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Asymmetric Risks to the Economic Outlook Arising from Financial System Vulnerabilities

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Abstract

When financial system vulnerabilities are elevated, they can give rise to asymmetric risks to the economic outlook. To illustrate this, I consider the economic outlook presented in the Bank of Canada's October 2017 *Monetary Policy Report* in the context of two key financial system vulnerabilities: high levels of household indebtedness and housing market imbalances. Uncertainty on the profile of consumption by indebted households—and, therefore, risks to growth in gross domestic product (GDP)—arises from higher interest rates and from recent changes to the Office of the Superintendent of Financial Institutions' B-20 mortgage underwriting guideline. I use non-linear Bayesian techniques to capture the potential amplification of negative shocks in a vulnerable environment. I find that the materialization of larger-than-expected impacts on consumption from higher interest rates and/or the tighter mortgage qualifying criteria would imply asymmetric risks to GDP growth.

Bank topics: Business fluctuations and cycles; Financial stability; Financial system regulation and policies; Monetary and financial indicators; Recent economic and financial developments; Uncertainty and monetary policy; Econometric and statistical methods
JEL codes: C, C0, C01, C1, C11, C15, E, E1, E17, E3, E32, E37, E4, E44, E47, E5, E58, E6, E66, G, G0, G01, G1, G18

Résumé

Lorsque les vulnérabilités du système financier sont élevées, elles peuvent faire peser des risques asymétriques sur les perspectives économiques. Pour illustrer cet énoncé, j'examine les perspectives économiques présentées dans la livraison d'octobre 2017 du Rapport sur la politique monétaire de la Banque du Canada dans le contexte de deux grandes vulnérabilités du système financier, à savoir le niveau élevé d'endettement des ménages et les déséquilibres sur le marché du logement. L'incertitude qui plane sur le profil de consommation des ménages endettés – et, de ce fait, les risques entourant la croissance du produit intérieur brut (PIB) – découle de la montée des taux d'intérêt et des modifications apportées récemment à la ligne directrice B-20 du Bureau du surintendant des institutions financières sur la souscription de prêts hypothécaires. J'ai recours à des méthodes bayésiennes non linéaires pour tenir compte de l'amplification possible des chocs négatifs dans une économie vulnérable. Je constate que la matérialisation d'une incidence plus forte que prévu de la hausse des taux d'intérêt ou du resserrement des conditions d'octroi des prêts hypothécaires induirait des risques asymétriques pour la croissance du PIB.

Sujets : Cycles et fluctuations économiques ; Stabilité financière ; Réglementation et politiques relatives au système financier ; Indicateurs monétaires et financiers ; Évolution économique et financière récente ; Incertitude et politique monétaire ; Méthodes économétriques et statistiques
Codes JEL : C, C0, C01, C1, C11, C15, E, E1, E17, E3, E32, E37, E4, E44, E47, E5, E58, E6, E66, G, G0, G01, G1, G18

1. Introduction

The Canadian financial system faces two key vulnerabilities at a time when both monetary and macroprudential policy are tightening: historically high levels of household debt and elevated housing market imbalances. The vulnerabilities lead to an uncertain impact of both monetary and macroprudential policies.

Two policy instruments are tightening price and non-price lending conditions at the same time. The policy rate was increased in July and September 2017, reflecting the strong performance of the Canadian economy. The effect of higher rates on households is expected to be gradual because many borrowers have payments that are fixed for several years. The November 2017 Bank of Canada *Financial System Review* (FSR) shows that about half of outstanding mortgages will be renewed more than one year from that time. Meanwhile, the new mortgage underwriting guidelines (the B-20 guidelines) from the Office of the Superintendent of Financial Institutions (OSFI) came into force in January 2018, making it harder for prospective borrowers to qualify for a mortgage.[2]

As noted in the Bank's October 2017 *Monetary Policy Report* (MPR), the interest rate increases in July and September and the B-20 guidelines are expected to slow consumption spending and housing demand in 2018. However, in the absence of comparable episodes in Canadian history, the estimated magnitude of their impact is uncertain. The macroeconomic impact could be larger than expected in the October 2017 MPR if the elasticity of consumption is larger or if more households fail to qualify for a mortgage.[3] This note aims to quantify the potential impact of these two downside risks on the distribution of future growth in gross domestic product (GDP).

