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The rise in household debt and housing prices during COVID-19: the role of pandemic support policies

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The rise in household debt and housing prices during COVID-19: the role of pandemic support policies

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Abstract

There was a significant increase in housing prices and household debt during the Covid-19 pandemic in Canada, even though both output and consumption experienced severe contractions. While a shift in household preferences toward housing—largely driven by increased demand for work-from-home arrangements—appears to be the primary driver of rising housing demand, various pandemic-related policy interventions may also have contributed to these trends. In this paper, we employ a medium-scale DSGE model calibrated to Canadian data to assess the contribution of pandemic-related support policies, including fiscal, monetary, and credit measures. Our findings indicate that these policies played a key role in driving the housing market boom during the pandemic, accounting for approximately 45 percent of the observed increase in household debt. In the case of housing prices, the model explains about 40 percent of the observed rise, although it fails to replicate the gradual increase observed in the data, instead predicting a more immediate rise.

JEL: classification: E32;E44; E52; E62

Keywords: pandemic, household debt, housing prices, fiscal policy, monetary policy

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1 Introduction

The COVID-19 pandemic caused severe economic distress in Canada. In the second quarter of 2020, at the height of the lockdown, both output and consumption declined by over 10 percent relative to the previous quarter. In contrast, the Canadian housing market experienced a substantial boom during the pandemic. Between the first quarter of 2020 and the second quarter of 2022, household debt increased by 14 percent, and housing prices rose by 21 percent. The housing boom during the COVID-19 pandemic was largely unexpected. For example, in the early stages of the outbreak, the Canada Mortgage and Housing Corporation (CMHC) projected that housing prices could decline by as much as 18 percent.[1] A decline in housing prices is typically associated with recessions, during which income losses due to job displacement reduce households' demand for both consumption and housing. For instance, during the Great Recession of 2008–09, housing prices in Canada declined by 9 percent. This historical precedent raises a compelling puzzle: why did the COVID-19 recession produce the opposite outcome? Rather than experiencing price corrections, we witnessed significant increases in housing prices alongside rising household debt levels, defying the conventional recessionary pattern.

Several factors may explain the surprising boom of the housing market. First, the nature of the COVID-19 shock differed fundamentally from previous recessionary episodes. Government-imposed lockdowns forced a reduction in consumption, but did not necessarily suppress the demand for housing. Second, household preferences toward housing have shifted during the pandemic. The widespread adoption of remote work increased the desirability of homeownership relative to renting, thereby fueling demand for housing. As a result, both mortgage debt and housing prices rose. Third, extensive pandemic support measures implemented by the fiscal and monetary authorities likely contributed to the housing boom. On the fiscal side, social transfers and household subsidies more than doubled during the pandemic. On the monetary side, the policy interest rate remained at the effective lower bound (ZLB) for seven consecutive quarters. In addition, the Bank of Canada introduced the Canada Mortgage Bond Purchase (CMBP) program, which involved purchasing mortgage bonds in the secondary market. We call this intervention credit policy since it aimed to support the value of mortgage-backed securities, thereby lowering mortgage rates and easing credit conditions. Together, these policy interventions may have directly influenced household income, credit supply, and borrowing conditions, contributing to the unexpected boom in the Canadian housing market during the pandemic.

In this paper, we focus on studying the impact of the policy interventions. We develop a small open economy Dynamic Stochastic General Equilibrium (DSGE) model that incorporates housing demand and household debt. The model features a banking sector subject to financial frictions, a government with an unbalanced budget, and a monetary authority constrained by the zero

[1] The Globe and Mail, "*CMHC predicts house prices could drop up to 18 per cent*," May 20, 2020. Available at: `https://www.theglobeandmail.com/business/article-canada-mortgage-and-housing-corp-predicts-house-prices-could-drop-up/` Accessed July 21, 2025.

lower bound (ZLB). These elements allow us to explicitly capture the effects of pandemic support measures—fiscal, monetary, and credit—on housing market dynamics. The unprecedented size of the COVID-19 shock and the temporary nature of the support policies pose challenges for conventional solution methods based on log-linearization around the steady state. To address this issue, we adopt a non-linear solution approach under the assumption of perfect foresight, following Faria-e Castro (2021), which enables us to trace the dynamic effects of large, temporary shocks more accurately than linear approximations.

