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Impacts of interest rate hikes on the consumption of households with a mortgage

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Introduction

The Bank of Canada started rapidly raising its policy rate in early 2022 to combat high inflation. As a result of these increases, households with mortgages have inevitably become concerned that they will have to renew their mortgages at higher interest rates.[1] When they do, their mortgage payments will increase, reducing the portion of their income available for non-housing consumption. We assess how much households with mortgages may reduce their consumption by because of increases in their mortgage payments.

To conduct our assessment, we first measure the rise in household mortgage payments after the recent increases in interest rates. By April 2024, monthly mortgage payments had increased by about 9% on average since 2022 and will likely increase by 17% on average by 2027. These increases in mortgage payments have caused declines in average disposable income—that is, household income net of mortgage payments—of 3% by April 2024 since 2022 and will likely cause a decline up to 5% by 2027.

We then measure the impact of the increases in mortgage payments on households' monthly non-housing consumption. Households with and without liquid savings respond differently to changes in their disposable income. Therefore, considering the liquidity situation of each household becomes important for evaluating the impact on consumption.[2] We assume a probability exists that a household can be in one of two possible situations: constrained or unconstrained. We then measure each household's change in consumption as an average of these two possibilities, weighted by that probability.

Constrained households hold few assets and exhaust all their disposable income. Therefore, changes in their consumption coincide fully with changes in their disposable income. Unconstrained households, however, hold enough savings that they can choose how much to spend, balancing their consumption over time. Adjustments to their current consumption are not fully subject to changes in their current disposable income. Instead, adjustments are determined by the average change in their disposable income over the household's whole life cycle.

To calculate expected changes in consumption, we use age and income to gauge the probability of a household being in each liquidity situation.[3] We find that unexpected increases in mortgage payments had reduced the consumption of mortgage borrowers by 2.8%, on average, by April 2024. This decline should continue and reach 3.8% in early 2028.

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[1] In Canada, mortgage terms are usually fixed for five years or less.

[2] As discussed in the literature—e.g., Kaplan et al. (2018), Alves et al. (2022) and Guo et al. (2023)—considering the distribution of household liquidity situations is crucial when measuring the total effects of macroeconomic policies.

[3] As described in the **Appendix**, we condition the probabilities of being constrained based on age and income because both the Bank's administrative data for mortgage contracts and Statistics Canada's Survey of Financial Security—where we can measure a household's liquidity situation—observe these characteristics.

A key insight from our analysis is that the downward pressure on consumption from rate hikes could last longer than the rate hike cycle itself. This is because rate hikes not only increase mortgage payments temporarily but also reduce the share of these payments that pay off the principal. A few years of higher rates will therefore lead to a household having a larger remaining balance to repay, negatively affecting borrowers' consumption in the future.

Unexpected increases in interest rates

We measure the effects of increases in interest rates by the difference in household consumption under two paths for interest rates as shown in **Chart 1**. The first path (red line) represents the realized increases in interest rates between March 2022 and January 2024.[4] The second path (blue line) depicts what the market expected in February 2022 for the same period. **Chart 1** shows that the market expected rates to rise, but significantly underestimated the pace and magnitude of increases.[5] The difference in consumption suggested by these two paths reflects the changes in mortgage payments that mortgage borrowers did not expect before the recent cycle of rate increases.[6] The gap between these two interest rate paths implies that mortgage borrowers will:

