Leaning Within a Flexible Inflation-Targeting Framework: Review of Costs and Benefits

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Abstract

This note examines the merits of monetary policy adjustments in response to financial stability concerns, taking into account changes in the state of knowledge since the renewal of the inflation-targeting agreement in 2011. A key financial system vulnerability in Canada is elevated household indebtedness: as more and more households are nearing their debt-capacity limits, the likelihood and severity of a large negative correction in housing markets are also increasing. Adjusting the path of policy rates can be effective in reducing the buildup of household debt and the likelihood of a house price correction over the medium term. Such adjustments can also generate a fall in inflation and in output over the short term compared with the case without a policy-rate adjustment. Overall, the estimated benefits of a leaning adjustment tend to be smaller than its social losses, since its impact on the buildup of vulnerabilities is modest and the reduction in the incidence of house price corrections or financial crises is limited.

Bank topics: Financial stability, Monetary policy framework
JEL codes: E0, E44, E52, E58, G18

Résumé

Cet article examine l'intérêt que présentent les modifications de la politique monétaire en réaction aux préoccupations liées à la stabilité financière, compte tenu de l'évolution de l'état des connaissances depuis le renouvellement de l'entente relative à la cible de maîtrise de l'inflation en 2011. L'une des principales vulnérabilités du système financier au Canada est l'endettement élevé des ménages : l'accroissement du nombre de ménages approchant leur capacité maximale d'endettement s'accompagne d'une hausse de la probabilité et de la gravité potentielle d'une correction négative marquée des marchés du logement. La modification de la trajectoire du taux directeur peut permettre, à moyen terme, de limiter l'endettement des ménages et de réduire la probabilité d'une correction des prix des logements. Ce scénario, par rapport à celui où l'on ne modifie pas le taux, peut également entraîner un recul de l'inflation et de la production à court terme. Dans l'ensemble, les avantages estimés d'une modification préventive tendent à être inférieurs aux pertes sociales qui en découlent, car son incidence sur l'accentuation des vulnérabilités s'avère modérée et la réduction de la fréquence des corrections des prix des logements ou des crises économiques est limitée.

Sujets : Stabilité financière; Cadre de la politique monétaire
Codes JEL : E0, E44, E52, E58, G18

1. Introduction

In the work leading up to the 2011 renewal of the inflation-targeting agreement, the Bank clarified that, in some rare circumstances, monetary policy could more directly incorporate financial stability issues in its decisions by targeting inflation over a longer horizon (Bank of Canada 2011).

The circumstances that would warrant such an adjustment are those that could have economy-wide implications. They can take the form of prolonged external disturbances such as a higher volatility in global financial markets. They can also originate from the buildup of excesses (e.g., increased risk taking by financial institutions seeking higher returns, or elevated household debt) in domestic financial markets due to interest rates being low for a long time.

Côté (2014) stresses that additional research may be useful to clarify the circumstances calling for a monetary policy response to financial stability concerns. Such research should focus on recent changes in financial stability risks and the effectiveness of policy tools that became available to mitigate those risks (Kryvtsov, Molico and Tomlin 2015).

In Canada in particular, household debt has increased and remained elevated at historically high levels. At the same time, the interest rates have remained low to support the economy's return to its potential growth path. Additionally, Bauer et al. (2016) conclude that the probability of a large house-price decline remains significant in Canada. Although the regulatory and macroprudential tools may be the first line of defence against financial vulnerabilities, Damar and Molico (2016) and Bauer et al. (2016) point to a number of factors that may limit the degree and scope of their effectiveness. This leads to the question: Should monetary policy incorporate financial concerns into its decisions to complement the roles of micro- and macroprudential policies in moderating household debt?

In this paper, we review the benefits and costs of monetary policy adjustments in response to financial stability concerns that have been recently documented for Canada and elsewhere, taking into account the latest advances in the state of knowledge on this topic.

2. Understanding the merits of monetary policy leaning

Monetary policy, in order to moderate the growth of household debt, can set a path for policy rates that is higher or more protracted than the path prescribed by price-stability considerations alone. For brevity, we will sometimes refer to such a policy adjustment as leaning. Extra tightening of monetary policy is expected to provide a cooling influence on financial markets, leading to lower debt levels for firms and households, reduced risk taking for banks and lower growth of asset prices over the medium term. Lower vulnerabilities in financial markets, in turn, would imply a lessened probability of risks and a less-severe impact of materialized risks, such as a sharp fall in house prices

and the consequent household deleveraging with potential knock-on effects on the financial system and real economy.

