



THE LONDON SCHOOL
OF ECONOMICS AND
POLITICAL SCIENCE ■



A Proposal for an Open-Source Financial Risk Model

Jong Ho Hwang

SRC Discussion Paper No 9

January 2014



Systemic Risk Centre

Discussion Paper Series

Abstract

This paper presents a policy proposal for building a new framework for gathering, measuring and disclosing financial risk information in the global economy. The paper examines the current state of the financial risk framework, notes its advantages and disadvantages and proposes a new construct that aims to address some of the shortcomings that are currently in place. The proposed open-source financial risk model separates the dual function that internal risk models perform within financial institutions, first to attempt to optimize the risk-return profile of mostly private economic rent-seeking entities, and second to maximize safety and soundness considerations for the public which is at risk of bearing the consequences of financial actors. The goals of a robust financial risk model are examined in order to determine the design of the proposed risk framework.

JEL classification: D82, G2, G28

Keywords: Open, Source, Risk, Financial, Models, Governance, Public, Regulation, Supervision, Global, Institutions

This paper is published as part of the Systemic Risk Centre's Discussion Paper Series. The support of the Economic and Social Research Council (ESRC) in funding the SRC is gratefully acknowledged [grant number ES/K002309/1].

Acknowledgements

I am grateful to Richard Haynes, Timothy Karpoff, Tobias Adrian, John Connolly, Patty Kao, Kim Egert, Marc Joffe, Darrell Duffie, Oliver Chen, Simon Cheshire, Annette Heuser, Anat Admati, Hyun Song Shin, Jon Danielsson, Charles Taylor and the research team at the U.S. Department of the Treasury's Office of Financial Research for their thoughtful comments, input and discussion. The commenters do not necessarily agree with the contents of this proposal. The views expressed here do not necessarily represent those of the U.S. Department of the Treasury. Any errors contained in this paper are entirely those of the author. The author was formerly a large broker-dealer risk supervisor at the U.S. Securities and Exchange Commission.

Jong Ho Hwang, Office of Financial Institutions Policy, U.S. Department of the Treasury

Published by
Systemic Risk Centre
The London School of Economics and Political Science
Houghton Street
London WC2A 2AE

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means without the prior permission in writing of the publisher nor be issued to the public or circulated in any form other than that in which it is published.

Requests for permission to reproduce any article or part of the Working Paper should be sent to the editor at the above address.

© Jong Ho Hwang submitted 2014

A Proposal for an Open-Source Financial Risk Model

Jong Ho Hwang

Office of Financial Institutions Policy
U.S. Department of the Treasury

Drafted: May 22, 2013
This version: August 16, 2013

Abstract

This paper presents a policy proposal for building a new framework for gathering, measuring and disclosing financial risk information in the global economy. The paper examines the current state of the financial risk framework, notes its advantages and disadvantages and proposes a new construct that aims to address some of the shortcomings that are currently in place. The proposed open-source financial risk model separates the dual function that internal risk models perform within financial institutions, first to attempt to optimize the risk-return profile of mostly private economic rent-seeking entities, and second to maximize safety and soundness considerations for the public which is at risk of bearing the consequences of financial actors. The goals of a robust financial risk model are examined in order to determine the design of the proposed risk framework.

I am grateful to Richard Haynes, Timothy Karpoff, Tobias Adrian, John Connolly, Patty Kao, Kim Egert, Marc Joffe, Darrell Duffie, Oliver Chen, Simon Cheshire, Annette Heuser, Anat Admati, Hyun Song Shin, Jon Danielsson, Charles Taylor and the research team at the U.S. Department of the Treasury's Office of Financial Research for their thoughtful comments, input and discussion. The commenters do not necessarily agree with the contents of this proposal. The views expressed here do not necessarily represent those of the U.S. Department of the Treasury. Any errors contained in this paper are entirely those of the author. The author was formerly a large broker-dealer risk supervisor at the U.S. Securities and Exchange Commission.

I. Introduction

Risk disclosure is complex and reflects the complexity of the underlying activities at increasingly diversified global financial institutions (FIs) today. An adequate risk system must address systemic risk, the risk of different subsets of the financial system, as well as the individual FI risks that are being currently captured.

Rebonato (2007) reminds us that there are limits to how far we can rely on quantitative methods to resolve uncertainty. Even so, there is still a lot to be learned through scientific study of financial risk and we should try to build a rational framework through open discourse with the participation of all affected stakeholders.

This paper proposes a new model for gathering, measuring and disclosing financial risk information in the financial system. The proposed model envisions an open-source risk modeling system that is best-in-class, evolving and built from a methodology that is completely transparent. The proposed model provides a way to expand financial institution risk supervision coverage without expanding supervisory headcount.

This proposal envisions a global scope, but the details in broadening the narrative for global consideration complicated the presentation. In the interest of clarity these details were excluded.

II. The Current Risk Framework

Going back to antiquity, participants in commerce have sought to protect their financial interests from uncertainty. This demand for security has evolved into the practice of financial actors setting an acceptable level of risk for transactions. In order to accurately and reliably set and keep within acceptable levels of risk, internal stakeholders of the firm need a robust way of measuring risk.

