the case of Moody's) between ABSs from the same sector, such as subprime residential mortgages.

It was a consequential assumption. A correlation of 0.3 or thereabouts made it possible not just to package the higher tranches of subprime or similar mortgage ABSs into "high-grade ABS CDOs," but also to package their mezzanine tranches into "mezzanine ABS CDOs." As shown in figure 4, the AAA tranches of the latter would be smaller in aggregate than in high-grade ABS CDOs, and some use of excess spread (see note 27) would normally be needed to achieve the requisite level of credit support. Nevertheless, to be able to take BBB raw materials and fashion a product that was mainly AAA was an enticing arbitrage opportunity, and it was one that was pursued with great vigor in the years immediately prior to the crisis.

- FIGURE 4 AROUND HERE -

The arbitrage was a result that was possible only because of the assumption of relatively modest correlation: one interviewee told me that assuming 0.5, rather than 0.3, would have undermined the arbitrage, leaving mezzanine ABS CDOs economically unviable. Given that – and given the dependence of rating agencies on fees earned from the issuers of securities, and the possibility of those issuers "ratings shopping" (choosing

the agencies that offer the more favorable ratings) – should we interpret the choice of a correlation of 0.3 or thereabouts as strategic behavior guided by anticipated fee income?

Consider, for example, S&P's choice of 0.3 as the intrasectoral ABS correlation parameter for *CDO Evaluator* (the first of the rating-agency Gaussian copula systems, released, as noted, in November 2001). The ABS CDOs of that period were far more diversified across sectors than later deals, and subprime residential mortgage-backed securities typically made up only 30-40 percent of their asset pools (Whetten and Adelson 2005, p. 20). In that context, the choice of correlation between sectors is at least as important to rating outcomes as correlations within them, because the correlation matrix will contain more intersectoral than intrasectoral correlations. S&P's choice of 0.1 for the former (Bergman 2001) was more stringent than the figure of zero it employed for interindustry correlations, and higher than the values of 0.04 to 0.06 Moody's was later to derive from analysis of ABS ratings transitions (Toutain et al., 2005, p. 13).

Amongst that backdrop, S&P's choice of 0.3 as the intrasectoral ABS asset correlation could actually be interpreted as cautious, more cautious, at least in the case of mortgages, than a purely econometric estimate: Parisi (2004) reports an average correlation of 0.06 of the losses on pairs of pools of US residential mortgages in the period 1995-2002. If the interviewee quoted above is correct in reporting that a major influence on the choice was the use of 0.3 as the intraindustry correlation assumption, then it was the transfer to the rating of ABS CDOs of an assumption that was at least sometimes seen in its original context as “overly conservative” (Chen et al. 2005, p. 3n). There *was* sharp controversy about one of the correlation assumptions in S&P's *Evaluator*, but it concerned the zero interindustry correlation (the remaining trace of the

older evaluation practices incorporating stressed scenarios and conditional independence),⁴² not the 0.3 intrasectoral ABS correlation. As far as I can tell, no-one at the time foresaw, at least at all clearly,⁴³ that the effects of the choice of 0.3 would in fact be far from conservative.

If the choice of 0.3 or thereabouts as the intrasectoral ABS asset correlation was the chief proximate precondition of the arbitrage that fueled mezzanine ABS CDOs,⁴⁴ the background precondition was the *separate* evaluation first of the ABSs in the CDO's asset pool and then of the CDO itself. As suggested above, that was the "natural" way to map the evaluation task onto the organizational structure of the rating agencies, but it is also clear, with hindsight, that this two-step organizational division of labor fed the arbitrage. The justification of awarding high ratings to securities based on a pool of assets of only moderate credit quality is ultimately the diversification of that pool. In that sense, diversification can be a "free lunch": at little additional cost, it dilutes away almost all the *idiosyncratic* risk posed by an equivalently-sized holding of a particular asset,

⁴² In an interviewee's words, "everyone said, 'how can you have no correlation between industries?'"

For examples of the criticism, see Chen, Cifuentes, Desai, and Ray (2005) and Adelson (2006b).

⁴³ Perhaps the closest was Adelson (2003), who argued that evaluation practices surrounding both ABSs and CDOs understated correlation and ignored the way in which it can rise in a downturn. Even here, though, there was no specific focus on the intrasectoral ABS correlation, and though Adelson's hypothetical examples include a pool with a correlation of 0.6, the range of values (0.25 to 0.4) mentioned in his text (p. 59) as examples of when "correlation is higher" includes the value of 0.3 chosen by S&P.

⁴⁴ The use for mortgage-backed securities of lower default probabilities and higher recovery rates than for equivalently-rated corporate bonds was also a facilitator. Again, I can find no criticism of this at the time, and indeed default data seemed unequivocally to point in that direction.

leaving only the *systematic* risk posed by the exposure of all the assets to the same underlying economic factor or factors.⁴⁵

In the two-step process, however, the lunch was frequently being eaten twice, so to speak. The rating of each ABS reflected the way in which the diversification of its pool of mortgages (including its geographical diversification) minimized idiosyncratic risk, and then diversification (in the form of the modest correlation assumption) was *also* taken to justify higher ratings of most of the CDO than of the component ABSs. Here is where the organizational analogy between the evaluation of a CDO made up of corporate bonds and a CDO made up of ABSs was treacherous. A corporate bond or loan will typically be high in idiosyncratic risk, hence the justification of giving higher ratings to tranches formed from a diversified pool of such bonds or loans than to its components. ABSs, however, often no longer contained much idiosyncratic risk that could be diversified away, but only systematic risk (exposure to common factors such as the risk of nationwide house price decline) that was not greatly reduced by packaging ABSs into

⁴⁵ There is a deeper issue here that cannot be explored fully for reasons of space. This logic applies only if instruments are being evaluated according to their default probabilities or expected losses (as they were by the rating agencies and implicitly by those investors whose decisions were shaped by ratings), but modern asset-pricing theory suggests they should not be evaluated in this way: their price should reflect not this “total risk,” but only its systematic component, precisely because its idiosyncratic component can be diversified away. Coval, Jurek, and Stafford (2009) argue that because of this the prices of corporate CDO tranches were too high by the standards of asset-pricing theory, and the ratings-spreads convention discussed in the introduction seems to be the cause: it led market participants unwittingly to compare instruments with high systematic risk (senior CDO tranches) to instruments with similar default probabilities but lower systematic risk (corporate bonds). Their article is thus a beautiful demonstration of a convention shaping patterns of prices, and creating what is (if modern asset-pricing theory is correct) a very large and very persistent inefficiency.

a pool. There is some evidence that relations between the ABS specialists and the CDO specialists in the rating agencies were not always good (an interviewee reports that in his agency “communication between the ABS and CDO groups was very poor”),⁴⁶ but even if they had been harmonious this effect – the benefits of diversification being consumed twice – would have been created if each group had continued to follow its habitual practices.

This issue – that in the two-step evaluation process the free lunch of diversification was often being eaten twice – also bears upon an argument frequently invoked by market participants prior to the crisis as implying the safety of ABS CDOs: that the US had never experienced a substantial *nationwide* house-price decline since the Great Depression, with sharp falls restricted to specific regions. If that could be extrapolated into the future (and of course we now know it could not be), it did mean that the safety of ABSs was increased by geographical diversification. However, it also was taken as indicating the even greater safety of ABS CDOs, which often added little further geographical diversification because the constructors of the underlying ABSs had already diversified them as much as possible to avoid ratings penalties.