There are three considerations that are important for understanding the merits of monetary policy leaning. First, to what extent does a low-interest-rate environment contribute to the buildup of financial sector imbalances? Second, to what degree does monetary policy affect the level of imbalances in the financial system; in particular, how effective is monetary policy leaning in reducing household indebtedness relative to the case without such actions? Third, how do the benefits of leaning compare with its costs?

2.1 Do low-for-long interest rates increase financial imbalances?

The case for leaning does not hinge only its effectiveness in reducing financial stability issues, but also on whether the alternative course of action—no monetary policy leaning—will be costly, fostering financial stability risks. Indeed, a sustained low-interest-rate environment may spur risk-taking behaviour by financial institutions that invest excessively in riskier assets in the pursuit of return targets, or by households that consider it to be a good time to borrow excessively to buy homes or other durable goods.

The evidence of excessive risk-taking behaviour in Canada is mixed. While previous Bank of Canada research found some evidence in favour of such behaviour, mainly by banks and fixed-income mutual funds (Paligorova and Santos, 2014; Gungor and Sierra, 2014; Damar, Meh and Terajima 2015), there is also evidence that excessive risk taking dissipates over time or may even have a positive influence on banks' balance sheets (Cociuba, Shukayev and Ueberfeldt 2015; Chodorow-Reich, 2014). Therefore, there is an ongoing research agenda to identify excessive risk taking by domestic financial institutions and to quantify its significance for systemic financial vulnerability, in particular, a vulnerability that could best be reduced by monetary policy.[1]

Recent studies also point to evidence of excessive risk-taking behaviour by global financial institutions (Rey 2015). This implies that risk or term premiums in small open economies, such as Canada's, may be compressed by external factors (Bauer and Diez de los Rios 2012). If that is the case, lower domestic policy rates may be less of a factor in the excessive risk taking by financial institutions in Canada because external forces are playing a larger role.

How do low interest rates affect households' balance sheet decisions? On the one hand, households can use the income saved from lower interest payments to pay off their existing debt

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[1] We do not present any results on how low-for-long interest rates affect risk taking in the three models that we use as a laboratory in this note because these models are not adequately equipped to address this issue directly.

and gradually de-lever.[2] On the other hand, they can also spend on non-housing consumption, other durable goods and homes by taking on more debt.

Higher debt, however, might not necessarily indicate excessive risk taking to the extent that house price appreciation reflects the sustained fundamental value of housing, as opposed to being driven by non-fundamental factors (e.g., self-fulfilling expectations of rising prices).

Nonetheless, the continued rise in household indebtedness, as recently observed in Canada, may lead to an increase in the number of households that are close to their debt-capacity limits. If that is the case, then the household sector becomes less resilient, as households that want to borrow for spending purposes will no longer have a balance sheet that would allow them to do so. Furthermore, pushing more borrowers against their debt capacity increases the vulnerability of, and would increase the severity of a correction in, the housing market if a correction were to occur.

Hence, the elevated levels of household debt may present a threat to financial stability. This threat, however, puts monetary authorities in a tough spot since raising rates may be costly either because higher rates can trigger the house price correction or because of a premature removal of much-needed stimulus (Poloz 2014).

2.2 How effective is monetary policy in reducing financial imbalances?

By affecting the returns of asset and liability positions, changes in monetary policy rates have a direct influence on financial behaviour, penetrating "in all the cracks" of the financial system (Stein 2014). For example, monetary policy tightening could reduce aggregate household debt via monetary policy's influence on the cost of borrowing.

To assess the effectiveness of leaning in reducing household indebtedness in Canada, we estimate the impact of a monetary policy leaning action using three of the Bank's policy models: the Macroprudential and Monetary Policy Model (or MP2) (see Alpanda, Cateau and Meh 2014); the Terms-of-Trade Economic Model (ToTEM) (see Dorich et al. 2013); and the Large Empirical and Semi-structural Model (LENS) (see Gervais and Gosselin 2014). In our exercise, the "leaning" adjustment of the interest rate path relative to its normal path is represented by a one-quarter per cent higher realization of the nominal interest rate, occurring in four consecutive quarters and gradually approaching its previous level afterwards.[3]

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[2] Households that are immediately affected by changes in borrowing rates are those that hold variable-rate debt. Over a five-year horizon, almost all borrowers will be affected, since the vast majority of households in Canada have terms between six months and five years on their mortgages (see Crawford, Meh and Zhou 2013).