2. Financial system vulnerabilities magnify downside risks to the outlook for gross domestic product

To motivate this work, I first highlight that GDP's response to negative shocks will be amplified when the financial system vulnerabilities are elevated (Chart 1). An economic downturn could be significantly worse than a typical recession. In its recent *Global Financial Stability Report* (IMF 2017), the International Monetary Fund (IMF) builds on Adrian, Boyarchenko and Giannone (2016) and examines the notion of GDP at risk, i.e., the evolution of the left tail of the probability distribution of future output.

Similarly, I use a quantile regression analysis (see Appendix 1) and find that high vulnerabilities translate into a greater probability of negative future GDP growth. Here I differentiate the consequences of high vulnerabilities during normal times and compared with periods of financial stress. The latter are characterized by higher spreads, elevated volatilities and valuation losses across a wide range of financial assets (Chart 2).

High vulnerabilities tend to be associated with somewhat larger median GDP growth in normal times (because rising debt fuels growth). They also increase the probability of negative GDP growth from 8 to 13 per cent (grey area between the two green curves in Chart 2). In periods of high financial stress, elevated vulnerabilities imply a material downside risk for future GDP, with the probability of negative growth increasing from 35 to 59 per cent (grey area between the two red curves in Chart 2).

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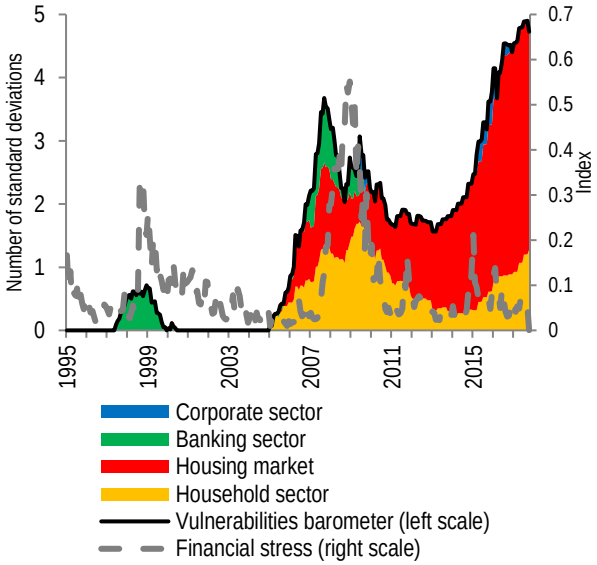
[2] The changes to the OSFI Guideline B-20 require that debt-service ratios of borrowers with down payments that are greater than 20 per cent be tested at the contract rate plus two percentage points or at the Bank of Canada five-year posted rate, whichever is greater. A similar regulation was introduced in autumn 2016 for borrowers with down payments of less than 20 per cent. For more discussion, see the the Bank of Canada *Financial System Review* (November 2017).

[3] This work relies on data available until the third quarter of 2017, and it uses the macroeconomic projections formed in October 2017 for 2018.

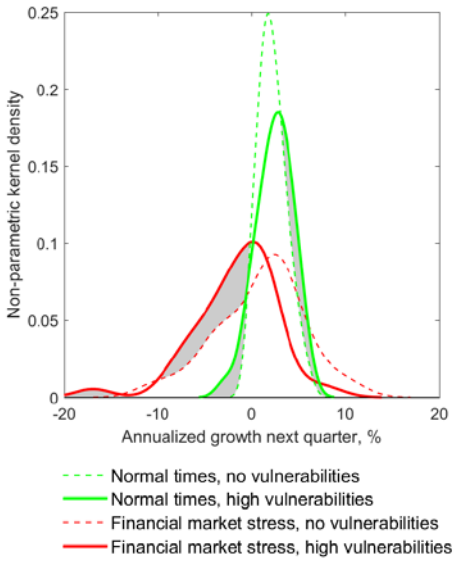
While several triggers could cause downside risks to materialize, in this note I focus on the uncertain impact of two policy changes: the sensitivity of the economy to higher interest rates and the impact of B-20 regulatory changes.