We model the pandemic shock as a shock to consumption demand—a forced-savings shock—to capture the fact that the lockdown policies compelled households to reduce consumption and increase savings. The model is calibrated to the eve of the pandemic, and the magnitude of the forced-savings shock is inferred using the observed path of aggregate consumption from 2020Q1 to 2021Q2. With the estimated shock in place, we first simulate the model under the assumption that the economy experiences the pandemic shock without any pandemic-related support programs. We then examine the effects of three major policy responses: (1) social transfers (fiscal policy), (2) the Canada Mortgage Bond Purchase program (credit policy), and (3) the extended period of low interest rates maintained by the central bank (monetary policy). Finally, we assess the combined impact of these programs and compare the simulated trajectories of housing prices and household debt to the corresponding data.

Our findings are as follows. First, in the baseline scenario without any support programs, housing prices increase in response to the pandemic shock. This is because the forced-savings shock primarily reduces demand for consumption goods, while having little impact on the demand for housing. Moreover, the resulting increase in household savings leads to a rise in bank deposits, enabling banks to lower mortgage rates. Lower borrowing costs, in turn, encourage households to take on more debt, further driving up housing prices. The model also indicates that, in the absence of policy support, the economy would experience deflation, and the nominal interest rate would remain at the zero lower bound (ZLB) for approximately four quarters.

Second, with respect to policies, our findings indicate that all three measures contribute to an additional increase in household debt and housing prices relative to the baseline scenario, while also helping to ease deflationary pressure. However, the mechanisms through which each policy operates differ. Under fiscal policy, the substantial increase in transfers primarily benefits financially constrained borrowers. Given that consumption was largely constrained during the pandemic, the effect of transfers on consumption is limited. Instead, borrowers allocate a significant share of these transfers to housing. Under the credit policy, the CMBP program raises the prices of mortgage-backed securities and reduces mortgage rates, therefore encouraging household borrowing. Under monetary policy, maintaining the policy rate at the ZLB longer than suggested by the baseline case enables households to accumulate additional debt and further amplifies the increase in housing prices. We also find that, quantitatively, extending the ZLB for an additional two quarters has a considerably larger impact on household debt and housing prices than the fiscal and credit measures implemented during the pandemic by the Canadian government.

Third, the policies reinforce each other when implemented jointly. In particular, we find that the combined effects of the three programs account for approximately 45% of the increase in household debt during the pandemic. For housing prices, the model explains about 40% of the observed rise, although it fails to capture the gradual increase seen in the data, instead predicting a more immediate surge. These findings suggest that, while the increase in housing demand driven by remote work remains the primary factor behind the rise in household debt and housing prices, the pandemic-related support policies also played a significant role in amplifying the housing market boom.

1.1 Related literature

Our paper contributes to the literature by employing a quantitative macroeconomic model to analyze the economic impact of the COVID-19 pandemic and to assess the effectiveness of pandemic-related support policies.[2] In the existing literature there are two approaches to study the economic effects of COVID-19. The first combines an epidemiological model with a standard macroeconomic framework to capture the interaction between disease transmission, economic activity, and macroeconomic policy (e.g., Eichenbaum et al. 2021, 2022; Atkeson 2020; Kaplan et al. 2020). In this approach, the dynamics of the epidemic are endogenous. The second approach, to which our paper belongs, treats the COVID-19 shock as exogenous and incorporates it into an otherwise standard macroeconomic model (e.g., Guerrieri et al. 2022; Faria-e Castro 2021; Bhattarai et al. 2023; Cardani et al. 2022; Ferroni et al. 2024; Bigio et al. 2020; Di Pietro et al. 2020).

Compared to the first approach, the latter is more reduced-form in nature. Its main advantage lies in the fact that it preserves the standard model structure, allowing the direct application of conventional tools used in quantitative analysis. Among the studies following this approach, our paper is particularly related to Cardani et al. (2022) and Faria-e Castro (2021). Cardani et al. (2022) employ an estimated DSGE model to analyze the economic impact of the COVID-19 crisis on the euro area. To address the estimation challenges posed by the size of the COVID-19 shock, they employ a heteroskedastic Kalman filter. Their findings highlight the "forced-savings" shock as the primary driver of GDP dynamics in the euro area during 2020–2021. Building on their insights, we incorporate a similar forced-savings shock in our model, treating it as a representation of the COVID-19 shock. Faria-e Castro (2021) model the COVID-19 shock as a shock to the utility derived from consuming services. The magnitude of this shock is calibrated to match the observed unemployment rate in the United States during 2020, while accounting for the effects of government policy interventions. We adopt a similar calibration strategy to determine the size of the forced-savings shock in our model and to quantify the macroeconomic impact of the pandemic.