[3] Our analysis measures the costs and benefits of monetary policy leaning by comparing equilibrium paths under leaning and paths without such action; in other words, we use the shock minus control method. After taking the difference between the shock and the control, the effect of leaning on quantities is unaffected by the starting point of simulation or any outside shocks in linearized models that we use for simulation. For this reason, all simulations in

Adjusting the path of policy rates can be effective in reducing the buildup of household debt over the medium term. Real household debt declines gradually, reaching its lowest level five years after the beginning of the leaning action (see Figure 2 in Appendix A). The lowest level is between 0.04 and 0.46 per cent below the undisturbed level across the three models.[4] This decline in debt, however, is small relative to its stock; for example, it would translate into a fall in the debt-to-income ratio between 164.1 and 164.8 per cent, relative to 164.9 per cent observed in Canada in the third quarter of 2015.

These results are in line with evidence from a variety of central bank models surveyed in IMF (2015), which found that the amount of real household debt decreases by up to 0.08 and 0.50 per cent after one to four years, depending on the model. Over the long run, household debt recovers to a level at or below the path it would have had without monetary policy leaning.

In addition, vulnerabilities in the housing sector are commonly measured by the growth rate of the debt or its level relative to GDP or disposable income. Measured this way, vulnerabilities may actually rise temporarily after monetary tightening. The debt-to-GDP ratio might rise when leaning occurs if GDP falls quicker than the debt level. Also, as the debt level recovers to its normal path, its growth rate may rise temporarily. These effects could further scale down the influence of leaning on household indebtedness. As we show in Section 2.3 in our simulations, the social benefits of leaning fall short of their social costs for all alternative measures of household indebtedness.

2.3. How do the benefits of leaning compare with its costs?

We assess the net benefits of leaning by computing the responses of key macroeconomic variables to a monetary policy leaning adjustment in three of Bank's policy models: MP2, ToTEM and LENS.[5]

The benefits of a leaning action are associated with a decrease in the probability and impact of a financial crisis. This response is obtained outside each of the models by constructing a relationship between the growth rate of household debt and the probability of a crisis.[6] That probability falls slowly in our baseline simulation, at most by 0.005 annualized percentage points, from 0.872 to

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our exercise start from steady state, but such experiments can also be considered a conditional reaction to an outside shock (e.g., over-exuberance in the housing sector that increases household debt) to household indebtedness or an initial condition that might call for leaning action.

[4] The response of debt to changes in interest rates for ToTEM and LENS comes from a satellite model that uses the output of the two base models as input. The satellite model (the Household Credit Model) has a unit root, and any shocks to interest rates have a permanent effect on household debt, which is why the two debt profiles for ToTEM and LENS in Figure 2 do not seem to return to the undisturbed level.

[5] The adjustment of the interest rate path relative to its normal path is represented by a one-quarter per cent realization of higher nominal interest rate for four consecutive quarters. (Appendix A provides the details.) A similar exercise is done in Svensson (2016) for the case of Sweden.

[6] Following Ajello et al. (2015), we estimate the impact of debt growth on the probability of a financial crisis by estimating a simplified version of a Schularick and Taylor-type crisis-probability function for Canada using Schularick and Taylor's (2012) cross-country panel data.

0.867 per cent after the beginning of the leaning action (Figure 4). This unremarkable effect reflects the modest impact of monetary leaning on the buildup of vulnerabilities and the marginal reduction in the incidence of financial crises or house price busts.

The costs of leaning stem from a mild recession over a short run, with the declines of inflation and output in the three models ranging between 0.01 and 0.09 percentage points for inflation (Figure 5), and between 0.05 and 0.21 per cent for output (Figure 6). Most of these responses dissipate five years after the beginning of the leaning shock, while the responses of the crisis probability are close to their troughs or still declining. The social loss from the decreases in inflation and output gap ranges between 0.09 and 0.30 per cent; the social benefits from reducing the probability of a financial crisis range between 0.0001 and 0.02 per cent in our baseline simulation.[7]

Hence, according to this simple calculation, the costs of leaning using monetary policy far exceed the benefits associated with lower probability of crisis. As we show in Appendix A, this finding is robust. The costs of leaning exceed the benefits when variations of our baseline model are considered; examples of variations are a longer or more severe crisis, a higher crisis probability (i.e., via a stronger relationship to debt growth) or a permanent reduction of household indebtedness.[8]

