

N° 014

2009

From New Deal institutions to capital markets:
commercial consumer risk scores and the making of subprime
mortgage finance

Martha Poon
University of California, San Diego
Department of Sociology
mpoon(a)ucsd.edu

CENTRE DE SOCIOLOGIE DE L'INNOVATION
MINES PARISTECH / CNRS UMR 7185
60 Boulevard Saint-Michel
75272 Paris cedex 06 FRANCE
<http://www.csi.ensmp.fr/>

PAPIERS DE RECHERCHE DU CSI

Cette collection a pour but de rendre aisément disponible un ensemble de documents de travail et autres matériaux de discussion issus des recherches menées au CSI (CENTRE DE SOCIOLOGIE DE L'INNOVATION).

Tous les droits afférant aux textes diffusés dans cette collection appartiennent aux auteurs.

Des versions ultérieures des papiers diffusés dans cette collection sont susceptibles de faire l'objet d'une publication. Veuillez consulter la base bibliographique des travaux du CSI pour obtenir la référence exacte d'une éventuelle version publiée.

CSI WORKING PAPERS SERIES

The aim of this collection is to make easily available a set of working papers and other materials for discussion produced at the CSI (CENTRE DE SOCIOLOGIE DE L'INNOVATION).

The copyright of the work made available within this series remains with the authors.

Further versions of these working papers may have been submitted for publication. Please check the bibliographic database of the CSI to obtain exact references of possible published versions.

CENTRE DE SOCIOLOGIE DE L'INNOVATION
MINES PARISTECH / CNRS UMR 7185
60 Boulevard Saint-Michel
75272 Paris cedex 06 FRANCE
<http://www.csi.ensmp.fr/>

A complete version of this paper is to appear in Accounting, Organizations and Society, special issue, "Tracking the numbers: Across accounting and finance, organizations, markets and cultures, models and realities", forthcoming, 2009.

From New Deal Institutions to Capital Markets:
Commercial consumer risk scores and the making of subprime mortgage
finance¹

Martha Poon

*Science Studies Program, University of California San Diego, Department of Sociology,
401 Social Science Building, La Jolla CA, 92093-0533, United States /
Center for the Sociology of Innovation, Ecole Nationale Supérieure des Mines de Paris,
60 boulevard St. Michel, 75272 Cedex 06, Paris, France*

¹ Acknowledgements are extended to Michel Callon, Emmanuel Didier, Steven Epstein, Horacio Ortiz, Onur Ozgode, Zsuzsanna Vargha and two rigorous anonymous reviewers for their assistance in the preparation of this paper. An earlier version of this work benefited from a graduate writing seminar hosted by Bruno Latour at Science-Po (Paris, France). The final version was fine-tuned at a CODES meeting of David Stark's Center on Organizational Innovation, Columbia University (New York, USA). The research reported here has been supported by NSF award no. SES-0451139. This paper was awarded the 2008 Sally Hacker - Nicholas Mullins Award from the American Sociological Association - Science Knowledge & Technology Section (ASA-SKAT).

E-mail address: mpoon@ucsd.edu

“The shift from reliance on specialized portfolio lenders financed by deposits to a greater use of capital markets represented the second great sea change in mortgage finance, equaled in importance only by the events of the New Deal.”

*FRB Chairman Ben Bernanke
August 31, 2007²*

Introduction: From New Deal Institutions to Capital Markets

At the tail end of 2006, the ‘subprime’ hit the news with a bang when default rates shot up in a segment of mortgage finance that had previously received little attention in mainstream reporting. Against rising central bank interest rates, and following the collapse of the housing bubble, borrowers bearing certain high-risk classes of loans ceased to maintain their repayment schedules. By the turn of 2007, the unanticipated inability of lenders to raise enough capital from borrowers impeded their own instalment payments to international residential mortgage backed securities (RMBS) holders. Major subprime lenders declared bankruptcy and several high profile hedge funds imploded. As regularized transnational circuits of capital flow broke down in the space of only a few months, the problem escalated into a financial credit crunch that soon took on global proportions. This series of all too recent and as yet ongoing events has made evident the long chain of financial connections that have come to co-ordinate the economic agencies of ordinary U.S. homeowners with those of international capital investors.

Those working at the intersection of ‘social studies of finance’ and ‘social studies of accounting’ (Miller, 2008) might immediately suspect that instabilities in the segment named ‘subprime’ have been accompanied by important organizational and infrastructural changes whose underlying significance, through disruption, are perhaps only now coming to light. One of the most dramatic of these transformations has occurred in the business of mortgage finance which sits at the nexus between the markets for real estate and those for asset backed securities. As emphasized by Federal Reserve

² Remarks made by Chairman Ben S. Bernanke at the Federal Reserve Bank of Kansas City’s Economic Symposium, Jackson Hole, Wyoming, August 31, 2007. The text is available online at <http://www.federalreserve.gov/boarddocs/speeches/2007/20070831/default.htm>.

Board Chairman Ben Bernanke in a speech responding to current events in the last ten years (quoted above), U.S. mortgage finance has shifted from an industry driven by government sponsored enterprises (GSEs) and specialized deposit-funded lenders, to an industry fuelled in large part by high-risk investment capital. No longer the purview of local banks and savings co-operatives, consumer mortgages have become the asset class feeding some of the most popular debt securities for sale on Wall Street.

The shift towards the unfettered involvement of private capital in mortgage lending and its downstream effects are becoming widely recognized in the U.S. A *New York Times Magazine* contributor who had just received a letter informing him that his mortgage obligations were being transferred to another financial group, expressed his personal sense of shock in this way: "...it came to me as a thunderous revelation: my debts were some other people's assets" (Kirn, 2006). In this spirit, the movement towards big capital has been tied to many of the most cited reasons in mainstream commentary for how mortgage credit became unsustainably amplified in the last few years. The profit driven interests of investment banks and hedge funds have ostensibly encouraged unscrupulous and irrational lending, fraudulent income reporting, a reduced responsibility towards the personal situation of borrowers. This was compounded by a naïve borrowing in the face of increasingly complex financing options and negligence on the part of the federal agencies who should have been protecting consumers from predatory lending. Critiques such as these have been deployed in the style of a classic 'sociology of errors' (Bloor, 1991), in which deviations from a retrospectively appropriate course of action are rooted out and condemned.

Analyses of technical systems that focus on (human) error are fundamentally 'asymmetric' because they are confined to situations of breakdown or crisis. This is why the *post hoc* denunciation of deleterious actions triggered by this new brand of mortgage finance reads like a stale list of 'the usual suspects' – the ones that are routinely rolled out whenever there is an issue with crushing consumer indebtedness (Black, 1961). This kind of reasoning leaves us open to two popular poles of argumentation: either to the ideologically driven conclusion that the current financial crisis is due to the natural excesses of free-marketteering run amock; to a 'contagious' psychology of 'irrational exuberance' (Shiller, 2005; 2008); or to a moralistic accusation that investment bankers allowed themselves to be seized by a greed-induced passion that temporarily overcame

their otherwise sound economic good sense. Either way, these perspectives sidestep the pressing contemporary question of how a financial network for lending so freely has come into being. Crisis or no crisis they fail to provide a compelling account of how these private capital players have managed to encroach, in practice, upon a marketplace the federal government has had to actively sustain, through specialized government sponsored agencies, since the New Deal. If government charters were once necessary to make the connections for liquid mortgage finance to exist – and in particular for making mortgage funding available to credit strapped populations – a move towards financial markets that sidesteps these entities cannot be sufficiently explained by a spontaneous ramping up of credit volume through supply and demand; and even less so by some kind of natural willingness among capital investors to cater to a consumer segment called the ‘subprime’.

How has mortgage finance been rendered open to the practices of high-risk investment that appeal to big capital players? Surely, something might be said about the genesis and development³ of subprime finance as a novel network of investment grade lending in and of itself. It is perhaps of interest, then, to take a step back from the collapse and to investigate the implementation of new calculative infrastructures and their consequences on how mortgage finance is arranged. To track such a change means taking up the painstaking search into the most mundane of details so familiar to social studies of science (Bowker & Star, 2000; Star, 1999) and of accountancy (Hopwood, 1987; Hopwood & Miller, 1994); it means exploring the innovations that have re-configured markets, their machineries and their places (Beunza & Stark, 2004; Çalışkan, 2007; Guala, 2001; Muniesa, 2000; Zaloom, 2006). In the case of the diffused industry of mortgage finance it means prying into the everyday apparatuses of underwriting and into the rise of consumer risk management techniques that have permitted a dramatic production of increased liquidity. Such an analysis would conclude that understanding subprime lending is less about unravelling the motivations and psychologies that might lead to financial overextension, than it is about understanding the development of technical apparatuses that have supported the practical activities of a new cadre of financial agents (Hopwood, 2000).

³ The term ‘genesis and development’ is borrowed from the work of Ludwig Fleck, a classic text on the establishment of scientific facts in science studies (Fleck, 1981)

Instead of questioning why so much mortgage credit was extended to borrowers at a high-risk of defaulting; instead of conflating the crisis with a set of culturally familiar categories such as the ‘poor’ or the ‘economically vulnerable’; instead of presuming to know what it is that is collapsing and offering calculatively empty, off-the-shelf reasons for why, this paper traces the technical constitution of an investment subprime – at once a class of consumers, a set of ‘exotic’ mortgage products, and a class of mortgage backed securities – as a viable and fluid network of high-stakes financial action. It may be helpful to note that generating financial action of this type is substantially more complicated problem than single market formation (see, for example (Garcia-Papet, 2007)). In the case of mortgages, making debts fungible involves numerous transactions crosscutting what might be considered four distinct markets arenas: First, there is market for real estate where home buyers and sellers meet to exchange property. Next, there is the market for loans, where homebuyers receive credit from financial institutions. Third, there is the point of exchange between mortgage brokers and wholesalers who pool loans.⁴ Finally, there is the secondary market where pools of these mortgages are packaged by securitizing bodies and sold off to international investors as financial products. For the full circuit to function, money or credit flows transversally in one direction while what is known as ‘paper’ in the industry, or debt, flows in the other. This is an extraordinary problem of coordination that demands much more than single interface where buyers and sellers meet.

Consistent assessment is central to framing financial exchanges. (In the absence of sustained calculation no financial action is possible, and there is little or no secondary mortgage market.) To create liquidity in any circuit of mortgage finance – government sponsored or otherwise – numerous agents must come to similar understandings of the value of the asset backed paper so that it can be successive transferred between market participants. If the overarching problem is to organize heterogeneous actors to agree upon the qualities of goods (Callon, 1998a; Callon, Méadel & Rabeharisoa, 2002), then there is strong reason to suspect that the recent explosion of secondary subprime financial activity is the result of a process thorough which a novel chain of mortgage valuation has been put into place. Rather than assuming that calculation is a monolithic means to market organization, however, this research takes for granted that calculative activities are by nature disorderly – that is, that at the outset, there are as many potential

⁴ For a detailed account of this particular market interface see (Bitner, 2008).

solutions to a problem of valuation as there are participating agents. From this position, stories about paradigmatic shifts towards quantification, models, or risk management are inadequate explanations, for even if such movements could spontaneously occur, it is unlikely that agents working on a calculative problem independently, from different fields, would spontaneously come to the same evaluative results.

To understand unprecedented subprime liquidity the empirical concern is to document the work that has been done to selectively reduce calculative multiplicity, particularly with regards to low quality loans. Instead of taking the uniformity of calculative frames from real estate to the secondary markets for granted, this paper will explore the importation of a distributed calculative (Hutchins, 1995) analytic apparatus into mortgage origination. In 1995, the GSE known by its nickname, 'Freddie Mac', adopted a commercially available consumer risk assessment tool called a FICO[®] credit bureau score which was originally designed to control risk in consumer credit (credit cards, small loans etc.). At that time, Freddie's goal was simple and clear: it wanted to standardize underwriting practices in federally sanctioned, prime mortgage lending by introducing a consistent means of screening credit risk into its newly automated system. The paper follows the gradual, sequential and material movement⁵ of this specific risk management tool, the FICO[®], as it spread from the GSEs throughout mortgage finance. It documents how, in redefining the calculation of prime quality, commercial scores simultaneously provided an expression of non-prime quality whose quantitative granularity was unprecedented.

What this account intriguingly suggests is that the displacement of the New Deal institutions through the activation of capital players is not a result of inaction or inattention on the part of GSE managers. To the contrary, the intensification of high-risk lending has been built out of the GSE's very own initiatives to wrest calculative control over mortgage finance.⁶ The key word is 'built'. The GSE's authoritative endorsement of a particular commercial solution to the problem of consumer credit risk assessment created the conditions of its widespread adoption. But this alone did not guarantee that all players would resort to the same risk management tool. Once marked

⁵ In an era where information transmission can seem effortless, the term 'material' is used to emphasize that the transfer of consumer credit scores packaged and sold as a commercial product comes with important monetary as well as organizational costs. It further signals that this movement is sequential rather than instantaneous, that it passes through physical media, rather than through a generalized culture or human cognitive capacity; and that it leaves behind traces that can be empirically followed.

⁶ For a key statement on how the state and accounting might be analyzed as mutually constitutive see (Miller & Rose, 1997).

by the government agencies' authoritative interpretation and entrenched in their newly automated underwriting software, continuous infrastructural investment had to be made to ensure that FICO® scores would be taken up and used in similar ways across the industry. Ratings agencies such as Standard & Poor's would, in turn, play an active role in stifling calculative diversity by translating the FICO® into non-government channels for securitization.

