INTERNATIONAL MONETARY FUND

IMF Country Report No. 17/211

CANADA

SELECTED ISSUES AND ANALYTICAL NOTES

July 2017

This Selected Issues paper on Canada was prepared by a staff team of the International Monetary Fund as background documentation for the periodic consultation with the member country. It is based on the information available at the time it was completed on June 21, 2017.

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International Monetary Fund
Washington, D.C.

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June 21, 2017

Approved By
Western Hemisphere Department

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ANNEX

INFRASTRUCTURE BANK: LEVERAGING PRIVATE CAPITAL IN THE PUBLIC INTEREST[1]

A. Introduction

1. Investment in infrastructure is a growing component of national economic growth strategies worldwide. While often used as a short-term stimulus to increase demand in an economy, infrastructure is also effective in the long-term by raising labor productivity growth and supporting export performance. IMF research has concluded that there is robust evidence that increasing public investment, and correspondingly the stock of public capital, is positively correlated with economic growth.[2]

2. In addition to increasing the amount of infrastructure spending, attention is being focused on the efficiency of such spending. Not all public investment is equally productive.[3] The World Bank and IMF have jointly developed the Public Investment Management Assessment (PIMA) to promote public financial management (PFM) institutions that, taken together, result in more productive public investment.

3. Countries are exploring institutions to support infrastructure investment. Given that budget funding is limited, many countries are considering institutions to mobilize private capital for infrastructure investment. One area of focus is infrastructure banks, currently operating in a handful of countries (for example, in Australia, the UK, and at the state level in the US) and internationally, such as the European Investment Bank.

4. Canada has proposed the Canada Infrastructure Bank (CIB). Legislation to create the CIB, which has been tabled with Parliament, states:

- The purpose of the Bank is to invest, and seek to attract investment from private sector investors and institutional investors, in infrastructure projects in Canada or partly in Canada that will generate revenue and that will be in the public interest by, for example, supporting conditions that foster economic growth or by contributing to the sustainability of infrastructure in Canada.[4]

5. The aim of this paper is to contribute to clarification of a limited number of issues before the CIB design is complete. Principal among them is the objectives of the CIB and the

[1] Prepared by David Gentry (FAD) and Kotaro Ishi (WHD).

[2] See Chapter 3, IMF World Economic Outlook, October 2014. See also "Estimating the Growth Effect of Public Infrastructure: Evidence from Canadian Provinces," in this selected issues paper.

[3] Making Public Investment More Efficient, IMF Staff Report, June 2015

[4] First Session, Forty-Second Parliament, 64-65-66 Elizabeth II, 2015-2016-2017, Bill C-44, Division 18, paragraph 6

interplay between those objectives and major components of its strategy and operations. Clarity regarding these issues may be helpful in promoting the CIB to Parliament and the public.

6. Below is a short summary of what is currently being proposed for the CIB, subject to change, with a focus on PFM issues.[5]

- The proposed Canada Infrastructure Bank (CIB) will be allocated Can$35 billion (approximately 1¾ percent of 2017 GDP) over an 11-year period. It will add to, and not replace, existing methods of financing public infrastructure at all levels of government, including the federal government's Can$187 billion *Investing in Canada* plan covering 12 years.

- Its main objective is to leverage private capital to add to total public spending on infrastructure, not to earn a financial return or to be financially self-sustaining. Can$15 billion of the Can$35 billion authorization is expected to be expensed.

- The CIB will be a wholly government-owned Crown corporation, subject to provisions of the *Financial Administration Act* (FAA), including the requirement to prepare a corporate plan, operating budget, and capital budget, for approval by the Government.

- The CIB will be on-budget. Funding will be provided to the CIB pursuant to the Minister of Finance's statutory authority under the proposed CIB Act. CIB borrowing is not currently envisaged but should the CIB borrow it would need to submit a borrowing plan, in addition to its corporate plan.

- The CIB and its investments will be on the federal government's balance sheet. However, the infrastructure-related special purpose vehicles[6] (SPVs) in which the CIB invests will not be on the government's balance sheet.

- Explicit fiscal risks are limited to expenses reflecting the concessional nature of CIB investments or realization of associated risks, and to guarantees, which require approval of the Minister of Finance.

B. Attracting Private Capital

7. Attracting private capital requires offering a rate of return acceptable to the investor. Worldwide, there are trillions of dollars looking for safe returns over the long-term. While the supply

[5] Obtained from the draft legislation, public announcements, and discussions with federal government officials

[6] A special purpose vehicle (SPV) in this context is a legal entity created to finance, construct, own, and operate an infrastructure asset. Equity investments by the CIB and the private investor would be in the SPV.

of capital is a necessary condition, private investment in infrastructure will not occur if the terms of the investment are not acceptable to the investor. Private investors are interested in financial returns, not economic or social returns[7]. This section focuses on i) how much can a private investor be expected to invest in a project; ii) what is the rate of return that a private investor requires, how can it be reduced, and how to prevent excess returns; iii) the role of the CIB in reducing the rate of return required by private investors; and iv) why the CIB invests equity alongside private investors.

8. The amount of private capital that can be attracted to a project can be described using the elementary finance equation in Box 1. The three components are:

- Future value, or free cash flow (FCF)[8], defines the maximum financial returns from the project that can be paid to private investors over the life of the investment.
- The risk-adjusted rate of return for an investor has two elements. i) The risk-free rate is the theoretical rate of return of an investment with zero risk of financial loss over a given period of time. Commonly used proxies are treasury bills issued by a highly rated government.

Calculating the Amount of Private Investment

A private investor would be willing to invest up to an amount equal to the present value of the future free cash flows of a project. The present value will rise if the future free cash flows increase or if the risk premium becomes smaller.

$$\sum_{t=0}^{N} \frac{(future\ value)_t}{(1 + risk\ free\ rate + risk\ premium)^t}$$

- ii) The risk premium is the rate of return in addition to the risk-free rate that is demanded by investors as compensation for the sum of risks in an investment. There can be many types of risk. While some risks apply to all investments, such as the risk of default, the type and magnitude of risks associated with infrastructure vary according to each project.

9. The amount of private capital leveraged will vary dramatically based on FCF and risk premiums. FCF and risk premiums can change through management decisions on a project-by-project basis. The focus of management and financing arrangements is on influencing both these

[7] Social returns are effects on society that are not reflected in prices charged to users, often referred to as externalities. While these can be positive or negative, reference to social returns in this paper assume they are positive.

[8] Free cash flow is calculated as cash revenue minus cash operating costs and minus cash required to maintain productive capital (in the case of infrastructure, this would be interpreted as capital replacement, while routine maintenance would typically be treated as a cost). Cash generated to provide financial returns can also be obtained through innovative tax measures, such as capturing an increase in property values due to the public infrastructure. This assumes no assets sales or borrowing to finance distributions to investors.

project characteristics in a positive direction (described below). The risk-free rate of return cannot be influenced by project managers.

- **Increase FCF.** FCF is the positive difference between cash inflows and cash outflows. Cash inflows can be directly increased by charging user fees. Decreasing cash outflows is most effectively achieved by having the private investor apply expertise to the entire life cycle of the project, from design and construction, to operations and maintenance. For example, it may be worthwhile to have a slightly more expensive design if it would result in significantly lower operation and maintenance costs.

- **Reduce the risk premium required by private investors.** Risk to the private investor can be reduced in many ways. Diversification, by distributing capital across many investments or grouping many infrastructure projects in a single financing agreement, is a standard approach. Risk borne by a private investor in a single project can be reduced in other ways, for example:

    - Responsibility for early stage project development could be shifted from the SPV to the CIB. For example, permitting, zoning, and public outreach require extensive staff time to represent and advocate for the project to appropriate authorities, and progress is often highly uncertain. The CIB could also be viewed as a more neutral third party, compared to the SPV.

    - Ensure predictable FCF over the period of the private sector financing, including i) a stable tax and regulatory environment, ii) CIB guarantees[9] of minimum user demand, fee rates, or total revenue, and fee rates are adjusted over the life of the asset by a trusted third party comparable to a utility rate commission, and iii) equity investment by the CIB that the private investor would see as a partnership in which the CIB helps it to protect project financial outcomes.

    - Match the project profile with investor knowledge and needs. Capital market expertise of CIB staff, and investor selection procedures, can help identify investors who understand risks and can better manage them, resulting in a lower risk premium. In addition, such knowledge and procedures can more closely match total project characteristics, such as size, term, and liquidity with the investor interests.

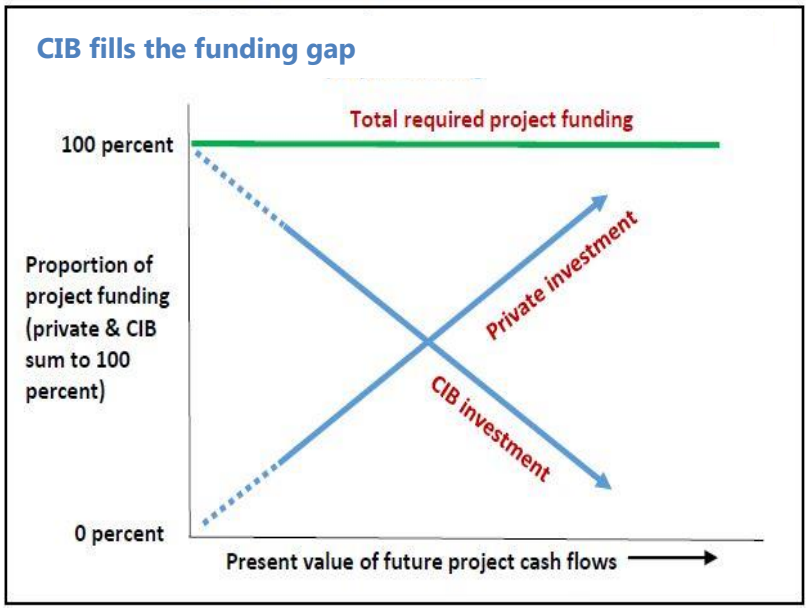
10. Investment in existing infrastructure is attractive to private investors because risks are lower. These are commonly referred to as brownfield investments. The development phase for these projects has been completed, and maintenance requirements and user demand are known. The sale of existing infrastructure by governments is often referred to as recycling assets, meaning extracting capital from one project and investing it in another. This is advantageous for the public

[9] The CIB should be cautious when awarding guarantees, in terms of number and potential payout, so as to limit contingent liabilities.

sector but it often requires the user to make payments for a longer period and possibly at higher rates to satisfy the new investment agreement related to the existing infrastructure asset.

11. The CIB fills the funding gap between private investment and total project funding.[10] If the amount of private investment is determined per the formula in Box 1, CIB investment fills the funding gap. Figure 1 illustrates that as the size of the discounted cash flows grows, the size of the funding gap, and thus CIB investment in the project, becomes smaller. Actual FCF exceeding that necessary to provide the private investor the rate of return agreed in the financing agreement should be distributed to the CIB.

12. This figure raises several important additional points.



- Minimum private investment required for CIB to participate: the figure represents with a dotted line the region in which the present value of future project cash flows, and thus private investment, is below the minimum required by law or policy. The minimum has not been officially announced, and thus the point at which the dotted line becomes solid in the figure is hypothetical. The smaller the proportion of private investment, the closer the project resembles a public-private partnership (PPP).[11]

- Forms of CIB investment: since it is desirable that the SPV is majority owned, and thus controlled, by the private investor, any investment by CIB greater than 49 percent equity would typically be loans. The permissible forms of investment by CIB beyond 49 percent of total project cost should be determined.

- Circumstances under which the CIB would experience financial returns: FCF would first be allocated to private investors, and only then to the CIB for return of capital and financial returns on that capital. If the project generates enough FCF for the CIB to receive returns equal to the

[10] To simplify the analysis in this paper, it is assumed that there are only two investors in a project: the CIB and one private investor. In fact, there are many possible combinations of investors, including federal, provincial, or municipal governments, and multiple private investors. The fact of multiple investors in a project does not invalidate this analysis.

[11] A key distinction between CIB projects and PPPs in Canada is that CIB projects must be revenue generating whereas PPPs need not be.

private investor, then the entire project could be financed privately (leaving aside non-financial benefits of having the CIB as a partner and cases where actual FCF turn out to be higher than anticipated in the financing agreement). Therefore, the CIB would be expected to indirectly subsidize, or be subordinate to, the private investor by accepting lower rates of return.

- Degree to which CIB acceptance of project risk would be reflected in the total project cost: in the aim of full disclosure, the estimated value of CIB risk mitigation efforts, including any guarantees and non-financial staff efforts to develop a project, should be reflected in the total project cost, regardless of the extent to which the project financing agreement contains provisions for cost recovery or return on those investments. This raises valuation challenges.

13. The risk-adjusted rate of return sufficient to attract an investor is not known with precision ex-ante. Investors will seek the highest rate of return possible above its minimum threshold. There is no objective measure of risk: perceptions of risk will vary based on the familiarity of an institutional investor with project risks, and its ability to manage them. An investor should be expected to reveal its true perception of risk, and thus its acceptable risk-adjusted rate of return, in a competitive bidding procedure, such as for selecting investors. This constitutes market rates. In addition, actual returns to private investors during the life of the investment can be controlled by allocating FCF to the private investor and the CIB in the manner noted in paragraph 11.

C. Effects on Public Finance

14. The effect on public finance can be viewed from multiple perspectives. The objective of attracting private capital to fund public infrastructure stated in the draft CIB legislation is quite general and provides little guidance when determining the role, strategy and operations of the CIB. This section addresses; i) how is maximization of spending for infrastructure measured; ii) how the CIB spends money allocated to it; iii) how budget funds are allocated to the CIB; iv) the fiscal risks arising from the CIB and its investments; and v) the effect of the CIB on the efficiency of public investment.