Within the framework of the reduced-form approach, our paper contributes to a specific strand of the literature that employs calibrated macroeconomic models to examine the effects of the pandemic

[2]The literature on COVID-19 has expanded rapidly and is now extensive. See Brodeur et al. (2021) for a comprehensive survey of the early research on the pandemic.

support policies. These studies primarily focus on evaluating the impact of fiscal stimulus measures. For example, Faria-e Castro (2021) uses a two-agent New Keynesian (TANK) model calibrated to the U.S. economy to assess the effectiveness of various fiscal policy instruments in mitigating the economic impact of the pandemic. His analysis shows that increasing government transfers—particularly unemployment benefits—is the most effective tool among the instruments considered for stabilizing household income. Di Pietro et al. (2020) conduct a comparable analysis, focusing on the Italian economy. Bayer et al. (2023) employ a medium-scale heterogeneous agent New Keynesian (HANK) model to examine the effects of fiscal transfers, finding that such transfers help mitigate the inequality generated by the COVID-19 shock. Several other studies explore the implications of policy interactions. For analyses of the interaction between fiscal and monetary policy—both conventional and unconventional—see Bhattarai et al. (2023), Wu and Xie (2025), and Bianchi et al. (2020), among others. For the trade-off between transfer and credit policies, see Bigio et al. (2020). However, none of the aforementioned studies explicitly examine the role of pandemic support policies in driving significant increases in household debt and housing prices. Our paper aims to fill this gap in the literature.

With respect to the model framework, our paper builds on Turdaliev and Zhang (2019), who develop a medium-scale DSGE model of a small open economy to study the effects of monetary and macroprudential policies on household debt in the Canadian context. The model in Turdaliev and Zhang (2019) draws on two distinct strands of the literature. The first strand originates from the work of Iacoviello (2005) and Iacoviello and Neri (2010), and has been widely applied in the study of housing markets using DSGE models (e.g., Justiniano et al., 2015, Alpanda and Zubairy, 2016). In this literature, housing is modeled as collateral for household borrowing, which implies that fluctuations in house prices have amplified effects on other key macroeconomic variables due to the presence of collateral constraints. The second strand relates to the literature on financial frictions in the banking sector, particularly as developed by Gertler and Karadi (2011) and Gertler and Kiyotaki (2010), which incorporates banking dynamics and lending constraints into macroeconomic models. Our paper extends beyond Turdaliev and Zhang (2019) by incorporating several additional features to account for pandemic-related policies. We explicitly model government borrowing and transfers rather than assuming a balanced budget constraint, include a credit policy component, and introduce a zero lower bound constraint on monetary policy—all features absent in Turdaliev and Zhang (2019).

Our paper contributes to the growing literature that examines the impact of COVID-19 and the associated macroeconomic policy responses on the Canadian economy. Within this literature, Lemieux et al. (2020) and Jones et al. (2021) adopt empirical approaches to study the Canadian labor market during the pandemic, while Moran et al. (2022) construct the first Canadian microeconomic uncertainty index related to COVID-19 and use vector autoregressions (VARs) to assess its effects on GDP and inflation. In a different approach, MacGee et al. (2022) employ an agent-based model to analyze household balance sheets, highlighting the accumulation of excess savings among highincome households and the effectiveness of government transfers in providing substantial income replacement for low-income households during the pandemic. To our knowledge, our paper is the first study to use a quantitative DSGE model to analyze the impact of COVID-19 support policies on household debt and housing price dynamics in the Canadian economy.

The remainder of the paper is organized as follows. Section 2 provides background on the impact of the pandemic on the Canadian economy and the related support policies. Section 3 presents the model. Section 4 outlines the calibration strategy and explains how we measure the pandemic shock and its effects on the economy. Section 5 analyzes the roles of fiscal, credit, and monetary policies in shaping macroeconomic outcomes, with a particular focus on household debt and housing prices. Section 6 concludes.

