

# Three essays in financial econometrics

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# Valorization

The research presented herein is about financial econometrics with applications to financial risk management and banking regulation. I have pursued a focus on risk evaluation, model comparison, and estimation risk. These topics are fundamental within the context of academic financial research, but they are also relevant for professionals in the financial sector as well as for regulators and supervisory authorities. In this work, I have studied three prominent classes of financial risk: *(i)* credit risk, *(ii)* market risk, and *(iii)* systemic risk. They originate from different sources but are unified by a common will of the economic and business worlds to properly quantify them. As with any task involving predictions of the future, risk forecasting is afflicted with estimation errors. The econometric content of my work aspires to the identification of such misestimation under an acceptable margin of error decided by a financial entity. In this addendum, I will attempt to summarize the main contributions of my work from both a methodological standpoint and the perspectives they open up for banking regulation and financial stability.

## Risk forecast evaluation and estimation uncertainty

Measuring financial risks is central in the process of managing risk. The set of underlying management problems is generally addressed via the estimation of financial risk measures whose purpose is to quantify financial risks with one number representing the future losses that could be potentially experienced on a risky position. Unhappily, modeling and estimating these measures is not sufficient in itself. Econometric methods to evaluate their ex-post validity are additionally needed. The relevance of this thesis with respect to the econometrics field can be recognized through two contributions. The first is through the alternative forecasting evaluation procedures and model comparison methods developed for financial risk measures. Because the financial risk measures are unobservable their evaluation cannot be conventionally performed as a direct comparison of the observed value with its forecast. One of the main contribution of this dissertation is to provide alternative methodologies that apply to the case of unobserved target functionals.

A second contribution of this thesis is an attempt to account for the problem of estimation uncertainty. Risk measures have to be estimated and their estimation counterparts are subject to estimation uncertainty. Replacing, in the theoretical formulas,

the true parameter value by an estimator induces uncertainty and errors on the subsequent forecast. This drawback is common to any financial risk measure and any facet of risk. Importantly, the question goes to the market activities (asset management and derivatives, portfolio allocation, etc.), the lending activities (secured and unsecured loans, bonds, etc.), and even to the systemic risk monitoring activities (contagion measurement, stress test exercises, etc.). The methods I offer in chapter 3 and chapter 4 are devoted to this question. I develop adjustment techniques associated with a given financial risk measure which is priorly affected by estimation uncertainty. In chapter 3, I have pursued a focus on expected shortfall estimation uncertainty, which can be easily extended to value-at-risk, while the purpose of chapter 4 is on systemic risk measurement. In addition, I formally establish in chapter 4 that the validation procedure itself is affected by estimation uncertainty. In presence of estimation uncertainty in the systemic risk indicators, I show that the standard inferential procedures no longer apply.

## **Banking regulation and financial stability**

Beyond the methodological contribution, my work also benefits both banking regulation and financial stability. The primary mission of regulatory authorities and supervisory agencies is to continuously monitor the financial system risk exposure. The methods presented in chapter 2 and chapter 3 are well suited to this objective. Both chapters offer new insights on how to evaluate and compare risk measure estimates. Financial risk measures are involved in the calculation of banks' capital charge and are thus of great importance. Consequently, any underestimation of these parameters may induce an underestimation of the regulatory capital and a lower banks' solvency. In chapter 2, I propose a model comparison method for the loss given default which induces the lowest estimation errors on the banks' capital charge. I show theoretically and empirically that the proposed approach improves banks' solvency compared to the current method used by academics, banks, and regulators. This work constitutes a further step in the ongoing process of embedding a more economic content to risk evaluation. In chapter 3, I suggest a relationship between value-at-risk and expected shortfall that considerably simplifies the estimation and assessment of expected shortfall from a regulatory viewpoint. Using the proposed relationship allows the implementation of easy-to-use validation tests of the expected shortfall estimates. These tests promote a more intelligible evaluation of risks and also come in response to the market failures revealed by the global 2007-2008 financial crisis. The methodological developments of this work may thus stand a better chance of gaining acceptance from banks and their regulators while enabling them to push forward the current legislation and guidelines in banking regulation.

Lastly, a relevant contribution to financial stability I would highlight is the approach proposed to assess market-based systemic risk indicators, which has been the subject

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of a considerable debate between the academic and regulatory spheres. It was the case when the European banking authority publishes the results of the 2014 EU-wide stress tests indicating that French banks are among the safest in Europe. These conclusions were immediately casted in doubt using systemic risk measures while revealing the exact opposite conclusions that French financial institutions would face an aggregate capital shortfall of almost \$400bn in case of crisis (according to the SRISK definition). My work attempts to explain these inconsistencies. I show that systemic risk measures are affected by large estimation errors and more importantly in times of crisis. My results suggest that the systemic risk measures are not always able to accurately conclude which institution is systemically riskier than another, or to determine the right level of regulatory capital for the systemically important financial institutions. This provides a first answer to the question of the conflicting outcomes observed from both methodologies.