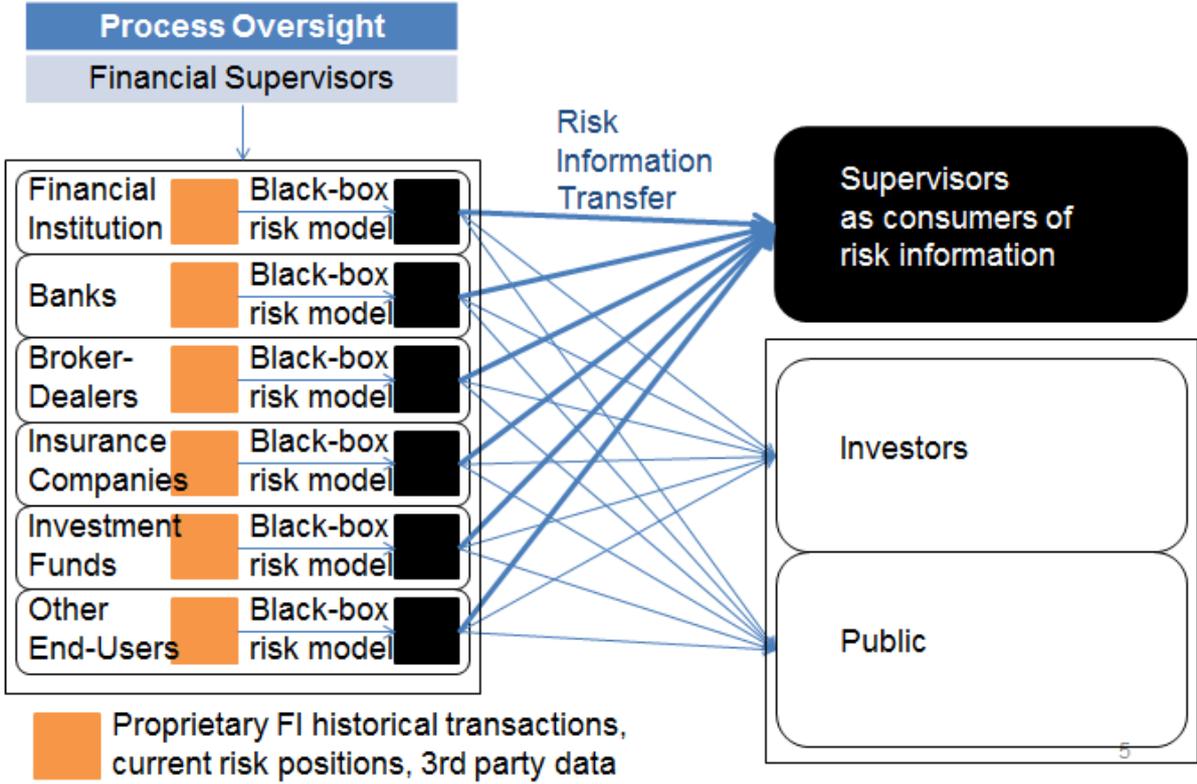
The 1988 Basel Capital Accord proposed the development of a consistent risk-sensitive capital standard applied globally. In spite of the major step forward that this signified, market risk was excluded from the capital requirements which led banks to shift risk exposures from credit risks to market risks. The 1996 Market Risk Amendment (MRA) sought to address this by imposing a capital charge for market risk. In 1999, the Basel Committee for Banking Supervision (BCBS) issued its consultative paper titled: “A New Capital Adequacy Framework” wherein BCBS raised the possibility of using internal risk ratings for credit risk capital requirements and using internal models for interest rate risk and other risks.

Today, financial data is gathered, risk is measured and reported via discrete, proprietary, highly customized, private risk models residing within each financial institution. The same internally-developed and maintained models serve two simultaneous functions:

1. Helps determine the risk appetite, tolerance and limits that guide the financial activity taking place within FIs to maximize risk-adjusted returns to the firms’ employees and shareholders, and
2. Determines regulatory capital charges that place limits on the financial risk-taking activities of FIs to ensure the safety and soundness of the firm and the global financial system.

The Basel initiatives married these two functions and, at the time, it made sense to leverage internal risk models for regulatory purposes because of efficiency considerations. Over time there have been questions about whether firms, in specifying their internal risk models, have appropriately modeled the externalities that affect outside stakeholders of financial institutions.

A view of the current risk framework:



III. Issues with the Current Risk Framework

1. Internal risk models are black boxes developed internally with methodologies that are considered proprietary. As a result, risk measurement methodologies are unpublished, opaque and incomplete to the public.
2. The robustness of internal risk models is uncertain to most users of the financial risk information that is measured by these models because of their opaque nature.
3. The reliability of internal risk models is uncertain because there is no continuous day-to-day independent monitoring of the quality of the population of these models.
4. The supply of qualified individuals to perform the complex development, maintenance and documentation of the internal risk models at thousands of financial institutions is scarce.
5. The supply of qualified regulatory supervisors to perform the validation of internal risk models at thousands of financial institutions is scarce.

6. The data and information used to calibrate and model risk is fragmented and incomplete.
7. The complexity of internal risk systems makes it difficult for internal risk staff to develop, maintain and document the models.
8. The coverage of risks in the financial system is incomplete because FIs need to be large in scope in order to justify the investment in complex internal risk systems.

When using a systemic financial institution designation system, there is a risk that FIs that are individually immaterial in size and scope may be material when aggregated into a group. This was the experience of the savings and loan crisis where 747 out of 3,234 savings and loan associations failed. The failed institutions had a book value of \$402 billion. In 1996 the Government Accountability Office estimated the total cost of resolution at \$370 billion of which \$341 billion was borne by taxpayers.

9. Well-designed and well-functioning financial risk systems are not widely available at reasonable cost.
10. BCBS (2013) in its RCAP study revealed that market risk models provide widely inconsistent risk measurements for the same portfolios of risk assets.
11. There is a large cost of compliance to address increasingly complex rules and regulations which need to be replicated at thousands of FIs. Complex regulatory arbitrage may benefit some and damage others unevenly.
12. Internal financial risk models are not generally designed to be flexible, upgradeable and scalable. They tend to grow as needed rather than according to a prescribed plan or design.
13. The current risk calculation and reporting system is geared to answer: what is the risk of financial institution A? If we change the question to: what is the risk of a subset of financial institutions X? we find that the current system is inadequate.

Risks are not additive. Correlations need to be taken into account. Casual readers might assume that risks in general are sub-additive; that the risk of a set of FIs is less than the sum of the risks of each individual FI in the set because of diversification effects. If VaR is used, the measure is not sub-additive implying that the risk of a set of FIs can be less or greater than the sum of the individual risks in the set of FIs. In essence, we know very little about the risk of groups of FIs or the financial system as a whole.