15. From the perspective of total spending on infrastructure, the objective of attracting private investors could be further refined by adopting one of the following options:

- Maximize total infrastructure spending by maximizing public and private financial resources
- Maximize total infrastructure spending under conditions of restrained public spending or borrowing dictated by fiscal policy
- Maximize infrastructure built by lowering project costs. In other words, the same amount of spending, regardless of financing source, purchases more infrastructure.

16. From a cost of funds perspective, private capital should be employed only if public borrowing is constrained. Government borrowing releases pressure on annual budgets by distributing the cost of a project over many years through debt service. The federal government of Canada currently can borrow using bonds yielding about 1.9 percent annually. Risk-adjusted rates of

return required by private investors will likely be between 5 and 15 percent, assuming private investors bear at least some of the project risk. Thus, the same project FCF could support more government borrowing than investor capital. To minimize financing costs, government should borrow to the maximum extent possible within a prudent fiscal framework before using private capital. In the case of Canada, the federal government wishes to limit borrowing and embark on a declining path of debt-GDP. In addition, there is a broad sense that the infrastructure gap in Canada is significant, although estimates range widely from Can$150 billion to Can$ 1 trillion (Advisory Council on Economic Growth, 2016). Accordingly, government alone cannot meet such a large amount of infrastructure demand.

17. A tension can exist under certain circumstances between financial and social returns to infrastructure investment. For example, financing infrastructure through user fees reduces social returns if the public infrastructure is used at less than its capacity.[12] Assuming that public infrastructure has social benefits that exceed financial returns, and the financial returns are less than necessary to attract private investors (otherwise the private sector would have already built the infrastructure), society is better off if the social benefits are made available to the maximum number of users through public subsidies until the infrastructure is used to capacity, after which prices would be used largely for demand management. To the extent that prices are charged (i.e. user fees) to finance the infrastructure, demand for the infrastructure may be unduly low and society is worse off. This is a justification for the CIB funding at less than market rates of financial return noted in the previous section, and is graphically displayed in Box 2.

18. Private sector expertise could result in lower project costs or longer asset life, thus offsetting higher financing costs. The likelihood of this potential being realized is enhanced if the CIB and private investor are joint equity investors, thus aligning the interests of both parties to achieve lower total costs in a cooperative fashion. As noted above, a life cycle contract with the SPV covering design, construction, operations, and maintenance would contribute to this aim. A non-financial role the CIB could play would be to document the extent to which private implementation of infrastructure projects reduces total costs compared to similar projects implemented by governments in Canada.

19. From the perspective of how the CIB deploys its funding, there are several possible ways for the CIB to best use taxpayer funds provided to it. Note each objective has consequences for project FCF and risk, which can be adjusted using the mechanisms described above. The objectives have important implications for project selection.

- Maximize the total amount of private capital leveraged. This objective would be advanced primarily by maximizing the number of CIB projects going forward, determined by selecting projects with ease of implementation in mind. It would also tend to encourage allowing private investors wide latitude from a wide pool in selecting projects they find most attractive, and would have the effect of investors
  focusing on the least risky projects. Stated another way, this objective maximizes FCF and thus

[12] The economist William Vickery explored in detail optimal pricing for public services

minimizes CIB investment in the aggregate, and may contribute to projects being implemented relatively quickly.

- Minimize the risk-adjusted rate of return required by the private investor. This objective would mean that the CIB investment in a project is minimized. It would also mean that there would be an incentive for the CIB to maximize the non-financial methods for reducing risk borne by the private investor, for example by CIB staff handling early project development efforts. The CIB would want wide latitude to choose projects from a relatively large pool.

- Advance projects where the private sector has the potential to achieve significant economies through its management expertise. These would tend to favor three quite different types of projects. First, projects for which a firm has developed a specialization, and has extensive experience in implementing that type of project. Second, large, complex projects requiring sophisticated technical or project management skills. Third, projects that may benefit from an arms-length relationship from public pressures.

20. From the perspective of allocating funds to the CIB, the CIB would be on-budget. Within the proposed Can$35 billion, the Minister of Finance will allocate funds as needed under the authority proposed in the CIB Act.[13] The draft legislation is silent on treatment of return of CIB equity investments or retention of earnings. It is also silent on whether approval in the budget process of CIB investments is in the aggregate or is on a project basis, which has a bearing on the degree to which the CIB can operate at arms-length from the federal government. SPVs in which the CIB invests would likely not be on-budget.

21. Fiscal risks associated with the CIB and its investments are mainly implicit. CIB expenses include investment loses. Whether planned or unplanned, such events lower the government's net worth but will not place an unexpected demand on spending because cash disbursements have already occurred. As noted above, a policy on retention by CIB of return of capital or financial returns has not been indicated. The CIB may issue guarantees which under the FAA are subject to approval by the Minister of Finance. The CIB will be protected from SPV liabilities by the corporate veil. A risk arises if the SPV, as a private entity, is not required to publish its accounts and the federal government through the CIB may be implicitly liable to finish a project or to operate infrastructure if the SPV fails. In addition, issues of confidentiality may prevent the CIB from publishing the terms of its financing for the SPV.

[13] Subsection 23

22. Viewing the CIB through the lens of the PIMA framework, the efficiency of public investment would be enhanced by the CIB in several ways.

- Lower project costs may result from the private investor exercising greater discipline in project design, construction and operation than might be possible for a government agency.

- The CIB would need to publish project selection criteria to effectively guide projects submitted to it through the planning process, and to publish investor selection criteria as part of an open and competitive selection process.

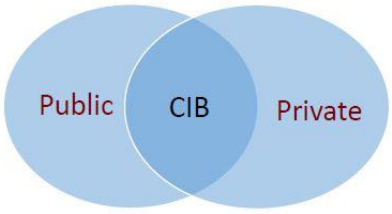
23. The efficiency of public investment might be marginally reduced by the CIB in several ways. Some of the points noted below are dependent on the details of the CIB project selection process, described in the next section.[14]

- Assets initially owned and operated by the SPV may not be on a government asset registry, and asset and asset depreciation will likely not be on government balance sheets. Although governments would not be responsible for maintenance of an asset until it is turned over to them, lack of information on an asset register could inhibit infrastructure planning.

- While the project selection process is yet undecided, as discussed below it is preferable that it is built on existing planning processes. If a separate planning process is established for the CIB, there is the potential to fragment priorities. Under all circumstances, additional complexity is added to the planning process if the CIB and private investors exercise discretion about what projects go forward.

D. CIB Project and Investor Selection

24. Selection of projects and investors requires balancing public and private interests. These and related issues include: i) ensuring that projects are in the public interest and are of high priority; ii) consistency with the CIB's objectives; iii) promoting the potential of private investors to exercise their expertise to lower project costs and find innovative solutions to meeting public priorities; iv) resolving timing differences for factors required in the project selection process but not known with certainty until after the project selection process is completed; and v) selecting private investors in a competitive and transparent manner to establish market risk-adjusted rates of return and avoid the appearance of favoritism.



25. Ensuring that projects are in the public interest and are of high priority should be determined in government planning processes. These processes are intended to identify projects

[14] While a pool of projects with high social returns are identified in the planning process, the CIB will likely focus on those projects within the pool with relatively high financial returns. That said, the CIB is intended to free up budget funds for infrastructure projects with high social returns that generate none or little revenue.

that have high rates of social returns. Currently, municipalities, provinces, and federal departments each have a planning process for this purpose. Existing programs to provide infrastructure funding to provinces and municipalities, such as the *Investing in Canada* plan, rely heavily on local governments to establish project priorities.[15]

26. Proposals have been made to establish a consolidated, federally-sponsored list of projects for the CIB. It is not clear why this proposal arises in the context of the CIB but not in discussions of other infrastructure financing programs that are significantly larger. Creating a new planning process that is expected to make trade-offs and establish priorities across jurisdictions raises a host of challenges, especially in country with a federal form of government. Also, it is a tenet of good PFM practice that a single set of priorities should be established regardless of financing source.

27. There are significant advantages to allowing the CIB and private investors latitude to select from a relatively large pool of projects that are deemed to have high social returns. As emphasized above, risk and therefore risk-adjusted returns are based on investor perceptions and expertise, and will vary widely among potential investors. If the planning process identifies a small number of projects for which the CIB is asked to mobilize private financing, opportunities for private investor participation may inadvertently be missed and may result in selection of projects for which investors demand a relatively high risk-adjusted rate of return. It will also limit the projects for which investors may offer innovative solutions, and limit the ability of the CIB to exercise its judgment regarding what projects can be implemented more quickly and with maximum leverage from public investment.

28. Innovative solutions proposed by private investors should be guided by government-stated priorities. These priorities may be goals and objectives, for which an innovative solution can be proposed, or well-defined projects. Innovation, thus, would typically be focused on issues of project delivery, including design, construction, operations, and maintenance. An unsolicited proposal from an investor for a goal, objective, or project that is not in the pool of proposed projects should not be entertained. Doing so, first, undermines the planning and priority-setting process. Second, it invites bi-lateral discussions between investor and a government that are inherently non-transparent, giving rise to suspicions of improper negotiations. Third, the unsolicited proposal can be written in a way to give an advantage to the investor proposing the project, thus undermining the competitive investor selection process. That said, a private investor could propose projects to governments who then advance the project through the planning process in a transparent manner.

29. Project innovations proposed in the investor selection process must be reviewed by the government that proposed the project. Innovations would typically be proposed at the time that an investor submits a bid in the investor selection process. The investor selection process would be based on projects selected through the planning process, and projects would commonly be

[15] Local governments are responsible for more than 90 percent of all infrastructure spending in Canada, including financing provided to them by the federal government

described in terms such as physical structure, location, capacity, life-span, and schedule for completion. If an investor proposes an alternative solution, these project characteristics would change. The innovative solutions proposed by an investor must be referred to the originating government to obtain its consent, which should be given before the investor financing agreement is finalized.

30. There are important timing challenges when selecting projects and investors. For example, the FCFs of a project are based on design capacity, user fees charged, and user demand. Preliminary estimates may change significantly following proposals from investors, especially innovative proposals. In addition, as noted above, the rate of return demanded by investors, and therefore the proportion of a project that can be funded by private investors given expected FCFs, cannot be known until the investor selection process is completed. This will determine the investment by the CIB. Such considerations might lead the CIB to employ a two-stage process, a short-listing followed by final selection based on a more detailed proposal, to ensure a fair and equitable selection process.

31. Criteria and process for selecting projects are directly related to CIB objectives. Components of possible project selection criteria have been discussed above. Taken together in different combinations they constitute strategies, which have important implications for how the CIB functions and the projects it undertakes. For example:

- Strategy 1 maximize infrastructure built: i) maximize annual mobilization of private capital, including quantity and speed of project delivery; ii) FCF is maximized (i.e. user fees are high and costs are reduced to the extent possible); iii) the CIB takes on a relatively large amount of risk in order to lower risk-adjusted return to the investor and maximize leverage; iv) a large pool of projects is available for selection by investors; v) investors will likely choose projects that are relatively simple and low risk.

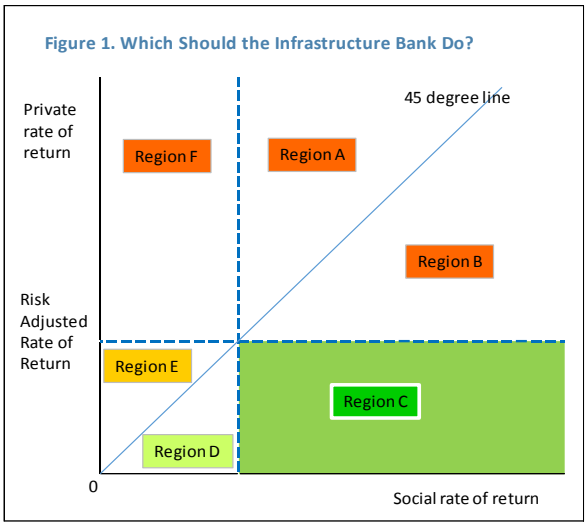
- Strategy 2 maximize social rate of return: i) CIB equity investment at less than market rates of return is large; ii) FCF is lower than potential (i.e. user fees are not maximized early in the life of the infrastructure when user demand may be light) and thus the CIB is responsible for a higher proportion of total project funding; iii) the CIB takes on relatively large amounts of risk; iv) the planning process is relatively more important, as it must identify those projects of highest priority; v) the investor selection process would adhere closely to priorities issued through the planning process and requires a second review by the proposing government or by the planning process in the event of proposed innovations which may affect the social rate of return.

- Strategy 3 maximize marginal benefit of CIB funds: i) the CIB leverages the most private capital per CIB dollar invested; ii) the CIB emphasizes use of non-financial means to lower the risk-adjusted rate of return of private investors, such as the use of CIB staff to assist in the early stage project development; iii) FCF is maximized (i.e. user fees are relatively high); iv) the pool of projects offered through the planning process should be large, allowing the CIB latitude to find the highest return projects; and v) the CIB will tend to encourage private investor innovation to lower upfront cost rather than long-term cost or effectiveness.

Box 1. Social Versus Financial Returns to Investment[1]

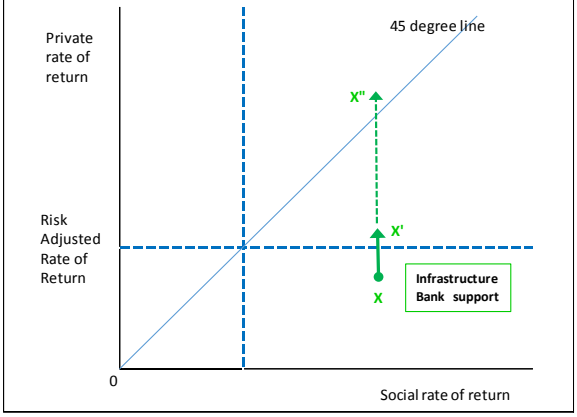
Which projects should the government do? Figure 1 shows a rate of return for a private infrastructure investor on the vertical axis and a social rate of return (which includes the externality effect arising from an investment project) on the horizontal axis. Projects with a positive externality are on the right side of the 45-degree line. The private sector is willing to undertake an infrastructure project if its rate of return exceeds its costs of funding (Regions A, B, and F). The government may want to prioritize projects with a high social rate of return. Thus, it prefers projects in Regions A, B, and C to those in Regions D, E, and F. However, the government does not need to undertake these projects on its own, as the private sector is willing to invest in Region A and B. This leaves Region C to the government. In Region C, projects have a high social return, but its private return is not high enough to cover costs of funding the project.