2 Background

2.1 Pandemic impact

Figure 1 illustrates the percentage changes in key macro variables from 2020Q1 to 2022Q2, with 2020Q1 serving as the reference quarter due to its proximity to the onset of the pandemic. Panel 1 reveals an 11 percent decline in real GDP during 2020Q2 relative to the level in 2020Q1. Panel 2 depicts an even sharper drop in real consumption, which fell by 14 percent over the same period. The contraction in economic activity led to a decline in the annual inflation rate, measured by the Consumer Price Index (CPI), from approximately 2 percent to zero, raising concerns about deflation in the Canadian economy (panel 3). In contrast, the housing market experienced a notable boom during the same period, as highlighted in panels 4-6. Panel 4 of Figure 1 demonstrates that the mortgage rates fell during the pandemic. Additionally, mortgage debt increased by 14 percent by 2022Q2, while the rise in housing prices outpaced this growth, with the housing price index climbing by 21 percent over the same period.

2.2 Pandemic support policies

To mitigate the adverse economic effects of COVID-19, the Canadian government launched various programs to support households and businesses. The scale of the stimulus package was unprecedented, amounting to approximately 9 percent of the GDP in 2020. In this section, our emphasis is on the main policy channels that directly influence household income and borrowing conditions. Figure 2 illustrates these policies from 2020Q1 to 2022Q2.

2.2.1 Fiscal policy

The Canadian government implemented a broad range of programs to provide support to households during the COVID-19 lockdown. From 2020Q2, several pandemic-related initiatives were introduced to assist individuals – including workers, students, families, seniors, and vulnerable groups. Similarly, businesses of all sizes, including small, medium, and large enterprises, as well as those in hard-hit sectors, received government support. Specifically, measures aimed at individuals included the Canada Emergency Response Benefit (CERB), which provided support to workers who lost their jobs due to COVID-19; the Canada Emergency Student Benefit (CESB) for students; and additional income support programs for families with children, seniors, and vulnerable populations. For businesses, key initiatives included the Canada Emergency Wage Subsidies (CEWS) and other related programs, designed to help employers retain workers and manage operating costs. Consequently, during the pandemic, there was a substantial increase in social benefits, as indicated by the Statement of Government Operations and Balance Sheet. The average Social Benefits to GDP ratio stood at 1 percent before the onset of COVID. As depicted in the first panel of Figure 2, total support provided to households more than doubled between 2020Q1 and 2020Q2, rising from 1.5 percent of GDP to approximately 4.6 percent.

2.2.2 Monetary and credit policies – policy rate and asset purchases

To bolster the economy, the Bank of Canada (BoC) responded swiftly on two fronts. First, it reduced the overnight rate by 150 basis points to the effective lower bound of 0.25%. This policy rate remained at the Zero Lower Bound (ZLB) for the subsequent seven quarters, through 2021Q4 (as shown in panel 2 of Figure 2). Second, the Bank implemented a number of asset purchasing programs to support financial market functioning and lower long-term interest rates. These programs involved acquisition of a range of assets, including long-term Government of Canada bonds, corporate bonds, mortgage bonds, commercial paper, and provincial bonds. This objective was to boost asset prices, therefore lowering borrowing costs for households and businesses.[3] This paper primarily focuses on the Canada Mortgage Bond Purchase Program (CMBP). Launched by the Bank of Canada on March 16, 2020, and active for approximately six months, the program aimed to stabilize the housing market and maintain low borrowing costs for households. Under the CMBP, the BoC purchased Canada Mortgage Bonds (CMBs) from primary dealers in the secondary market. The total purchase amounted to CAD 8 billion, with CAD 6 billion acquired between March and June and additional CAD 2 billion between July and October. The program concluded in October 2020. The panel 3 of Figure 2 depicts the share of total CMBs outstanding that the Bank acquired through the program, based on a total CMB stock of approximately $170 billion in 2020.

