

SYSTEMIC RISK IN FINANCIAL SYSTEMS AND
CAPITAL MARKETS IN RELATIONSHIP WITH THE
PROPOSED DRAFT *CAPITAL MARKETS
STABILITY ACT*

Report of Darrell Duffie,

Dean Witter Distinguished Professor of Finance at the Graduate School of Business,
Stanford University

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Darrell Duffie

Résumé

Le présent rapport examine certaines questions relatives à l'ébauche d'avant-projet de la *Loi sur la stabilité des marchés des capitaux (LSMC)*. Les enjeux liés à la *LSMC* ne sont pas étudiés de façon exhaustive dans ce rapport. Il s'agit d'un rapport parmi plusieurs rapports d'experts, chacun traitant d'un sous-ensemble de questions.

La partie 1 décrit le rôle du système financier au sein de l'économie nationale en général, en mettant l'accent sur le rôle des marchés de capitaux et les interdépendances au sein des marchés de capitaux.

Le système financier (c.-à-d. la partie de l'économie qui gère les flux de capitaux, la liquidité et le risque financier) est essentiel à l'économie réelle (c.-à-d. la production, la distribution et la consommation de biens *réels*). Sans un accès stable et peu coûteux aux marchés financiers, l'économie réelle ne pourrait fonctionner. Les marchés de capitaux sont la sous-catégorie du système financier qui comprend les marchés des réclamations relatives aux obligations et aux capitaux propres, ainsi que les services financiers et les marchés qui les soutiennent.

Les produits financiers, les fournisseurs de services financiers et les marchés au sein desquels les produits financiers sont échangés sont interreliés de façon complexe et forment le système financier. Les éléments du système financier sont fortement interdépendants. Une perte de fonctionnalité de n'importe quelle composante majeure du système entraînerait dans la plupart des cas une dégradation de l'efficacité d'une bonne partie du reste du système, avec des retombées financières préjudiciables dans l'économie réelle. Cette interdépendance est particulièrement importante dans le secteur des marchés de capitaux.

Malgré les différences importantes d'une province à l'autre en matière de réglementation et de supervision financière, les marchés de capitaux fonctionnent à des fins pratiques comme un ensemble unique de marchés caractérisé par une importante cohésion. Conséquemment à l'intégration économique étroite des marchés de capitaux du Canada, lorsque des problèmes nuisent au fonctionnement d'un marché de capitaux, ou d'un produit financier ou d'un fournisseur de services en particulier, les répercussions sont généralement de portée nationale, et non pas restreintes par les frontières provinciales. Le système financier du Canada est également fortement intégré au système financier mondial.

La partie 2 traite de la nature, de la propagation et des coûts du risque systémique.

Un risque systémique est une menace ayant des retombées dans l'économie générale déclenchée ou amplifiée par une certaine perte de fonctionnalité du système financier. Presque par définition, il est extrêmement difficile de prédire quand et comment un risque systémique se manifesterait lors d'une crise financière. Des exemples de risques systémiques pourraient inclure la perte soudaine de continuité des services financiers

essentiels; les liquidations soudaines forcées, à grande échelle ou répandues; des krachs éclairs; et la perte de confiance à l'égard du marché. Les questions relatives au risque systémique sont souvent distinctes des préoccupations quotidiennes relatives à la réglementation des marchés de capitaux, dont les plus importantes sont liées à la conduite financière, à la protection des investisseurs, ainsi que les préoccupations relatives à l'efficacité du marché qui ne menacent pas souvent la stabilité financière.

Les coûts les plus importants pour l'économie générale liés aux risques systémiques qui se concrétisent en de véritables événements systémiques sont les diminutions corrélatives de la consommation, de l'emploi et de l'investissement réel. Ces coûts sont attribuables : *i)* aux pertes directes en épargnes et d'autres formes de richesse financière, entraînant une diminution des dépenses et des investissements; et *ii)* aux réductions préventives en matière d'investissement et dans les comportements de dépenses causées par l'incertitude accrue ou les attentes réduites à l'égard du rendement économique futur.

Une fois qu'une menace systémique s'est manifestée par un effet indésirable réel tel qu'une crise, le coût résultant à l'économie générale peut être amplifié par diverses formes de propagation d'événements. Les crises financières sont souvent amplifiées lorsque des insolvabilités ou des quasi-insolvabilités mènent les fournisseurs de crédit à court terme à thésauriser leurs biens liquides. Le risque systémique peut aussi se propager par des effets de rétroaction qui font l'aller-retour entre les marchés de capitaux et l'économie réelle.

Même si l'expérience canadienne relativement aux crises financières a été relativement bénigne jusqu'à présent, par rapport à d'autres économies avancées, la stabilité financière du Canada a tout de même été confrontée à des menaces sérieuses de temps à autre, et encore aujourd'hui. Lorsqu'on régleme les risques financiers, il est également essentiel de garder à l'esprit que les systèmes financiers changent au fil du temps. En l'absence d'une vigilante réglementation macroprudentielle du système financier dans son ensemble, les pratiques ou les produits visés par la réglementation quotidienne et considérés comme bénins sur le plan systémique peuvent se transformer ou devenir plus populaires et menacer de causer l'instabilité. En outre, le réseau d'interdépendances dans le système financier peut changer. Les risques peuvent se propager dans le système sous des formes ou dans des directions précédemment inattendues.

La partie 3 est axée sur la pertinence pour le risque systémique de plusieurs domaines de compétence fédérale proposés dans la dernière ébauche d'avant-projet de la LSMC, dont on m'a demandé de traiter : i) les indices de référence financiers, ii) les marchés de financement de titres, principalement les pensions sur titres et les prêts de titres, et iii) les fonds communs de placement du marché monétaire.

Les indices de référence financiers fiables servent un certain nombre de fonctions importantes au sein du système financier. Cependant, la tentation de manipuler un indice

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de référence afin de tirer profit d'une position dans un contrat financier peut entraîner un problème systémique. Il existe des scénarios plausibles dans lesquels un indice de référence financier faible pourrait devenir une menace systémique sérieuse.

Le Canada compte deux principaux indices de référence relativement au taux d'intérêt : le taux CDOR (*Canadian Dollar Offered Rate*) et le taux canadien des opérations de pension à un jour (CORRA). Cependant, la gouvernance pour les indices de référence financiers au Canada est fragmentée. Puisque les indices de référence financiers du Canada sont d'une importance cruciale pour le rendement de l'ensemble du système financier, et qu'ils représentent une source potentielle de risque systémique, il serait plus efficace de désigner et de réglementer les indices de référence clés de manière plus uniforme pour l'ensemble du système, à l'échelle nationale.

Les opérations de financement de titres sont essentielles au bon fonctionnement des marchés modernes de capitaux, particulièrement les marchés d'obligations négociées en bourse activement, y compris notamment les marchés d'obligations du gouvernement. Les grands investisseurs et intermédiaires misent beaucoup sur le marché des prises en pension, pour le financement, les opérations de couverture, la spéculation et l'intermédiation de valeurs mobilières.

La Banque du Canada a identifié le marché de prises de pension du Canada comme un « marché de financement essentiel », ce qui sous-entend qu'il s'agit d'une importante source de financement pour les institutions au centre du système financier, et une source pour laquelle il n'y a souvent aucun substitut immédiat. Par conséquent, les risques systémiques qui se concrétisent dans le marché des prises de pension sont très susceptibles de se propager dans l'ensemble des marchés de capitaux du Canada. Dans la mesure où la réglementation du capital bancaire diminue l'appétit des banques pour ce qui est d'effectuer des opérations de financement de titres, les institutions financières non-bancaires pourraient accroître de façon significative leur participation à ces marchés. Une perte de la fonctionnalité des marchés de prises de pension au Canada, notamment l'échec de sa contrepartie centrale, représenterait un risque systémique clair et direct pour l'économie.

Les fonds communs de placement du marché monétaire (FCPMM) sont utilisés pour la gestion de trésorerie « en gros » ainsi que par les consommateurs. Ils sont souvent utilisés comme substitut aux dépôts bancaires. Si les investisseurs d'un marché monétaire craignent que la valeur marchande réelle des fonds risque bientôt de diminuer en dessous du prix normal, ils seront incités à revendre leurs parts immédiatement.

La possibilité d'une sortie précipitée du fonds du marché monétaire constitue un risque systémique chaque fois que le montant global des actifs détenus par des FCPMM est important. Une importante vente au rabais des actifs détenus par des fonds du marché monétaire pourrait déstabiliser les marchés relatifs à ces actifs. De plus, dans l'éventualité d'une sortie du marché monétaire, les emprunteurs importants sur le plan systémique dont les liquidités dépendent des investissements de fonds du marché monétaire, tels que les grands courtiers en valeurs mobilières ou les banques, pourraient soudainement perdre l'accès à une de leur importante source de financement.

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Le montant total des actifs actuellement gérés par les FCPMM canadiens, lequel est inférieur à la moitié de son niveau antérieur à la crise, est relativement faible, ce qui signifie que le risque systémique est modérément faible à l'heure actuelle. Cela n'exclut toutefois pas le risque que des futures menaces systémiques puissent survenir. Le recours aux FCPMM au Canada pourrait augmenter ou changer, présentant de nouvelles menaces à la stabilité financière.

EXECUTIVE SUMMARY

This report explores a selection of issues relevant to the proposed Capital Markets Stability Act (CMSA). This report is not comprehensive with respect to issues associated with the CMSA. It is one of a number of expert-evidence reports, each of which addresses a subset of issues.

Part 1 describes the role of the financial system in the broader national economy, with a focus on role of capital markets and joint dependencies within capital markets.

The financial system (that is, that part of the economy managing flows of capital, liquidity, and financial risk) is essential to the real economy (that is, the production, distribution, and consumption of *real* goods). Without low-cost and stable access to financial markets, the real economy could not perform effectively. Capital markets form the subset of the financial system that is comprised of markets for debt and equity claims, along with related supporting financial services and markets.

Financial products, providers of financial services, and the markets in which financial products are traded are intricately woven together to form the financial system. The elements of the financial system are strongly mutually dependent. A loss of functionality of any major component of the system would in most cases degrade the effectiveness of much of the rest of the system, with adverse spillover costs to the real economy. This mutual dependency is particularly strong in the area of capital markets.

Despite significant differences across provinces with respect to financial regulation and supervision, the capital markets themselves function for practical purposes as a single and highly cohesive national set of markets. It follows from the tight economic integration of Canada's capital markets that when problems impair the operation of a capital market, or a particular financial product or service provider, the impacts are generally national in scope, and not limited by provincial boundaries. Canada's financial system is also heavily integrated within the global financial system.

Part 2 addresses the nature, propagation, and costs of systemic risk.

A systemic risk is a spillover threat to the general economy that is triggered or magnified by some loss in the functionality of the financial system. Almost by definition, it is extremely difficult to predict when or how systemic risk will be manifested in a financial crisis. Examples of systemic risks could include sudden losses of continuity of critical financial services; large or widespread sudden forced liquidations; flash crashes; and loss

of market trust. Systemic-risk issues are often distinct from the concerns of “day-to-day” capital markets regulation, the most important of which are related to financial conduct, investor protection, and market efficiency concerns that do not often threaten financial stability.

The most important costs to the general economy associated with systemic risks that materialize into actual systemic events are the consequent reductions in consumption, employment, and real investment. These costs stem from (i) direct losses of savings and other forms of financial wealth, leading to reduced spending and investment, and (ii) precautionary reductions in investment and spending behaviour induced by heightened uncertainty or reduced expectations for future economic performance.

Once a systemic threat is manifested in an actual adverse outcome such as a crisis, the resulting cost to the general economy can be magnified by various forms of event propagation. Financial crises are often magnified when insolvencies or near insolvencies lead providers of short-term credit to hoard their cash liquidity. Systemic risk can also propagate through feedback effects that travel back and forth between capital markets and the real economy.

Although Canada has had a relatively benign history with financial crises relative to other advanced economies, material threats to Canada’s financial stability have existed from time to time, and still exist. When regulating for financial risk, moreover, it is crucial to bear in mind that financial systems change over time. Without vigilant macroprudential regulation of the financial system as a whole, practices or products that are covered by day-to-day regulation and have been considered systemically benign can morph or grow in popularity, and come to threaten instability. Further, the network of inter-dependencies in the financial system can change. Risks can travel through the system in previously unexpected forms or directions.

Part 3 focuses on the relevance to systemic risk of several proposed areas of federal authority under the current draft of the CMSA that I have been asked to address: (i) financial benchmarks, (ii) securities financing markets, predominantly repos and securities lending, and (iii) money market mutual funds.

Reliable financial benchmarks serve a number of important functions in the financial system. A systemic problem can arise, however, from the temptation to manipulate a benchmark in order to benefit from a position in a referencing financial contract. There are plausible scenarios in which a weak financial benchmark could become a serious systemic threat.

Canada has two key interest-rate benchmarks: the Canadian Dollar Offered Rate (CDOR) and the Canadian Overnight Repo Rate Average (CORRA). However, the governance setting for financial benchmarks in Canada is fragmented. Because Canada's financial benchmarks are critically important to the performance of the financial system as a whole, and represent a potential source of systemic risk, it would be more effective to designate and regulate key benchmarks in a more unified system-wide national manner.

Securities financing transactions are crucial to the well-functioning of modern capital markets, particularly markets for actively traded bonds, including therefore government bond markets. Major investors and intermediaries rely heavily on the repo market for financing, hedging, speculation, and intermediation of securities.

Canada's repo market has been identified by the Bank of Canada as a "core funding market," implying that it is an important source of funding for institutions at the center of the financial system, and a source for which there is often no immediate substitute. Systemic risks that materialize in the repo market therefore have a high probability of propagating throughout the core of Canada's capital markets. As bank capital regulations reduce the appetite of banks to conduct securities financing transactions, non-banks may significantly increase their participation in these markets. A loss of functionality of Canada's repo markets, including a failure of its repo central counterparty, would represent a clear and direct systemic risk to the economy.

Money market mutual funds are used for both "wholesale" and consumer-level cash management. They are often used as a substitute for bank deposits. If investors in a money market fund fear that the actual market value of the fund's assets might soon drop below the normal rounded price, they have an incentive to redeem their shares immediately, or "run".

The potential for a run on money market funds is a systemic risk whenever the aggregate amount of assets held by MMMFs is large. A large fire sale of assets held by money market funds could destabilize the markets for these assets. In the event of a run on money market funds, moreover, systemically important borrowers that depend for liquidity on investments by money market funds, such as large securities dealers or banks, could suddenly lose access to a significant source of financing.

The total amount of assets currently managed by Canadian MMMFs, below half of its pre-crisis level, is relatively low, implying moderately low systemic risk at this time. This does not, however, rule out the potential for future systemic threats. The use of MMMFs in Canada could increase or change, presenting new threats to financial stability.

Outline of Expert Evidence Submitted by the AGC

When I was first consulted by the AGC about the possibility of providing expert evidence in this case, it was my view that complete evidence on these issues would be best provided by seeking contributions from other experts in specific areas of economics. For this reason, part of my initial mandate for the AGC was to identify the subject areas that should be addressed by other experts.

Outside of the field of economists, the distinctions between our areas of expertise may not be immediately apparent. I hope the following comments will assist in understanding how our reports and expertise fit together.

My own qualifications, described below, allow me to cover a range of capital-markets and financial-stability issues, based in particular on my research and experience with secondary securities markets, repo markets, central banking, clearinghouses, and financial benchmarks, all of which are considered in this report.

Two separate expert reports submitted to Justice Canada treat relevant topics that are not covered in my own report.

In one of these separate reports, Professor John Hull of the University of Toronto, a leading expert on derivatives markets, covers CMSA-related issues concerning derivatives markets and risk associated with reliance on credit ratings.

An additional report is offered by Professor Andrew Metrick of Yale University, a major authority on the measurement and management of systemic risk who was on leave at the U.S. Treasury Department during the financial crisis in order to assist with crisis management. Professor Metrick's report addresses variation across countries in systemic risk regulation, giving a global perspective, among other topics.

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Mandate

I have been retained by the Department of Justice Canada to provide evidence and expert opinion in the area of systemic risk in the capital markets, the financial system and the broader economy.

Part of my mandate is to set out the broad context of this matter, focusing on the nature of systemic risk in financial systems and capital markets. This underlying factual context is intended to assist the reader in understanding the more in-depth areas of my own report and also to provide background for reports to be filed by other experts retained by Justice Canada, including Professors Andrew Metrick and John Hull.