From this viewpoint, it is worth considering what would have happened if, instead of splitting the evaluation of ABS CDOs into two steps, conducted by two separate groups (the ABS group and the CDO group), the rating agencies had allocated the entire task to

⁴⁶ See also Adelson and Jacob (2008b, p. 8): “A key problem at many firms has been reluctance on the part of professionals in the areas of CDOs and structured credit to seek and accept input from ABS/MBS experts [MBS are mortgage-backed securities]. ... Significantly, the problem was not confined to just one type of firm. It was endemic among CDO and structured credit professionals at all kinds of firms: banks, securities dealers, rating agencies, bond insurers, money managers, and others.”

just one of the groups, and instructed it to use just its own techniques, developing those techniques as necessary, despite the very large amount of extra work that would have been created. To ask what would have happened if an ABS CDO had been evaluated using solely the logistic regression or hazard-rate models and historically-based stress scenarios sketched in the second section of this article is an exercise in the counterfactual. It would have required merging the loan-level data from multiple ABSs, applying those models to the entire merged pool, then modeling the cash flow consequences for each ABS of the predicted defaults and recoveries, and finally modeling the knock-on consequences for the CDO. I have not found an instance of this being done, and interviewees seem to regard it as still not fully practicable, primarily for computational reasons.⁴⁷

What does seem clear, though, is that had it been technically feasible to rate a mezzanine ABS CDO using only ABS practices, doing so would have been unlikely to permit the CDO to have large AAA tranches. When the mortgage default rates that characterized a AAA stress were applied to the giant merged pool, the cash flow to most

⁴⁷ For example, the cash-flow modeling would involve use of the huge commercially available “deal library” maintained by Intex Solutions (a firm based in Needham, MA), and those who have experimented with an approach of this kind tell me that practical complications (notably the fact that many ABS CDOs included tranches of other ABS CDOs in their pools) can cause the layered Intex models to run very slowly. Considerations such as this remind us that (though I have not focused on this issue) evaluation practices are *material* practices, and their materiality is consequential. It is also worth noting that a different reason why it would not have been attractive to rate ABS CDOs in the way described in the text is that the managers of a CDO generally enjoy the right to sell assets from its pool and replace them with others with the same or higher ratings. While it is quick and easy to use the conventional two-step approach to re-evaluate an ABS CDO whose pool has been changed in this way, the approach described here would have to be restarted from scratch, by forming and then re-analyzing a new merged pool.

of the BBB ABS tranches would most likely cease. Cash flow into the ABS CDO would then be greatly reduced, and in consequence even its higher tranches would default, and would thus have had to be deemed not eligible for a AAA rating. (Indeed, that is in essence what has actually happened. The US mortgage market has suffered default rates that approach those of a AAA stress. The AAA tranches of subprime ABSs have so far generally survived that stress – while many have suffered ratings downgrades, only a few have defaulted, as shown in table 1 below – but their BBB tranches often haven't survived, and mezzanine ABS CDOs, which are composed mainly of those tranches, have therefore failed *en masse*.)

There are, however, not counterfactual but actual instances of the obverse: evaluating an ABS CDO using only CDO practices.⁴⁸ In around 2006, some CDO specialists at one of the rating agencies tried as “a case of intellectual curiosity,” as one of them put it to me, to do just that. They applied the oldest and simplest of all the Gaussian copulas – Vasicek's model – to pools of mortgages, calibrating its correlation parameter to the typical ratings of ABS tranches (they found a value of between 0.3 to 0.4 to fit). They then “allocate[d] losses randomly to each ABS deal ... so that the frequency (and severity) with which each BBB ABS tranche defaulted could be recorded. This allowed the correlation between each pair of ABS tranches to be calculated.” The result was far from the modest level of 0.3 that generated the ABS CDO arbitrage: “This correlation turned

⁴⁸ Although analytically less relevant here because it concerned a bank, not a rating agency, it is worth noting that in around 2006 Goldman Sachs started modeling ABS CDOs in a way broadly similar to that described in the text (although the Goldman model of the underlying ABSs was calibrated to the spreads they offered, not their ratings). The results also seem to have been significantly more pessimistic than those of the conventional two-step approach. Unfortunately, my interview data do not throw light on whether these results played a role in Goldman's crucial late-2006 decision to liquidate or hedge its mortgage-related positions.

out to be very high indeed, in the region of 0.8.” Unfortunately, however, these specialists did not at that point have organizational responsibility for ABS CDO evaluation (“it wasn’t ‘under our watch’ at the time”), and they knew their “method was simplistic,” so they “never wrote it up” and took the issue no further.

The analysis they had performed is what participants call a “drilldown,” an evaluation of a structured financial instrument that does not simply re-use previous evaluations of its components but “drills down” to the assets underlying those components (in this case mortgages). Additional evidence that the organizational division of labor, and not simply the pursuit of fees, mattered to the ratings evaluation of ABS CDOs comes from the contrast in this respect between the evaluations of them and of the instruments whose structure most closely resembled theirs: CDO²s (“CDO-squareds”). These are CDOs whose asset pools consist of tranches of corporate CDOs. CDO²s did not cross organizational divides in the way ABS CDOs did: they were firmly within the remit of the agencies’ CDO groups, which had responsibility for the evaluation both of the structure itself and of its components. In this case, drilldown analyses *were* performed. The CDO groups rated CDO²s by merging the asset pools of the underlying CDOs and applying their Gaussian copula systems to the merged pool. This evaluation practice meant that the “free lunch” of diversification was eaten only once in the evaluation of CDO²s, not twice as in the case of ABS CDOs. It also took into account another potential source of correlation: the frequent presence of the debts of the same corporation in several of the CDOs whose tranches made up the asset pool of a CDO². Drilldown evaluation muted the attractiveness of CDO²s as arbitrage opportunities, and the sector never grew to approach anything like the scale of ABS CDOs.

ABS CDOs and the Causes of the Credit Crisis

The overall performance of ABS CDOs is most easily tracked via the incidence of “events of default,” which are triggered by very poor performance of the underlying assets.⁴⁹ While the ABS CDOs issued from 2001 to 2003 have not performed catastrophically by that metric, from 2004 on each successive vintage was worse than its predecessor. Events of default have been declared in around 30 percent of ABS CDOs issued in 2005; in over 40 percent of those issued in the first half of 2006; in over 70 percent of deals from the second half of 2006; and in over 80 percent of deals from 2007 (Sakoui 2009). By March 2010, events of default had been declared in 418 CDOs totaling \$371.6 billion, the vast majority of them ABS CDOs.⁵⁰ The exact losses are still unknown (only 27 percent of those deals had actually been liquidated at that point) but the IMF’s October 2008 estimate, quoted in the introduction, of \$290 billion still looks reasonable.

⁴⁹ Though there are a number of event-of-default tests laid down in the documentation of most CDOs, the critical issue is whether ratings downgrades or other reductions of the value of the CDO’s asset pool have been big enough to cause the pool’s total value to fall below the aggregate face value of the securities making up the CDO’s topmost tranches (those initially rated AAA). That typically constitutes an event of default, following which control of the CDO passes from its managers to the “controlling class” of investors (normally the holders of the super-senior tranche), who have the right to declare an “acceleration” (which usually means diverting all cashflow to themselves) or to wind up the CDO by selling the assets in the pool (Goodman, Newman, Lucas, and Fabozzi 2007). Either course of action will leave the holders of lower tranches facing losses that may be close to total, and even the holders of the super-senior tranche will in current circumstances incur substantial losses.

⁵⁰ See the CDO event-of-default list at <http://www.totalsecuritization.com>.