The establishment of FICO® as a common calculative tool in mortgage making led to clear changes in lending practices. As the paper will further show, once a common interpretation of these scores was achieved, a gradual shift away from traditional, exclusionary practices of credit *control-by-screening* and towards graded practices of credit *control-by-risk* occurred. Where subprime lending required overriding the very judgment that was central to *control-by-screening* (since by definition a subprime loan was a mortgage that has been screened out), in a regime of *control-by-risk*, subprime lending became an exercise in risk management within a newly created space of calculative possibility. Under *control-by-risk*, managerial decision making was no longer confined to approving or withholding loans, but was extended to the exploitation of stabilized grades of credit quality accessed through scores to create multiple borrowing options tailored to accommodate varying levels of risk. This point is pivotal. It is through this calculative shift, enacted through FICO®, that the original GSE markets were circumvented by the development of a second, infrastructurally distinct circuit of high-risk mortgage investment known as the 'subprime'.

Tracking FICO® credit bureau scores

Work on financial markets is only one part of a broader research movement towards an anthropology of markets that considers exchange as the outcome of intensive processes of economic formatting⁷ (Callon, 1991; 1998b; Callon & Çalişkan, forthcoming).

⁷ The term 'economic formatting' might be thought of as a less cumbersome term for what Callon has also called 'economization'. It refers to the process through which activities, arrangements and behaviours are qualified as 'economic'. Because Callon argues that there are multiple definitions of what is economic and that these are perpetually under construction, controversy and maintenance, cases of economic formatting can only be identified empirically according to the definitions that actors themselves deploy for what constitutes an economic situation.

Although the social studies of finance⁸ as a movement is perhaps broader than influential science and technology studies renditions would have it (compare (Godechot, 2001) to (MacKenzie, 2006)) an attentiveness to technologies of calculation – both mathematical and non-mathematical variants (Callon & Muniesa, 2002) – has certainly been central to work in this field. Calculation comes into play in retail markets (Cochoy & Grandclément, 2006; Lave, 1988; Lave, Murtaugh & de la Rocha, 1984) or labor markets (Godechot, 2006), among others, but it plays a special role in finance where the products being exchanged are not only the objects of calculation, but are in and of themselves (as with securities and derivative products) mathematical derivations based on underlying commodities, risk estimates or indices (Lépinay, 2007; Millo, 2007). This is why the investigation of a financial market is often enmeshed with an anthropology of calculation, an exercise in tracking the history and circulation of facts, figures and formulas⁹.

Tracking calculative objects can be an extremely fruitful method for following the constitution of the financial products as well as the coordinated assessment of their qualities, around which are configured market forms (Lépinay, 2002; MacKenzie, 2003; Muniesa, 2000). The case of consumer credit scoring in the U.S. is a case in point. Credit scoring originally referred to a number of statistical techniques used for predicting credit risk that produced a credit score: the punctual empirical assessment of the odds that a consumer might default on a loan expressed as a probability. Over time the term has been diffracted in two directions: scoring techniques have been extended beyond default predictions to address such questions as the likelihood that a consumer might respond to a marketing campaign or generate revenue by making use of the revolving function on a credit card; and secondly, among credit data analysts, scoring has come to loosely refer to any system that produces a rank ordering of a population of credit consumers even if this does not involve strict probabilities or numerical scores.

⁸ SSF is also much narrower than the field of economic sociology (Smelser & Swedberg, 1994; Swedberg, 2003) although it might be brought into relationship with the sociology of markets (Fourcade-Gourinchas, 2007). For a statement on the 'sociology of financial markets', see (Knorr Cetina & Preda, 2005). For an early sociological take on financial markets that predates the SSF movement see (Adler & Adler, 1984; Baker, 1984). Several research networks have been organized to support work in SSF. Donald MacKenzie's ESRC professorial fellowship sponsors a researcher's list and conferences for the U.K. (see: <http://www.sociology.ed.ac.uk/finance/index.html>). The Social Studies of Finance Network (see: <http://www.ssf.org/>) run out of the LSE's Department of Information Systems is partnered to the French network 'Association d'Etudes Sociales de la Finance' (see: <http://ssfa.free.fr/>) at the Centre for the Sociology of Innovation, Ecole Nationale Supérieure des Mines de Paris. In the U.S., the website for the Social Studies of Finance conference hosted by David Stark at the Center on Organizational Innovation (COI, New York, 3-4 May, 2002) has also served as an important resource.

⁹ Much excellent work in science and technology studies has been devoted to tracing the history and circulations of things, tools and technologies (Clarke & Fujimura, 1992; Daston, 2000; Kohler, 1994; Latour, 1987; Levinson, 2006; Rheinberger, 1997).

The proliferation of credit scoring activity in backstage banking has come to the attention of several social scientists concerned about a paradigmatic shift towards quantitative risk management in consumer finance (Guseva & Rona-Tas, 2001; Leyshon & Thrift, 1999; Marron, 2007)¹⁰. But what distinguishes these studies from those in the social studies of finance is that they do not treat scoring pragmatically as a set of concrete systems worthy of detailed exploration so much as they exploit it as a terrain on which to theorize grander themes such as rationalization, quantification, discipline and governance. Because credit scoring is portrayed as an example of a larger movement, these studies tend to put aside the formal properties of technical systems. Analysing technologies in terms of how they fit into bigger pictures means taking for granted the significance of a trajectory of innovation that shapes specific tools. Yet, from a science and technology studies inspired perspective, it is within the details of these processes that the formal calculative properties of technical systems – in and of themselves the potential agents of change – are created and established.

As I have discussed elsewhere the distinctive properties of the credit scoring system in the U.S. are very much a product of idiosyncratically unfolding processes (Poon, 2007). Credit scoring is not only body of statistical methods that is being applied within financial institutions to assemble and digest consumer credit information into a decision making tool; it is also a thriving industry for ‘analytics’ in which a range of consumer risk management products designed and marketed by specialized firms circulate with stabilized contents as commercial goods. These firms may have little or no ability to generate consumer data on their own, but each one possesses a delicate *savoir-faire* (De Certeau, Giard & Mayol, 1998), a prized ‘way of doing’ based on accumulated experience, artisanal skills, and in-house software that allows practitioners to exploit credit information and fix the results of their analysis into applications suited for business decision-making. The broader research project this piece is taken from traces the U.S. origins of an industry for credit analytics. This industry began in the late 1950’s with the pioneering efforts of a single firm – Fair, Isaac & Company Incorporated (today, Fair

¹⁰ For an exploration of the equivalent practices of risk calculation in corporate finance see (Kalthoff, 2005). It is interesting to note that commercial lending is much less quantified than U.S. consumer lending.

Isaac Corporation)¹¹ – to sell ‘custom application scorecards’, a statistical tool originally adapted to the needs of finance companies.¹²

The commercial basis of credit scoring provides a unique opportunity for understanding the material transfer, that is, the step-by-step movement from one location to the next, of risk management practices and information. Similar to the way in which formulas issued from academic scientists might bear the signature of their author(s) – the Black-Sholes-Merton option pricing formula is a key example of this – proprietary credit scoring models made by credit analytics providers will bear the brand mark of their maker. This means that many of the tools for the statistical analysis of credit data have an independent and distinctly traceable origin from the more diffuse and maverick methods for data mining into which credit scoring as a practice is currently being subsumed. The most celebrated invention issued from this fruitful circumstance of corporate innovation is called a ‘credit bureau score’. A U.S. bureau score is any consumer credit risk estimate that is calculated using individual level credit (and repayment) information compiled and periodically refreshed from a number of sources, such as revolving credit card lines, small personal loans and auto financing.¹³ Financial institutions issuing credit, regardless of their contribution to the data pool, can purchase commercial risk scores, available in several distinct brands from each bureau, as a generic tool that aids in evaluating the overall credit risk of an individual borrower.

The strength of the bureau scores as risk management aids is that they give competitive lending firms equal access to general snapshots of the consumer that are continuously

¹¹ Research for the author’s PhD dissertation on the history of credit scoring technology (University of California San Diego, expected 2009) began with a series of over thirty open-ended, face-to-face interviews carried out between June 2004 and October 2005. Respondents were (predominantly) former Fair Isaac personnel, including executives, analysts, project managers, sales people, and technical and administrative support staff contacted through snowball sampling. Only two of the interviews are quoted directly in this piece. The remaining data presented here were collected between January and August 2007 from a variety of trade journals, government documents, regulatory manuals, newspapers, and online sources.

¹² The original Fair Isaac scorecards were custom crafted algorithmic tools designed to capture patterns of default in firm-level consumer credit data. The tool rendered scoring possible at the point of retail sale by representing the algorithm as sets of figures to be added on a printed card. Today, scorecards are no longer visible as they have been embedded into electronic systems. Although Fair Isaac continues to be a leader in the field, they face increasing competitive pressure from rival providers as well as from in-house analytics groups. For a general account of their methods by a former company executive, see (Lewis, 1992).

¹³ Credit bureau data can be negative (default information), or positive (repayment information). U.S. bureaus keep both kinds. There are other major data gathering operations in business that compile consumer credit histories and provide other marketing services (such as preparing direct solicitation mailing lists), but by strict definition a U.S. bureau sells actual credit histories and is subject to the Fair Credit Reporting Act (FCRA) 15 U.S.C § 1581 et seq.

recalculated as new data is amassed from participating lenders. Such scores are by no means produced from an ‘ideal’ data set. They are parasitic and pragmatic constructions that make the most of information that is readily available at the bureaus as a resource for manufacturing pre-packaged analytic products. These black-boxed statistical figures are in large part ‘behavioural scores’. They do not seek to qualify static qualities of the person so much as they constitute a temporally responsive picture of consumer risk that is useful for tracking a person’s ongoing relationship to credit. Unlike classic ‘application scores’ which use data provided directly by a consumer on a form, it is noteworthy that bureau scores are calculated in the absence of input on income, occupation, or socio-demographic characteristics, even the ones that may legally be considered, because this kind of data is simply too costly to be accessed and reliably maintained by the bureaus.

Beyond the fact that bureau scores exist, there is an additional and important peculiarity about the U.S. market for scores. Through an unexpected business configuration achieved by Fair Isaac, three statistically distinct proprietary scoring algorithms were put in place at Trans Union, Equifax, and Experian, the three major credit bureaus. As a result of these joint ventures similar scores are manufactured by these otherwise highly competitive organizations under a common FICO® brand-label. The FICO® line of scores numerically tags an estimated 75% of the U.S. population eligible for consumer credit on a linear scale of 300-850 units, trademarked by Fair Isaac. The robustness and penetrance of the pan-bureau ‘product’ with its high substitutability and low switching costs explains why, in a situation where product proliferation and heavy competition among multiple, *sui generis* statistical solutions would otherwise be expected, there exists instead, a single analytic product that saturates the market for scores. The co-ordinating effects of this widely circulating piece of ‘economic information’ (Callon, 2002) are significant: the overwhelming commercial success of this tool is arguably what has given recent U.S. consumer credit markets their coherence, confluence and vibrancy.¹⁴

As the FICO® has travelled across financial institutions it has become a distinctive *market device* (Callon & Muniesa, 2002; Callon, Muniesa & Millo, 2007a), that is, it is a traceable

¹⁴ This argument is made in the author’s PhD dissertation. Moving through several iterations of the technology as it emerged from the activities of Fair, Isaac and Company Incorporated beginning in 1957, this research shows how consumer credit scoring has gradually become the information infrastructure sustaining multiple U.S. consumer credit markets. The work culminates with an analysis of how scoring has participated in generating the current credit crisis, largely triggered by calculative overflows of risk within the consumer credit sector.

technological system involved in aligning the decision-making of lenders with regards to the qualities of borrowers. A market device is any distributed technological arrangement that participates in the production of calculative agencies that are firm enough to render a singular qualification of market goods and therefore sustain the coming together of agents in acts of exchange (for a number of concise case studies see (Callon, Muniesa & Millo, 2007b)). In short, a market device is a social scientific concept for identifying objects of investigation whose analysis can demonstrate that “Calculation is neither a universally homogeneous attribute of humankind, nor an anthropological fiction” (Callon et al., 2007a, p 5). The implication of this provocative phrase is that market devices are by no means technologically determined, that is to say, they do not exist prior to their own implementation in actual practice. Nor can devices be reduced to discrete technologies. That technologies become market devices is achieved by active translation (Callon, 1986) through which they are adjusted, interpreted, modified, reworked, extended and distributed to become the bedrock of a collective calculative infrastructure.

Before their use in mortgage making, the FICO[®] scores had already become a genuine market device in the wider U.S. consumer credit markets (personal loans, credit cards, retailer credit). Their circulation had singularized calculations of consumer risk and had considerably reified the position of the consumer into a highly governable person (Miller & O’Leary, 1987; 1994) in those markets. Commercial scores give lending institutions access to a common viewpoint on the consumer; they assign individuals a routinely updated placement in a shared cartography of the marketplace. It is in large part through these scores (assisted by a smattering of other scoring tools), that the competitive basis of consumer credit have undergone a dramatic turn from one set of calculative agencies into quite another. Over the past few decades, consumer credit markets have progressively moved away from blunt forms of profitability based on tighter consumer selection – *credit control-by-screening* characterized by simple but rigid barriers of exclusion designed to sift for acceptable credit quality; and towards razor sharp segmentation games that demand superior product matching – *credit control-by-risk* characterized by a segmented accommodation of varying credit qualities. To remain competitive, consumer finance operations must do additional statistical work to refine the risk estimates produced by FICO[®], supplementing these with in-house data and subtle re-calculation. But this does not undermine the fundamental effect that shared commercial risk scores have had on co-ordinating lenders’ overall vision of an accessible population, as well as for stimulating

strategies of product design and targeted marketing. The result is a risk segmented and saturated U.S. market for consumer credit.