14. Jarrow (2006) in his critique of Basel II postulates the following:
 1. the ideal level of regulatory capital > than the bank's optimal capital,
 2. the ideal level of regulatory capital is not known to regulators, and
 3. required regulatory capital is < the ideal level of regulatory capital.

The incongruence in postulate 1 above arises from the inclusion of the cost of externalities in regulatory capital. Considerations for systemic safety and for the safety of other groups outside of the firm may be less than appropriate in internal risk model specification. The firms tend to focus on their own risks and spend fewer resources on externalities. These risks may be difficult to model given each firm’s limited experience in the overall market and the inherent uncertainty of risks at the tail.

15. Internal risk models may be subject to biases that understate risk even in the presence of strong governance and controls. Even the perception of the presence of such biases may be damaging to the firm.
16. The Financial Stability Board’s (FSB) Enhanced Disclosure Task Force (EDTF) issued its report in 2012 which stated that:

“High quality risk disclosures should be viewed as a collective public good given the systemic importance of banks and the contingent liability they represent for taxpayers. Poor quality disclosures can result in higher uncertainty premiums, and this can undermine the extension of credit needed to support employment and productive investments in struggling economies, and affect its price.”

IV. Proposed New Public Open-Source Risk Model

This paper proposes:

1. The development of a central, publicly-owned, open source position and portfolio risk calculation and reporting system.

	Ownership	Development	Oversight
Public	X	X	X
Private		X	X
Government			X

2. **Stakeholders** - The model would be under the governance of three principal groups of stakeholders including:
 - a. The public-at-large whose interests would be overseen by its own governance structure within a non-profit foundation. Some of the questions considered by the public governance structure may include:
 1. What is the public interest in financial risk?
 2. How can the diffuse voice of the diverse public be accurately captured by an organization that represents the public interest?

3. What is the appropriate system of governance that efficiently and effectively communicates the voice of the public interest in the development of a public financial risk model?
4. What are the appropriate parameters within which the public should assert its interest in financial risk?
5. What are the rights, responsibilities and obligations of the public associated with its ownership of the public financial risk model?
6. What are the goals of the public, given its ownership of the financial risk model?
7. What is the role of non-profit foundations as agents of the public interest and how can non-profit foundations specifically add value through its agency role?
8. Are the goals of non-profit foundations aligned with those of the public? If not, how can the effect of divergences be measured and mitigated?

Often in discussions of the public's participation in open-source projects, a stereotypical image of a twenty year-old unemployed person with too much time on his hands is conjured up. But perhaps the most powerful constituency in the public stakeholder sphere is the investor; more specifically the institutional investor. Along with them are investment analysts and portfolio managers that advise large portions of capital and markets. These parties are large and influential clients of large financial institutions and exert great influence on their decision-making.

Often these parties are not thought of as part of the public, but rather as part of private financial institutions. While this is true, a distinction should be made between: (1) financial institutions as aggregators, wholesalers and distributors of risk which would fall under the private financial institutions stakeholder group, and (2) investors (that may sometimes be the same financial institutions on the buy-side) that are looking to better assess the riskiness and value of an offering, and are part of the public.

The latter would have a keen interest in enhancing transparency and being able to assess more precisely the risk that is involved when they place their capital. Whereas most of the public is very diffuse, there are important and influential pockets of engaged and interested parties.

Transparency may cause a re-pricing of positions based on a shift in the perception of risk across many asset classes as more information is revealed. This effect, over the long-run, may have the result of reducing uncertainty in the market through better, more reliable, robust and complete risk disclosures, ultimately leading to a lower cost of capital. Investors may find it in their interest to invest in a consistent and robust risk framework, as their financial interests are directly impacted.

As a group, investors may be able to elicit change in faster and more powerful ways than supervisors, regulators, policy-makers and legislators can. As an example, many phases of the Basel standards had long multi-year phase-in periods. Market participants demanded and received faster, and in some cases almost instant compliance with rules with far-dated legal implementation deadlines. It is one thing to lobby government agents and a different one to propose a measure to a sophisticated investor that is detrimental to their financial well-being. This portion of the public has the right incentives and substantial means to effect beneficial changes.

Historically, the public interest in externalities that result from systemic risk has not had a direct voice in the construction and ongoing development of the financial risk framework. Under this proposal, this stakeholder constituency would participate broadly in ownership, development and oversight of the framework.

- b. Financial institutions and financial transactors are critical stakeholders. As a group, they engage in financial markets, place their capital at risk, generate and mitigate financial risk as necessary to make the modern economy efficient, and provide essential services to society. The envisioned role of this constituency is to provide expertise, development and oversight to the new risk framework. Representative governance structures should be constructed to give voice to the interests of users of financial risk.
- c. Finally, government in its legislative and regulatory capacity would continue to provide oversight onto the risk framework.

An *Office of Financial Risk* is proposed within the U.S. Department of the Treasury, or alternatively a supra-national entity for global scope, in order to:

1. Coordinate the financial supervisory responsibilities of regulatory agencies,
 2. Oversee that appropriate controls are in place and functioning properly to ensure that the public risk model is secure from unauthorized changes,
 3. Coordinate the data management process with the Office of Financial Research (OFR),
 4. Coordinate with other stakeholders to ensure the timely and accurate release of public risk methodology documentation to the public.
3. Structure and Construction of the Proposed Risk System