Chart 1: The vulnerabilities barometer is close to its historical peak



Notes: The vulnerabilities barometer from Duprey and Roberts (2017) combines aggregate data from four sectors transformed into a number of standard deviations away from thresholds historically associated with periods of financial stress. Positive values indicate the presence of vulnerabilities. The financial stress index builds on Duprey, Klaus and Peltonen (2017).
Last observation: November 2017

Chart 2: GDP tail risks increase when financial stress occurs while vulnerabilities are high



Notes: The chart displays the density of quarter-over-quarter real gross domestic product (GDP) growth, estimated for 16 advanced economies, and projected for Canada in 2017Q4. The grey shaded areas represent the additional risk of negative GDP growth associated with the presence of high vulnerabilities, i.e., moving from a vulnerabilities barometer of zero to its current value for Canada. See Appendix 1 for more details.
Last observation: 2017Q3

3. Downside risk scenarios associated with the interest elasticity of consumption and the B-20 changes

The tightening of both price and non-price lending conditions in a high-debt environment is already discussed in the October 2017 MPR. The effect could, however, be larger than expected. I present various downside risk scenarios around the Bank's base case, the October 2017 MPR.

High household debt may have raised the sensitivity of consumption to the interest rate more than expected

The interest rate increases from the third quarter of 2017 will continue to affect consumption in 2018. Financial institutions will continue to adjust their lending rates to higher funding costs, and households progressively renew their mortgage at a higher rate. However, there are two dimensions that are particularly hard to capture. First, with households being income-constrained and unable to borrow, their decision to buy or rent a house could be altered significantly. Most macroeconomic models abstract from this extensive margin and assume a fixed proportion of constrained borrowers. Second, the uncertainty when estimating the elasticity of consumption could be larger given the lack of historical episodes in Canada with comparable macrofinancial conditions. The estimation of elasticities in a high-debt environment is harder given that the most recent period was marked not only by increasing debt but also by falling interest rates for an extended time, leading to fairly constant

debt service costs. I consider three cases around the October 2017 MPR that rely on the Terms of Trade Economic Model (ToTEM) III.[4]

- **Base case**: this is the median elasticity of consumption to a policy rate change.
- **Higher elasticity**: this corresponds to the 10th percentile confidence interval.
- **Tail elasticity**: this corresponds to the 1st percentile confidence interval.

The new B-20 guidelines could have a greater effect on economic activity than expected

The revised B-20 guidelines are expected to bring financial stability benefits by improving the quality of low-ratio mortgages. That said, tighter underwriting guidelines are anticipated to generate a drag on economic activity because of weaker consumption and housing demand. In the October 2017 MPR and the November 2017 FSR, it was estimated that the new B-20 guidelines could affect 10 per cent of borrowers with down payments of more than 20 per cent. This could subtract about 0.2 per cent from the level of GDP by the end of 2019.

However, there is uncertainty around this impact because it depends on how borrowers and financial institutions respond to the new rules. One important dimension of uncertainty is the extent to which affected borrowers react by increasing their down payments to qualify for a mortgage. Increasing down payments affects household savings and consumption, while not entering the market or downsizing directly affects housing demand. In a context of elevated housing imbalances, it is possible that the new B-20 guidelines could discourage potential homebuyers even more than what is embedded in the base case, thereby leading to a larger GDP effect. I rely on the policy model MP2 and consider three different risk scenarios to estimate how borrowers will respond.[5, 6]

- **Base case**: GDP is 0.2 per cent lower, in line with the October 2017 MPR. This is consistent, for example, with the loan volume for new purchases by affected borrowers decreasing by 50 per cent. This reflects a combination of borrowers leaving the market and downsizing.[7]
- **Larger impact**: GDP is 0.35 per cent lower. This is consistent with the loan volume for new purchases by affected borrowers decreasing by 75 per cent.
- **Tail impact**: GDP is 0.6 per cent lower. This assumes that 100 per cent of affected borrowers for new purchases are priced out of the market or must delay their purchase.

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[4] For more details on ToTEM III, see the appendix of the October 2017 MPR.