Credit scoring is a prime example of how numbers might matter to market activity not so much because of what they represent and whether they represent accurately, but because of what they enable agents to *do* (Vollmer, 2007). From a perspective that is sensitive to the generative capacities¹⁵ of calculative tools in action, it should come as no surprise that the movement of a tool such as the FICO[®], from consumer credit into the mortgage finance¹⁶, might provoke the configuration of a specific set of economic agencies heretofore unseen in mortgage making. A method that has therefore proved useful for making the emergence of these agencies visible is to track the details of the scores' movement through their uptake by the government sponsored agencies and out into mortgage making infrastructures. (For clarity, the handful of institutions involved is described in *Table 1*.) As this research will show, the government agencies' interpretation of how to use the tool, once impressed upon the scores, has led to the bipartite organization of today's U.S. mortgage markets into the conventional prime and high-risk subprime. Grasping the scores' bubbling potential to reconfigure the calculative underpinnings of the mortgage markets, however, first requires an understanding of how credit quality was previously assessed by the GSEs in the absence of circulating numerical consumer credit scores.

Government sponsored mortgage market making

In the U.S., homeownership is not just a part of the 'American Dream'; it is also actively facilitated by specialized state initiated institutions. Since the Great Depression, the U.S. federal government has played an important role in making a liquid and stable mortgage market (Carruthers & Stinchcombe, 1999). As part of the New Deal, the Federal Housing Administration (FHA) was started in 1934 to provide guaranteed insurance to

¹⁵ A distinction should be made here between the notion of 'capacities' and that of 'generative capacities' with regard to technology. Generative capacities are possibilities that inhere in technical systems, but they are not developed without continued enrolment and innovation. In the current case, the possibility of risk based pricing inheres within credit scoring but is not necessarily expressed if users do not develop this capability through additional innovation. The GSEs for instance, do not.

¹⁶ In U.S. economic reporting loans secured by real estate have traditionally been treated separately from consumer credit, the latter referring to retail credit, credit cards, small loans, and car financing. The distinction reflects the different institutional pathways through which these kinds of credit are originated.

mortgages, and the Federal National Mortgage Association (FNMA) in 1938 to create a government assisted market for loans. In 1968, the FNMA was transformed from a government owned body into a government sponsored enterprise (GSE), changing its name to 'Fannie Mae'. A second GSE, 'Freddie Mac' (Federal Home Loan Mortgage Corporation, FHLMC), was created in 1970.¹⁷ Freddie's charter demanded that it "promote access to mortgage credit throughout the Nation (including central cities, rural areas, and underserved areas)".

The enterprises were created to fulfil an equalizing and democratizing function. From the 1970's on, the stated mechanism by which it was to accomplish this mission was "by increasing the liquidity of mortgage investments and improving the distribution of investment capital available for residential mortgage financing".¹⁸ The federal government's intention was that the GSEs would 'attract private capital for public purpose', serving as a kind of 'institutional market maker'¹⁹ by liaising homeowners borrowing funds to buy houses in the primary markets to capital holders seeking investment opportunities in the secondary markets. The GSEs were not intended to make loans like banks. Rather, their purpose was to facilitate the movement of debts in one direction in order to generate renewed funds in the other, either by purchasing and holding, or packaging and selling, financial instruments called mortgage-backed securities (MBS). Considered a type of bond, the original GSE-MBS was a simple pool of

¹⁷ Through a statutory process the GSEs were placed in conservatorship on September 7, 2008 by the freshly created regulatory body, the Federal Housing Finance Agency (FHFA). The move was an effort to stem the systemic impact of their increasing weakness on the ongoing credit crisis. Treasury Secretary Paulson has argued that because they are federally chartered but publicly traded, profit-oriented corporations, "only Congress can address the inherent conflict of attempting to serve both shareholders and a public mission" (Secretary Henry M. Paulson Jr. on Treasury and Federal Housing Finance Agency Action to Protect Financial Markets and Taxpayers, September 7, 2008. The text is available at <http://www.ustreas.gov/press/releases/hp1129.htm>). At the time they were created the GSEs were intended "to overcome then-existing legal and institutional impediments to the flow of funds for housing" (Congressional Budget Office, 2003, p1). Initially they did so by issuing debt securities, but they also became major investors in private mortgage securities, purchasing 13% of all of products produced in 2006 and 2007. For a detailed description of how these agencies have operated as well as of the recent spate of challenges they have faced see (Frame & White, 2007).

¹⁸ Federal Home Loan Mortgage Corporation Act January 2005 12 U.S.C.1451 Sec. 301 4. It is noteworthy that the original FNMA did not securitize loans but purchased and held them (Sarah Quinn, personal communication).

¹⁹ The technical definition of a 'market maker' in finance is an exchange member who is positioned to take responsibility for making the market. These figures are obligated to buy and sell from their own account when ever there is an excess of orders in either direction. For a detailed description of this profession see (Abolafia, 1997). The term is employed only loosely here.

conforming mortgages called a ‘single class pass-through’ (Adelson, 2004), which was calculated to yield a certain percentage as they matured.²⁰

To understand the reasons for the GSEs it is important to recognize that the default state of debts is inertial. As a part of their production, debts are entangled in managerial rules, institutional relationships, and local processes of decision making. A recent handbook on asset securitization by the Office of the Comptroller of the Currency (OCC) explains, “in the days before securities, banks were essentially portfolio lenders; they held loans until they matured or were paid off”. Under this arrangement loans, including mortgages, “were funded by deposits, and sometimes by debt, which was a direct obligation of the bank (rather than a claim on specific assets)” (Comptroller of the Currency, 1997, p 2). A securities market only works, then, providing that debts can be converted into mobile and transferable goods whose qualities buyers and sellers can come to agree upon in the present, even though these qualities will only be expressed in the future. The value of a simple MBS, its quality, depended on the credit risk (estimated rate of default) and the prepayment risk (estimated rate of payment in advance of the due date) of the pooled assets, as either event could decrease the eventual return to the investor. The need to assess these qualities explains why specialized agencies were required to provide the production function necessary to bring securitization and the liquidity advantages that accompany it into being.²¹

In the securities markets, this function has belonged in large part to third party ratings providers such as Standard & Poor’s, alongside Fitch’s and Moody’s (Sinclair, 2005). The system of credit rating they manufacture is an important financial indicator. Ratings describe the overall quality of pools of loans underlying debt securities such as bonds and other financial instruments issued from private companies or even from nation states (treasury bonds). Like information printed on packaging (Cochoy, 2002), performance testing to report on products in a consumer magazine (Mallard, 2007), or classifications

²⁰ For a lively description of the early problems in organizing a mortgage backed bond market in the 1980’s see (Lewis, 1990), a engaging memoir of the writer’s days in the employment of Solomon Brothers.

²¹ The advantage of MBSs for lenders is that they provide more liquidity than keeping primary loans on the books. Today, securitization has come to be seen as increasingly financially desirable because these carry lower capital requirements under Basel, which in turn “improves return on capital by converting an on-balance-sheet lending business into an off-balance-sheet fee income stream that is less capital intensive” (Comptroller of the Currency, 1997, p 4). While this paper considers the translation of default risk into commercial numerical scores, it is noteworthy that uncertainty surrounding prepayment risk was controlled contractually in subprime finance through the imposition of heavy penalty fees.

of grain that allow different growers to merge their stocks (Cronon, 1992, p 97-119), ratings are what allow investors to know something about the contents of investments so they can decide what to buy. Providing standardizing information about mortgage holders in the days before individual level credit bureau scores was a challenge, and “investors and other market participants faced greater difficulties in comparing the riskiness of loans from different lenders” (Adelson, 2004, p 5). While the ratings agencies are experts in the process of evaluating the credit risk of million dollar asset pools, nation states, and large corporations, they have traditionally not been attuned to fine processes of rating individual mortgage consumers. For this reason, even they have had to follow behind the authoritative market making guidelines set by the GSEs.²²

The government agencies have therefore had to serve as an all-in-one expert and organizational solution to both the problem of standardizing underwriting (quality control of individual loans) and the downstream problem of certifying securities (quality control of aggregated loan pools). In the absence of competing market forces and with the weight of the federal government behind them, they have filled their function by keeping a firm hand on the micro-organization of loan origination. The GSEs calculated a value of loans and loan pools, but their original methods were not quantitative. Instead, prior to the advent of scoring, their main strategy was to issue thick books of underwriting guidelines, stringently designed to screen for acceptable quality loans. The GSE’s independently devised ratings grades, carved through their thicket of rules became recognized across the industry: A for prime investment and A-, B, C, and D for non-investment grade, or less than prime. The ratings agencies did provide their own systems for rating RMBS, but for the most part they confined their efforts to certifying asset pools outside of GSE control. Nevertheless, although those pools might have been excluded by the agencies due to a variation in the underlying loan configurations, “[u]ntil the mid 1990’s all loans included in securitized pools in the non-conforming market were assumed to meet agency prime loan credit standards” (Raiter & Parisi, 2004). The privately securitized loans were ‘non-prime’ (as distinguished from subprime), because

²² It was not until 2001 that Freddie’s products began to be independently rated by S&P. This move is part of the increasingly complex intertwinement of the government sponsored and private investment mortgage markets described in the last section of the paper. The testimony of Leland Brendsel, then Chairman and CEO of Freddie Mac before the U.S. Senate Committee on Banking, Housing and Urban Affairs, Subcommittee on Housing and Transportation on this topic is available online at http://banking.senate.gov/01_05hr/050801/brendsel.htm.

they were considered acceptable from a credit risk standpoint according to the official GSE rulebooks.²³

Each of the thousands of lenders around the country could use the GSE classification system for loan origination. But the limiting property of a rule-based form²⁴ of rating, its Achilles weakness, was that the interpretation of the rules on the ground “differed from one company to the next” (Adelson, 2004, p 5). Due to the imperfect transmission of a standard meaning of the rule, what ended up happening in practice was that “one lender’s ‘A-’ looked a lot like another lender’s ‘B’” (Raiter & Parisi, 2004, p 3). Given the wide margins of uncertainty in the resulting grades, the GSEs rendered their debt products attractive by investing exclusively in ‘A’ quality loans and offering only a modest return on investment. They further sweetened the deal by offering to share the risk burden with investors, guaranteeing the value of the principal (although not of the interest). The agencies “promise the security holders that the latter will receive timely payment of interest and principal on the underlying mortgages”, and for their services they claim “an annual “guarantee fee” of about 20 basis points on the remaining principal” (Frame & White, 2007, p 85). Under these conditions, in a market dominated by long term 15- and 30-year fixed interest rate loan products, it is easy to see why mortgage securitization was an unappealing proposition to the fast-paced, high-return world of private equity.

Automating mortgage underwriting and the importation of bureau scores

The shift away from rule-based rating towards a system of score-based rating for RMBS marked a fundamental change in mortgage underwriting. However, this shift need not have passed through the FICO[®] scores, and indeed this was not Fair Isaac’s original inclination. By the early 1990’s the company’s success at making and marketing bureau scores for the consumer credit markets was nearing its pinnacle, and the company was seeking new opportunities for expansion. According to oral history²⁵ they set their sights

²³ For example, a loan that “conforms to traditional prime credit guidelines, although the LTV, loan documentation, occupancy status or property type, etc. may cause the loan not to qualify under standard underwriting programs” (Raiter & Parisi, 2004, p 2). Another example is ‘jumbo loans’ which are loans that exceeded the government imposed size caps that were placed on the GSEs until this year.

²⁴ For a theoretical discussion of the notion of a form see (Thévenot, 1984).

²⁵ As part of this research the author has carried out interviews with two former Fair Isaac bureau score specialists who worked almost exclusively with the mortgage industry throughout the 1990’s. Both were conducted in September, 2006.

on the mortgage industry, hiring professionals from the field with the idea of developing a specialized credit risk score for home loan underwriting. Their analytic scouts soon discovered that the way credit data was brought into the mortgage underwriting was through an ‘RMCR’ – a residential mortgage credit report. The practice of merged reporting, a system of gathering the personal data that would be fed through the GSE guidelines, had grown out of the days when the bureaus were small, geographically scattered operations and where an individual might have reports lodged in several places all containing relevant information. Fair Isaac’s first instinct, therefore, was to try and partner with report merging firms to develop a scoring system for RMCR data.

The problem with scoring the RMCRs was that the reports were infamous for being inherently unreliable. To create an RMCR a mortgage broker would assemble data from several credit bureaus and “bring in other elements that might not necessarily be part of the credit bureau. So they would do a verification of employment, or verification of income”. However, the process of merging reports provided commission motivated mortgage brokers with “the wiggle room, [...] to manipulate the system to get a mortgage loan through”. In addition to merging data, the other “service [brokers] did was to ‘cleanse’ the credit report. They formatted it a certain way, and then if the mortgage worker said, ‘this information is wrong’ they would manually fix it on their merged credit report”. GSEs were aware of these kinds of procedural loopholes which they tried to close by passing more and more supplementary rules. So as time went on, the mortgage underwriting guidelines became “so rigid that if you followed them by the letter no one would ever originate a loan”! The situation only reinforced the brokers’ motivation to engage in tactics that are as old as the industry, to invent resourceful ways to drive loans forward and to keep the system moving. This meant that Fair Isaac’s business strategy (an isomorphic imitation of the bureau scoring project) would eventually stall. The GSEs, which fixed the rules for the secondary market, would not accept to purchase loans underwritten by a novel score calculated from merged reports whose content they knew were subject to manipulation.²⁶

In the same period, the GSEs had begun their own searching for automated solutions to tighten the system. Expected to balance a complex set of objectives – promoting flexible and affordable housing, all while maintaining their reputation for investment quality

²⁶ All quotations in this paragraph are taken from the two interviews cited above.

products, rewarding their shareholders, and adequately controlling risk²⁷ – the agencies were facing considerable pressure from all sides to gain consistent knowledge of the quality of loans they were purchasing from mortgage originators. Numerous efforts were being made, in particular at Fannie Mae, to produce automated underwriting programs based on mentored artificial intelligence (AI)²⁸. In their original conception, these kinds of systems “simply converted existing underwriting standards to an electronic format” (Freddie Mac, 1996, Chapter 1 Improving the World’s Best Housing Finance System)²⁹. They were attempts “to try to train a system to reproduce the credit decisions of a human underwriter (or group)”. While simple automation “brought speed and consistency to the underwriting process” they could not, however, ‘optimally predict defaults’. Industry reports seem to agree that by mid-1990’s “mentored AI systems had largely lost out to or begun to progress to statistical mortgage scoring—which brought the key advantage of modeling the actual likelihood of mortgage default” (Straka, 2000, p 214).

