BANK OF CANADA
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Bank of Canada Oversight Activities for Financial Market Infrastructures

2018 Annual Report

MARCH 2019

Executive summary

Financial market infrastructures (FMIs) are a critical component of the financial system. They support economic activity by providing a platform to transfer funds and settle transactions. Since financial transactions are concentrated in FMIs, they are a potential source of risk to the financial system. The Bank of Canada (the Bank) oversees those FMIs operating in Canada that have the potential to pose significant risk to ensure that the risk is adequately controlled.

The *Bank of Canada Oversight Activities for Financial Market Infrastructures 2018 Annual Report* (the Report) outlines how the Bank fulfills its mandate for oversight of designated FMIs.[1] The Report outlines key issues about the safety and soundness of designated FMIs. It also specifies the Bank's expectations on the risk-management enhancements to be pursued by designated FMIs in 2019. Oversight of designated FMIs contributes to the Bank's broader mandate of promoting the stability and efficiency of the Canadian financial system.

Designated FMIs continued to make significant progress in their risk-management practices throughout 2018 to address the Bank's oversight expectations. As part of an ongoing process, the Bank has identified further enhancements to pursue in 2019.

This report also discusses initiatives performed by the Bank that are related to FMI risk management.

[1] These include payment clearing and settlement systems designated for oversight by the Governor of the Bank under the *Payment Clearing and Settlement Act* (PCSA).

Contents

The Bank's approach to oversight of financial market infrastructures

Financial market infrastructures (FMIs) play an important role in enhancing the stability of the financial system. The services provided by FMIs are critical for individuals and firms to safely and efficiently purchase goods and services, invest in financial assets and manage financial risks. Given their central role, FMIs require strong risk-management practices and must be resilient to shocks.

Regulatory framework

The Bank's powers to oversee FMIs stem from the *Payment Clearing and Settlement Act* (PCSA), which allows the Governor to designate FMIs if they are deemed to have the potential to pose systemic risk or payments system risk in Canada.[2] The PCSA further stipulates that the Bank is responsible for oversight of these designated FMIs. In this role, the Bank coordinates with other federal and provincial authorities that are also responsible for domestic designated FMIs.[3] Formalized agreements between the Bank and the relevant federal and provincial authorities have been established to guide this collaboration.

The Bank's responsibilities also include the designation and oversight of foreign-domiciled FMIs that have the potential to pose systemic risk to the Canadian financial system. To fulfill this responsibility, the Bank relies on co-operative

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[2] The federal Minister of Finance must agree that designation is in the public interest. See the glossary in Appendix 2 for a full definition of systemic risk and payments system risk.

[3] The Autorité des marchés financiers, the British Columbia Securities Commission and the Ontario Securities Commission also have regulatory responsibility for the Canadian Depository for Securities (operator of CDSX) and the Canadian Derivatives Clearing Corporation (operator of CDCS). The Minister of Finance shares the responsibility to oversee Payments Canada.

arrangements that take the form of oversight colleges. These colleges are led by the FMI regulator in the jurisdiction where the foreign FMI is domiciled.[4]

The Bank must ensure that FMIs adequately control their risks because they operate infrastructure that is essential to the Canadian financial system. To achieve this, the Bank assesses the FMIs against its Risk-Management Standards for Systemic FMIs and the Criteria and Risk-Management Standards for Prominent Payment Systems (PPS).[5] These standards were established by the Bank based on the principles and key considerations of the *Principles for financial market infrastructures* (PFMI), which were developed by the Committee on Payments and Market Infrastructures (CPMI), together with the International Organization of Securities Commissions (IOSCO).[6]

The designated FMIs, listed in Table 1 and described in further detail in Appendix 1, include both domestic and foreign-domiciled FMIs that are central to the Canadian financial system.

Table 1:
Financial market infrastructures designated for Bank of Canada oversight[1]

Domestic designated FMIs	
CDCS	The Canadian Derivatives Clearing Service is a central counterparty operated by the Canadian Derivatives Clearing Corporation (CDCC) that clears transactions in all derivatives trades on the Montréal Exchange and certain fixed-income securities, repurchase agreements and over-the-counter (OTC) equity derivatives. CDCC is a wholly owned subsidiary of the Montréal Exchange.
CDSX	CDSX is a system operated by the Canadian Depository for Securities Limited (CDS) that consists of a securities settlement system, a central securities depository for equities and fixed-income securities, and a central counterparty service for eligible Canadian exchange-traded and OTC equities. CDS is a wholly owned subsidiary of the TMX group.
LVTS	The Large Value Transfer System is an electronic funds transfer system operated by Payments Canada that settles large-value and time-critical payments.
ACSS	The Automated Clearing Settlement System is a retail payment system operated by Payments Canada that clears cheques and electronic items, such as pre-authorized debits, direct deposits and Interac debit payments.
Foreign-domiciled designated FMIs	

[4] The New York Federal Reserve Bank is the lead regulator for the CLS Bank, and the Bank of England is the lead regulator for SwapClear.
[5] For more details, see the Bank of Canada's Risk-Management Standards for Designated FMIs and the Criteria and Risk-Management Standards for Prominent Payment Systems.
[6] The PFMI establish minimum expectations for risk management for systemically important FMIs to preserve and strengthen financial stability. See the CPMI-IOSCO's web page for more information on the PFMI and CPMI-IOSCO.