Figure 1. Which Should the Infrastructure Bank Do?



How can the Infrastructure Bank help? The government does not need to carry out all infrastructure projects in Region C on its own. It can provide financial incentives in various forms to the private sector so that the risk-adjusted rate of return for them is higher—which is shown an upward shift from X to X' in Figure 2. However, there are operational challenges. One of them is that such financial incentives should not be too generous: otherwise, the private rate of return (after including government financial incentives) could be higher than social rate of return (point X"). Thus, fair and transparent competition and professional expertise are required in the process of selecting projects and negotiating financing terms.

Figure 2. What Roles Should the Infrastructure Bank Have?



1/ The analytical framework in this box largely draws from Warner, A., 2013, "A Framework for Efficient Government Investment," IMF Working Paper, WP/13/58.

E. Comparative Advantages of the CIB

32. Two aspects of the proposed CIB enable benefits that cannot be obtained from other Canadian public infrastructure institutions. First, only the CIB is directed to invest in revenue generating infrastructure. PPPs in Canada generally employ budget financing, and revenue generated by a PPP is typically deposited into the general treasury. Second, only the CIB is directed to invest in equity alongside private investors. This signals government commitment to a project and

establishes a partnership with the private sector even with symbolic levels of CIB investment. Such equity partnership aligns interests of all parties owning equity, and enhances monitoring by providing access to SPV operational and financial information.

33. The issues identified in previous sections have implications for the CIB as an organization.

- The CIB is better characterized as a fund than a bank. It cannot be financially self-sustaining. However, substantial benefits can be derived from the CIB as a fund.

- The respective roles of the CIB and the planning process must be clear. The planning process is the primary channel for evaluating project social rates of return and determining a limited pool of projects available for private investment that enhance the public interest. Asking the CIB also to evaluate social rates of return is redundant and could result in conflict with previously published priorities. A clear role for the CIB would be to focus on financial issues integral to its strategy, and move projects previously screened for the public interest forward as quickly as possible.

- The skills set of CIB staff should reflect its role and strategy. If the strategy emphasizes non-financial risk reduction, increases the intensity of interaction with governments, or focuses on social rates of return, more weight should be given to staff with government and public service skills. Conversely, a strategy that emphasizes creative financing, financial means of risk reduction, and matching of investor financial needs with project characteristics, more weight should be given to staff with capital markets skills. This decision will likely affect total staff compensation.

F. Possible Public Concerns

34. The federal government may wish to address early in the public debate on the CIB objectives, policies, and procedures of concern to Parliament or the public. Explaining why certain policies and procedures are necessary to achieve widely-agreed objectives may make them more acceptable. While it is impossible to anticipate all such concerns, a few seem likely:

- User fees: public surveys consistently report public resistance to user fees. However, revenue generated from infrastructure is perhaps the single most important distinguishing characteristics of the CIB. In addition, user fees supplement government financial resources obtained through taxation, and increasing infrastructure investment requires additional revenue.

- Perceptions of excess returns to investors: the process for selecting investors must be open and competitive. This is especially important if the public perceives the rate of return to investors to be high. A competitive selection process must assure the public that private investor rates of return are the lowest possible rate given the risk of each project, and that a sub-set of investors do not receive any form of favoritism. This process should parallel good procurement practices.

The CIB must be prepared to withdraw a project that requires unusually high risk-adjusted rates of return, and must have the staff capacity to make this assessment.

- Subsidizing private investors: CIB financing at a lower rate of return, writing-off investments, or granting funds may be necessary to give private investors the rates of return acceptable to them. The public interest is served through such funding if the alternative is that government fully funds the project itself and bears all the project risk. It is highly likely that many people will characterize such funding in support of private investors as subsidies, and as being unfair.

- Input on project selection: the process for selecting projects for which private investment is invited is of key concern to all governments and the public. These concerns may relate to the distribution of projects geographically and across jurisdictions, and how governments at all levels have a voice in the project selection process.

- Input on project implementation: all projects will be physically located in one or more provincial and municipal government jurisdictions, even if the project is under the responsibility of a federal department. Local governments need to be assured of opportunities to provide input on the final design and implementation of the project, especially if innovative proposals have been made.

G. Conclusions

- The CIB is expected to be an effective new tool to increase investment in public infrastructure by mobilizing private capital. It adds to existing Canadian programs and resources in support of public infrastructure.

- The public interest would be served by instituting a process for selecting projects, to which private investment is invited, that builds on, without replacing, the existing infrastructure planning process at all levels of government.

- Private capital will be attracted by acceptable risk-adjusted rates of return. While private capital is costlier than government financing, private investors are expected to apply their expertise to lower total project costs, thus offsetting at least partially the higher financing costs. Private investors should be selected for specific projects in an open and competitive manner to minimize the risk of these rates of return being excessive.

- The CIB is expected to enhance public finances. User fees add to public funds available to support infrastructure. The size of private investment would be determined by the size of project-generated cash flows. The CIB will be on-budget in aggregate and will be reflected in the federal government balance sheet. Measures are available to contain explicit fiscal risks.

- The CIB should be thought of as a fund rather than a financially self-sustaining bank. Its main role is to match private investors with a short-list of high priority revenue-generating public projects, and find ways to advance those projects. It will be unique in its ability to invest public

funds in equity alongside private investors, thus aligning private capital and expertise with public interests.

- Communicating to the public CIB's objectives, and policies and practices required to meet these objectives such as the need for user fees, is critical to gaining approval to establish the CIB and ensuring ongoing public support for its operations. Some public concerns can be anticipated and should be addressed proactively, such as resistance to user fees and public perceptions of high rates of returns benefiting private investors at government expense,

ESTIMATING THE GROWTH EFFECT OF PUBLIC INFRASTRUCTURE: EVIDENCE FROM CANADIAN PROVINCES[1]

A. Introduction

1. Canada has launched an ambitious infrastructure program to boost its long-term growth potential. The federal government is committed to investing Can$ 187 billion (equivalent to 7½ percent of GDP) in public capital, a half which (Can$ 96 billion) is new additional infrastructure spending. This will triple investment in public capital over the next decade. Priority projects include: (i) public transit infrastructure to better connect Canada's transportation system within the country and to the world to facilitate trade and movement of people; (ii) green infrastructure to create greener energy and cleaner land; and (iii) social infrastructure to provide affordable housing, child cares spaces, and communities centers.

2. The objective of this chapter is to estimate the macroeconomic effects of infrastructure investment. For countries where infrastructure bottlenecks are constraining growth such as in Canada, the gains from alleviating these bottlenecks are likely to be large. Using panel data for 10 Canadian provinces over 1961-2015, we present some evidence that public investment in infrastructure could boost economic growth and complement private investment. Importantly, we find that public infrastructure investment generates positive spillover effects across regions: higher public investment in one province boosts output in the rest of Canada

B. The Size of the Problem

3. There is broad consensus that the infrastructure gap in Canada is sizable, although estimates range widely from as low as Can$150 billion to as high as Can$ 1 trillion (Advisory Council on Economic Growth, 2016). The World Economic Forum Global Competitiveness Index suggests that Canada's overall ranking in the quality of infrastructure dropped to 21st position most recently, down from 17th position a decade ago, with the decline in the ranking of roads and railroad as the most evident.

Table 1. Canada: Global Competitiveness Index
(Rank)

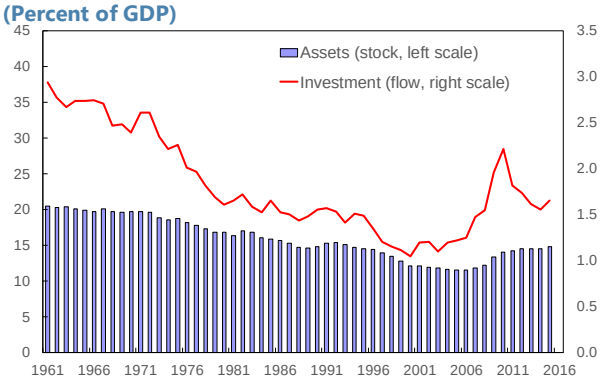
	2006/07	2016/17	Change in rank (+: rank up)
Overall	17	21	-4 ↓
Roads	16	22	-6 ↓
Railroad	14	18	-4 ↓
Port	16	19	-3 ↓
Air transport	17	16	1 ↑
Electricity supply	18	16	2 ↑

Source: World Economic Forum Global Competitiveness Index.

[1] Prepared by Kotaro Ishi and Rodrigo Mariscal (both WHD) and David Gentry (FAD).

4. In addition, the stock of economic infrastructure stands at a historical low. Economic infrastructure includes railways, ports, airport, pipelines, roads, and energy networks that supports the delivery of public services, connects people to jobs, and facilitates businesses through reduction of costs of doing businesses. Investment in economic infrastructure therefore directly affects economic production. However, the stock of economic infrastructure has declined from about 20 percent of GDP in 1961 to as low as 12 percent in 2007, reflecting a steady decline in public investment for four and a half decades. The downward trend was reversed during the 2008-09 global financial crisis when the government increased infrastructure spending as part of its stimulus efforts, but the stock of economic infrastructure assets remains at historic lows, 5¾ percent of GDP below the level in 1961.

Figure 1. Economic Infrastructure Assets and Investment (Percent of GDP)

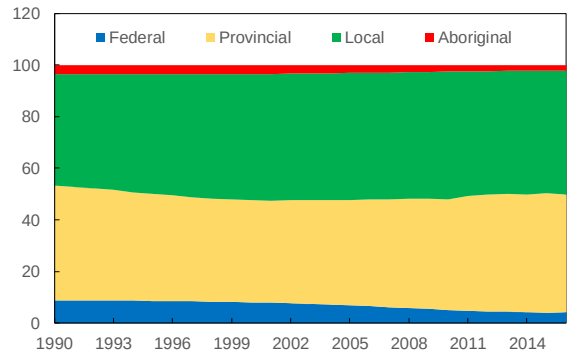


Sources: Statistics Canada CANSIM Table 031-0005; and Haver Analytics

C. Policy Considerations

5. Canada's fiscal federalism presents both advantages and challenges in coordinating infrastructure investment. The bulk of economic infrastructure assets is owned and managed by provincial and local authorities. The federal government's share of infrastructure assets has halved to 7 percent since 1990, while provincial and local governments have increased their share to more than 90 percent of total assets today.

Figure 2. General Government Economic Infrastructure Assets 1/
(Percent share)



Sources: Statistics Canada, CANSIM Table 378-0121; and Haver Analytics
1/ Book value.

- **Advantages.** Lower levels of government (provincial and local governments) are better positioned to identify what local communities need. For example, they are more likely to know which communities would benefit most from local infrastructure projects, such as water supply or urban transit. In this case, decentralization to provincial and local governments is both feasible and desirable for allocative and administrative efficiency (Ahmad, Hewitt, and Ruggiero, 1997).

- **Challenges.** Since many infrastructure facilities—including roads, railways, and airports— have connectivity and are part of networks, investing in infrastructure in one province would likely have spillover effects to other provinces. Accordingly, better coordination across jurisdictions in the planning and execution of infrastructure projects could improve economic benefits (in terms of efficiency and growth gains). However, currently, there is neither an established institutional

mechanism for federal-provincial coordination nor a national infrastructure strategy that aligns priorities across all levels of government. The federal government provides conditional grants to provincial and local governments to influence their decision making over infrastructure projects, but some question their effectiveness as a i policy tool (Public Policy Forum, 2016).

6. Better coordination. Increasing the efficiency of public investment is critical to reap its full benefits. Canada has a highly efficient public investment framework but there is room for improvement. The federal government should develop coordination mechanisms that identify infrastructure gaps and increase transparency. More specifically, the IMF Public Investment Management Assessment framework suggests merits of reforming the following areas.

- Specifying capital funding amounts by department in the medium-term budget framework, which could support more detailed sectoral investment strategies and a project pipeline
- Promoting inter-governmental coordination by consolidating federal and provincial approved projects into a single report updated annually
- Identifying major public investment projects in budget documents to clarify their contribution to achieving program objectives and protect their funding during budget execution
- Improving transparency regarding public investment spending by publishing Project Briefs and business cases for approved major projects, total expected financial obligations of ongoing projects, project audits, and PPP risks
- Establishing and publishing recommended methodologies for appraising proposed projects and evaluating projects upon completion
- Publishing the total cost of projects at the time of initial funding.

D. Empirics

7. The empirical analysis focuses on estimating the macroeconomic effects of increasing economic infrastructure and asks the following questions.

- *Does infrastructure investment contribute to boost output? If so, how much?*[2]

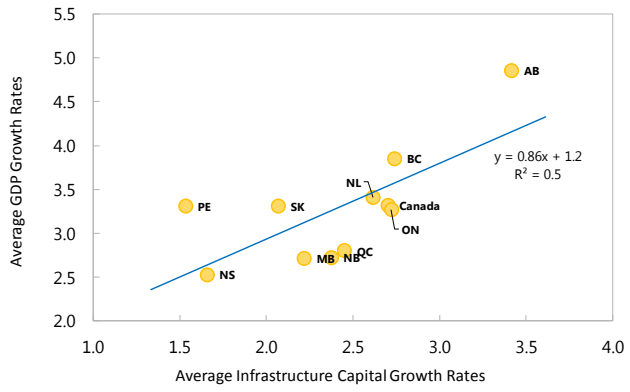
[2] IMF (2014) analyzes the macroeconomic impact of public investment shocks in advanced economies, using the local projection methodology proposed by Jordà (2005). The analysis shows that public investment shocks have statistically significant and long-lasting effects on output, with an unanticipated 1 percentage point of GDP increase in investment spending increasing the level of output by about 0.4 percent in the same year and by 1.5 percent four years after the shock.