While losses on ABS CDOs have not been central to all the failures or near-failures of major institutions (they played, for example, only a small part in the bankruptcy of Lehman Brothers: see Valukas 2010), their overall role has been large. They triggered the bankruptcy in the early summer of 2007 of two hedge funds run by Bear Stearns, which was the single most clearly identifiable trigger of the crisis. When the funds' main creditor, Merrill Lynch, seized \$850 million of their ABS CDOs on June 15, it found it could sell them only at around 20 percent of their face value, "triggering the repricing of CDOs around the world" (Onaran 2008). The world's largest insurer, AIG, was pushed to the brink of bankruptcy by write-downs of \$33.2 billion (49.6 percent of its total losses) on credit default swaps via which it had sold protection on ABS CDOs. The world's largest bank, Citigroup, nearly suffered the same fate following \$34.1 billion ABS CDO write-downs (61.6 percent of its total losses). Merrill Lynch incurred calamitous \$26.1 billion ABS CDO write-downs, UBS a near-calamitous \$21.9 billion, Ambac (a leading monoline insurer) \$11.1 billion, Bank of America \$9.1 billion, and Morgan Stanley \$7.8 billion. Amongst the major institutions whose losses are analyzed by Benmelech and Dlugosz (2009), ABS CDO write-downs totaled around two and a half times the write-downs on residential mortgage-backed securities themselves.

Of course, ABS CDO losses came from ABS losses, and those in turn stemmed from mortgage defaults. By the end of 2009, 4.58 percent of all the residential mortgages in the US were in foreclosure (a rate without precedent since the Great Depression), and a further 10.44 percent were delinquent (one or more payments overdue), with rates for subprime or the intermediate category of Alt-A even higher: for example, 15.58 percent of subprime mortgages were in foreclosure, and a further 25.26 percent delinquent.⁵¹ The

⁵¹ Data from Mortgage Brokers Association (<http://www.mbaa.org>), accessed March 21, 2010

result has been losses on ABSs hugely in excess of those assumed in the rating of ABS CDOs (see table 1), and those losses are the ultimate cause of events of default in the majority of recent ABS CDOs.

- TABLE 1 AROUND HERE -

These mortgage default rates have multiple, interacting causes, including the substantial falls in US house prices since 2006, the sharp rise in unemployment since 2007, and the well-documented decline in the standards of US mortgage underwriting in the years prior to the crisis. The burgeoning literature on the credit crisis has yet to reach a definitive judgment on the relative importance of these causes, and that is a task well beyond the scope of this article. Most directly pertinent here are mortgage underwriting standards. It is well-established – three existing papers, using different methodologies, have all found evidence of it⁵² – that the securitization of mortgages weakened the screening of applicants by the originators of these mortgages. The likely reason is similarly well-understood, and not unique to the current crisis: securitized lending creates an agency problem by transferring many of the costs of default from loan originators to investors, a problem that is exacerbated if – as was often the case – the originators of loans are remunerated, directly or indirectly, according to the volume of loans they originate. Problems of this kind undermined all the various pre-1930 waves of mortgage securitization in the US (Snowden 1995). For example, in the 1880s and early 1890s large numbers of mortgage companies issued bonds backed by Western farm mortgages. The 1890s’ depression saw most such companies fail, in part because “their local agents ...

⁵² Keys, Mukherjee, Seru, and Vig (2008); Mian and Sufi (2008); Rajan, Seru, and Vig (2008).

[g]enerally working on a commission basis ... were overgenerous in approving loans” (Bogue 1955, p. 267).

For a quarter of a century from the 1977 rebirth of private-label mortgage securitization in the US, this ever-present agency problem was largely held at bay. Clearly, one important set of gatekeepers in this respect was the rating agencies, and much attention has focused on the question of whether they loosened their standards of evaluation of mortgage-backed securities in the years prior to the crisis (see, e.g., Smith 2008a, b; Fligstein and Goldstein 2010). Unfortunately, the snowballing process led me predominantly to rating-agency interviewees who were CDO specialists, not ABS specialists, so my interview data do not answer this question. However, Ashcraft, Goldsmith-Pinkham, and Vickery (2009) examine trends through time in the fraction of subprime and Alt-A mortgage-backed securities that were rated lower than AAA, taking into account both the extent of other forms of credit support (insurance and excess spread) and the characteristics of the underlying mortgage pools (the FICO score of the borrower, loan-to-value ratio, local-area house price changes, etc.). They find that, controlling for all the other variables, the fraction rated below AAA went down by around 20 percent between mid-2005 and mid-2007 (see also Fligstein and Goldstein 2010). This is consistent with a decline in rating standards, and while Ashcraft et al. “remain agnostic” whether the cause is “innocent errors” or “agency problems due to the ‘issuer pays’ credit rating model” (2009, p. 22), an extensive body of rating-agency e-mail messages released in April 2010 by the Senate Permanent Subcommittee on Investigations does suggest both market-share pressures and a degree of internal doubt about the appropriateness of some ratings.⁵³

⁵³ The e-mails are available at <http://levin.senate.gov/newsroom/>, accessed April 27, 2010.

It is worth noting, however, that this 20 percent decline in the fraction rated below AAA represents only a modest change in the structure of a typical subprime ABS: from lower tranches totaling around 24 percent of the structure to the 19 percent shown in figure 3. The change is small relative to the huge differences – of between twelve-fold and over 300-fold – between the previous historical experience of ABS defaults (which I have shown in table 1 as it was captured in the default probability assumptions of *CDO Evaluator*)⁵⁴ and the actual incidence of those defaults during the crisis. Certainly, small causes can have big effects, but any analysis of the crisis that attributes it primarily to declining standards at the rating agencies would have to show a plausible mechanism by which that might have happened here.

It is, therefore, worth also considering the other gatekeepers, discussed in the second section: the traditional buyers of mezzanine ABS tranches, normally rated BBB (Adelson and Jacob 2008a). By 2005-6, those investors, and the specialists who earlier had insured the mezzanine tranches, had been almost entirely displaced: “About 90% of the recently issued triple-B-rated tranches [of subprime ABSs] have been purchased by CDOs” (Adelson 2006d, p.5). The mezzanine ABS CDO managers who replaced them did sometimes try to be discriminating in their ABS purchases. One, for example, told me how he and his colleagues tried to avoid ABSs constructed by the subprime lender Ameriquest, because they felt its lending standards were lower than those of its peers.

⁵⁴ The ABS default probabilities in *Evaluator* were obtained by “scaling” corporate default probabilities (which because of the larger numbers of corporate defaults were easier to estimate statistically) by factors that reflected overall differences between ABSs and corporate debt. An interviewee told me that the “scaling factors were chosen to provide the best overall agreement with the (limited) historical data, such as the average transition behavior of ABS and corporate ratings.”

Another told me how, despite the fact that by 2005-6 the week that traditional mezzanine-tranche buyers had been given to analyze ABSs had often shrunk to less than a day, his firm had nonetheless set up the expensive tools needed for that analysis in such a way that much of it could be performed “in an hour or two.”

However, what the constructor of a mezzanine ABS CDO could not do was avoid those tranches altogether. As another interviewee put it: “So, you know, you talk to people [CDO constructors], and they’re complaining about the quality [of ABSs] . . . But they got a mandate to do the CDO, they got to get it done. They got to buy something. So, ‘cos they want their fees.” In particular, the constructors of ABS CDOs would still buy ABSs even when their spreads no longer seemed, to ABS specialists, to justify their risks: ABS CDOs “will not hesitate to bid spreads tighter than can be fundamentally justified so long as their ‘arb’ [arbitrage] can still be made to ‘work’” (Adelson 2006d, p. 1). Indeed, the aggregate demand from ABS CDOs for mezzanine tranches of ABSs exceeded total supply (as an interviewee put it, CDOs “were so into it, that the amount of paper being created wasn’t enough for them”), so even poorly regarded ABS constructors were still able to sell their mezzanine tranches, traditionally the hardest to place. The gatekeeper role of the traditional buyers of those tranches thus vanished entirely.