CLS Bank	CLS Bank is a special-service bank that offers the settlement of foreign exchange transactions, including those involving the Canadian dollar.
SwapClear	SwapClear is an LCH (London Clearing House) clearing platform for interest rate swaps and other OTC interest rate derivatives denominated in multiple currencies, including the Canadian dollar.

[1] Except for the ACSS, all FMIs listed in this table are subject to the Bank's risk-management standards for systemically important systems. The ACSS is subject to the prominent payment system standards.

Enhancing the FMI oversight framework

In 2014, the Bank formalized its practices for overseeing domestic designated FMIs by introducing an annual process for evaluating risks. Because the risk-management practices of designated FMIs have subsequently matured, the original framework needs to adapt to conduct more in-depth assessments of how FMIs observe the Bank's standards.

The oversight process has therefore introduced annual "core assurance reviews" that focus on and delve deeper into specific FMIs' controls and risk-management practices. Under this approach, all the Bank's risk-management standards will be covered in depth over a three-year cycle. The overall intent of these core assurance reviews is twofold: (i) to gain greater understanding of the FMI's risk controls in a specific area, and (ii) to provide greater assurance that the FMI is meeting the Bank's risk-management standards.

Recommendations arising from core assurance reviews will help inform the priorities that the Bank will set for FMIs the following year.

The Bank will continue to rely on co-operative arrangements to conduct its oversight of foreign-domiciled FMIs designated as having the potential to pose systemic risk to the Canadian financial system.

Progress on the 2018 key oversight priorities for FMIs

The Bank oversees designated FMIs to ensure that they adequately control their risks. As part of this effort, the Bank engages in activities to identify enhancements that FMIs need to implement to fully meet the Bank's risk-management standards. The Bank then sets key priorities for each FMI based on the enhancements that are most relevant to the safety and soundness of the FMI and the broader financial system.

The key oversight priorities for 2018 were as follows:[7]

- Modernization
- Cyber security
- Default management
- Human resources planning

Modernization

Canada's domestic designated FMIs are modernizing their core clearing and settlement systems. Payments Canada is working toward transforming its payment systems by introducing

- Lynx as the replacement for the Large Value Transfer System (LVTS);
- the Settlement Optimization Engine (SOE) as the replacement for the Automated Clearing Settlement System (ACSS) and the US Dollar Bulk Exchange; and
- the new Real-Time Rail (RTR) for delivering faster, data-rich payments.

Additionally, the TMX Group, through CDS and CDCC, is updating the technology underlying its clearing and settlement platform and financial risk-management systems.

The Payments Canada Modernization program will result in notable benefits to all Canadians, including consumers, businesses and governments. All modernized systems are being designed with enhanced security and risk-management capabilities. In addition to these improvements, further data will become available to the industry, which will enable more efficient back-office reconciliation processes. Moreover, the RTR will result in faster settlement for retail payments, ensuring funds can be sent and received in a matter of seconds at any time

[7] In 2019, the presentation of priorities has transitioned to highlight only the subset of priorities that are common to many designated FMIs or are significant priorities for a specific FMI.

throughout the day. This system will also simplify how end-users can initiate payments and will serve as a platform for innovation by supporting new payment solutions.

In 2018, Payments Canada continued to advance the Modernization program. An application provider, SIA, was selected for the development of the Lynx real-time gross settlement software application. As well, the procurement process to choose a vendor to deliver hosting and system integration services for Lynx is well underway. Payments Canada also made progress on the design phase of the RTR.

Given that the SOE is not expected to be introduced until the later stages of the Modernization program, Payments Canada also improved the ACSS in two ways. First, it introduced a credit risk model to improve the safety and soundness of the system. Second, it enhanced automated funds transfer payments by allowing consumers to receive funds two hours after their financial institution receives a payment and by introducing a third period later in the day for financial institutions to exchange batch payments, benefiting, in particular, member institutions and their clients on the West Coast.

For the TMX Group, modernization will help satisfy end-user demands and streamline business processes, provide richer data to support new efficiencies, and facilitate improved security and risk-management capabilities.

The first phase of the TMX Group's modernization project involves deploying a new risk-management system for CDCC. Over the course of 2018, CDCC finalized business requirements for the system and began the testing phase. Testing is expected to be completed in the first half of 2019. The second phase of TMX Group's modernization will introduce a new core clearing, settlement and depository platform for CDS. The TMX Group is expected to finalize the business requirements for the system in 2019.