[5] The MP2 model of Alpanda, Cateau and Meh (2014) is a general equilibrium model that includes a loan-to-value constraint. Given that the model does not have a debt-service constraint, I map the new stress-test requirement in the loan-to-value space to proxy for additional down payments. In addition, to proxy for borrowers postponing their purchase of housing, I introduce temporary shocks to the preference for housing in the model. Following higher loan-to-value and demand shocks, I assume no response from the monetary policy.

[6] The different scenarios make the simplifying assumption that existing homeowners affected by the new rules—i.e., borrowers who refinance their existing mortgage—increase their down payments. Prospective first-time homebuyers are assumed to adjust mostly by downsizing or postponing their decision to buy. Existing homeowners could also decide to downsize, but they are more likely to be locked in with their current housing choice, and they likely have accumulated home equity or financial wealth to be able to increase their down payment.

[7] A survey published by Mortgage Professionals Canada (2017) shows that half the borrowers who would be disqualified would drop out of the housing market.

4. Interest rate and B-20 uncertainties magnify downside risks around the outlook

I now assess the impact of different risk scenarios on the distribution of future GDP. The projection in the October 2017 MPR is in line with the base case elasticity of consumption and B-20 impact mentioned in section 2 above. Here, I focus on the implications of downside risk scenarios associated with a higher elasticity of consumption and a larger impact of B-20.

As discussed in Section 1, the elevated level of vulnerabilities implies larger downside risks and asymmetric uncertainty around the median forecast. To take this into account in my modelling, I use a Bayesian threshold vector autoregressive model (BTVAR, see Appendix 2) to assess the impact of the different risk scenarios on GDP. The model embeds non-linear downside risks by allowing for a different response of the economy in normal and financially stressful times.[8] In this framework, sizable increases in tail risks can be generated with small deviations from the median forecast. Indeed, when vulnerabilities are high, small shocks can be sufficient to trigger a change in regime that generates adverse macrofinancial amplifications. The different scenarios on the elasticity of consumption and the impact of B-20 weaken the median path of GDP. This increases the risk of a change in regime, which can disproportionally increase tail risks.

Table 1 displays the change in median GDP growth, compared with the base case, as generated with the BTVAR along my two risk dimensions. Assuming no monetary policy response, higher elasticities of consumption lead to lower median GDP growth, with an impact of -0.27 and -0.65 percentage points for high and tail elasticities, respectively (first column). The magnitude of these estimates is roughly in line with the impact of B-20 under the different scenarios (first row).

Table 1: After one year, the median path of the growth in real gross domestic product decreases compared with the base case

Cumulative change in median real GDP growth after one year, shock minus control (p.p.) from the BTVAR, 60% confidence bands

		New mortgage underwriting guidelines (B-20)		
		Base case	Larger impact	Tail impact
Elasticity of consumption to interest rate	Base case	*Control* *October 2017* Monetary Policy Report	**-0.15** [-0.06; -0.68]	**-0.40** [-0.16; -1.75]
	Higher elasticity	**-0.27** [-0.10; -0.88]	**-0.61** [-0.25; -1.91]	**-1.01** [-0.45; -3.09]
	Tail elasticity	**-0.65** [-0.24; -2.11]	**-1.10** [-0.41; -3.27]	**-1.52** [-0.62; -4.66]

When the higher elasticity of consumption is combined with the higher impact of B-20, the drag on median GDP is larger than the sum of the individual effects. In this adverse scenario, the median

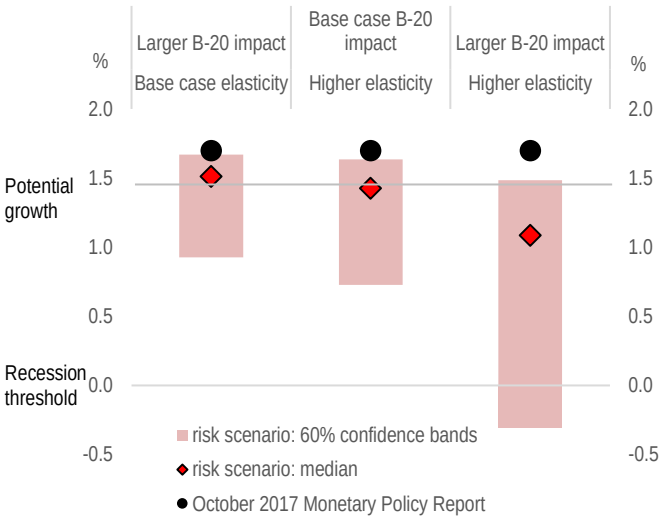
[8] When financial stress is high, shocks to the macroeconomy can have more severe effects. This is due to the decreased effectiveness of the financial system in performing its economic roles in the presence of high stress. This includes, for example, a tightening of bank lending conditions. This can occur even if the financial system does not experience a banking crisis, which is an even more severe situation.