This result reflects the well-known bluntness of monetary policy as a tool for reducing financial stability risks: its effect on the growing imbalances in the financial sector is limited relative to its contractionary effects.[9] Boivin, Lane and Meh (2010) come to a similar conclusion when financial imbalances are sector-specific and a well-targeted prudential tool is available. They also show that monetary policy may have a role to play along with prudential policy, if the available prudential tool is broad-based and if financial imbalances have a significant spillover effect across sectors without creating a tension between financial-stability and price-stability objectives. In this case, they argue that coordination across the two tools is key in achieving a better outcome for leaning against imbalances.

3. Recent quantitative studies of the merits of leaning

Our calculations abstract from several factors that are important for providing a more comprehensive view of the implications of monetary policy leaning. Appendix B provides a discussion of the key mechanisms that amplify and propagate the effects of financial market

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[7] Social loss is computed as a function of the cumulative percentage point decline in inflation and output from steady state. To compute the cumulative benefits of the leaning action, we assume that the severity of the crisis associated with the social loss is five times the loss, in each quarter, from the decline in inflation and output after the leaning with the crisis lasting six quarters. See Appendix A for details.

[8] In addition to the analysis presented in this section and in Appendix A, we examined—using MP2—the optimal degree of leaning when monetary policy is allowed to lean against real household debt growth through an augmented Taylor rule. Our finding remains the same: the costs of leaning outweigh the benefits, mainly because leaning hurts borrowers disproportionately.

[9] See Bank of Canada (2011).

vulnerabilities and lead to financial crises. And, while there is no readily available unified framework for analyzing the balance of all relevant factors that could influence the cost-benefit analysis of leaning, a few informative studies have emerged.

Bauer and Granziera (2016) estimate the effects of leaning in a country panel vector-autoregression (VAR) model that includes the likelihood of a house price correction (Bauer 2014), the growth rates of real debt, real house prices and the global risk premium. They find that large and persistent leaning is effective in reducing house prices and debt growth but that such leaning is costly since it leads to a significant decline in the growth rate of output.

Alpanda and Ueberfeldt (2016) analyze the costs and benefits of leaning in response to house market booms. Such booms raise the probability of the economy entering into a crisis regime associated with a large increase of the borrowing costs, a credit crunch, and a fall in output and inflation. In their model, calibrated to the Canadian economy, crises happen on average once every 24 years and last over a period of 10 quarters. Moreover, these episodes occur more frequently in the case of high household debt levels. In addition to occasional crises, Alpanda and Ueberfeldt's model nests a financial accelerator mechanism and households divided into savers or borrowers. Crises are especially severe because of the possibility of a binding zero lower bound on nominal interest rates.

In their model, leaning has the benefit of reducing both the probability and severity of crises. Despite significant benefits, however, the costs of extra monetary policy tightening are even greater, because of the workings of the redistribution channel of monetary policy and to a higher volatility of output and inflation during non-crisis times. Focusing on the redistribution channel, leaning—by discouraging debt—hurts borrowers who must rely on leverage to finance their consumption and housing expenditures. In fact, without taking into account the considerably higher social loss incurred by borrowers during monetary tightening, one might underestimate the costs of leaning. In all, Alpanda and Ueberfeldt (2016) conclude that, in most variations of their model, monetary policy should not respond to financial vulnerabilities. The findings in Alpanda and Ueberfeldt (2016) are consistent with a few recent studies and our own calculations discussed above using the MP2 model.

Woodford (2012) lays out a framework in which monetary policy can address the severity of risks to financial stability within a flexible inflation-targeting framework. In Ajello et al. (2015), the optimal interest rate adjustment in response to credit gaps identified in Schularick and Taylor (2012) is minuscule. Ajello et al. (2015) find that the crisis probability declines very little in response to increases in the policy rate. For a similar reason, Svensson (2016), using a model calibrated to Sweden, finds that the costs of leaning exceed its benefits.