These large-scale projects are highly complex and have the potential to disrupt the clearing and settlement infrastructure. The Bank is therefore closely involved in all stages of these initiatives to monitor the delivery of the modernized systems and to help ensure they comply with the Bank's risk-management standards.

Cyber security

The Bank has identified cyber security as a key vulnerability to the financial system, as outlined in its June 2018 *Financial System Review*. This view is shared by risk-management experts working in the financial system, as indicated by the results of two financial system surveys released in 2018. Results from both surveys recognized the potential for a cyber attack as the most important risk to the Canadian financial system.

A cyber attack against a single financial institution or critical service provider could have significant effects on that institution by interrupting its business activities. Further, given the high degree of interconnectedness between financial institutions and FMIs, such an attack could be amplified by spreading quickly and widely across the financial system and disrupting the delivery of a crucial financial service, such as that of a designated FMI.

To help safeguard against a cyber threat, the Bank requires FMIs to comply with the operational risk principle of the PFMI as well as the CPMI-IOSCO guidance on cyber resilience for FMIs.

As communicated in the 2017 Report, a key priority for all Canadian designated FMIs in 2018 was to strengthen their cyber security posture, including the ability to detect and manage cyber risks. To meet this requirement, designated FMIs were expected to conduct table-top exercises with the Bank to determine how they would respond to and recover from a major cyber attack. This work was also intended to inform the next steps for meeting the objective of a two-hour recovery time established by the CPMI-IOSCO cyber guidance for FMIs.

Both the TMX Group and Payments Canada made considerable progress on this priority.

Payments Canada successfully conducted an internal crisis management exercise and an industry-wide cyber resiliency exercise in 2018. Additionally, Payments Canada made progress based on recommendations from an external assessment of its cyber security posture. A few notable enhancements included measures to strengthen governance around cyber security and the introduction of more advanced detection and response capabilities.

The TMX Group organized two workshops with the Bank and the Canadian Securities Administrators (CSA) in 2018. These workshops were intended to facilitate a broader understanding of their overall incident management process and challenges toward resuming operations after a cyber attack. During these workshops, the TMX Group presented the steps it would take to recover from a cyber attack and discussed recovery challenges associated with a scenario affecting data integrity. Discussions about the actions and timing implications for resolving specific cyber scenarios will continue in 2019. Additionally, the TMX Group developed a dashboard to report cyber security attacks to the Bank. This is expected to be implemented in 2019.

Default management

An FMI should establish appropriate default-management plans and procedures to ensure that the default of a participant is well-managed and that its effects on the FMI, other FMI participants and the broader financial system are contained.

Given the potentially serious implications of a default, the 2017 Report highlighted enhancing default-management plans to mitigate risks in line with the Bank's risk-management standards as a key priority for CDCS, CDSX and the ACSS. Their progress against these priorities is described below:

- CDCS—CDCC tested the enhanced auction framework that was introduced in 2017, which greatly improved staff and participant readiness for a successful auction in the event of a participant default. [8]
- CDSX—CDS has secured a liquidity agreement totalling $600 million to ensure that settlement agents who are not also direct participants in the LVTS have sufficient liquidity to support its obligations arising from a default event.
- ACSS—Payments Canada conducted an annual default exercise with all ACSS participants. Because the ACSS was designated for Bank of Canada oversight only in May 2016, this was the first exercise that included all ACSS participants.

Human resources planning

As described previously, CDCC, CDS and Payments Canada are each undertaking a large-scale modernization project. Significant human resources will be required to deliver their projects successfully. Moreover, CDCC and CDS have recently integrated some aspects of their operations, which has led to changes in their organizational structures and staffing.

To help ensure a successful delivery of these projects and organizational changes, and to ensure that ongoing core operations are sufficiently supported, a key oversight priority conveyed in the 2017 Report was to require each FMI to closely monitor and manage their staffing so they can respond to their evolving organizational needs.

For CDCC and CDS, the focus of this priority was to improve their succession planning by enhancing their ability to respond to the departure of key staff. Over 2018, both TMX Group organizations developed comprehensive succession plans to react to the departure of key individuals, ranging from an analyst to a Board member.

For Payments Canada, the expectation was to develop appropriate metrics and tools to monitor the organization's resource capacity and the integration of new staff. During 2018, Payments Canada developed and implemented human resources metrics to monitor the integration of new staff in their roles and engagement across various staff and management levels. Additionally, given that

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[8] An auction may be necessary for CDCS to close out any open positions the defaulting participant may have. This is an essential part of the default-management process.

a significant increase in capacity was put in place in 2018, Payments Canada conducted a review of its hiring strategy to assess whether its resources met its organizational requirements.

2019 key oversight priorities for FMIs

As described above, the Bank is transitioning to a more focused in-depth oversight framework using core assurance reviews. To complement the Bank's ongoing oversight activities that cover the Bank's risk-management standards, multiple core assurance reviews that focus on key risk areas will be conducted each year. An assessment of each key risk area will be completed over a three-year cycle.