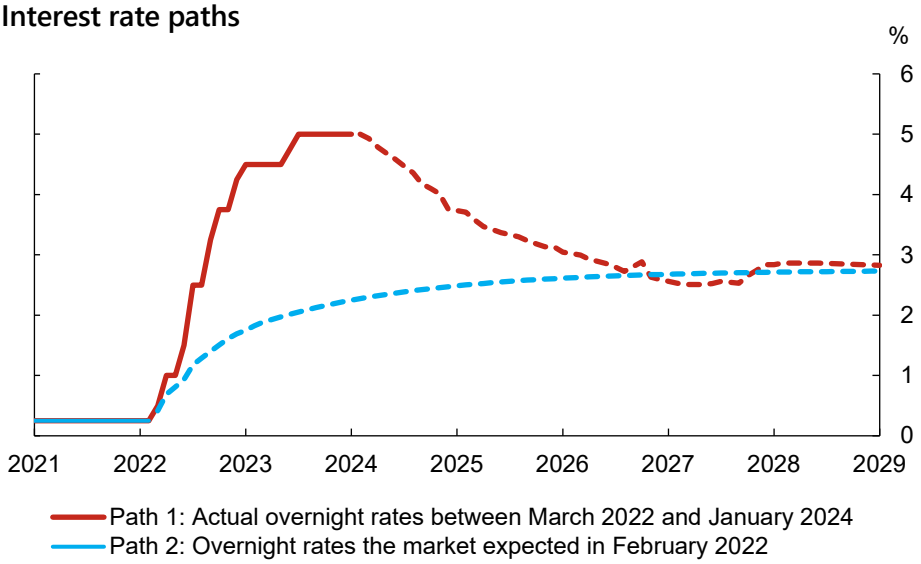
- renew their mortgages at a rate higher than they expected
- face unexpected increases in their mortgage payments

[4] On March 3, 2022, the Bank announced the first increase in the policy rate since the start of the COVID-19 pandemic.

[5] This gap between the market's expectation and the central bank's policy also appeared in the United States during the same period. See Wallerstein (2024) for a more detailed discussion.

[6] We assume that mortgage borrowers and financial markets share the same expectation about future interest rates. Because households make consumption choices based on their expected future income, we need to construct the long-term paths of payment change, which is why the interest rate path goes beyond 2024. More details can be found in the **Appendix**.

Chart 1: Interest rate paths



Note: Solid red and blue lines indicate realized history of rates. Dashed lines indicate market expectations for rates.
Source: Bank of Canada calculations Last data plotted: December 2028

Effects on mortgage payments and disposable income

We focus on households that had an outstanding balance on their mortgage in February 2022.[7] For each household, we first calculate their monthly mortgage payments and disposable income under each path for interest rates. We then calculate the corresponding differences between these two scenarios.[8] **Chart 2**, panel a, shows that the unexpected part of the rate increase leads to a gradual rise in the household mortgage payments. This is because the majority of mortgages in Canada have fixed rates and increases in mortgage payments are triggered only after renewal.[9] The average increase in mortgage payments should peak at 17% around 2027, when almost all mortgages that were outstanding in February 2022 will have been renewed. This increase directly reduces disposable income (**Chart 2**, panel b). At the peak, the average household with a mortgage will experience a 5% decrease in its level of disposable income.[10]

[7] We construct our sample using Canadian administrative data from the Office of the Superintendent of Financial Institutions. These data include anonymized loan-level information of all residential mortgages issued by federally regulated lenders in Canada. More details are available in the **Appendix**.

[8] We assume in this calculation that households renew into the same type of mortgage contract and do not make prepayments. See teNyenhuis and Su (2023) for more details.

[9] Among the mortgages in our sample, 74.1% have fixed rates, accounting for 66.7% of the remaining balance that households owed in February 2022.

[10] Here, disposable income refers to a household's gross income minus mortgage payments. When we calculate the path of disposable income for each household, we use a gross income growth trajectory that considers their age. See the **Appendix** for more details.