To the extent that the removal of this second set of gatekeepers facilitated the loosening of standards of mortgage lending, ABS CDOs contributed to their own downfall. They were also at the pinnacle of a broader change. From 1970 to around 2000, mortgage securitization in the US could be described as predominantly being “securitization in order to lend” (a way of funding lending), and those who saw it like that had an incentive, over and above the presence of rating-agency and mezzanine-buyer

gatekeepers, to avoid poor-quality lending: even if defaults on securitized loans no longer directly impacted on them to any great degree, they would indirectly damage their organization's reputation and thus endanger future funding. In the following decade, however, these priorities were often reversed. "Lending in order to securitize" became a dominant motivation, in other words making loans in order to capture the arbitrage profits to be reaped by packaging them into ABSs, and then packaging those ABSs into CDOs. The "assembly lines" – as market participants often called them – that did this packaging needed an ample supply of raw material, in other words of mortgages. Demand for the latter was so strong that mortgage brokers found themselves the objects of eager attention from "wholesalers," representatives of banks or other finance companies who would pay commissions to brokers for their clients' mortgage applications. Some wholesalers reportedly even offered sexual favors in addition to fees (der Hovanesian 2008).

As already suggested, however, the resultant decline in mortgage-underwriting standards needs weighed up against other causes of high default rates such as falling house prices, and while the ample, relatively low-cost funding provided by securitization contributed to the house price bubble that ended in these sharp house-price falls (see, especially, Mian and Sufi 2008), it was not the only cause of the bubble. Furthermore, while mezzanine ABS CDOs were the crucial purchasers of the lower tranches of ABSs, high-grade ABS CDOs were only one source amongst others of the demand for higher tranches.⁵⁵ So the argument that ABS CDOs contributed importantly to the US mortgage

⁵⁵ These other purchasers of the higher tranches of ABSs included "conduits" and "structured investment vehicles" (SIVs), which also sought a form of arbitrage profit. They were created by banks to invest in long-term, relatively high-yielding assets such as ABS tranches, while funding themselves more cheaply by the issuance of "commercial paper" (short-term debt). It was, however, a genuine arbitrage only if commercial-paper funding remained available to the conduits and SIVs, which ceased

crisis by removing a crucial set of gatekeepers and encouraging the “lend to securitize” imperative remains a hypothesis, albeit a plausible one.

More definitively identifiable are the roles played by two further imports from credit derivatives to the world of ABSs: credit default swaps and tradable credit indices. Credit default swaps on ABSs made it possible, effectively for the first time, for traders in hedge funds and banks directly to bet against subprime mortgages. Via a default swap, such traders could buy protection on an ABS tranche (normally a mezzanine tranche, with its high exposure to default) without needing to own the securities involved. If the tranche defaulted, they would receive from the protection seller any shortfall in the money due to an owner of the securities, which would be a handsome return for modest protection premiums.

Such purchases of protection grew rapidly, especially after the terms of credit default swaps were standardized in 2005. Even though they were underpinned by skepticism about the prospects for ABSs, they paradoxically had the temporary effect of further fueling the growth of ABS CDOs, because – in a situation in which, as noted, the demand from the constructors of ABS CDOs for mezzanine ABSs had outstripped supply – they made possible synthetic ABS CDOs. Instead of buying ABSs, the latter sold protection on them, via credit default swaps, to traders betting against subprime mortgages, and used the swap premiums to pay investors. The ABS CDO “system,” if

to be the case once the crisis broke. The rating agencies had insisted that the parent banks provide their conduits with pre-agreed credit facilities should this happen, and banks often, for fear of damage to their reputations, felt obliged to support their SIVs as well. Those conduits and SIVs are thus another route, in addition to ABS CDOs, by which ABS losses were concentrated within the banking system.

one can call it that, thus quite literally absorbed the dissent that underlay the purchases of protection. Indeed, as was highlighted by the April 2010 civil fraud action launched by the SEC against Goldman Sachs, in some cases the selection of ABSs for an ABS CDO reflected input from those (such as hedge fund manager John Paulson) who wished to use the CDO as a way of hedging their exposure to subprime or betting against it.

ABS credit default swaps and synthetic subprime ABS CDOs magnified the risks of mortgage lending. If losses on the underlying mortgages reached a level that caused an ABS tranche to default, then more was at stake than the consequent losses to direct investors in that tranche such as cash CDOs. All the credit default swaps on the tranche would also be triggered, causing additional losses, for example to synthetic CDOs that had sold protection on the tranche. As ABS defaults mounted, the eventual result was massive transfers of wealth from ABS CDOs and other sellers of protection to the buyers of protection: hedge funds such as Paulson's, and those banks – notably Goldman Sachs and Deutsche – that had also started to buy protection on a large scale, either as a way of hedging their positions or as a way of profiting from the coming disaster. The total amount of such transfers is not known, but something of their scale is indicated by the fact that John Paulson made \$15 billion for his fund in 2007, mainly in this way (Zuckerman 2009). To some extent, of course, these transfers were simply from one bank to another, but they were of sufficient size dangerously to erode the capital base of those banks that had been large net sellers of protection.

The second set of imports from the world of credit derivatives, tradable credit indices, rendered visible the extent to which banks' assets had lost value. Two new broadly canonical-mechanism tradable indices – the ABX, launched in January 2006, and

its tranching version, TABX, launched in February 2007 – allowed traders to buy and sell protection on standard packages of subprime ABSs.⁵⁶ As the cost of buying protection on an ABX index rises, the level of that index falls, and because that level (unlike the price of individual ABS credit default swaps) was public, it rendered visible a decline in perceived creditworthiness. The result of a greatly increased demand from hedge funds and banks such as Deutsche and Goldman to buy protection was that the ABX indices fell sharply early in 2007, and then again from the late spring onwards. By early 2008, ABX levels implied the expectation of almost total capital losses on the BBB and BBB- tranches of the subprime ABSs they covered, and very large losses even on higher tranches (Fender and Scheicher 2008).

The banks that owned ABS CDOs and ABSs (many of the latter in “warehouses” awaiting packaging into ABS CDOs) generally held them in what are called their “trading books,” which meant – under current “fair value” accountancy regimes – that they had to be marked-to-market: i.e. revalued as market prices changed. The ABX provided a market that could be used to do just that. There was fierce dispute as to its adequacy – “ABX and TABX don’t really count as grown-up markets. The market participants needed to create proper two-way flows in ABX remain elusive” (Hagger 2007) – and there were

⁵⁶ The ABX consists of five indices, each made up of one tranche from each of the 20 largest recently-issued subprime ABSs. (The 20 tranches making up the AAA ABX index all had initial ratings of AAA, and there are similarly-constructed AA, A, BBB, and BBB- indices.) Buying and selling protection on the ABX index means entering into a credit default swap on the aggregate of the tranches making up the index in question. Originally, a new set of benchmark ABSs was selected each six months, so creating a new “series” of the ABX. This ABX “index roll” was suspended in December 2007 because too few new ABSs were being issued (Creditflux 2007), and it has not subsequently resumed.

accusations that even though tradable credit indices apparently were proper canonical-mechanism markets, they could actually be manipulated (interview data; Hughes 2008). However, there was strong pressure from auditors (some fearful after the scandals and criminal convictions earlier in the decade, notably concerning Enron and WorldCom, of “any impression that they are going soft on clients”) to use the levels of the ABX to value banks’ holdings. “It’s cover-your-ass stuff,” said one critic of the practice, but it meant that “Banks that mark assets far from where the indices trade incur the ire of their auditors” (anon. 2008, pp. 95-96).

Using the ABX, and such other market prices as were available, to value ABS and ABS CDO portfolios meant that such valuations were forward-looking: those prices incorporated predictions of defaults to come, not simply those defaults that had already happened. In the eyes of the proponents of “fair value” accounting of this kind, these valuation practices appropriately rendered mortgage-related losses quickly visible. In the eyes of its opponents, they worsened the crisis by making these predictions self-fulfilling, because they produced accounting write-downs of such a magnitude that they spilled over into “the real economy,” causing first an effective shutdown of subprime mortgage lending (leaving borrowers without opportunities to refinance, for example when “teaser” rates ended) and then a general collapse of other credit that led, *inter alia*, to a sharp rise in unemployment. In so doing, those evaluation practices may have helped bring about the huge default rates on which they were predicated.

