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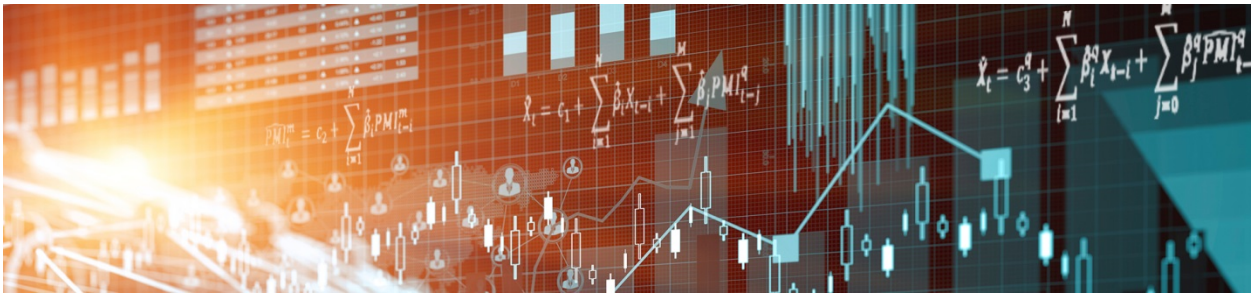
The "Too Big to Fail" Subsidy in Canada: Some Estimates



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Abstract

Implicit government guarantees of banking-sector liabilities reduce market discipline by private sector stakeholders and temper the risk sensitivity of funding costs. This potentially increases the likelihood of bailouts from taxpayers, especially in the absence of effective resolution frameworks. Estimates of "too big to fail" (TBTF) implicit subsidies are useful to understand bank agents' incentives, measure potential resolution costs and assess the credibility of regulatory reform. Given the implicit nature of the subsidy, I propose a framework that adopts two empirical approaches to assess the quantum of the subsidies accruing to systemic banks in Canada. The first is based on credit rating agencies' assessment of public support and the second relies on a contingent claims analysis. Results suggest more progress on resolution is needed, such as the implementation of a credible statutory bail-in regime for senior obligations, to increase market discipline and help address TBTF externalities. That said, Canada being an early adopter of Basel III might help explain the significant reduction in the government's contingent liability since the peak years of the crisis.

Bank topics: Financial institutions; Financial stability
JEL codes: G13, G21, G28

Résumé

Les garanties implicites offertes par l'État à l'égard des passifs du secteur bancaire réduisent la discipline de marché exercée par les intervenants du secteur privé et atténuent la sensibilité au risque des coûts de financement. Cela pourrait accroître la probabilité que l'argent des contribuables serve à renflouer les caisses d'institutions financières, particulièrement en l'absence de cadres de résolution efficaces. Les estimations des subventions implicites octroyées aux institutions financières trop importantes pour faire faillite permettent de comprendre les motivations des agents financiers, de mesurer les coûts éventuels de la résolution et d'évaluer la crédibilité de la réforme réglementaire. Compte tenu de la nature implicite de la subvention, l'auteure propose un cadre qui repose sur deux approches empiriques pour évaluer la valeur des crédits octroyés aux banques d'importance systémique au Canada. La première est fondée sur l'évaluation faite par les agences de notation du soutien public et la seconde s'appuie sur une analyse des créances contingentes. Les résultats montrent que le processus de résolution doit être amélioré, par exemple en instaurant un régime obligatoire de recapitalisation interne crédible pour les obligations de premier rang, afin de renforcer la discipline de marché et de faciliter la résolution des externalités des institutions trop importantes pour faire faillite. Cela dit, le fait que le Canada a été l'un des premiers pays à adopter le dispositif de Bâle III pourrait expliquer la réduction considérable du passif éventuel du gouvernement depuis les sommets atteints durant la crise.

Sujets : Institutions financières ; Stabilité financière
Codes JEL : G13, G21, G28

Non-technical summary

Concerns over widespread contagion (to other financial institutions and to the broader economy) during the 2008-2009 global financial crisis left some countries with no credible alternative but to provide public funds and guarantees to financial institutions considered systemic, or "too big to fail" (TBTF). These institutions are broadly defined as those of such size, market importance and interconnectedness that their distress or failure would cause significant dislocation in the financial system and have adverse economic consequences (Financial Stability Board, 2010). The G20 countries have since committed to fundamental reform of the global financial system to move toward increased resiliency and safety. As the financial system becomes more resilient, implicit TBTF subsidies should decrease. Nonetheless, questions remain about the impact and credibility of these measures in effectively mitigating the probability and impact of future crises, and what might be the unintended consequences of financial sector reforms.

This paper complements work done in other jurisdictions and contributes to the TBTF debate by developing an empirical framework to assess implicit public support for the largest domestic financial institutions in Canada. So far, analyses in the Canadian context have been limited, and this work is novel given the adopted approaches. Furthermore, earlier studies stop short of the most recent period, not fully assessing the post-implementation effects of reforms targeted at enhancing resolution regimes.

The application to Canada's largest financial institutions, the six domestic systemically important banks and the credit union Desjardins Group, aims to (i) quantify the funding advantage these institutions benefit from; and (ii) measure the government's contingent liability if these institutions come under severe stress and require public assistance. For (i), we rely on data from credit rating agencies and pricing of senior bonds in the primary market to measure the funding advantage accruing to the identified banks. On (ii), we apply a variation of the structural credit risk model by Merton (1974) to quantify the expected shortfall in capital given implied default probabilities for the banks. The methodologies are straightforward to implement, and the necessary data are available in the Canadian context, allowing for an ongoing assessment of implicit TBTF subsidies in Canada. As such, measures of TBTF subsidies can be used to assess the credibility of regulatory reform measures announced and implemented domestically.

Results indicate that more progress on resolution, such as the implementation of a statutory bail-in regime for senior obligations, may be needed to increase market discipline and better align banks' funding costs with their stand-alone riskiness (without accounting for public support expectations). That said, Canada being an early adopter of Basel III might help to explain the significant reduction in estimates of the government's contingent liability since the global financial crisis, as higher levels of capital appear to be working to reduce the probability of a large bank failing. While the main focus of Basel III reforms is on reducing the probability of crisis, resolution reforms are more targeted at ensuring that the impact of a crisis is mitigated and that banks become "safe to fail."

1. Introduction

The paper complements work done in other jurisdictions and contributes to the "too big to fail" (TBTF) debate by developing an empirical framework to assess implicit public support for the largest domestic financial institutions in Canada. So far, analyses in the Canadian context have been limited, and this work is novel given the adopted approaches. Furthermore, earlier studies stop short of the most recent period, not fully assessing the post-implementation effects of reforms targeted at enhancing resolution regimes.

The application to Canada's largest financial institutions, the six domestic systemically important banks (D-SIBs) and the credit union Desjardins Group, aims to (i) quantify the funding advantage these institutions benefit from; and (ii) measure the government's contingent liability if these institutions come under severe stress and require public assistance. As such, measures of TBTF subsidies can be used to assess the credibility of regulatory reform measures announced and implemented domestically.

The rest of the paper is structured as follows. Section 2 motivates the analysis by framing how government guarantees may affect bank behaviour and why it matters for financial stability. Section 3 reviews key measures of the post-crisis regulatory reform agenda and its implementation status, globally and in Canada. Section 4 describes possible empirical strategies, and section 5 discusses the empirical application and results. Section 6 concludes and draws policy implications. Additional information is reported in the annexes.

2. Motivation: Why "too big to fail" matters for financial stability

Banks have historically been at the centre of some of the most serious financial crises, with credit booms and asset price bubbles emerging as common factors in the run-up to crises (Claessens and Kose 2013; European Central Bank 2015). Government guarantees to banks temper the risk sensitivity of funding costs and create incentives for excessive risk-taking (Damar et al. 2012). If these guarantees are not actuarially fairly priced, they help create allocative and competitive distortions both within the banking sector and across sectors (Cechetti and Kharroubi 2012; Arcand et al. 2012).[1] Banks may react by re-risking assets, levering up their balance sheets, and holding more unstable shorter-term funding. In this context, bondholders and shareholders have reduced incentives to properly monitor the banks' actions and exert market discipline, leading to moral hazard.[2] All these factors affect the resiliency of banks and of the financial system and increase the risk of fundamentally driven runs.[3] An increased likelihood of severe stress events and the potential recourse to taxpayers' funds is expected to have negative implications for public sector finances, confidence and growth. In fact, experience from the global financial crisis has exposed the negative feedback loop between public sector implicit and explicit guarantees to banks and the strength of the home sovereign (particularly in Europe).[4]

[1] The relation between financial development and economic growth may be non-monotonic. There appears to be a threshold beyond which the financial system may become too large and a drag on growth, leading to re-risking and misallocation of resources.

[2] Because government support works to reduce the funding costs of bondholders, bank profitability and the value of residual claims (held by shareholders) should increase.

[3] For further discussion on moral hazard and the benefits of government guarantees (or the desirability and effectiveness of government guarantees) in the banking industry, refer to Allen et al. (2015).