I was also asked to address specific products and practices in additional detail, a mandate which has been divided between myself and Professor Hull based on our respective areas of expertise. In my report, I have addressed financial benchmarks, securities financing transactions (focusing on repos and sec lending), and money market mutual funds.

Qualifications

I am the Dean Witter Distinguished Professor of Finance at the Graduate School of Business, Stanford University, and Professor by Courtesy, Department of Economics, Stanford University. The functioning of capital markets is at the center of my research, teaching, and policy-related work.

I have acted as a consultant to major banks and hedge funds on issues that include swap markets, bond markets, equity markets, securities financing markets, risk management, and financial instrument valuation. Since my appointment to Stanford's faculty in 1984, I have taught or co-taught courses covering most key aspects of capital markets, including those covering derivatives and securities, and related topics. I have designed and delivered these courses to participants in Stanford University doctoral, MBA, and executive programs. I have also given in-house courses covering capital markets, risk management, and related topics, for several major financial institutions.

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I frequently participate in regulatory policy forums concerning capital markets. From 2007 until the end of 2015, I served on the Financial Advisory Roundtable of the Federal Reserve Bank of New York. This Roundtable consists of the leadership of the New York Fed, several academic economists, and several senior personnel of major financial institutions. Its semiannual meetings cover a wide range of issues centered on the stability of capital markets. At these meetings I have made a number of policy presentations concerning financial stability in capital markets, among other topics. I have also co-organized with the Federal Reserve Bank of Chicago an annual series of conferences for the past five years on swap markets and the central clearing of swaps. I have provided U.S. congressional testimony regarding financial stability on a number of occasions, and have made a number of written submissions to U.S. financial regulators regarding the drafting of financial regulations. I am frequently asked to participate in regulatory policy meetings.¹

Since October 2008, I have been on the Board of Directors of Moody's Corporation, a global provider of credit ratings and financial analytics. From 2008 to 2011, I served on the board of directors of iShares, the world's largest constellation of exchange traded funds (ETFs). A frequent concern of both of these boards is the financial stability of capital markets, including those for bonds, equities, derivatives, foreign exchange, and securities financing.

I was elected the 2009 President of the American Finance Association, the leading U.S. and international academic organization of financial economists. I am a Fellow and

¹ For example, in the twelve-month period ending June 2016, among many other regulatory participations, I will have taken part in policy discussions or made related research presentations at the U.S. Federal Reserve System (at the Board of Governors and at several of the Reserve Banks), the U.S. Commodity Futures Trading Commission, The Peoples Bank of China, The Banque de France, the Autorité des Marchés Financiers (of France), the Banca d'Italia, The Swiss National Bank, the Bundesbank (Germany's central bank), The European Central Bank, the Monetary Authority of Singapore, the Norges Bank (Norway's central bank), the Riksbank (Sweden's central bank), The Bank of England, The Financial Conduct Authority of the United Kingdom, the Bank for International Settlements, the Financial Stability Board, and the Bank of Canada.

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member of the Council of the Econometric Society, a Research Associate of the National Bureau of Economic Research, a Senior Fellow of the Stanford Institute for Economic Policy Research, and a Fellow of the American Academy of Arts and Sciences. I have served on the editorial boards of a number of leading academic journals in the fields of finance and economics.

In 2013-2015, I chaired the Market Participants Group (MPG), charged by the Financial Stability Board with recommending reforms to LIBOR, EURIBOR, and other interest-rate benchmarks used in over-the-counter swap markets. The members of the MPG, drawn from many G20 countries, included the chairman of International Swaps and Derivatives Association (ISDA), representatives of major dealers, an exchange operator, and many other major capital market participants such as global multinational corporations, and asset-management firms.

I have written research papers, policy reports, and books that address the valuation, design, trading, and risk management of a wide variety of financial instruments including bonds, equities and derivatives; as well as the design, efficiency, and stability of capital markets. I am a co-author of *The Squam Lake Report: Fixing the Financial System* (Princeton University Press, 2010). I am the author of other recent books related to the topic of this report, including *Dark Markets: Asset Pricing and Information Transmission in Over-the-Counter Markets* (Princeton University Press, 2012), *Measuring Corporate Default Risk* (Oxford University Press, 2011), and *How Big Banks Fail* (Princeton University Press, 2010). My CV, which includes my other scholarly publications and additional relevant qualifications, is provided with this report.

I. The financial system and capital markets within the national economy

What is the financial system?

1. The financial system is that part of the economy managing flows of capital, liquidity, and financial risk. In common terms, whenever firms and individuals require financial services such as borrowing or investing, they rely on service providers and infrastructure provided in markets that collectively make up the financial system. In Canada, as in most developed countries, the most significant classes of systemically important financial markets are those for:
 - i. Bank lending, deposit taking, and payment processing.
 - ii. Insurance.
 - iii. Underwriting primary issuances of securities, by which firms and local governments arrange the sale of their bonds, equities, and other financial instruments.
 - iv. Secondary-market trading, intermediation, and investment management of bonds, equities, commodities, currencies, derivatives, and other financial instruments. Once securities are issued, they are frequently re-traded in markets which investor services are offered by exchange operators, dealers, and others.
 - v. Securities financing and collateral transformation, including those provided under repurchase agreements and securities lending agreements. Among other applications, markets for these services are useful to those who wish to obtain cash financing for their purchases of bonds and equities, using the same securities as collateral.
 - vi. The settlement and clearing of financial trades, and securities custody. Here, securities are paid for, transferred, and held safely and with legal certainty in the name of the ultimate owner.

- vii. The provision of financial information such as benchmarks, trade data repositories, and credit ratings.
2. The “real economy” handles the production, distribution, and consumption of real (as opposed to financial) goods and services, such as labour, commodities, foodstuffs, consumer services, automobiles, construction, governmental services, and so on. Without low-cost and stable access to financial markets, the real economy could not perform effectively. Individuals would be unable to efficiently and safely convert their current savings into future consumption. Producers and distributors of real goods and services could not make or receive payments for their goods and services, nor could they efficiently obtain the capital, liquidity, and risk management services necessary to manage their businesses. Governments would be unable to finance necessary public services or invest in major civic infrastructure. Financial-services firms themselves require access to effective and stable financial services from others.
3. The importance of the financial system to the real economy should not be measured in terms of the fraction of the total economy devoted to providing financial services. An ideal goal is that financial services are provided effectively while constituting a small fraction of gross economic product.² The productivity of any advanced economy relies on the continual operation of robust and sophisticated financial systems. Regardless of the size of the financial services sector, the role it plays in facilitating the operation of the real economy is the essence of its importance.
4. For example, during the financial crisis of 2007-2009, the real economy was deeply impaired by a loss of financial stability. Although Canada’s real economy was less

² As a factual reference point, Philippon (2015) estimates that the ratio of the total income of U.S. financial intermediaries has risen significantly over the past 130 years to about 7% of U.S. GDP. He finds that the cost of financial intermediation per unit of intermediated assets has been remarkably stable over this period at about 2%.

severely affected than that of some other major countries, the adverse impact on Canadian real economic welfare was nevertheless heavy. For example, Chart 1 of Lane (2013) shows that Canada's real GDP dropped by over 2% during the crisis, during a period over which normal economic performance would have *raised* GDP by over 2%. Approximately 2.5% of Canadian jobs were lost during the financial crisis.³ Given the important economic functions of the financial system that I have described above, it is no surprise that when financial markets are impaired, the real economy deteriorates.

5. As just a few salient examples of the scale of dependence of Canada's real economy on its financial system between 2014 and 2016:
 - Non-financial Canadian businesses⁴ had outstanding credit of \$1.7 trillion, of which over \$550 billion was in the form of bonds and other instruments traded on capital markets. Canadian firms obtained approximately \$130 billion of new financing on Canada's capital markets⁵ in the form of newly issued bonds (\$95 billion) and equities (\$35 billion).
 - Federal, provincial, and municipal governments issued approximately⁶ \$165 billion of new debt securities on Canada's capital markets.
 - The equity shares of 1,487 corporations were listed on the Toronto Stock Exchange,⁷ having a combined market value of \$2.3 trillion. In 2015 alone,

³ See Lane (2013), page 4.

⁴ Source: Bank of Canada *Banking and Financial Statistics* (January 2016), pp. S58.

⁵ Source: Bank of Canada *Banking and Financial Statistics* (January 2016), pp. S74.

⁶ Source: Bank of Canada *Banking and Financial Statistics* (January 2016), pp. S70-72. For municipalities, an estimate for 2015 was extrapolated from the available data for 2000-2014.

⁷ Source: TMX Group (2016).

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Canada's TMX Group exchanges had 194 newly listings, ranking second in the world according to the World Federation of Exchanges.⁸

- Roughly 3,100 Canadian mutual funds managed assets of over \$1.2 trillion.⁹
- Canada's banks had total notional derivatives positions exceeding \$34 trillion, with which they absorbed or transferred risks associated with interest rates, equities, foreign exchange, credit risk, and commodities.¹⁰ The net magnitude of risks transferred in derivatives markets is difficult to judge directly from gross notional volumes. The available trade data regarding Canada's derivatives markets are nevertheless consistent with the importance of derivatives to the functioning of Canada's financial system, and thus its real economy.
- The average daily volume of exchange of Canadian dollars for foreign currencies was over \$65 billion.¹¹
- Canadian consumer credit¹² totalled approximately \$1.9 trillion, of which about 75% was for residential mortgages. Nearly 9 trillion individual credit card payments¹³ were made in 2014.

⁸ Source: "Canada's Markets: TMX Group 2016 Annual Report," March, 2016. <https://www.tmx.com/resource/en/514/2015-annual-report-en.pdf>

⁹ Source: Investment Funds Institute of Canada (2015). According to the Investment Company Institute (2015), Canada had over 3,100 distinct mutual funds at the end of 2014.

¹⁰ These measures are as of the third quarter of 2015. Further breakdowns are available on the web site of the Office of the Superintendent of Financial Institutions, at <http://www.osfi-bsif.gc.ca/Eng/wt-ow/Pages/FINDAT.aspx>

¹¹ The Canadian Foreign Exchange Committee, based on a press release of July 2015, at http://www.cfec.ca/files/2015/announcement_pressrelease_july2015.pdf

¹² Source: Bank of Canada *Banking and Financial Statistics* (January 2016), pp. S55.

¹³ Source: CPI (2015).

- According to Statistics Canada's National Balance Sheet data,¹⁴ of Canada's total economic assets of \$35.8 trillion at the end of 2015, \$26.5 trillion were in the form of financial assets, including \$2.4 trillion of currency and bank deposits, \$4.1 trillion of debt securities, \$5.1 trillion of loans, and \$10.0 trillion of equities and investment fund shares.

What are capital markets?

6. In a narrow sense, the term "capital markets" refers to that portion of the financial system comprising markets for debt and equity. The buyers participating in capital markets invest in debt and equity claims that offer desirable risk-return tradeoffs. The primary issuers of these claims are businesses and governments that must fund new capital projects or manage their cash flows. For example, if a Canadian firm wants to grow bigger or start a new line of business, it will generally need to hire more workers, obtain new real estate, and invest in plant and equipment. These steps would usually be delayed dramatically if the firm was forced to obtain the necessary funds by saving its earnings. Instead, larger firms generally obtain the necessary capital by selling new debt and equity securities on capital markets. Similarly, governments use capital markets to obtain the additional debt financing needed for new roads and bridges, sewer systems, schools, and many other infrastructure and other real-economy government programs on which citizens rely. Issuers of debt claims also include special-purpose financial companies that conduct "securitization" by purchasing pools of consumer or corporate loans that they finance with debt. In principle, securitization lowers the cost of borrowing for homeowners and firms. As sadly discovered during the financial crisis of 2007-2009, however, U.S. residential mortgage securitization was a major source of systemic risk. In Canada, as I will later explain in more detail, a particular form of

¹⁴ See CANSIM Table 378-0121 at <http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=3780121&&pattern=&stByVal=1&p1=1&p2=-1&tabMode=dataTable&csid=>

securitization known as asset-backed commercial paper (ABCP) was a source of systemic risk that emanated from within Canada's capital markets.

7. Capital markets include both primary issuance markets (those covering the initial sales of securities by their issuers), as well as secondary markets for the re-trading of securities by public investors of many types.
8. From its stated objectives and framing, the proposed Capital Markets Stability Act (CMSA) naturally takes a broader stance by also encompassing a range of financial services that directly support debt and equity markets. In this broader sense, "capital markets" cover related financial products such as derivatives, as well as services that provide infrastructure and information, such as central clearing, trade data repositories, credit ratings, and financial benchmarks. This broad notion of the term "capital markets" is also in common usage.
9. Of the seven classes of financial services listed above, Classes iii through vii naturally fall within the scope of the proposed CMSA and provincial securities regulation, whereas Classes i and ii, commercial banking and insurance, do not. I nevertheless consider lending by banks to large corporations and sovereigns to be both a banking service and a capital-markets service. Moreover, the functional distinctions between corporate bonds and large commercial bank loans have been shrinking.
10. This sort of morphing over time of a product category, so that it takes on much of the character of another product category, is one instance of a general concern to systemic-risk regulation. When regulating for financial stability, it can be counterproductive to classify financial markets or products into distinct subsets for separate regulation or oversight. A conventional banking product or service may appear in a new guise in traded capital markets, and vice versa. Innovations in derivatives, securitization, and exchange-traded funds have been particularly rapid and challenging to regulators. The systemic risks presented by specific markets and products change over time as the financial system adapts to meet new

applications and changes in the real economy, or in order to take advantage of cross-jurisdictional variation in regulation. A holistic national approach to systemic-risk regulation and supervision is more effective in detecting and managing risks as they arise, especially those caused by innovation in practices and products.

11. As for most nations with advanced economies, Canada's most important providers of capital-markets services are Canada's largest banking groups, which operate both banks and securities dealers. The separately regulated dealer subsidiaries of these banking groups develop, underwrite, and provide market-making, brokerage, and investment-management services for essentially all capital-markets products. Other significant providers of capital-markets services include the operators of exchanges and clearinghouses, securities depositories, and agency-based asset managers such as hedge funds, private-equity firms, and purveyors of mutual funds. Key information-service providers include credit-rating agencies,¹⁵ trade-data repositories, and financial benchmark administrators.
12. Although insurance firms and pension funds can be formally classified as consumers (rather than producers) of capital-markets services, their high volumes of trade in bonds, equities, derivatives, securities lending agreements, repurchase agreements, and other financial instruments place them among the most important providers of liquidity on secondary capital markets.
13. Canada also has a substantial amount of "shadow banking," which is defined by the Financial Stability Board (2015a) as "credit intermediation involving entities and activities outside of the regular banking system." For example, money market mutual funds and some hedge funds are active shadow bankers. Among the 26 countries covered by a recent study conducted by the Financial Stability Board

¹⁵ I am a member of the board of directors of Moody's Corporation. I therefore avoid offering specific views in this report concerning credit rating agencies or their regulation.

(2015a), Canada's shadow banking sector ranked as seventh largest in terms of the absolute magnitude of credit provided at the end of 2014, and ninth largest when ranked by amount of credit provided relative to GDP.¹⁶ Although shadow banking generally represents a useful source of credit and liquidity to Canada's economy, the existence of such a significant amount of credit intermediation outside of the immediate scope of the bank-based regulatory framework is notable from a systemic-risk perspective.