A genuine ‘mortgage score’ was a statistical undertaking considerably more ambitious than anything a free standing analytics firm with no way to generate empirical data on their own could have undertaken. Such a score would be made from a model in which credit data (such as bureau data) figure in alongside industry specific data on the characteristics of the property and the type of loan being considered, as well as information on income and personal finance. With their massive stores of historical mortgage data the GSEs were the only institutions in a position to envisage and implement such a project. It was at this point that Freddie Mac made series of crucial decisions that would lay down the calculative foundations for dramatic change. Not only did Freddie decide to pursue statistical underwriting to the detriment of the traditional rule-based methods, but, secondly, rather than testing the bureau holdings for the most predictive combination of consumer credit data for mortgage lending, they opted to

²⁷ One way of keeping housing affordable has been to offer loans to less solvent borrowers but to distribute risk by arranging an appropriate amount of mortgage insurance from a network of other federally mandated institutions such as the Federal Housing Administration (FHA) or the Department of Veterans Affairs (VA).

²⁸ General Electric Capital, a financial subsidiary of General Electric (GE), also came out with an AI based system (automated but not statistical) called GENIUS in the same period.

²⁹ In March 1996, Leland C. Brendsel testified before a subcommittee of the Senate Banking Committee on HUD oversight. Part of the purpose of his appearance was to discuss “the extraordinary benefits that automated underwriting is bringing to home mortgage lending”. Following the presentation, Senator Carol Moseley-Braun (D-IL) commissioned the agency to prepare a report “on automated underwriting and credit scoring and their impacts on the wide range of American families who borrow money to purchase homes” (Freddie Mac, 1996). The document is available online at <http://www.freddiemac.com/corporate/reports/moseley/mosehome.htm>. In the absence of page numbers I have indicated chapter titles.

insert consumer credit data, pre-digested in the form of numerical commercial bureau scores, into their nascent systems.³⁰ Inspiration or caprice, the exact reasoning behind the decision to adopt the general commercial risk scores was not reported to even the makers of the FICO[®] scores whose own ambition was to design and market a new consumer risk calculation specifically adapted to mortgage risk.

What is certain is that Freddie Mac's primary objective was to include a reliable selection of consumer credit data into their automated systems in a form that could not be locally manipulated by the brokers. As the giants in the field, the agency's gesture was designed to simultaneously restrain the artful brokers, to provide a way to monitor credit standards (Schorin, Heins & Arasad, 2003), and to create a criterion of commensurability (Espeland, 1998) for assembling and describing prime, GSE quality MBSs. It should be noted, however, that these goals might have been equally achieved by employing electronically transferred raw credit data purchased from the bureaus, and dissolving them seamlessly into the proprietary algorithms the GSEs were assembling from scratch.³¹ The astounding result was that although 'credit data' was only one category of information included in mortgage scores, it was now reduced to a discrete factor whose composition could potentially become invariable between automated systems. While the estimates of property value, the loan-to-value ratio, personal income, and any number of other factors included in the mortgage might be calculated in many different ways, providing the industry followed Freddie's guidelines for FICO[®] scores, the interpretation of credit risk could potentially be the same across all automated systems.³²

³⁰ In an industry review article, John Straka, then Director of Consumer Modeling at Freddie Mac reveals that Freddie originally endorsed both FICO[®] default risk scores and the competitive CNN-MDS bankruptcy risk scores. But since the prediction of bankruptcy is narrow in scope than default and were only available from a limited number of bureaus, the latter seem to have fallen out of the picture.

³¹ In fact, this is precisely what Fannie Mae has done in an attempt to remove FICO[®] scores from their models when the issue of their non-transparency became a heated political issue (Quinn, September 2000). Nevertheless, although Fannie Mae's Desktop Underwriter system no longer uses FICO[®] scores as part of its internal risk assessment of individual loans, lenders must still submit scores with loan applications. This strongly suggests that the scores are an essential to the process of securitization, that is, to describing the quality of securities products to the secondary markets, even if they are not employed in the loan underwriting process. The incident confirms that there are many ways to adequately calculate consumer credit risk in mortgage origination, but only one calculation that allows buyers to compare the quality of Fannie's products to others offerings. This is essentially what it means to say that the FICO[®] constitutes a 'market device'.

³² This is true with a couple of caveats. Firstly, since the contents of the bureaus are not exactly the same scores calculations for an individual file vary between the three providers. Secondly, since the score shifts over time as new information is accumulated, it can change within the period of loan underwriting.

Treated side by side with the mortgage industry, Fair Isaac received a letter from Freddie Mac dated July 11, 1995³³. Firmly grounded in the tradition of *credit control-by-screening* – that is, of seeking to lend only to those of a credit quality that made them highly unlikely to default – Freddie announced its decisions, including a third significant stipulation: that a FICO[®] score of 660 was the eyeball threshold for their definition of loans eligible for the prime investment. Within a month Fanny Mae swiftly followed suit adopting the identical convention in October to demarcate their prime loans. Industry insiders suggest that Fannie had no choice because they suddenly found themselves besieged by bad paper – that is, by loans that passed through their rule-based guidelines but which were adversely selected because many had already been picked over and rejected by Freddie³⁴. The decision to use FICO[®] as well as GSE manner of interpreting them was materially hardwired into the system through the release of proprietary, agency designed, automated underwriting software that would henceforth be used to underwrite all loans destined for agency purchase. The first system in circulation was Freddie Mac’s Loan Prospector[®] which had become commercially available to all Freddie Mac lenders in February 1995. Fannie Mae’s Desktop Underwriter[®] would soon follow suit.

The FICO[®] feature of automated system design was politically useful when the software was showcased to legislators³⁵. A score within a score, FICO[®] could be neatly pulled out of the formula as a discrete factor in both systems; it could be isolated and independently interpreted as having meaning. For example, to explain statistical automation, discreet, individualized FICO[®] scores conveniently substitute for the quality of ‘creditworthiness’ which government officials and the public had come to recognize as being an essential part of loan evaluation. In a report to a subcommittee of the Senate Banking Committee the section devoted to explaining the use of commercial credit bureau scores made an explicit equivalence between the use of FICO[®] scores and an evaluation of ‘creditworthiness’ even though the former is a shifting quality assigned statistically with respect to the aggregate and the latter has traditionally been considered a personal property of the individual often thought to be interchangeable with ‘character’. Through

³³ Freddie Mac Industry Letter from Michael K. Stamper, “The Predictive Power of Selected Credit Scores” July 11, 1995 as referenced in (Avery, Bostic, Calem & Canner, July 1996).

³⁴ Former Fair Isaac mortgage and bureau score specialist A, interview, September, 2006. A similar story is reported in (Dallas, 1996).

³⁵ See footnote 29.

this analogy with known concepts (even though the commonalities were thin³⁶) FICO[®] helped circumvent some of the technical difficulties in explaining statistical underwriting to lay audiences.

The effect of bureau scores was not only to facilitate the evaluation and pooling of loans, but it also introduced a common lexicon into the industry. The same Senate Banking report took great pains to explain the demarcation of a categorical break at FICO[®] 660. Freddie Mac's independent studies showed that this score corresponded to their existing standards, such that "borrowers possessing weak credit profiles [...] as FICO scores under 620", were found to be "18 times more likely to enter foreclosure than borrowers with FICO scores above 660" (Freddie Mac, 1996, Chapter 3 Looking Inside Loan Prospector). Given the GSE mandate to help and not hinder homeownership, 660 was intended to be a soft minimum score and not a firm cutoff, since the ultimate evaluation depended on the contribution of all of the other factors that could be weighted in through the larger mortgage scoring algorithm. In this regard statistical analysis made the distinction between acceptable and not acceptable less immediately clear to the system user (Standard & Poor's, 1999, p 10). Nevertheless, FICO[®] 660 rapidly became a free standing benchmark of prime investment grade status, recognizable among underwriters, securitizing bodies, investors, regulators, and later (after 2001³⁷) to informed consumers as well. The overall effect was that a 'prime lender' could now identify as catering to consumers with 660 FICO[®] scores and above. By default, anyone willing to develop products that catered to risk scores lower than a FICO[®] 660 would become a high-risk or 'subprime' lender.³⁸

³⁶ As mentioned earlier, FICO[®] scores are behavioural scores which means that they fluctuate according to changing credit behaviour. They are not based on a fixed quality of the person such as 'character' even though they were cast as a substitute for this traditional quality of the person in loan underwriting.

³⁷ Brokers were quick to inform consumers whose loan applications were rejected that the 'reason' was the weakness of their FICO[®] scores. The discovery of the scores on the eve of the refinancing boom and housing bubble led to protests by consumer advocates, who argued that the scores should be released to the public. In 2000 the California State legislature ruled that consumers would have a right to be told their scores. Rather than risk further regulation Fair Isaac conceded and it hastily created a dot.com that made individuals' scores available to individuals for a fee.

³⁸ Beyond the distinction between prime and subprime, FICO[®] scores are considered basic descriptors in mortgage finance. In addition to front end pricing sheets, scores are ubiquitous component in the representation of a firm's holdings in investor presentations, annual reports, SEC 8-K as well as in 10-K filings that fulfil the pool level disclosure reporting requirements of the SEC (1111(b)(11) of Regulation AB). Finally, they are being used by economists as an analytic tool for visualising and evaluating the trajectory of current events. For one example of this kind of work by Federal Reserve researchers see (Chomsisengphet & Pennington-Cross, 2006), which traces the 'evolution of the subprime mortgage market' by the recording the volume of loan origination by score, but not the origins of the technical practices that sustain these increases.

The ratings agencies adopt the scores

It is important to note that the demarcation of subprime lending by FICO[®] scores is a distinct moment from its amplification into a functioning financial circuit. The development of the subprime into a coherent network of mortgage finance in which securitization could take place was not a given. It would itself have to be materialized. To create a circuit of subprime finance would require a proliferation of specialized underwriting software equally grounded around and further reinforcing the use of the specific brand name credit scores elected and interpreted by the GSEs. If at any moment another solution to evaluating consumer risk had been incorporated into private software when faced with the consumer, lenders would have produced a series of disconnected risk assessments. While this situation would not have precluded the emergence of subprime finance, it would have demanded a patch work of solutions to the problem of commensuration, which would have complicated the calculative picture and, much like the previous system of letter grades, considerably weakened the transferability of risk into the secondary markets.

The GSEs continued to play an active role in the project of statistical automation. Given the mortgage industry's growing appetite for the swiftness of automation (although not necessarily for statistical underwriting³⁹), as well as the propensity of the industry to follow the government agencies' every lead, the effects of the new GSE systems would not stop at the borders of the government sanctioned mortgage finance. Reports to government officials confirm that Freddie was eager "[t]o address lender demand for an automated underwriting service capable of evaluating loans in any mortgage market" and not only in the conventional, conforming one. Freddie soon "joined forces with [Standard and Poor's], a rating agency with significant experience evaluating subprime loans" (Freddie Mac, 1996, Chapter 5 Expanding Markets, Lowering Interest Rates Across Markets). Standard and Poor's (S&P) interest in Loan Prospector[®] was to test how this system for underwriting, a pre-packaged algorithm from their point of view,

³⁹ In the mortgage industry the changes brought about by 'automation' are frequently conflated with the introduction of 'analytics' (statistical analysis) because these occurred simultaneously. As the paper has described the automation of traditional rule-based underwriting could have occurred without the introduction of statistical underwriting. Automation favours the introduction of statistical analysis but does not determine it. There was a process of translation to brings automation and statistical underwriting together.

might further contribute to rating securities in a secondary market that had been interchangeably referred to as non-conforming or non-GSE.

Under manual underwriting, most forms of rating were done at the level of the portfolio (at the level of a lender's pool of loans). In the absence of automation and scores, the secondary market had learned to rely on indicators designed to describe the risk level of the aggregated pool, such as a calculation of the average interest rate (WAC⁴⁰), or the geographical distribution of loans across regionally distinct housing markets. Until 1995, the description of the risk of each individual loan through underwriting was done with an entirely separate set of tools, metrics, and vocabulary than those used to describe a securitized pool of loans as a composite whole. In other words, before the introduction of commercial bureau scores, securitizing bodies "weren't used to looking at metrics that allowed you to drill so deeply into an individual consumer credit profile so effectively". Individualized consumer risk scores interpreted by the GSEs and funnelled through their automated underwriting systems introduced a substantially "different view than what [the ratings agencies, securities firms and bond issuers] were accustomed to evaluating".⁴¹

Work had to be done to educate each of the securitization and ratings agencies 'about how credit scores worked'. Once Fair Isaac caught wind of the direction of change, the scorecard makers actively went out and "urged them to use [bureau scores] as components in their analysis".⁴² Some securitizing bodies were harder to convince, but from Fair Isaac's standpoint S&P was an ally that 'got it right away'. Score-supported statistically based underwriting programs began to flow into and merge with the rating phase of securitization. The rating agency regarded the result of these changes as positive in that "For the first time, a totally integrated risk management capability is available to loan originators, portfolio managers, investors, traders and regulators" (Raiter, Gillis, Parisi, Barnes, Meziani & Albergo, 1997, p 1). For S&P the implications of automated underwriting extended well beyond the moment of underwriting, because as their research would show, "the use of credit and mortgages scores is not limited to the origination process" (Raiter et al., 1997, p13). A 1997 S&P report on innovations in mortgage underwriting enthusiastically affirmed that in addition to rendering

⁴⁰ WAC refers to Weighted Average Coupon. The term coupon refers to the stated percentage rate of interest paid out to a security.