[4] The International Monetary Fund (Amaglobeli et al. 2015) estimates that the median direct fiscal costs of the banking crisis (particularly related to bank bailouts) were about 4.2% of annual gross domestic product (GDP) for both advanced and emerging

On the other hand, guarantees can play a stabilizing role. Because these, implicit or explicit, work to reinforce banks' charter values (the expected present value of economic rents), the prospect of losing a valuable source of monopoly power provides an incentive for bank agents to act more prudently and reduce risk-taking activities, in order to minimize the probability of failure and remain "open" (Martinez-Miera and Repullo 2008).[5] Guarantees, or the perspective of support being available in times of stress, help to mitigate the probability of funding runs occurring, by both depositors and wholesale debtholders, which is the main argument for public safety nets and some form of deposit insurance or preference. Further, a deposit is an operating liability of the bank, not a source of funding or capital, so there is an argument to be made against these being subject to losses. Retail depositors are not expected to be the primary stakeholders that impose market discipline. Because these guarantees are explicit and charged a premium, they can be seen as insurance and are not necessarily a "free lunch," as is the case for implicit guarantees. That said, the determination of the premia is based on individual riskiness, without consideration for spillovers and systemic risk. Hence, a "free lunch" issue may still be outstanding.

The prevalent view is that moral hazard concerns dominate. Since banks do not internalize the potential cost of a systemic crisis, they are prone to take on excessive risk, raising prospects of financial instability. Given the high degree of interconnectedness among financial sector players and the relatively high levels of concentration of the banking sector in many jurisdictions, including Canada, there is a case for systemic risk to build up in the presence of implicit government guarantees. Evidence from the global financial crisis corroborates this view. With the exception of Lehman Brothers, all large US and European financial institutions that came into stress during that period received some form of government support, ranging from direct recapitalization, loans, implicit and explicit guarantees and public support for mergers and acquisitions (Schich and Lindh 2012).[6] Further, stress in the financial sector has the potential to induce sovereign crises and reinforce the bank-sovereign nexus (Jordà et al. 2016). A sharp increase in sovereign debt yields threatens to weaken the sovereign's fiscal position and ultimately undermines the credibility and effectiveness of public interventions, working to self-perpetuate the stress in the system.[7]

Because large banks are generally expected to create the most systemic risk,[8] size and its drivers also matter. Besides diversification (across economic activities and geographies), there are at least three reasons why banks may wish to become larger: (i) to gain TBTF status and benefit from implicit government guarantees

economies across a sample of recent crises (2007-2011). The full cost of the banking crisis, including output losses, increased unemployment and higher public debt, largely exceeds these estimates. Luttrell et al. (2013) estimate cyclical output losses of US$6–14 trillion.

[5] Martinez-Miera and Repullo (2008) show that in less competitive markets, increased risk-taking activities by banks may not result in a higher probability of failure, arguing that the relation between competition/risk-taking and the risk of bank failure is non-linear.

[6] Although no extraordinary form of support (bail-outs of explicit guarantees) were provided to Canadian financial sector players during the 2008-2009 crisis, authorities made use of moral suasion (Allen et al. 2016).

[7] Banks are affected directly (through mark-to-market losses on their assets) and indirectly (reduced value of collateral for repos and access to central bank liquidity) by losses of value in sovereign debt. Reduced profitability for banks, and consequent deleveraging, works to reduce the credit flow to the real economy, affecting GDP growth and tax revenues, weakening the sovereign's ability to service its own debt. Sovereign debt is typically the *safest* asset and financial institutions may "gamble for resurrection"; i.e., banks have incentives to pile on sovereign debt in periods of duress.

[8] Laeven et al. (2014) find that large banks are riskier than small banks and create more systemic risk, especially when capital is inadequate and funding is unstable. Since the late 1990s, large banks have increased in size but also in complexity and involvement in market-based activities, together with an increasingly interconnected global economy. The authors further note that shifting away from traditional lending, coupled with higher leverage, may have resulted in more fragile business models.

(via reduced funding costs on debt and potentially equity);[9] [10] (ii) economies of scale;[11] and (iii) empire-building (market power). The latter two reasons do not necessarily lead to excessive risk-taking and moral hazard, as these might increase banks' charter value.

3. The post-crisis regulatory reform agenda: ending TBTF

During the global financial crisis, the lack of adequate powers to orderly resolve large financial institutions resulted in the extensive use of taxpayer money to fund bail-outs, helping put a price tag to governmental implicit guarantees.[12] It is now widely recognized that bank resolution frameworks in force at the time, modelled on corporate insolvency proceedings, were ill adjusted to the specificities of financial institutions, in particular the need to maintain access to critical functions during resolution (e.g., access to transactional accounts for payments and savings).

In November 2008, G20-country leaders committed to a fundamental reform of the global financial system. The main objective of the reform agenda is to reduce the probability and impact of severe stress events, thereby increasing overall resiliency and safety (albeit at an opportunity cost in terms of investment and consumption).

One of the core elements of this reform agenda is "ending too big to fail." In our analysis, we will be focusing more narrowly on the banking system, but regulatory reform focuses on systemically important financial institutions more broadly, including insurance companies and other non-bank, non-insurer entities, like mutual funds. Table 6 in Annex A reviews progress on resolution in a selected number of jurisdictions, including Canada. To build resilient banks and end TBTF, institutions that generate more systemic risk have additional requirements imposed on them. Some of the key measures include the identification of global (and domestic) systemically important banks and insurers through the global systemically important bank (G-SIB)/global systemically important insurers (G-SII) designation process, increased loss absorbency capacity requirements and additional capital and liquidity buffers, more intensive supervision,[13] changes to bank structure and the scope of permissible banking activities (e.g., Vickers and Volcker rules), the establishment of supervisory colleges and crisis-management groups for global banks, recovery and resolution planning, and new forms of resolution (bail-in). The combination of measures should result in a reduction in leverage and financial sector risk, help mitigate moral hazard, and lead to positive, long-term, real economy impacts, including more stable growth.

[9] Concerns over some financial institutions being TBTF predate the financial crisis. Continental Illinois Bank (the 7th largest US bank by deposits) received public support in the form of capital and liquidity assistance in 1984.

[10] The IMF recently estimated that G-SIBs alone benefitted from $15-70 billion implicit subsidies in 2011-2012. The mispricing works toward a misallocation of resources and induces greater leverage and inflated balance sheets. The increase in asset size may come at the expense of reduced profitability given diminishing marginal returns, especially on a risk-weighted basis, translating into a higher probability of default, and higher loss given default.

[11] Optimal bank size is uncertain and a matter of debate. Early literature suggests economies of scale are exhausted at $50 billion in assets, notably the current threshold for enhanced prudential oversight in the US under the Dodd-Frank Act, but recent studies suggest that this asset threshold may be higher due to the growing cost of technology and corporate overhead/compensation.

[12] Moody's notes the "experience during the crisis has validated the assumption that many banks have some reasonable expectation of external support, the effect of which is to reduce any loss borne by creditors" (rating methodology: Global Banks, 2014).

[13] In 2010, the G-20 endorsed the FSB's Systemically Important Financial Institutions (SIFIs) Framework ("Reducing the moral hazard posed by Systemically Important Financial Institutions," FSB 2010). Leaders called for a "review of resolution regimes and bankruptcy laws in light of recent experience to ensure that they permit an orderly wind-down of large complex cross-border institutions."

On resolution, the G-20 endorsed the Financial Stability Board's (FSB's) Key Attributes of Effective Resolution Regimes for Financial Institutions (or Key Attributes) in 2011, further updated in 2014 (FSB 2011, 2014).[14] The new international standard sets out key characteristics and a roadmap toward effective and credible resolution regimes. Improving bank resolution works to maintain access to critical functions and keep the bank open during resolution. Further, the bail-in of creditors (and uninsured depositors in certain jurisdictions) helps address moral hazard concerns, by increasing the potential "skin in the game" of private players and hence limit taxpayers' exposure to loss for motives of solvency support. Further, by avoiding the dead weight of liquidation losses, bail-in resolution strategies work to minimize the full cost of resolution.

Although FSB members, including Canada, committed to having the Key Attributes in place by the end of 2015, the pace of implementation has been uneven and faster in the regions most affected by the financial crisis, particularly the US and Europe, which now have operational resolution regimes in place. Despite significant progress, the latest FSB peer review on resolution (FSB 2016) noted that currently, only a subset of FSB membership has "broad" resolution regimes in force and which are aligned with the Key Attributes. Canada, along with five other jurisdictions, was noted in the peer review as still lacking some of the resolution powers prescribed by the Key Attributes, most noteworthy an operational bail-in regime. To this last point, legislation that introduces a statutory bail-in framework and the possibility that senior unsecured bonds may be converted into equity to recapitalize a failing institution has since received Royal Assent (June 2016) and is expected to come into force in 2018. D-SIBs will have until 1 November 2021 to build their loss absorbency to the minimum requirements set by the Office of the Superintendent of Financial Institutions (OSFI).[15] Further, a contractual bail-in regime has been in force for Tier 2 securities since 2013. The resolution peer review noted substantial progress in Canada, as provisions for the imposition of temporary stays on the exercise of contractual early termination rights, recovery planning, resolution planning and resolvability assessments are all in place.

4. Empirical frameworks

Given the implicit nature of the TBTF subsidy, there is no single direct observable variable or ideal methodology to help quantify its size and it is common that empirical analyses use a combination of approaches. The focus is on establishing an admissible range for the subsidy instead of point-estimates, helping to mitigate model risk. Below, I review the most commonly used methodologies and discuss their applicability in the Canadian context.[16] While some empirical analyses to estimate the subsidies focus on quantifying the aggregate reduction in funding costs enjoyed by TBTF institutions, others aim to obtain a measure of the government contingent liability given severe stress in the banking sector. The former approach provides for an ex-ante measure of the estimate, and can serve to identify the reasons behind a misallocation of resources. As for the latter, it tries to assess the quantum of potential direct costs related to public support for solvency in resolution (i.e., not including second-round effects on the economy). Table 1 discusses a selected number of empirical frameworks and applicability in Canada.