Mutual functional dependence

14. Financial products and the various providers of financial services are intricately woven together to form the financial system. The elements of the system are strongly mutually dependent. A loss of functionality of any major component of the system would in most cases degrade the effectiveness of much of the rest of the system, with adverse spillover costs to the real economy.
15. Canada's largest financial institutions are deeply embedded into the economy at every level (retail, corporate, and government), and in support of almost every type of economic activity, especially through lending, deposit taking, payments processing, and a range of important capital-markets activities, including underwriting, asset management, brokerage, and dealing. Many of the capital-markets activities of these banking groups occur within dealer subsidiaries that are regulated separately from their affiliated banks.
16. Mutual dependency is particularly strong in the area of capital markets. It would be difficult to issue equities or debt without well-functioning underwriters and an efficient secondary market for re-trading the securities. In the absence of an efficient and stable secondary market for hedging and liquidating risky positions, investors would in many cases be reluctant to pay prices for new debt and equity

¹⁶ See Exhibits 5 and 6, respectively, of Financial Stability Board (2015a).

securities that issuers would find acceptable. Likewise, many issuers would face unacceptably high costs of capital in the absence of effective derivatives markets, which support risk management for issuers, underwriters, intermediaries, and ultimate investors. According to Paligorova and Staskow (2014), in Canada, “[t]he use of financial derivatives is widespread across all sectors of the economy.”¹⁷

17. Secondary markets cannot be effective unless exchanges and clearinghouses are continually functional. Obviously, markets are essentially frozen if an exchange has an operational outage. Clearinghouses guarantee the ultimate settlement of financial trades. In effect, they become the seller to the original buyer, and the buyer to the original seller. If one of the two original parties becomes insolvent, the clearinghouse is still there to ensure payment. The failure of a large clearinghouse is therefore automatically a systemic event, for this implies that many market participants will suffer a financial loss.
18. For their effectiveness, secondary markets rely on robust market making by banks and other intermediaries.¹⁸ In order for prices to efficiently incorporate information about fundamental asset values, a process known as “price discovery,” capital markets rely on specialty information and opinion providers, such as benchmark

¹⁷ “We collected data on the use of derivatives for a sample of firms listed on the Toronto Stock Exchange (TSX) for the following contracts: interest rate swaps, as well as foreign exchange futures, forwards, swaps and options. Excluding financial firms and utilities, we obtained information for the use of derivatives contracts for 1,522 non-financial firms over the 2005–13 period. The portion of Canadian firms that relies on derivatives contracts is significant. In total, 33 per cent of the firms in our sample use at least one of the contracts listed above; 18 per cent use interest rate swaps and 24 per cent use at least one type of foreign exchange contract. Of the firms that use FX contracts, 25 per cent use FX swaps, 54 per cent use FX forwards and 46 per cent use either FX futures or FX options.... For example, 24 per cent of firms in mining and oil, 37 per cent in diversified industries, 14 per cent in technologies and 24 per cent in all other sectors (communications and media, forest products, and life sciences) use at least one of the above-mentioned derivatives contracts. Interest rate swaps are the most common type of derivatives used in mining and oil and in diversified industries.... FX forwards, followed by FX futures and options, are the most prevalent instruments in technologies.” [Paligorova and Staskow (2014), p. 48].

¹⁸ The importance of robust market making is explained in more detail in Duffie (2012).

administrators, trade-data disseminators, and credit rating agencies. These information providers are also crucial to risk management.

19. Without reliable financial benchmarks, including daily published fixings of commodity prices, foreign exchange rates, and interest rates, investors would have difficulty comparing the prices they are quoted with current market values, and it would be impossible to unambiguously settle payments due on many types of derivatives contracts, commodity contracts, foreign currency trades, and floating-rate loans.¹⁹
20. The financial intermediation of actively traded bonds depends critically on repurchase agreements, known as “repos,” and other securities financing and collateral transformation markets, as explained in Section 3 of this report. Effective shorting depends on access to derivatives, repo, and securities-lending markets. The ability to execute short positions is often necessary for both hedging and speculation. Speculation is a crucial ingredient to both price discovery and market liquidity. The ability to hedge financial positions is necessary to asset management and financial intermediation.
21. Hedge funds, mutual funds, pension funds, and other agency-based asset managers cannot provide investment services to their clients, nor assist in the provision of liquidity to markets, without functional secondary financial markets and all of the above-described supporting service providers. Hedge funds and others also rely heavily on robust brokerage services that are typically offered in Canada by dealers.
22. All major financial market participants rely for their cash management on access to commercial bank deposits, repos, commercial paper, bankers' acceptances, or

¹⁹ For more explanation of the economic functions performed by benchmarks, see Duffie and Stein (2015).

money market mutual funds. There is significant substitutability, however, between some of these cash-management instruments.

23. The most obvious and hard-linked dependencies within the financial system are financial market infrastructure (FMI), such as payment, settlement, and clearing systems. In its Financial System Review of 2015, The Bank of Canada wrote: “if one participant in the FMI chain fails, the ability of other participants to meet their own obligations could be adversely affected, potentially causing a series of failures that ultimately impairs the functioning of the financial system.”²⁰ For example, Lacker (2003) describes the systemic problems²¹ for securities markets caused by physical damage to critical payments systems located in lower Manhattan during the attacks on the World Trade Center on September 11, 2001. Another example is the failure in 1987 of the clearinghouse (central counterparty) of the the Hong Kong Futures Exchange, with consequent outright losses to market participants and, more importantly, opportunity costs and risks caused by a suspension of trading.²²

²⁰ “Domestic interconnectedness refers to direct and indirect linkages across entities and activities in the financial system, including common exposures. These connections contribute to the safety and efficiency of the system in normal times, but they also have the potential to pose systemic risk in periods of stress. Financial market infrastructures (FMIs)—the payment clearing and settlement systems that facilitate financial transactions—are a particularly relevant example. FMIs expedite transactions for participating financial entities, such as banks and investment dealers, allowing consumers and firms to purchase goods and services, make financial investments, and transfer funds. However, if one participant in the FMI chain fails, the ability of other participants to meet their own obligations could be adversely affected, potentially causing a series of failures that ultimately impairs the functioning of the financial system.” *Bank of Canada Financial System Review*, June 2015, p. 39.

²¹ Lacker (2003) writes that “Government securities settlement was especially hurt by the attacks. Cantor Fitzgerald, a key interdealer broker, was devastated, losing 658 employees. Many market participants were forced to relocate to backup sites, where internal systems and communications were not as reliable. Several banks had difficulty processing payment instructions, and the resulting accumulation of large balances drove net balances in the remainder of the banking system negative, necessitating the Fed’s huge injections.” The securities settlement failures associated with this event are characterized by Fleming and Garbade (2002).

²² This CCP was the Hong Kong Futures Guarantee Corporation, which collapsed in the wake of a large clearing member default arising from declines in the Hang Seng Index, triggered by even larger declines

24. The most systemically important financial market infrastructure operating in Canada are:
- The Canadian Depository for Securities (CDS),²³ which in 2014 held nearly \$4.6 trillion worth of securities²⁴ and processed approximately 430 million securities delivery instructions representing over \$122 trillion dollars in transactions.
 - The Canadian Derivatives Clearing Corporation (CDCC), which as of the end of 2014 was the central counterparty for over 159 million cleared transactions of derivatives and securities trades.²⁵

on the New York Stock Exchange on October 19, 1987. See Hay Davison (1988). Additional stresses included the decision of the Hong Kong government to place a halt on the trading of equities on the Hong Kong stock exchange, “the reasons given being the threat of panic selling and a disorderly market, brokers’ potentially precarious liquidity positions, and the possibility of runs on banks. Special attention was also drawn to the overwhelming of the exchange’s settlement system (supposed to operate on the basis of a 24-hour settlement period), which had left a backlog of 250,000 unsettled deals, equivalent to one week’s trading” [Cornford (1995), p. 194].

²³ According to the Bank of Canada, “CDS and its participants are subject to the legislation and regulations of different jurisdictions. At the federal level, CDSX has been designated under the PCSA and is therefore subject to oversight by the Bank of Canada. At the provincial level, CDS is regulated by Quebec’s Autorité des marchés financiers (AMF), the British Columbia Securities Commission (BCSC), and the Ontario Securities Commission (OSC). The Bank coordinates its oversight of CDS with these other regulators pursuant to a Memorandum of Understanding (<http://www.bankofcanada.ca/2014/04/notice-memorandum-understanding/>). In addition, CDS reports as required to the Canadian Securities Administrators (CSA), an umbrella organization of provincial and territorial securities regulators. Finally, CDS co-operates with federal and provincial financial institution regulators that oversee CDS participants.” <http://www.bankofcanada.ca/core-functions/financial-system/clearing-and-settlement-systems/>

²⁴ BIS statistics at <https://www.bis.org/cpmi/publ/d142.pdf>.

²⁵ BIS statistics at <https://www.bis.org/cpmi/publ/d142.pdf>. According to the web site of the CDCC, “Canadian Derivatives Clearing Corporation (CDCC), a wholly-owned subsidiary of the Montréal Exchange (MX), acts as the central clearing counterparty for exchange-traded derivative products in Canada and for a growing range of customized financial instruments.” See http://www.cdcc.ca/index_en According to the Bank of Canada, “At the federal level, the Bank of Canada oversees CDCC under the Payment Clearing and Settlement Act. At the provincial level, CDCC is regulated by Quebec’s Autorité des marchés financiers (AMF), the Ontario Securities Commission (OSC) and the British Columbia Securities Commission (BCSC). CDCC also co-operates with federal and provincial financial institution regulators that oversee CDCC participants. As well, to support clearing derivatives contracts that are registered for sale to U.S. residents, CDCC files documentation in accordance with the requirements of the Securities and Exchange Commission.” See <http://www.bankofcanada.ca/core-functions/financial-system/clearing->

- The Large Value Transfer System²⁶ (LVTS), operated by the Canadian Payments Association, which processed interbank payments of nearly \$39 trillion in 2014. The LVTS is also the main operational setting for the implementation of monetary policy by the Bank of Canada.²⁷
25. The interdependencies described in the preceding paragraphs imply strong network externalities. That is, the effectiveness and reliability of any major element of the financial system depends on the effectiveness and reliability of most other parts of the system. In particular, the continuity of the services provided by essentially any major element of the financial system is crucial to the avoidance of major losses throughout the system.

Integration of national and global capital markets

26. Despite significant differences across provinces with respect to financial regulation and supervision, the capital markets themselves function for practical purposes as a single and highly cohesive national set of markets.²⁸ For example, investors in Alberta or Quebec are not significantly different from investors in New Brunswick or any other province or territory with respect to their ability to buy or sell equities issued by firms in British Columbia that are listed on the Toronto Stock Exchange. For publicly traded equities, bonds, and derivatives contracts, Canadian market participants face essentially the same investment opportunities, at the same prices and return risks. All Canadian issuers of public securities, likewise, have access to

[and-settlement-systems/](#). Canada's other central counterparty for derivatives, NGX, handles energy contracts. http://www.ngx.com/?page_id=8.

²⁶ See

https://www.cdnpay.ca/imis15/eng/Clearing_Settlement/Large_Value_Transfer_System/eng/sys/Large_Value_Transfer_System.aspx?hkey=5151eb94-f08d-4d6f-bf7c-dc325aec9659.

²⁷ http://www.bankofcanada.ca/wp-content/uploads/2010/11/large_value_transfer_system.pdf.

²⁸ For distinctions between provinces regarding registration and provision of capital-markets service providers, and the structure of the "passport" system, see <http://www.securitiescanada.org>.

essentially the same investors on terms that do not vary significantly across the country. Canadian exchanges, clearinghouses, and other market infrastructure are available on equal financial terms throughout Canada's capital markets. Canada's securities dealers and banks offer financial terms of trade on a national basis, without discrimination according to the location of their clients, whether they provide broker-dealer services or act as counterparties on derivatives and foreign exchange trades.

27. It follows from the tight economic integration of Canada's capital markets that when problems impair the operation of a capital market, or a particular financial product or service provider, the impacts are generally national in scope, and not limited by provincial boundaries. This is the case whether or not any such problems are related to regulation or supervision at the provincial level.
28. Canada's financial system is also heavily integrated within the global financial system. Whatever segmentation exists within global financial markets is based largely on informational frictions and the boundaries of national legal jurisdictions. Informational, tax, and legal differences typically result in a national "home bias" by investors. That is, typically, investors in a given country tend to have investment portfolios with a disproportionately heavy weight on domestic securities over foreign securities. The frictions that drive home bias are small enough, however, that Canadian users of financial services are generally able to take significant advantage of the integration of Canada's capital markets within global capital markets. (Whenever legal barriers prevent this, there is often a costly inefficiency.)
29. For example, Canadian firms and governments²⁹ often obtain lower costs of capital by issuing securities on global markets, allowing them access to a wide range of

²⁹ For example, according to the *Bank of Canada Financial System Review* for December 2015, "The share of GoC bonds held by foreign investors has increased from around 15 per cent in September 2009 to

foreign investors. Indeed, over 60% of bond issuance by Canadian firms during 2015 was on foreign capital markets.³⁰ Canadian firms also use global financial markets to conduct trade-related foreign-exchange transactions, hedge commodity imports and export price fluctuations, and manage risks associated with changes in foreign currency prices³¹ and interest rates. Canada's federal government makes heavy use of international derivatives markets to manage risks associated with its foreign exchange reserves.³² Canadian investors can obtain better portfolio diversification, and thus a higher mean investment return for a given risk profile, through their access to foreign securities and derivatives.

30. As a partial offset to the significant benefits of integration within global capital markets, Canada's financial system (and thus its general economy) is exposed to adverse shocks that sometimes emanate from external financial markets. This is a normal state of affairs for developed economies, and calls for prudent oversight of the resilience of Canada's financial system and real economy to both internal and external shocks to financial stability.

roughly 33 per cent in September 2015 (Source: Statistics Canada CANSIM tables 176-0071 and 376-0146)."

³⁰ Bank of Canada *Banking and Financial Statistics* (January 2016), p. S74, at http://www.bankofcanada.ca/wp-content/uploads/2016/01/bfs_january16.pdf.

³¹ The OTC Derivatives Working Group (2010) states that "FX swaps are an important element in the core funding of Canadian financial institutions, as evidenced by the fact that FX contracts are more widely used in Canada where the IAG has at least one side of the trade (23 per cent in Canada vs. 9 per cent globally)." According to Paligorova and Staskow (2014) FX swaps and FX options are used by about 10% and 14% (respectively) of large Canadian firms.

³² According to financial disclosure provided in Canada's 18K filing with the U.S. Securities and Exchange Commission, "In 1996, Canada implemented the EFA foreign currency swap program. Under these foreign exchange swaps, Canadian dollar liabilities are swapped into liabilities in foreign currencies, allowing Canada to raise foreign exchange reserves cost effectively. As of September 30, 2015, \$36,619 million of Canadian dollars have been swapped for USD 34,828 million, \$14,540 million of Canadian dollars have been swapped for EUR 9,965 million, \$4,417 million of Canadian dollars have been swapped for GBP 2,338 million and \$820 million Canadian dollars have been swapped for JPY 75,522 million." <http://www.sec.gov/Archives/edgar/data/230098/000119312515403649/d40771dex99d.htm>

31. For example, the IMF's 2010 "country report" for Canada showed³³ how severely Canada's real economy was affected by the 2007-2009 financial crisis emanating from the United States. "The financial crisis further slashed the demand for and production of automotive products, as consumer credit tightened and home equity loans used to finance car purchases in the 2000s dried up." The IMF noted³⁴ that during 2007-2009 Canadian auto production declined by 42.3%, and direct employment in the auto sector declined by 28.5%. As for broader measures of the impact of the financial crisis on Canada's real economy, I have already noted that Canada's gross domestic product and employment were reduced by approximately 4% and 2.5%, respectively, according to Lane (2013).
32. As another example, the U.S. financial crisis raised the concerns of investors in Canadian non-bank asset backed commercial paper (ABCP). These concerns were magnified by the low transparency and limited access to liquidity of these ABCP conduits.³⁵ That is, investors were often unaware of the qualities of the assets of these conduits, and probably became suspicious that the assets might be of the low credit quality of U.S. securitized products that had failed. A lack of transparency of the conduit assets probably incited a fear of loss during stress periods. Many conduits were therefore unable to pay maturing debt claims with new investor money. Further, many conduits had not arranged for back-up sources of funds. Even if investors had viewed a given conduit's assets as sound, they would have worried that other investors would not renew their loans to the conduits, and the conduits would have insufficient funds to pay maturing debts. As a result, many of Canada's ABCP conduits were unable to continue renewing their

³³ IMF (2010).

³⁴ IMF (2010), Table 1, p. 39.

³⁵ For details, see Kamhi and Tuer (2007). According to Chant (2009), in August 2007, \$32 billion of non-bank sponsored ABCP was frozen due to an inability of their conduits to roll over their maturing notes.

financing and ceased to be effective. In this case, an external shock coupled with the poor design and oversight of a Canadian financial product resulted in a significant and costly failure.

