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## **Taking into account financial modelling in the debate on “banking culture” and “excessive risk taking” in financial market supervision**

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### **Abstract**

The purpose of this discussion paper is to explore the place of models based on mathematical formula applied to finance in the discussions about supervision of excessive risk taking behaviour and wider risk culture in financial institutions. With a particular focus on European reforms for supervision of the financial sector, the first part brings together some reflections about the links between moral categories applied to financial sector behaviour and practices and supervisory reforms at European level after the 2007-2008 global financial crisis. It draws mostly from publications and sources that include European institutions as well as organizations at an international level. In a second part, we explore the risks associated with models and how they might have an influence on risk culture in the financial sector. We argue that fostering a more prudent risk-taking culture should include a reflection on the epistemic culture and wider organizational environment in which models are embedded. We conclude by outlining how Science and Technology Studies and the literature on social studies of finance could provide a compelling theoretical lens for capturing one angle of the debate on wider risk culture: the importance of the social processes and wider organizational environment in which models are developed and embedded.

## **I. Introduction**

The collapse of the Lehman Brothers investment bank in September 2008 suddenly put financial markets and their malfunctioning in the spotlight. Financial market supervision and regulation had previously been considered technical; it became political. One of the most important characteristics of the change from technical to political was the application of moral categories to the financial crisis, to financial markets and to the way they function (Fourcade et al. 2013, 3)

The first section summarizes the narratives that derive from using moral categories for understanding behavior, practices and wider functioning in the financial sector. It also gives a very brief overview of how these narratives were reflected in the two landmark expert reports on reforming the financial sector after the crisis in the European Union, the De Larosière report (2009) and the Liikanen report (2012), before exploring how more recent trends focus on wider questions of risk culture in what we have termed the *cultural turn* in the discourse of supervisors and regulators.

The second part of the paper is an attempt to understand why modelling and the reliance on mathematical finance is relevant in the wider debate on risk culture in the financial sector. Modelling and the reliance on mathematical finance remains relatively absent in the cultural turn of financial sector. Building on the work of social scientists in the field of Science and Technology Studies (STS) as well as the recent social approaches to financial studies, we explore how we can start to comprehend the role of modelling in wider considerations of risk taking culture in the financial sector.

## **II. Risk-taking: from a focus on individual's unethical behaviour to a discourse on culture**

The application of moral categories to behaviour, practices and wider functioning of the financial sector after the 2007-2008 global financial crisis could be summarized schematically into three big narratives that sometimes overlap.

The first narrative stems from a focus on individuals and the unethical behaviour of market participants and practices in the financial sector. This was the most prominent narrative in the direct aftermath of the crisis and points to unethical and sometimes illegal practices amongst market participants. It resonates well beyond regulatory authorities and the financial sector. Unethical behaviour of financial market professionals has been widely portrayed in popular culture. Hollywood rewarded the Documentary *Inside Job* on 2011 with the Oscar for Best documentary. Both *The Wolf of Wall Street* (2014) and *The Big Short* (2016), portraying individual's behavior and roles in the financial sector, were nominated for Best film. Finally *Margin Call* (2011) was nominated for Best Original Screenplay for portrayal of a large Wall Street investment bank in the initial stages of the financial crisis of 2007–2008.

A second narrative is built around calls for “reconnecting the financial sector and the real economy” or “putting the financial sector at the service of society”. This narrative reflects the perception that finance is disconnected from real life and that the exponential development in financial markets, in particular derivative markets, is a “socially useless activity” (Lord Turner 2009). Furthermore, this ties in with evidence that financial markets were not doing their job properly emerged with the crisis: financial markets didn't allocate resources to areas of the real economy and instead used capital for speculation (Point 40 of the De Larosiere 2009, 13).