The final process that needs examined is how ABS CDO losses came to be highly concentrated in banking and insurance, given that instruments of that kind were expected to minimize the effects of losses of this sort by allowing the shedding of dangerous

accumulations of credit risk. (Of the IMF's estimate of \$290 billion ABS CDO losses, at least half was incurred by banks, and a further 20-25 percent by insurers: see IMF 2008, p. 9, table 1.1.) The chief cause of the concentration of losses was that the safest tranches of ABS CDOs – the AAA super-senior tranches that typically made up more than half of even mezzanine ABS CDOs (see figure 4) – were hard to sell to outside investors, because the finite cashflow into an ABS CDO meant its super-senior tranche could offer only very modest spreads, usually around only 25 basis points (a quarter of a percentage point) over Libor, without overly reducing the spreads on the lower tranches.

Banks such as Merrill Lynch and Citigroup, with giant ABS CDO “assembly lines,” thus had little option but to retain most of their super-senior tranches, leaving them with huge exposures when defaults threatened even those tranches. The credit default swaps via which banks bought protection on super-senior tranches from AIG and the monolines were the largest single cause of insurers' losses. Analytically most interesting, however (because they are most directly indicative of beliefs about super-senior ABS CDO tranches), are those cases in which traders at banks without large-scale involvement of their own in ABS CDOs nevertheless chose to buy super-senior tranches originated by other banks, or to sell those banks protection on them via credit default swaps.

Most fascinating of all these cases is a trade put on by a proprietary trading group at Morgan Stanley from September 2006 to January 2007.⁵⁷ I first learned about this trade

⁵⁷ Other cases of banks buying super-senior ABS CDO tranches seem mainly to be so-called “negative basis trades,” in which a trader would buy a super-senior tranche (yielding annually around 25 basis points over Libor), buy protection on it from AIG or a monoline (for a premium around 15 basis points per annum), pay a charge around 5 basis points per annum to his or her bank's treasury for tying up the bank's capital, and thus be left with a profit of 5 basis points per annum. (I draw these “round number”

in a February 2010 interview, and a fuller, but almost entirely consistent, account was then given by Lewis (2010, pp. 200-19), on which I also draw here. The total loss on it was \$9 billion, just over half of the total credit-crisis losses that temporarily threatened the survival of the world's second most prominent investment bank (Lewis 2010, p. 215; Benmelech and Dlugosz 2009, p. 163, table 1).⁵⁸ What makes the trade interesting is that the Morgan Stanley group responsible for it was amongst those *skeptical* of the prospects

figures from an interviewee familiar with the trade. In the credit derivatives market, the “basis” is the difference between the cost of buying protection on an asset such as a CDO tranche and the spread that the asset offers; here the basis is negative, hence the trade’s name.) Because the swap seemed to eliminate whatever modest credit risk was involved in the super-senior tranche of an ABS CDO, it enabled that tranche to be classed in banks’ risk management and accounting systems as fully hedged, which in turn allowed the full present value of the 5 basis point per annum profit to be “booked” immediately as “Day 1 P&L” (immediate profit: “P&L” is profit and loss). UBS’s traders, for example, bought super-senior tranches totaling \$20.8 billion, \$15 billion of them for negative basis positions, and the latter were all judged “Day 1 P&L eligible” by the bank’s relevant division, Business Unit Control (UBS AG 2008, pp. 14-15 and 23). Some traders may privately have doubted whether, in the cataclysmic scenario in which widespread losses were incurred even on super-senior tranches, the monolines or even AIG would have the financial strength to pay out, but in order to secure Day 1 P&L, “people bought protection they knew was worthless but that they know they will never need,” as a risk manager at another bank told me in an email message on April 8, 2008 (at which time the full extent to which they actually *did* need that protection was only gradually becoming clear). That quotation suggests belief that the position was safe (and so suggests these cases are like the Morgan Stanley trade discussed in the text) and the interviewee who explained the economics of the trade also indicated to me that it involved genuine belief in the AAA ratings of super-senior ABS CDO tranches. It is worth emphasizing, in this context, that though the trade was conducted on such a giant scale that it could threaten the survival of UBS, its profitability was modest. At 5 basis points per year on \$15 billion, the trade’s profit was \$7.5 million per annum, which for a major bank is almost immaterial.

⁵⁸ Morgan Stanley’s purchases of protection on other ABS CDO tranches generated a profit of \$2.3 billion, hence the lower (\$7.8 billion) total ABS CDO loss quoted earlier.

for the US mortgage market, and like others they had accumulated a large (\$2 billion) “short” position in credit default swaps on BBB mezzanine tranches of ABSs, in other words a position that would pay out, via the swaps, if those tranches defaulted. They were – rightly – convinced that the position would thus be extremely profitable, but until that happened it was what traders call a “negative carry” position: keeping it in place required expenditure (the premiums that had to be paid to the protection sellers). A common way of eliminating the negative carry of a “short” BBB position (and of hedging against the possibility that one’s pessimistic view of creditworthiness is wrong) is to match it with a “long” AAA position in the sector in question, the rationale being that a decline in creditworthiness will have a far greater impact on BBB than on AAA assets, while the income from being long the latter (i.e. from holding them or selling protection on them) will eliminate the negative carry. So the Morgan Stanley group did just that in late 2006 and early 2007. Unfortunately, though, they did this not by going long AAA ABS tranches, but going long AAA ABS CDO tranches. They matched their \$2 billion of purchases of protection on BBB *ABS* tranches with \$16 billion or more of sales of protection on AAA super-senior *ABS CDO* tranches. (The different in size – again perfectly understandable – reflected the fact that BBB tranches are far more sensitive to declines in credit quality and have much higher credit default swap premiums than AAA.⁵⁹)

The difference between a AAA position in ABSs and in ABS CDOs may seem minor, but it changed the nature of the trade utterly. The asset pools of the ABS CDOs in

⁵⁹ There is a discrepancy between my interview data and Lewis’s account concerning the exact ratio of the two positions and the rationale for it, but fortunately that is not crucial to the analytical import of the episode.

which the Morgan Stanley traders had a long position consisted largely of mezzanine ABS tranches of the kind they were short. In the terminology of the world of corporate CDOs, that it made it a correlation trade, and had the position been shown to a correlation trader he or she would immediately have seen that the trade utterly depended on the correlation of those BBB tranches remaining at the modest levels reflected in the AAA rating. If correlation was high, and if some BBB tranches defaulted (as the Morgan Stanley traders expected them to), then it was probable that many other such tranches would also default. If that happened, even the AAA super-senior tranche of an ABS CDO composed of these tranches would be likely to default in its turn. Indeed, a corporate correlation trader, in a different section of the bank, would simply not have been allowed to take on such a gigantic exposure to correlation, as this position would have been understood, in that section, to involve.

The fact that the position was taken on indicates either belief that correlation was indeed low, or simply belief that a tranche rated AAA must be much more creditworthy than a BBB tranche. (It is more likely that it was the latter, but my data do not allow me to be certain.) Crucially, the detailed history of the trade reveals that such convictions were not restricted to the Morgan Stanley group. Merrill Lynch turned down the latter's offer to buy \$2 billion of its super-senior ABS CDO tranches because the 28 basis point spread Morgan Stanley demanded was greater than the 24 basis points Merrill was prepared to pay (Lewis 2010, p. 208). The difference, as Lewis points out, was a mere \$800,000 a year, a sum Merrill's traders would surely gladly have paid had they thought that there was any real risk of the tranches in question defaulting. Similarly, even as the crisis began to unfold in July 2007, two other banks, UBS and Mizuho Financial Group,

purchased large chunks of Morgan Stanley's super-senior ABS CDO positions from it at what appears to be reasonably close to face value.