- *Does infrastructure investment have spillover effects across Canadian provinces?* Since most infrastructure assets are owned and managed by provincial and local authorities, but an infrastructure policy coordination framework has not been fully developed, finding positive spillover effects would argue for establishing a coordinating framework.

- *Does infrastructure investment crowd in private capital investment?* This question revisits a long-standing debate on whether public infrastructure crowds in or crowds out private capital (see for example, Afonso, A., and M. St. Aubyn, 2008). On the one hand, an increase in public investment could lead to higher interest rates (if the investment is debt-financed) or to a higher tax burden for the private sector: in either case, demand for private investment would be dampened. On the other hand, an increase in public investment could lead to higher quantity and quality of infrastructure assets, thus contributing to higher productivity of private capital, as costs of doing business fall. In this case, an increase in infrastructure investment would crowd in private investment.

8. To answer these questions, we run panel regressions, using data from 10 Canadian provinces. The sample period is from 1961 to 2015 (annual data), and the panel dataset is balanced (see data description in Annex I). For the average of the full sample period, we observe a relatively strong positive relationship between the annual increase in the stock of infrastructure assets and provincial GDP growth (Figure 3).

Figure 3. Growth of Infrastructure and Provincial GDP, 1961-2015
(Period average, percent)



Sources: Statistics Canda CANSIM Table 031-0005; and Haver Analytics

9. A standard Cobb-Douglas production function is estimated. Following Aschauer (1979) and Munnell (1990), we assume that infrastructure capital contributes to output and enters the production function.

$$Y_{it} = \mathrm{A} L_{it}^{\beta^L} K_{it}^{\beta^K} G_{it}^{\beta^G} \overline{GO}_{it}^{\beta^{GO}} \quad (1)$$

where Y_{it} is real GDP, A captures total factor productivity, L_{it} is employment, K_{it} is real private capital stock, G_{it} is real infrastructure stock, $\overline{GO}_{it}$, real infrastructure stock in the other provinces, for province i and time t. Coefficients β^L, β^K, β^G, and β^{GO} denote elasticities of output with respects to inputs.

We include $\overline{GO}_{it}$ to examine whether output in province i depends on infrastructure in other provinces. In other words, we test whether infrastructure in one province could cause spillover effects to the rest of Canada. We experiment with two different weighting methods to calculate this variable.

- Weighted by geographical distance. Spillover effects could be greater across nearby provinces. For example, Ontario's GDP would be affected more by infrastructure in Quebec than in British Columbia. To test this hypothesis, we construct weights based on the distance between pairs of provinces (capital cities).

- Simple average. Given that economic activity across Canadian provinces is highly integrated, geographical distance may not matter. In this case, Ontario's GDP would be affected not necessarily by infrastructure in Quebec but by overall infrastructure in all Canadian provinces. To examine this hypothesis, we calculate $\overline{GO}_{it}$ as the simple average of other provinces.

Taking logarithms of equation (1), we estimate the following baseline model.

$$y_{it} = \beta_i^L l_{it} + \beta_i^K k_{it} + \beta_i^G g_{it} + \beta_i^{GO} \overline{go}_{it} + u_{it} \quad (2)$$

$$u_{it} = \alpha_i + \gamma_i \omega_t + \varepsilon_{it}, \quad (3)$$

where lower case variables denote natural logarithms. Unobservable u_{it} can be interpreted as total factor productivity, and is composed of a province specific intercept, α_i, a time trend, $\gamma_i \omega_t$, and the white noise error terms $\varepsilon_{it} \sim IID(0, \sigma^2)$. On the time trend, we examine both a linear trend and a time-variant trend (see below).

10. We estimate the above equation using a fixed effects model and pooled mean group estimation. Note that Canadian provinces are diverse, with different settings in structural and economic fundamentals, including natural resource endowments, legal and regulatory frameworks, industry structures, and labor markets. In estimating equation (2), heterogeneity across Canadian provinces should be considered. The fixed effects model is the most restrictive one, where the slope coefficient β_i and the time trend coefficient $\gamma_i \omega_t$ are assumed to be the same across provinces ($\beta_i = \beta, and\ \gamma_i = 1, for\ all\ i$), but the intercept term, α_i, is different across provinces. Next, we relax the assumption of the fixed coefficient β and allow it to vary across provinces (but the time trend, $\gamma_i \omega_t$, is still assumed to be constant). To this end, we apply the mean group (MG) estimator developed by Pesaran and Smith (1995).[3] Finally, we relax the assumption of the constant time trend, and apply a mean group estimator with a common dynamic process (MG-CDP), developed by Eberhardt and Teal (2010).[4]

Results

[3] The MG procedure is simple: first estimate equation (2) by OLS for each province, and then take the average.

[4] MG-CDP procedures takes the three steps. First, obtain an estimate of the CDP, by estimating a pooled differenced OLS model with time dummy variables. The estimated parameters of these time dummies will represent the CDP. Second, the CDP is then added to the model by either subtracting it from the dependent variable (i.e. $\tilde{y}_{it} = y_{it} - CDP$, or by including it in each of the 10 regressions. Third, estimate 10 individual regressions and compute the averages or the individual estimated slopes as in Pesaran and Smith (1995).

11. The regression results are presented in Table 2.

- In all models, the coefficients on private capital and employment are positive and highly significant.

- Models 1-3 present the results of fixed-effects models. In Model 1, the coefficient on infrastructure assets is positive but not significant. Model 2 includes other provinces' infrastructure assets (weighted by geographical distance). This shows that 'province i's (for example, Ontario's) own investment in infrastructure would boost its own GDP, and infrastructure investment in the rest of Canada would boost Ontario's GDP, too. But this evidence is weak, as their coefficients are not significant. Model 3 includes the simple average of other provinces' infrastructure assets, but these coefficients (both own and other provinces') are negative and insignificant.

- Models 4-6 are based on the MG estimator. The coefficient on 'province i's own infrastructure assets is positive but is still not significant in Model 4. The coefficients on other provinces' infrastructure assets in Model 5 (using simple average $\overline{GO}_{jt}$) and in Model 6 (using weighted average $\overline{GO}_{jt}$) are positive but not significant. Moreover, the coefficients on own infrastructure are now negative and insignificant.

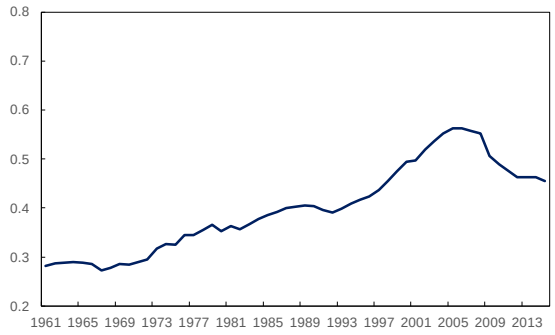
- Models 7-9 are based on the MG-CDP estimator. The coefficient on 'province i's own infrastructure assets is now positive and significant (Model 7). Including other provinces' infrastructure assets, however, Model 8 shows that the coefficient on 'province i's own infrastructure assets is positive but not significant, while that on other provinces' infrastructure assets (weighted) is negative and insignificant. Model 9 performs relatively well. The coefficient on 'province i's own infrastructure assets is positive and significant (at 15 percent level), while that on other provinces' infrastructure assets is positive and highly significant.

In sum, we can conclude that there is some evidence that infrastructure assets are positively correlated with real GDP and have spillover effects. We judge that the estimates based on the MG-CDP model—which accounts for both a province-specific slope β and a province-specific time dummy $\gamma_i \omega_t$—look most plausible, given that the estimated coefficients are all significant at reasonable levels. Models 7 and 9 suggest that the elasticity of infrastructure assets would be around 0.08 and 0.10, respectively.

Marginal product of infrastructure assets

12. The regression results permit a calculation of the marginal product of capital (MPK). Using the estimated elasticity of public infrastructure, an MPK can be calculated as the elasticity multiplied by the output to public infrastructure ratio.[5] Figure 4 presents the MPK for Canada (based on the estimated elasticity of 0.08, Model 7). Although some caution is needed in interpreting this result, the figure shows a steady increase in the MPK between the early 1960s and mid-2000s, which reflects a decline in the stock of public infrastructure as a percent of GDP.[6] As the government changed course and raised investment in public infrastructure after the 2008-09 global financial crisis, the MPK has started to fall. However, the current level of the MPK remains above historical levels. This seems to suggest—together with a fact that the current level of interest rates is much lower than its historical norm—that there is room to further increase public infrastructure while keeping the return of infrastructure investment higher than the cost of funding.

Figure 4. Marginal Product of Capital



Source: Authors' estimates

Crowding in effects of infrastructure

13. We test whether infrastructure assets crowd in private capital. Whether public capital spending would crowd-in or crowd-out private capital spending has been much debated. We assume that infrastructure capital would affect real GDP through private capital and modify equation (1) as follows.

$$Y_{it} = \mathrm{A} L_{it}^{\beta^L} K_{it}^{\beta^K + \beta^G lnG + \beta^{GO} ln\overline{GO}} \tag{4}$$

Taking logarithms of equation (4), we estimate the following model.

$$y_{it} = \beta_i^L l_{it} + \beta_i^K k_{it} + \beta_i^G g_{it} k_{it} + \beta_i^{GO} \overline{go}_{it} k_{it} + u_{it} \tag{2}$$

$$u_{it} = \alpha_i + \gamma_i \omega_t + \varepsilon_{it}, \tag{3}$$

14. The results suggest evidence of crowding-in (Table 3). The estimated coefficient of the cross term between 'province *i*'s own infrastructure (*g*) and private capital assets (*k*) is highly

[5] In equation (2), $\beta^G = (\partial Y/\partial G)(G/Y)$ (for exemplification, i is dropped). Hence, $\partial Y/\partial G = \beta^G (Y/G)$.

[6] We assume that the elasticity of public infrastructure is constant at any point in time, but this assumption may not hold if the elasticity fluctuates, for example depending on the cyclical state of the economy. A caution is also needed in interpreting the level of the MPK, as the estimated elasticity varies depending on model specification and estimation methodology.

significant and positive 0.008 (Model 1), while the cross term between other provinces' infrastructure (*go*) and "province *i*"s own private capital assets (*k*) is also highly significant and positive 0.01 (Model 2).

E. Conclusion

15. This chapter analyzed the macroeconomic effects of public infrastructure. We found some evidence that higher public infrastructure is correlated with higher economic growth and could crowd in private investment. We also found that infrastructure investment has positive spillover effects across provinces. This means that more concerted efforts across different layers of jurisdictions to better coordinate infrastructure planning would maximize the economic benefit of infrastructure investment. In sum, the empirical findings in this chapter provides an economic case for more infrastructure spending. With underinvestment of infrastructure over the past several decades, combined with historically low cost of funding, investing in infrastructure would generate a net positive return.

Table 2. Regression Results (Production Function Models) 1/

Dependent variable: Real GDP

Estimation method	Fixed effects			Mean Group Estimators					
				P&S MG (1995) 2/			E&T MG-CDP (2010) 3/		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Real private capital stock (K)	0.252***	0.255***	0.249***	0.348***	0.341***	0.321***	0.101***	0.0836**	0.104***
	(0.0738)	(0.0707)	(0.0736)	(0.0498)	(0.0550)	(0.0552)	(0.0365)	(0.0403)	(0.0377)
Employment (L)	0.750***	0.748***	0.734***	1.355***	1.173***	1.155***	0.560***	0.507***	0.526***
	(0.178)	(0.176)	(0.187)	(0.167)	(0.190)	(0.146)	(0.120)	(0.0964)	(0.101)
Economic infrastructure assets (G)	0.0448	0.0463	-0.0296	0.0444	-0.0281	-0.00284	0.0768*	0.0626	0.105+
	(0.108)	(0.108)	(0.149)	(0.0738)	(0.110)	(0.105)	(0.0422)	(0.0658)	(0.0704)
Economic infrastructure assets of other provinces per employment (GO, weighted average)		0.0470			0.107			-0.0943	
		(0.141)			(0.0821)			(0.0585)	
Economic infrastructure assets of other provinces per employment (GO, simpe average)			-0.937			0.0974			0.274***
			(0.551)			(0.110)			(0.0752)
Common dynamic process							0.902***	0.936***	0.905***
							(0.0853)	(0.0978)	(0.103)
Constant	7.676***	7.472***	16.40**	8.239***	8.161***	7.043***	8.967***	9.279***	6.017***
	(0.931)	(0.893)	(5.204)	(1.077)	(1.639)	(0.830)	(0.782)	(0.672)	(0.586)
Memorandum items:									
Observations	550	550	550	550	550	550	550	550	550
R-squared	0.988	0.988	0.988						

1/ Robust standard errors are in parentheses, with *** indicating significance level at 1 percent, ** at 5 percent, * at 10 percent, and + at 15 percent.
2/ Pesaran and Smith (1995) mean group estimator.
3/ Eberthardt and Teal (2010) mean group estimator.