And finally, a third big narrative encompasses both the link between inequalities and financial markets, and the question of burden sharing. Based on macroeconomic analysis, this idea points to the procyclical nature of financial markets. Financial markets' activities grew tremendously because of inequalities. A stagnation of real wages, deregulation and tax policies favored capital income (Stiglitz, 2012) and led to debt fueled consumption and growth – at first private household debt that turned into public debt once the crisis unfolded and the banks were bailed out by governments. With the additional dimension of banks and financial institutions that are “too big to fail”, the financial burden of excessive leverage and risk-taking in an inflated financial sector befalls the tax-payers. The words of Charlie McCreevy, European Commissioner for Internal Market and Services, in a speech on derivatives and risk allocation in 2009, illustrate this narrative: “When the crisis started, neither the market nor supervisors knew who was bearing what risk in the economy. But now, it has become obvious: It's the taxpayer. And that is certainly not right” (McCreevy 2009).

The narratives related to moral categories applied to the financial sector seeped into the technical discourses of senior supervisory officers at EU and international levels. The narratives transpired in high level supervisors and regulators discourse and, to a lesser extent, in reforms to supervise and regulate the financial sector after the financial crisis in 2008. At first, the focus was on individual market participants and measures to tackle individuals' unethical behaviour. But more recently, supervisors have started to adopt a broader rhetoric that focuses on risk culture more generally in the financial sector.

At first, narratives link individual's unethical behaviour with violation of market principles. For instance, in a speech on the “Lessons of the crisis: Ethics, Markets, Democracy” in 2010, Lorenzo Bini Smaghi, Member of the Executive Board of the European Central Bank (ECB), points the finger at the exploitation of information asymmetries, conflict of interest and incentives to disregard ethical principles when economic returns outweigh the “reputational damage of the market participant” (Smaghi 2010). In a more nuanced way, Jose Manuel Barroso, President of the European Commission in an interview in 2009 talks of “*action and behaviour which have been very negative from an ethical point of view. We have to balance, however, the importance of restricting some activities with the importance of maintaining free markets, free economies and free societies*” (Goodman, 2009). Though the Capital Requirements Directive IV (CRD IV) in 2009 aims at tackling remuneration practices and incentive systems that encourage excessive risk-taking, moral categories weren't the primary focus of supervisory reform at European level. Rather, market principles of efficiency and stability prevailed. The de Larosière report, published in 2009, briefly mentions remuneration incentives and “corporate governance failures” that fueled “excessive risk taking” and “excessive leveraging” but makes financial stability the primary *raison-d'être* of increased supervision. Already in October 2012, the Liikanen Report goes into much more detail about measures relating to “Corporate Governance and remuneration” to tackle “excessive risk taking” (Point 4.2.5. of the Liikanen 2012, 78–79). The report includes recommendations about categories such as “moral hazard” and “excessive risk-taking behaviour” in much greater detail. It sets out measures for tackling moral hazards by separating banking activities, guaranteeing better consumer protection and recommends the introduction of corporate governance rules.

More recently, a broader link between ethics and finance in technical discourse amongst senior representatives in supervisory authorities has emerged. Discourse focuses on the general “banking culture” and “risk culture” in the financial sector and not only on individuals (prosecuting, capping bonuses, remuneration incentives, etc. – though these remain a major component of regulatory and

supervisory attempts to curb unethical behaviour in the financial sector). Christine Lagarde, Managing Director of the International Monetary Fund (IMF) in a speech of May 2015 on ‘Ethics and Finance—Aligning Financial Incentives with Societal Objectives’ speaks of building “*a financial system that is both more ethical and oriented more to the needs of the real economy—a financial system that serves society and not the other way round.*” (Lagarde 2015). Ignazio Angeloni, Member of the Supervisory Board of the ECB, at a 2014 conference on “The New Financial Regulatory System: Challenges and Consequences for the Financial Sector”, speaks of “*something deeper [that] needs to happen: the underlying ethical behaviour of the financial sector has to improve as well*”. He goes on to use this as a justification for increasing the role of supervisors: “changing the banking culture” thanks to the “impartial spectator” – i.e. the supervisor (Angeloni 2014).