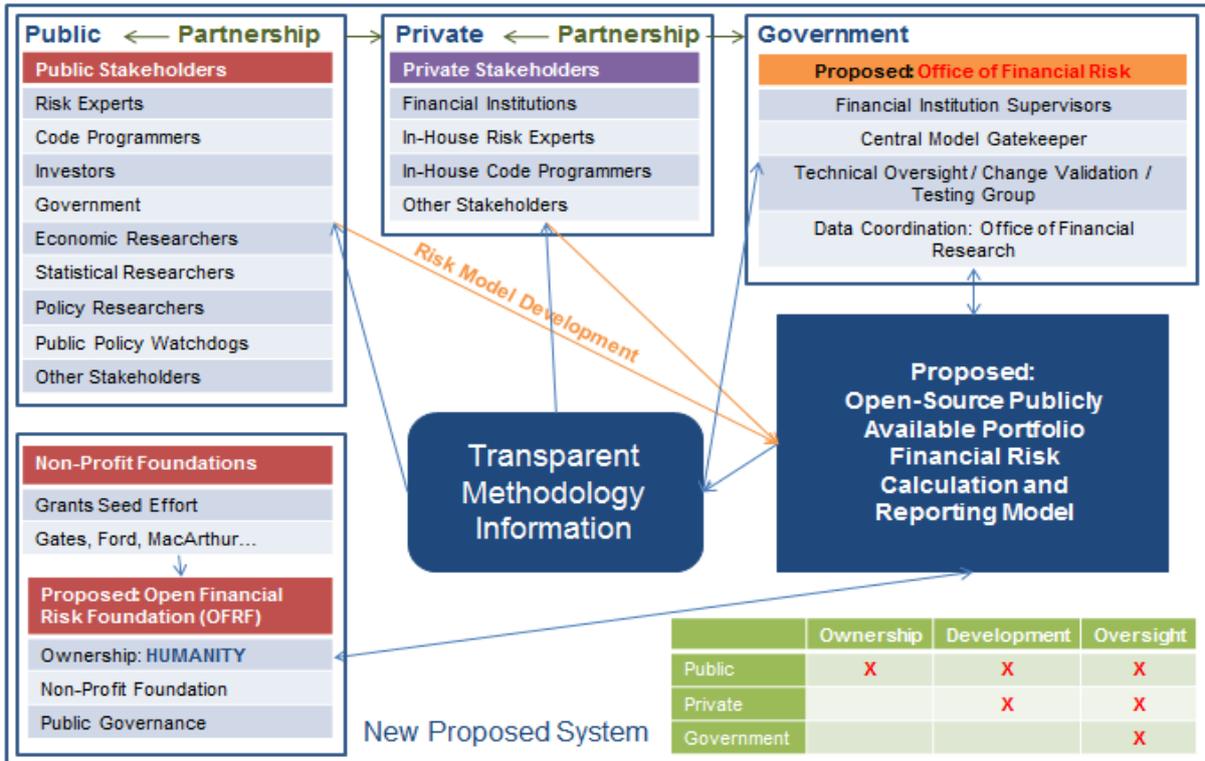
We propose the creation of incentives for FIs and financial risk users to contribute their current models, processes, accumulated knowledge and best practices to the new proposed public open-source risk model. This can only occur if the users of financial risk see value in a shift to the new proposed public open-source risk model.

We propose that statutes should be revised to require:

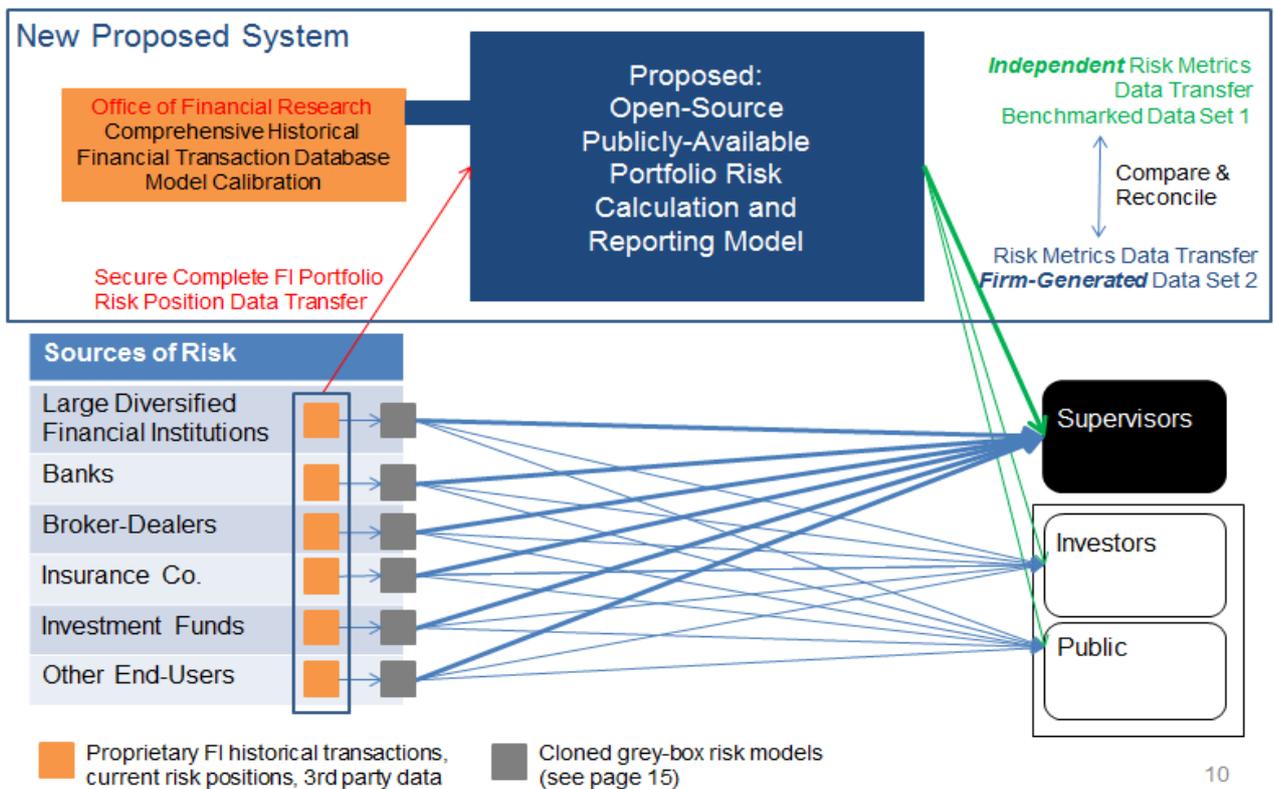
1. A bifurcation of the calculation of in-house risk and risk for regulatory capital purposes by mandating that FIs calculate their minimum regulatory capital and liquidity requirements using the new proposed public open-source risk model.
2. Financial regulatory supervisors to cease their efforts to validate the thousands of FI internal risk models and validate only the new proposed public open-source risk model.
3. All FIs and other financial risk users to report all financial transactions to enhance the robustness of the new proposed public open-source risk model. New infrastructure may be necessary in order to automate the capture of this information at the moment of creation, transformation and extinguishment of financial risks.