Table 3. Testing Complementarity of Public Infrastructure and Private Capital 1/

Dependent variable: Real GDP

Estimation method: a mean group estimator with a common dynamic process (MG-CDP)

	Model 1	Model 2
Employment (l)	0.542***	0.375***
	(0.112)	(0.0534)
g*k	0.00839***	
	(0.00315)	
go*k		0.0134***
		(0.00387)
Common dynamic process	0.927***	0.966***
	(0.101)	(0.0926)
Constant	9.512***	9.770***
	(0.391)	(0.377)
Memorandum items:		
Observations	550	550
R-squared		

1/ Based on E&T Mean Group Estimators. Robust standard errors are in parentheses, with *** indicating significance level at 1 percent, ** at 5 percent, * at 10 percent, and + 15 percent.

Annex I. Data Description

- **Real GDP.** In logarithm. Gross domestic product at market prices, chained 2007. CANSIM Table 384-0038. Data for provincial GDP prior to 1980 were estimated using nominal GDP data (CANSIM Table 384-0015) divided by the GDP deflator for Canada.
- **Employment.** In logarithm. Labor Force Survey, CANSIM Table 282-0089.
- **Real private capital stock.** In logarithm. Non-residential buildings plus engineering construction in the non-government sector, geometric end-year net stock, chained 2007, CANSIM Table 031-0005.
- **Real infrastructure stock.** In logarithm. Non-residential buildings plus engineering construction in the government sector, geometric end-year net stock, chained 2007, CANSIM Table 031-0005.

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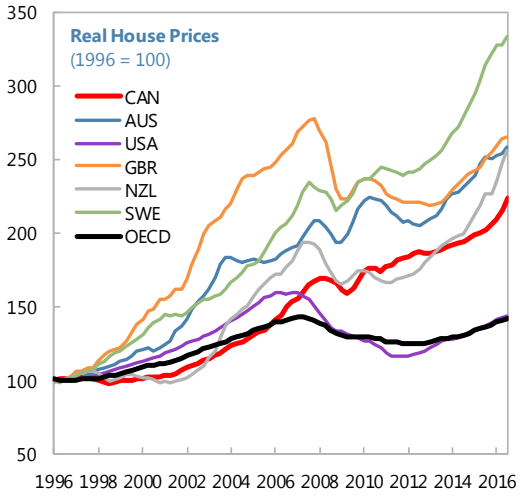
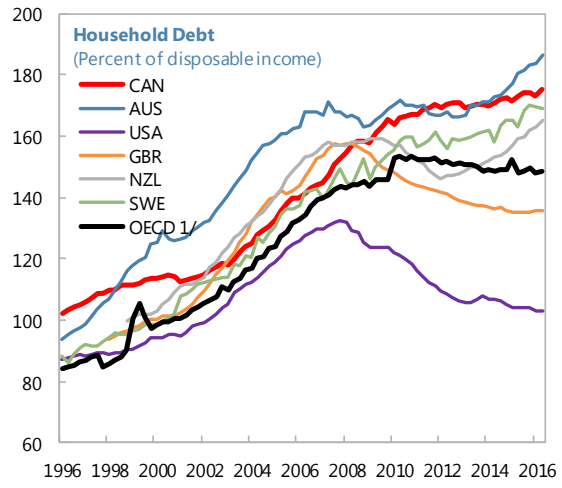
HOW ADVANCED ECONOMIES TACKLE HOUSING MARKET IMBALANCES: LESSONS FOR CANADA[1]

A. Introduction

1. Housing market imbalances, fostered by the low interest rate environment and abundant liquidity, have been a concern in several advanced countries in recent years. Strong population growth in the major urban areas has also been a factor in some countries. Rapidly rising housing prices usually have been coupled with rising household indebtedness (Figure 1). High household debt raises the vulnerability of the financial system to a sharp house price correction. This has led to countries making use of prudential- and macroprudential measures to reduce housing imbalances. With the rapid acceleration in house prices across countries, housing affordability has also become an issue for public policy (Table 1).

Figure 1. Selected countries: Trends in Real House Prices and Household Debt





Sources: OECD Statistics and IMF staff calculations

[1] Prepared by Zsofia Arvai (MCM) and Yulia Ustyugova (WHD).

Table 1. Housing Affordability Ratings by Country: Major Housing Markets
(Over 1,000,000 population)

Country	Affordable (3.0 & Under)	Moderately Unaffordable (3.1-4.0)	Seriously Unaffordable (4.1-5.0)	Severely Unaffordable (5.1 & Over)	Total	Median Market
Australia	0	0	0	5	5	6.6
Canada	0	1	3	2	6	4.7
China (Hong Kong)	0	0	0	1	1	18.1
Ireland	0	0	1	0	1	4.7
Japan	0	1	1	0	2	4.1
New Zealand	0	0	0	1	1	10.0
Singapore	0	0	1	0	1	4.8
United Kingdom	0	2	12	7	21	4.5
United States	11	22	8	13	54	3.9
Total	11	26	26	29	92	4.2

Sources: 13th Annual Dermographia International Housing Affordability Survey, 2017.

2. Housing market trends often exhibit stark differences across regions within a country. While some key factors affecting housing markets such as interest rates and access to credit are common, other factors such as demographics, income trends, investor activity, including foreign buyers, housing market expectations, building activity and land-use constraints, often vary across regions. The interplay of demand and supply factors drive housing booms in major markets.

3. Economies around the world have used a variety of policy tools to deal with housing market booms. These include macroprudential measures based on prudential tools such as caps on loan-to-value ratios (LTV), debt-service-to-income ratios (DSTI), and higher risk weights and provisioning, as well as traditional fiscal policy measures, including property taxes, sellers' and buyers' stamp duties, and capital gains tax.

4. This chapter provides a summary of the demand measures some economies have taken to target speculative and investment demand, as well as regional imbalances. Peer group economies discussed in this chapter are advanced economies that have experienced rapid house price growth and household debt (Australia and New Zealand); have introduced measures targeting high household indebtedness and investment properties (U.K.); or have had a longer history of macroprudential measures aiming at speculative and investment property demand (Hong Kong SAR and Singapore). Policies to improve the supply of residential properties, while very important to reduce imbalances, are beyond the scope of this chapter.

5. We find that economies tackled housing market imbalances both by progressively expanding the scale and coverage of prudential-based tools and modifying real estate taxation. The latter measures were aimed solely or predominantly at foreign buyers in some countries and both at resident and non-resident speculative and investment demand in others. Some economies have introduced housing market measures that are tailored geographically or by

property value. Loan-to-income (or debt-to-income) ratios are among the latest macroprudential measures to be increasingly employed as they directly target household indebtedness.

B. Australia and New Zealand

6. The rise in real house prices and household indebtedness in Australia and New Zealand has been among the fastest across advanced countries over the past two decades. After a lull following the global financial crisis, both house prices and household debt ratios started to pick up again in 2013, and household debt as a ratio of disposable income now exceeds 185 percent in Australia and 165 percent in New Zealand, representing all-time highs in the respective countries.

7. The price increases have been skewed toward the major cities. In Australia, the two most populous cities, Sydney and Melbourne, have seen house price increases well above the national average in recent years, and rank high in the unaffordability index. In New Zealand, the house price increase was particularly pronounced in Auckland, reflecting rapid population growth and geographical constraints limiting the supply response. In both countries, the highly concentrated banking sector has a large housing exposure.

8. Demand by private property investors has been an important driver of housing market dynamics in both countries. Both resident and non-resident buyers have been active in the market for investment properties. Specifically, in Australia, interest-only mortgages have become a focus of supervisory guidance.

Prudential and Macroprudential Measures

9. Both countries put in place prudential and macroprudential measures as the rise in house prices and indebtedness accelerated.

- **Australia.** After issuing a prudential practice guide on sound risk management practices for residential mortgage lending in November 2014, the Australian Prudential Regulation Authority (APRA) announced one month later a further increase of the level of supervisory intensity with a focus on higher risk mortgages, such as interest-only and high loan-to-value ratio mortgages, investor lending growth above a benchmark of 10 percent, and strong loan serviceability tests with sufficient interest rate buffers and floors.

- In July 2015, APRA announced an increase in average mortgage risk weights for large banks using the internal risk based ratings approach from around 16 to at least 25 percent by July 2016.

- In March 2017, APRA reiterated its focus on risky lending and tightened the rules for interest-only mortgages: financial institutions are expected to limit new interest-only lending to 30 percent of total new mortgage lending, and within that to tightly manage new interest-only loans extended at high LTVs. Furthermore, the Australian Securities and Investments Commission has stressed the importance of lenders and brokers ensuring that consumers are

not provided with unsuitable interest-only loans, and the budget 2017 more generally includes initiatives for a more accountable banking system.

- **New Zealand.** The Reserve Bank of New Zealand (RBNZ) introduced several rounds of macroprudential measures: The first round of measures in October 2013 focused on a cap on the share of high loan-to-value ratio loans in general, while the second round in 2015 had a specific focus on investor loans in Auckland, and the third round in 2016 primarily targeted residential property investors in general.

- First round: in October 2013, the RBNZ placed an exposure limit ('speed limit') on high loan-to-value ratio residential mortgage lending. Banks were required to restrict the flow of new mortgages at LTVs over 80 percent to no more than 10 percent of their total residential mortgage lending.

- Second round: The RBNZ announced additional measures in May 2015, with effect of November 2015, as prices picked up again in 2015 after an initial moderation of house price increases:

    - The maximum share of loans with LTV of more than 70 percent for residential property investors in Auckland was set at 5 percent.

    - The existing 10 percent speed limit for loans at LTVs of greater than 80 percent was retained for owner-occupiers in Auckland.

    - For the rest of New Zealand, the speed limit for all residential mortgage loans with a LTV ratio above 80 percent was raised from 10 to 15 percent, to reflect the more subdued housing market conditions there.

    - In addition, in the period between 2013 and 2015, capital requirements for housing loans were adjusted to better align risk weights with the underlying risk of the exposure, with higher risk weights for residential property investor compared to owner-occupier mortgage loans.

- Third round: The October 2016 measures eliminated geographic differentiation as rapid house price increases were spreading beyond Auckland and further tightened the rules for residential property investors compared to owner-occupiers:

    - *Owner-occupiers:* The existing 10 percent speed limit for loans at LTVs greater than 80 percent in Auckland was extended to the rest of the country.

    - *Residential property investors:* For all borrowers in New Zealand, a 5 percent speed limit was set for loans at LTVs greater than 60 percent.

- As the share of lending at high debt-to-income (DTI) ratios is high and increasing, around a third of borrowers have a DTI of 500 percent, the introduction of a DTI ratio or similar instrument into

the macroprudential toolkit is under discussion and the RBNZ has recently issued a consultation paper on "serviceability restrictions as a potential macroprudential tool in New Zealand".

Real Estate Taxation

10. Real estate taxation in both Australia and New Zealand tilts investment decisions towards housing and has the potential to amplify housing cycles. Key elements of the tax system that work in this direction are tax concessions on capital gains and the possibility to apply losses from negative housing investment gearing to income from other sources. In 2015, New Zealand strengthened the enforcement of existing capital gains taxation rules by introducing a presumption of resale intention at purchase if an investment property is being resold within two years ("bright-line test"). A withholding tax for non-residents that resell within that period was also introduced. In a similar vein, the Australian government intends to increase the withholding tax for non-residents in mid-2017 and to exclude them from the main residence capital gains tax exemption from mid-2019. The government recently also introduced a penalty for non-residents who leave their property vacant for more than six months per year. Within already existing foreign investment approval rules for non-residents, foreign ownership in larger new apartment developments is planned to be restricted to 50 percent.

11. As demand for real estate for investment purposes has been considerable, Australia and New Zealand also put in place specific restrictions and measures targeting real estate investors. The fiscal based measures primarily target foreign investors in Australia, while in New Zealand, the measures are aimed at speculative activity without differentiating between residents and non-residents.

- **Australia.** Real estate purchases by foreigners require foreign investment approval. However, this allows for only imperfect tracking of foreign buyers' activity as only part of the approvals lead to actual real estate purchases.
    - Non-resident foreigners generally need to apply for and receive foreign investment approval before purchasing any residential property in Australia.
    - Non-resident foreigners will normally be allowed to purchase new dwellings in Australia without being subject to any conditions. There is no limit on the number of new dwellings a foreign non-resident may purchase, but approval is generally required prior to each acquisition.
    - Non-resident foreigners generally cannot purchase established dwellings as homes, for use as a holiday home or to rent out.
    - Foreign buyers have to provide citizenship and visa details, as well as Foreign Investment Review Board clearance, through the stamp duty process.

12. Several Australian states levy additional stamp duties on foreign buyers. The stamp duty surcharges vary among states:

- *Victoria:* In 2015, additional stamp duty was introduced to any arrangement or transaction that involves the transfer of an interest in residential property to a foreign purchaser. For transactions between July 2015 and July 2016, the surcharge was 3 percent. After 1 July 2016, the additional duty rate is 7 percent. There is also a 1.5 per cent surcharge on land tax.

- *New South Wales:* In June 2016, a 4 percent stamp duty surcharge was imposed on foreign buyers of residential property. The stamp duty surcharge was set to rise to 8 percent as of July 1, 2017. In addition, the annual land tax on foreign homeowners would rise to 2 percent from 0.75 percent.

- *Queensland:* In October 2016, 3 percent surcharge was levied on foreign purchases of houses and apartments.

13. In both Australia and New Zealand, the prudential measures would appear to have had at least a temporarily moderating effect on house price increase and credit growth, and they helped to improve the resilience of household and bank balance sheets. However, prices have still been increasing at a fast pace, further eroding affordability.

C. United Kingdom

14. Following a large drop in the aftermath of the global financial crisis, UK house prices resumed their rise in 2012, while household debt stopped falling. Household debt to disposable income declined between 2007 and 2015 by more than 20 percentage points, but remained high by historical standards at around 137 percent in 2016 and started rising in 2017. The buy-to-let segment of the housing market has been buoyant with the share of buy-to-let mortgages in GDP, while much smaller than owner-occupier mortgages, continuously growing.