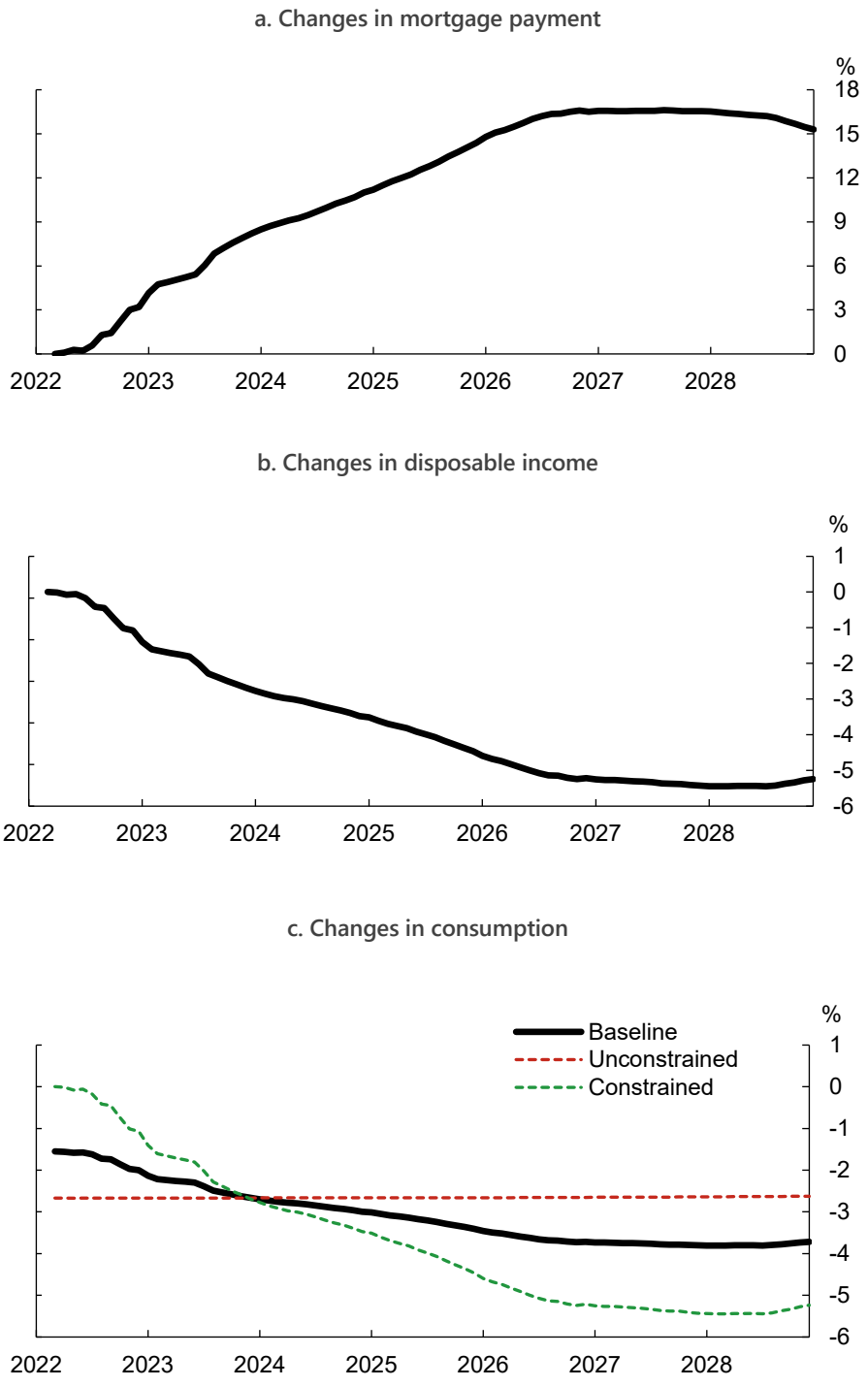
Effects on consumption

With less disposable income, households with mortgages have to reduce their consumption. But by how much and when depends on their liquidity. Constrained households whose disposable income is already low have to cut their monthly consumption one-for-one with decreases in their disposable income.

Households with a disposable income that more than covers their desired level of consumption—meaning they are unconstrained—will adjust their consumption smoothly based on the whole path of future changes in their disposable income. We assume that each type of household has a certain probability of being constrained, which we measure using each household's age and income. Using this probability, we calculate the changes in each household's consumption as the average between the two liquidity situations.

Chart 2, panel c, shows the results. If all households are constrained, the path of changes in consumption mirrors that of changes in disposable income. If all households are unconstrained, consumption changes will be evenly allocated over time: reductions in consumption start immediately, but the peak effect would be smaller than that for constrained households. This path reflects household actions to prevent their consumption from being as volatile as their disposable income. The path of expected changes in consumption is a combination of the above two paths. Unexpected increases in mortgage payments have forced mortgage borrowers to cut their consumption by an average of 2.8% between March 2022—when the rate hike cycle began—and April 2024. Their consumption will likely continue to decrease until early 2028 and peak at 3.8%.