⁴¹ Former Fair Isaac mortgage and bureau score specialist B, personal communication, May 24th, 2007.

⁴² Former Fair Isaac mortgage and bureau score specialist B, personal communication, May 24th, 2007.

underwriting faster and more consistent, statistical automation could go one step further, giving rise “to the introduction of standardized risk grades” (Raiter et al., 1997, p 13).

In sharing metrics for risk quantification, the primary and secondary markets were to be placed on the same calculative platform. A recent fact sheet for S&P’s mortgage security rating system called LEVELS[®] (c1996) reflects the taken-for-granted nature of this change. The program is said to combine “the power of automation with Standard & Poor’s time-tested ratings criteria to assess the credit risk of individual *or* pooled residential mortgage loans” (emphasis added).⁴³ So while LEVELS[®] was developed to rate *pools* of securities, in a statistical regime it can equally be used to evaluate *individual* loans. This is, in fact, what LEVELS[®] was designed to do. It performs a loan-by-loan analysis as a means of assembling an investment quality asset pool (Raiter et al., 1997, p 28). Through a common use of FICO[®] scores the calculative field could be vertically integrated⁴⁴, even though the chain of institutional intermediaries between borrowers and lenders (brokers, lenders, ratings agencies, underwriting systems, investors and so on) remained populated by heterogeneous and diverse economic agents. If access to a rich source of mortgage data was secured, and then supplemented by commercially accessible consumer risk scores, a system of risk estimation could be devised that held its meaning as products moved fluidly from the level of individual loans up into that of aggregated asset pools.

Several competing systems of automated statistical underwriting tools were soon in the works beyond the GSE models.⁴⁵ While using Freddie’s Loan Prospector[®] or Fannie’s Desktop Underwriter[®] would facilitate the sale of loans to one of the GSEs, distinctive models built off of data from non-conforming, non-conventional loan specialists became available on the commercial market for automated systems or simply for use in-house.

⁴³ S&P 2006 Product Fact Sheet: LEVELS[®], Loan Evaluation and Estimates Loss System. The document is available at <http://www2.standardandpoors.com/spf/pdf/fixedincome/LEVELS2006.pdf>.

⁴⁴ Vertical integration refers to the ability to communicate the quality of the loans with calculative continuity as they are converted from single mortgages, into pools of paper, and on into securities. At every stage in the chain of transfer FICO[®] plays role in calculation even though the content of what the actors are calculating (whether to grant a mortgage, how to price a pool of loans, whether to invest in a security...) is different. Vertical integration constitutes a chain of production. This is distinct from horizontal integration (see next paragraph, main text) which denotes the ability to compare between the financial products originating from different competitive producers.

⁴⁵ Examples of early subprime underwriting systems included ‘CLUES’ (Countrywide’s Loan Underwriting Expert System). Countrywide Financial was one of the top 10 subprime lenders in the U.S., which flourished and then declined with the collapse of the recent real estate bubble. There were several other systems produced by mortgage insurance firms, such as GE Capital ‘Mortgage Insurance Omniscore’, and Mortgage Guaranty Insurance Corporation’s plainly named ‘Mortgage Score’.

Even though the valuation made of individual mortgages at the moment of underwriting could be methodologically aligned with the valuation of the asset pool (not to mention to the calculation of mortgage insurance), the existence of separate, competing systems to carry out this work for non-GSE destined loans impeded horizontal market integration. Outside of the GSE controlled market, there was an open season on innovation. The hardwiring of other brands of bureau scores, or at the very least, other interpretations of the FICO® became distinct possibilities. Private label securitization tools cropping up all over – each based on proprietary databases, built by in-house analytics teams, with preferences for certain statistical methods, a unique take on variables, and a distinctive statistical *savoir faire* – could be expected to produce a diverse set of algorithms and therefore a different set of risk calculations.

Controlling the problems that flourishing calculative diversity posed was S&P's business. As a certifying body, a calculating expert and a gateway to the secondary markets, it initiated a service to validate underwriting systems. For system developers willing to submit their software creations to external evaluation, an initial development review was “intended to validate the soundness and statistical validity of the process used to build the predictive system”. Once the data used to develop the system was received from the vendor S&P would perform “a series of statistical analyses that determine how well the system measures risk relative to actual loan performance, what key predictive variables have the most influence on the system's score, and finally the observed default rates associated with various scores.” In its most basic level validation checked the internal soundness of models. With regards to solving the problem of horizontal coordination, however, these results were “then compared with those of other automated underwriting systems and discussed with the issuer” (Raiter et al., 1997, p 3-12). Acting to produce coordination in financial markets, S&P aligned the risk outcomes of various models, by imposing definitions or by modifying the factors they took into account.⁴⁶

⁴⁶ This document explained that the process of validation and testing would begin when S&P received “a sample data file of a pool of approximately 10,000 to 15,000 loans randomly selected over three years of origination” (sent in Salomon 400 data format). In addition, they required “1,000 bad loans specifically selected to augment this randomly selected group”. The process of validation required a commitment to a deep fix. The document emphasized that “for a system to enjoy validation benefits, Standard & Poor's requires the vendor to agree contractually not to make any modifications to its system without first notifying Standard & Poor's and to provide Standard & Poor's with sufficient information to determine the impact of such modification” (Raiter et al., 1997, p 10). The system would be re-validated by S&P semi-annually with fresh data, on a continuous basis.

Because FICO® was a standard ranking criterion that S&P itself used to test the soundness of an underwriting model this effectively put pressure on vendors to include FICO® scores in their models. This was not merely a suggestion. A key incentive to adopt FICO® then was that pools of loans tagged with an S&P validated ‘mortgage score’ could be more easily rated for securitization by S&P’s proprietary securities rating system. As a final part of validation S&P offered to “calibrate each system against a model portfolio of credit reports and mortgage application information to facilitate use of scores by Standard & Poor’s LEVELS™ [sic] model” (Raiter et al., 1997, p 9). In 1998, “only 50% of Prime [...] and 30% of Non-prime mortgages incorporated a credit score in their underwriting data file” (Raiter & Parisi, 2004). By 2003 this had increased to virtually 100%. What is more, a 1999 document to update the industry on the methods of rating in a post-automation era crisply announced that having “reviewed the guidelines established by Fannie Mae and Freddie Mac”, S&P would endorse “similar guidelines for selecting FICO scores included with new loans submitted for rating” (Standard & Poor’s, 1999, p 14). So once S&P had implemented credit bureau scores as “an integral factor in our underwriting review”, validation and rating gave S&P the opportunity not only to push the FICO® scores, but to transmit the specific interpretations of them that it had absorbed from its earlier collaboration with the GSEs.

The Freddie Mac–S&P connection was not the only means through which the FICO® scores have been extended beyond the GSE market. The FICO® had already generated a lot of momentum following their implementation at the GSEs, and S&P would admit it was in large part “[d]ue to the overwhelming utilization of credit scores” seeping into the industry that it became “a factor in our current credit risk analysis” (Standard & Poor’s, 1999, p 20). The point of this account has been simply to demonstrate one channel through which bureau score-supported underwriting passed out of the GSE market into the non-GSE market. The S&P endorsement had specific consequences in opening up an alternative passage point to securitization that piggy-backed on GSE risk management practices, but moved them into alternative software systems, outside of the government sanctioned market, and of GSE control. Within a proliferation of underwriting programs, algorithms, mortgage scores, ratings agencies, and lenders, for practical intents and purposes, in the mortgage industry, there are two independently functioning circuits of mortgage finance — the government sanctioned prime and the private label subprime. What divides them are information systems, their regard for risk, and product

development; what unites them is a common reliance and baseline interpretation of FICO[®] scores (see *Figure 1*).

The calculative shift from screening to risk

The difficulty of precisely evaluating individual mortgage quality – that is, in stating credit risk as a firm expression transferrable across domains – is the reason why, for half a century, there was only weak investment activity outside of a slow and steady, federally chartered prime investment market. The government sponsored agencies were a quasi-obligatory passage point to the production and sale of investment quality residential mortgages backed securities because they were the only institutions in a position to certify the quality of loans and securities. Held together by these institutions in their active role to build and implement sets of guidelines as market devices, this non-quantitative but nonetheless calculative arrangement (Callon & Muniesa, 2005) worked to stabilize the quality of securities and to produce a steady secondary market. It was on the authority of the institutions' guidelines, their initiatives in interface design, as well as their dirty, hands-on involvement as a driver of RMBS production that the market was made. This paper has described how the market coordination provided by the institutionally made and managed guidelines (rule-based market devices) was supplanted by the coordination provided by commercial consumer scores (statistical market devices). What remains to be shown is the mechanism through which this created an avalanche of subprime securities investment.

The GSEs guidelines embodied traditional credit production practices in which lending was reserved to arrangements where borrowers could be considered 'creditworthy' and all cases that failed to make this standard were rejected. As ethnographic studies have shown, however, establishing creditworthiness under traditional lending was subject to subtle negotiations in which numerous forms of justification could come into play (Wissler, 1989). What was considered 'manipulation' of the RMCR reports by brokers grew out of the permissiveness of this type of practice. Such activities were able to occur, because the definition of the creditworthiness, even when filtered through rules and guidelines, was being flexibly assembled in the moment of loan production rather than being taken from fixed criteria. It is precisely this aspect of traditional consumer

lending that demanded the stabilizing force of the GSEs in quality assessment. Nevertheless, despite its local and practical multiplicity, in the practice of *control-by-screening* lenders tended to act as though they faced two (and only two) kinds of people – those who deserve to be worked with and those who did not. The credit manager’s mandate was to minimize risk by distinguishing as clearly as possible between these binary groups.

Empirically derived credit scoring techniques have created a new kind of consumer whose calculability defied conventional assumptions about the binary nature of creditworthiness. Individuals viewed through statistics no longer need to be classified as either ‘in’ or ‘out’ of the market. Armed with a graduated sliding scale, people all along a spectrum of risk can be offered specially designed products at alternative terms and prices. There is nothing that precludes using the scale from being used conservatively to screen for high quality borrowers, as the GSEs clearly intended.⁴⁷ But once in place, the score scale is a generator of calculative possibility. It became a platform for creative design work that brought lines of risk calibrated products, both mortgages and securities, into existence. The introduction of a numerical scale of consumer credit quality into mortgage origination permitted calculative actions that were simply unanticipated from within the conventional frameworks of the GSEs. This is how *control-by-screening* was concretely edged out in the non-GSE circuit by the productivity of *credit control-by-risk*, whose characteristic is to act at the level of population, harnessing a variety of credit qualities through a proliferation of financial goods.

In both screening and risk forms of lending there is elasticity in credit arrangements, a multiplicity of configurations under which lending can occur. The first tends to create loan paper on a case-by-case basis, while the second distributes a variety of standardized products to markets segments. Although they achieve this fit in different ways, in both types of credit practice the terms and the property type must be appropriately matched to the borrower in order to make the loan. The difference that is most relevant to this paper, however, is as follows: once ‘creditworthiness’ is expressed through a statistical scale of graduated risk, a loan can be arranged for people who are of low credit quality; that is, for those who would not be considered particularly ‘creditworthy’ from a

⁴⁷ It is not incidental that the original Fair, Isaac scorecard was actually designed to do control-by-screening. In its original conception the flexibility of the scoring tool acted as a switch that allowed credit managers at finance companies to adjust the risk level at which floor personnel were screening.

screening point of view. Screening is a *risk minimizing* strategy; statistical lending is a *risk management* strategy, that is, one that embraces risk (Baker & Simon, 2002). It is this displacement, the result of an innovative fusion between FICO® and the ratings agencies, that catapulted the ‘subprime’ from a specialized low profile area of non-conforming lending and into a burgeoning financial market. It is through the rise of this risk management apparatus that subprime loans escaped the books to become the raw materials for mass produced financial products destined for mainstream consumption.

That the subprime has developed as a distinct financial space, yet one positioned with a high degree of congruence to the prime, is an historical phenomenon produced by the particularities of the commercial technology whose history has been presented here. Private label sources did not invade GSE territory. Instead, by borrowing but modifying the GSEs’ very own market making tool kits they have built their endeavour up beside it. Specialized lenders can and do underwrite conventional loans to prime eligible individuals⁴⁸, yet they have clearly preferred to exploit more lucrative subprime lending opportunities. So although the existence of information that provides an incremental and linear ranking of risk could theoretically have given rise to a confluent market space, open to an infinite variety of competitive decisions on how to segment the mortgage market, what we find instead is the entrenchment of a fairly tangible break. The binary partition is the conservative imprint of the GSE’s upon the FICO® technology for the purposes of screening for prime market candidates. Once the institutional benchmark for how the scores should be used was hardwired into the material infrastructure of underwriting and rating software, it ran deeply enough in the infrastructure to cleave the lending space in two.