In his speech, he refers to the Financial Stability Board (FSB) recommendations for supervisors on assessing risk culture in organizations in the financial sector: “Guidance on supervisory interactions with financial institutions on risk culture”, published in 2014. It is the first document the FSB has published that relates entirely to behavioural and cultural aspects in financial organizations. It is a short document – ten pages long – and a simple word count reveals that “risk” appears 192 times, “culture” 97 times and “behaviour” 30 times. Perhaps more surprisingly, reference to modelling only appears twice. As financial institutions and indeed regulators and supervisors rely so heavily on models to assess risk exposure, this could be somewhat puzzling. The implicit assumption is that models are simple tools as the paper refers to the “quality of models” only in passing. Both the US and EU supervisory authorities have published guidelines to improve the “quality of models”: US Federal Reserve System’s paper on Guidance on Model Risk Management for supervisors and banking organizations (FED 2011) and the European Banking Authority’s (EBA) Guidelines on common procedures and methodologies for the supervisory review and evaluation process (SREP) (EBA/GL/2014/13 2014).

However, the risks associated with quantifying risk and over-reliance on modelling both in financial institutions and by supervisory authorities aren’t really addressed in the general debate on “risk culture”.

### **III. Risks associated with the reliance on modelling**

The relative absence of any reflection on model risk management from a cultural perspective is all the more surprising as financial institutions and supervisory authorities rely heavily on modelling to evaluate risk. More generally, modelling based on complex mathematical formulas and technological innovation is an essential characteristic of modern finance. Modelling is probably more than the simple application of science to technology. It actually shapes modern finance. In an article published in 2009 Howarth and Hardie analyse how liberalization and financial innovation based on mathematical finance in combination with technological innovation – i.e. modelling - are responsible for a shift in culture from a bank-based to a market-based culture in France and Germany and the potential implications this has for both German and French models of capitalism (Hardie and Howarth 2009, 4). Though innovation isn’t the sole reason for this shift – policies to liberalize markets also fuelled this transformation – it is one of the defining characteristics of modern finance. Exploring the implications of the risks related to faulty model design and over-reliance on models could add another layer to our understanding of the wider risk culture in the financial sector.

The following paragraphs aim at introducing various channels of investigation through the particular lens of two types of risks associated with modelling: first, risks associated with the actual models and the application of theory, notably mathematical formula, to practice. Mathematical formula applied to financial models seek to replicate real world phenomena and actions. However, even the most informed theory and complex set of underlying hypothesis can't fully replicate the realities of real world economic practices (Dorman, Thaleb, Sornette in West, p.600). And secondly, the risks linked to how market participants and regulators make use of risk modelling, notably over-reliance on models' output and the black-boxing of the evaluation of exposure to risk. We use existing literature on social approaches to financial studies and studies of the role of modellers in the financial sector to introduce these reflections. Finally, we attempt to draw some thoughts on the implication for supervision of risk culture more broadly.

#### **A. The intrinsic links between mathematics, financial innovation and technological development in modern finance**

Mathematical formula applied to finance are responsible for the re-emergence and creation of financial derivatives (Johnson, 2015; McGoun, E. G., 2003).<sup>1</sup> Mathematical formula applied to finance create coherence between otherwise unrelated or independent phenomena based on the quantification of risk. Their success stems from commodifying uncertainty by pricing risk: derivatives are products that enable the trading of risk. Fuelled by financial innovation - mathematics applied to finance in combination with technological development in the form of models – derivative markets have expanded massively since the seventies and even more so since 2000, and financial products have become more and more sophisticated. In this context, financial institutions and banking organizations rely on models for all kind of activities<sup>2</sup>: rely on modelling either for business strategies or to capture gross errors that may generate unacceptable risk exposure. Supervisors and regulators also rely on model outputs in the form of ratings or stress testing.

Thus, modelling is both the instrument used to measure exposure to risk and the instrument that enables the increased trading of, and presumably, exposure to risk.