Chart 2: Impacts of unexpected interest rate increases



Note: Differences are based on the two interest rate paths depicted in **Chart 1**. The sample consists of households with a remaining balance in February 2022. Panels show income-weighted average across households.

Sources: Real Estate Secured Lending data (OSFI) and Bank of Canada calculations

Last data plotted: December 2028

Persistent effects of a rate hike cycle

The gap between the two paths for interest rates is expected to close around 2027 (**Chart 1**). However, this does not imply the end of mortgage payments that are higher than households expected. During the cycle of rising rates, households renew their mortgages at higher rates, leaving a smaller share of the payments going toward paying the principal. Therefore, the average mortgage borrower in January 2028—when the market expects the gap between these two interest rate paths to have already closed—will face a remaining balance that is 2.8% higher than they expected in February 2022. This increased debt burden in the future will further reduce consumption of households with mortgages, suggesting that the effects of a rate hike cycle can last longer than the cycle itself.

Conclusion

We combine loan-level data about residential mortgages in Canada with a realistic measure of each household's liquidity situation to assess how much the recent rate hike cycle has affected and will affect mortgage borrowers' consumption through its impact on mortgage payments. Our results indicate that increases in interest rates have reduced the average mortgage borrowers' consumption by 2.8% as at April 2024 and that the decrease is expected to fall further and reach 3.8% in early 2028. These increases reduce mortgage borrowers' consumption for two reasons: their mortgage payments increased during the rate hike cycle, and they will face a higher remaining balance to be paid off in the future. Because a rate hike cycle will increase the total debt burden of mortgage borrowers, the negative effects of a rate hike cycle on mortgage borrowers' consumption will last longer than the rate cycle itself.

Appendix

Appendix A: Extra details about the measurements

A.1 Construction of interest rate paths

Baseline path: This path consists of actual interest rates up to January 2024 and the future path for interest rates based on market expectations in January 2024. The data on market expectations in January 2024 are available for interest rates until 2028. We use the Bank of Canada's Large Empirical and Semi-structural model, known as LENS (Gervais and Gosselin (2014)), to construct a path for interest rates beyond 2028, assuming a convergence to 2.5%, which is the midpoint of the Bank's estimated range for the neutral rate of interest.[11]

Low-rate path: This path consists of the history of actual interest rates up to February 2022 and the future path for interest rates based on market expectations in February 2022. The data on market expectations in February 2022 are available for interest rates up to 2023. Beyond that, we use LENS (Gervais and Gosselin (2014)) to construct a long-term interest rate path that gradually converges to 2.5%, the midpoint of the Bank's estimated range for the neutral rate of interest.

A.2 Sample of mortgages

Data from the Office of the Superintendent of Financial Institutions (OSFI) : We use anonymized loan-level regulatory data from OSFI for our mortage payment simulation. These are the monthly flow data on mortgage originations and renewals from 2014 to 2024.[12] The dataset includes many details about the borrower and the loan, such as loan size, amortization, product type, qualifying income and contractual interest rate. We use this

[11] See Champagne *et al.* (2023) for details.

[12] Originations include mortgages for purchase and refinancing. An origination requires underwriting by the lender.

dataset to construct the stock of mortgages outstanding on a given date, with the expected payment at that time (assuming the borrower pays down exactly as specified in their contract without any prepayments or refinancing).[13] See teNyenhuis and Su (2023) for more details on the dataset and the assumptions we use in the mortgage payment simulation.

Sample selection : We include mortgages with remaining balances in February 2022 and any accompanying information on borrowers' incomes and ages.