path of GDP growth decreases by -0.61 percentage points, while the combined effect of both scenarios taken individually is -0.42 (i.e., -0.27 and -0.15). The asymmetry in the confidence intervals of Table 1 comes from the non-linear nature of the BTVAR model. If the economy is in fact facing a higher elasticity and a larger impact of B-20, the probability of the economy entering a regime of elevated market stress increases. This stress regime is associated with a larger downside amplification, shifting the distribution of expected GDP growth much more into negative territory.

Chart 3 displays the projection for GDP growth in 2018 based on my risk scenarios. The lower bound of the confidence intervals is much wider, and the skewness increases with weaker scenarios. This highlights the risk of significantly underestimating GDP impacts when abstracting from non-linearities. Starting from a situation of zero output gap and growth in line with potential, a higher elasticity of consumption or a larger impact of B-20 could be sufficient to generate excess supply again, all else being equal.

Chart 3: In 2018, growth in gross domestic product can be at risk

Year-over-year percentage change of real GDP at the end of 2018



Note: Potential growth is 1.5 per cent, consistent with the October 2017 MPR. The scenarios are evaluated using a non-linear model, the BTVAR.

The combination of a higher interest elasticity and a larger impact of B-20 changes increases the risk of returning to excess supply after one year by nearly 10 percentage points relative to the control (Table 2).[9] Similar calculations can be performed for the risk of recession. In this case, I find that the additional risk of falling into a recession remains small in most cases. With a higher (tail) consumption elasticity and a larger (tail) impact of B-20 changes, the probability of entering a recession after one year increases by 5 (16) percentage points.

[9] I do not emphasize the level of the probabilities. Although the level of GDP is pinned down by the path of the October 2017 MPR, the level of uncertainty around the base case depends my modelling assumptions because I do not use the same model as the one used for the projections. For that reason, I only report the change in the probability estimates between the base case and the various risk scenarios.

Table 2: After one year, the risk of the economy returning into excess supply increases

Change in the probability of below potential growth of the gross domestic product, growth after one year, shock minus control (p.p.) from the BTVAR, 60% confidence bands

		New mortgage underwriting guidelines (B-20)		
		Base case	Larger impact	Tail impact
Elasticity of consumption to interest rate	Base case	*Control* *October 2017* Monetary Policy Report	**2.6** [0.8; 7.8]	**5.8** [1.7; 17.3]
	Higher elasticity	**3.5** [1.4; 12.1]	**8.5** [3.4; 25.7]	**13.8** [5.1; 30.8]
	Tail elasticity	**8.8** [3.2; 28.0]	**14.3** [5.8; 37.5]	**18.6** [7.9; 42.2]

Note: Growth below potential is defined as GDP growth below 1.5 per cent, consistent with the October 2017 *Monetary Policy Report* (MPR, see Box 2).

5. Conclusion

The level of households and housing vulnerabilities can magnify downside risks to the economic outlook. In this context, the 2017 rate hikes and the 2018 regulatory requirements for mortgage underwriting can reinforce each other by tightening price and non-price borrowing conditions. This could weigh on the distribution of future output growth by reducing consumption growth more than expected in the October 2017 forecasts. Plausible risk scenarios increase the likelihood of growing below potential, but less so for the risk of a recession.

Other sources of uncertainty can also affect the economic outlook and amplify negative risks. Higher interest rates and lower mortgage originations could trigger an additional non-linearity associated with a housing price correction in the presence of self-reinforcing expectations. This would further erode consumption compared with the scenarios considered in this note.