3 The Model

The model is adapted from Turdaliev and Zhang (2019). Consider a discrete time, infinite-horizon economy populated by multiple agents: households, goods producers (wholesalers and retailers), capital producers, house producers, financial intermediaries, and both monetary and fiscal authorities. Households are heterogeneous in their time preferences. Patient households act as

[3] During the pandemic, the Bank of Canada established the following seven asset purchase programs: Bankers' Acceptance Purchase Facility (BAPF), Canada Mortgage Bond Purchase Program (CMBP), Corporate Bond Purchase Program (CBPP), Commercial Paper Purchase Program (CPPP), Government of Canada Bond Purchase Program (GBPP), Provincial Bond Purchase Program (PBPP), and Provincial Money Market Purchase Program (PMMP).

savers, while impatient ones function as borrowers. During the COVID-19 pandemic, both types of households experience a forced-savings shock, resulting in a substantial reduction in their demand for consumption goods. Savers are not financially constrained and subject to taxation. In contrast, borrowers, representing the impatient households, face financial constraints and are the recipients of transfers during the pandemic.

Banks, acting as financial intermediaries, collect deposits from patient households (savers) and extend loans to both firms and impatient households. The asset portfolio of banks includes business loans—claims on capital issued by firms—and mortgage loans—claims on housing collateral provided by households. During the pandemic, a portion of these financial assets is acquired by the monetary authority. Firms use the loans obtained from banks to purchase capital, which is supplied by capital producers. Wholesale goods are produced using both capital and labor sourced from households. These goods are then sold to retailers, who transform them into final consumption products. The monetary authority sets the nominal interest rate according to a Taylor rule, while the fiscal authority finances government expenditures and transfers through a combination of taxation on patient households and the issuance of government debt.

Given that the model incorporates many standard features of a DSGE framework, we focus below on the components most relevant for analyzing the impact of the pandemic—specifically, the behaviors of households, banks, and the monetary and fiscal authorities. A detailed description of the production side of the economy, including the wholesale and retail sectors, capital and house producers, as well as importers and exporters, is provided in Appendix 1.

3.1 Households

Households are infinitely lived and have a total measure of one. There are two types of households — patient and impatient — who differ only in their intertemporal discount rates. Patient households, denoted by p constitute a share α of the population, while impatient households, denoted by ip, make up the remaining share $1-\alpha$. The discount factors for patient and impatient households are β_p and β_{ip}, respectively, with $\beta_p > \beta_{ip}$. Because impatient households place less weight on future utility, they act as borrowers, whereas patient households, being more future-oriented, serve as lenders. Financial intermediaries (banks) collect deposits from patient households and extend credit to both impatient households and firms.

As stated earlier, in the literature, the pandemic is typically modeled in one of two ways. One approach combines an epidemiological model with a DSGE framework, allowing for the explicit modeling of infection dynamics. The alternative is a reduced-form approach, in which the pandemic is represented as an exogenous shock. For instance, Faria-e Castro (2021) model the pandemic as a shock to the marginal utility of consumption, while Cardani et al. (2022) introduce a forced-savings shock to capture the effects of the pandemic. In this paper, we follow the latter approach and adopt the forced-savings shock framework of Cardani et al. (2022), assuming that both savers and borrowers experience a substantial forced-savings shock during the pandemic period.

3.1.1 Patient households

A patient household maximizes expected lifetime utility given by

$$E_0 \sum_{t=0}^{\infty} \beta_p^t \left[\log\left((c_{p,t} - \varepsilon_t^{fs}) - b(c_{p,t-1} - \varepsilon_{t-1}^{fs}) \right) + \varkappa \log h_{p,t} - \psi \frac{l_{p,t}^{1+\eta}}{1+\eta} \right], \tag{1}$$

where $c_{p,t}$ denotes consumption of non-durable goods by patient households, and b is the habit persistence parameter. The variable $h_{p,t}$ represents the stock of housing held at the end of period t, and $l_{p,t}$ denotes hours worked. The parameters $\varkappa$ and ψ govern preferences for housing services and disutility from labor, respectively. The parameter η is the inverse of the Frisch elasticity of labor supply. Following Cardani et al. (2022), we use ε_t^{fs}—the forced-savings shock—to represent the pandemic shock. We assume that $\varepsilon_t^{fs} = 0$ prior to the COVID-19 pandemic, and that a negative value of ε_t^{fs} reflects a reduction in consumption demand.[4] The key distinction between a forced-savings shock and a standard consumption demand shock lies in their interaction with habit formation. In the case of a standard demand shock, habit persistence generates a hump-shaped consumption response, causing the effects of the shock to persist even after it has subsided. In contrast, the forced-savings shock operates outside the habit channel—its impact on consumption dissipates as soon as the shock itself vanishes. Therefore, once the pandemic ends, consumption is expected to return to its pre-shock level immediately. This feature makes the forced-savings shock a more suitable device for capturing the transitory, policy-induced suppression of consumption observed during the COVID-19 pandemic.