A.3 Effects on mortgage payments and disposable income

We index the households in our sample by h and each mortgage by (h, i). For a given path of interest rates, we follow the method documented in teNyenhuis and Su (2023) to simulate the monthly payment of each mortgage starting from February 2022. Underlying this simulation are two key assumptions, specifically that mortgage holders:

- do not make prepayments
- renew into the same mortgage product

We denote the simulated path of mortgage payments for a household i under the baseline rate path as $P^b_{i,t}$ and under the counterfactual rate path as $P^c_{i,t}$. We then simulate a household's disposable income by:

$$DI^x_{i,t} = \underbrace{\texttt{Gross income}_{i,y(\bar{t}_i)} \times \prod_{\tau=y(\bar{t}_i)}^{y(t)-1} (1+\gamma_{\tau-y(t_0)+\text{Age}_{i,\bar{t}_i}})}_{\text{predicted gross income of household } i \text{ at time } t} - P^x_{i,t}, \ \forall x \in \{b, c\}. \tag{1}$$

Here, $\bar{t}_i$ denotes the time period when the most recently available record of income of a household i was available; $y(t)$ denotes the calendar year of time t; $\text{Age}_{i,\bar{t}_i}$ denotes the average

[13] We calculate the payment using the loan amount, contractual interest rate and amortization period. It is simulated forward assuming that the borrower's interest rate risk premium is maintained throughout, i.e., a borrower originating with a spread of 80 basis points below prime will hold this spread for the entire simulation, with changes in their rate aligning with market expectations for future rates.

age of the household members at $\bar{t}_i$; and $\gamma_{\tau-y(t_0)+\text{Age}_{i,\bar{t}_i}}$ denotes the age-specific income growth rate we use to simulate the total gross income of household i.

Age-dependent income growth path (γ_{Age}): We use a combination of data from OSFI and survey information. In the OSFI data, the only information available on income is the income used to qualify for the mortgage (usually similar to a gross or pre-tax household income), which is provided only at the time of origination. For past income growth, we apply the monthly growth rate in wages from Statistics Canada's Labour Force Survey (LFS), adding in age effects to account for income growth over the life cycle. For future income growth, we use average wage growth recorded in the LFS over the available history plus estimated age effects. Age effects are derived from mortgagors in Statistics Canada's Survey of Financial Security 1999–2019 (SFS).

A.4 Effects on consumption

We use the simulated path of the difference in disposable income (i.e., $\Delta DI_{i,t} \equiv \log DI^b_{i,t} - \log DI^c_{i,t}$) to measure the effects of unexpected rate hikes on household consumption. For a given path of disposable income change, $\Delta DI_{i,t}$, the consumption responses of a household depend on its liquidity. We consider two types of possible consumption response in this measurement: constrained and unconstrained. Constrained households fully consume their disposable income, and $\Delta c^{HtM}_{i,t} = \Delta DI_{i,t}$. The consumption responses of unconstrained households are consistent with the permanent income hypothesis and are determined by the following rule:

$$\Delta c^{Non-HtM}_{i,t} = \sum_{\tau=0}^{T} s_{i,t_0+\tau} \cdot \Delta DI_{i,t_0+\tau}, \tag{2}$$

where t_0 denotes the starting period of the simulation and $s_{i,t_0+\tau}$ is the share of disposable income in period $t_0 + \tau$ within the total lifetime wealth for household i , which is measured

by:[14]

$$s_{i,t_0+\tau} = \frac{\overline{DI}_{\text{Age}_{i,t_0+\tau}}/R^{\tau}}{\sum_{\tau=0}^{T} \overline{DI}_{\text{Age}_{i,t_0+\tau}}/R^{\tau} + \bar{a}_{\text{Age}_{i,t_0}}}, \tag{3}$$

where $\overline{DI}_{\text{Age}}$ and $\bar{a}_{\text{Age}}$ denote the average monthly disposable income and net wealth of households with a given average age, and R denotes the average monthly discounting rate. We set $R = 1 + \frac{3\%}{12}$ and measure both $\overline{DI}_{\text{Age}}$ and $\bar{a}_{\text{Age}}$ based on the sample of households with a mortgage in the 2019 SFS.

Because we cannot directly observe the liquidity status of a household, we assume a probability exists that a household is constrained and measure its consumption response as a weighted average of the two types of consumption response outlined above:

$$\Delta c_{i,t} = \alpha_i \cdot \Delta c_{i,t}^{HtM} + (1 - \alpha_i) \cdot \Delta c_{i,t}^{non-HtM}, \tag{4}$$

where α_i denotes the probability of a household being constrained. Following the definition in Kaplan *et al.* (2014), we categorize households with liquid wealth less than their two-week income as being constrained. For a given household, we approximate its probability of being constrained, α_i , by the historical average share of constrained households among households with mortgages and similar age and income levels in the SFS data.