Macroprudential Measures Based on Prudential Tools

15. The UK Financial Policy Committee (FPC) identified two risks from high levels of household indebtedness: a direct risk to the resilience of the UK banking system, and an indirect risk via its impact on economic stability. In particular, buy-to-let borrowers are seen as potentially more vulnerable to rising interest rates because these loans are more likely to be interest only and extended on floating-rate terms, and affordability tends to be tested at lower stressed interest rates than for owner-occupied lending.

16. In June 2014, the FPC recommended two policy measures to address the loosening of underwriting standards in the owner-occupied mortgage market and a significant increase in the number of highly indebted households. In September 2014, it requested powers of Direction over the mortgage market. Additionally, since 2013 the FPC had powers of direction over sectoral capital requirements for residential and commercial mortgages.

- **The affordability test.** When assessing affordability, mortgage lenders should apply an interest rate stress test that assesses whether borrowers could still afford their mortgages if, at any point

over the first five years of the loan, the Bank Rate were to be 3 percentage points higher than the prevailing rate at origination.

- **The loan to income flow limit.** The Prudential Regulation Authority (PRA) and the Financial Conduct Authority (FCA) should ensure that mortgage lenders do not extend more than 15% of their total number of new residential mortgages at loan to income ratios at or greater than 4.5.

- **Powers of Direction.** In September 2014, the FPC requested powers to direct the PRA and FCA to require regulated lenders to place limits on residential mortgage lending, both owner-occupied and buy-to-let, by reference to: (a) loan to value ratios; and (b) debt-to-income ratios, including interest coverage ratios for buy-to-let lending. In the same month, the PRA published a Supervisory Statement setting out its expectations for underwriting standards for buy-to-let mortgages.

17. By end-2016, the FPC had been granted powers to direct both owner-occupied and buy-to-let mortgages. In April 2015, the Government gave the FPC powers of Direction over the PRA and the FCA in relation to LTV and LTI limits for owner-occupied mortgage lending, and in November 2016 over buy-to-let mortgages as well. In 2016, in concluding its review of the June 2014 recommendations, the FPC agreed to maintain the LTI measures at their original calibration as they were expected to continue to provide insurance against a deterioration in credit underwriting standards.

Measures Based on Fiscal Tools

18. The prudential-based tools were complemented by tax-based measures for the owners of additional properties. In its Spending Review and Autumn Statement 2015, the UK government announced a Five Point Plan for housing to support low-cost home ownership for first-time buyers.[2]

19. As part of this plan, higher rates of Stamp Duty Land Tax (SDLT) were required for additional properties. [3] The government explained its intent to impose higher duty on owning additional properties by noting that they can affect other people's ability to get on to the property ladder. The higher rates are 3 percentage points above the existing SDLT rates, and took effect from April 1, 2016 (Table 2). The government announced that some of the additional tax would go to provide £60 million for communities in England where the impact of second homes is particularly acute. The tax receipts also help double the affordable housing budget. As a further measure, as of April 2017, the amount of income tax relief landlords can obtain for the financing costs of residential properties have been restricted.

[2] See Section 6.6 in Spending Review and Autumn Statement 2015

[3] Consultation outcome on Higher rates of Stamp Duty Land Tax on purchases of additional properties

Table 2. United Kingdom: Stamp Duty Rates for Property Transactions

Property Value	Stamp Duty Rate for Owner-Occupiers	Stamp Duty Rate for Second Property/Buy-to-Let
		(No duty payable properties costing under £40,000)
Up to £125,000	0%	3%
The next £125,000 (the portion from £125,001 to £250,000)	2%	5%
The next £675,000 (the portion from £250,001 to £925,000)	5%	8%
The next £575,000 (the portion from £925,001 to £1.5 million)	10%	13%
The remaining amount (the portion above £1.5 million)	12%	15%

Sources: UK authorities and IMF staff calculations.

D. Hong Kong SAR and Singapore

Macroprudential Measures Based on Prudential Tools

20. Hong Kong SAR and Singapore have been using macroprudential policies to contain risks arising from the housing market for more than two decades. Both economies had a period of sharply rising housing prices and speculative activity in the mid-1990s which prompted the authorities to introduce a package of cooling measures, most importantly imposing lower limits on LTVs. Some of these measures were subsequently reversed following the onset of the Asian financial crisis, but they helped the banking sector weather the stress of the Asian crisis well, with lower LTVs providing banks with a cushion to absorb price corrections, and maintained incentives for borrowers to continue servicing their loans.

21. Both economies embarked on a new tightening cycle in 2009 to cool renewed housing market pressures that were driven to some extent by foreign and domestic speculative and investment demand. Following the global financial crisis, house prices grew strongly again driven by historically low interest rates,[4] credit availability, strong economic prospects, limited housing supply amid the rapidly growing number of resident households, and demand by non-residents. By April 2017, house prices almost tripled in Hong Kong SAR compared to 2009, and increased by about 50 percent in Singapore. The new measures have progressively expanded the scale and coverage of macroprudential policy.

- **Hong Kong SAR.** The authorities gradually lowered the caps on LTV and debt service ratio (DSR), extended the prudential focus from luxury homes to investment properties, and later, to those where borrowers repay their debt with foreign income or have multiple mortgages. The LTV cap became differentiated, with a lower cap on higher-valued properties and investment properties. The banks were also required to compute the stressed DSTI ratio for all types of

[4] While house prices have risen more quickly than median incomes, all-time low mortgage interest rates have reduced debt servicing costs.

properties, including residential, commercial and industrial properties, assuming a mortgage rate increase of 300 basis points. Additionally, a risk weight floor of 15 percent was introduced on all residential mortgages for banks using the internal ratings-based approach, given the concern that the risk weights generated by banks' internal models were too low. In May 2017, the risk weight for new mortgages was raised to 25 percent.

- In early 2015, the Hong Kong SAR authorities announced new macroprudential measures to safeguard financial stability**.** Renewed concerns about the above-trend credit-to-GDP ratio and housing price growth prompted the authorities to announce a countercyclical capital buffer of 0.625 percent that was activated at the beginning of 2016. It was accompanied by a capital conservation buffer of 0.625 percent and higher loss absorbency surcharges between 0.25 - 0.625 percent for domestic systemically important banks under Basel III. While these measures go beyond the property sector, their implementation was expected to enhance banks' overall resilience and reduce their vulnerability to property sector shocks.

- In May 2017, the HKMA also tightened the capital requirements for banks with respect to their lending to property developers.

- **Singapore.** During both tightening episodes, the macroprudential toolkit was progressively broadened and refined. The macroprudential measures targeted speculative activity, while protecting owner-occupied mortgages. LTV limits were set at lower levels for holders of multiple mortgages to reduce access to credit for investment properties, while insulating households with single mortgages. Over the last tightening episode, the authorities introduced caps on loan tenors and DSTI to prevent borrowers from becoming overindebted. Also, some measures were tightened incrementally over time—for example, by capping the LTV on second and additional mortgages at lower and lower levels. Such refinement of individual measures helped close loopholes but led to higher regulatory complexity.

Measures Based on Fiscal Tools

22. Taxes on property transactions were an integral part of the response to housing market imbalances both in Hong Kong SAR and Singapore.

- **Hong Kong SAR.** On several occasions, the government raised taxes on property transactions in conjunction with the macroprudential measures. A Special Stamp Duty of up to 15 percent on residential properties resold within specific time periods was introduced in November 2010. This amounted to 15 percent within first six months of purchase, 10 percent between six and 12 months, 5 percent between 12 and 24 months.

    - In October 2012, the Special Stamp Duty was raised to up to 20 percent on resales within 36 months (20 percent within first six months of purchase, 15 percent between six and 12 months, 10 percent between 12 and 36 months), while a Buyer's Stamp Duty of 15 percent was introduced for buyers of residential properties who are not Hong Kong SAR permanent residents. This was followed by a doubling of the existing ad valorem stamp duty rates to a

maximum of 8.5 percent in February 2013. The ad valorem stamp duty is on nonresidential and multiple residential property purchases.

- **Singapore.** Concern about speculative activity by foreigners and domestic corporations led to the imposition of a higher stamp duty for these groups to discourage property "flipping". The share of transactions with foreign buyers (excluding companies) increased sharply from around 11 percent in early 2010 to 20 percent in late 2011.

  - ***Stamp duty for foreign buyers.*** In December 2011, a 10 percent stamp duty was imposed on foreigners and corporate entities buying any residential property. In January 2013, the foreign buyer's stamp duty was raised to 15 percent.

  - ***Stamp duty for investment property. A buyer's stamp duty*** was imposed in December 2011 with a rate of 3 percent on permanent residents buying second or subsequent residential property or Singapore citizens buying their third residential property. In January 2013, buyer's stamp duties were raised both for permanent residents and Singapore citizens. Depending on the number of properties owned, the buyer's stamp duty could be as high as 10 percent.[5]

  - ***Stamp duty for investment property. A seller's stamp duty*** was introduced in February 2010 on all private properties sold within one year of purchase at a rate between 1- 3 percent. In 2011, the stamp duty was raised significantly to 16 percent for a holding period of up to one year but with every additional year of holding period reducing the stamp duty by 4 percentage points. After a sustained period of softer housing markets, stamp duty rates were reduced by 4 percentage points for each year of holding period and eliminated beyond three years in 2017.[6]

23. In Hong Kong SAR, tighter macroprudential policy and stamp duties helped enhance the resilience of the banking system and limit household leverage. The average LTV ratio at origination declined by about 10 percentage points in four years to 55 percent in mid-2013 and mortgage lending growth slowed (though it has rebounded since mid-2014). The impact on house prices has been less clear; prices leveled off following the measures but resumed growing in mid-2014.

24. In Singapore, home prices have remained flat since end-2011, while the volume of transactions has declined. The share of foreign buyers collapsed in the first half of 2012 to 5½ percent after peaking at 20 percent earlier. This could be attributed to new macroprudential measures targeting foreigners and weakening external investment sentiment, with buyers from China falling by nearly 50 percent.[7]

[5]See details at the following website: Singapore Buyer's stamp duty and additional stamp duty

[6]See details at the following website: Singapore Seller's stamp duty

[7] Such a drastic decline may also reflect the impact of the economic slowdown in China.

E. Conclusion

25. Low interest rates and abundant liquidity globally has led to significant demand pressures on housing markets around the world. Economies have tackled growing imbalances with the continued tightening of prudential-based tools and, in some cases, targeted tax measures. While the outcomes of these policies are not straightforward to assess, and up-to-date empirical evidence is not readily available for the individual economy cases, the measures likely have slowed down increases in house prices and household indebtedness, and improved the resilience of the financial sector to housing market related shocks.[8] The trend towards coordinating prudential measures with tax-based measures is likely to improve the overall effectiveness of macroprudential policy in cases when speculative and investment demand play a major role.

[8] See the chapter on "Macroprudential Tools at Work in Canada" for an empirical analysis of the effectiveness of individual macroprudential policy measures implemented in Canada and of the overall effectiveness of different prudential-based tools for a wider set of advanced and emerging countries.

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MACROPRUDENTIAL TOOLS AT WORK IN CANADA[1]

1. The aim of this paper is to assess which macroprudential policy measures have been effective in containing house price and mortgage credit growth in Canada and other economies. Our analysis indicates that macroprudential policy measures have had a moderating effect on house prices and mortgage credit in Canada since 2010. International experience suggests that lower caps on debt-service-to-income (DSTI) ratios and loan-to-value ratios could be effective in containing both mortgage credit and house price growth.

2. The discussion below is organized as follows. First, we analyze the effectiveness of macroprudential measures in Canada, then we discuss lessons from the international experience with macroprudential measures. Finally, we offer concluding remarks.

A. Assessing the Effectiveness of Macroprudential Measures in Canada

3. A distinctive feature of Canada's prudential toolkit stems from a large government role in mortgage insurance. More than a half of outstanding mortgage debt is covered by mortgage insurance due to a requirement that borrowers must obtain insurance for high loan-to-value (LTV) mortgages (with LTV over 80 percent).[2] Government-backed mortgage insurance is provided by the Canada Mortgage and Housing Corporation (CMHC) - a crown corporation with half the market share of new insured mortgages[3] - and two private companies. The government guarantees 100 percent of CMHC's obligations and backs private mortgage insurers' obligations subject to a deductible equal to 10 percent of the original principal amount of the mortgage loan. To address risks associated with the provision of these guarantees, the government sets eligibility requirements for insured mortgages. This serves as an important macroprudential tool in addition to traditional macroprudential tools available to the regulators responsible for financial stability.

4. Since 2000s Canada's policies managing housing market risks have gone through two contrasting stages:

- **Easing up to 2007.** Mortgage insurance rules were relaxed in the mid-2000s. Together with lower interest rates, this boosted mortgage credit and housing prices. The higher house prices led to a sharp expansion of home equity credit lines.

- **Tightening since 2008.** As house prices and mortgage credit surged, the government's focus changed to containing the growth of imbalances in the housing market as well as to reduce its exposure to mortgage insurance. Since 2008, the federal government has undertaken multiple rounds of measures to tighten mortgage insurance rules, going beyond a reversal of the

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[2] In Ontario, provincially-regulated credit unions are also required to have mortgage insurance in cases where the LTV exceeds 80 percent. Mortgages with LTV ratios of 80 percent or below ("low LTV" or low-ratio mortgages) may also be insured on a portfolio basis.

[3] CMHC captures close to 65 percent of outstanding insured mortgage debt.

loosening in the mid-2000s (Table A1). In addition, OSFI introduced numerous microprudential measures to strengthen bank balance sheets (Table A2).