Within a matter of days, such sales could no longer be made. When Morgan Stanley finally extricated itself from some of the remainder of its super-senior position by selling it back to Deutsche, it received only 7 percent of its face value (Lewis 2010, p. 214). In a single year, a \$16 billion ABS CDO position that had been evaluated as AAA had apparently lost up to 93 percent of its value.⁶⁰ Repeated across the portfolios of many of the world's leading banks, falls of this kind helped push many of them close to, or beyond, the boundary of insolvency.

Conclusion

This article has shown how the clusters of evaluation practices surrounding ABS and CDOs differed, and how (via the "convention" formed by the ratings-spreads nexus and the organizational division of labor in ratings agencies) those practices fueled an arbitrage that had the disastrous consequences outlined in the previous section. A number of questions nevertheless remain.

One question is substantive: since corporate CDOs themselves embodied an arbitrage similar in its nature to the ABS CDO arbitrage, why did they not have similar disastrous effects? The answer appears to be contingent. The capacity to sell on "leveraged loans" (loans that were used mainly for "leveraged buyouts," in other words debt-fueled takeovers) by packaging them into CDOs helped increase levels of leverage,

⁶⁰ I write "apparently" because, as indicated in the discussion of the ABX above, it remained the case that there was no fully definitive way of valuing positions of this kind.

and it did loosen lending standards in that sector too. In particular, CDO funding was associated with less tight loan covenants (these covenants give rights to creditors and impose restrictions on borrowers). However, the other correlates of the packaging of leveraged loans into CDOs – cheaper and more readily available credit – had the countervailing effect of making it possible to finance leveraged buyouts of much larger firms. The fact that other things being equal such firms are safer – they “generated more free cash flows ... and were less risky” (Shivdasani and Wang 2009, p. 5) – seems to have counterbalanced the effects of the tendency to looser covenants.⁶¹ As in other aspects of the account given here, specific contingencies (in this case, the presence in corporate lending of a countervailing effect absent in mortgage lending) matter greatly.

A more general issue, an analytical one, raised by my focus on evaluation practices concerns belief. Should we understand the conduct of those practices and the use of their results as having been driven by belief in them, or should it be seen as cynical, as driven simply by the pursuit of gain (for example, by earning fees from ratings)? More broadly, were those involved self-interested rational actors freely choosing their actions, or did those actions, at least sometimes, “incorporate institutional rules by taking them for granted without much decision or reflection” (Meyer 2009, p. 41)? Did “habit” (Camic 1986) or even “habitus” (e.g., Bourdieu 1984) play a role?

Of course, habits and social interests are interwoven: what is in our interest often becomes habitual (as, indeed, Bourdieu’s work reminds us). Nevertheless, because of the

⁶¹ See also Hu, Solomon, and May (2008), who show that loans packaged into CLOs (as CDOs whose pools are leveraged loans are called) suffered fewer downgrades on average than a control group of non-packaged loans.

understandable desire to assign blame it is easy in the aftermath of a calamity such as the credit crisis to adopt too simplistically what (Vaughan 1996, p.36) calls the “amoral calculator hypothesis.” Certainly, reflexive, calculative action has played a major role in my narrative: what is arbitrage, after all, if it is not action of this kind, action that exploits discrepancies in others’ evaluations (see Beunza and Stark 2004)?⁶² Yet the episodes discussed here include at least one set of cases (the super-senior ABS CDO trades outlined at the end of the previous section) that are hard to interpret without invoking belief either in evaluation practices or in the ratings that were their products. Nor, I think, would amoral calculation be a correct interpretation of the way the rating agencies evaluated ABS CDOs: I have found no clear evidence that they saw the danger of ABS CDOs, and ignored it for the sake of fees. On the contrary, the evaluation of ABS CDOs using existing corporate CDO models and similar correlation values is plausibly interpretable as organizational routine: the extension to a new domain of evaluation practices that were familiar and convenient, and that did not involve the considerable development effort that analyzing ABS CDOs in the alternative ways I sketched in that section would have needed.

The analogy with Vaughan’s work also raises a second analytical issue: organizational structure. There is a sense in which the account presented here contrasts quite sharply with Beunza and Stark’s (2004) discussion of arbitrage, despite our shared

⁶² It would also, for example, be quite mistaken to imagine that all ratings were believed in. Thus one of my rating-agencies interviewees reported a discussion with investors, prior to the crisis, about a type of market-value CDO (see note 28) called a CPDO, Constant Proportion Debt Obligation, which a different agency had rated AAA. He told them that in his view a more appropriate rating would be BBB. They agreed, but they still welcomed the AAA rating because of the lower regulatory capital-reserve requirement the higher rating brought with it.

focus on differences between evaluation practices. In their analysis, “the friction among competing principles of arbitrage” is productive: it “generates new ways of recognizing opportunities” (Stark 2009, p. 16). While that is the case here too, it is so only temporarily: opportunities that *are* recognized are soon eclipsed by dangers that are not identified. Instead of Stark’s “heterarchy” (flexible governance that makes friction productive by facilitating organizationally-distributed “reflexive cognition,” with for example elements of “self-management” and “lateral accountability” rather than simply “vertical authority”⁶³), what I have found is more often reminiscent of the rigidities and barriers to information flow in the background of the Challenger disaster (Vaughan 1996). As noted in the introduction, the ABS CDO seems less the productively polysemic “boundary object” of the social studies of science (Star and Griesemer 1989) than a kind of epistemic orphan, cognitively peripheral to its parent worlds, and not the object of a new creole or even much of a pidgin (q.v. Galison 1997).⁶⁴

What is in retrospect striking is how little sense there was before the crisis of the dangers that were accumulating in ABS CDOs. As noted in the introduction, the first interviews for the research reported here were conducted in 2006 and early 2007, before

⁶³ Stark (2009, pp. 5 and 113). The notion of “heterarchy” is of course the inheritor of a long-standing strand of work in organizational sociology, stretching back at least to the “organic management” identified by Burns and Stalker (1961) as suitable for fast-changing environments.

⁶⁴ For example, while there were around a dozen textbooks of corporate CDO correlation modeling, and hundreds of publicly available technical reports and research papers stretching back at least to 1996, there was no textbook of the equivalent practices in regard to ABS CDOs and I have been able to find only three publicly available research papers, all from the end of the period discussed here (2007-8) and by the same two researchers from the Franco-Belgian Bank, Dexia (e.g. Garcia and Goosens 2008).

the crisis, and they concerned the evaluation practices surrounding corporate CDOs. The practitioners of these had their concerns – one rating-agency employee reported: “Some investors have said ... to us ... ‘does a AAA mean the same thing as it meant five years ago?’” – but to the extent that those concerns had a specific focus it was a sophisticated form of CDO called a CPDO (constant proportion debt obligation), not the vastly bigger volume of the “boring” ABS CDOs. Similarly, the pre-crisis conference “trip reports” by Mark Adelson of Nomura (now publicly available: see e.g. Adelson 2006c,d and 2007a) reveal widespread awareness amongst ABS specialists of growing problems and high levels of fraud within the US mortgage market, but not the perception that the apparently safe ABS CDOs were exquisitely exposed to those problems. To recognize the dangers of ABS CDOs, one had to have an awareness both of the risks accumulating in ABSs *and* of the pivotal role of the assumption of only modest correlation amongst those ABSs in the evaluation of ABS CDOs, and it seems as if few did. Certainly, those who were prepared on the very eve of the crisis to buy the super-senior tranches of those CDOs seem not to have had.