33. Conversely, problems in Canada's capital markets can have a significant adverse impact on foreign investors. Examples include the failures of Olympia and York³⁶ in 1992 and Confederation Life in 1994.³⁷ Each of these collapses instigated the largest defaults in U.S. bond markets in their respective years.
34. Canada's financial regulators share responsibility with regulators in other nations for managing risks that can easily spill across national boundaries.
35. Like most developed economies, Canada places few restrictions on flows of capital across its borders, in either direction, in or out. Were significant restrictions on cross-border capital flows to be imposed, Canada's real economy would suffer dramatically, for reasons that I have explained. Given its open capital markets, it

³⁶ The collapse of Olympia and York, a Toronto real-estate investment firm, led to the defaults of many of its international subsidiaries and affiliates. Ghosh, Guttery, and Sirmans (1994) wrote: "On 14 May 1992, Olympia and York Development Ltd (O&Y), the world's largest privately held real estate developer, filed for bankruptcy protection in the United States under Chapter 11 of the Federal Bankruptcy Code, and in Canada under the Companies' Creditors Arrangement Act. The investment community characterized the \$18.55 billion restructuring [referring to a *Financial Post* report] as 'the first truly multinational real estate workout, with properties, lenders, and documentation subject to different legal systems, business traditions, and bank regulatory practices.'" In describing the defaults of U.S. bonds in 1993, Moody's Investors Services wrote: "The year's largest defaulter was the special purpose corporation Olympia & York Water Street Finance Corporation, whose sole business concerns the office building at 55 Water Street in lower Manhattan. ... The default is a landmark not only because of its size relative to other 1993 defaults (\$548 million or 15% of the year's total), but also because it is a rare example of a structured finance transaction in distress."

³⁷ Moody's described the failure of Confederation Life as the largest default in 1994 of any rated debt issue, writing: "The year's largest default occurred when the Canadian life insurance provider Confederation Life Insurance Company (and related entities) was seized by regulators. The \$490 million of debt involved in the Confederation default accounts for 21% of 1994's total dollar amount of defaults. Confederation's misfortune stemmed primarily from overexposure to the North American real estate market." And, from the transcript of Becker, Murray, Gies, and Mahoney (1999): "Confederation Life was seized in August of 1994. This was a very unusual situation. You had cross-border issues. Michigan was the state of entry in the U.S. for Confederation Life. Under Michigan law a trust is to be maintained with assets sufficient to meet U.S. liabilities, so it's collateralized. U.S. policyholders have first claim on the trust assets as well as a residual claim on the general account of the Canadian company."

is difficult for Canada to immunize itself from systemic risk arising in foreign jurisdictions that are riskier or less well regulated.

36. Indeed, the financial crisis of 2007-2009 revealed that the United States was just such a jurisdiction, toxic with systemic risk that was poorly regulated. U.S. home mortgages and securitizations of these mortgages constituted a giant keg of financial dynamite. U.S. securities dealers were dramatically over leveraged. One of the largest U.S. insurance firms, AIG, and two giant U.S. mortgage agencies, Fannie Mae and Freddie Mac, all took enormous and unsafe investment risks in home mortgages. The critical core of U.S. repurchase markets was badly designed for systemic risk and heavily exposed to the failure of a major broker dealer such as Lehman Brothers. U.S. money market mutual funds were also badly designed and prone to a run by investors at the first sign of trouble, as I explain in Section 3. These were more than just fragilities; all of these financial products and firms failed dramatically during the crisis.
37. U.S. regulators proved in every one of these instances that, leading up to the financial crisis, they were not up to task of controlling systemic risk. Since the crisis, the United States has therefore gone through a massive change in its financial regulation, with a heavy focus on controlling systemic risk.
38. A key lesson of this history is that Canada should never assume that it can close its borders to the importation of systemic risk emanating from foreign jurisdictions.

II. Systemic Risk

39. This section addresses the nature, costs, and propagation, of systemic risk.

What is systemic risk?

40. A systemic risk is a spillover threat to the general economy that is triggered or magnified by some loss in the functionality of the financial system.³⁸ A “threat” implies a potential for significant unexpected loss.³⁹ Almost by definition, it is extremely difficult to predict when or how systemic risk will be manifested in a financial crisis. If an upcoming crisis were predictable far enough in advance to

³⁸ A somewhat similar definition is provided by Adrian, Covitz, and Liang (2014), who write: “We define systemic risk as the potential for widespread financial externalities—whether from corrections in asset valuations, asset fire sales, or other forms of contagion—to amplify financial shocks and in extreme cases disrupt financial intermediation. Potential financial externalities may have cyclical causes. For example, in an economic expansion, leverage might proliferate throughout the financial sector, which in turn could increase the potential for asset fire sales. Potential financial externalities may also have structural roots, as with money market mutual funds, which in their current form are susceptible to runs by their own investors and consequently tend to always create the potential for asset fire sales and other forms of contagion.” Chant (2003) writes that “The immediate costs of financial instability arise from the breakdown of the financial system’s ability to perform its functions. Part of this breakdown will take place in the immediate area of the initial shock. Experience with bad loans and the weakened condition of borrowers may make financial institutions less willing to provide new loans. They may also restrict credit to their existing borrowers or charge them higher interest to reflect their perception of heightened risk. The possible failure of counterparties in the payments and clearing system may lead to greater caution among participants, causing them to limit lines of credit to other participants or to require higher collateral. Transactions previously treated as routine may be delayed on a discretionary basis. Disappointed expectations may cause users of the payments system to seek alternative ways to make payments. But the costs of a financial crisis need not be confined to the proximity of its source. In the aftermath of a systemic shock, the pressures will spread to other parts of the system, impairing their ability to perform their normal functions. For example, the effects of a failure in foreign exchange settlements may create settlement problems in a domestic payments system. In turn, any resulting deterioration of the condition of financial institutions could limit their ability to continue financing business activity. In the extreme, financial instability could lead to systemic failure, where key parts of the financial system as a whole break down and cannot fulfil their functions effectively.”

³⁹ The U.S. Office of Financial Research (2016) states that “Threats to financial stability arise from vulnerabilities in the financial system. ... Resilience of the financial system and its converse, threats to financial stability, are systemwide concepts. To measure, assess, and monitor them, we must look across the financial system. We must examine financial institutions and markets to improve our understanding of how threats spread from one institution or market to others. Only then will we be able to find ways to counter those risks and make the financial system more resilient.”

make the prediction valuable, then market participants and regulators would have the opportunity and strong incentives to reduce the underlying risks to the point that the crisis would not likely occur. This point has been made similarly by Minneapolis Federal Reserve Bank President Neil Kashkari, when speaking about crisis-prediction attempts in 2006 by the U.S. Treasury Department, Federal Reserve, and Securities Exchange Commission.⁴⁰

41. Examples of systemic risks include the following.
42. **Sudden losses of continuity of critical financial services.** Plausible scenarios for systemic “outages” include the following.
 - i. One or more large banks could fail,⁴¹ a common trigger of financial crises, as detailed by Calomiris and Haber (2014).
 - ii. An exchange could suffer a loss of technical functionality, as when the NYSE Designated Order Turnaround system fell far behind in its order processing,⁴² contributing significantly to the stock crash of 1987.

⁴⁰ Kashkari (2016) stated: “A second lesson for me from the 2008 crisis is that almost by definition, we won’t see the next crisis coming, and it won’t look like what we might be expecting. If we, or markets, recognized an imbalance in the economy, market participants would likely take action to protect themselves. When I first went to Treasury in 2006, Treasury Secretary Henry Paulson directed his staff to work with financial regulators at the Federal Reserve and the Securities and Exchange Commission to look for what might trigger the next crisis. Based on his experience, we were due for a crisis because markets had been stable for several years. We looked at a number of scenarios, including an individual large bank running into trouble or a hedge fund suffering large losses, among others. We didn’t consider a nationwide housing downturn. It seems so obvious now, but we didn’t see it, and we were looking. We must assume that policymakers will not foresee future crises, either.”

⁴¹Although Canada has sparse experience with banking crises, for reasons noted by Bordo, Redish, and Rockoff (2015), Haltom (2013), and Calomiris and Haber (2014), it has not been completely immune from them. According to the Estey Report to the Parliament of Canada, “The CCB collapse in March 1985 shook the money markets,” and was a “borderline crisis.” See Estey (1986).

⁴² See the Presidential Task Force on Market Mechanisms (1988).

- iii. A clearinghouse could fail to meet its default-management obligations and discontinue clearing,⁴³ as with the collapse of the clearinghouse of the Hong Kong Futures Exchange⁴⁴ in 1987. In Section 4, I discuss the issue of systemic risk in relationship to Canada's largest clearinghouses.
- iv. A benchmark administrator could become unable to obtain the information necessary to publish a fixing, thus causing an important loss of price transparency. This could prevent the settlement of a large quantity of financial contracts. I describe this threat in more detail in Section 3 of my report.
- v. One or more financial services firms could fall prey to a successful cyber attack that results in a crippling loss of accessibility by customers to their assets.

43. **Large or widespread sudden forced liquidations: “firesales.”** A firesale is a sudden large and urgent demand to sell assets. Because of its suddenness, a firesale can cause the price of a class of assets to drop significantly below the level that would apply in an orderly market. The sudden drop in market prices caused by a firesale can lead to large losses of investor wealth and distortionary reductions in secondary market transparency and liquidity. A firesale could be triggered by insolvencies, threats of insolvency, loss of liquidity, or leverage-induced unwinds. Unwinds can be instigated by sudden price drops, increases in volatility, or increases in margin requirements.⁴⁵ A systemically consequential firesale can be conducted by one large market participant, as was the case with the Drexel junk-

⁴³ See Duffie (2015).

⁴⁴ See Hay Davison (1988) and Cornford (1995).

⁴⁵ On the effect of changes in margins and haircuts on financial stability, see Fontaine and Garcia (2009), Committee on the Global Financial System (2010), and Kamhi (2009).

bond unwind⁴⁶ and the collapse of Long Term Capital Management, or by a wide segment of smaller market participants.⁴⁷ Through the price impacts induced by a firesale, the creditworthiness or liquidity of significant financial intermediaries can be threatened, which in turn can lead to a full-blown financial crisis.

44. **Flash crashes.** The provision of liquidity to exchange-based markets could suddenly deteriorate. For example, high-frequency trading algorithms, breakdowns in cross-platform linkages, or delays in reliable transaction data feeds could cause liquidity providers to suddenly and dramatically withdraw from making markets. For example, Aldrich, Grundfest, and Laughlin (2016) find that delayed data feeds were the most likely cause of the “flash crash” that occurred in U.S. equity markets in April 2010.
45. **Loss of market trust.** The loss of credibility for a practice, product, or financial service provider can cause market participants to draw back from their use of some part of capital markets, with consequent costs to themselves and market liquidity. An important loss of market trust could arise, for instance, through the loss of credibility of a major financial benchmark due to manipulation. This could lead investors to refrain from entering new contracts that reference the benchmark, or could cause those submitting data that determine a benchmark fixing to pull back from this responsibility out of fear of legal or reputational costs. As another example, the loss of credibility in 2007 of Canada’s asset backed commercial paper, which I have described, caused the failure of essentially the entire non-bank ABCP market.
46. Systemic risks that are less relevant to Canada include threats of monetary instability (such as hyper-inflation), sovereign debt crises, and extreme capital

⁴⁶ See Brewer and Jackson (2000).

⁴⁷ Some have suggested that systemic risk is present from the potential for a wave of investor redemptions of bond mutual funds and exchange traded funds.

flight, as occurred during the Asian debt crisis of 1987-88. These threats are more often associated with emerging-market economies.

The costs and propagation of systemic risk events

47. I now turn to the costs and propagation of systemic risk that occur when the risk actually materializes.

Costs

48. The most important costs to the general economy associated with systemic risks that materialize into actual systemic events are the consequent reductions in consumption, employment, and real investment. These costs stem from (i) direct losses of savings and other forms of financial wealth, leading to reduced spending and investment, and (ii) precautionary reductions in investment and spending behaviour induced by heightened uncertainty or reduced expectations for future economic performance.
49. What ultimately matters is the economic well-being of individuals, normally measured by economists in terms of current and future consumption levels, and the costs to individuals of increased uncertainty over their future well being. Voluminous economic research shows the heavy toll to individuals of bearing economic risk and uncertainty. Section 1 of my report summarizes Canada's significant loss in economic output and jobs during the financial crisis of 2007-2009.
50. One should make a distinction between costs that are directly due to systemic malfunction within the financial-services sector, versus costs that may materialize in tandem with a financial crisis due to the revelation of "bad news" about the aspects of the macroeconomy that had been present before the crisis, but had been obscured or ignored. These "baked-in" bad facts may include excessive indebtedness of operating companies, governments, or home owners, which may have unsustainably *raised* economic output in advance of the crisis. Systemic risk regulations, including measures proposed in the CMSA, do not directly address

these sorts of macroeconomic weaknesses, but do address the ability of the financial system to remain functional when hit by macroeconomic shocks. Continuity of the stable performance of Canada's capital markets is crucial to the resilience of the real economy in the face of macroeconomic shocks.

Event Propagation

51. Once a systemic threat is manifested in an actual event such as a major financial default, operational outage, or firesale, run on a financial intermediary or product, or sharp withdrawal from participation in a market, the resulting cost to the general economy can be magnified by various forms of event propagation.
52. For example, if a major exchange or clearinghouse is unable to operate, market participants lose the opportunity to adjust their portfolios or obtain liquidity. As a result, they may suffer significant direct opportunity costs or increased risk. Many investors may liquidate their positions at the first opportunity (or liquidate other assets), contributing to a firesale that causes a potentially severe fall in the prices of many debt and equity securities, and thus an increase in the cost of capital for firms, and loss of investor wealth.
53. As another channel of event propagation, significant failures of banks or "shadow banks" (such as securitization firms, money market mutual funds, hedge funds, or repo market participants) can lead to a costly reduction in the provision of credit to the general economy. Through this channel, for example, bank failures exacerbated the Great Depression (Bernanke, 1983).
54. When major financial firms suddenly fail, thus restricting credit to the general economy, investment and employment by operating companies can be placed on lower (or negative) growth paths. General actors throughout the economy may consequently reset their expectations for future wages, employment, and asset payoffs, triggering a negative feedback loop through further reductions in asset valuations. These feedback effects are magnified, as explained above, by

leverage-induced unwinds and firesales, and can sometimes lead to the failures of additional major financial intermediaries.

55. Major bank failures could also seriously disrupt the transmission of the central bank's monetary policy through the bank lending channel (Bernanke and Gertler, 1987). This can lead to problems with controlling inflation. The economy could, as a result, enter a deep recession.
56. Another potential channel of transmission of systemic risk events is a chain-reaction of defaults at the core of the financial system. While such a "dominoes" effect is indeed possible in extreme scenarios, the more common channel of transmission of system risk is through reduced access to financial services, especially through sharply reduced provision of credit and liquidity, whether to actors within or outside the financial system.⁴⁸ The failure of a single major bank, clearinghouse (or other critical financial market infrastructure), even if it does not cause the failure of another financial entity, could trigger significant real economic costs.

⁴⁸ Sujit Kapadia, Senior Manager in the Prudential Policy Division at the Bank of England, argued that that it is important to look at the more indirect channels that reflect "liquidity risk—where banks withdraw their funding from each other—as well as fire sales or pure fear-driven contagion linked to uncertainty." Focusing on counterparty risk and defaults alone is insufficient "because a lot of the contagion and externalities occur before the point of default." See Minoiu and Sharma (2014). For other examples, the U.S. Savings-and-Loan Crisis of the 1980s (White, 1992) and the "quant-equity meltdown" of August 2007, although systemically threatening and costly, did not ultimately cause a severe loss of functionality of other parts of the financial system. In August 2007, there was a "rush for the exits" among a number of asset managers using "quantitative equity" (also called "quant-equity") strategies. These strategies take long and short positions in publicly traded equities based on quantitative models. The unrelated losses of some alternative asset managers with heavy quant-equity exposures caused them to significantly and quickly reduce the sizes of their quant-equity positions. The resulting price impact on quant-equity positions was severe enough to cause some other asset managers to quickly liquidate significant portions of their own quant-equity positions. This uncoordinated and self-fulfilling prophecy of a "crowded trade" resulted in heavy losses for some asset-management firms that had significant quant-equity exposure. These losses ranged from 5% to 30%, as documented by Khandani and Lo (2007). Although I would not describe the outcome of quant-equity meltdown as a systemic event, it was a shock large enough to generate a systemically important event under circumstances in which many large alternative asset management firms had excessive leverage.