5. Our analysis focuses on macroprudential policy measures related to changes in mortgage insurance rules during the tightening stage. Here we distinguish six rounds of macroprudential measures introduced in 2008, 2010, 2011, 2012, early-2016 and late-2016 (Table 1). We did not include the increases in mortgage insurance premia in 2014 and 2015 into our empirical exercise as the changes were too small to have an impact on credit demand.[4]

Table 1. Canada: Macroprudential Measures Related to Changes in Mortgage Insurance Rules Since 2008

2008 round	*October 2008* *(announced in July)*	Maximum amortization for new government backed insured mortgages was lowered (from 40 to 35 years) Maximum LTV for new mortgages was reduced (from 100 percent to 95 percent) Minimum credit score requirement (of 620) for high ratio mortgages was introduced. Maximum of 45 per cent total debt service ratio was introduced (the amount of gross income that is spent on servicing debt and housing-related expenses such as heat or condo fees). Loan documentation standards strengthened to ensure reasonableness of property value and of the borrower's sources and level of income
2010 round	*April 2010* *(announced in February)*	Maximum LTV for insured refinanced mortgages was lowered (from 95 percent to 90 percent) Minimum down payment on properties not occupied by owner was raised (from 5 percent to 20 percent) More stringent eligibility criteria were introduced (all borrowers are required to meet the standards for a five-year fixed-rate mortgage, even if they choose a mortgage with a variable interest rate and shorter term. Specifically, the debt service ratios for borrowers opting for a variable-rate or short-term mortgages were to be calculated at the greater of the contract rate or Bank of Canada posted rate.)
2011 round	*March 2011* *(announced in January)*	Maximum amortization for new government backed insured mortgages was lowered (from 35 to 30 years) Maximum LTV for refinanced mortgages was lowered (from 90 percent to 85 percent) Government-backed insurance on non-amortizing lines of credit secured by houses (HELOCs) withdrawn in April
2012 round	*July 2012* *(announced in June)*	Maximum amortization for new government backed insured mortgages was lowered (from 30 to 25 years) Maximum LTV for refinanced mortgages was lowered (from 85 percent to 80 percent) Maximum gross debt service ratio and maximum total debt service ratios were capped at 39 percent and 44 percent, respectively Government-backed insured mortgages limited to homes with a purchase price of less than Can$1 million.
Not included	*May 2014 (announced in February 2014)*	Mortgage insurance premiums were raised

[4] In 2014, CMHC increased its mortgage loan insurance premiums by approximately 15 percent for homeowners and 1-4 unit rental properties which raised monthly mortgage payment by approximately $5. In 2015, mortgage loan insurance premiums for homebuyers with less than a 10% down payment increased by approximately 15%, resulting in additional increase of approximately $5 to their monthly mortgage payment.

Table 1. Canada: Macroprudential Measures Related to Changes in Mortgage Insurance Rules Since 2008 (concluded)		
Not included	*June 2015 (announced in April 2015)*	Mortgage insurance premiums were raised
Early 2016 round	*February 2016 (announced in December 2015)*	The minimum down payment for new insured mortgages increased from 5 to 10 percent for the portion of the house price above $500,000. The 5 percent minimum down payment for properties up to $500,000 remained unchanged
Late 2016 round	*October 17, 2016 (announced on October 3, 2016)*	To ensure the uniform rules for all insured mortgages, all new mortgage borrowers with a down payment of less than 20% and seeking mortgage insurance are required to qualify at the posted rate for a conventional mortgage for a five-year term or the contract rate, whichever is higher.
	November 30, 2016 (announced on October 3, 2016)	The standards for low-ratio mortgage portfolio insurance are tightened to become uniform with those for insured high-ratio mortgages.

Sources: Department of Finance Canada, CMHC, OSFI

Methodology

6. We estimate two separate equations, for mortgage credit and house prices, assuming that macroprudential measures affect house prices indirectly through the mortgage credit. Each equation is estimated separately using OLS.[5] All variables are monthly in a sample from August 1998 to February 2017.

7. For mortgage credit growth, we estimate the following specification:

$$M_t = \alpha_m + \beta_m X_t + \gamma_m D_t^i + \varepsilon_{mt} \quad (1)$$

where M_t is mortgage credit year-on-year growth rate;

X_t is a matrix of control variables including the unemployment rate and hourly wage growth, five-year mortgage interest rate,[6] and house price growth. The control variables enter the equations with lags to account for delays in the response of mortgage credit to changes in the explanatory variables.

D_t^i stands for a dummy variable equal to 1 in the months following the implementation of a set of macroprudential measures i (2008, 2010, 2011, 2012, and two 2016 rounds) and zero otherwise. To isolate the effects of individual rounds of measures, each dummy variable takes a value of 1 until the end of the sample.

[5] The results of the model estimated using SUR or 3SLS estimators are consistent with the results of the model estimated using OLS estimator.

[6] Source: Canada Mortgage and Housing Corporation, conventional mortgage lending rate, five year term.

We assess the impact of the rounds of measures on mortgage credit using the entire sample, but also test the impact over 1, 3, 6, and 9 months after they were introduced, and for the whole period between rounds.[7]

Separately, we test the effectiveness of individual measures and replace the dummy variable in specification (1) with changes in a specific instrument, such as the maximum LTV ratio for new and refinancing loans and amortization period.

8. For house price growth, we estimate the following specification:

$$H_t = \alpha_h + \beta_h Y_t + \varepsilon_{ht} \quad (2)$$

where H_t is house price year-on-year growth rate;

Y_t is a matrix of lagged control variables including the growth rate of the number of completed but unsold houses, mortgage credit growth, nominal GDP growth, and growth of sales of existing houses.[8] The control variables enter the equations with lags to account for the delay in the house price response to changes in their determinants.

Results

9. The estimated specification (1) suggests the following effectiveness of the individual rounds of macroprudential measures (Table A3):

- **2008 round does not appear to have had an impact on mortgage credit growth.** The estimated coefficient for the 2008 measures is not statistically significant across the different specifications. The lack of effects could be related to the limited scope of the measures: the maximum amortization period for new government backed insured mortgages was lowered from 40 to 35 years but remained high; and even though the maximum LTV for new mortgages was reduced from 100 to 95 percent, the effective LTV ratio was still at 100 percent.[9] Credit growth did decelerate in the 12 months following the measures, but this was likely due to the cyclical downturn in the economy accompanied by higher unemployment and a decline in household income.

- **2010 round had a statistically significant impact on mortgage credit growth,** dampening it by about 2.3 percentage points on average. The package of measures included a lower LTV ratio on refinancing loans, a significant increase in the down payment on properties not occupied by owners (from 5 to 20 percent), and tighter eligibility criteria that prevented some potential borrowers from qualifying for mortgages.

[7] Given that the annual mortgage credit growth rate is regressed on monthly data, the estimated effect of macroprudential measures could be muted on impact and increase overtime,

[8] This follows Peterson and Zheng (2011). Igan and Kang (2011) also use similar specifications for Korea.

[9] The government set a minimum down payment of 5 percent for insured loans, but "cash backs," unsecured borrowing and gifts could have been considered part of the down payment.

- **2011 round also appears to have reduced mortgage credit growth,** by about 0.9 percentage points on average. The implemented measures further lowered the LTV ratio on refinancing loans and brought the maximum amortization period closer to the average. This likely prevented more borrowers from taking new loans and reduced the size of the loans.[10]

- **2012 round seems to have been the most effective one** as it trimmed down mortgage credit growth by an estimated 3 percentage points on average. The effect appears to have gotten stronger over time. The measures focused on the amortization period, the LTV ratio for mortgage refinancing and DTIs. The new LTV ratio on refinance loans (down to 80 percent) was likely quite effective, as more than half of the new insured refinance loans in the period before the 2012 measures had a LTV ratio higher than 85 percent. These measures reduced the effective LTV for first-time home buyers from 100 to 95 percent.[11] The effects of the 2012 measures might have also captured new mortgage underwriting standards implemented by OSFI at the end of fiscal year 2012.

- **Early 2016 round did not seem to have an impact on mortgage credit growth,** possibly because it affected a relatively small proportion of the mortgage market. The 2016 tightening of mortgage insurance rules included increasing the minimum down payment for new insured mortgages from 5 to 10 percent but only for the portion of the house price above $500,000.[12]

- **Late 2016 round seems to have been effective in reducing mortgage credit growth.** Estimates suggest that more stringent qualifying rules had an immediate effect on mortgage credit growth, as they tightened underwriting standards and affected all new borrowers with a down payment below 20 percent. These results, however, are based on few observations and should be interpreted with caution.

10. The results for individual measures suggest similar effectiveness of tighter LTVs for new mortgages and refinancing loans. The estimates indicate that a one percentage point reduction in both the maximum LTV for new mortgages and for refinancing loans tends to reduce

[10] CMHC (2011) suggested that the volume of refinance loans dropped by 22 percent following the 2011 measures. Dunning (2012) estimated that the 2011 measures would push debt-service ratios above the maximum limit for about 6 percent of the high LTV mortgages taken out during 2010. He also suggested that about 11 percent of the borrowers in 2011 would have not been able to access credit following the latest reduction of the maximum amortization period.

[11] OSFI's B-20 guideline stipulates that banks should make reasonable efforts to determine if down payment is sourced from the borrower's own resources or savings. CMHC (2012a) indicates that 35 percent of households who purchased a house in 2011 were first-time borrowers and about 15 percent of them borrowed at least part of the down payment.

[12] Dunning (2015) suggests that only a small minority of home buyers (2 percent) and mortgage borrowers were affected and for most of them the additional required down payments were relatively insubstantial.

y/y credit growth by about 0.5 percentage points (Table A4). Reducing the amortization period by one year appears to have lowered credit growth by 0.2 percentage points.[13]

11. Estimates suggest that there is a strong link between mortgage credit and house price growth. The estimated equation for house price growth indicates that other things being equal mortgage credit growth has a one-for-one effect on house price growth (Table A5). This means that tighter mortgage insurance rules indirectly dampened house price growth by reducing mortgage credit growth.

12. The household debt to income ratio would have likely been even higher had the authorities not acted. We calculate the fitted regression values of mortgage growth rates both with the measures and without them. Other things being equal, without these measures the average mortgage credit growth since April 2010 would have been higher by more than 5 percentage points. The household debt-to-income ratio would have been closer to 200 percent as of the third quarter of 2016, instead of the actual 167 percent.

B. International Experience

13. Economies around the world have used a variety of policy tools to deal with house price and mortgage credit booms. These include traditional monetary and fiscal policies, including transaction tax, property tax, sellers' and buyers' duty (Crowe et al., 2011 and Dell'Ariccia et al., 2012) and other macroprudential measures (see Appendix in Lim and others (2013)). Caps on LTV, and the DSTI ratio, provisioning requirements and risk weights are among the most frequently used tools.[14]

14. We update the macroprudential dataset in Lim and al. (2013) and examine the international experience over 2000–16 with four most frequently used measures: limits on LTV ratios; caps on DSTI ratios; greater risk weights for banks' credit assets; and higher provisioning requirements for banks. We estimate their impact on mortgage credit and house price growth with panel data regressions across a sample of 35 economies controlling for the business cycle and the cost of borrowing.[15]

Economies in the Dataset

Argentina	India	Poland
Australia	Ireland	Romania
Bulgaria	Israel	Serbia
Canada	Korea	Singapore
China	Latvia	Spain
Colombia	Lithuania	Sweden
Croatia	Luxembourg	Switzerland
Czech Republic	Malaysia	Thailand
Estonia	Netherlands	Turkey
Finland	New Zealand	United Kingdom
Hong Kong SAR	Norway	Uruguay
Hungary	Peru	

[13] Using loan-level administrative data and household survey data for 2005-10, Allen et al. (2017) find that policies targeting the loan-to-value ratio have a larger impact on demand than policies targeting the debt-service ratio, such as amortization.

[14] See Lim et all (2011), Crowe et al. (2011), Akinci and Olmstead-Rumsey (2015), Almeida, Campello and Liu (2005), Wong et al. (2011), Ahuja and Nabar (2011), Igan and Kang (2011), IMF (2011), Arregui and others (2013), Kuttner and Shim (2014), Hallissey and others (2014), Vandenbussche, Vogel, and Detragiache (2012) for more detailed discussion on implementation and evidence of instruments' effectiveness.

[15] The regressions broadly follow the approach in Arregui and others (2013).

For mortgage credit growth, we estimate the following specification:

$$M_{it} = \alpha_{1i} + \alpha_2 X_{it} + \alpha_3 D_{it} + \varepsilon_{it}$$

where *M* is real mortgage credit year-on-year growth;

X is a matrix of variables including lagged real mortgage credit growth, real GDP growth, and real lending rates;

D stands for an MPP measure. Following Krznar and Morsink (2014), we use a "step function variable" for each macroprudential instrument, that is, a variable that increases (decreases) by one every time the instrument is tightened (loosened) and stays there until the instrument is changed. For house price growth, we estimate the following specification:

$$H_{it} = \beta_{1i} + \beta_2 Y_{it} + \beta_3 D_{it} + \varepsilon_{it}$$

where *H* is real house price year-on-year growth;

Y is a matrix of variables including lagged real house price growth, real GDP growth, and real lending rates;

D stands for an MPP measure, constructed as a "step function variable".

We use GMM Arrellano-Bond estimator, which is designed for the situations with fixed individual effects and explanatory variables that are not strictly exogenous.[16]

15. The results suggest that all four measures can be effective in containing mortgage credit growth (Table A6). The economies that lowered the caps on the LTV and DSTI ratios, tightened provisioning requirements or raised risk weights for banks' credit assets moderated the mortgage credit growth rate on average by 0.9–2 percentage points.

16. Lower caps on LTV and DSTI ratios appear to have a statistically significant but economically small effect on house price growth (Table A7). Both measures contained the house price growth by about 0.4 percentage points.