4. Implications for monetary policy

We have argued that adjusting the path of policy rates can be effective in reducing the buildup of household indebtedness and, in turn, reducing the probability and severity of a financial crisis and a large macroeconomic downturn over the medium term. The estimated benefits, though fairly noisy, tend to be relatively small. The reason is twofold. First, financial crises are rare events and their link to financial vulnerabilities, although significant, appears to be fairly modest in the context of imbalances observed in Canada over the last five years. Second, monetary policy is a blunt tool: its impact on vulnerabilities, such as the growth in household debt, is limited, and vulnerabilities tend to return after the leaning adjustment. In contrast, leaning generates a fall in inflation and output over the short term, which both add up to a social loss that far outweighs the above-mentioned benefits in most simulations.

While the elevated household indebtedness in Canada may imply a higher risk to financial stability because of the size of the resulting impact should a trigger event occur, monetary policy tightening may not be the best choice for a corrective policy action in such cases. To reduce this vulnerability as well as the accumulation of further debt by households that are approaching debt-capacity limits, the best approach might be proactive uses of macroprudential policies in close coordination with monetary policy. It would give monetary policy more scope to focus on its main policy objective of bringing the economy back to its potential, while addressing financial concerns within its flexible inflation-targeting framework.

Appendix A. Monetary policy tightening in the Bank's models

We estimate the impact of a monetary policy leaning action using three of the Bank's policy models: the Macroprudential and Monetary Policy Model (MP2) (see Alpanda, Cateau and Meh 2014); the Terms-of-Trade Economic Model (ToTEM) (see Dorich et al. 2013); and the Large Empirical and Semi-Structural Model (LENS) (see Gervais and Gosselin 2014). The "leaning" adjustment of the interest rate path relative to its normal path is represented by a one-quarter per cent higher realization of nominal interest rate maintained for four consecutive quarters, as plotted in Figure 1. The response of household debt is plotted in Figure 2.

Figure 1. Short-term nominal interest rate

Figure 2. Real household debt
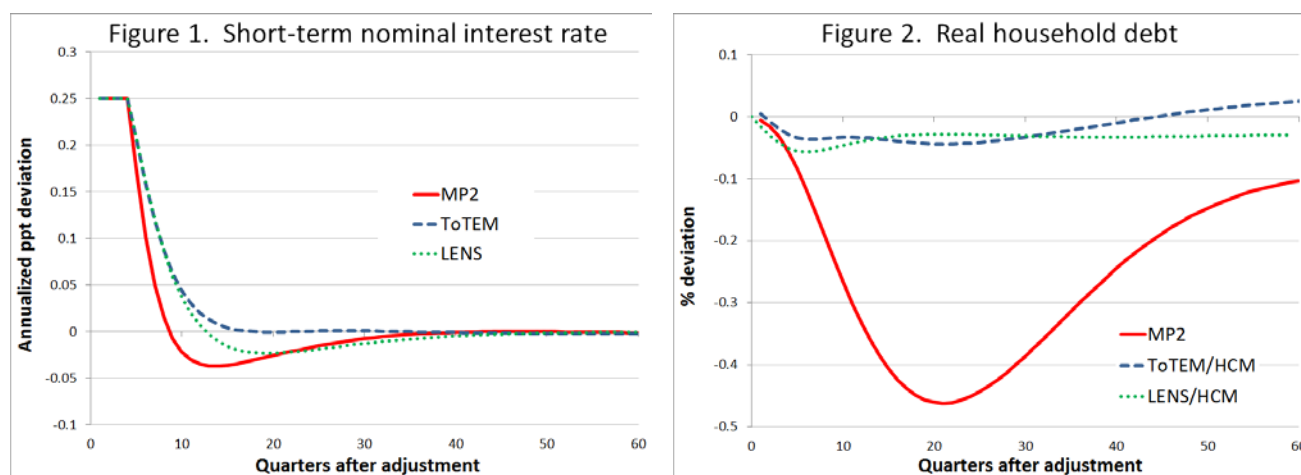
The effect of monetary tightening on household indebtedness takes time to build, with the response of household debt reaching its lowest level only five years after the beginning of the leaning action. Although this delayed effect is significant, the magnitude of the household debt response is relatively modest, with its lowest level at just 0.46 per cent below the undisturbed level for MP2, and less than 0.06 per cent for ToTEM/HCM and LENS/HCM.[10]

Schularick and Taylor (2012) argue that the growth rate of private debt is associated with the probability of financial crises. Following Ajello et al. (2015), we estimated a simplified version of a Schularick and Taylor-type crisis probability function for Canada using Schularick and Taylor's (2012) cross-country panel data. Figure 3 shows the annualized probability of crisis as a function of the five-year cumulative growth of debt. On average, real private debt in Canada grew by 25 per cent over five years in the Schularick and Taylor data. The implied average probability of financial crisis in Canada is therefore 0.87 per cent.[11]