Going forward, the priorities related to FMIs operated by Payments Canada will be set in late spring to be addressed in the following 12 months, while FMIs operated by the TMX Group will continue to have their priorities for the following year set in late fall.

The 2018 Report marks a transitional phase. As a result of the approach and the differences in timing for the review of FMIs, the oversight priorities for 2019 highlighted in this document primarily relate to the TMX Group. It also includes oversight priorities for foreign-domiciled FMIs. The 2019 Report will provide more balance of the oversight expectations for all FMIs.

The priorities for 2019 are as follows:

- Modernization projects
- Liquidity risk management
- Model risk management
- CLSNow
- Risk management of SwapClear

In 2019, the Bank will be conducting core assurance reviews for each of the domestic designated FMIs on the following topics:

- Business, custody and investment risk
- Cyber security

In addition, Payments Canada's systems will undergo a liquidity risk core assurance review while the TMX Group will undergo a review of its default-management procedures.

A core assurance review on default management was conducted at the end of 2018 for Payments Canada. The results of this review will help form risk-management priorities for Payments Canada in 2019–20.

Modernization projects

Throughout 2019, Payments Canada and the TMX Group are expected to continue their respective modernization projects. For Payments Canada, this will involve transitioning some core aspects of the project from the design stages to the initial development phase. Given the project's critical importance and complexity, Payments Canada is working closely with the Bank to ensure the systems are compliant with the Bank's risk-management standards.[9]

For the TMX Group modernization initiative, key milestones in 2019 will include CDCC launching a new risk-management system and CDS consulting industry on plans for a new clearing and depository system for CDSX.

Liquidity risk management

In 2018, CDS increased its prefunded liquidity coverage for its central counterparty (CCP) services, Continuous Net Settlement (CNS) and New York Link (NYL), according to liquidity needs under normal market conditions for Cover 1. While these were significant steps in improving liquidity risk management, further work is needed to meet PFMI expectations. PFMI require prefunded liquidity to be sized according to exposures of the participant that generates the largest obligations following a default, under stressed conditions.

Under stressed conditions, CDS's liquidity requirements rise significantly, particularly for the CNS service. This is driven by triple witching (TW) market activity, which occurs every three months and leads to increased equity settlement.[10]

In 2018, CDS developed a plan to collect cash from participants, to be invested into reverse repurchase (repo) transactions, as a means of supplementing its current liquidity coverage during TW periods. This cash would be collected only from participants who create exposures beyond the current liquidity facility (i.e., participants engaged in TW activity).

In 2019, the Bank expects CDS to engage with potential reverse repo counterparties, make changes to the relevant rules and policies, and complete the board and regulatory approval process.

In the longer term, CDS is also expected to adjust the CNS settlement model so that it can achieve same-day settlement of payment obligations in the event of a participant default and work toward a revised operational settlement model that can facilitate this.

[9] For further details on Payments Canada's modernization plans, see its Modernization Delivery Roadmap.
[10] TW occurs when the contracts for index futures, index options and stock options all expire on the same day. This occurs four times a year, specifically on the third Friday of March, June, September and December. Several (but not all) CCP participants have significantly increased volumes of activity and, in particular, more outstanding equity positions submitted for settlement in the CCP due to their trading behaviour associated with TW.

Model risk management

Model risk management (MRM) involves confirming and testing the validity of a model's underlying assumptions and parameters, theoretical underpinnings and empirical results. In recent years, the TMX Group drafted and began implementing MRM policies at its designated FMIs.

CDCC has made significant progress since formalizing its MRM practices in a comprehensive framework in 2017. In 2019, CDCC is expected to fully implement its MRM policy and conduct ongoing validation and risk-based model vetting. To complete this model vetting, CDCC and CDS have developed an independent model vetting function under Internal Audit.

CDS has made less progress on implementing its MRM policy and is in the process of leveraging the work completed by CDCC to ensure a consistent and comprehensive application of sound risk-management practices for models across the two systems. For 2019, the Bank expects CDS to make significant progress toward implementing its MRM policy and enhance its governance processes to strengthen the effectiveness of its MRM. CDS has confirmed this will be a key priority in 2019.

CLSNow

Same-day foreign exchange transactions that occur outside the multilateral netting mechanism of CLSSettlement are generally settled directly between financial institutions, which introduces settlement risk. The exception is the Americas same-day settlement (SDS) service, which provides a payment-versus-payment (PvP) solution for the USD/CAD market. This service settles same-day USD/CAD transactions once a day on a multilateral net basis but has proven to be a difficult solution to expand across different time zones.

In 2019, CLS plans to launch CLSNow, a new service that will provide bilateral trade-by-trade PvP settlement of same-day foreign exchange transactions throughout the day. CLSNow will thereby expand the possibility to securely settle same-day transactions beyond North America. The currencies the new service will initially include are the US dollar, euro, pound sterling, Swiss franc and the Canadian dollar.