57. Chain-reaction defaults at the core of the system, while indeed an important threat when untreated, are normally halted by a mobilization of capital or liquidity from the government or central bank. Chart 3 of Lane (2013) shows the extensive liquidity support provided by the Bank of Canada during the financial crisis of 2007-2009, at times exceeding \$35 billion dollars. Lane (2015) remarks that “As a result of these actions, Canada’s core funding markets stayed open, and credit kept flowing to the private sector.”
58. Aggressive government or central bank intervention, while necessary during a period of financial instability, may encourage excessive risk taking leading up to a crisis, a phenomenon known as “moral hazard.” This is an obvious factor in support of robust systemic-risk regulation.
59. **Defensive hoarding of capital and liquidity, and panic.** Extremely grave financial crises are often magnified when insolvencies or near insolvencies lead providers of short-term credit to hoard their cash liquidity. Their panic-based fears, or rational calculation that others may act similarly to themselves, can cause a self-fulfilling prediction of a collapse in the supply of credit to a large segment of capital markets. During the U.S. financial crisis of 2007-2009, for example, Gorton and Metrick (2012) describe a run on asset-backed securities. Squam Lake Group (2010) reviews the run on U.S. prime money market funds that occurred when the Reserve Primary Fund was unable to redeem shares at “par value” because of losses incurred at the failure of Lehman. Although there were no announcements of any such losses by other money market funds, large sophisticated investors in these funds did not wait for any such bad news. In a defensive run, they suddenly redeemed approximately \$400 billion dollars of their investments in prime money market funds, over 25% of this entire segment of money markets. In Duffie (2010), I describe how this run on money funds would likely have continued and caused the collapse of the largest U.S. broker dealers had the U.S. Treasury not stopped the run by offering a guarantee to all money market funds.

60. Canada had a somewhat related experience with its own asset-backed commercial paper (ABCP) market. Chapman, Lavoie, and Schembri (2011) write that “The non-bank Canadian ABCP conduits that were affected during 2007 provide a prime example of how a liquidity crisis can unfold with MBF [Market Based Financing]. In that case, maturing instruments were not rolled over into new issues as investors became more aware of, and concerned about, the potential risks.” Christensen, Kumar, Meh, and Zorn (2015) analyse the propagation of this crisis in Canada’s ABCP market in 2007, explaining that “The crisis was triggered by investor concerns about U.S. subprime mortgages and the structured products backed by such mortgages. ABCP programs, by design, lead to significant maturity mismatches, since long-duration assets are funded by short-term paper, which creates the potential for rollover risk that is typically mitigated by a liquidity backstop. Of the \$116 billion of outstanding ABCP at the end of July 2007, \$81 billion was sponsored by major Canadian commercial banks, while the rest (\$35 billion) was third-party (non-bank) ABCP with liquidity backstops, largely from foreign banks. ... Stress in the ABCP market led ABCP conduits to draw on backup liquidity from sponsoring banks as investors started demanding redemptions. This created short-term funding pressures in the banking sector, resulting in contagion and the repricing of risk across domestic short-term funding markets.”
61. Traditional bank credit provision, while not a capital-markets service, can also suffer from the spill-over effects of capital-markets losses of banks.⁴⁹

⁴⁹ Chant (2003) writes that “Experience with bad loans and the weakened condition of borrowers may make financial institutions less willing to provide new loans. They may also restrict credit to their existing borrowers or charge them higher interest to reflect their perception of heightened risk.”

Feedback between financial markets and the real economy

62. Systemic risk can also propagate through feedback effects that travel back and forth between capital markets and the real economy. For example, excessive or poorly monitored housing or commercial mortgage credit, granted to the extent that a significant fraction of mortgages may fail to perform, could cause mortgage lenders to suffer major losses. This, and the threat of additional losses, can lead these creditors to further restrict the provision of credit. This could lead to lower property prices, inducing additional mortgage failures, and thus an adverse feedback loop that could reduce the provision of credit on a broad basis.
63. A broad failure of residential mortgages instigated the propagation of systemic risk during the U.S. “sub-prime crisis.” The U.S. sub-prime crisis also included the transmission of shocks within capital markets, through the failures of large financial institutions, securitizations, money market mutual funds, and off-balance-sheet financial vehicles. The crisis would have been much more severe had the government and central bank of the United States not stepped in with significant capital and liquidity support to the financial sector. According to the Bank of Canada (2015), the largest current threats to financial stability in Canada are the “elevated level of household indebtedness, and imbalances in the housing market.”
64. Historically, and globally, non-performing real-estate credit is a common source of financial instability. In the early 1990s, Canadian commercial property prices fall almost 40 per cent. Canadian banks and trusts suffered large loan losses as a consequence. Currently, according to the Bank of Canada (2015),⁵⁰ exposure to

⁵⁰ “The most important domestic financial system risk remains a severe recession and a sharp, widespread rise in unemployment that reduce the ability of households to service their debt, causing a broad-based decline in house prices. The most likely trigger is a large, negative demand shock. ... Should this risk materialize, the impact on the broader Canadian economy would still be quite large. The capacity of the financial system to offer credit and liquidity would suffer as banks and other financial institutions took steps to manage their exposures in the face of increasing defaults and more difficult funding conditions, with further negative implications for economic activity.” Bank of Canada, Financial

residential housing credit represents “the most important domestic financial system risk.”

65. Although systemic risk can arise locally, for example from excessive indebtedness in a metropolitan real estate market, truly systemic financial crises are rarely contained locally. Because of the high degree of integration of capital markets that I described earlier in this report, when a local crisis is serious, the crisis usually propagates at least nationally (as with the Sweden’s banking crisis⁵¹ of the early 1990s), if not internationally, as with the Asian debt crisis⁵² of 1997-1998, the global financial crisis of 2007-2009, and the European sovereign debt crisis⁵³ of 2010-2012.
66. As I have emphasized, capital markets and the macroeconomy evolve over time in a manner that presents changing, new, and difficult to predict threats to financial stability. What had long appeared to be a stable set of capital markets can present surprise instabilities. This calls for vigilant regulation and supervision of the entire financial system, attempting to identify and control the most important new threats to stability as they arise.
67. Regulators should therefore equip themselves with the best possible tools to “connect the dots,” which requires a broad and holistic supervisory framework and extensive access to data. Due to the inherently unpredictable nature of financial

System Review, December 2015, pp. 22-23. “The rise in household debt driven by the growth of mortgage credit both supports and is fuelled by ongoing increases in house prices. Elevated house prices, particularly when accompanied by high leverage, can be a financial system vulnerability. For example, a downturn in house prices could undermine collateral values and result in losses for both lenders and mortgage insurers if the borrower defaults.” Bank of Canada, Financial System Review, December 2015, p. 15.

⁵¹ See Englund (1999).

⁵² See IMF Staff (1998).

⁵³ See Alter and Beyer (2013).

crises, however, this is not enough. Threats can arise from unexpected directions. Regulators must also be prepared to act decisively on short notice, for example with failure-resolution powers or innovative forms of central-bank liquidity, among many other unforeseen measures. The urgent-measures powers of the proposed CMSA therefore serve an important role.

When is financial regulation not about systemic risk?

68. Systemic-risk issues are often distinct from the concerns of “day-to-day” capital markets regulation, the most important of which are related to financial conduct, investor protection, and market efficiency concerns that do not often threaten financial stability. These concerns, which are addressed by a wide range of financial regulations, include, among many others:
- i. Investor and consumer protection. Concerns here include, among others, front running, loss of privacy, fair disclosure, protection of ownership title records, impeded access to assets, and provision of inappropriate or unfairly priced products and services.
 - ii. Insider trading. Investors with material non-public information pertinent to the likely value of a security may take unfair advantage of other investors by trading before that information becomes public. Aside from fairness concern, markets are less efficient if investors refrain from trade out of fears that they may suffer from exploitation by insiders.
 - iii. Market manipulation, whether through misinformation or manipulative trading practices. The resulting price distortions can cause unfair losses to other investors, and inefficiencies in the allocation of the affected asset.

- iv. Anti-competitive behaviour in the provision of financial products or services.⁵⁴

The illegal exercise of market power, for example through collusion, can unfairly and inefficiently inhibit trade and deter entry into the market of better products and services.
 - v. Weak pre-trade or post-trade price transparency. If investors are unaware of the “going price” for an asset, they may inefficiently hold back from trade, or be exploited by dealers. Regulation can therefore promote an improvement in market efficiency by forcing the publication of bid, offer, and transaction prices.
 - vi. Insufficient margin or capital. Margin refers to the amount of collateral provided by an investor to back the investor’s promised performance. Financial intermediaries are normally required to maintain a safe amount of capital relative to the amount and riskiness of their assets. In both cases, regulations reduce the risk of loss to creditors.
69. Regulatory treatments for day-to-day conduct or efficiency concerns include codes of conduct for financial services firms and personnel; registration of financial services providers and their personnel; minimum requirements for liquidity, margin, or capital (for both products and intermediaries); supervision of practices, products and services, and service providers; and registration and disclosure requirements for public securities; among many other regulations, including laws that are not specific to the financial system, such as those pertaining to general fraud, anti-competition, and malicious destruction of property (for example, cyber attacks).
70. Many jurisdictions, including Canada and its provinces, rely heavily on so-called self-regulatory organizations (SROs) for some day-to-day financial regulation. In

⁵⁴ See Bank of England (2015).

most cases, SROs are not equipped for, nor have incentives that are fully aligned for, systemic risk regulation.

71. As I have emphasized, because the financial system can sometimes be threatened suddenly, the regulation of systemic risk under laws such as the proposed CMSA should allow for emergency intervention (presumably under “urgent orders” or “urgent regulations”) by cognizant federal authorities whenever financial stability is seriously threatened (or has already materialized) at the national level, *including* through events arising from practices, products, and entities that are normally covered by “day-to-day” regulations.
72. For instance, there could arise cases in which exchanges have operational failures requiring urgent orders, for example mandating trading halts or alternative trading arrangements. The nature of any such urgent order is, by definition, difficult to foresee, but extreme and unpredictable events do happen, however rarely, and may require decisive and novel action to protect the real economy from heavy losses.

Microprudential versus macroprudential regulation

73. The regulation of financial risks facing narrow segments of investors, for example the depositors of an individual financial institution or the clients of a dealer, are often called “microprudential.” In contrast, as explained by Borio (2003), the supervision and regulation of risks that threaten the broader financial system are called “macroprudential.”
74. Microprudential matters can normally be covered by “day-to-day” regulation. In some cases, however, microprudential concerns rise to the level of broad systemic risk, through sufficiently severe or sudden degradation in the integrity or functionality of individual products, financial service providers, or markets. I have given many examples of how this may occur. Controlling the threat of elevation of “day-to-day” risks to a system-wide threat level requires close cooperation,

including information sharing, between microprudential and macroprudential authorities. In my experience, information sharing among financial regulatory authorities that depend for crucial information on communication with each other has often been a difficult challenge.

75. Regulation of margin and capital requirements is an area in which important distinctions between appropriate microprudential and macroprudential regulation are apparent. Microprudential margin or capital requirements are typically designed to protect the depositors or counterparties of a specific financial intermediary or investor from loss. The microprudential approach to these regulations need not always be concerned with threats to the broader financial system and the soundness of capital markets, which can suffer from the spillover effects of the failure of one or more financial firms or financial products. The margin or capital requirements appropriate to broad financial stability may therefore be of a different nature, or more stringent.
76. For example, under new international “Basel III” capital accords, special add-ons are applied to the capital requirements of the largest financial institutions, specifically because of these spillover threats to financial stability. In the United States and Europe, special new systemic risk authorities are given extra supervisory and failure resolution powers over designated systemically important financial firms, beyond those covered by banking regulation. Likewise, new regulatory data repositories are being constructed specifically for the purpose of systemic risk oversight, beyond the data needed for microprudential supervision. Regulators are currently working on the potential need for margin requirements for derivatives and repos that adjust over time so as to treat systemic risk associated with changes in price levels or the riskiness of capital markets.
77. Powers to take urgent measures that are provided under the proposed CMSA might someday be needed to make adjustments to margin or capital requirements, whether to tighten them *or to relax them*, relative to levels deemed appropriate

under normal macroprudential or microprudential standards. While it might seem superficially counter-intuitive that a threat to financial stability could be mitigated by an urgent requirement to relax a margin requirement, one may consider a scenario in which financial intermediaries or clearinghouses are defensively raising their own margin requirements in order to protect themselves from a perception of rising risks. Normal regulations stipulate minimum margin levels, and would not prevent this defensive action. When margins are raised sharply enough, however, systemically important investors can face a sudden liquidity crunch. They can become destabilized, or forced to sell assets and contribute to a growing firesale of the asset class in question, causing a crisis to ensue or become magnified. Similarly, at the onset of a stress to capital markets, normal levels of regulatory capital or liquidity-coverage requirements may prevent dealers or banks from providing the amount of short term credit to their clients that might stabilize markets. An urgent requirement to relax these capital or liquidity rules may be deemed appropriate.

78. Of course, if normal margin or capital requirements are not sufficiently high, any such urgent relaxations of minimum requirements may cause more harm than good. Authorities must be equipped with the expertise and data necessary to realize when and how they should take decisive action.
79. In other situations, growing threats to financial stability arising from changing practices or products may imply that higher or different forms of capital, liquidity, or margin requirements are appropriate, and these might be effected under urgent measures.
80. Although Canada has had a relatively benign history with financial crises relative to other advanced economies, material threats to Canada's financial stability have existed from time to time, and still exist. When regulating for financial risk, moreover, it is crucial to bear in mind that financial systems change over time. Without vigilant macroprudential regulation of the financial system as a whole,

practices or products that are covered by day-to-day regulation and have been considered systemically benign can morph or grow in popularity, and come to threaten instability. Further, the network of inter-dependencies in the financial system can change. Risks can travel through the system in previously unexpected forms or directions.

81. An obvious example that arose in October 2008 is the co-dependence of money-market mutual funds, securities dealers, and securities financing infrastructure. (I briefly reviewed this event in the previous section, and provide more detail in the next section.) It was only when Lehman failed that U.S. regulators suddenly came to understand the critical inter-dependencies that had built up over previous decades among these key elements of the core of their financial system. Somehow, the U.S. Federal Reserve and the U.S. Securities and Exchange Commission had not acted in sufficient concert with each other to identify and control this grave risk.
82. In summary, macroprudential regulation is unlikely to be effective in maintaining financial stability if it does not cover the national financial system in a holistic manner that is able to detect and treat changes in systemic risk.

III. Selected Areas of Proposed CMSA Authority

83. This section discusses the relevance to systemic risk of three specific proposed areas of authority under the CMSA that I was asked to consider, and which fall within my expertise: (i) financial benchmarks, (ii) repurchase agreements and securities lending agreements, and (iii) money market mutual funds.

Financial benchmarks

84. Financial markets make use of a wide array of benchmark indices, including widely referenced interest rates, commodity prices, and foreign exchange rates. Reliable financial benchmarks serve a number of important functions in the financial system.

85. First, the price transparency afforded by a reliable benchmark improves the ability of market participants to conduct comparison shopping. This is crucial in over-the-counter markets, where low price transparency gives dealers an incentive to quote wide bid-offer spreads, thus discouraging some socially beneficial trading.⁵⁵
86. Second, benchmarks allow the customers of financial services firms to more easily estimate their delegated execution costs. For example, by observing the WM/Reuters FX fixing on a given day for the price in Canadian dollars for the Euro, the chief financial officer of a Canadian corporation can check whether his or her firm got reasonable execution for its purchase of Euros.
87. Finally, benchmarks serve as settlement devices for related financial instruments. Relying on a reference rate such as CDOR, for example, Canadian banks and derivatives exchanges can provide market participants with a rich set of floating-rate products, such as mortgages, corporate loans, swaps, forwards, futures, swaptions, caps, and floors.
88. A systemic problem can arise, however, from the temptation to manipulate a benchmark in order to benefit from a position in a referencing financial contract. This temptation is proportional to the sizes of positions that exist in the referencing product market. For example, an investor with a total notional interest-rate swap position of \$10 billion could profit handsomely if the referenced interest rate is adjusted by only a basis point or two.⁵⁶ As explained in an appendix to this report, the quantity of transactions referencing Canada's interest-rate benchmarks is quite

⁵⁵ Even dealers, as a group, are better off in many cases by committing to a benchmark, because this encourages trading activity. In fact, groups of dealers have voluntarily introduced most of the benchmarks that we have today, including those covering many commodities, foreign exchange prices, and interest rates. See Duffie, Dworczak, and Zhu (2015).