Probability of being constrained (α_i) is the likelihood that a given household holds less than two weeks of income in net liquid assets among households with mortgages recorded in the SFS 1999–2019, dependent on two observable variables that can be matched to Real Estate Secured Lending (RESL) data: age group and inflation-adjusted income group. Income is negatively correlated with the probability of being constrained, while age displays a hump shape with the highest probability of being constrained around age 40. Other factors, such as the loan-to-value ratio or the loan-to-income ratio, are highly correlated with the two

[14] Because we want to focus on the cash flow effects, we intentionally exclude the effects of interest rate changes through the inter-temporal substitution effects. See **Appendix** B.1 for details.

selected variables. Similarl to Kaplan *et al.* (2014), we define net liquid assets as the sum of chequing and saving accounts, stocks, mutual funds, bonds and tax-free savings accounts (tax-protected savings), minus credit card debt (after payment of statement, if paid) and installment debt.

Response of unconstrained households' consumption to disposable income ($s_{i,t_0+\tau}$) We directly measure the components of $s_{i,t_0+\tau}$ using a subsample of households with a mortgage in the 2019 SFS. We measure $\overline{DI}_{\text{Age}_{i,t_0+\tau}}$ as total income of the household net of mortgage payments and $\bar{a}_{\text{Age}_{i,t_0}}$ as total net worth. We compute the average of these variables across households with mortgages in a certain age bracket and linearly interpolate the path from t to T using the midpoint of the bracket defined by the SFS. Flows are discounted using an annual interest rate of 3%.

Appendix B: Extra details of derivation

B.1 Consumption under the permanent income hypothesis

We assume that consumers have perfect foresight of their future disposable income $\{DI_{t+\tau}\}$ at time t and they choose their optimal consumption choices for their remaining lifetime to maximize their discounted utility under the budget constraint:

$$\max_{c_\tau} \sum_{\tau=0}^{T} \beta^\tau \cdot c_{t+\tau}^{1-\sigma}$$
$$\text{s.t.} \quad a_{t+\tau+1} = R_{t+\tau} \cdot (a_{t+\tau} + DI_{t+\tau} - c_{t+\tau}),$$

where β and σ denotes the discounting factor and elasticity of inter-temporal substitution; $R_{t+\tau}$ is the gross return rate of household saving, and a_t is the value of total net wealth of a household at time t, and T denotes the length of remaining lifetime. The optimal

consumption can be characterized as:

$$\begin{aligned} c_t =& \frac{1}{\sum_{\tau=0}^{T} (\beta^{T-\tau})^{\frac{1}{\sigma}} \cdot \Lambda_{t,t+\tau-1}^{\frac{1}{\sigma}-1}} \cdot \left[\sum_{\tau=0}^{T} \frac{DI_{t+\tau}}{\Lambda_{t,t+\tau-1}} + a_t \right] \\ c_{t+\tau} =& c_t \cdot \left(\beta^{\tau} \cdot \Lambda_{t,t+\tau-1}\right)^{\frac{1}{\sigma}}, \end{aligned}$$

where the discounting factor Λ is defined as:

$$\Lambda_{t,t'} = \begin{cases} \Pi_{\iota=t}^{t'}(1+r_\iota) & \text{if } t' \geqslant t \\ 1 & \text{if } t' < t \end{cases}. \tag{5}$$

From the optimal consumption choice, we can derive the path of consumption change induced by a given path of disposable income change as:

$$\Delta c_t = \sum_{\tau=0}^{T} s_\tau \cdot \Delta DI_{t+\tau} \tag{6}$$

$$\Delta c_{t+\tau} = \Delta c_t, \tag{7}$$

where

$$s_\tau = \frac{\frac{DI_{t+\tau}}{\Lambda_{t,t+\tau-1}}}{\sum_{\tau=0}^{T} \frac{DI_{t+\tau}}{\Lambda_{t,t+\tau-1}} + a_t} \tag{8}$$

can be interpreted as the share of the disposable income in a certain period within a household's total lifetime income.

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