[14] http://www.fsb.org/wp-content/uploads/r_141015.pdf
[15] http://www.osfi-bsif.gc.ca/Eng/fi-if/rg-ro/gdn-ort/gl-ld/Pages/tlac_gias.aspx
[16] See also Siegert and Willison (2015) for a comprehensive review of different approaches to estimate TBTF subsidies.

4.1. Estimating the funding advantage

It is expected that the cost of debt for large and complex institutions is lower than for non-TBTF institutions (namely for senior unsecured debt, including uninsured deposits). To estimate the funding advantage accruing to the largest Canadian banks, I focus on credit rating agencies' (CRAs') assessment of public support. Mapping credit rating uplifts into a funding cost advantage works to price the implicit subsidy. The funding advantage is given by the reduction in yield spreads implied by the higher rating. Although rating agencies' assessments may not always be accurate, there is some evidence that investors take information conveyed by ratings into account when pricing bank debt (Ueda and di Mauro 2011, Morgan and Stiroh 2005, Resti and Sironi 2005). Pricing data from bond indexes or bond issuances can be used to compute the mapping function. Because credit ratings also affect a bank's funding though other channels — for example, through its relevance in defining collateral values and haircuts for repos and access to central bank liquidity — the estimates of the funding advantage generated by this approach may be conservative as they account only for the direct impact on the issuance cost of such debt. One advantage of the approach is that it controls for bank characteristics and risk profile, as ratings already account for such differences across institutions. Data availability is also not a significant concern. A disadvantage of the approach is that results can be somewhat backward-looking and sticky. Although rating methodologies incorporate qualitative assessments and commit to adopting a forward-looking view of risks and the overall economic environment, there is a significant influence of accounting information, and changes to the ratings are infrequent. Finally, estimates may be influenced by the quality of the ratings' agencies assessment regarding support expectations.

Table 1. Summary of selected methodologies employed to estimate TBTF subsidies

Approach		Pros	Cons	Applicable in Canada	Selected References
Funding advantage	Ratings uplift	Data available; controls for bank characteristics	Backward-looking bias; infrequent changes to ratings	Yes	IMF 2014; Schich and Lindh 2012; Haldane 2010; Noss and Sowerbutts 2012; Sveriges Riksbank 2011
	Credit spreads	Forward-looking; dynamic measure; controls for bank characteristics	Lack of control variable in some countries	No (data gaps)	Acharya et al. 2014; IMF 2014; Santos 2014; Lester and Kumar 2014; Noss and Sowerbutts 2012
	Balance sheet	Data available	Backward-looking bias; frequency of data	Yes	Beyhaghi et al. 2014
Contingent claims	Structural credit risk model (Merton)	Forward-looking; dynamic measure	Data gaps; sensitivity to volatility inputs	Yes	Noss and Sowerbutts 2012
	Actual vs. implied CDS spreads	Forward-looking; dynamic measure; controls for bank characteristics	Data gaps; no/illiquid CDS pricing (especially in times of stress)	No (data gaps)	IMF 2014; Bijlsma et al. 2014; Noss and Sowerbutts 2012

The funding advantage that TBTF institutions enjoy may also be assessed by comparing interest costs on unsecured bonds issued by TBTF and non-TBTF banks. To correct for sector effects, some studies adopt a difference-in-differences approach to estimate whether the relative funding advantage from which the largest banks benefit is significantly different from that accruing to the largest non-financial corporations. Because this framework relies on market data and incorporates stakeholders' current expectations and public information, estimates are dynamic and forward-looking. Nonetheless, the methodology can be difficult to apply in countries with highly concentrated banking sectors, as is the case for Canada, where it is difficult to define a robust control group. Although D-SIBs enjoy relatively good access to the wholesale funding market, smaller banks have very limited and sporadic bond issuance and tend to rely on non-marketable liabilities such as brokered deposits for funding. To circumvent this issue, data from small banks in foreign jurisdictions can be used in the control group, although at the expense of precision and robustness of the estimates, as other types of risks will be factored in (e.g., country risk, different market structure and competitive environment).

Other analyses use accounting data, such as interest expense ratios, for the different types of funding instruments. However, results can be backward-looking.

4.1.1. Overview of rating methodologies for banks

CRAs, including Moody's, Standard & Poor's (S&P), Fitch and DBRS, assess banks on a dual rating scale. The dual ratings approach is specific to the banking sector, as non-financial corporates are not typically assessed through a dual rating process, i.e., not seen to benefit from extraordinary public support. Although the exact terminology varies across agencies, conceptually the two ratings are as follows:

- A *baseline credit assessment* (BCA) or *stand-alone rating*, which reflects an opinion of the bank's intrinsic financial strength. It provides a measure of the probability of stand-alone failure. Although the assessment is generally publicly available, it is not an official credit rating but rather an input to determine the final *all-in* rating of the institution. The main factors considered to assess a bank's intrinsic financial strength are franchise value, risk, regulatory environment, operating environment and financial fundamentals.[17]
- The *all-in* rating, or rating, builds on the stand-alone assessment and further incorporates expectations of various forms of external support (e.g., from parent companies or cooperatives, and public authorities). Extraordinary support expectations may change over time, to account for new government laws and regulations, government actions and public policy statements, and shifts in political sentiment. Consideration is given to both the willingness[18] and capacity[19] of authorities (e.g., sovereign, regional or local authority, central bank) to commit public funds to avoid default of certain obligations (e.g., via extraordinary liquidity provision, authorizing the use of public funds for recapitalization, guarantees on

[17] Stand-alone assessments promote comparability between bonds issued by banks and those issued by non-financial corporates.

[18] *Willingness* is assessed as a factor of general public policy (applies to the entire banking sector) and the importance of the bank (probability that support is extended to that institution). Key factors are the level of government ownership of banks, the track record of support (history of bank defaults) in that jurisdiction, the importance of the banking system (bank assets as percentage of GDP), and the strength of the overall banking system.

[19] *Capacity* is proxied by the sovereigns' own long-term local-currency rating, which acts as a ceiling for the bank's rating. This is for reasons of ability to provide support but also because the country's rating is indicative of the more general macroeconomic and financial market trends.

deposits or other financial obligations). As such, the banks' ratings are typically capped at the home sovereign's rating.

The difference between the two assessments generates a ratings uplift factor that reflects the expectation of extraordinary support available to banks. The uplift factor is calculated by assigning a numerical scale to the two ratings and taking the difference between them, with one notch of uplift being equivalent to one step in the rating scale (e.g., A1 versus A2 using Moody's ratings scale). Fitch's stand-alone and support ratings, however, are not directly comparable (Afonso et al. 2014). The external support strengthens a bank's credit risk profile and generally works to lift the final rating to a higher level, translating into a funding cost advantage that might provide incentives for excessive risk-taking.[20] Credit risk becomes a function of intrinsic financial strength, the likelihood of it receiving external support and the risk of a credit event owing to the actions of the sovereign. Consequently, default and loss depend upon the performance of both the primary obligor (the bank) and all other entities offering support (including the government).

4.2. Estimating the government contingent liability

A different approach to estimating the subsidies focuses on pricing the contingent claims accruing to authorities upon the materialization of severe stress in the banking sector, or the expected government support needed to ensure the banking system remains solvent and avoids default.

Premised on extraordinary government support being available to large banks in stress, expectations of default should be lower. A variation of the structural credit risk model proposed by Merton (1974) can be adopted to assess the contingent liabilities, where the government is seen as being short a portfolio of put options on TBTF institutions. The underlying instrument is given by the individual banks' market value of assets and the strike price corresponds to a systemic threshold which, if breached, would likely trigger government intervention. The threshold is a function of a given asset shock and the minimum capital levels required for the banks to remain viable. Because this approach assumes the government will intervene with certainty, results may overestimate the provision of support; i.e., in cases where there are no systemic concerns, or if a bail-in of private creditors is triggered to recapitalize the bank, the government's solvency support may not be fully granted. On the other hand, because the model assumes a normal distribution of shocks, results fail to capture the effects of low probability and highly damaging scenarios (such as banking crisis), hence potentially underestimating the shortfall.

Alternative approaches look at expectations embedded in various financial market instruments to assess the probability of government intervention. High-frequency financial market data such as credit default swap spreads (CDSs) and equity options can be used to extract information about bank default probabilities, and help to quantify government contingent liabilities arising from bank failure. Expected default risk is backed out from both CDS premia and equity options, with the difference providing an estimate of the government support. Given that equity is a residual claim of the bank's assets, shareholders' equity is expected to be wiped out before the government intervenes; hence, the default risk embedded in equity option prices should reflect the stand-alone risk of the bank. On the other hand, because CDSs offer insurance against the risk of bonds

[20] Afonso et al. (2014) find evidence that a greater likelihood of government support (as seen in increases in credit ratings uplifts) leads to a rise in bank risk-taking and a larger volume of bank lending becoming impaired.

defaulting, the implied default risk may include an expectation of extraordinary support. Under this approach, the estimates of the subsidy are dynamic and forward-looking. However, data gaps may be an important impediment to the adoption of this framework in certain jurisdictions. CDSs typically exist only in the most developed markets and for the largest corporations/banks, and even these may lack sufficiently liquid pricing in moments of stress, risking inaccurate measures of the subsidy when market liquidity is poor. As the CDS market for Canadian banks is incomplete and illiquid, it is challenging to adopt this empirical approach for the domestic banks.[21]

5. Empirical application and results

In March 2013, the OSFI designated Bank of Montreal, Bank of Nova Scotia, Canadian Imperial Bank of Commerce, National Bank of Canada, Royal Bank of Canada, and Toronto-Dominion Bank as "domestic systemically important banks." As a result, this group of banks was required to carry additional capital (a 1% risk-weighted assets capital surcharge commencing in January 2016), subject to more intensive supervision and enhanced disclosure expectations. In June 2013, Quebec's Autorité des marchés financiers also designated Desjardins Group as systemically important, adding similar regulatory requirements for the credit union. Further, Royal Bank of Canada was designated a "global systemically important bank" (G-SIB) by the FSB in November 2017. The D-SIBs account for more than 90% of total banking assets in Canada.