These spaces are distinguished by their distinctive risk management practices. While the GSEs have tended to stick to their ‘plain vanilla’ prime market loans after the adoption of bureau scores, a new breed of lending outfits continued to work with the scores to

⁴⁸ As the crisis has unfolded the consumer fairness issue is to assess when a subprime loan is justified and when it is predatory. Many prime eligible borrowers did take out subprime loan products during the bubble. While consumers in disadvantaged areas may have done so because they had greater geographical access to subprime lenders, others were attracted to these loans by their lower monthly payment schemes which could be advantageous especially when making multiple property investments. Treasury Secretary Paulson’s proposed plan (unveiled in December 2007) which included freezing interest rates on adjustable rate mortgages, but only for individuals with credit scores of 660 or more, is a perfect example of how FICO® scores are being redeployed to refine and justify the distinctions between prime and subprime treatment through ongoing policy intervention. Such decisions reduce ambiguities in the definition of subprime by strictly aligning a category of loan products with a category of borrowers. The consequences of this on market mobility have yet to be discussed.

innovate techniques of granular risk-based pricing with hundreds of potential price levels (Collins, Belsky & Case, 2004). In 1996, a full ten year before the onset of the contemporary credit crisis, First Franklin Financial⁴⁹ CEO and co-founder, William D. Dallas, published an ambitious article entitled ‘A time of innovation’, in the trade journal *Mortgage Banker*. He stated that it was clearly “unsuitable for lenders to sell what is truly a subprime loan (loans that fail to meet secondary market agency standards) to the secondary market corporations” (Dallas, 1996). Having engaged with Fair Isaac, Freddie Mac, and Standard & Poor’s, he enthusiastically predicted the growth of a subprime business arguing that “there are much higher margins and reduced risk when you properly price a subprime loan instead of mispricing it and jamming it into the prime pipeline” (Dallas, 1996). First Franklin’s slogan –‘Score it, price it, close it’ – captures the élan of score infused private label finance. With FICO[®] poised to act as a vertical bridge between the primary and secondary markets, it was a short step from systematically originating subprime mortgage loans, to moving these up through the ratings agencies and into investment portfolios.

A 2004 Joint Center for Housing Studies (Harvard University) working paper, by two employees of Standard & Poor’s, has provided evidence that this separation is empirically meaningful (Raiter & Parisi, 2004). Examining the relationship between FICO[®] scores and mortgage coupons (interest rates) from data in S&P’s proprietary database of 9.3 million residential mortgages, the study concluded that rational risk based pricing had become more refined and more expansive since 1998. By ‘rational’ they meant that that the interest rate of the loans increase as the FICO[®] scores decreased, but also that “the coupon rate charged on the loan at origination [...] translated into true dollar costs over the life of the loan” (p 20). What is perhaps more significant is the finding that “risk-based pricing is more efficiently applied in the *nonprime* arena” (emphasis added) which implied that “lenders are more concerned about accurately pricing default risk in a market segment that is perceived to be of higher risk than in the prime” (p 18). Vaunting the qualities of LEVELS[®] the paper drew attention to the fact that while the GSEs “would provide one mortgage rate for all borrowers qualifying for a particular product,

⁴⁹ 1st Franklin Financial Corporation operates in Georgia, Alabama, South Carolina, Mississippi and Louisiana. In the heart of the real estate bubble First Franklin was bought by Merrill Lynch as a ‘subprime specialist’ for 1.3 billion, an acquisition that would weight heavily on the firm only a year later as the market collapsed (Keoun, October 17, 2007).

originators in the non-conforming market could provide a range of coupons dependent on their ability to stratify risk” (p 6).⁵⁰

These alternative dynamics of subprime lending are now taken to be matters-of-fact in the banking industry. The FRB’s Commercial Bank Examination Manual and the Bank Holding Company Supervision Manual both observe that a FICO of 660 is the reported industry benchmark for the subprime lending (consumer credit and mortgages) although they are careful to indicate that the government guidance does not endorse any “single definitive cutoff point for subprime lending” (Federal Reserve Board, 1994a, p 11; 1994b, p11)⁵¹. The Commercial Manual goes on to frankly state that “Subprime loans command higher interest rates and loan fees than those of offered to standard-risk borrowers” (Federal Reserve Board, 1994b, p 2). As long as lenders charge prices that are high enough to cover the higher loan-loss rates and overhead costs, associated with this business then the subprime can be expected to be profitable. Moreover, this manual points out that “The ability to securitize and sell subprime portfolios at a profit while retaining the servicing rights makes subprime lending attractive to a larger number of institutions, further increasing the number of subprime lenders and loans” (p 2). Indeed, under contemporary conditions, whose achievement has been traced in this paper, it does not seem at all astounding that securitization would be infinitely more attractive in the subprime than in the prime.

⁵⁰ It is perhaps not incidental that the first author, Frank Raiter, was, as managing director of Residential Mortgage Group within S&P Structured Finance unit, a key advocate of credit scoring during the period of industry automation. The study discussed here is perhaps somewhat tautological in that it uses FICO® scores to show that the market is rational, when it is arguable the rationale of the FICO® that has made the market able to perform this rationality.

⁵¹ The FRB examination manuals provide guidance to supervisory personnel in planning and conducting bank inspections, although they are not legal documents.

The GSE paradox⁵²

During the housing bubble the mortgage market grew due to a proliferation of lending that did not meet the agencies' risk management criteria because the GSEs' 'non-accepts' – the very loan categories they eliminated and deemed *bors du marché* – became private-label's main market. The result is a startling paradox: "Fannie and Freddie have become the opposite of what they were. They are now lenders to safe markets, while private institutions serve markets that were once liquidity-deprived" (Thornbert, August 24, 2007). So although the GSEs exist to better attract capital to the market, as Richard Syron, Chairman and CEO of Freddie Mac pointed out to the recent Congressional Committee on Financial Services inquiry, today, "Numerous investors compete vigorously for mortgage assets" (Syron, March 15, 2007). The record of Syron's testimony indicates that mortgage risk is, in all actuality, widely dispersed among many investors. For the duration of the housing boom, it was investment capital that generously funded a proliferation of mortgage options, and attended to the very groups that are arguably most in need of ownership assistance according to the mandate of the GSEs.

The central observation is that "the issuers of private-label residential MBS are holding the aces that were once held by government-sponsored enterprises (GSEs), Fannie Mae and Freddie Mac" (England October 2006). "Once a junior – but powerful – player in the market private-label residential mortgage backed securities (RMBS) are now the leading force driving product innovation and the net overall volume of mortgage origination" (England October 2006). As the composition of loan originations moves towards non-standard products and as the secondary market attracts less risk restricted firms willing to fund those loans, "[the GSE's] share of U.S. residential mortgage debt outstanding (MDO) has dropped significantly, while the MDO share for competing

⁵² The account of GSE involvement in the crisis has taken a dramatic turn since these were placed under conservatorship (see footnote 17). The paradox described here has all but dropped out of the picture. Propagated by the publicity of federal hearings ("Federal Responses to Market Turmoil", Committee of the Budget, U.S. House of Representatives, September 24, 2008), and heightened by the drama of electoral politics, new arguments have emerged charging that it was in fact the GSEs that underwrote the mass of subprime loans at the root of the default crisis. These claims place fault squarely on Democrats for resisting greater oversight during the 2004 Congressional Hearings into accounting practices at Fannie Mae, as well as for supporting policies that encouraged GSE involvement in the project of affordable housing. It is important to note, however, that Fannie Mae's direct involvement in underwriting subprime lending began late in the game, in 2006, as an effort to stem the erosion of their market share (Hilzenrath, August 19, 2008). Caught up in the dynamics of the new market configuration looping back upon them, it is arguably at this moment that the GSEs absorbed some forms of *control-by-risk* developed in the parallel subprime markets.

investors has grown dramatically” (Syron, March 15, 2007, p 30)⁵³. Freddie Mac and Fannie Mae continue to be “large forces in the mortgage market”, but it is becoming widely recognized that they are playing “a small and diminishing role in the subprime business as large Wall Street institutions and hedge funds have become more active” (Bajaj, February 28, 2007).⁵⁴

Some recent production figures from the heart of the real estate boom drive home the magnitude and acceleration of these changes. By 2003, private-label accounted for 24 percent, or some \$586 billion of RMBSs. At that time, most of the loans involved were ‘jumbo prime mortgages’, that is, mortgages considered to involve a low credit risk but whose size would exceed the purchasing limits imposed on the GSEs in their charters. In only the first two quarters of 2006, however, private-label issuance had grown to nearly the same amount as in all of 2003 – to \$577 billion – and their percentage share of the market had leapt up to 57 percent.⁵⁵ What is even more striking is how these figures are distributed by type of market or market segment. While the issuance showed a healthy increase from \$57 billion (Q1-03) to \$67 billion (Q1-06) in the prime segment, it had more than tripled – from \$37 billion (Q1-03) to \$114 billion (Q1-06) – in the ‘subprime’. It has further been reported that in 2003, “62 percent of originations were conventional, conforming loans underwritten to GSE guidelines. By contrast, in the first half of 2006, only 35 percent of mortgages were conventional, conforming loans” (England October 2006).

In the last decade private capital has been tripping over itself – or so it appeared – to become a handmaiden to the American Dream. The subprime collapse has turned the tables back again, and the GSEs are now taking a sound scolding from their masters in Congress for having left vulnerable populations, the very groups most in need of temperate government assistance to the Wall Street wolves. In its defense, Syron has

⁵³ Document available online at <http://www.freddie.com/corporate/about/policy/pdf/syron3-15-07finaltestimony.pdf>.

⁵⁴ In addition to facing new sources of competition, the GSEs have been besieged by harsh accusations of ‘creative bookkeeping’. In response to these affairs, H.R. 1461 the Federal Housing Reform Act of 2005 was passed on October 26, 2005. The Federal Housing Reform Act of 2007 introduced March 9 (H.R. 1427), was being debated at the time of writing. Bills have included provision to force the Agencies to raise capital reserves and to divert funds towards affordable housing in high-risk groups. Although the bill does not specify how high-risk will be assessed, an educated guess is that this will be determined at least in part by the participation of FICO® scores or some other bureau tool. The potential repercussion of these and other capital requirement to the agencies’ potential hold on even the prime market is clearly discussed in (Frame & White, 2007).

⁵⁵ Source: Inside Mortgage Finance Database, reported in (England October 2006).

diplomatically pointed out that “Freddie Mac’s business is confined to the residential mortgage market – in good times and bad. We can’t diminish our support for this market when there are more profitable investments to be had elsewhere”. Unlike the private equity funds, hedge funds, non-bank financial institutions, the GSEs need to maintain more conservative portfolios because they have a “statutory requirement to provide liquidity to the nation’s mortgage market” (Syron, March 15, 2007). Perhaps the final blow of irony is that as the crisis began, the GSEs themselves were caught holding some \$170 billion in private-label subprime securities⁵⁶, products which they would never have underwritten themselves. Like so many others, they had purchased these as investments because they were triple-A rated by the ratings agencies⁵⁷.

Discussion: Market devices as agents of change

It seems to make obvious sense today that lenders should be moving all kinds of loans into the capital markets. High-risk loans flying off the books – this is indeed as Ben Bernanke has put it, a ‘great sea change’ from the days when the GSEs were the chartered institutions necessary to facilitate mortgage finance in a risk minimizing fashion. Rather than taking simplified dynamics of ‘supply and demand’ or ‘risk versus return’ as naturalized backdrops of this type of change, this paper has proposed that we take the practical configuration of these economic principles in distributed material devices as an object of investigation. Instead of searching for accelerations of financial activity in the ideas and motivations of market participants this means examining the moments when the material content of industry practices have changed. These changes have generated novel pathways of microeconomic market participation which have gradually become amplified, through continuous ongoing innovation, into macroeconomic circuits of capital flow.

Adapting tools from science and technology studies and the social studies of accounting to the social study of finance, this paper has presented a calculatively sensitive account of the origins of the subprime mortgage market. It has traced the movement of commercial

⁵⁶ This figure was reported in an Office of Federal Housing Enterprise Oversight (OFHEO) news release available online at: <http://www.ofheo.gov>.

⁵⁷ A statement to this effect was made by James B. Lockhard III, director of the OFHEO at the Federal Reserve Bank of Chicago’s 44th Annual Conference on Bank Structure & Competition, at the luncheon address, May 16, 2008 (author’s field notes). The increasingly complex relationship between the GSEs and the ratings agencies manifests itself in numerous ways as indicated earlier in footnote 22.

consumer credit analytics into mortgage underwriting as a means of demonstrating that what might look like the spontaneous rise of a ‘free’ capital market divested of direct government intervention, has been thoroughly embedded in the concerted movement of technological apparatuses. When dealing with the recent breakdown of this financial circuit, the approach replaces ‘transgressions of economic common sense’⁵⁸ with the ‘generative calculative practices of economic agency’ (Callon & Law, 2003; Preda, 2006; Rose & Miller, 1992). In this view, financial phenomena are no longer categorised as the results of correctness or falsity, of rationality or irrationality, so much as they are analysed symmetrically according to how financial activities are framed, constituted and brought into being – until as it may happen, their own internal consistency brings them to the point of overflow and collapse (MacKenzie, 2006).

FICO[®] scores can therefore be said to have reconfigured mortgage markets, putting into place a space of potential high-risk investment action. The intriguing plot twist is that these scores were introduced into the mortgage industry by risk-adverse government agencies. When the GSEs adopted the FICO[®] they interpreted scores conservatively, assuming they could be used to reinforce the binary spirit of the traditional form of *credit control-by-screening*. But because the tool had inscribed within it the possibility of making financially meaningful risk management calculations, it enabled the rise of a new form of financial activity: *credit control-by-risk*. As FICO[®] scores were hardwired across a number of independent information processing infrastructures they aligned the calculative activities of distinct groups of actors. The new control was not exploited uniformly; it proliferated outside of the government facilitated market through developments in private automated loan evaluation software, giving rise to a vibrant and invested subprime.