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Appendix 1: Estimating the density distribution of growth in gross domestic product

I estimate the following quantile regression model of annualized real GDP growth (gGDP) over a panel of 16 advanced economies. The level of vulnerabilities is captured across economies by the vulnerabilities barometer (VB) in Duprey and Roberts (2017). The intensity of financial market stress is captured by the Country-Level Indices of Financial Stress (CLIFS) in Duprey, Klaus and Peltonen (2017) adjusted to make the relative magnitudes comparable across economies. The parameters are specific to each of the 39 different quantiles *q* I estimate.

$$gGDP_t = c^q + \beta^q \cdot gGDP_{t-1} + \gamma^q \cdot VB_{t-1} + \alpha^q \cdot CLIFS_{t-1} + \zeta^q \cdot VB_{t-1} \cdot CLIFS_{t-1} + \epsilon_t$$

The distribution of GDP growth one quarter ahead is recovered by fitting a kernel smoother on the GDP forecast associated with the various quantiles. I project Canada's GDP growth in 2017Q3 one quarter ahead in the following four scenarios:

- **Normal times, no vulnerabilities**: $CLIFS_{t-1}$ at its current value for Canada and $VB_{t-1} = 0$
- **Normal times, high vulnerabilities (the current state in Canada)**: $CLIFS_{t-1}$ and VB_{t-1} at their current value for Canada
- **Financial market stress, no vulnerabilities**: $CLIFS_{t-1}$ at its 2008 Canadian level and $VB_{t-1} = 0$
- **Financial market stress, high vulnerabilities**: $CLIFS_{t-1}$ at its 2008 Canadian level and VB_{t-1} at its current value for Canada

Appendix 2: Recovering tail risks around the October 2017 *Monetary Policy Report*

I consider 16 variables, represented by the vector Y_t below, at a monthly frequency for Canada from 1981 to 2017. Most variables are in annualized growth rates. The Bayesian threshold vector autoregressive model (BTVAR) endogenously identifies two macroeconomic regimes, namely normal times, *N*, and financially stressful times, *S*, depending on an estimated cut-off level of financial market stress τ.

$$Y_t = \begin{cases} \beta^N \cdot Y_{t-1} + \epsilon_t^N & if\ normal\ \ times: \quad Financial\ Stress < \tau \\ \beta^S \cdot Y_{t-1} + \epsilon_t^S & if\ stressful\ \ times: \quad Financial\ Stress > \tau \end{cases}$$

Financial market stress is defined as valuation losses, increased spreads and increased volatility occurring simultaneously across a wide range of asset classes (Duprey 2018). Episodes of high financial market stress identified for Canada correspond to the housing market correction in 1990 or the financial crisis around 2008–09, for example. In periods of elevated financial market stress, small macroeconomic shocks are amplified and can generate a negative feedback loop between financial and real economic stress (Chatterjee et al. 2017).

The model is estimated with three lags using the method developed by Bruneau and Chapman (2018), namely using Markov chain Monte Carlo simulations. I use sign restrictions to identify demand and policy rate shocks.

I generate non-linear scenarios to assess the downside risk associated with different sources of uncertainties. I follow three steps.

1. I recover the sequence of shocks that match the Bank of Canada's October 2017 *Monetary Policy Report* (MPR), the control. Thus, absent any other shocks, the BTVAR replicates the MPR projection for 2018.
2. I recover the historical distribution of shocks as estimated by the BTVAR. I draw random shocks from this distribution to generate some uncertainty around the MPR projections. This allows for the computation of tail GDP around the control given the distribution of possible paths.
3. I reproduce alternative risk scenarios in the BTVAR. They affect both the median forecast and the uncertainty that was added around it in step 2. I then report the difference in GDP growth in the scenarios compared with the control.

I focus on the analysis of two downside risks, namely the elasticity of consumption to interest rate shocks and the new B-20 guidelines. The downside risk scenarios are generated using two satellite models, namely ToTEM III as described in the October 2017 MPR and MP2 in Alpanda, Cateau and Meh (2014). The downside risk scenarios are introduced in the BTVAR as follows. For the elasticity of consumption, I compute the additional decline in consumption associated with monetary policy tightening if the elasticity of consumption is higher than the base case. For B-20, I use a sequence of demand shocks to generate the desired drop in the median path of GDP growth.