We expect that efficiencies and savings resulting from elimination of unnecessary replication of effort in continuously maintaining, updating proprietary risk infrastructure may be deployed in funding a global collaborative effort to create a better risk system that benefits all financial market participants.

Stakeholder Participation and Governance Framework:



Transaction and Risk Information Flows:



4. Why Open-Source?

Open source is a pragmatic philosophy that promotes free redistribution and access to a product's design and implementation methodology. The tenets that should be applied when designing the new risk framework model include transparency, efficiency, low-cost access (few things are free), and unrestricted distribution.

Today, risk methodology and information is closely guarded and available only to those who have access to data and internal processes at large financial institutions. A relatively small number of risk professionals determine the way in which this important scientific field of study takes shape. Rebonato and others tell us that the World's problems and uncertainty cannot be resolved just with more data and more refinements in quantitative methodology. While this may be true at the efficient frontier of technology, there appears to be a large divide between where we stand today and that margin.

A looming issue is that the present risk system structure requires the replication of proprietary models through a process that inefficiently allocates very scarce human resources in a way that is not scalable. As the World continues to become more complex with new discoveries and expanding needs, a likely way that the present model will be sustained is through a steady erosion in quality in risk management. Risk professionals need many years of training and many more years of experience in order to be effective. Access to knowledge and experience in this field is severely restricted. It may be better to construct a strategy where scarce professionals in this field focus on depth of study and analysis rather than keeping up with the proliferation in the use of proprietary risk models increasingly prescribed by supervisors.

Increased distribution of information about the methodologies employed in risk management has the potential to give many current scientists and students the tools to access a field of study that is critical to the well-being of society. Perhaps a larger, more diverse audience would be able to find creative solutions to the problems that we face.

Open-source comes in many shapes, and it would be prudent to have access, vetting, testing and validation controls around the code that drives the risk model to ensure that the best ideas are incorporated into the new risk structure. Governance structures with appropriate representation from the three stakeholder groups should be responsible for these functions. The end-product should be distributed freely at the lowest cost possible.

5. Risk System Attributes

The figure below provides a preliminary list of attributes, features or capabilities that may be desirable to build into the new public risk framework. It is more comprehensive and exhaustive than most internal implementations which tend to focus on principal risks based on firm-specific cost-benefit analysis and localized resource constraints.

Risk Modules	Industry Modules	Product Modules	Requirements
Market Risk	BHCs	Rates	Strong Governance
Credit Risk	Banks	Currencies	Independence
Liquidity Risk	Broker-Dealers	Credit	Supervision/Validation
Operational Risk	FCMs	Equity	Internal/External Audit
Closeout Risk	Clearinghouses	Commodities	Quantitative Skillset
Run Event Risk	Exchanges	Services	Technology Skillset
Leverage Risk	Insurers		Analytical Skillset
Systemic Risk	Investment Funds	<div style="border: 1px solid black; padding: 5px; background-color: #4a7ebb; color: white;"> Customized industry-specific models should be developed in order to take into account differing business models and legal constraints that FIs operate under. </div>	Vision
Model Risk	Corporates		Development
Stress Testing	Other Registered FIs		Implementation
	Unregistered FIs		Vendor Quality Control
			Documentation

6. Risk System Inputs and Outputs

On the input side, we propose that FIs and other financial risk users, as sources of risk, establish private accounts on a public system. Care must be taken that user submitted data is secure and non-public. As stated previously, complete data submissions should be required by statute. The submission, vetting and approval processes of new code enhancing the risk model, and the placement of these into production should be transparent and robust.

The Office of Financial Research has a mandate under the Dodd-Frank Act to develop a comprehensive database of historical and open transaction data which is a key input for risk model calibration.

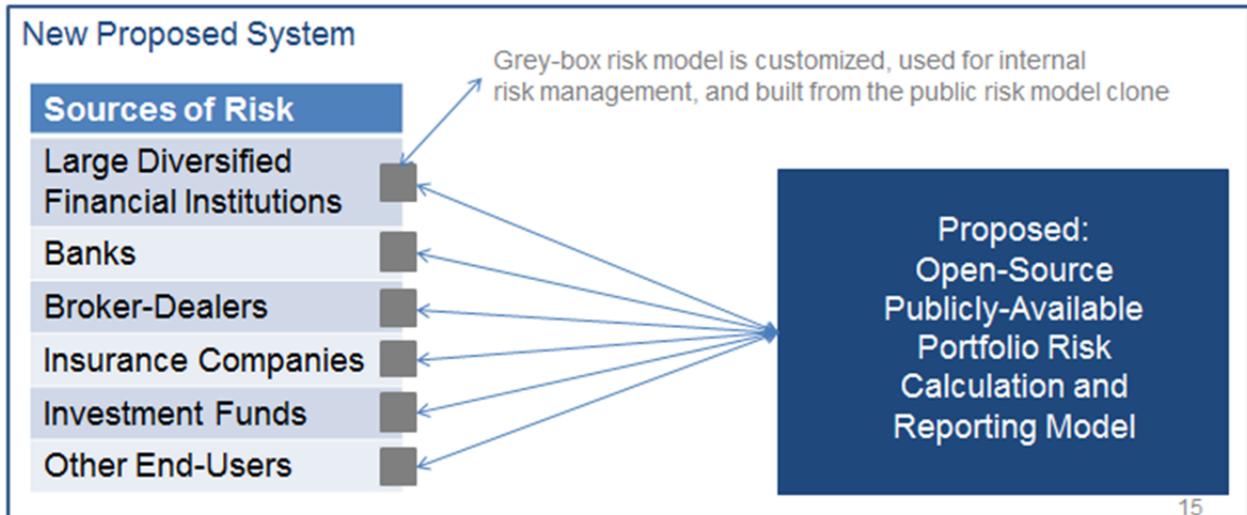
- a. We propose that it should be mandated that only the public risk model should have access to the use of this comprehensive data set for a period of time in order to provide an additional incentive for financial institutions to develop the public risk model.