Again, the amoral calculator hypothesis is conceivable: that some of the almost complete pre-crisis silence on the dangers of ABS CDOs was a version of Bourdieu’s “complicitous silence,” the silence of those who could have spoken but did not do so.⁶⁵ Stark’s work, however, suggests an alternative conjecture: that it would have taken heterarchical organization to fuse together the two institutionally separate insights needed fully to grasp those dangers. The conjecture is plausible: in particular, Goldman Sachs, reported by several of my interviewees to be more heterarchical in its organization than

⁶⁵ “The most successful ideological effects are the ones that have no need of words, but only of *laissez-faire* and complicitous silence” (Bourdieu 1990, p. 133; see Tett 2009b).

most other major banks (it was a partnership, not a public company, until 1999), escaped financially almost unscathed. Unlike almost all other banks, Goldman hedged or liquidated its ABS and ABS CDO positions several months before the crisis. However, the systematic, comparative organizational research needed to test the conjecture is, for reasons of access, currently impossible.

This is only one of the ways in which the account given here does not claim to be comprehensive. I have emphasized that my aim is to complement other explanations of the crisis, not to replace them, and the account I have given clearly needs integrated with broader analyses, for example of the causes of the generalized increase in risk-taking in banking in the run-up to the crisis. (Although I've emphasized the crucial role of ABS CDOs in the crisis, some banks – such as Lehman and the UK's HBOS – rendered themselves insolvent or close to it mainly by old-fashioned reckless lending, particularly in commercial property.) Nor has my account exhausted the sociological interest of credit derivatives, which are for example a rich topic for Muniesa's (2007) "pragmatics of prices."⁶⁶ There are also at least two further ways in which other forms of the economic sociology of evaluation could be applied in this area. First, it has been crucial to the

⁶⁶ Restrictions on the dissemination of the prices of credit derivatives – even those traded in what are in other respects canonical-mechanism markets – mean that there is often no unique set of market prices. Dealers can, and do, quote different prices – narrower or broader spreads between the prices at which they will buy and sell protection – to different categories of market participant. Again, materiality matters, in this case via the technical possibility of capturing the email messages containing dealers' price quotations and extracting and then circulating the prices they contain, a possibility which some dealers have attempted to block by making their emails non-forwardable. CMA, a firm specializing in extracting prices in this way, has circumvented this by developing a system that in effect electronically "scans" these non-forwardable emails.

development of the credit default swap market that these swaps are not classed as insurance, because if they were the buyer of protection would have to own the asset in question or have some other “insurable interest” in it, and the seller would be governed by the regulatory framework surrounding insurance. The contested legitimacy of contracts that resemble insurance but do not have these features largely remains to be studied (though it is touched on by Huault and Rainelli-Le Montagner 2009, pp. 559-60).

Second, in my interviews there is an intriguing hint of the presence of an “order of worth” (Bolanski and Thévenot 2006; Stark 2009) quite different from monetary calculation. One interviewee told me how, as mortgage defaults mounted, traders in his bank started to exclaim “No respect for the obligation!” I confess that I was so unused to hearing moralism of this sort from City of London or Wall Street traders that I asked him whether they were being ironic, and was told they were not: they were genuinely affronted by what they took to be violations of moral obligation. In other contexts it would be regarded as positively irrational if the owner of an asset who enjoys limited liability (as, *de facto*, American residential-mortgage borrowers generally do) does not default when the asset’s market value falls far below the sum of debt that funds it.⁶⁷ This may be an indication that – even amongst Wall Street traders – personal debts, especially home mortgages, with all their entanglement in the world of domesticity,⁶⁸ implicitly enjoyed a

⁶⁷ The postulate that a firm’s shareholders will allow it to default when this happens is the foundation of the “Merton model” (see note 32) that informed the development of the Gaussian copula. Only in certain states, such as California, are home mortgages legally no-recourse loans, but in practice US mortgage lenders seem not to pursue defaulters’ other assets, even when legally they can, because the costs of doing so tend to be larger than the sums recovered.

⁶⁸ See Boltanski and Thévenot (2006, pp. 164-78), though what they mean is broader than the ordinary meaning of the domestic.

special status, perhaps even that this special status in some way underpinned the pervasive sense that mortgage-backed securities were uniquely safe. That, though, is speculation, and certainly cannot be tested with the data I have.

I hope that in its focus on evaluation practices at the heart of the credit crisis, the article has thrown some light on it, and has also shown that attention to these practices is of interest to economic sociology more generally. If nothing else, the crisis has shown how dangerous it can be (for example to public policy) to assess market processes in abstraction from the cognitive and organizational reality of evaluation practices. In April 2006, the IMF noted:

There is growing recognition that the dispersion of credit risk by banks to a broader and more diverse group of investors, rather than warehousing such risks on their balance sheets, has helped to make the banking and overall financial system more resilient. (IMF 2006, p. 51)⁶⁹

As we now know, quite the opposite was in fact happening. Driven in part by the evaluation practices and organizational processes discussed here, risk was being accumulated, not dispersed, and the financial system was growing more fragile, not more resilient. There can surely be no more vivid demonstration of the need for a broadening of the disciplinary basis of research on financial markets, and in that broadening economic sociology has a vital role to play.

⁶⁹ In fairness to the IMF, I should acknowledge that it did point out that while “pricing data are relatively easy to obtain ... measuring the degree and effectiveness of risk transfer continues to present statistical and methodological challenges” (IMF 2006, p. 78)

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	S&P	Moody's
	AAA	Aaa
	AA+	Aa1
	AA	Aa2
	AA-	Aa3
	A+	A1
	A	A2
	A-	A3
Investment	BBB+	Baa1
Grade	BBB	Baa2
	BBB-	Baa3
<hr/>		
Speculative	BB+	Ba1
Grade	BB	Ba2
	BB-	Ba3
	B+	B1
	B	B2
	B-	B3
	CCC+	Caa1
	CCC	Caa2
	CCC-	Caa3
	CC	Ca
	C	C
<hr/>		
Defaulted	D	

Figure 1: rating grades

Fitch's grades are identical to S&P's, except that Fitch employs a single CCC grade with no + or – modifier. Sources: <http://www2.standardandpoors.com>; <http://v3.moodys.com>; <http://www.fitchrating.com>. All accessed August 20, 2009.