⁵⁶ See Duffie and Stein (2015).

large relative to the amount of transactions in the underlying borrowing market that determines the benchmarks.

89. Manipulations can occur either from distorting transactions in the underlying market that determines a benchmark fixing, or by corrupting the judgment applied by submitters of data or opinions that are used to determine fixings. Both of these methods of manipulation are relatively easy if the underlying market used to fix the benchmark is thinly traded, and both have been used in practice.
90. There are plausible scenarios in which a weak financial benchmark could become a serious systemic threat. First, in light of concerns over manipulation, low transparency, or the eventual ability to produce a reliable benchmark, many market participants could begin to worry that their contractual positions might some day cease to be legally or accurately settled. They could begin to withdraw from the market. Without good alternatives, market efficiency could be seriously impaired. If this happened abruptly, there could even be a firesale. Alternatively, banks or others responsible for submissions to benchmark fixings could become frightened of the reputational risk or threat of legal liability. They might pull back from providing submissions. Withdrawals from the group of banks making submissions to EURIBOR became severe in the wake of manipulation scandals, and were stopped only when significant moral suasion was applied by regulators.
91. As remarked by Bank of Canada Deputy Governor Tim Lane,⁵⁷ “Here at home, better articulated governance arrangements for CDOR and other important financial benchmarks will contribute to greater financial stability.”

⁵⁷ See Lane (2014).

92. Recently, The United Kingdom⁵⁸ and Japan introduced statutes that provide for the regulation of key benchmarks and benchmark administrators. The European Union (EU) has also proposed comprehensive benchmark legislation and regulation.⁵⁹ The United States has refrained from doing so.

Key Benchmarks in Canada

93. Canada has two key interest-rate benchmarks: the Canadian Dollar Offered Rate (CDOR) and the Canadian Overnight Repo Rate Average (CORRA).
94. CDOR is the benchmark rate on bankers' acceptances (BAs) with maturities of less than a year. CDOR determines interest payments on approximately 130 billion CAD in floating rate notes, 9.3 trillion CAD in CAD interest rate swaps, and over 750 billion CAD in exchange-traded derivatives.⁶⁰ CDOR is fixed by a daily survey of the 7 largest participants in Canada's market for bankers acceptances.

⁵⁸ In its findings in support of placing a number of benchmarks within a new framework of legislation and regulation, in 2014 the Bank of England, expressed the following view. "Given the widespread use of benchmarks in financial contracts, it is vital that consumers and market participants are confident that benchmarks – particularly those that lie at the heart of systemically important markets – are credible, trustworthy and accurate. The credibility of a benchmark can be undermined if the benchmark can be distorted, either by accidental errors in its compilation or calculation, through the exposure of participants to conflicts of interest or incentives to manipulate the benchmark, or through abuse of a dominant competitive position in the compilation of a benchmark. ...The objectives of benchmarks regulation, generally, are therefore to ensure that, when financial activities come to depend significantly on a benchmark, protections are available to deal with risks associated both with the mechanism for producing the benchmark and with the data that go into the benchmark." See Bank of England (2014).

⁵⁹ In describing the EU's proposed financial-benchmark statutes and regulations, the Secretariat of the European Union Council (2015) wrote: "The failure of critical benchmarks may impact financial stability, market integrity, the financing of households and corporations, consumers or the real economy. Those potentially destabilising effects of the failure of a critical benchmark could be felt in a single Member State or in more than one. It is therefore necessary that this Regulation provides for a process to determine those benchmarks that should be considered critical benchmarks and that additional requirements apply to ensure the integrity and robustness of such benchmarks." (Paragraph 30, page 24.) Once in force, EU benchmark regulations will supplant those of individual EU countries, including the U.K.

⁶⁰ See Lane (2014).

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95. CORRA is a “risk-free” reference rate. Specifically, CORRA is a measure of the average overnight financing rate on repos collateralized by government securities.⁶¹ An Overnight Index Swap (OIS) market based on CORRA has existed in Canada since⁶² the late 1990s.
96. CDOR and CORRA are both calculated by Thomson Reuters, the official benchmark administrator appointed by the CDOR Working Group. More details on the governance of these benchmarks are provided in Appendix 1.
97. The Bank of Canada posts on its website indicative foreign exchange (FX) rates, based on market transactions and quotes for currency pairs involving the Canadian dollar. Although these exchange rates are provided for informational purposes, some firms nevertheless use them as a benchmark for settlement of some financial contracts.⁶³ To my knowledge, there is no associated federal law or regulation that restricts this practice, nor one that provides for official supervision of the practice, whether with respect to the FX rate reported by the Bank or any other published foreign exchange rate.
98. Participants in Canada’s financial markets also depend heavily on benchmarks set in foreign markets. These include LIBOR, EURIBOR, and WM/Reuters FX benchmarks, and many commodity benchmarks (such as those for gold and oil).

⁶¹ CORRA is calculated as the volume-weighted average rate of actual overnight repo transactions collateralized by Government of Canada securities that are conducted on-screen through designated inter-dealer brokers between 6:00am and 4:00pm ET on the date of the fixing. See Twomey, B. (2011). Inside the Currency Market: Mechanics, Valuation and Strategies. John Wiley & Sons. Relevant pages retrieved from

https://books.google.com.sg/books?id=eZ1OkXT3_sgC&pg=PT95&lpg=PT95&dq=canadian+overnight+repo+rate+calculation+6:00am&source=bl&ots=uAHqXLmFWg&sig=Ne5Xt_Afbfxwj6sWWGWqVqCyNFU&hl=en&sa=X&ved=0ahUKEwjg2Y6muvjJAhXXWo4KHU49C2wQ6AEIJTAC#v=onepage&q=canadian%20overnight%20repo%20rate%20calculation%206%3A00am&f=false

⁶² See Financial Stability Board (2015).

⁶³ A press account is given by Altstedter (2014).

All of these have experienced important bouts of manipulation. Canadian regulators have recently participated in international forums⁶⁴ for the reform of global interest-rate and foreign-exchange benchmarks. (My role in the reform of interest-rate benchmarks is briefly described in Section 1.)

99. The governance setting for financial benchmarks in Canada is fragmented. Standards, codes of conduct, and various sorts of oversight of benchmarks and necessary data collection involve the Investment Industry Regulatory Organization of Canada (a “self-regulatory” industry body), the Bank of Canada, and the Office of Superintendent of Financial Institutions. Some of the recent history of their respective roles is provided in Appendix 1. No entity has jurisdiction over the regulation of benchmarks. The proposed CMSA will address this gap in the regulation of benchmarks.
100. Because Canada’s financial benchmarks are critically important to the performance of the financial system as a whole, and represent a potential source of systemic risk, it would be more effective to designate and regulate key benchmarks in a more unified system-wide national manner.

Securities financing transactions: repos and sec lending

101. The most common forms of securities financing transactions are repurchase agreements (“repos”) and securities lending (“sec lending”) agreements.
102. Repos are transactions that combine the immediate sale of securities with a commitment to repurchase the same securities from the original counterparty at a pre-agreed price on a specific future date. Aside from some legal distinctions related to counterparty insolvency (reviewed in Appendix 2), a repo can also be viewed as a loan collateralized by the underlying securities. Indeed, repos are

⁶⁴ These include, at the Financial Stability Board, the Foreign Exchange Benchmark Group and the Official Sector Steering Group, for reference rate reform.

frequently used to finance an investment in securities by using those same securities as collateral.

103. A “reverse repurchase” is merely the transaction conducted by the counterparty to a repurchase agreement. Reverse repos are frequently used to invest cash. Reverse repos can also be used to obtain short term access to specific securities. For example, a bond market intermediary such as a major bank may have a client who wishes to buy specific securities. The bank may conduct a reverse repo with a third party in order to obtain the securities for its client more rapidly than could be arranged by finding a direct seller of the securities. Reverse repos thus improve the liquidity of the market for the underlying assets and expand the accessible supply of the assets.
104. Reverse repos are also used to conduct short sales. In this case, the securities obtained on the opening leg of the repo are immediately sold to a third party. In order to return the securities at maturity to the original repo counterparty, the short seller must then buy the securities in the cash market. The short seller profits if it is able to buy the securities back at the maturity of the repo at a price below the original sale price. Access to short selling opportunities through the repo market improves the efficiency of capital markets by improving price discovery (allowing the price of the asset to more easily and quickly reach its fundamental fair value). Short selling through the repo market also improves risk management, by allowing investors and dealers to more effectively hedge their investment positions in one asset with short positions in closely related assets.
105. Securities lending transactions are economically and legally similar to repurchase agreements, and are sometimes used as a substitute for repos. As with a repo, a securities lending transaction is a trade between a cash investor and a provider of collateral securities who receives the cash at the inception of the trade and returns the cash with interest at the completion of the trade. At the completion of the trade,

the collateralizing security is returned to its provider. Securities lending agreements are often used to effect a short investment position.⁶⁵

106. Securities financing transactions are crucial to the well-functioning of modern capital markets, particularly markets for actively traded bonds, including therefore government bond markets. Recent bouts of settlement failures in U.S. treasury markets,⁶⁶ for example, are in my opinion likely to be exacerbated by reduced intermediation incentives in U.S. repo markets. Major investors and intermediaries rely heavily on the repo market for financing, hedging, speculation, and intermediation of securities.
107. Table 1 summarizes quarterly trading volumes in Canada's repo markets, by type of collateral, during the first three quarters of 2015, along with volumes of secondary market trading. The volume data in Table 1 clearly reveal a heavy reliance by the market for Canada's government securities on liquidity provided by the repo market.

Systemic Risks

108. Canada's repo market has been identified by the Bank of Canada as a "core funding market,"⁶⁷ implying that it is an important source of funding for institutions at the center of the financial system, and a source for which there is often no immediate substitute.⁶⁸ Systemic risks that materialize in the repo market therefore have a high probability of propagating throughout the core of Canada's capital

⁶⁵ Once the cash investor receives the security as collateral, it can be immediately sold. This generates a shortsale profit if the price of the security declines before it must be bought in the market and returned to the security lender.

⁶⁶ See Fleming and Keane (2015).

⁶⁷ See Côté (2012).

⁶⁸ See Zorn and Garcia (2011).

markets. Correspondingly, the Bank of Canada has designated Canada's largest clearing house for repos, the Canadian Derivatives Clearing Service (CDCS), under the Payment, Clearing and Settlement Act.⁶⁹

109. During the 2007-2008 financial crisis, which preceded the development of a central counterparty for Canada's repo transactions, the repo market encountered periods of illiquidity, with some providers of cash under reverse repurchase agreements attempting to reduce their credit exposures. This created funding pressures. Amounts of financing obtained in the repo market were rapidly reduced. Banks curtailed their repo activity, leading to decreased liquidity and market turbulence across the entire financial system.⁷⁰

Table 1. Quarterly trading volumes in Canada's repo and cash bond markets⁷¹

Type of Collateral	Repo	Trading
Government of Canada bonds	22,757.4	5,624.8
Federal Crown Corporation bonds	4,899.4	441.9
Provincial bonds	3,027.8	779.8
Corporate bonds	57.6	166.2
Municipal bonds	5.8	14.2

⁶⁹ See "Regulatory Oversight of Designated Clearing and Settlement Systems," Bank of Canada, at <http://www.bankofcanada.ca/core-functions/financial-system/oversight-designated-clearing-settlement-systems/#responsibilities>

⁷⁰ See Chatterjee, Embree, and Youngman (2012).

⁷¹ Data source: Investment Industry Regulatory Association of Canada (2015b,c). The data are based on trading by IIROC's dealer members.⁷¹

Bank, Trust, and Mortgage company securities	35.3	200.4
Asset-backed securities	332.9	69.1
Maple and other domestic bonds	34.0	17.4
Strip bonds	30.8	49.3
Government of Canada Treasury bills	1,491.4	1,002.1
Provincial securities	36.8	322.4
Total (\$ billions) in Q1-Q3 2015	32,709.2	8,687.6

110. The very unlikely, but nevertheless plausible, event of the failure of CDCS is a clear systemic risk. Risks to CDCS arise primarily from the potential for default by one or more clearing members and from liquidity risk, especially given its intraday liquidity requirements.⁷² Central counterparty failures, and even severe threats of failure, are rare, but have occurred.⁷³ The risk of failure of central counterparties, and failure resolution, are active topics in current regulatory discussions globally.
111. Although the CDCC is currently effective at controlling the systemic risk emanating from the repos that it clears, over 80% of Canada's repo market is not centrally cleared. This "bilateral" segment of the market is where most of the risk resides. Unfortunately, as in many other countries, Canada's bilateral securities financing market is opaque. A recent survey conducted by the Financial Stability Board (2015a) reveals that relatively little data are available, even to Canada's regulators,

⁷² Ibid.

⁷³ Kiff (2014).

regarding counterparty exposure, the types of securities used, and concentration of positions across counterparties, among other potential systemic-risk measures.

112. As I have explained, the proposed CMSA could provide useful new regulatory powers to address financial-stability concerns arising in repo markets, for example through the ability to increase or reduce margin requirements. Powers under the CMSA might also include the ability to mandate central clearing for designated types of repos or users of repo markets. Other potential measures include the development of relatively comprehensive repo data repositories that could be used by regulators to monitor the emergence of concentrations of counterparty risk, or weak risk management practices.
113. For the reasons that I have described, a loss of functionality of Canada's repo markets, including a failure of its repo central counterparty, would represent a clear and direct systemic risk to the economy. Although the probability of a major failure of Canada's repo market is currently likely to be low, there is a lack of transparency. Moreover, the impact of a failure or of loss of market functionality is easily high enough to warrant systemic risk oversight under the CMSA.
114. An example of severe systemic risk emanating directly from weaknesses in repo market structure was revealed in 2008. At that time, two system-critical tri-party repo agent banks provided roughly \$2.5 trillion in intra-day credit to a handful of major U.S. securities dealers. Under plausible circumstances, the failure of a major dealer could have caused an enormous fire sale, or even the failure of a tri-party agent bank, either of which could have brought down the core of U.S. capital markets.
115. Beyond the direct threats posed by a failure of repo markets or repo-market infrastructure, repo markets are a key channel of transmission of financial stress to and from other systemically important markets, especially during a financial crisis. For example, frailties in repo markets played a key role in the global financial

crisis of 2007-2009, as explained⁷⁴ by Duffie (2010) and Gorton and Metrick (2012). For examples:

116. The risk of Lehman's failure caused its tri-party repo agent bank, J.P. Morgan Chase, to suddenly pull back from offering access to the repo liquidity that it had been providing to Lehman.
117. Losses incurred through investments in Lehman by a large money market mutual fund, the Reserve Primary Fund, caused a broad and severe run on the entire sector of U.S. prime money market mutual funds. Redemptions in these money market mutual funds threatened to starve U.S. securities dealers for short-term credit.
118. In Canada, repo is only a moderately important source of funding for large banks. Nevertheless, Gravelle, Grieder, and Lavoie (2013) caution that "shifts in the composition of the collateral used, or in the maturity breakdown of transactions, need to be monitored over time. In addition, anecdotal evidence suggests that there is an increasing use of repos by some Canadian pension funds as a means to implement leveraged investment strategies. If this practice continued to grow, it could be a source of concern in times of market stress and is thus also an area worth monitoring."
119. As bank capital regulations reduce the appetite of banks to conduct securities financing transactions, non-banks may significantly increase their participation in these markets. This could raise systemic risk in a manner that would not be addressed under Canada's banking regulation. A broad national-market approach

⁷⁴ For additional details, see Krishnamurthy, Nagel, and Orlov (2014).

to regulating the systemic risk associated with securities financing transactions is suggested.

Money market mutual funds

120. A money market mutual fund (MMMF) is a mutual fund whose assets are held in liquid low-risk short-maturity debt instruments, such as cash, government bills, bank deposits, repos, commercial paper, and bankers acceptances. Money market mutual funds are used for both “wholesale” and consumer-level cash management. They are often used as a substitute for bank deposits, and are sometimes preferred over bank deposits because of their somewhat better credit risk diversification and higher yields, despite other potential concerns.
121. A major concern regarding the design of money market funds is the industry norm of a “stable” or “constant” net asset value (NAV), by which redemptions and purchases of money market funds can normally be done at a rounded number of dollars per share. Under U.S. regulations, the rounded per-share prices of MMMFs is normally one dollar. For Canadian constant-NAV MMMFs, the norm is a rounded-dollar-per-share price⁷⁵ of either \$10 or, sometimes, \$1⁷⁶.
122. If investors in a money market fund fear that the actual market value of the fund’s assets might soon drop below the normal rounded price, they have an incentive to redeem their shares immediately. This incentive to run is exacerbated by the knowledge that the first investors to run have less risk than those that follow, because initial redemptions at the rounded price dilute the claims of unredeemed shares whenever the actual NAV, in market value terms, is less than the rounded

⁷⁵ See Bythe (2012).