This would provide FIs access to better calibration due to the richer available dataset. Currently internal black-box models are calibrated using a limited data set made up of proprietary FI historical transactions, current risk positions, available third party data and institutional knowledge.

On the output side, calibration is needed to determine the appropriateness of disclosures for different users of financial risk information. Supervisors should receive an almost comprehensive view of risk with a very small scope for non-disclosure on a case-by-case basis as has been practiced in the past. Investors and the public should receive comprehensive aggregated information that may have been purged of certain identifying information, perhaps through the use of cryptographic methods suggested by Abbe et al (2011), in order to protect the proprietary commercial interests of market participants.

Methodology documents and changes should be released as close to real-time as possible and should be comprehensive. The goal is to have public open-source risk model disclosures that are consistent across firms. Public model disclosures can be compared to outputs from proprietary models and firms can reconcile differences by providing a basis for their differences in opinion.

7. Model Distribution Through Cloning



We propose a distribution model whereby FIs extract a clone of the public risk model and use it as a foundation, appending changes to reflect private views of risk, in order to manage firm risks internally as per individual tolerances. The reasons for this approach are to:

- a. Allow all financial transactors, large and small, to have access to a robust, validated financial model at a reasonable cost. FIs no longer build risk infrastructure from scratch lowering barriers to entry.
- b. Allow diversity in views of risk to guide divergent financial positioning among financial participants.
- c. Apply efficiency in the use of scarce knowledge resources.
- d. Leverage expanded technological capabilities across the financial space to make higher quality tools more widespread, which should reduce uncertainty, expand the availability of capital and reduce the cost of capital.
- e. Invest in maintenance, updates and other costly services in a rational manner.
- f. Give every market participant the benefit of the information imparted by risk-calibration using the comprehensive OFR data set. This central dataset is a public good that can be delivered to the market in a way that is useful to participants.

8. Legal, Privacy and Policy Considerations

A new unified legal and regulatory framework is necessary, not to force FIs to change their risk approach to that in our proposals, but to provide appropriate incentives to create an environment where all three major stakeholder groups are better off for having adopted these suggested proposals.

In order to balance financial information privacy and the public interest in the financial markets, Abbe, et al. (2011) suggest the use of cryptographic methods to provide a robust way to transmit proprietary financial information while limiting the communication of input attributes and curb “reverse-engineering”. The paper discusses the use of trade secrecy by the financial industry in contrast to intellectual property and patent laws to protect business processes and methods.

Bisias, et al. (2012), in the initial OFR working paper, provide an overview of the current systemic risk environment. The paper works through the issues in policy implementation highlighted in Lucas (1976). A similar analysis should be applied to this proposal. The scope of this proposal is more than just systemic as it contemplates a robust, consistent approach toward risk management, and the implementation of a model risk approach at most individual financial institutions.

V. Project Funding Proposal

Funding for the public open-source risk model should be borne by risk users in the financial system.

A user fee could be calculated as follows:

1. Define 1 unit of risk as \$1 in expected loss derived by any approved methodology in the public open-source risk model.
2. Derive the number of entity units of risk (E) and the total units of risk (T) in the system, both under the public open-source model. The proportion of individual FI risk to total risk in the system determines an FI’s user fee.
3. In order to create a baseline for the user fee, we begin with total current expenditures for risk management. The table below provides an estimate of current aggregate annual risk management expenditures of \$16 billion.

Risk Expenditure Estimates	2010
BLS Annualized Weekly Financial Sector Compensation 2012	\$ 48,932
BLS Estimate of Financial Sector Employment April 2013	5,890,200
Estimate of Financial Sector Annual Compensation	\$ 288,219,266,400
KPMG Average Estimate of Risk Full Time Employees 2010 (2)	2.90%
Estimate of Financial Risk Management Sector Employment	170,816
KPMG Average Estimate of Risk Salaries 2010 (2)	4.50%
Estimate of Financial Risk Management Sector Salaries	\$ 12,969,866,988
Chartis Market Risk Technology Solutions 2010 (3)	\$ 1,280,000,000
Chartis Estimate of Solvency II Technology Solutions 2013 (3)	\$ 1,680,000,000
Total Estimate of Risk Expenditures	\$ 15,929,866,988
(1) Bureau of Labor Statistics	
(2) Phelan, R., Rush, G., November 2010, "Assessing the Costs and Benefits of Risk Management", KPMG Banking Newsletter Australia.	
(3) Chartis, May 25, 2010, "Risk management IT set for increased spending".	

4. User fees are arbitrarily calibrated to be 2% of the \$16 billion estimate of risk expenditures or \$320 million. The estimate is an example and the assessment level can be further discussed and the estimate can be made more precisely.