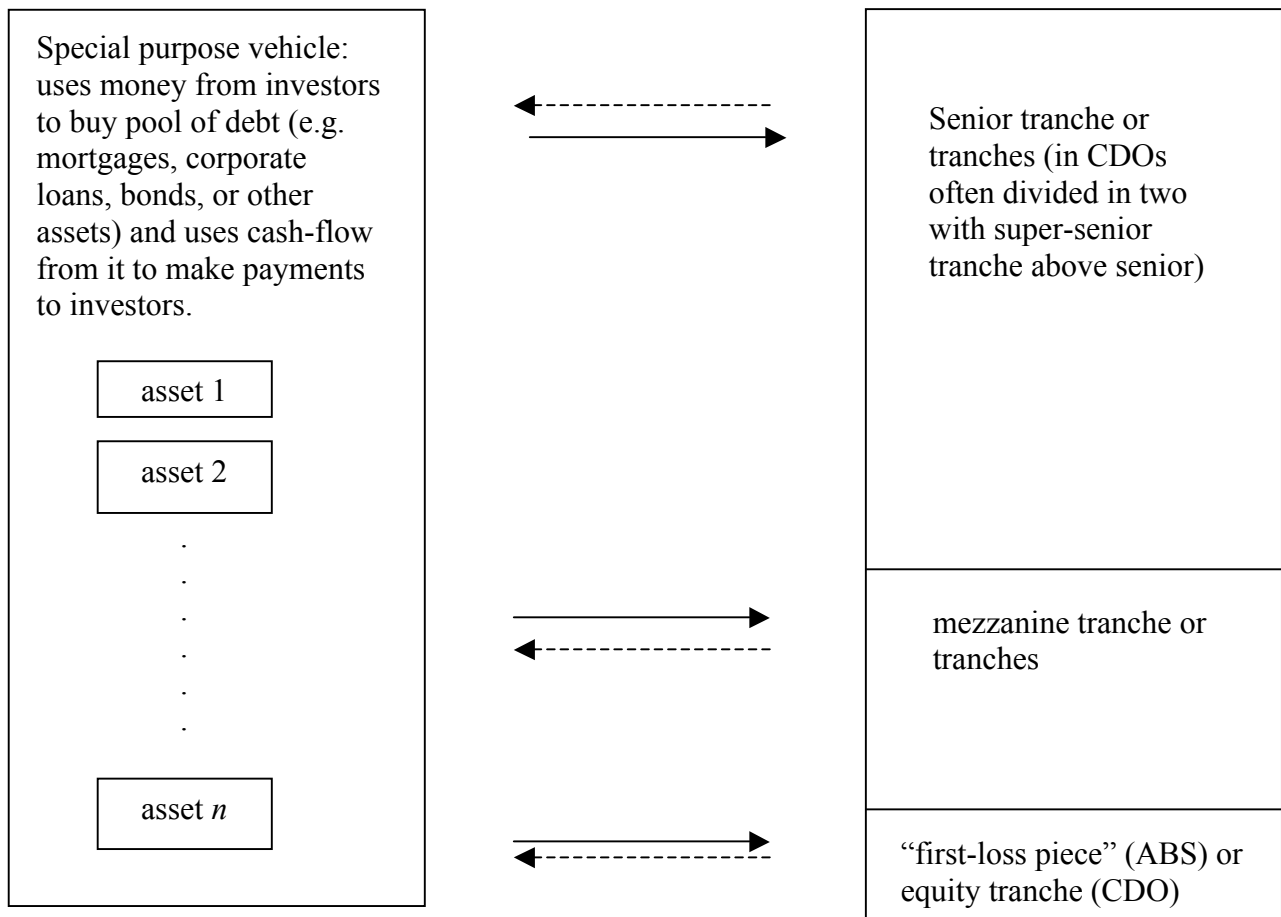


Figure 2: An ABS or CDO (simplified and not to scale)

←----- capital investments by investors
 -----→ payments to investors

Investors in lower tranches receive payments only if funds remain after payments due to investors in more senior tranches are made. In an ABS the assets in the pool are typically mortgages or other consumer debt. In a corporate CDO they are loans made to corporations or bonds issued by them. What is shown is a “cash CDO”: in a “synthetic CDO” the special purpose vehicle “sells protection” on the assets via credit default swaps (see the third section of the article) rather than buying them.

AAA	81%
AA	11%
A	4%
BBB	3%
if securities issued, either rated BB or not rated	1%, not in all deals

Other credit enhancement:
excess spread, over-
collateralization

Figure 3: schematic structure of a typical subprime mortgage-backed security.

Source: based on Lucas (2007). Note that the overall size of the tranches is not shown to scale. The lowest tranche was often replaced by over-collateralization (see note 27 for the meaning of this and of “excess spread”), but if first-loss securities were issued they were generally either unrated or rated BB.

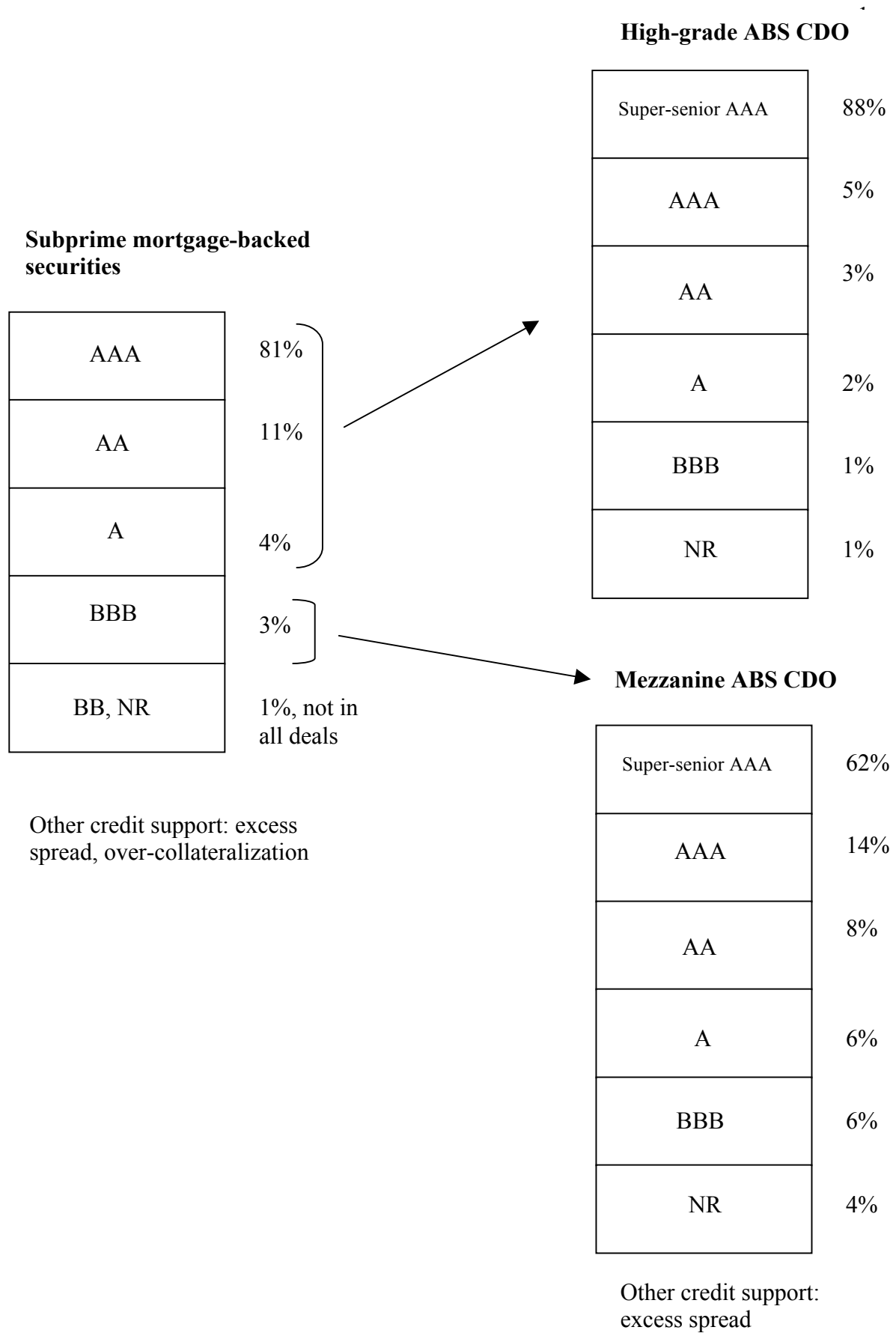


Figure 4 Packaging tranches of subprime

mortgage-backed securities into ABS CDOs.

Source: modified from Lucas (2007).

Tranche sizes not shown to scale.

“NR” means “not rated.”

	<i>CDO Evaluator</i> three-year default probability assumptions, as of June 2006 (percent)	Realized incidence of default, as of July 2009 (percent)
AAA	0.008	0.10
AA+	0.014	1.68
AA	0.042	8.16
AA-	0.053	12.03
A+	0.061	20.96
A	0.088	29.21
A-	0.118	36.65
BBB+	0.340	48.73
BBB	0.488	56.10
BBB-	0.881	66.67

Table 1 *CDO Evaluator's* three-year default probability assumptions versus realized default rate of US subprime mortgage-backed securities issued from 2005 to 2007.

Sources: Adelson (2006a); Erturk and Gillis (2009).