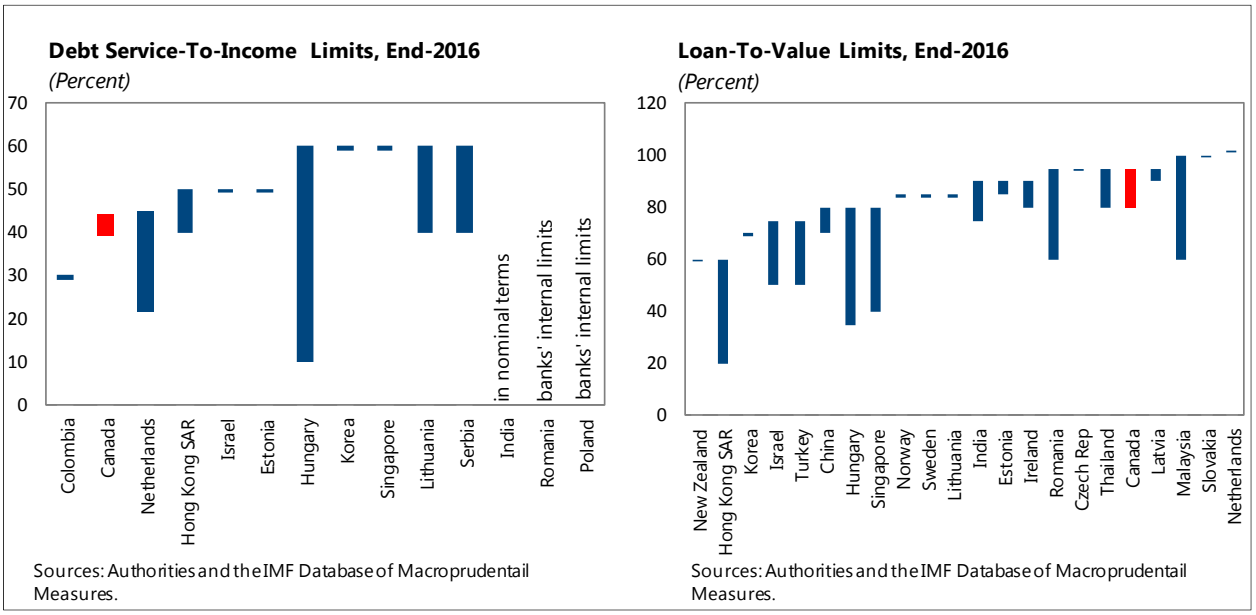
C. Conclusion

17. Canada's macroprudential policy seems to have lowered mortgage credit growth thus moderating the surge in house prices on a national basis. The 2010, 2011, 2012 and late 2016 rounds of measures are estimated to have been effective, possibly due to their larger scope and size.

18. International experience over 2000–16 suggests that tighter LTV limits and lower caps on DSTI ratios could be effective in moderating both mortgage credit and house price growth. Canada's DSTI limits are relatively stringent compared to the other economies , but the limits on the

[16] Given the challenges associated with finding valid instruments, we also estimated the same specifications using fixed effects models that produced generally consistent results (except for the coefficient for provisioning that lost significance in the mortgage credit growth equation).

LTV ratio are above the average in our sample of economies. Further tightening of the LTV ratios could help contain growth in mortgage credit and house prices.



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Annex I. Annex Tables

Table A1. Canada: Mortgage Insurance Products Until 2008	
2003	Genworth Financial broadened the eligible sources of funds for the minimum down payment, allowing it to be borrowed as opposed to coming from the borrowers' unencumbered funds
March 2004	CMHC "Flex Down" program broadened the eligible sources of funds for the minimum down payment (5 percent), allowing it to be borrowed as opposed to coming from the borrowers' unencumbered funds
March 2006	CMHC: 0 percent down payment, 30-year amortizations
	Genworth announces 30/35-year amortizations, Genworth Financial has been offering a similar "Business for Self" product (self-employed)
June 2006	CMHC: 0 percent down payment, 35-year amortizations; insurance on interest-only mortgages
October 2006	Genworth announces 40-year amortizations
December 2006	CMHC started to insure 40-year loans
March 2007	CMHC started to insure mortgage loans to self-employed
July 2007	LTV limit after which a loan must be insured increased to 80 percent (from 75 percent)
Source: CMHC, Genworth.	

Table A2. Canada: Microprudential Measures	
June 2011 (effective on January 1, 2013)	Protection of Residential Mortgage Hypothenar Insurance Act (PRMHIA) and amendments to the National Housing Act assented
	- Formalizes the rules for government-backed mortgage insurance and other existing arrangements with private mortgage insurers
	- Provision for the Minister of Finance to charge fees to compensate the Government for its exposure to risk represented by loan insurance
November 2011/January 2012	IFRS standards were implemented requiring banks to report debt securitizations on balance sheet
March 2012	Economic Action Plan 2012 announcements
	- Canadian banks prohibited from issuing covered bonds backed by government-insured mortgages (sets strong eligibility criteria for mortgages in the cover pool)
	- CMHC designated as administrator of the covered bond framework
	- CMHC's mandate was enhanced to include financial stability as an objective of CMHC's commercial activities
	- CMHC commercial activities subject to OSFI examination
June 2012	Guideline on Sound Residential Mortgage Underwriting Practices (B-20)
	- A guideline for residential mortgage underwriting practices and procedures was issued by OSFI (including assessment of borrower's background and demonstrated willingness to service debt payment in a timely manner, assessment of borrower's capacity to service debt, assessment of property value/collateral effective credit and counterparty risk management, comprehensive residential mortgage underwriting policy)
	- Maximum LTV on the revolving portion of HELOCs cut (from 80 to 65 percent)
	- Stated Income mortgages are no longer allowed without some verification of income
February 2014	Economic Action Plan 2014:
	- CMHC will pay guarantee fees to the Receiver General to compensate for mortgage insurance risks (pursuant to NHA 8.2), effective January 1, 2014. This will align CMHC with guarantee fees paid by private mortgage insurers. Fees are 3.25 percent of premiums written and 10 basis points on new portfolio insurance written
	- CMHC reduced its annual limit of issuance of portfolio insurance from $11 billion to $9 billion
	- For 2014, the Minister of Finance authorized $80 billion for NHA MBS (down from $85 billion in 2013) and $40 billion for CMB (down from $50 billion in 2013)

Table A2. Canada: Microprudential Measures (concluded)	
September 2014 (effective on January 1, 2015)	Revised Minimum Capital Test Guideline for property and casualty insurers
	- The guideline introduced new and updated risk factors and margins plus a revised definition of available capital
May 15, 2015	Amendments to PRMHIA. Substitution of loans in portfolio insurance pools was prohibited to increase market discipline in residential lending and reduce taxpayer exposure to the housing sector
June 30, 2015, full implementation (announced in November 2014)	Residential Mortgage Insurance Underwriting Practices and Procedures (Guideline B21) was issued. This guideline: - Outlines OSFI's expectations concerning mortgage insurers' governance and internal risk management practices - Outlines principles for mortgage insurers' own internal underwriting operations, including setting prudent requirements for lenders and applying appropriate due diligence to lenders' practices - Enhances disclosure requirements, which will support greater transparency, clarity and public confidence in mortgage insurers' residential mortgage insurance underwriting practices
December 11, 2015	CMHC announced changes to its securitization programs
	- Changes in the guarantee fee schedule (effective July 1, 2016). Fees were raised for large MBS issuers
	- For 2016, the Minister of Finance authorized $105 billion for NHA MBS and $40 billion for CMB.
December 11, 2015 (effective November, 2016	OSFI updated the regulatory capital requirements for residential mortgages:
	- OSFI imposed a risk-sensitive floor for one of the model inputs (losses in the event of default) that tied to increases in local property prices and/or to house prices that are high relative to borrower incomes
	- For federally regulated private mortgage insurers, OSFI introduced a new standardized approach updating the capital requirements for mortgage guarantee insurance risk. It requires more capital when house prices are high relative to borrower incomes
February 10, 2016 (effective July 1, 2016)	The DOF required that portfolio-insured loans be funded only through CMHC securitization programs
October 3, 2016	A consultation process with market participants on lender risk sharing was launched. The goal is to find ways to limit the federal government's financial obligations in the event of mortgage defaults and promote prudent lending practices.

Table A3. Canada: Mortgage Credit Equation

Dependent variable: Mortgage credit (y/y)	I.
House prices	0.08 **
	0.03
Wages	0.35 ***
	0.10
Interest rate	-1.84 ***
	0.17
Unemployment rate	-1.88 ***
	0.20
2008 measures	-0.56
	0.49
2010 measures	-2.26 ***
	0.53
2011 measures	-0.94 **
	0.45
2012 measures	-3.07 ***
	0.29
2016 measures 1/	0.31
	0.42
2016 measures 2/	-1.33 ***
	0.38
Number of observations	217
R^2	0.84

Effectiveness of Measures 3/	I. 1 month	II. 3 months	III. 6 months	IV. 9 months	V. Between rounds
2008 measures	1.09	1.51	1.34	1.11	-0.45
	0.81	*0.99*	*0.91*	*0.88*	*0.61*
2010 measures	-2.43 ***	-2.69 ***	-2.38 ***	-2.55 ***	-2.58 ***
	0.81	*0.81*	*0.70*	*0.61*	*0.56*
2011 measures	-0.64	-0.47	-0.38	-0.69	-1.04 **
	0.51	*0.42*	*0.40*	*0.46*	*0.47*
2012 measures	-1.60 ***	-2.01 ***	-2.10 ***	-2.19 ***	-3.06 ***
	0.26	*0.37*	*0.32*	*0.31*	*0.31*
2016 measures 1/	0.73 **	0.74 ***	0.59	0.26	0.26
	0.27	*0.27*	*0.35*	*0.43*	*0.43*

1/ *,**,*** indicate respectively statistical significance at the 10, 5, and 1 percent level. Standard deviations in italic.
2/ The estimation period is 1999:2–2017:2, using montly, seasonally adjusted data. Newey-West consistent variance estimator is used to calculate coefficients' standard deviation.
3/ Regressions I to IV estimate macroprudential measures effects after 1, 3, 6 and 9 months respectively after their implementation. Regression V estimates effects of each macroprudential measure between rounds of measures.

Table A4. Canada: Effects of Specific Macroprudential Measures on Mortgage Growth, OLS Estimation

Dependent variable: Mortgage credit (y/y)	I	II	III
Amortization period	0.19 ***		
	0.02		
LTV on refinance loans		0.53 ***	
		0.04	
LTV on first time borrowers			0.55 ***
			0.10
Number of observations	217	217	217
R^2	0.59	0.74	0.54

1/ *,**,*** indicate respectively statistical significance at the 10, 5, and 1 percent level.

2/ The estimation period is 1999:2–2017:2, using monthly seasonally adjusted data. Newey-West consistent variance estimator is used to calculate coefficients' standard deviation. Standard deviations in italic.

3/ All regressions include control variables as in Table A3 but are not shown here.

Table A5. Canada: House Price Equation

Dependent variable: House prices (y/y)	I
Mortgage credit	0.99 ***
	0.18
Completed houses	-0.11 ***
	0.04
Existing sales	0.10 ***
	0.03
GDP	0.30 *
	0.20
Number of observations	217
R^2	0.48

1/ *,**,*** indicate respectively statistical significance at the 10, 5, and 1 percent level. Standard deviations in italic.

2/ OLS estimation, period of 1999:2–2017:2. Monthly, seasonally adjusted data are used.

3/ Newey-West consistent variance estimator is used to calculate coefficients' standard deviation.

4/ The dependent variable is the y-o-y change in house price index (source: CREA).

Table A6. Effects of Macroprudential Measures on Mortgage Credit Growth-Panel GMM Estimation (2000–16)

Dependent variable: Mortgage credit growth (real)

	(1)	(2)	(3)	(4)
Mortgage credit growth (t-1)	0.90***	0.90***	0.89***	0.90***
	0.01	*0.01*	*0.01*	*0.01*
GDP growth (t)	0.28***	0.29***	0.28***	0.29***
	0.04	*0.04*	*0.04*	*0.04*
Lending rates (t)	-0.12***	-0.11**	-0.14***	-0.12***
	0.04	*0.04*	*0.04*	*0.04*
Risk weights	-1.99***			
	0.42			
Provisioning		-1.06**		
		0.49		
LTV			-1.30***	
			0.25	
DSTI				-0.87**
				0.34
N	2117	2117	2117	2117
Countries	35	35	35	35

1/ *,**,*** indicate respectively statistical significance at the 10, 5, and 1 percent level. Standard deviations are in italic.

2/ The estimation period is 2000:1–2016:4; quarterly, seasonally adjusted data.

3/ Data for China, India, Colombia, Romania, Lithuania, Luxembourg and Uruguay pertain to claims to private sector since mortgage credit data is unavailable.

4/ Real mortgage credit growth is defined as the y-o-y growth rate of nominal mortgage credit deflated by CPI.

Table A7. Effects of Macroprudential Measures on House Price Growth-Panel GMM Estimation (2000–16)

Dependent variable: House price growth (real)

	(1)	(2)	(3)	(4)
House price growth (t-1)	0.78***	0.78***	0.78***	0.78***
	0.01	*0.01*	*0.01*	*0.01*
GDP growth (t)	0.35***	0.36***	0.34***	0.34***
	0.03	*0.03*	*0.03*	*0.03*
Lending rates (t)	-0.50***	-0.48***	-0.55***	-0.53***
	0.06	*0.06*	*0.06*	*0.06*
Risk weights	-0.14			
	0.38			
Provisioning		0.52		
		0.37		
LTV			-0.38***	
			0.13	
DSTI				-0.44**
				0.20
N	1406	1406	1406	1406
Countries	30	30	30	30

1/ *,**,*** indicate respectively statistical significance at the 10, 5, and 1 percent level. Standard deviations in italic.

2/ The estimation period is 2000:1–2016:4; quarterly, seasonally adjusted data.

3/ Real house prices are defined as house price indices deflated by CPI (Source: OECD, Global Property Guide, IMF dataset).