The crisis revealed that instead of mitigating risk, financial innovation accumulated risk in the financial sector (MacKenzie, 2011). This represented a failure in the measurement of risk and in the supervisory authorities' assessment of the amount of exposure to risk present in the financial sector. Furthermore, the formulas underpinning much of the activities on financial markets are based on a set of assumptions. And academics working in mathematics', accounting or business departments (Johnson 2012; Wilmott 2000; Walter 2010; McGoun 2003) as well as practitioners that designed or worked with these models (Haug and Taleb 2011; MacKenzie and Spears 2014) have raised the point that the formula can only go so far in delivering reliable predictions and risk assessments. Improving the

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<sup>1</sup> Elton McGoun, in his article *Finance models as metaphors* (2003), explains that the word derivative only appears in academic literature in 1982. But it was the Black-Scholes Option Pricing Model (OPM) that created the category (p.428), back in 1973.

<sup>2</sup> The Division of Banking Supervision and Regulation of the Board of Governors of the US Federal Reserve System lists the following uses for models in a letter referring to the Guidance on Model Risk Management, on the 4<sup>th</sup> of April 2010: "models might be used for analysing business strategies, informing business decisions, identifying and measuring risks, valuing exposures, instruments or positions, conducting stress testing, assessing adequacy of capital, managing client assets, measuring compliance with internal limits, maintaining the formal control apparatus of the bank, or meeting financial or regulatory reporting requirements and issuing public disclosures." (FED 2011)

measurement of exposure to risk is one dimension of addressing the risk culture in the financial sector. A second is understanding the implications of reliance on model output.

## **B. The emergence of a form of epistemic dominance: the quantification of risk**

Given the level of complexity in financial modelling, and the extended role of models in finance (High Frequency Trading takes this to another level again), one might expect a growing focus on modellers, or “quants” as they are called in the financial sector, in fostering a more responsible culture. The global business Cognizant that provides services for financial institutions amongst others on risk modelling makes the following analysis in its White paper on Models, Model Risk and Running effective model management programs: “Modellers are in constant struggle to find the best possible trade-off between speed of build, complexity (to better represent reality), simplicity (to improve the tractability of their modelling), and efficiency (demanding minimum run time for the models)”. And in doing so, there are a number of errors that can occur: “model errors that arise from mathematical errors or misleading assumptions in the design, data errors that arise from incomplete, outdated, inaccurate data, implementation errors and usage errors – i.e. models that are safe for certain products are less so for others.” (Cognizant 2015, 6). The vulnerability of models to misuse or the possibility of models being incorrect pervades the thinking underpinning the US Federal Reserve System’s paper on Guidance on Model Risk Management for supervisors and banking organizations (FED 2011) as well as the European Banking Authority’s (EBA) Guidelines on common procedures and methodologies for the supervisory review and evaluation process (SREP) (EBA/GL/2014/13 2014). Both documents put forward guidelines on ways to improve the models and ensure that the design is not faulty and vulnerable to misuse. Models are considered to be tools. The documents focus on the role of senior management in ensuring that model risk management is properly in place. Though they acknowledge the importance of the role of model developers, they don’t mention their discretionary role.

However, some research suggests that the role of quants is central when it comes to mitigating excessive risk taking culture in the financial sector. West (2014) work on the educational and professional background of quants (2014) distinguishes between two pathways: the first encompasses what he calls “seasoned veterans” with training in mathematics, physics or engineering and practical experience of the application of stochastic processes to finance. The second group of quants are those that have been trained as specialist in mathematical finance, curricula that have developed in parallel with the exponential development of financial markets. The latter, he argues are at risk of having too weak a set of ethical principles to guide the application of theory to practice which could lead to “overconfidence in the models” (West 2014, 602). West argues for a stronger set of ethical principles amongst the quants as they are the only ones that can truly grasp the complexities of the models that financial organizations rely on.

This somewhat underestimates the institutional constraints that quants operate in. In their work on the use and development of models based on the Gaussian Copula family, MacKenzie and Spears (2014) offer a more nuanced picture: interviews with quants who were involved in using these formula in developing models before and after the financial crisis of 2007-2008 reveal that they were often very aware and critical of the Gaussian Copula family. They continued to develop and use these models because they are embedded in the wider organizational environment in which quants work. The authors conclude that “the use of the model [the Gaussian copula base correlation model] helped harmonize prices and practices and facilitate communication and it provided a shared yardstick that enabled accountants and auditors to determine whether a valuation was correct and risk managers

to assess whether a position was properly hedged". (MacKenzie and Spears 2014, 437). From this perspective, the role of formula applied to models goes well beyond the function of a tool or the application of theory to technology. It shapes interactions between different actors in financial markets and across different institutions, including regulators and accountants. It results in some form of path-dependent reliance on Gaussian copula models because "the organizational costs of abandoning them would be too high, notably in terms of communication".