The individual user fee (F) is thus: $F = E / T * \$320 \text{ million}$

5. Apply this user fee rate to all entities that take risk and are thus required by statute to use the system.

The charge is commensurate to the firm's contribution to overall financial risk. Does this indicate the presence of a free lunch as the cost of risk management is reduced 98%? No. Many entities that previously had no access to sophisticated risk calculation methods are using the system, and paying risk-adjusted fees. This increases the fee-paying base. The inefficiency of replicating & maintaining models in thousands of different FIs is eliminated.

Although large FIs realize some savings from not having to perform all development, maintenance and compliance activities related to the internal model, expenditures are still needed at FIs for internal monitoring and compliance of employee risk-taking activities. We expect that the realized savings from collaboration and efficiency will yield savings in excess of the 2% assessment based on total prior risk function expenditures. This would make the proposal cost neutral or cost saving to financial risk takers. An economic cost-benefit analysis should be undertaken to confirm this assertion.

VI. Addressing Issues Raised in the Current Risk Framework Using the New Proposed Public Open-Source Risk Model

In this section we revisit the issues raised in the current risk framework in section III, one-by-one to explore whether the new construct addresses the needs highlighted in the earlier discussion.

1. *Black-box/Opacity* – Under the new public open-source model, black boxes turn grey and public model methodology is completely transparent to users.
2. *Uncertainty of Robustness/Opacity* - Under the new public open-source model, all stakeholders work together to ensure the robustness of the new model while significantly expanding knowledge inputs.
3. *Uncertainty of Reliability/Monitoring* - The new public open-source model will be more heavily scrutinized by a larger number of persons who will have access to methodology and testing.
4. *Risk Talent Supply* - Under the new public open-source model, the centralized design of the construct defines the scope and breadth of the project. One model is developed and maintained, not thousands.
5. *Supply of Qualified Regulatory Talent* - Under the new public open-source model, the centralized design of the construct defines the scope and breadth of the project. One model is supervised, not thousands.
6. *Fragmented and Incomplete Data* – Comprehensive OFR data calibrates the model. This is mandated by statute.
7. *Complex Risk System Maintenance and Documentation* - Under the new public open-source model, the centralized design of the construct allows depth of study and analysis. One model is developed and maintained, not thousands.
8. *Incomplete Risk Coverage* - Under the new public open-source model, having only one model allows a build with a comprehensive list of attributes.

Individually Immaterial/Material in Aggregate - Under the new public open-source model, risks can be aggregated in different ways correctly because a complete or more comprehensive dataset is available.
9. *High Cost/Access* - Under the new public open-source model, efforts are collective, inefficiencies are eliminated and costs are shared.
10. *Internal Model Inconsistency* – Under the new public open-source model, regulatory capital is applied consistently so that everyone knows they are paying a cost proportional to risk taken.
11. *Compliance and Regulatory Cost/Arbitrage* - Under the new public open-source model, the cost of compliance is proportional to risk taken.
12. *Flexibility/Upgradeability/Scalability* - Under the new public open-source model, it will be easier to effect changes on one model compared to thousands.
13. *Risk Sub-additivity* - Under the new public open-source model, exposures are aggregated, therefore aggregating fragmented risk outputs ceases to be a problem. New problems and increased complexity will inevitably arise from handling a much larger set of exposures, but it will be a worthwhile achievement just to get to that step.

14. *Jarrow Critique/ Capture of Externalities* – Under the new public open-source model, there is a new active voice in governance, that of the public. It is their job to advocate for the modeling of these risks appropriately.
15. *Risk Understatement Bias* - Under the new public open-source model, governance processes with open, transparent participation provide the tools and environment to correct this possibility.
16. *The Financial Stability Board’s (FSB) Enhanced Disclosure Task Force (EDTF) issued its report in 2012 which stated that: “High quality risk disclosures should be viewed as a collective public good given the systemic importance of banks and the contingent liability they represent for taxpayers. Poor quality disclosures can result in higher uncertainty premiums, and this can undermine the extension of credit needed to support employment and productive investments in struggling economies, and affect its price.”*

The new public open-source model aims to provide high-quality risk exposure information to all who need it efficiently at a reasonable cost.

VII. Incentives and Disincentives

Financial Participants	Regulatory Agencies
Risk is a cost center. FIs want the best risk model possible at the lowest cost.	The new model provides a manageable set of responsibilities for risk supervision.
Human capital (knowledge) driving improvement in the new model is greater than what can be gathered in-house.	Not validating FI in-house financial risk models & validating one public model:
The cost of maintaining risk infrastructure is shared and reduced.	- Allows scarce, qualified FI supervisory staff to focus on depth of analysis and also achieve breadth of coverage.
FIs will build the best possible model if its regulatory capital, liquidity & leverage levels depend on the new model.	- Allows the standardization of supervisory processes & coverage across thousands of FIs based on reliable and consistent risk information.
Only the public model has access to the comprehensive transaction data of OFR allowing for better risk model calibration.	- Allows the leveraged use of technology to automate supervisory processes.
Information security & privacy resolved through cryptographic protocols.	Requires a new legal/regulatory framework to address the new risk measurement & reporting system.
Asymmetric risk knowledge, understanding and management is no longer a competitive advantage.	Requires reorganization of the risk supervisory structure at the agencies.

This advantage is critical to FIs.

VIII. Potential Issues

1. Herd mentality; lack of diversity of opinion in risk matters.

Will FIs continue to maintain robust independent risk models that reflect valid differences from the consensus view of risk?

Will FIs just free-ride the public model?

2. Governance issues.

How will disputes in methodology be resolved?

Who will have a voice at the table?

How will the process remain fair?

3. Loss of information in aggregation of risk positions.

Qualitative aspects of risk management may not be captured in quantitative risk models. As risk is aggregated, some risk professionals have expressed concerns that useful information is lost and as scale builds this may be significant. We acknowledge that this is a problem, but perhaps one that may need to be addressed after significant aggregation is first achieved. An approach may be to design flexibility and incentives to foster an environment conducive to change and evolution toward concrete goals.