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[10] HCM stands for Household Credit Model.
[11] Note that Schularick and Taylor's (2012) data set includes total private debt; we apply their specification to the growth rate of household debt. We also repeated Bauer's (2014) estimation of the probability of a large (> 10 per cent) house price correction in Canada. Bauer's model implies that the probability is linked to the ratio of household debt to GDP. On average, that ratio is 56 per cent (93 per cent in the second quarter of 2015), implying a probability

Based on these three models, the estimated impacts of monetary policy leaning on the probability of financial crises are minuscule, as shown in Figure 4. MP2 predicts that the crisis probability reaches its trough in four years after the shock, falling by about 0.005 annualized percentage points and returning to its undisturbed path in nine years, at which point it overshoots that path, reflecting faster growth of household debt. The responses implied by ToTEM and LENS are an order of magnitude smaller.

Figure 3. Estimated link between debt growth and crisis probability in Canada

Figure 4. Crisis probability
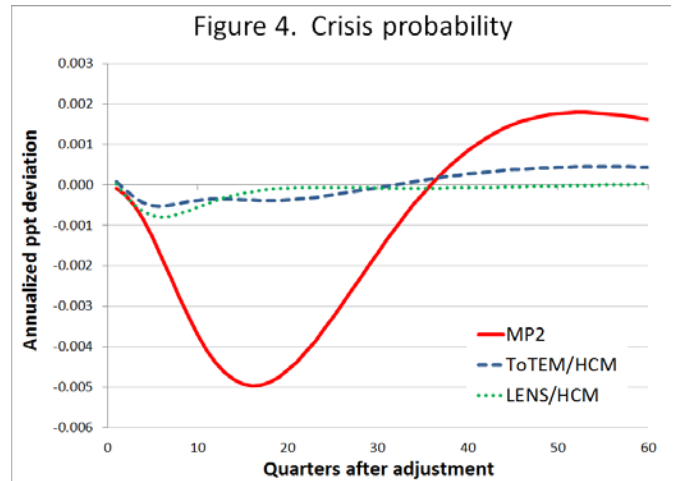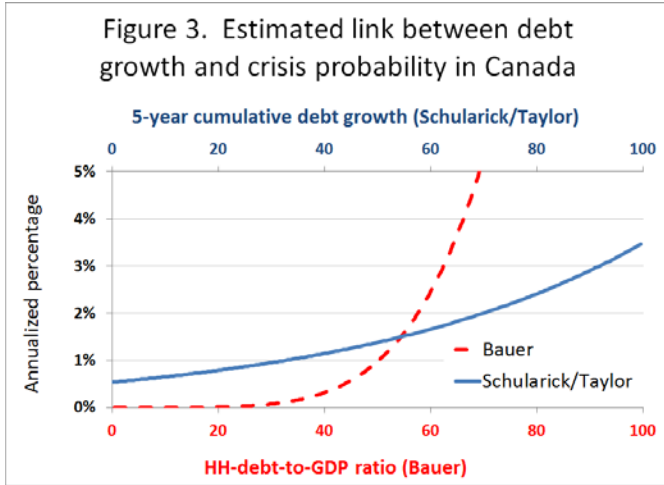
In turn, monetary policy leaning leads to a mild recession in the short term, as both inflation and output decline. Figure 5 shows that annualized inflation decreases by 0.01 to 0.09 percentage points; Figure 6 shows that output gap falls by 0.05 to 0.21 per cent.[12] All responses return to their undisturbed levels after 10 to 12 years following the beginning of the leaning shock.