This paper adopts two of the empirical approaches discussed above to estimate TBTF subsidies for the domestic systemic banks. For completeness and to minimize model risk, I first use credit ratings data to derive the funding advantage banks may have in their issuances of senior unsecured debt. Results from this methodology will likely provide a lower bound estimate of the guarantees, because I consider that the reduction in funding costs applies only to a subset of the liabilities (wholesale unsecured debt). Further, no consideration is being given to the influence of the higher ratings on additional uses of these securities, such as for repo purposes and access to central bank liquidity facilities. The second approach builds on the structural credit risk model proposed by Merton (1974) to measure the government's contingent financial risk associated with the failure of the largest domestic banks.

The range of results obtained will reflect the strengths and weaknesses of the different approaches and the characteristics of the data used as input. While the former analysis is parsimonious, it relies on a subjective assessment of expected government support by CRAs. In contrast, the contingent claims approach uses information from financial market prices, which has the advantage of reflecting current expectations of a broad set of economic agents, to assess the likelihood of bank failure and quantify the shortfall in capital. That said, one disadvantage of this method is that the subsidy may be amplified by increases in investor risk aversion, particularly in stress periods.

[21] According to IHS Markit's liquidity metrics on credit derivatives, only four of the six D-SIBs have quoted CDSs. Further, these are often based on parsed, infrequent dealer runs. For example, Canadian bank CDSs were rated 4 or 5 on a scale of 1-5 (5 being the least liquid, 1 being the most) as of January 2017.

5.1. Funding advantage

Building on Schich and Lindh (2012) and Noss and Sowerbutts (2012), I estimate the public subsidy accruing to the seven largest domestic financial institutions by mapping the ratings uplift determined by Moody's and S&P to a funding cost advantage on these banks' senior unsecured wholesale debt issuances.[22]

I retrieve the ratings history for the long-term senior unsecured liabilities/deposits of the seven banks from the two rating agencies from 2007 until the end of fiscal year 2017 (October) and compute a time series of the uplift.[23] Data for S&P start at the end of 2011 when the agency began reporting the dual ratings. Because we are considering the banks' ratings at the parent level, the uplift reflects only expectations of extraordinary support by public authorities (i.e., not from other group entities). The largest domestic banks currently receive a rating uplift of two to three notches by Moody's and one to two notches by S&P. Annex C includes detailed data on the individual banks' ratings history and uplift factors.

In calculating the mapping function to convert the ratings uplift into a funding cost advantage, I use pricing data on primary market senior unsecured *plain vanilla* issuances available from Bloomberg.[24] The mapping function works to provide an indication of the typical yield spread over a risk-free rate for the different ratings. To ensure a mapping function *through the cycle*[25] (as in IMF 2014), our sample includes all investment grade issuances (as sampled banks are all in this category) of fixed coupon and bullet maturities' senior unsecured bonds issued by entities domiciled in Canada. Maturities range from 1 to 11 years; bonds are denominated in both Canadian and US dollars, and have been issued from 1 January 2007 to 31 October 2017. For each bond, at issuance date, I calculate the yield spread (or equivalent spread in Canadian dollars for US-dollar-denominated issues, considering the swap spread at the date of issuance) over the risk-free rate (given by the closest maturity Government of Canada [GoC] bond yield).[26] Yield spread data are aggregated for each ratings bucket to arrive at the mapping function, using the median of the spreads to account for outliers. The computations are run for each of the two rating agencies; i.e., yield spreads are aggregated per the rating each CRA attributes to the individual bonds. The original search of bond issues resulted in 1,645 and 1,119 bonds

[22] Although I further considered ratings data from DBRS, I chose not to report results given the lack of change in the ratings during the observation period. For reference, DBRS attributes one notch of uplift across all the banks in the sample, unchanged since 2007.

[23] Data are hand-collected from the CRAs' websites and from individual ratings reports.

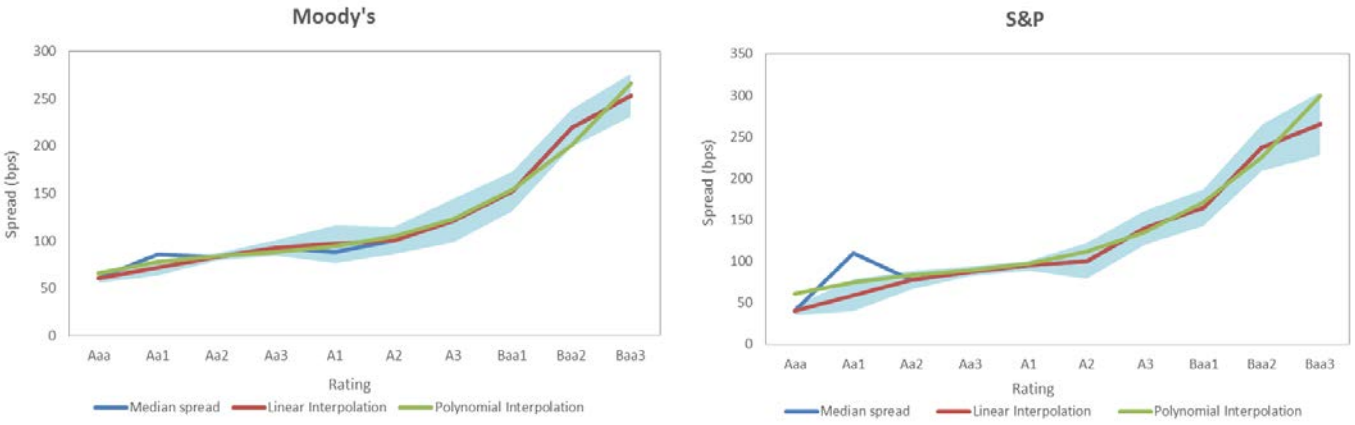
[24] Alternatively, this information may be derived from yields (or yield spreads over a risk-free rate) embedded in market indexes and yield curves. The breakdown of indexes published for the Canadian bond market is insufficient to estimate a comprehensive mapping function (e.g., there are individual indexes only for AA-, A-, and BBB-rated securities).

[25] The translation of ratings uplift into a funding cost spread relies on the historical relationship between credit ratings and bond spreads, and does not account for possible changes to this relationship. The difference in funding cost across multiple ratings should account for differences in credit risk but is likely to also include a time-varying risk premium. We further computed annual mapping functions (included in Annex C), and observe some variability across the annual estimates, in particular for when market conditions are volatile and risk aversion is higher (2007-2008). The relationship between credit ratings and funding costs — in particular, the steepness of the curve — is not stable over time and reflects market conditions; e.g., the same uplift would translate into a greater funding advantage in 2009 versus 2016. Noss and Sowerbutts (2012) use annual mapping functions in their analysis, which might be a complementary approach as these are useful to estimate expected "peak TBTF subsidies" (likely higher in duress). Literature indicates that the perception of TBTF subsidies varies over time and is positively related to financial or economic stress.

[26] Although the yield at issue for the sampled bonds is not always directly available from Bloomberg, it may be estimated using the Bloomberg function YAS. The GoC bond is given by the Canadian Generic Bond Index for that maturity on issue date of the corporate bond. Whenever a GoC benchmark was unavailable for a specific maturity, we computed the interpolated yield of the two closest maturities.

rated by Moody's and S&P, respectively. After accounting for missing values on some of the parameters (e.g., yield), the two samples include 1,547 and 1,119 issues. Charts of the two mapping functions are included below and additional tables are reported in Annex C.

Figures 1 and 2. Mapping functions per credit rating agency — median yield spread



Source: Moody's, S&P, Bloomberg, staff calculations
Shaded areas represent 95% confidence interval bands for the yield spreads

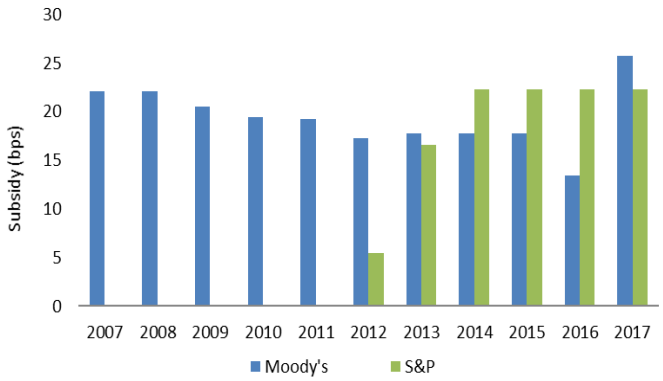
The mapping functions are upward sloping, meaning the aggregated yield spreads are generally inversely correlated with the ratings quality of the issuers. This is in line with expectations that an institution with a better rating should fund itself at a lower cost. Across the two mapping functions, there are a few isolated cases in which this relationship does not hold; i.e., dips or hikes in the distribution are observed, which may be related to a relatively lower number of bonds used to calculate expected yield spreads in these rating buckets or illiquidity factors. To correct for the effect, I interpolate the median values across the closest observations, and given that the resulting estimates generally fall within the 95% confidence interval bands, the corrected estimates are used.