What the exercise of tracking shows is that the scores have not achieved these effects abstractly or from a distance. Shifting from one form of market calculation to another requires a gradual and continuous process of material extension in which scores have travelled long distances, lodge themselves in many places, and participated in traceable processes. Thus it is not quantification, model building, or numerical expression as information *per se*, that should be linked to increased channels for high-risk investment in

⁵⁸ The reference to ‘transgressions’ points to both the errors that are attributed to having followed economic ideas too closely, as well as to those that are said to result from overriding a naturalized economics.

the mortgage industry. Nor can responsibility for the changes be flatly pinned on the GSEs for having adopted the scores in the first place. It is the pioneering journey of FICO® scores throughout the industry that has integrated, assembled, and aligned different market agents. The integrity of the chain – which might have been truncated at any point along its length had an alternative solution or even another interpretation of these scores been adopted – is what has rendered these diverse agents capable of engaging together in a distinctive and coherent, globe spanning circuit of productive subprime real estate finance.

This is not a story of technological diffusion because continuous distribution, adaptation, discovery and innovation have mattered. The scores did not diffuse unhindered, but passed through and were adjusted at several institutional passage points. Nor is it a story about technology selection where a technical method is purposively promoted by overtly politicized actors because it coheres to the needs of a greater particular movement or political program (for this kind of account see (Burchell, Clubb & Hopwood, 1985)). Instead, the political outcomes of this case (broadly speaking) have unfolded within the messy and uncertain process of constituting the scores as appropriate tools for mortgage finance. Political change results from the multiple local movements that remake the technology into a market device. In this story a risk management apparatus becomes in and of itself the diffused principle of coordination between groups with different interests and objectives. This is why an overarching or driving ‘discourse’ or preexisting ‘rationality’ is notably absent – because actors who are not discursively aligned at the outset end up being organized through shared risk management practices.⁵⁹

A technological platform for common calculation can be the carrier of profound political displacement and of astounding economic change. But since statistical solutions are naturally multiple the achievement of such a platform has to be taken as an analytic puzzle not as a causal force. As a form of modelling for simplifying and disambiguating through a process of abstraction (Rosenblueth & Wiener, 1945), calculative problems can be framed in multiple ways, and calculative solutions are constantly threatened by the introduction of alternative possibilities (Callon, 1998b; Callon & Law, 2003). From Fair Isaac’s point of view the impetus for selecting their product across the board is its scientific superiority within a competitive market for scores. Yet as we have seen, the

⁵⁹ The insightful observation that accounting systems can participate in the creation of their own organizational contexts is discussed in (Hopwood, 1983).

constitution of this staying power is deeply entangled with the activities of government and ratings agencies whose endorsements, independent research initiatives, interpretations and automated systems greatly contributed to re-qualifying and singularising (Callon et al., 2002) this particular brand of consumer risk scores such that it became a calculatively effective risk management product for another market situation. Once this calculative tool was stabilized in and as an infrastructure it intensified and generated downstream complexity⁶⁰ as it made an alternative form of co-ordinated and coherent collective decision making possible.

As devices, both the GSE's exclusionary rulebooks and rank-bearing FICO[®] scores have proved workable solutions to the problem of rendering financial action possible. What is remarkable is that in achieving their objectives through the assembly of different tools, methods and organizational arrangements, each one assembles mortgage markets with distinctive qualities of financial action. Agency guidelines are one distributed market making device whose way of achieving common calculability is actively reinforced by the GSEs, which take responsibility for checking behind the application of guidelines and who reassure investors by taking up the central position in the securitization process. Moreover, the GSEs have a direct stake in financial outcomes as holders of their own as well as private label securities. Knotted together in this way, GSE devices have performed a concentrated low-risk mortgage market with a limited set of explicitly and implicitly guaranteed investment products.

The shift towards circulating credit bureau FICO[®] scores, on the other hand, has performed high-risk markets with differentiated and structured products. Like the GSE guidelines, commercial bureau scores are also constituted by institutional arrangements (Poon, 2007). Yet, unlike the guidelines whose efficacy is intimately tied to their ongoing association with the authority of the GSEs, bureau scores enter exchange activity as detached pieces of scientific calculation that circulate independently of their makers. Through the commercial transactions in which they are bought and sold, scores are

⁶⁰ A topic entirely omitted in this paper that is crucial to the unfolding of the eventual subprime induced crash is the rise of structured finance, credit enhanced securities with what are called 'senior subordinated structures'. These investment vehicles are built with tiers of mutually insuring, differentially graded tranches that layer risk unequally at different rates of return in the design of the product. In the crisis it was the junior classes of these products held by hedge funds that degraded first as they are built to do, but not as rapidly as they did. That the single class pass-through gave way to these structured securities after 1997 (Adelson, 2004) strongly suggests that the adoption of commercial credit scores played a role in the advancement of structuring. This paper touches upon only the immediate innovation that followed behind the introduction of FICO[®] scores.

emancipated from the conditions of their own production, an effect that contributes to their very appeal (Latour, 1987). The result is a curious distinction: Despite the fact that distributed market devices play a crucial role in generating the qualities of both circuits of mortgage finance, prime lending, facilitated by the visible hand of accountable government sponsored enterprises, is considered to be ‘regulated’ or ‘managed’; while subprime lending, sustained by the invisible hand of economic information, is described as the culmination of independent decision making by economic agents who are ‘dispersed’ and ‘free’.

Conclusion

This research is part of a broader project that seeks to draw attention to the introduction of default risk, established through new calculative apparatuses, in changing the nature of U.S. consumer finance.⁶¹ By engaging with empirical details of how risk management tools are transmitted on the ground, the work emphasizes that shared forms of calculation do not arise spontaneously but must be established progressively through their insertion into local practices. Some may find it a strange conclusion, but the consequence of this observation is as follows: inherently superior qualities are not necessarily what allow some calculations to rise above the many other solutions to the problem of assessing risk. It is the idiosyncratic process of being reworked and implemented which might enable specific calculations to acquire a unique positioning that renders them effective agents of collective financial action.

In the case discussed here, the infrastructural qualities of FICO[®] scores in mortgage finance were engineered through successive movement and translation as they spread across the industry. It is important to remember that at the outset, credit bureau scores were considered a sub-optimal, if not inappropriate tool for mortgage underwriting, by scoring experts at Fair Isaac. Nonetheless they were a convenient solution to the problem of controlling credit quality, one that was perhaps cheaper and faster to implement than doing R&D. Adopted by Freddie Mac, commercially available credit scores entered into the mortgage industry to do a humble job of reinforcing extant practices of *control-by-screening*. The distinctive mark of 660 is a testimony of these limited intentions. Subsequently taken up by Fannie Mae, FICO[®] became part of a united GSE

⁶¹ It is noteworthy that the U.K.’s commercial bureau scoring system is the most similar to that of the U.S., largely due to the influence of Fair Isaac.

solution to evaluating credit quality. Scores were hardwired into proprietary automated underwriting software, and rapidly became a recognized piece of loan-making machinery. Facilitated, for example, by an enthusiastic partnership between Freddie Mac and S&P, FICO[®] was also hardwired into private automated underwriting software. In both financial circuits bureau scores smoothed out production. They provided vertical integration by allowing the quality of single loans and pools of loans to be expressed by the same risk metric. They also provided horizontal integration in that investors could now use the description in terms of FICO[®] to compare the value of complexly constructed securities.

The scores bubbled with generative capacities, providing fresh material for financial innovation as they propagated throughout the industry. An empirical demonstration that the qualities of calculation are not deterministic, but must be acted upon and developed, the paper further describes how this potential was taken up differentially by the GSE and private label players. In the hands of the GSEs statistical scores continued to be used as a conservative screening device for selecting prime quality loans; in the hands of private label, however, they were used to develop risk managed products that exploited the newly risk quantified space of non-GSE lending. Coordinated by FICO[®], a new regime of *control-by-risk* emerged. As exotic mortgage products and increasingly structured securities proliferated, the ‘non-prime’ – by definition excluded from investment, was transformed into ‘the subprime’ – a place of elevated return on investment. In the subprime, an alternative circuit of mortgage production supported by the rise of direct retail channels to consumers⁶² and bond rating agencies, capital players could now circumvent authoritative government sponsored apparatuses. They calculatngly poured money directly into asset backed paper based on consumer real estate.

As investment capital flooded into housing, it crashed into two pillars: The fabled American Dream of homeownership, and the reputation of real estate as a safe and stable sector. These golden images, foraged in the days when the GSEs’ rule-based market making apparatus dominated mortgage finance, carried over untarnished even as information infrastructure was changing the nature of lending industry under everyone’s feet. Given that the mandate of the GSEs was to facilitate home ownership, it should

⁶² As of October 2008, twenty two of the thirty largest specialized subprime operations had been shut down, gone bankrupt, or been seized by the FDIC (i.e. Indymac and WaMu). It is noteworthy that other casualties of subprime involvement such as Bear Sterns, were too small as players to make this list.

come as no surprise then that the success of subprime was initially heralded as a solution to the problem of affordable housing. The tensions that make democratic lending a puzzle in a regime of *control-by-screening*, seemed to dissolve away in a regime of *control-by-risk*. Yet what went overlooked was that the transition from low-risk exclusionary to high-risk inclusionary lending practices had transformed the very nature of homeownership. It intensified competition and raised properties prices by equipping more home buyers across the nation with immediate purchasing capability. Moreover, faced with complex choice sets it demanded that everyday people exercise degrees of financial judgment that had heretofore not been required of them.

Readers searching for a smoking gun will no doubt find this account of the origins of subprime finance tremendously disappointing. It is admittedly counterintuitive to consider the onset of crisis from anything but the perspective of fault or error. But although it may be true, to take one example, that lax income statements ran rampant in the subprime business, it could also be expected that the age-old tactics of brokers would take on a renewed fervour as lending boomed. Misstated income is not new; what is new are the infrastructural conditions under which these misstatements have occurred. To belabour the point of underwriting error is to forget that the rationale of statistical automation was to minimize and overcome the virulence of precisely this kind of well-recognized ground level activity. A provocative hypothesis would be that such error could be expected to proceed unchecked and to increase exactly as it ostensibly did, once muted at the systemic level.⁶³ In a world where multiple calculations and multiple frames of meaning are possible, what is an error at one moment can quickly become a non-error by the criteria of another, and vice versa. It is only by retreating to the rigid view of worthiness in *control-by-screening* that actions occurring in a regime of *control-by-risk* can be criticized as fundamental ‘errors’. This is the flaw of ‘error’ as a social scientific concept in situations that are in motion: it can only be fixed retrospectively and defined from an analytically external point of view.

This paper has taken an altogether different approach to the subprime crisis. It has suggested that the explosion of the subprime was not caused by a sheer increase in lending volume stemming from irrational, fraudulent, or extra-governmental activity, but by the super-coordination of market actors’ decision-making around stabilized frames of

⁶³ For a detailed enumeration by a practitioner of the underwriting battles that went on between brokers and subprime mortgage wholesalers see (Bitner, 2008).

risk provided by third party commercial consumer analytics companies. If risk is tied to the capacity to make decisions as Millo and Holzer (Millo & Holzer, 2005) have cogently suggested – that is to say, a decision not to lend at all is a zero risk decision – then the unfolding volatility of subprime finance as well as its amplified supply and demand would not be related to having misjudged or underestimated risk, so much as it would be generated by economic agents acting upon newly constituted risk-bearing entities materialized, shaped and described by FICO[®] credit bureau scores. It was not from a dearth of information (information asymmetry), but from the *presence* of innovative forms of digitized consumer risk scores that the infamous model of originate-to-distribute, of creating profit by pushing loans in volume onto the secondary markets, was put into practice. In this view, the protracted globe-spanning credit crisis beginning in 2007 should be studied first and foremost as the temporary achievement of a tightly calculated system of financial order, not as disorder. The contemporary financial turbulence is the empirical result of having engaged with novel conditions of calculative possibility.

References

- Abolafia, M. (1997). *Making Markets: Opportunism and Restraint on Wall Street*. Cambridge MA: Harvard University Press.
- Adelson, M. (2004). Home Equity ABS Basics. New York: Nomura Fixed Income Research, p. 24.
- Adler, M., & Adler, P. eds. (1984). *The Social Dynamics of Financial Markets*. Greenwich: JAI Press.
- Avery, R., Bostic, R., Calem, P., & Canner, G. (July 1996). Credit Risk, Credit Scoring, and the Performance of Home Mortgages. *Federal Reserve Bulletin*, 621-648.
- Bajaj, V. (February 28, 2007). Freddie Mac Tightens Standards. *New York Times*. New York.
- Baker, T., & Simon, J. eds. (2002). *Embracing Risk: The Changing Culture of Insurance and Responsibility*. Chicago: University of Chicago Press.
- Baker, W. (1984). The Social Structure of a National Securities Market. *American Journal of Sociology* 89, 775-811.
- Beunza, D., & Stark, D. (2004). Tools of the Trade: The Socio-Technology of Arbitrage in a Wall Street Trading Room. *Industrial and Corporate Change* 13, 369-400.
- Bitner, R. (2008). *Confessions of a Subprime Lender, An Insider's Tale of Greed, Fraud, and Ignorance*. Hoboken: John Wiley & Sons Inc.
- Black, H. (1961). *Buy Now, Pay Later*. New York: William Morrow and Company.
- Bloor, D. (1991). *Knowledge and Social Imagery*. Chicago: University of Chicago Press.
- Bowker, G., C., & Star, S.L. (2000). *Sorting Things Out: Classification and Its Consequences*. Cambridge MA: The MIT Press.
- Burchell, S., Clubb, C., & Hopwood, A. (1985). Accounting In Its Social Context: Towards a history of the value added in the United Kingdom. *Accounting, Organization and Society* 10, 381-413.
- Çalışkan, K. (2007). Price as a market device: cotton trading in Izmir Mercantile Exchange. *The Sociological Review* 55, 241-260. In M. Callon, F. Muniesa, & Y. Millo, *Market Devices*. Oxford: Blackwell Publishers.
- Callon, M. (1986). Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St. Brieuc Bay. *Power Action and Belief: Sociological Review Monographs* 32, 197-233.
- Callon, M. (1991). Techno-economic networks and irreversibility. In J. Law, *A Sociology of Monsters*. London: Routledge, pp. 132-161.
- Callon, M. (1998a). Actor-Network Theory - The Market Test. In J. Law, & J. Hassard, *Actor Network Theory and After*. Oxford: Blackwell, pp. 181-195.
- Callon, M. (1998b). An essay on framing and overflowing: economic externalities revisited by sociology. In M. Callon, *The Laws of the Market*. Oxford: Blackwell Publishers, pp. 244-269.
- Callon, M. (2002). From Science as an Economic Activity to the Socioeconomics of Scientific Research. In P. Mirowski, & E.M. Sent, *Science Bought and Sold: Essays on the Economics of Science*. Chicago: University of Chicago Press, pp. 277-317.
- Callon, M., & Çalışkan, K. (forthcoming). Economization: New Directions in the Studies of Markets. *Economy and Society*.
- Callon, M., & Law, J. (2003). On Qualculation, Agency and Otherness. *Environment and Planning D: Society and Space* 23, 717-733.