Figure 5. Quarterly inflation

Figure 6. Real GDP
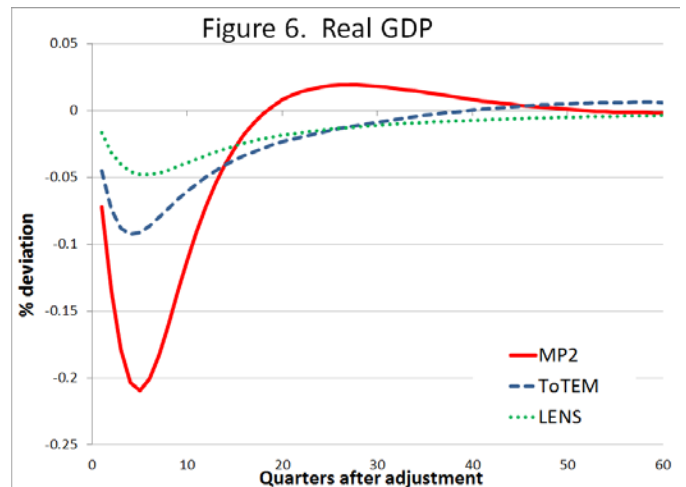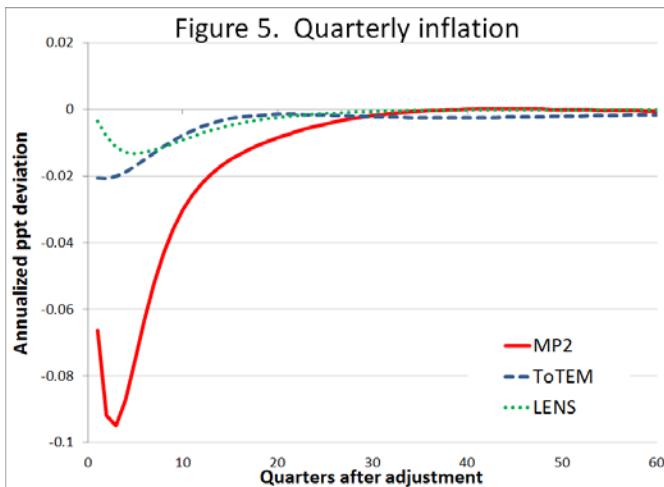
of a drop in house prices of 1.8 per cent (20.8 per cent in the second quarter of 2015). In our computations, we employ both Schularick-Taylor and Bauer specifications.

[12] The larger responses in MP2 relative to those in ToTEM and LENS can be attributed, to some extent at least, to the workings of the financial accelerator mechanisms between households and banks and between banks and borrowers.

The costs and benefits of the tightening can be summarized as follows. Costs are measured by a cumulative sum of declines in quarterly inflation and output from undisturbed levels. The weight on output is one-sixteenth of the weight on quarterly inflation, which is consistent with the loss function used in the Bank's previous computations. Social costs associated with negative inflation and output range from 0.09 to 0.30 per cent relative to undisturbed levels.

The benefits of leaning are measured by the reduction in the severity of a crisis and the cumulative reductions in crisis probability over time due to the temporarily lower growth rate of household debt. We assume that a crisis, if it occurs, lasts for six quarters and that, in each period during the crisis, the cost is five times the total loss generated by leaning.[13] In addition to estimating the Schularick and Taylor (2012) probability function for Canada, we use Bauer's (2014) estimated probability of a large house-price correction in Canada as a function of the debt-to-GDP ratio. Table 1 reports the ranges of the costs and benefits of monetary leaning over simulation results from the three models and for both specifications of crisis probability.[14]

The table shows that, in our baseline case, the cumulative benefits are at least an order of magnitude smaller than the costs. The benefits are so small because the crisis probability barely changes when cumulative debt growth moves around empirically plausible levels.

Table 1 also presents the results for other variations of this exercise that generate greater benefits of leaning. These variations include a case of a crisis that is twice as severe; a case with a higher[15] crisis probability; a case with a twice-steeper crisis probability function; and a case in which leaning permanently lowers the level of household debt by 1 per cent below the undisturbed level. In all of these variations, the costs of leaning are still larger than the benefits. Hence, according to this simple calculation, the costs of leaning by monetary policy far exceed the benefits associated with a lower probability of the crisis.

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[13] Denes, Eggertsson and Gilbukh (2013) conduct a simulation in which a crisis leads to declines in output and inflation of 10 and 2 per cent, respectively. Given six quarters of crisis duration, this translates into a 6.75 per cent worsening of social loss. In our baseline simulation with MP2, a crisis is associated with a 9 per cent social loss. While the assumed severity of crisis is smaller in ToTEM and LENS, Table 1 shows that our results still hold, even if we assume crises of a much larger magnitude.

[14] A large house-price correction need not in general imply a financial crisis, unless it is associated with widespread mortgage defaults. Our assumption therefore represents an upper bound on the benefits of leaning, using this specification of crisis probability.

[15] In this variation, the average probability is 5.8 times higher for the Schularick and Taylor specification, and 1.6 times higher for the Bauer specification.