Each bank's funding cost advantage is given by the difference in estimated funding costs between bonds assigned the two ratings (with and without support). Results indicate that on average, and per Moody's data, the seven largest domestic banks currently benefit from a funding advantage of 26 basis points (bps) in their senior unsecured bond issuances, within a range of 14 to 56 bps. Differences in the funding cost advantage between banks flow directly from larger uplift as well as relatively lower stand-alone ratings. In terms of trends, the subsidies to the banks have been relatively stable since Moody's formally introduced an assessment of public support in 2007, on average around 20 bps, failing to reflect progress on regulatory reform. Although Canada has been at the forefront of implementing many of the regulatory reform measures prescribed by the G20, progress on resolution has been slower and targeted measures in this area may be important drivers for the evolution of the implicit subsidies.

Estimates are slightly lower using data from S&P; on average, 22 bps (range 6-45 bps, across banks). This is influenced by the lower uplift factor S&P attributes to the banks, but also by differences across the estimated mapping function.[27] Annex C includes additional details on the different mapping functions.

The translation of the ratings uplift into a funding cost spread relies on the historical relationship between credit ratings and bond spreads, and does not account for possible changes to this relationship. However, this relationship is volatile and significantly influenced by risk aversion levels. We observe that the mapping function steepened considerably in 2008-2009 (see Annex C). As an illustration, if we recalculate our estimates for Moody's data based on the relationship that held during the peak year of the crisis, we observe that the estimate reported above for 2008, 22 bps, would rise three-fold, to 78 bps.

Figure 3. Estimates for the funding advantage in basis points (2007-2017)



Source: Moody's, S&P, Bloomberg, author's calculations

Selected empirical studies in other jurisdictions suggest that although TBTF subsidies appear to have receded since 2008, large banks continue to benefit from a significant funding advantage, which may still be higher than in the pre-crisis period (Haldane 2010, Noss and Sowerbutts 2012, Schich and Lindh 2012, IMF 2014).[28] That said, some of the estimation periods in the referred studies fall short of the implementation of key regulatory measures (Basel III and resolution), and hence cannot be called to assess the impact of financial sector reforms. My estimates of the implicit subsidies are broadly aligned with such empirical results, although generally lower and more stable.[29] This may be explained by the lack of a history of bail-outs during the crisis in Canada, higher overall ratings of the domestic banks (and government), and investors' perception that the Canadian financial system is relatively safer. In dissonance, however, is the fact that we do not observe a decrease in the subsidies since the peak years of the crisis and in fact see a slight increase since 2012. It might

[27] On 19 January 2017, BMO commented to investors on the expected impact of the implementation of an operational bail-in regime in Canada. It noted that "a spread of 10-30 bps back of like-termed legacy senior unsecured debt seems logical for initial issues," which appears generally in line with our estimates.

[28] Since the global financial crisis, several empirical analyses have estimated TBTF subsidies accruing to the largest and most complex banks. Estimates vary across approaches and are not entirely comparable across studies due to differences in methodologies, samples, observation periods and definitions used to identify the TBTF institutions.

[29] The IMF (2014) confirms the persistence of TBTF subsidies in the years following the crisis, and suggest these might stand at 70-100 bps in the US using a ratings approach.

be explained by relatively less progress on resolution than in the US and Europe. Less progress on resolution is reflected in credit ratings, which partially drive funding costs, and may explain the stability of estimates for Canada's largest banks.[30]

Tables 2 and 3 show estimates of the average funding advantage for D-SIBs at each fiscal year-end (October) considering different liability metrics, and are expressed in dollar value and as a percentage of GDP. A scaled measure of the subsidies should help to quantify the direct impact of bank failure on public finances more broadly if the burden of loss is not shared with private creditors. Our results suggest that the estimated reduction in funding costs for wholesale unsecured liabilities amounts to annual savings of between $1.5 and $1.7 billion, in aggregate (or circa 7-8 bps of non-inflation-adjusted nominal GDP).

Tables 2 and 3. Funding advantage estimates, in Canadian dollars and as % GDP (Moody's and S&P)

Moody's

Year	Average funding advantage (bps)	Funding advantage ($ millions)			Funding advantage (% GDP)		
		Senior unsecured debt	Wholesale unsecured debt	Total liabilities	Senior unsecured debt	Wholesale unsecured debt	Total liabilities
2007	22			4,206			0.27%
2008	22			4,370			0.27%
2009	20			4,978			0.31%
2010	19			4,980			0.30%
2011	19			5,156			0.29%
2012	17			5,100			0.28%
2013	18			4,416			0.23%
2014	18			4,678			0.23%
2015	18	369	952	5,202	0.02%	0.05%	0.26%
2016	13	350	800	5,146	0.02%	0.04%	0.25%
2017	26	713	1,665	10,538	0.03%	0.08%	0.50%

S&P

End fiscal year	Average funding advantage (bps)	Funding advantage ($ millions)			Funding advantage (% GDP)		
		Senior unsecured debt	Wholesale unsecured debt	Total liabilities	Senior unsecured debt	Wholesale unsecured debt	Total liabilities
2012	5			2,042			0.11%
2013	17			4,789			0.25%
2014	22			6,556			0.33%
2015	22	546	1,542	7,207	0.03%	0.08%	0.36%
2016	22	562	1,399	7,802	0.03%	0.07%	0.38%
2017	22	559	1,482	7,802	0.03%	0.07%	0.38%

Source: Moody's, S&P, Bloomberg, OSFI's M4 return, author's calculations

[30] However, an increase in implicit subsidies was also observed in other jurisdictions since 2011, potentially driven by a rise in risk premiums following the exacerbation of the Eurozone debt crisis.

Notes to the tables:

- Results as of October 2017.
- The measure of funding advantage using senior unsecured debt and wholesale unsecured debt is for D-SIBs only; i.e., excludes Desjardins, given that a breakdown of liabilities is unavailable for the credit union.
- GDP data sourced from Statistics Canada. Table 380-0064 — Gross domestic product, expenditure-based, quarterly (July 2017).
- Total Liabilities net of Shareholders Equity sourced from OSFI M4 (balance sheet) returns (fiscal year-end is October 31).
- The standard balance sheet template does not provide a detailed breakdown of liabilities, which is the reason we report historical estimates in dollar value and as a % of GDP considering all liabilities. Because OSFI began reporting a more detailed report template to the Bank of Canada (Net Cumulative Cash Flow) from January 2015, we were able to access outstanding wholesale unsecured debt and senior unsecured debt values and calculate the alternative, narrower dollar value estimate of the subsidy.

We considered three alternative measures of outstanding debt: senior unsecured debt (lower bound), total wholesale unsecured debt (base case), and total liabilities net of shareholder equity (upper bound), which are then applied to our estimates for the funding cost advantage (per bank). The latter measure (all liabilities) could be viewed as an upper bound for the annual cost savings, as we are considering that the estimated level of funding advantage computed for senior unsecured debt would accrue to the total liabilities, specifically to those that are more junior in the creditor hierarchy; for example, subordinate debt. Canada, however, has had a contractual bail-in regime in place since 2013 that applies to issuances of subordinate debt and preferred shares.[31] And further, empirical evidence shows that junior creditors such as subordinate debt and preferred shares' holders are usually called to participate in the losses of bank failure, suggesting market discipline should apply to this class of liabilities. In any case, subordinate debt tends to constitute a relatively small share of bank liabilities and it is likely that additional resources may be needed to recapitalize the bank and restore its viability in most cases. We have insufficient data to compile a historical series of the dollar value of the subsidy for the narrower measures (total wholesale and senior unsecured debt), but are able to provide estimates since end of fiscal year 2015.

5.2. Contingent claims

A variation of the structural credit risk model by Merton (1974) can be used to value the implicit subsidy accruing to the largest banks. Within the Merton framework, the liabilities of the regulator can be modelled as contingent claims on the banks' assets. Per the discussion in section 4, we see this approach as complementary to the one based on ratings data. The use of high-frequency financial market pricing data has the advantage of reflecting aggregate expectations of investors and resulting in a more forward-looking indicator. Data availability is also not commonly an issue. The framework is well established in the literature, having been applied in empirical analyses to price deposit insurance premia and estimate TBTF subsidies for the banking system and individual banks (Laeven 2002, Oxera 2011, Noss and Sowerbutts 2012), with some authors also using it to measure credit and systemic risk (Lehar 2005 and Tarashev et al. 2010).