Risk management of SwapClear

Through the LCH Global College process, the Bank will continue to focus its oversight efforts to ensure that the FMI's risk-management frameworks meet global standards and supports Canadian participation in the SwapClear service. This includes assessing any significant changes arising from LCH's introduction of new products. The Bank will also continue to closely monitor LCH's planning surrounding the withdrawal of the United Kingdom from the European Union.

Bank of Canada activities

In addition to ongoing monitoring of the risk-management practices of designated FMIs, the Bank is involved in several other activities related to its oversight mandate. These activities are described in this section as follows:

- Introducing an FMI resolution regime in Canada
- Reviewing the potential for designating the RTR
- Contributing to international regulatory efforts
- Supporting international organizations in reviewing Canada's policy frameworks
- Researching and monitoring trends in the FMI landscape

Introducing an FMI resolution regime in Canada

The Bank's oversight activities promote the stability of the Canadian financial system. Despite these efforts, there is potential that an FMI could face circumstances so severe that it is unable to continue providing its critical functions to the financial system. To address such an unlikely scenario, the Bank and financial sector authorities have worked diligently over the past few years to develop a resolution regime for domestic designated FMIs that will help support the critical services of an FMI, promote financial stability and minimize the potential exposure of public funds to loss.[11] This regime would provide the Bank with the powers and tools necessary to place an FMI into resolution, take control of it and take resolution actions.

As part of the 2017 federal budget, the Government of Canada proposed legislative amendments to the PCSA that allow for the implementation of a resolution regime for domestic designated FMIs. These amendments would also appoint the Bank as Canada's FMI resolution authority. Providing the Bank with these new powers is consistent with the scope of the resolution powers recommended by the Financial Stability Board's (FSB's) Key Attributes for Effective Resolution Regimes for Financial Institutions.

In June 2018, these amendments (through Bill C-74) received Royal Assent. Work is now underway to complete the regulations required for the resolution regime to come into effect, which is expected in the second half of 2019.

Over 2019, the Bank will begin to operationalize the resolution regime. FMI resolution guidance will be published to inform FMIs and their participants about

[11] E. Woodman, L. Chung and N. Chande. "Establishing a Resolution Regime for Canada's Financial Market Infrastructures," Bank of Canada *Financial System Review* (June 2018): 25–35.

how the Bank would expect to act on its resolution powers and carry out its new mandate as the resolution authority for FMIs. Moreover, the Bank will establish a federal FMI resolution committee, which will be chaired by the Governor and include senior officials from the Department of Finance Canada, the Office of the Superintendent of Financial Institutions (OSFI) and the Canada Deposit Insurance Corporation (CDIC).

Resolution plans will also begin to be developed for some domestic designated FMIs, and this work will continue beyond 2019. In addition, certain policies and procedures necessary to operationalize the regime within the Bank will also be developed, which will enable the Bank to effectively resolve an FMI.

Reviewing the potential for designating the RTR

Under the PCSA, the Governor has formal responsibility for the designation and oversight of clearing and settlement systems that have the potential to pose systemic risk or payments system risk.[12] Each year, the Bank also monitors whether any changes, new information or developments would require the Bank to designate new or existing systems for Bank of Canada oversight.

The Bank will review the design of the RTR and its potential to pose payments system risk. This process will leverage the Criteria and Risk-Management Standards for Prominent Payment Systems as a set of criteria for its assessment. Given that the RTR will be introduced as a new system that is expected to clear and settle significant retail payment volumes, the Bank expects to designate the RTR as a prominent payment system.

Contributing to international regulatory efforts

The Bank supports the work of the G7 and the G20 and participates on other international committees, including the FSB and the CPMI-IOSCO, which seek to develop, promote and uphold international risk-management standards for systemically important FMIs. Discussions at these forums and any resulting international guidance help to shape the risk-management standards that the Bank maintains for Canada's designated FMIs.

Throughout 2018, the Bank contributed to the development of two G7 publications that offer guidance on strengthening cyber resilience in the financial sector.

The G-7 Fundamental Elements for Third Party Cyber Risk Management in the Financial Sector provides financial entities with a risk-based framework for

[12] The Governor of the Bank of Canada must be of the opinion that the clearing and settlement system could be operated in a manner that poses a systemic risk or payments system risk, and the Minister of Finance must be of the opinion that it is in the public interest to designate the system.

managing cyber risk from third parties. It also contains guidance for authorities to inform their policy work and supervisory activity related to third-party cyber security risks.

To enhance resilience against cyber attacks, the G7 also published the G-7 Fundamental Elements for Threat-Led Penetration Testing. This document provides financial entities with a guide to assess their resilience against malicious cyber incidents through simulation of the tactics of real-life threat actors. It also provides a guide for authorities designing threat-led penetration testing regimes within their jurisdictions.