⁷⁶ See FAIR Canada (2010).

price.⁷⁷ A run can be further accelerated by a lack of transparency of the NAV and by fears that large sudden redemptions from a fund can only be met through a fire sale of its assets.

123. In 2009, amid fears that some Canadian money market funds would drop below the normal rounded price (an event called “breaking the buck,” or breaking the ten bucks”) some fund sponsors avoided the associated reputation risk⁷⁸ when they pre-emptively waived⁷⁹ their management fees. Support by a sponsor of off-balance-sheet shadow-banking products such as MMMFs can weaken the sponsor’s own creditworthiness, and is therefore a potential source of systemic risk whenever the sponsor is systemically important and may have suffered significant losses of its own, as discussed in more detail in Duffie (2010).
124. When the Reserve Primary Fund broke the buck through its exposure to Lehman’s default, net redemptions of U.S. prime money market funds soared to \$400 billion in the subsequent two weeks. This run was conducted almost entirely through redemptions by institutional investors, who are prone to run far more quickly than retail investors.
125. The potential for a run on money market funds is a systemic risk whenever the aggregate amount of assets held by MMMFs is large. A large fire sale of assets held by money market funds could destabilize the markets for these assets. In the event of a run on money market funds, moreover, systemically important borrowers that depend for liquidity on investments by money market funds, such as large securities dealers or banks, could suddenly lose access to a significant source of

⁷⁷ See Witmer (2012) for a comparison of the actual experience of runs, between MMMFs with stable (“constant”) NAVs and those with floating NAVs. Witmer’s results support theories that CNAV funds have experienced more rapid redemptions in stress scenarios than MMMFs without the CNAV design. The Squam Lake Group (2010), of which I am a co-author, provides additional discussion of this issue.

⁷⁸ See Won (2009).

⁷⁹ See Mikels (2009).

financing, as I explained earlier in the context of Lehman's failure in 2008. In tandem with the run on MMMFs, the U.S. commercial paper market essentially stopped functioning.

126. If large financial institutions rely heavily on lending by money market mutual funds for their liquidity, they might fail or at least suffer such liquidity stress that they cut back sharply on the liquidity they provide to others. In this scenario, this potentially systemic liquidity crunch might be eased by a flood of emergency central bank lending. This sort of extreme action by central banks is a last resort, however, both because it creates moral hazard and can also stigmatize banks that rely on it, thus exacerbating the concerns of private-market liquidity providers.
127. Because of the risks to financial stability caused by money market mutual funds that were revealed during the financial crisis, the U.S. Financial Stability Oversight Council (FSOC) identified the need for additional regulation of these funds by the Securities and Exchange Commission (SEC). The SEC subsequently substantially tightened its regulation of MMMFs, causing a major change in industry practice.
128. Canadian MMMFs have not had a major history of systemic risk concerns, at least in comparison with their U.S. counterparts. In particular, Canadian MMMFs weathered the crisis storms that occurred in Canada's asset-backed commercial paper (ABCP) market. The relatively low total amount of assets currently managed by Canadian MMMFs, below half of its pre-crisis level, also implies moderately low systemic risk. This does not, however, rule out the potential for future systemic threats. The use of MMMFs in Canada could increase or change, presenting new threats to financial stability. For example, new types of financial firms could become more heavily dependent for financing on MMMFs, and could suffer a sudden loss of liquidity if many investors in MMMFs were to quickly redeem their shares. Thus regulatory oversight of money market mutual funds from a systemic risk perspective would be a natural matter for macroprudential regulatory oversight under the CMSA.

129. In my view, Gravelle, Grieder, and Lavoie (2013) have correctly identified the three most important potential sources⁸⁰ of systemic risk related to MMMFs: (i) the run incentives, under stress, that are induced by the constant-NAV model, (ii) stale accounting information to investors, implying a lack of transparency that provides an additional incentive in stress scenarios for investor runs, and (iii) substantial reliance by MMMFs on backup bank liquidity, coupled with the reliance (although currently quite modest) by banks on MMMFs for their own liquidity.

⁸⁰ Gravelle, Grieder, and Lavoie (2013) write: "First, the prevalence of constant net asset value (CNAV) funds, as well as the general absence of a capital cushion, combined with potential uncertainty regarding the ability and willingness of a fund sponsor to provide support in times of stress, increases the risk of runs by investors. Second, the lack of timely information associated with Canadian MMFs' holdings resulting from infrequent and delayed reporting (quarterly, with a two month lag) may accentuate this risk. Finally, a majority of Canadian MMFs are sponsored by Canadian banks and these funds, as noted above, purchase large amounts of debt issued and securitized by Canadian banks. Thus, should investors suddenly withdraw funds from Canadian MMFs, Canadian banks may feel compelled to provide liquidity on short notice to meet investor redemptions, while simultaneously facing short-term funding pressures."

Attestation

This report was prepared by me, is factually correctly to the best of my knowledge, and states my true opinions.

A handwritten signature in black ink that reads "Darrell Duffie". The signature is written in a cursive style with a large, prominent 'D' at the beginning.

Darrell Duffie

Palo Alto, California, May 3, 2016.

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Appendix 1: Key Canadian financial benchmarks

Appendix 1: Key Canadian financial benchmarks

1. This appendix (i) reviews key existing Canadian benchmarks and the methods by which they are determined, (ii) overviews the current governance and regulatory oversight of Canada's financial benchmarks, and (iii) discusses related systemic risks.
2. For the reader's convenience, additional sources cited in this appendix are listed at the end of the appendix.

Key Benchmarks in Canada

3. Canada has two key interest-rate benchmarks: the Canadian Dollar Offered Rate (CDOR) and the Canadian Overnight Repo Rate Average (CORRA). CDOR is the financial benchmark used for short term debt instruments known as bankers' acceptances (BAs). Reference to CDOR determines interest payments on approximately C\$130 billion in floating-rate notes, US\$9.3 trillion in CAD interest rate swaps, and over C\$750 billion in exchange-traded derivatives. CDOR is fixed by a daily survey of the 7 largest market participants in Canada's BA market (originating, collectively, 99% of outstanding positions), dropping the highest and lowest rates, and averaging the 5 remaining rates. In contrast to benchmark rates such as LIBOR, CDOR is a bid-side rate. That is, banks are asked for the rates at which they believe they could lend to other banks, rather than the rates at which they believe they could borrow. The bid-side approach is preferred from the viewpoint of manipulation, as submitters have had a demonstrated incentive to understate their borrowing costs during stress periods. Thomson Reuters publishes the "real-time" rate for CDOR at 10:15am Eastern Time (ET), and a delayed rate at 4:00pm ET, to owners of an End User Licence.⁸¹ Non-licence owners can view the delayed rate on the web site of the Bank of Canada at 4:00pm ET.

⁸¹ Thomson Reuters (2015).

Appendix 1: Key Canadian financial benchmarks

4. CORRA is Canada's main "risk-free" reference rate. Specifically, CORRA is a measure of the average overnight financing rate on repos collateralized by government securities.⁸² An Overnight Index Swap (OIS) market based on CORRA has existed in Canada since⁸³ the late 1990s. CORRA has also recently been referenced in floating-rate notes issued by the province of Nova Scotia, which cited its transparency and closer alignment with the market.⁸⁴ CORRA for a given day is published on the following business day. The Bank of Canada publishes the preceding day's CORRA on its website at 4:00pm ET. Thomson Reuters publishes CORRA for the preceding day at 9:00am ET, for owners of its End User Licence.⁸⁵ If less than C\$500 million in eligible overnight trades are reported, CORRA is set at the target (policy) overnight rate of the Bank of Canada.⁸⁶
5. CDOR and CORRA are calculated by Thomson Reuters, the official benchmark administrator appointed by the CDOR Working Group, which was set up to enact benchmark reform in Canada. More details on their governance and regulatory oversight are provided by Thorn and Vikstedt (2014).⁸⁷
6. In addition to these two key interest-rate benchmarks, the Bank of Canada posts on its website indicative foreign exchange (FX) rates, based on market transactions and quotes for currency pairs involving the Canadian dollar. The Bank averages the trade prices of these currency pairs that occur within one minute of 12:00 noon Eastern

⁸² CORRA is calculated as the volume-weighted average rate of actual overnight repo transactions collateralized by Government of Canada securities that are conducted on-screen through designated inter-dealer brokers between 6:00am and 4:00pm ET on the date of the fixing. See Twomey (2011).

⁸³ Financial Stability Board (2015).

⁸⁴ Altstedter (2014).

⁸⁵ Thomson Reuters (2015).

⁸⁶ Investment Industry Association of Canada (2012).

⁸⁷ Thorn and Vikstedt (2014).

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Time. The exchange rate reported by the Bank is provided for informational purposes only. No FX benchmark is officially endorsed by the Government of Canada or the Bank for legal contracting purposes. Nevertheless, some firms use the indicative exchange rate posted by the Bank as a benchmark for settlement of some financial contracts. To my knowledge, there is no associated federal law or regulation that restricts this practice, nor one that provides for official supervision of the practice, whether with respect to the FX rate reported by the Bank or any other published exchange rate.

Governance and Regulatory Oversight of Benchmarks

7. The regulatory environment for financial benchmarks in Canada has been described as “fragmented.”⁸⁸ Typically, the Canadian Securities Administrator (CSA) publishes “model” rules for consultation, and recommends amendments to the model rules as deemed necessary. Each province may then publish its own rules for comment and implementation, although I am not aware that any provinces have provided specific benchmark regulations.
8. Benchmarks often require access to transactions data generated in over-the-counter markets, which implies a need for trade data repositories. To this point, Canada’s provinces have not adopted a harmonized regulatory framework for trade reporting.
9. In August 2012, the Investment Industry Regulatory Organization of Canada (IIROC) reviewed the governance of existing supervisory practices for determining CDOR.⁸⁹ The IIROC review was contemporary to the release by International Organization of Securities Commissions (IOSCO) of its Principles for Financial Benchmarks, which was triggered by severe problems with the manipulation of LIBOR and other financial

⁸⁸ Barnes (2014).

⁸⁹ Lane 2014.

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benchmarks.⁹⁰ IIROC noted that while rate submitters had the same basic understanding of the questions to be addressed by their CDOR submissions, they made slightly different assumptions when actually submitting their rates. This led to some inconsistencies in CDOR reporting procedures, and caused a need to strengthen independent compliance oversight of CDOR rate setting, and more explicit documentation of the calculation methodology, definitions, and transparency of CDOR.⁹¹ IIROC found that submitters were divided on the issue of transparency. While submitters agreed that it would be “unnecessary and infeasible” to tie CDOR to actual transactions, they were less in agreement regarding possible changes to the current calculation methodology and the practice of making individual submissions public.⁹² Ultimately, the Canadian Heads of Regulatory Agencies suggested that the Office of the Superintendent of Financial Institutions (OSFI) was “best-placed”⁹³ to assume the role of supervising CDOR submissions, given its mandate and expertise in supervising the major Canadian banks, which originate CDOR submissions.

10. A CDOR code of conduct⁹⁴ has been published by CDOR panel members in consultation with IIROC and the Bank of Canada. This code of conduct provides regulatory guidance via a relatively open-ended “principles-based” approach. The code of conduct does not dictate any internal oversight structure for the CDOR submission process. The onus remains with CDOR-submitting banks to notify OSFI of any material breaches of the guidelines in a “proactive and timely” manner. OSFI

⁹⁰ International Organization of Securities Commissions (2013).

⁹¹ Thorn and Vikstedt (2014).

⁹² Investment Industry Regulatory Organization of Canada. (2013).

⁹³ Office of the Superintendent of Financial Institutions (2014c).

⁹⁴ Investment Industry Regulatory Organization of Canada (2014).

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has contacted all submitting banks to discuss the nature of the information that it plans to review, and the frequency with which it plans to do so. The details of such reviews have not been made public. OSFI has also released its own set of guidelines⁹⁵ pertaining to corporate governance and internal controls surrounding the CDOR submission process within submitting banks. Full implementation was to have been completed by December 31, 2014.

11. For example, under OSFI guidelines, the senior management of a submitting bank must assume responsibility for developing and implementing a governance framework and oversight functions, independent of operational management, to control the CDOR submissions process. Senior management must then provide assurances to the board of the bank at least once a year that all submissions processes are operating adequately and that risk is controlled.
12. The CDOR Working Group, comprising representatives of the CDOR submitting banks, the Investment Industry Association of Canada (IIAC), and the Bank of Canada, has established and appointed a benchmark administrator, Thomson Reuters Benchmark Services Limited (Thomson Reuters).⁹⁶ The initiative to appoint an administrator appears to stem from IIROC's declaration⁹⁷ that it "does not have jurisdiction" over the CDOR-setting process, since no investment dealers remain involved in the process. In its 2013 review of CDOR supervisory practices, IIROC stated: "As is the case with benchmark rates globally, neither current legislation nor IIROC rules explicitly address benchmark rate-setting activity or manipulation in the rate-setting context; however, a number of IIROC's principles-based rules do

⁹⁵ Office of the Superintendent of Financial Institutions (2014a,b,c).

⁹⁶ Investment Industry Regulatory Organization of Canada (2014) and Canadian Bankers Association (2014).

⁹⁷ Investment Industry Regulatory Organization of Canada (2013).

Appendix 1: Key Canadian financial benchmarks

apply.”⁹⁸ OSFI has also clarified that “[OSFI] is not the regulator of CDOR.” OSFI nevertheless plays a role in supervising the governance and risk controls involved in the banks’ CDOR submission processes.⁹⁹ Given the lack of clarity over which entity is responsible for CDOR, the authority of the CDOR Working Group to appoint an administrator does not have a clear legislative foundation, to the best of my knowledge. (I am not, however, a legal expert.)

13. Under IOSCO Principles,¹⁰⁰ a benchmark administrator is responsible for “all aspects of the benchmark-determination process,” including ensuring that the day-to-day operation of the benchmarks remains compliant with the IOSCO Principles. In June 2014, the CDOR Working Group (composed of CDOR submitting banks, IIAC, and the Bank of Canada) appointed Thomson Reuters to serve as the administrator, calculation agent, and publication agent for both CDOR (effective December 31, 2014) and CORRA (effective March 31, 2015).¹⁰¹ Based on an internal audit conducted in 2015, Thomson Reuters stated that CDOR and CORRA remained in compliance with IOSCO Principles.¹⁰²
14. In October 2015, Thomson Reuters also introduced licensing arrangements for users of CDOR and CORRA. End users who wish to view either real-time or delayed rates via Thomson Reuters must pay a licensing fee each year. Institutions that structure

⁹⁸ Investment Industry Regulatory Organization of Canada (2013).

⁹⁹ Greenwood (2014).

¹⁰⁰ International Organization of Securities Commissions (2013).

¹⁰¹ Canadian Bankers Association. (2014).

¹⁰² Thomson Reuters states on its website: “TRBSL is contractually obligated to publicly disclose a statement regarding the extent of its compliance with the IOSCO Principles as they relate to CDOR and CORRA, no later than 30th June 2015. An independent review conducted by Thomson Reuters’ internal audit in 2015 has found that the operation of CDOR and CORRA is broadly in compliance with the IOSCO Principles for Financial Benchmarks.”
<http://financial.thomsonreuters.com/content/dam/openweb/documents/pdf/tr-com-financial/cdor-corra-iosco-statement.pdf>.

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products and contracts referencing these rates must pay Thomson Reuters an annual fee.¹⁰³

15. Although Thomson Reuters has been given responsibility by the Bank of Canada for calculating CORRA, the Bank of Canada continues to publish the rate on its website at the end of each day.¹⁰⁴
16. This weak legacy patchwork of regulatory and “self-regulator” treatment of benchmarks can be improved with clear and direct powers provided under the CMSA for the designation and regulation of benchmarks.