- Callon, M., Méadel, C., & Rabeharisoa, V. (2002). The economy of qualities. *Economy and Society* 31, 194-217.
- Callon, M., & Muniesa, F. (2005). Economic markets as calculative and calculated collective devices. *Organization Studies* 26, 1229-1250.
- Callon, M., Muniesa, F., & Millo, Y. (2007a). An introduction to market devices. *The Sociological Review* 55, 1-12. In M. Callon, F. Muniesa, & Y. Millo, *Market Devices*. Oxford: Blackwell Publishers.
- Callon, M., Muniesa, F., & Millo, Y. eds. (2007b). *Market Devices*. Oxford: Blackwell Publishers.
- Carruthers, B., & Stinchcombe, A. (1999). The Social Structure of Liquidity: Flexibility, Markets, and States. *Theory and Society* 28, 353-382.
- Chomsisengphet, S., & Pennington-Cross, A. (2006). The Evolution of the Subprime Mortgage Market. *Federal Reserve Bank of St. Louis Review* 88, 31-56.
- Clarke, A., & Fujimura, J. eds. (1992). *The Right Tools for the Job*. Princeton: Princeton University Press.
- Cochoy, F. (2002). *Une sociologie du packaging ou l'âne de Buridan face au marché*. Paris: Presses Universitaires de France - PUF.
- Cochoy, F., & Grandclément, C. (2006). Histoires du chariot de supermarché. Ou comment emboîter le pas de la consommation de masse. *Vingtième siècle* 91, 77-93.
- Collins, M., Belsky, E., & Case, K.E. (2004). Exploring the Welfare Effects of Risk-based Pricing in the Subprime Mortgage Market. *Joint Center for Housing Working Paper Series*. Cambridge MA: Harvard University.
- Comptroller of the Currency. (1997). Asset Securitization, Comptroller's Handbook. *Liquidity and Funds Management*, p. 89.
- Congressional Budget Office. (2003). Effects of Repealing Fannie Mae's and Freddie Mac's SEC Exemptions. The Congress of the United States.
- Cronon, W. (1992). *Nature's Metropolis: Chicago and the Great West*. New York: W. W. Norton & Company.
- Dallas, W.D. (1996). A time of innovation. *Mortgage Banking* 57.
- Daston, L. (2000). The Coming into Being of Scientific Objects. *The Biographies of Scientific Objects*. Chicago: Chicago University Press, pp. 1-14.
- De Certeau, M., Giard, L., & Mayol, P. (1998). *The Practice of Everyday Living: Living and Cooking*. Minneapolis: University of Minnesota Press.
- England, R.S. (October 2006). Cover Report, Industry Trends: The Rise of Private Label. *Mortgage Banking*.
- Espeland, W.N. (1998). Commensuration as a Social Process. *Annual Review of Sociology* 24, 313-343.
- Federal Reserve Board. (1994a). Section 2128.08, December 2002, Subprime Lending (Risk management and Internal Controls). *Bank Holding Company Supervisory Manual*.
- Federal Reserve Board. (1994b). Section 2133.1, November 2002, Subprime Lending: 'Supervisory Guidance for Subprime Lending'. *Commercial Bank Examination Manual*.
- Fleck, L. (1981). *Genesis and Development of a Scientific Fact*. Chicago: University of Chicago Press.
- Fourcade-Gourinchas, M. (2007). Theories of Markets, Theories of Society. *American Behavioral Scientist* 50, 1015.
- Frame, S.W., & White, L.J. (2007). Charter Value, Risk-Taking Incentives, and Emerging Competition for Fannie Mae and Freddie Mac. *Journal of Money, Credit and Banking* 39, 83-103.

- Freddie Mac. (1996). *Automated Underwriting Report: Making Mortgage Lending Simpler and Fairer for America's Families*. McLean, Virginia: Freddie Mac.
- Garcia-Papet, M.-F. (2007). The Social Construction of a Perfect Market: The Strawberry Auction at Fontaines-en-Sologne. In D. MacKenzie, F. Muniesa, & L. Siu, *Do Economists Make Markets?* Princeton: Princeton University Press, pp. 20-53.
- Godechot, O. (2001). *Les traders, essai de sociologie des marchés financier*. Paris: La Découverte.
- Godechot, O. (2006). "What's the market wage" How compensation surveys give form to the financial labor market. *Genèse* 63, 108-127.
- Guala, F. (2001). Building Economic Machines: The FCC Auctions. *Studies in the History and Philosophy of Science* 32, 453-477.
- Guseva, A., & Rona-Tas, A. (2001). Uncertainty, Risk and Trust: Russian and American Credit Card Markets Compared. *American Sociological Review* 66, 623-646.
- Hilzenrath, D.S. (August 19, 2008). Fannie's Perilous Pursuit of Subprime Loans, As It Tried to Increase Its Business, Company Gave Risks Short Shrift, Documents Show. *Washington Post*.
- Hopwood, A. (1983). On trying to study accounting in the contexts in which it operates. *Accounting, Organization and Society* 8, 287-305.
- Hopwood, A. (1987). The archaeology of accounting systems. *Accounting, Organizations and Society* 12, 207-234.
- Hopwood, A. (2000). Understanding financial accounting practice. *Accounting, Organizations and Society* 25, 763-766.
- Hopwood, A., & Miller, P. eds. (1994). *Accounting as social and institutional practice*. Cambridge: Cambridge University Press.
- Hutchins, E. (1995). *Cognition in the wild*. Cambridge MA: MIT Press.
- Kalthoff, H. (2005). Practices of Calculation: Economic Representations and Risk Management. *Theory, Culture and Society* 22, 69-97.
- Keoun, B. (October 17, 2007). First Franklin purchase weight on Merrill chief. *International Herald Tribune*.
- Kirn, W. (2006). My Debt, Their Asset. *New York Times Magazine*, p. 26.
- Knorr Cetina, K., & Preda, A. (2005). *The Sociology of Financial Markets*: Oxford University Press.
- Kohler, R. (1994). *Lord of the Fly: Drosophila Genetics and Experimental Life*. Chicago: University of Chicago Press.
- Latour, B. (1987). *Science in Action: How to follow scientists and engineers through society*. Cambridge MA: Harvard University Press.
- Lave, J. (1988). *Cognition in Practice: Mind, Mathematics and Culture in Everyday Life*: Cambridge University Press.
- Lave, J., Murtaugh, M., & de la Rocha, O. (1984). The dialectic of arithmetic in grocery shopping. In B. Rogoff, & J. Lave *Everyday cognition*. Cambridge MA: Harvard University Press, pp. 67-94.
- Lépinay, V.-A. (2002). Finance as circulating formulas. *Conference on Social Studies of Finance*. Center on Organization Innovation, Columbia University: Social Science Research Council.
- Lépinay, V.-A. (2007). Parasitic Formulae: The Case of Capital Guarantee Products. *The Sociological Review* 55, 261-283. In M. Callon, F. Muniesa, & Y. Millo, *Market Devices*. Oxford: Blackwell Publishers.
- Levinson, M. (2006). *The Box: How the Shipping Container Made the World Smaller and the World Economy Bigger*. Princeton: Princeton University Press.

- Lewis, E. (1992). *An Introduction to Credit Scoring*. San Rafael: Fair, Isaac and Co.
- Lewis, M. (1990). *Liar's Poker: Rising Through the Wreckage on Wall Street*. Markham: Penguin Books.
- Leyshon, A., & Thrift, N. (1999). Lists come alive: electronic systems of knowledge and the rise of credit-scoring in retail banking. *Economy and Society* 28, 434-466.
- MacKenzie, D. (2003). An Equation and its Worlds: *Bricolage*, Exemplars, Disunity and Performativity in Financial Economics. *Social Studies of Science* 33, 831-868.
- MacKenzie, D. (2006). *An Engine, Not a Camera*. Cambridge MA: The MIT Press.
- Mallard, A. (2007). Performance testing: dissection of a consumerist experiment. *The Sociological Review* 55, 152-172. In M. Callon, F. Muniesa, & Y. Millo, *Market Devices*. Oxford: Blackwell Publishers.
- Marron, D. (2007). 'Lending by numbers': credit scoring and the constitution of risk within American consumer credit. *Economy and Society* 36, 103-133.
- Miller, P. (2008). Calculating Economic Life. *Journal of Cultural Economy* 1, 51-64.
- Miller, P., & O'Leary, T. (1987). Accounting and the Construction of the Governable Person. *Accounting, Organization and Society* 12, 235-265.
- Miller, P., & O'Leary, T. (1994). Governing the calculable person. In A. Hopwood, & P. Miller, *Accounting as social and institutional practice*. Cambridge: Cambridge University Press, pp. 98-115.
- Miller, P., & Rose, N. (1997). Mobilising the consumer: Assembling the subject of consumption. *Theory, Culture and Society* 14, 1-36.
- Millo, Y. (2007). Making things deliverable: The origins of index-based derivatives. *The Sociological Review* 55, 196-294. In M. Callon, F. Muniesa, & Y. Millo, *Market Devices*. Oxford: Blackwell Publishers.
- Millo, Y., & Holzer, B. (2005). From Risks as Second-order Dangers in Financial Markets: Unintended consequences of risk management systems. *New Political Economy* 10, 223-246.
- Muniesa, F. (2000). Un robot walrasien: Cotation électronique et justesse de la découverte des prix. *Politix* 13, 121-154.
- Poon, M. (2007). Scorecards as devices for consumer credit: The case of Fair, Isaac & Company Incorporated. *The Sociological Review* 55, 284-306. In M. Callon, F. Muniesa, & Y. Millo, *Market Devices*. Oxford: Blackwell Publishers.
- Preda, A. (2006). Socio-Technical Agency in Financial Markets: The Case of the Stock Ticker. *Social Studies of Science* 36, 753-728.
- Quinn, L.R. (September 2000). Credit Score Scrutiny. *Mortgage Banking*, 50-55.
- Raiter, F., Gillis, T., Parisi, F., Barnes, S., Meziani, S., & Albergo, L. (1997). Innovations in Mortgage Risk Management. Standard & Poor's Rating Services.
- Raiter, F., & Parisi, F. (2004). Mortgage Credit and the Evolution of Risk-Based Pricing. *Joint Center for Housing Studies Working Paper Series*. Cambridge, MA: Harvard University.
- Rheinberger, H.-J. (1997). *Toward A History of Epistemic Things: Synthesizing Proteins in the Test Tube*. Stanford: Stanford University Press.
- Rose, N., & Miller, P. (1992). Political Power beyond the State: Problematics of Government. *The British Journal of Sociology* 43, 173-205.
- Rosenblueth, A., & Wiener, N. (1945). The Role of Models in Science. *Philosophy of Science* 12, 316-321.
- Schorin, C., Heins, L., & Arasad, A. (2003). *Home Equity Hand Book*. Morgan Stanley.
- Shiller, R.J. (2005). *Irrational Exuberance*. Princeton: Princeton University Press.
- Shiller, R.J. (2008). *The Subprime Solution*. Princeton: Princeton University Press.

- Sinclair, T.J. (2005). *The New Masters of Capitalism: American Bond Rating Agencies and the Politics of Creditworthiness*. Ithaca: Cornell University Press.
- Smelser, N., & Swedberg, R. (1994). *The Handbook of Economic Sociology*. Princeton: Princeton University Press.
- Standard & Poor's. (1999). *Structured Finance: U.S. Residential Subprime Mortgage Criteria*. New York: The McGraw-Hill Companies.
- Star, S.L. (1999). The Ethnography of Infrastructure. *American Behavioral Scientist* 43, 377-391.
- Straka, J.W. (2000). A Shift in the Mortgage Landscape: The 1990s Move to Automated Credit Evaluations. *Journal of Housing Research* 11, 207-232.
- Swedberg, R. (2003). *The Principles of Economic Sociology*. Princeton: Princeton University Press.
- Syron, R. (March 15, 2007). Testimony of Richard F. Syron. *Committee on Financial Services, U.S. House of Representatives*.
- Thévenot, L. (1984). Rules and Implementations: Investment in Forms. *Social Science Information* 23, 1-45.
- Thornbert, C. (August 24, 2007). Fannie and Freddie, old and new: In an uncertain market, perhaps the lenders' future lies in their past. *Los Angeles Times*. Los Angeles.
- Vollmer, H. (2007). How to do more with numbers: Elementary stakes, framing, keying, and the three-dimensional character of numerical signs. *Accounting, Organizations and Society* 32.
- Wissler, A. (1989). Les jugements dans l'octroi de crédit. In L. Boltanski, & L. Thévenot, *Justesse et justice dans le travail, vol. 33*. Paris: Presses Universitaires de France, pp. 67-120.
- Zaloom, C. (2006). *Out of the Pits: Traders and Technology from Chicago to London*: The University of Chicago Press.