The Bank also supports international work on CCP resolution undertaken through the FSB in co-operation with CPMI-IOSCO. In July 2017, the FSB adopted Guidance on Central Counterparty Resolution and Resolution Planning to assist authorities in their resolution planning for CCPs. As a follow-up to this work, in November 2018 the FSB published a consultation paper entitled Financial Resources to Support CCP Resolution and the Treatment of CCP Equity in Resolution. The responses to the consultation, in conjunction with the experience of authorities in evaluating financial resources, will inform the development of further guidance on this topic by the end of 2020.

Oversight staff also contributed to work at the CPMI-IOSCO, including a report on cross-border retail payments that was released in February 2018. This report sets out a holistic view of cross-border retail payments to analyze the market and identify challenges by drawing on a survey of almost 100 established and innovative providers of cross-border retail payment services. Additionally, oversight staff have been actively involved in an initiative to identify areas of good practice for CCP default-management auctions.[13] This work will continue through 2019, with the release of a discussion paper expected mid-year.

Supporting international organizations in reviewing Canada's policy frameworks

The Bank also helps facilitate international organizations, including the CPMI-IOSCO and the International Monetary Fund (IMF), to review Canada's financial sector policy frameworks. Two major assessments that the Bank helped facilitate throughout 2018 include the CPMI-IOSCO level 2 assessment of the PFMI and the IMF Financial Sector Assessment Program (FSAP).

Through a peer-review implementation-monitoring program, the CPMI-IOSCO monitors its members' implementation of the PFMI. This program has three levels

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[13] More information is provided in the welcome remarks of the Chair of the CPMI at the Economics of Payments IX conference in Basel (November 2018).

of assessment, ranging from verifying that required policies have been implemented to evaluating the compliance of an FMI's practices with the PFMI.

In 2018, the CPMI-IOSCO completed a level 2 assessment, which evaluated the consistency of Canada's policy framework with the PFMI.

In Canada, this framework includes the Bank's risk-management standards and the joint supplementary guidance that was developed by the Bank and the CSA.[14] Overall, the assessment team concluded that the policy framework in Canada had been implemented in a complete and consistent manner for all but one of the principles (Principle 7 – liquidity risk).[15]

The Bank and CSA have acknowledged the findings from the CPMI-IOSCO assessment. To address these findings, the Bank and CSA have revised the joint supplementary guidance following a holistic review. The updated guidance is in the process of being approved and will be published in 2019.

The IMF is currently conducting its third assessment of Canada under FSAP. The IMF FSAP consists of a comprehensive and in-depth analysis of a country's financial sector to assess

- the resilience of the financial sector,
- the quality of the country's regulatory and supervisory framework, and
- the ability of authorities to respond effectively in case of systemic stress.

The current assessment includes a review of Canada's systemically important FMIs against international standards.

The Bank, other major financial sector authorities (such as the Department of Finance Canada and provincial regulators) and FMI operators in Canada have been highly involved in supporting the IMF during its assessment. Results of the assessment are expected to be available in 2019 through the forthcoming publication of the IMF's Financial System Stability Assessment.

Researching and monitoring trends in the FMI landscape

The Bank's oversight activities include research into areas of FMI risk management and financial stability.

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[14] The Supplementary Guidance is additional context and clarity on certain aspects of these new standards in the Canadian context. For more details on the scope of the assessment, see the CPMI-IOSCO Level 2 assessment for Canada.

[15] While the assessment team provided other minor observations, none was considered to represent material deviations from the PFMI.

In 2018, oversight staff published research on margin procyclicality at CCPs, which is a risk many jurisdictions view as a potential threat to financial stability.[16] The paper examines how margin procyclicality may be safely reduced at CCPs and describes the factors that would affect incentives for central clearing under less procyclical margins. A key finding is that less procyclical margins pose a trade-off between collateral cost and risk-sharing. Following this, an increase in risk-sharing can invite moral hazard and create incentives to reduce trading. Nonetheless, proper bank regulation would be instrumental for curbing such moral hazard incentives.

To help inform work on payments modernization, oversight staff conducted research to estimate the potential exposures and netting benefits from merging retail and wholesale payments and conducting multiple intraday settlements.[17] The results demonstrate that credit risk exposures faced by participants in the system are largely dependent on their relative activity in the retail and wholesale payment systems.

In 2018, the Bank continued to further its research on the potential benefits of distributed ledger technology (DLT), focusing on its application in securities settlement and cross-border payments.

Building on the results of Jasper Phase II, a third phase was introduced to broaden the DLT ecosystem beyond wholesale interbank payments to include securities settlement for TSX-listed equities.[18] The project was commissioned by Payments Canada, the TMX Group and the Bank of Canada in collaboration with partners Accenture and R3. The Jasper Phase III findings suggested that while DLT shows promise to deliver efficiency improvements, the ledger may need a much larger scope of coverage to realize these benefits.