4. Economic incentives for desirable capital formation.

How will socially desirable goals that are economically sub-optimal be handled?

IX. Conclusion

The current system for creating, validating, distributing and ensuring the overall integrity of financial disclosures and information is inadequate, inefficient and needs reform. Risk aggregation, unlike that of assets and liabilities, is not additive. Correlations affect risk. The financial system needs to be designed to be able to aggregate risks correctly and with flexibility. Without this information, financial market participants and regulators cannot make decisions that are based on a robust foundation.

Only a small number of FIs are now subject to risk model supervision. Mainly those we think of as systemic. What if the systemic designation process fails and the next crisis comes from a set of non-systemic FIs?

The current system is not scalable to encompass the vast majority of FIs.

The proposed solution envisions a public, transparent, open source utility that can act as a benchmark for best-in-class risk measurement and reporting for most FIs, market participants and their financial transactions. It removes the need for:

1. Validation of proprietary risk models
2. Risk model rulemaking (to the financial institutions)

3. Monitoring (of proprietary models)
4. Enforcement of model rule infractions (at financial institutions)

The proposed structure is scalable for increased coverage and complexity.

References

- Abbe, E., Khandani, A., and Lo, A. (2011), “*Privacy-Preserving Methods for Sharing Financial Risk Exposures*”, working paper, MIT Laboratory for Financial Engineering.
- BCBS (2013), “*Regulatory consistency assessment programme (RCAP) - Analysis of risk-weighted assets for market risk*”.
- Bisias, D., Flood, M., Lo, A., Valavanis, S. (2012), “*A Survey of Systemic Risk Analytics*”, working paper #1, Office of Financial Research, US Department of the Treasury.
- Brunnermeier, M., Gorton, G. and Krishnamurthy, A. (2011), “*Risk Topography*”, NBER Macroeconomics Annual 2011, Volume 26, p. 149 – 176.
- Danielsson, J., Jorgensen, B., Samorodnitsky, G., Sarma, M., de Vries, C.G. (2005), “*Fat Tails, VaR and Subadditivity*”, forthcoming in the Journal of Econometrics.
- Danielsson, J., Shin, H.S. (2002), “*Endogenous Risk*”, Working paper, presented at the Research Workshop Crisis Resolution Conference sponsored by the Bank of England. September 23.
- Duffie, D. (2011), “*Systemic Risk Exposures: A 10-by-10-by-10 Approach*”, NBER Working Paper No. 17281.
- FRB (2013), “*Bank Holding Company Supervision Manual*”.
- FRB, SEC, CFTC (2011), “*Risk Management Supervision of Designated Clearing Entities*”, Joint Report of FRB, SEC, CFTC.
- FSB EDTF (2012), “*Enhancing the Risk Disclosures of Banks*”, Report of the Enhanced Disclosure Task Force.
- Gerding, E. F. (2009), “*The Outsourcing of Financial Regulation to Risk Models and the Global Financial Crisis: Code, Crash, and Open Source*”, Washington Law Review, 84(2), 127–198.
- Greenwald, B., Stiglitz, J. (1986), “*Externalities in Economies with Imperfect Information and Incomplete Markets*”, The Quarterly Journal of Economics, 101(2), 229-264.
- Hendricks, D. and Hirtle, B. (1997), “*Bank Capital Requirements for Market Risk: The Internal Models Approach*”, FRBNY Economic Policy Review: 1-12.
- Hirtle, B. (2003), “*What Market Risk Capital Reporting Tells Us About Bank Risk*”, FRBNY Economic Policy Review: 37-54.
- Hirtle, B., Levonian, M., Saldenberg, M., Walter, S. and Wright, D. (2001), “*Using Credit Risk Models for Regulatory Capital: Issues and Options*”, FRBNY Economic Policy Review: 19-36.
- Ingo, H. (2012), “*How to grow your open source project 10x and revenues 5x*”, OpenLife.cc blog.

- Jarrow, R. (2006), "*A Critique of Revised Basel II*", Journal of Financial Services Research, Springer, vol. 32(1), 1-16.
- Jicklin, M and Murphy, E. (2010), "*Who Regulates Whom? An Overview of U.S. Financial Supervision*", Congressional Research Service.
- Landier, A. and Thesmar, D. (2012), "*Regulating Systemic Risk through Transparency: Tradeoffs in Making Data Public*", No 17664, NBER Working Papers, National Bureau of Economic Research, Inc.
- Lessig, L. (1999), *Code and Other Laws of Cyberspace*, Basic Books.
- Lopez, J. and Saidenberg, M. (2001), "*The Development of Internal Models Approaches to Bank Regulation & Supervision: Lessons from the Market Risk Amendment*", Bank Fragility and Regulation: Evidence from Different Countries, George Kaufman (ed.), pages 239-254. Holland: Elsevier Science.
- Lucas, R. (1976), "*Econometric Policy Evaluation: A Critique*". Carnegie-Rochester Conference Series on Public Policy 1 (1): 19–46.
- Rebonato, R. (2007), *Plight of the Fortune Tellers*, Princeton University Press.
- Stiglitz, J. (2011), "*Re-Thinking Macroeconomics: What Failed, and How To Repair It?*", Journal of the European Economic Association, June 28, 2011, Volume 9, Issue 4, Pages 591-645, August 2011.
- U.S. General Accounting Office (1996), "*Financial Audit: Resolution Trust Corporation's 1995 and 1994 Financial Statements*", pp. 8, 13, table 3.



THE LONDON SCHOOL
OF ECONOMICS AND
POLITICAL SCIENCE ■



Systemic Risk Centre

The London School of Economics
and Political Science
Houghton Street
London WC2A 2AE
United Kingdom

Tel: +44 (0)20 7405 7686
systemicrisk.ac.uk
src@lse.ac.uk