Whether by lack of critical knowledge of the formula underpinning models or through path dependence to a certain set of models, a form of epistemic dominance emerges: the quantification of risk as the means to manage risk. This could lead to the emergence of a second type of risk that stems from an over-reliance on output of models and the rampant use of models: more models are developed to assess the output of other models.

"Quantitative enthusiasm" and the expansion of the experts' remit to all areas that can be covered by assessing uncertainty has the consequence of black boxing the models that calculate risk and support risk management (Mikes 2011). The degree to which an organization focuses on controllable risks or on uncontrollable risks will have an incidence on the reliance on measurement-based risk control.

One instance of over-reliance on model outputs and "black-boxing" of the use of models in the financial sector is that of ratings produced by Credit Rating Agencies (CRA) in the build up to the financial crisis notably on ABS CDOs (MacKenzie 2011). Ratings of ABS CDOs, a third type of derivative product that combined two different products, Asset Based Securities (ABS) and Collateral Debt Obligations (CDOs), "simplified the complexities of evaluation by establishing a rough equivalence among debt instruments of different kinds and with different particularities", namely ABS and CDOs (MacKenzie 2011, 1784).

Market participants as well as supervisors and regulators continue to rely on ratings since the 2007-2008 crisis with the current EU Regulation of CRA predominantly a form of product regulation aimed at ensuring rating accuracy (Chiu 2013). The ambiguous role that is allocated to ratings could be an indicator of how models and model outputs have a function that goes well beyond the simple application of science to technology: private external ratings continue to be used in supervisory roles to measure exposure to risk even as their primary role is one of mediation of information asymmetry about products on financial markets, thereby assisting investors in risk measurement.

The goals of modelling differ between rating agencies and investment banks. And supervisors and regulators use model outputs for different reasons again (exposure to risk, stress testing). Understanding the organizational contexts in which risk assessment models are embedded and the reasons for their development could be as useful to changing risk culture as improving the actual models or designing better models.

#### **IV. Conclusion**

Prior to the financial crisis, risk was being accumulated in the financial sector (MacKenzie 2011, 1834) and this was largely down to excessive-risk taking behaviour and sometimes downright unethical practices amongst financial market participants. But it was also partly because of the reliance on flawed risk modelling assumptions that underestimated the eventuality of error, the black boxing of

evaluation practices, notably ratings, and unsupervised financial innovation in the form of highly sophisticated financial products, such as swaps, CDOs traded outside of any supervision. Ascertaining whether or not these problems have been corrected through increased regulation and supervision since the crisis is not the purpose of this paper. But the relative absence of any reference to model risk management and reflection on over-reliance on modelling to evaluate exposure to risk in supervisory discourse on risk culture is somewhat perplexing.

Epistemologically and theoretically, the approach developed by sociology of knowledge production and Science and Technology studies offers a good analytical framework for engaging with this issue of the use of models in financial markets. Science and Technology Studies (STS) focus on the social, cognitive and institutional processes that are central to the construction of scientific understanding (Irwin, 2006). Social approaches to finance draw on themes from Science and Technology Studies (STS) as well as sociological approaches to knowledge and expertise. They take into consideration the wider social and organizational contexts in which financial markets participants and practices are embedded. Rather than looking at what models do, these approaches focus on how they are produced and how they are used. It involves understanding the wider use of scientific knowledge and its application in practice – i.e. models. It involves looking into the role of those who design models and how they view their role and work in financial institutions they work in and wider financial sector. It involves exploring how markets participants, rating employees, regulators and supervisors assess and make use of these models and for what purpose. This could provide a framework for a better understanding of the role of models in the wider context of supervising risk culture in the financial sector.

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