The Bank also contributed to the report "Cross-Border Interbank Payments and Settlements" along with the Monetary Authority of Singapore, the Bank of England and a group of commercial banks.[19] This report investigates proposals for new and more efficient models for processing cross-border transactions by examining the existing challenges and frictions. The overall conclusion of the report is that current cross-border initiatives underway would represent only modest improvements to the challenges that are faced today. To more fully

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[16] R. Raykov, "Reducing Margin Procyclicality at Central Counterparties," *Journal of Financial Market Infrastructures* 7, no. 2 (December 2018): 43–59.
[17] H. Pérez Saiz, S. Untawala and G. Xerri, "A Calibrated Model of Intraday Settlement," Bank of Canada Staff Discussion Paper No. 2018-3 (January 2018).
[18] Bank of Canada, TMX Group, Payments Canada, Accenture and R3, *Jasper Phase III—Securities Settlement Using Distributed Ledger Technology* (October 2018).
[19] Bank of Canada, Bank of England and Monetary Authority of Singapore, *Cross-Border Interbank Payments and Settlements—Emerging Opportunities for Digital Transformation* (November 2018).

address these challenges, there may need to be a fundamental paradigm shift, including changes to technology platforms, regulation and governance.

Appendix 1 | Overview of Designated Financial Market Infrastructures

LVTS (Payment System | Designated Systemic FMI 1999)

The Large Value Transfer System (LVTS) is a Canadian electronic funds-transfer system operated by Payments Canada that settles large-value and time-critical Canadian-dollar payments.

Measure	2016	2017	2018
Daily average value settled	$175 billion	$173 billion	$181 billion
Daily average volume settled	34 thousand	36 thousand	38 thousand
Daily average collateral pledged	$38 billion	$37 billion	$38 billion
Number of direct participants	17	17	17

CDSX (Securities Settlement System, Central Securities Depository, Central Counterparty | Designated Systemic FMI 2003)

CDSX is a Canadian system operated by the Canadian Depository for Securities Limited (CDS) that consists of a securities settlement system, a central securities depository and a central counterparty service for Canadian exchange-traded and over-the-counter (OTC) equities.

Measure	2016	2017	2018
Daily average value of equity and fixed-income securities cleared and settled	$493 billion	$541 billion	$578 billion
Daily average volume of equity and fixed-income securities cleared and settled	1.8 million	1.7 million	2.1 million
Average value of securities held at the central securities depository	$5.1 trillion	$5.4 trillion	$5.2 trillion
Number of direct participants	97	95	94

CDCS (Central Counterparty | Designated Systemic FMI 2012)

The Canadian Derivatives Clearing Service (CDCS) is a Canadian central counterparty operated by the Canadian Derivatives Clearing Corporation (CDCC) that clears transactions in certain fixed-income securities, OTC repurchase agreements (repos), OTC equity derivatives and all derivatives traded on the Montréal Exchange.

Measure	2016	2017	2018
Daily average value of OTC repos cleared	$27 billion	$27 billion	$28 billion
Daily average notional value cleared (exchange-traded derivatives)	$121 billion	$134 billion	$139 billion
Daily average notional value cleared (OTC derivatives)	$9.7 million	$13.3 million	$10.6 million
Number of direct participants	35	34	38

ACSS (Payment System | Designated Prominent Payment System 2016)

The Automated Clearing Settlement System (ACSS) is a retail payment system operated by Payments Canada that clears cheques and electronic items, such as pre-authorized debits, direct deposits and Interac debit payments.

Measure	2016	2017	2018
Daily average value settled	$26 billion	$28 billion	$29 billion
Daily average volume settled	30 million	30 million	32 million
Number of direct participants	12	12	12

CLS Bank (Payment System | Designated Systemic FMI 2002)

CLS is a special-service bank that offers the settlement of foreign exchange transactions, including those involving the Canadian dollar.

Measure	2016	2017	2018
Daily average foreign exchange settlement (total)	US$4,820 billion	US$5,185 billion	US$5,830 billion
Daily average Canadian-dollar foreign exchange settlement[1]	Can$178 billion	Can$199 billion	Can$216 billion
Settlement members	68	69	73

[1] The methodology for calculating the daily average Canadian-dollar foreign exchange settlement was revised to remove data points equal to zero on Canadian holidays.

LCH SwapClear (Central Counterparty | Designated Systemic FMI 2013)

SwapClear is an LCH clearing platform for interest rate swaps and other OTC interest rate derivatives denominated in multiple currencies, including the Canadian dollar.

Measure	2016	2017	2018[1]
Notional outstanding OTC interest rate swaps, in all currencies, as at December 31	US$252 trillion	US$292 trillion	US$309 trillion
Notional outstanding OTC interest rate swaps, denominated in Canadian dollars, as at December 31	Can$9.6 trillion	Can$12.1 trillion	Can$18.4 trillion
Number of direct participants	104	105	109

[1] Three new currencies were added for clearing in 2018: the Chinese Yuan, the South Korean Won and the Indian Rupee.