The contingent claims approach computes the subsidy across TBTF banks by estimating the expected payment from the government, or other stakeholders, necessary to prevent their default and restore the banks to viability. This assumes the shock would create sufficient systemic concerns for authorities to intervene and fully support the financial system. In theory, however, some idiosyncratic shocks, even if severe, may be

[31] Beyhaghi et al. (2014) suggest there is market discipline for subordinated debt in the Canadian context, although not for senior bonds, as its credit spreads are relatively insensitive to bank-specific risk factors.

addressed through private sector solutions (e.g., assisted sales). Also because, even in a systemic crisis, private stakeholders might be called to participate in the losses of bank failure through a bail-in of debt securities, results from the approach may overestimate the contingent liability to authorities. Hence, they should then be interpreted as an upper bound estimate for the support that the government might have to be ready to provide to the banking system.[32] For now, however, we assume no bail-in of private sector creditors to share the losses of bank failure. The domestic statutory bail-in regime has not yet come into force and there is some recent evidence that even when this is allowed or required by legislation, authorities may choose not to trigger a bail-in of senior debt (e.g., the Banco Popular, Banco Popolare di Vicenza and Vento Banca resolutions in 2017). On the other hand, this empirical framework relies on an assumption that returns are normally distributed, and as such may fail to adequately account for fat-tail events, leading to an overall underestimation of the total contingent liability.

We value the government's contingent liability for each individual bank and assume shocks to the financial institutions are uncorrelated; i.e., the probability of failure and expected shortfall of a given institution are not affected by those of the other D-SIBs. In the analysis, the government is short a basket of American put options on TBTF institutions, with a one-year term, where the underlying asset is given by the individual banks' market value of assets and the strike price is equal to a systemic threshold. For each individual bank, if assets fall below the threshold level at expiration date, the option would be *in the money* and hence exercised, with the payoff given by the difference between the market value of the assets and the threshold. The premium of that put option, or the implicit subsidy, can be interpreted as the present value of the expected future shortfall (hence, considering the probability of the option being, or not, exercised at the end of the one-year period). If, on the other hand, banks' asset values exceed the systemic threshold at the option's expiration date, the bank remains a going concern entity and the option expires, worthless. By quantifying the individual put option premia, the analysis can identify which banks contribute more to the government's contingent liability.

Key inputs to the analysis are measures of the financial soundness of the individual institutions and the volatility of its assets. The former set of indicators provides a sense of the ability of the institution to absorb shocks, while the latter influences its probability of failure.[33] Because the market value of assets is not directly observable, we model the future distribution of each D-SIB's asset values by relying on the historical volatility of share prices.

We focus the contingent claims analysis on the six D-SIBs, as Desjardins Group is not a traded entity and therefore some required data are unavailable. For each bank, we retrieve financial market pricing data from Bloomberg and balance sheet information from OSFI's M4 returns on a daily and monthly basis, respectively, since 1993. The risk-free rate is given by the yield on the benchmark GoC security at time t. We follow Lehar's (2005) structural model to estimate the market value of banks' assets and its volatility. For each month and per bank, we estimate the parameters of the asset distribution (mean and volatility) given a rolling window of monthly market values of equity over the past 24 months and the last observed value of debt.[34] The estimated

[32] As well, estimates further abstract from the broader economic costs of financial distress and the value of recoveries.

[33] Because we are focusing on pricing the subsidies on an individual basis, we abstract from correlations between the bank's assets. An extension of the analysis could price the subsidies as an index of put options instead of a basket of options. Hence, we focus our interpretation on the average of the subsidy per bank.

[34] To compute the volatility of assets, an alternative to using the historical volatility from share prices is to consider the implied volatility from equity option prices. Oxera (2011) does not find significant differences between the two. Some analyses linearly model the asset distribution, converting the volatility of equity into the volatility of assets based on a gearing ratio.

median asset volatility ranges between 1.35% and 4.63%, which appears to be in line with estimates from other studies (Oxera 2011 suggests 2-4% for the UK banks, and considers a 4% level in the base-case valuation). A maximum likelihood estimator is then used to compute a time series for the market value of assets of each bank.

We determine the systemic threshold to be a function of the minimum capital levels that need to be maintained for the bank to remain a going concern, with a breach of this level likely triggering intervention and recapitalization efforts. We test three different levels for the systemic threshold. In the central scenario, we assume that intervention occurs when assets fall below the current minimum capital requirements, i.e., 8% of risk-weighted assets for Tier 1 capital ratio and capital buffers (Conservation and D-SIB buffers) per the Basel Capital Accord. We further consider two additional systemic threshold levels. Because a bank can fail while its assets still exceed those necessary to meet the minimum capital ratio — due to liquidity pressures, for example — we consider a threshold of 10% risk-weighted assets (upper bound). To help determine the lower bound for the estimates, we consider a scenario in which intervention would occur only when capital requirements are fully exhausted (or the market value of debt is equal to the book value of debt).

Results indicate that the average contingent liability for each of the six D-SIBs peaked in 2009 at over $3 billion in the base case, equivalent to 18 bps of GDP and 1.2% of each of the banks' market value of assets (as reported in Table 4). Assuming an earlier intervention point (before minimum capital requirements are breached), the average subsidy per D-SIB rises above $4 billion (27 bps of GDP and 1.45% of each of the banks' market value of assets). In the table below, we further report estimates for a late intervention point, suggesting that at a minimum the government's liability might accrue to over $1 billion per bank in the peak years of the crisis. We believe these latter figures are very conservative, given that the bank would have stopped being viable long before capital was fully exhausted.

Table 4. Estimates of government's contingent liability (as of October 2017)

		Average per D-SIB			Aggregate		
		Early intervention	Base case	Late intervention	Early intervention	Base case	Late intervention
Peak	$ Ml	4,152,234	3,173,117	1,136,679	24,913,407	19,038,702	6,820,074
	% GDP	0.27%	0.20%	0.07%	1.60%	1.23%	0.44%
	% MV(Assets)	1.45%	1.20%	0.60%			
Current	$ Ml	135,374	88,612	13,426	812,244	531,669	80,554
	% GDP	0.01%	0.00%	0.00%	0.14%	0.09%	0.01%
	% MV(Assets)	0.02%	0.02%	0.00%			

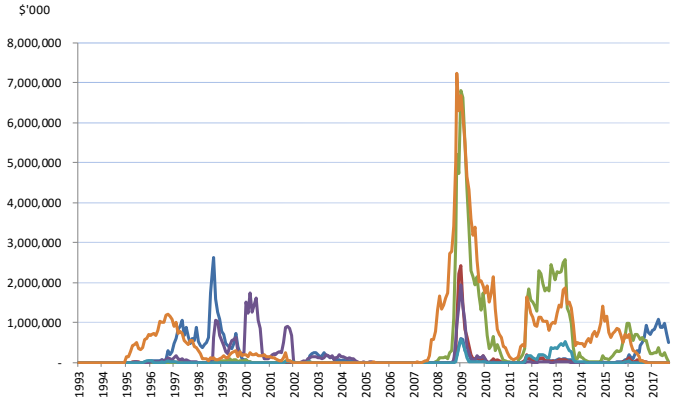
Source: Bloomberg, OSFI's M4 return, staff's calculations

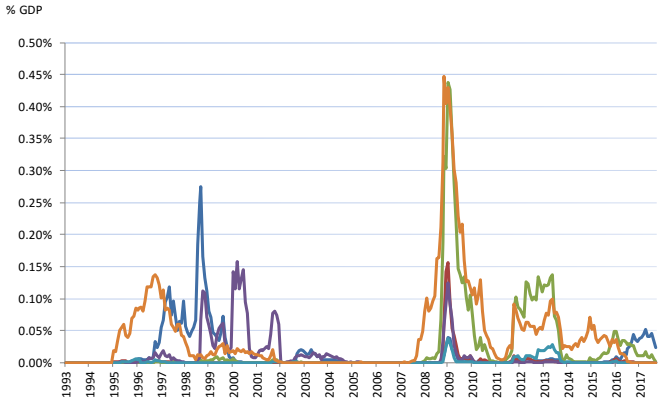
Looking at the individual results (Figures 4 to 6), we observe that two of the six banks seem to generate most of the liability, especially in non-crisis periods. The sensitivity of the estimates to the riskiness of assets is by design and might also partly explain why current estimates of the subsidy are not large. Current low estimates for the liability (average of 90 million dollars per bank, in the base case) may be reflecting relatively benign macro conditions and the consequent downward pressure on the volatility of assets. But because the measure of the subsidy becomes more relevant in periods of market stress, when the government might be called to intervene and support the individual banks or system, peak results are informative. Estimates for the

group of banks are further reported below, indicating the extent of the liability, if a systemic crisis were to occur that affects all the large domestic financial institutions.