The stock of housing evolves according to

$$h_{p,t} = (1-\delta^h) h_{p,t-1} + i_{p,t}^h, \tag{2}$$

where δ^h is the depreciation rate of the housing stock, and $i_{p,t}^h$ denotes residential investment (i.e., new housing construction).

The patient household faces the following nominal budget constraint:

$$P_t c_{p,t} + P_t^h i_{p,t}^h + D_t + B_t + D_t^* e_t \leq W_{p,t} l_{p,t} + R_{t-1} D_{t-1} + R_{t-1} B_{t-1} + D_{t-1}^* R_{t-1}^* \iota_{t-1} e_t - T_t + P_t \Pi_t, \tag{3}$$

where P_t and P_t^h are the prices of consumption goods and houses, respectively. D_t is the amount of domestic deposits, B_t denotes holdings of government bonds, and D_t^* represents holdings of foreign bonds. The variable e_t is the nominal exchange rate. R_t and $W_{p,t}$ denote the nominal interest rate and the nominal wage, respectively. R_{t-1}^* is the foreign nominal interest rate, and ι_{t-1} is the country-specific risk premium. As in Iacoviello (2005), only patient households pay taxes T_t.

[4] To understand how the forced-savings shock works, consider a simpler case where $b = 0$, and a negative forced-savings shock with $\varepsilon_t^{fs} = -\omega$, where $\omega > 0$. With the shock, the utility derived from consumption $c_{p,t}$ is given by $log(c_{p,t} + \omega)$, which is larger than $log(c_{p,t})$, the utility when the shock is absent. In other words, with a negative forced-savings shock, households can attain the same level of utility with a lower quantity of actual consumption, thereby enabling them to save more.

They also receive profits Π_t, which primarily consist of the profits from the retail sector.[5] Following Schmitt-Grohé and Uribe (2003), the risk premium ι_t is modeled as a decreasing function of the net foreign asset position relative to GDP:

$$\iota_t = \exp\left(-\upsilon \frac{e_t D_t^*}{P_t y_t}\right), \tag{4}$$

where $\upsilon > 0$ and y_t denotes real GDP. Define $q_t = \frac{P_t^h}{P_t}$, $f_t = \frac{e_t P_t^*}{P_t}$ (the real exchange rate), $w_{p,t} = \frac{W_{p,t}}{P_t}$, $t_t = \frac{T_t}{P_t}$, $d_t = \frac{D_t}{P_t}$, $b_t = \frac{B_t}{P_t}$, $d_t^* = \frac{D_t^*}{P_t^*}$ and $\pi_t = P_t/P_{t-1}$. We obtain the budget constraint in real terms:

$$c_{p,t} + q_t i_{p,t}^h + d_t + b_t + d_t^* f_t \leq w_{p,t} l_{p,t} + R_{t-1}\frac{d_{t-1}}{\pi_t} + R_{t-1}\frac{b_{t-1}}{\pi_t} + R_{t-1}^*\frac{d_{t-1}^*\iota_{t-1}}{\pi_t^*} f_t - t_t + \Pi_t. \tag{5}$$

Households maximize their lifetime utility given in equation (1), subject to the constraints (2) and (5).

3.1.2 Impatient households

We assume that impatient households are also subject to the forced-savings shock ε_t^{fs}. They maximize expected lifetime utility:

$$E_0 \sum_{t=0}^{\infty} \beta_{ip}^t \left[\log\left((c_{ip,t} - \varepsilon_t^{fs}) - b(c_{ip,t-1} - \varepsilon_{t-1}^{fs})\right) + \varkappa \log h_{ip,t} - \psi \frac{l_{ip,t}^{1+\eta}}{1+\eta}\right], \tag{6}$$

subject to the housing accumulation equation:

$$h_{ip,t} = (1-\delta^h) h_{ip,t-1} + i_{ip,t}^h. \tag{7}$$

Impatient households borrow $\mathcal{L}_t$ from financial intermediaries at a gross interest rate denoted by R_{t-1}^ℓ. Unlike patient households, they also receive government transfers Tr_t, which we will calibrate using a series of exogenous shocks such that the model-generated Tr_t matches the data (shown in panel 1 of Figure 2).