Appendix 2 | Glossary of Terms

central counterparty (CCP)	An entity that interposes itself between counterparties to contracts traded in one or more financial markets, becoming the buyer to every seller and the seller to every buyer, thereby ensuring the performance of open contracts.
central securities depository	An entity that provides securities accounts, central safekeeping services and asset services, which may include the administration of corporate actions and redemptions. A central securities depository plays an important role in helping to ensure the integrity of securities issues (that is, it ensures that securities are not accidentally or fraudulently created or destroyed or their details changed).
clearing	The process of transmitting, reconciling and, in some cases, confirming transactions before settlement, potentially including the netting of transactions and the establishment of final positions for settlement. On occasion, this term is also used (imprecisely) to cover settlement. In the context of futures and options, clearing also refers to the daily balancing of profits and losses and the daily calculation of collateral requirements.
collateral	An asset or third-party commitment that is used by a collateral provider to secure an obligation for a collateral taker.
credit risk	The risk that a counterparty, whether a participant or other entity, will be unable to fully meet its financial obligations when due or at any time in the future.
default	Generally, an event related to the failure to complete a transfer of funds or securities in accordance with the terms and rules of the system in question.
default-management auction	A default-management auction is one of the tools that a CCP may use to transfer a defaulted participant's positions or subset thereof to a non-defaulting participant, thereby removing the position and risks from the CCP and restoring it to a matched book.
designated system / designated financial market infrastructure	A financial market infrastructure designated under the *Payment Clearing and Settlement Act* for oversight by the Bank of Canada.
financial market infrastructure (FMI)	A multilateral system among participating institutions, including the operator of the system, used for the purposes of clearing, settling or recording payments, securities, derivatives or other financial transactions.
liquidity risk	The risk that a counterparty, whether a participant or other entity, will have insufficient funds to meet its financial obligations as and when expected, although it may be able to do so in the future.

payment system	A set of instruments, procedures and rules for the transfer of funds between or among participants. The system includes the participants and the entity operating the arrangement.
payments system risk	The risk that a disruption to or a failure of an FMI could cause a significant adverse effect on economic activity in Canada either by impairing the ability of individuals, businesses or government entities to make payments or by producing a general loss of confidence in the Canadian payments system.
payment-versus-payment (PvP)	A settlement mechanism that ensures that the final transfer of a payment in one currency occurs if and only if the final transfer of a payment in another currency or currencies takes place.
procyclicality	The changes in risk-management requirements or practices that are positively correlated with business or credit cycle fluctuations and that may cause or exacerbate financial instability.
recovery	The ability of a financial institution, including an FMI, to resume operations after a threat to its viability and financial strength so that it can continue to provide its critical services without requiring the use of resolution powers by authorities. More specifically, in the context of an FMI, recovery is defined as the actions of the FMI that are consistent with its rules, procedures and other ex ante contractual arrangements to address any uncovered loss, liquidity shortfall or capital inadequacy, whether arising from participant default or other causes (such as business, operational or other structural weaknesses), including actions to replenish any depleted pre-funded financial resources and liquidity arrangements, as necessary, to maintain the FMI's viability as a going concern and the continued provision of critical services.
resolution	The set of actions that a resolution authority can take when recovery efforts have been unsuccessful or when recovery measures are deemed by the authorities to be insufficient to return the financial institution or FMI to viability.
securities settlement system	An entity that enables securities to be transferred and settled by book entry according to a set of predetermined multilateral rules. Such systems allow the transfer of securities either free of payment or against payment.
systemic risk	The risk that the inability of a participant to meet its obligations in an FMI as they become due, or that a disruption to or a failure of an FMI, could, by transmitting financial problems through the FMI, cause the following: • other participants in the FMI to be unable to meet their obligations as they become due, • financial institutions in other parts of the Canadian financial system to be unable to meet their obligations as they become due,

	• the FMI's clearing house or the clearing house of another FMI within the Canadian financial system to be unable to meet its obligations as they become due, or an adverse effect on the stability or integrity of the Canadian financial system.
US Dollar Bulk Exchange	The US Dollar Bulk Exchange (USBE) is a parallel system to the Retail System. The USBE is used for payment items in US dollars, drawn on a US-dollar account at financial institutions in Canada, but settled in the United States.

Appendix 3 | Abbreviations

ACSS	Automated Clearing Settlement System
CCP	central counterparty
CDCC	Canadian Derivatives Clearing Corporation
CDCS	Canadian Derivatives Clearing Service
CDS	Canadian Depository for Securities Limited
CNS	continuous net settlement
CPMI	Committee on Payments and Market Infrastructures
CSA	Canadian Securities Administrators
DLT	distributed ledger technology
FMI	financial market infrastructure
FSAP	Financial Sector Assessment Program
FSB	Financial Stability Board
IOSCO	International Organization of Securities Commissions
LVTS	Large Value Transfer System
MRM	model risk management
NYL	New York Link
OTC	over-the-counter
PFMI	Principles for Financial Market Infrastructures
PCSA	*Payment Clearing and Settlement Act*
PPS	prominent payment system
PVP	payment-versus-payment
RTGS	real-time gross settlement
RTR	Real-time Rail
SOE	settlement optimization engine
TW	triple witching