Table 1. Simulation of the costs and benefits of leaning

Case	Cost range	Benefit range	Net benefits range
Baseline	0.09 – 0.30	0.00 – 0.02	**-0.09 – -0.29**
Crisis twice as severe	0.09 – 0.30	0.00 – 0.03	**-0.09 – -0.29**
Higher crisis probability	0.09 – 0.30	0.00 – 0.04	**-0.09 – -0.29**
Crisis probability rises faster with imbalances	0.09 – 0.30	0.00 – 0.03	**-0.09 – -0.29**
Permanently lower household debt (MP2)	0.42	0.01 – 0.08	**-0.42 – -0.34**

Note: Ranges are given across results from three models: MP2, ToTEM/HCM and LENS/HCM, and for two crisis probability functions—Schularick and Taylor (2012) function estimated for Canada, and the Bauer (2014) probability of a correction. The social loss function computes the cumulative impulse responses over the first 40 quarters after the beginning of the leaning action, discounted by 0.99.

Appendix B. How do financial imbalances lead to financial crises?

Our calculations abstract from several factors that are important for providing a more comprehensive view of the implications of monetary policy leaning. In particular, these factors include the mechanisms that amplify and propagate financial market inefficiencies and lead to financial crises. Two standard mechanisms operate via the financial accelerator and the redistribution channels of monetary policy.

First, the financial accelerator mechanism operates through the amplifying effect of asset price fluctuations on borrowers' net worth. In a recession, the decline in borrowing and investment activities is amplified by the decline in asset prices, since it weakens borrowers' terms of borrowing by decreasing their net worth and increasing leverage. Lower asset prices may also decrease the value of collateral assets, which tightens the borrowing constraints of households and firms, further amplifying the initial fall in demand for credit and investment.[16]

Second, the impact of monetary policy on macroeconomic variables and on social welfare depends to a large degree on how interest rate changes are distributed across households, which vary in their willingness to spend from their disposable incomes. This is also known as the redistribution channel. There is ample evidence of the large variation in the marginal propensity to consume across households: low-income households tend to consume more per every dollar of disposable income than high-income households, and the same goes for borrowers versus savers.[17]

Auclert (2016) shows that the redistribution channel can amplify the fall in consumption spending that is a response to monetary tightening. The reduction in consumption by those borrowers who face higher borrowing rates can be much larger than the increase in consumption by savers out of their interest income.[18] If, in addition, monetary tightening dampens house prices, it may dampen the equity-based borrowing that some households use to sustain their consumption. Finally, during monetary tightening, banks may be willing to channel credit away from borrowers who are more exposed to balance-sheet risk towards safer debtors.[19]

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[16] Seminal references include Carlstrom and Fuerst (1997); Bernanke, Gertler and Gilchrist (1999); Kiyotaki and Moore (1997); and Iacoviello (2005). Alpanda, Cateau and Meh (2014) nest the financial accelerator mechanism in the Bank's MP2 model.

[17] Parker et al. (2013) exploit the randomized timing of the 2008 economic stimulus payments in the US to show that low-income households spend on average $1.28 for every $1.00 in payments received, while households with high incomes do not increase their consumption in any significant way. Johnson, Parker and Souleles (2006) found similar evidence for the Bush 2001 tax rebates. Their results also suggest that households with low liquid wealth spent on average twice as much as households with high liquid wealth.

[18] The effect increases with the number of borrowers who can adjust their borrowing rate, e.g., new borrowers or those who have variable-rate mortgages. However, if higher interest rates are associated with high inflation, this effect is partially offset by real wealth redistribution from savers to borrowers, with positive effect on aggregate consumption.

[19] Cheaper credit predominantly goes to the low-income, low-search-cost borrowers. This is because the government guarantees mortgage debt in Canada and therefore banks do not face credit risk. Allen, Clark and Houde (2014a;

Yet the financial accelerator and redistribution mechanisms fall short of allowing policy models to generate large contractions. Our calculations, using MP2, show that the social costs associated with the financial cycles resulting from both these mechanisms are too small to justify leaning. The explicit mechanisms that can explain how financial imbalances lead to financial crises require an entirely different approach and have not yet been fully developed and incorporated into policy models. In the absence of such mechanisms, the link between financial imbalances and financial crises can be assumed directly, taking the form of a probabilistic relationship that can be estimated from the data.

2014b) document variation in the terms of borrowing across households due to price discrimination by lenders and higher search by low-income borrowers.

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