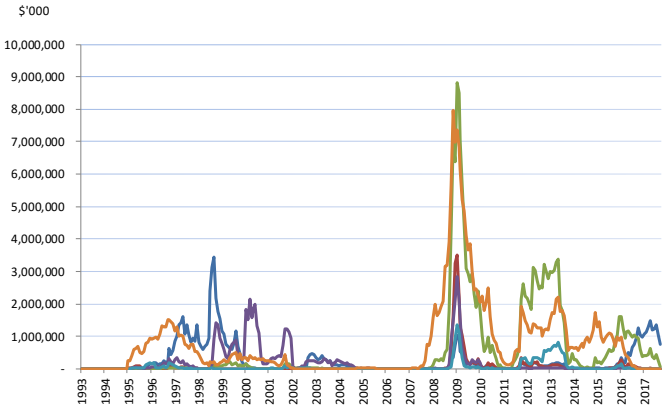
Figures 4, 5, and 6. Estimates of Government's contingent liability to individual banks

Base case (in thousands of dollars and as a % GDP); each line represents one bank:

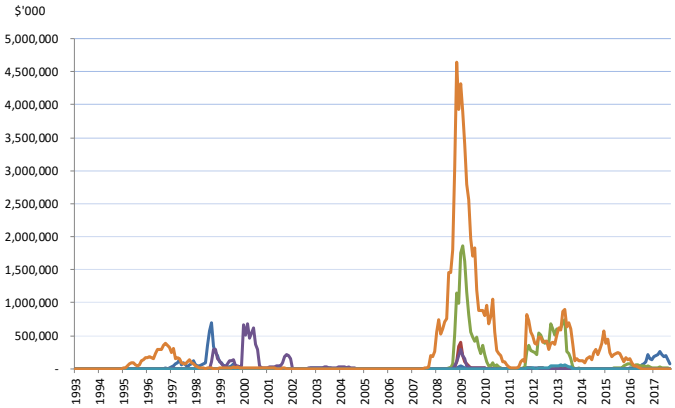




Early intervention:



Late intervention:



Source: Bloomberg, OSFI's M4 return, staff's calculations

Notes to the tables and charts:

- Results as of October 2017.
- Each line represents the contingent liability of one bank, measured in billions of dollars, as a % of GDP and as a % of the market value of assets of that particular institution.
- The measure of contingent liabilities is for D-SIBs only; i.e., excludes Desjardins, given a lack of necessary data.
- GDP data sourced from Statistics Canada. Table 380-0064 — Gross domestic product, expenditure-based, quarterly (July 2017).
- Total Liabilities net of Shareholders Equity sourced from OSFI M4 (balance sheet) returns (fiscal year-end is October 31).
- Share prices and market capitalization from Bloomberg.
- Volatility of equity, volatility of assets and market value of assets per staff's calculations.

6. Concluding remarks

Implicit government guarantees of banking-sector liabilities reduce market discipline by private sector stakeholders and temper the risk sensitivity of funding costs, potentially increasing the likelihood of bail-outs from taxpayers, especially in the absence of effective resolution frameworks.

In this paper, we examine two different approaches to pricing the implicit subsidies. One is based on the assessment of public support expectations by CRAs and the other looks to apply a variation of the structural credit risk model by Merton. Our analysis suggests that the funding advantage accruing to the largest banks remains significant, and may translate into annual savings of between 1.5 and 1.7 billion dollars for each of the financial institutions in our sample per the first approach. Although Canada has been at the forefront of implementing many of the regulatory reform measures prescribed by the G20 in 2008, progress on resolution has been relatively slower and targeted measures in this area may be needed before we can expect to see a significant decline in the implicit subsidies. Results from the credit risk model approach suggest that the government's contingent liability to the banks may have peaked in 2009 at a significant level (an average of over 3 billion dollars per bank). Current benign macro conditions, lower volatility of assets, and better capitalized institutions might provide an explanation of why the contingent liability is now estimated to be relatively low. This second approach better captures progress on Basel III reforms, namely, increases in capital levels for the domestic banks and reduced leverage.

An effective recovery and resolution regime is necessary to minimize the TBTF subsidy, since it allows the government to credibly commit to not rescuing a failing bank. A core part of the Canadian recovery and resolution regime is a statutory bail-in regime that allows banks to be recapitalized through the conversion of debt to equity. The coming into force of the new regime in 2018 should improve the resilience of the Canadian financial system through the reduction of the TBTF funding cost subsidies. A reassessment of the implicit subsidies to the largest Canadian banks would be pertinent after that, working to evaluate the credibility of new forms of resolution and assess whether banks are becoming "safe to fail."

Annex A

The regulatory reform agenda to end TBTF

Table 5. Resolution regimes — status of selected international initiatives

Canada	• Framework to identify systemically important institutions (OSFI) • Annual recovery and resolution plans[35] written by OSFI/CDIC since 2012; banks currently responsible for authoring the resolution plans • Contractual bail-in regime for subordinate debt and preferred shares in place since 2013 (conversion into common shares is automatically triggered if non-viability is determined by OSFI)[36] • Broadened resolution toolkit since June 2016: CDIC can take control of a failing institution without the need for an immediate buyer; legislation on the statutory bail-in tool for D-SIBs received Royal Assent in 2016; regime is expected to come into force in 2018 (including a minimum requirement for loss-absorbing capacity by 2021)
US	• The Dodd–Frank Act (Dodd-Frank 2010) requires the Federal Reserve to impose enhanced prudential standards for the largest bank holding companies and granted broadened powers to the FDIC, including: o The power to require SIFIs to prepare resolution plans ("living wills") and, in case these are not credible, impose more stringent capital, leverage, or liquidity requirements and order structural change (Title I) o As a backstop, Title II of the Act introduced the Orderly Liquidation Authority, which allows the FDIC to bail in unsecured creditors of systemically important financial institutions and stay certain early termination rights of counterparties to eligible financial contracts • Volcker rule, which imposes restrictions on banks engaging in investment banking activities (proprietary trading, hedge funds and private equity funds) • Total loss-absorbing capacity (TLAC) requirement
Europe	• The European Parliament established a Single Resolution Mechanism in 2014, with the bail-in tool in effect since early 2016 (European Commission 2014) • The Single Resolution Board governs resolution procedures and centralizes authority over resolution of financial institutions established in member states[37] • High loss-absorbing capacity requirements in place (Minimum Requirements for Eligible Liabilities (MREL) applies to all banks in European Union member countries and is expected to be consistent with the TLAC requirement)
Others	• Limited progress, namely in Asia; however, jurisdictions with international financial centres, such as Singapore and Hong Kong, have made progress in terms of introducing resolution regimes that are aligned with the Key Attributes, and G-20 peer pressure is working toward convergence of frameworks

[35] The plans detail the overall resolution strategy and specific resolution actions CDIC would employ were a bank deemed non-viable and placed into resolution. CDIC also periodically conducts resolvability assessment for the large banks, with a focus on reviewing the credibility and feasibility of the resolution strategies and actions.

[36] The largest Canadian banks started issuing non-viability contingent capital debt in January 2014.

[37] The European Bank Recovery and Resolution Directive is the European Union's (EU) implementation of the FSB's Key Attributes on Effective Resolution Regimes for Financial Institutions. The EU directive creates a minimum harmonization regime for resolution of banks and investment firms in the EU. The implementation date for EU member states was January 1, 2015 (apart from the bail-in resolution tool, which entered into force in January 2016).

Annex B

A short history of bank credit rating actions in Canada

Prior to 2008, there was limited evidence that governments might agree to broad-based bail-out policies of the financial sector, which might explain why these support expectations did not feature prominently in credit rating agencies' decisions.[38] However, in some periods before 2007, there were differences between the baseline credit assessments (BCAs) and the ratings for domestic banks, specifically CIBC[39] and National. This suggests that, although the ratings methodology did not explicitly account for the potential of external support, there was already some expectation that government intervention could occur in case of stress/failure.

S&P has issued stand-alone credit profiles since 2011, while DBRS has been publishing intrinsic assessments of the domestic banks since at least 2007. Also in 2007, Moody's began to officially recognize that different forms of external support could be made available to the largest banks' senior debt obligations. As a result, it uplifted the largest domestic banks' long-term senior unsecured bond ratings without making changes to the stand-alone assessments. For example, in Canada, RBC and TD's ratings were upgraded to Aaa, the same rating as the sovereign. At the time, Moody's noted that "because the failure of any of these institutions would be very disruptive to the Canadian financial system (…) the probability that the Canadian sovereign would support any of the six large Canadian banks in a period of extreme financial distress is 95%." (Moody's 2007) Moody's left the banks' subordinated and preferred shares claims ratings unchanged, which suggests there is a perception of greater market discipline for these liabilities.[40]

Given recent changes to the regulatory environment, in particular the introduction of bail-in resolution tools in some jurisdictions, CRAs began revising their methodologies and reducing assumptions on the level of government support that is available to financial institutions (especially for European and US banks) (Moody's 2015b, Afonso and Santos 2015). As an example, Moody's introduced a revised bank rating methodology in March 2015 that "incorporates several new elements designed to help accurately predict bank failures and determine how *each creditor class* is likely to be treated when a bank fails and enters resolution, reflecting insights gained from the crisis and the fundamental shift in the banking industry and its regulation", i.e., new forms of bank resolution such as bail-in. Loss severity assumptions are now more granular. When the jurisdiction has an "operational resolution regime" in place, loss, given default expectations, may vary across individual creditor classes to reflect the stack of liabilities that will be called to absorb losses ahead in resolution.[41] Hence, the quantum of subordinated debt matters to determine the probability of senior bondholders being affected by losses.

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[38] Gruenberg (2015) notes, "(…) prior to the recent financial crisis, the major jurisdictions around the world did not envision that these globally active, systemically important financial institutions could fail."

[39] In 2002, Moody's revised CIBC's stand-alone assessment downward while leaving its debt ratings unchanged, citing its "role as a major Canadian intermediary that is integral to the Canadian banking system" as a reason.

[40] During the financial crisis, not all classes of debt received the same levels of support: there have been significantly more instances of losses incurred on various junior instruments versus those incurred on senior debt — thus, the capital structure — and specifically, the amount of debt that ranks most junior in the creditor hierarchy also matters to determine credit risk of the debt instrument.

[41] The determination of an operational resolution regime implies that legal tools are in place to trigger a bail-in of creditors' liabilities, but also that loss-absorbing capacity is adequate. That said, the assessment is subjective, and what *operational* means may differ across rating agencies.