Potential Systemic Risks

17. The Bank of Canada has emphasized that a loss of confidence or credibility in benchmarks could¹⁰⁵ “profoundly impact liquidity” in markets that reference these benchmarks. The markets that reference Canadian interest rate benchmarks vastly overshadow the underlying markets on which these rates are based. For example, in Canada, CDOR fixings are based on approximately \$67 billion in outstanding bankers acceptances, but determine interest payments on approximately \$9.3 trillion in interest rate swaps, \$750 billion in exchange-traded derivatives, and \$130 billion in floating-rate notes.¹⁰⁶ This disproportionately large quantity of financial instruments referencing a benchmark increases the incentive to manipulate the benchmark fixing.¹⁰⁷ A price impact on the small underlying market that determines the rate could

¹⁰³ Thomson Reuters (2015).

¹⁰⁴ Bank of Canada. Daily Digest. Retrieved from <http://www.bankofcanada.ca/rates/daily-digest/>

¹⁰⁵ Thorn and Vikstedt (2014).

¹⁰⁶ Thorn and Vikstedt (2014).

¹⁰⁷ Duffie and Stein (2015).

Appendix 1: Key Canadian financial benchmarks

lead to a significant manipulative profit on a large position in the market that references the rate.¹⁰⁸

18. A weak governance framework could leave benchmarks vulnerable to manipulation. Manipulation is potentially more problematic for benchmarks such as CDOR that are fixed from opinion-based surveys.
19. Globally, more regulators and legislatures are moving towards adopting the Principles for Financial Benchmarks set out by IOSCO. For example, the European Commission is considering a proposed law that would prohibit EU entities from trading products referencing benchmarks that fail to adhere to the Principles.¹⁰⁹
20. While concerns about benchmark manipulation have previously focused mostly on survey-based benchmarks, allegations of manipulation of transaction-based foreign exchange benchmarks have also recently come to light.¹¹⁰ Three Canadian law firms have launched a \$1 billion lawsuit against Canadian financial institutions, alleging that these institutions conspired to manipulate the supply of foreign currencies in the foreign exchange market, affecting dozens of currency pairs including USDCAD.¹¹¹ The banks are accused of conspiring to affect quotations by aggressively buying and selling currencies during the fix window, and by sharing proprietary information on pending client orders ahead of the fix window via online chat rooms with names like “The Cartel.”¹¹² These lawsuits are similar to matters in the United States concerning

¹⁰⁸ Duffie and Stein (2015).

¹⁰⁹ Thorn and Vikstedt (2014).

¹¹⁰ Thorn and Vikstedt (2014).

¹¹¹ Mizrahi (2015).

¹¹² Weinberger (2015).

Appendix 1: Key Canadian financial benchmarks

the same banks. Five of the defendants named in the Canadian case have pled guilty in the U.S. lawsuits, and a further four banks have settled with plaintiffs in the U.S.¹¹³

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¹¹³ See Sokolov (2015) and Weinberger (2015).

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Appendix 2: Canada's Repo Market

Appendix 2: Canada's Repo Markets

1. This appendix summarizes the current regulatory and governance structure of Canada's repo market, at both provincial and federal levels, as well as the treatment of repos under insolvency regimes, an important financial-stability issue.

Regulatory and governance structures

2. Various entities are involved in the regulation and governance of Canada's repo market. The Bank of Canada and Department of Finance are the key players at the federal level. The federal government has jurisdiction over primary markets for Government of Canada securities, but does not directly regulate the repo market.¹¹⁴ The Bank of Canada, through its oversight role for financial market infrastructure, oversees the CDCS. This oversight includes the review of audits and defining standards,¹¹⁵ although does not appear to involve direct powers governing compliance and failure administration.
3. At the provincial level, the Canadian Securities Administrators (CSA), an umbrella organization of provincial and territorial securities regulators, provide rules for secondary bond market activity referred to as instruments, and are nearly standardized across members.¹¹⁶ As a private-sector "self-regulatory" organization, IIROC, working in concert with the CSA and the federal authorities, has developed regulations applying to all investment dealers in Canada. These include Rules 2800

¹¹⁴ IIROC. (2015). Rule 2800. Retrieved from http://www.iroc.ca/Rulebook/MemberRules/Rule02800_en.pdf

¹¹⁵ Côté, Agathe (2012) Strengthening Financial Infrastructure: The New Canadian Central Counterparty.

¹¹⁶ See Côté (2012) and Canadian Securities Administrators. (2015). Access Rules & Policies. Retrieved from https://www.securities-administrators.ca/industry_resources.aspx?id=47

Appendix 2: Canada's Repo Market

and 2800C, which focus on codes of conduct and reporting rules respectively, govern the operating of the secondary market.

4. The Office of the Superintendent of Financial Institutions (OSFI), does not directly provide regulation regarding repo transactions, however OSFI supervision of banks includes guidelines regarding reporting and accounting of repo.¹¹⁷
5. The CMSA would fill an important gap by providing for systemic risk regulation of the repo market. This would allow, for example, for the mandatory clearing of specified classes of repos.

Treatment under insolvency regimes

6. Under the Bankruptcy and Insolvency Act, Canada's primary federal legislation regarding bankruptcy and insolvency, repos are considered to be "eligible financial contracts," thus exempted under section 65.1.7 from the automatic stay that would normally be applicable under section 65.1.1.¹¹⁸ Under section 65.1.9, permitted actions in case of bankruptcy include "the netting or setting off or compensation of obligations," "the sale or foreclosure ... of financial collateral," and "the setting off or compensation of financial collateral or the application of the proceeds or value of financial collateral."¹¹⁹

¹¹⁷ OSFI (2014). Capital Adequacy Requirements. Retrieved from http://www.osfi-bsif.gc.ca/eng/fi-if/rg-ro/gdn-ort/gl-ld/pages/car_chpt9.aspx

¹¹⁸ Minister of Justice (2015). Bankruptcy and Insolvency Act. Retrieved from <http://laws-lois.justice.gc.ca/PDF/B-3.pdf> and Mann, D. "An Overview of Canadian Insolvency Law." Retrieved from <https://www.acc.com/education/webcasts/upload/An-Overview-of-Canadian-Insolvency-Law.pdf>

¹¹⁹ Mann, op. cit.

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7. These special exemptions from stays, and the associated setoff, closeout, and collateral rights, can either enhance or detract from financial stability, depending on the circumstances.¹²⁰

¹²⁰ See Duffie, Darrell, and David Skeel, "A Dialogue on the Costs and Benefits of Automatic Stays for Derivatives and Repurchase Agreements", In *Bankruptcy Not Bailout: A Special Chapter 14*, edited by Kenneth E. Scott and John B. Taylor, Hoover Press, 2012. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1982095

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Curriculum Vitae and Declaration (art. 235 C.C.P.)

Curriculum Vitae of DARRELL DUFFIE

Contact:

email: duffie@stanford.edu
 personal webpage: darrellduffie.com

Postal Address:

Graduate School of Business
 655 Knight Way
 Stanford University
 Stanford CA 94305-7298

UNIVERSITY
EDUCATION

Stanford University, Ph. D. (Engineering Economic Systems) (1984)

University of New England (Australia), Master of Economics (Economic Statistics) (1980)

University of New Brunswick (Canada), Bachelors of Science in Engineering (Civil Engineering) (1975)

AWARDS
AND
HONORS

1985-86 NSF Research Fellowship

1988-89 Batterymarch Fellowship

1990-92 NSF Research Grant

1992-93 Catalyst Institute Research Grant

1994-95 Q Group Research Award

1994-96 NSF Research Grant

Fellow, Econometric Society

1997 Smith-Breeden Distinguished Paper Prize, *Journal of Finance*

2001 Graham and Dodd Award, *Financial Analysts Journal*

2002 NYSE Prize for equity research, Western Finance Association

2003 Distinguished teacher award, Doctoral Program, Graduate School of Business, Stanford University

2003 Financial Engineer of the Year, International Association of Financial Engineering

2004 Clarendon Lectures in Finance, Oxford University.

2007 Princeton Lectures in Finance.

2007 Elected Fellow of the American Academy of Arts and Sciences.

2008 2011, Elected to the Council of the Econometric Society.

2008 Nash Lecture, Carnegie-Mellon University.

2009 Elected President of the American Finance Association.

2010 Tinbergen Institute Finance Lectures, Duisenberg Institute.

2011 Minerva Foundation Lectures, Columbia University.

2015 Ross Prize, FARFE (with Jun Pan and Ken Singleton).

2015 Fisher-Shultz Lecture, World Congress, Econometric Society.

EMPLOYMENT

1984-present: Graduate School of Business, Stanford University

Current Position: Dean Witter Distinguished Professor of Finance

On leave: Mathematical Sciences Research Institute, University of California, Berkeley, 1985-1986; Université de Paris, Dauphine, 1998; University of Lausanne, 2007-2008; EPFL, 2015-2016.

RESEARCH
INTERESTS

Incomplete security markets; derivative security markets; market and credit risk management of banks and other financial institutions; asset pricing theory; preference theory under uncertainty, financial market innovation and security design; interest-rate modeling and fixed-income security pricing; options and other derivative security markets; credit risk; over-the-counter markets; financial market infrastructure, central banking.

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Journal of Mathematical Economics, July, 1988 to February, 1996.

BOARDS

Advances in Futures and Options Research, May, 1989 to May 1991.

Annals of Applied Probability, September, 1989 to May, 1994.

Economic Theory, December, 1989 to February, 1996.

Journal of Economic Theory, 1986 to 1999.

Mathematical Finance, October, 1989 to January, 2001.

Econometrica, July, 1990 to July, 2014.

Asia Pacific Financial Markets, August 1993 to 2006.

The Review of Derivatives Research, December, 1993 to 2007.

Finance and Stochastics, 1995 to 2002 (co-editor, 1998-2002).

Review of Finance, July, 1995 to 2012.

Journal of Computational Finance, February, 1997 to present.

Advances in Mathematical Economics, August, 1998 to present.

Stochastic Processes and Their Applications, July, 1999 to April, 2006.

Journal of Financial Economics. November, 2001 to present.

Journal of Bond Trading and Management. 2002 to 2003.

Journal of Banking and Finance. November, 2005, to 2008.

Mathematics and Financial Economics. April, 2007, to present.

AEJ: Microeconomics. May, 2007, to present.

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International Journal of Central Banking. January, 2009, to present.
Stochastic Systems. January, 2009, to present.
Review of Asset Pricing Studies. June, 2010, to June 2014.
Journal of Credit Risk. December 2015 to present.
Quantitative Finance. July 2015 to present.
Private Equity Review. November 2015 to present.

PROFESSIONAL Council, Bachelier Society, 1996 to 1999.
 International Association of Financial Engineers, Governing Board (1997 to 2000), Senior Fellow from 2005.

SERVICE External Advisory Board, Institute for Computational Finance, University of Texas, Austin, 1996 to 2005.
 Co-Director and Co-Developer, Stanford University Graduate School of Business Executive Education Courses on Market and Credit Risk for Financial Institutions, 1996 to 2005.
 International Advisory Board, Centre for Financial Engineering, National University of Singapore.
 Advisory Board, Financial Strategies Group, Graduate School of International Business Strategy, Hitotsubashi University, Tokyo, Japan.
 Econometric Society, Fellow, Member of Council (2009-2012), Investments Committee (2009-present).
 National Bureau of Economic Research, Research Associate.
 International Examinations Committee, The Association of Certified International Investment Analysts, Japan.
 NCCR FinRisk, International Scientific Council, Switzerland; 2005-2012.
 Organizing Committee, Quantitative Developments in Finance, Newton Institute, Cambridge University, 2005.
 American Finance Association, Executive Committee, 2007-2011; Vice-President, 2007-2008; President-Elect, 2008-2009; President, 2009-2010; Board of Directors, 2000-2003, 2007-2011.
 Banff International Research Station, Scientific Advisory Board, 2005 to 2010.
 The Chicago Mercantile Exchange-Mathematical Sciences Research Institute Prize Committee, 2005 to 2011.
 The Federal Reserve Bank of New York, Financial Advisory Roundtable, 2006 to present.
 Financial Economists Roundtable, 2007 to 2015.
 Pacific Institute of Mathematical Sciences, Board of Directors, 2007 to present.
 Stanford University, Working Group on Global Markets, Member, 2008 to present.
 Squam Lake Working Group, Member, 2008 to present.
 Stanford Institute of Economic Policy Research (SIEPR), Senior Fellow, 2009 to present.
 Society of Financial Econometrics (SoFiE), Council, 2009 to present.
 Swiss Finance Institute, Scientific Council, 2010 to present.
 Duisenberg Institute, Scientific Council, 2010 to 2015.
 Initiative on Global Markets (IGM), University of Chicago, Experts Panel, 2010-present.
 Stanford University, Financial Institution Resolution Group, 2009-present.
 SWIFT Institute Advisory Council, 2012-present.
 American Academy of Arts and Sciences, Fellow. 2010-present.
 Stanford University, Financial and Risk Modeling Institute, Co-director, 2012-present.

Curriculum Vitae and Declaration (art. 235 C.C.P.)

Asian Bureau of Finance and Economics Research, Senior Academic Fellow.
 Bureau of Finance and Economics Research, Senior Academic Fellow.
 Member, World Economic Forum Global Agenda Council on the Global
 Financial System.
 World Economic Forum, The Role of Financial Services in Society, Steering
 Committee.
 Market Participants Group on Reference Rate Reform (chair).
 P.R.I.M.E. Finance Foundation, Panel of Recognized International Market
 Experts in Finance. December.
 Institute for Global Finance, University of New South Wales, Senior Fellow.

CORPORATE BOARDS	iShares Funds and Trusts, San Francisco, 2008-2011. Moody's Corporation, New York, October 2008 to present.
OTHER	Bank One and I.R.S., Chicago (expert testimony, valuation of swaps). Board of Directors, Affinium Fund, London.
COMPENSATED	International Monetary Fund, Washington, D.C. (credit risk). Citigroup, New York (economic capital).
ACTIVITIES	Merrill Lynch, New York (risk management). Paloma Partners, Greenwich CT (risk management).
2003-2015	Ixis, Paris (credit markets). Schering-Plough, Kenilworth NJ (asset valuation). MBIA, New York (credit risk management). Bombardier, Toronto (corporate debt valuation). Moody's, Academic Research and Advisory Committee, New York. Credit Suisse, New York (financial markets and risk management), New York. Quinn Emanuel, New York, (consulting and expert witness testimony, credit risk corporate debt valuation, credit derivatives, interest-rate swaps). New York State Tax Authority (repurchase agreements), New York. Cantor Fitzgerald (inter-dealer broker markets), New York. Independent Health Care Trusts for UAW Retirees of General Motors Cor- poration and of Ford Motor Corporation, (exercise of equity options), Detroit. State Street Bank (speech to investor conference), Boston. PayNet Inc. (estimation of default probabilities), Chicago. Matterhorn Investment Management (global capital markets), London. Cantor Fitzgerald (interdealer brokerage of treasuries), New York. Public Prosecutor of Milan (valuation of swap agreements), Milan Italy. Federal Reserve Bank of Chicago (central clearing counterparties), Chicago. Kepos Capital (academic advisory board), New York. Lehman Estate (consultation on bankruptcy-related issues), New York. Incisive Media (public speaking). Rothwell, Figg, Ernst & Manbeck (consultation on intellectual property rights), Washington DC, Sansome Capital (consultation on global capital markets), San Francisco. Och-Ziff Management LP (consultation on hedge fund risk management), New York.

This curriculum vitae is current as of December, 2015.

Curriculum Vitae and Declaration (art. 235 C.C.P.)

MODEL ESTABLISHED BY THE MINISTER OF JUSTICE**Declaration regarding the carrying out of
the mission of an expert
(article 235 C.C.P.)**

I declare that I will carry out my mission as an expert with objectivity, impartiality and rigour. To enlighten the court in making its decision, I will give my opinion on the basis of my qualifications concerning the points submitted to me, taking into account the facts relating to the dispute or, if my services are required as a court bailiff, I will make an ascertainment describing the materials facts or situation of which I have personal knowledge.

I will, on request, provide the court and the parties with details on my professional qualifications, the progress of my work and, if applicable, the instructions received from a party. I will also comply with the time limits given to me and, if necessary, request the directives from the court that are necessary to carry out my mission.



Signature



Title



Date

Onglet 14

EXPERT REPORT OF ANDREW METRICK

Prepared for Justice Canada

Deputy Dean & Michael H. Jordan Professor of Finance and Management

Yale School of Management

May 4, 2016

A handwritten signature in black ink, appearing to read 'Andrew Metrick', written in a cursive style.

Andrew Metrick