Despite progress on regulation, CRAs continue to generally factor in some (or even the same) expectation of public support, which suggests that challenges to effective resolution are expected to remain. In Canada, revisions to the ratings' methodologies did not generally result in changes to state-support expectations for the domestic banks. Moody's still rates Canada as a "supportive jurisdiction" in its government support assessment framework, reflecting an expectation that the government would still need to bail out a large financial institution given the size of Canadian banks relative to the national economy, and the potential for contagion among large interconnected players. Following the release of the 2014 bail-in consultation paper (Department of Finance Canada 2014), CRAs placed the credit ratings of the D-SIBs and Desjardins under negative watch, indicating they would likely be revised down "in the near future."[42] Moody's kicked off the revisions in July 2014 by changing the outlook of the seven largest Canadian banks' long-term senior unsecured debt and deposit notes' ratings to "negative" from "stable." S&P followed in August 2014, also revising the D-SIBs' outlook to "negative" from "stable," factoring in an expectation that extraordinary government support to D-SIBs' senior bondholders would become less certain.

While bail-in legislation received Royal Assent in summer 2016, CRAs have not yet changed the support assumptions, publicly stating they are still awaiting more detail on the operational aspects of the regime. More recently, in a request for comments published on November 6, 2017, Moody's proposed designating Canada as an "operational resolution regime," given the introduction of preliminary bail-in rules, signalling that government support expectations for D-SIBs are likely to decrease soon. This would be consistent with large bank ratings being lowered up to three notches in the US and the EU in response to Dodd–Frank Title II and the EU Bank Recovery and Resolution Directive.

[42] Rating outlooks provide a sense of the future direction of the rating over the medium term, typically six months to two years. Although a negative outlook indicates the rating may be lowered over this period, it is not a firm commitment by the rating agency.

Annex C

Additional graphs and tables — credit ratings approach

History and uplifts of ratings

Moody's

	RBC			TD			NBC			BNS			BMO			CIBC			Desjardins		
		Intrinsic			Intrinsic			Intrinsic			Intrinsic			Intrinsic			Intrinsic			Intrinsic	
Year	Rating	Rating	Uplift	Rating	Rating	Uplift	Rating	Rating	Uplift	Rating	Rating	Uplift	Rating	Rating	Uplift	Rating	Rating	Uplift	Rating	Rating	Uplift
2007	Aaa	Aa2	2	Aaa	Aa2	2	Aa2	A1	2	Aa1	Aa3	2	Aa1	Aa3	2	Aa2	A1	2	Aaa	A2	5
2008	Aaa	Aa2	2	Aaa	Aa2	2	Aa2	A1	2	Aa1	Aa3	2	Aa1	Aa3	2	Aa2	A1	2	Aaa	A2	5
2009	Aaa	Aa2	2	Aaa	Aa2	2	Aa2	A1	2	Aa1	Aa3	2	Aa1	Aa3	2	Aa2	A1	2	Aa1	A2	4
2010	Aaa	Aa2	2	Aaa	Aa2	2	Aa2	A1	2	Aa1	Aa3	2	Aa2	A1	2	Aa2	A1	2	Aa1	A2	4
2011	Aa1	Aa3	2	Aaa	Aa2	2	Aa2	A1	2	Aa1	Aa3	2	Aa2	A1	2	Aa2	A1	2	Aa1	A2	4
2012	Aa3	A2	2	Aaa	Aa2	2	Aa2	A1	2	Aa1	Aa3	2	Aa2	A1	2	Aa2	A1	2	Aa1	A2	4
2013	Aa3	A2	2	Aa1	Aa3	2	Aa3	A3	3	Aa2	A1	2	Aa3	A2	2	Aa3	A2	2	Aa2	A3	4
2014	Aa3	A2	2	Aa1	Aa3	2	Aa3	A3	3	Aa2	A1	2	Aa3	A2	2	Aa3	A2	2	Aa2	A3	4
2015	Aa3	A2	2	Aa1	Aa3	2	Aa3	A3	3	Aa2	A1	2	Aa3	A2	2	Aa3	A2	2	Aa2	A3	4
2016	Aa3	A2	2	Aa1	Aa3	2	Aa3	A3	3	Aa3	A2	2	Aa3	A2	2	Aa3	A2	2	Aa2	A1	2
2017	A1	A3	2	Aa2	A1	2	A1	Baa1	3	A1	A3	2	A1	A3	2	a1	A3	2	Aa2	A1	2

S&P

	RBC			TD			NBC			BNS			BMO			CIBC			Desjardins		
		Intrinsic			Intrinsic			Intrinsic			Intrinsic			Intrinsic			Intrinsic			Intrinsic	
Year	Rating	Rating	Uplift	Rating	Rating	Uplift	Rating	Rating	Uplift	Rating	Rating	Uplift	Rating	Rating	Uplift	Rating	Rating	Uplift	Rating	Rating	Uplift
2012	AA-	A+	1	AA-	A+	1	A	A	0	AA-	A+	1	A+	A	1	A+	A	1			
2013	AA-	A+	1	AA-	A+	1	A	A-	1	A+	A	1	A+	A-	2	A+	A-	2	A+	A	1
2014	AA-	A+	1	AA-	A+	1	A	A-	1	A+	A	1	A+	A-	2	A+	A-	2	A+	A	1
2015	AA-	A+	1	AA-	A+	1	A	A-	1	A+	A	1	A+	A-	2	A+	A-	2	A+	A	1
2016	AA-	A+	1	AA-	A+	1	A	A-	1	A+	A	1	A+	A-	2	A+	A-	2	A+	A	1
2017	AA-	A+	1	AA-	A+	1	A	A-	1	A+	A	1	A+	A-	2	A+	A-	2	A+	A	1

Source: Moody's, S&P, author's calculations
All ratings as of end fiscal year

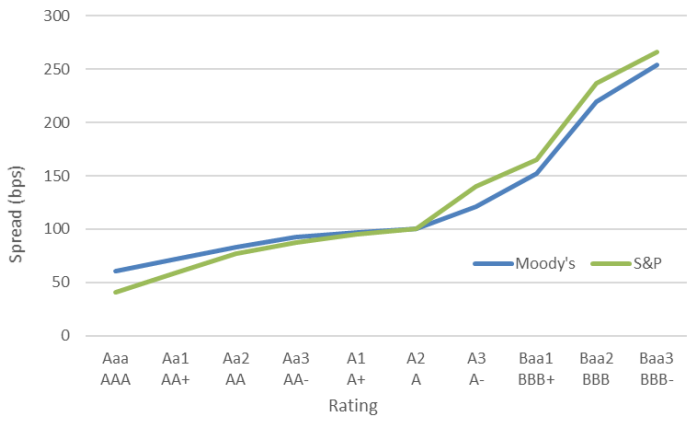
Mapping function – median values in bps

Moody's				S&P			
Rating	Actual	**Linear Interpolation**	Polynomial Interpolation	Rating	Actual	**Linear Interpolation**	Polynomial Interpolation
Aaa	60	**60**	66	AAA	41	**41**	61
Aa1	86	**72**	78	AA+	109	**59**	75
Aa2	83	**83**	84	AA	77	**77**	83
Aa3	93	**93**	88	AA-	88	**88**	89
A1	89	**97**	94	A+	95	**95**	98
A2	101	**101**	104	A	101	**101**	112
A3	121	**121**	123	A-	140	**140**	135
Baa1	152	**152**	154	BBB+	165	**165**	171
Baa2	219	**219**	201	BBB	237	**237**	225
Baa3	254	**254**	267	BBB-	266	**266**	299

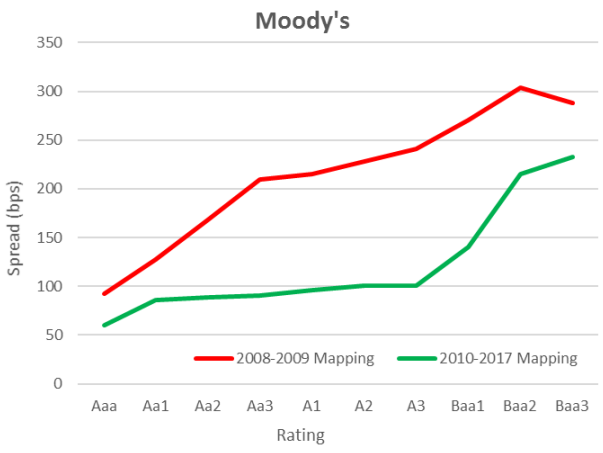
Source: Moody's, S&P, Bloomberg, author's calculations

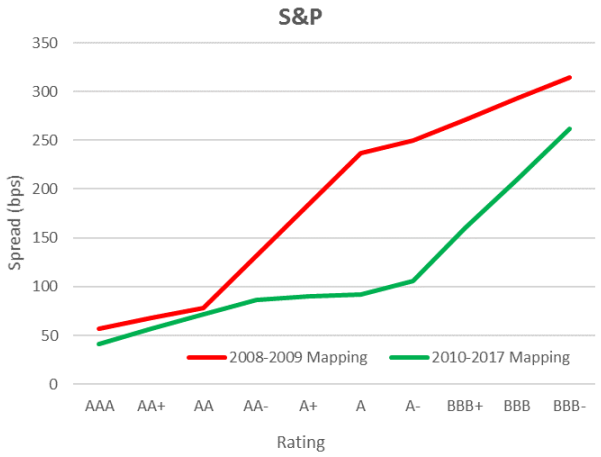
Moody's and S&P Mapping Functions

Median, linear interpolation



Stress vs. non-stress, linear interpolation





Source: Moody's, S&P, Bloomberg, author's calculations

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