Their nominal budget constraint is given by:

$$P_t c_{ip,t} + P_t^h i_{ip,t}^h + R_{t-1}^\ell \mathcal{L}_{t-1} \leq W_{ip,t} l_{ip,t} + \mathcal{L}_t + Tr_t. \tag{8}$$

Following Iacoviello (2015), the borrowing constraint faced by impatient households is given by:

$$\mathcal{L}_t \leq \rho^\ell \mathcal{L}_{t-1} + (1-\rho^\ell) E_t\left(\frac{\theta P_{t+1}^h h_{ip,t}(1-\delta^h)}{R_t^\ell}\right), \tag{9}$$

[5]Profits also include the net value of assets transferred from exiting to entering bankers, as will be described in Section 3.2.1.

where $\rho^\ell \in [0,1]$ captures inertia in the borrowing constraint, and θ is the loan-to-value (LTV) ratio. Equation (9) can be interpreted as a reduced-form way to model long-term debt. When $\rho^\ell = 0$, the borrowing constraint reduces to the standard collateral constraint, in which the maximum amount an impatient household can borrow is a fraction θ of their housing wealth, given by $P^h_{t+1} h_{ip,t}(1-\delta^h)$. When $\rho^\ell > 0$, the constraint implies that only a portion of mortgage loans is subject to the collateral requirement. This reflects the realistic feature that, in each period, only a fraction of loans are either newly issued or renegotiated, consistent with the presence of long-term mortgage contracts.

Similar to the previous section, Equations (8) and (9) can be expressed in real terms as follows:

$$c_{ip,t} + q_t i^h_{ip,t} + R^\ell_{t-1} \frac{\ell_{t-1}}{\pi_t} \leq w_{ip,t} l_{ip,t} + \ell_t + tr_t, \tag{10}$$

and

$$\ell_t \leq \rho^\ell \frac{\ell_{t-1}}{\pi_t} + (1-\rho^\ell) E_t \left(\frac{\theta q_{t+1} \pi_{t+1} h_{ip,t}(1-\delta^h)}{R^\ell_t} \right), \tag{11}$$

where $\ell_t = \mathcal{L}_t / P_t$, $w_{ip,t} = W_{ip,t}/P_t$, and $tr_t = \frac{Tr_t}{P_t}$. The impatient households maximize their lifetime utility given in equation (6), subject to the constraints (7), 10 and (11).

3.2 Financial intermediaries

3.2.1 Banks' problem

Financial frictions in the banking sector are modeled following the framework developed by Gertler and Kiyotaki (2010) and Gertler and Karadi (2011). At the beginning of period t, each financial intermediary (bank) holds net worth n_t. The bank issues deposits $d^b_t = \alpha d_t$ to patient households and uses these deposits, together with its own net worth n_t, to finance two types of lending: capital acquisition by intermediate goods producers and mortgage loans to impatient households. Specifically, as described in the Appendix, firms issue capital claims s^k_t at price q^k_t in order to finance investment. The real return on these capital claims is denoted by R^k_t. Banks purchase these claims from firms and, in addition, they extend mortgage loans $\ell^b_t = (1-\alpha)\ell_t$ to impatient households. Thus, at the beginning of period t, the total assets held by the bank are given by:

$$\begin{aligned} a_t &= q^k_t s^k_t + \ell^b_t \\ &= d^b_t + n_t. \end{aligned} \tag{12}$$

Following Gertler and Kiyotaki (2010) and Gertler and Karadi (2011), we assume the presence of a moral hazard problem: at the end of each period t, the bank has the option to divert a fraction κ of its assets for personal use. However, doing so incurs the cost of being forced into bankruptcy at the beginning of the following period. To ensure that patient households are willing to deposit funds, the bank must satisfy the following incentive compatibility constraint:

$$V_t \geq \kappa a_t, \tag{13}$$

where V_t denotes the continuation value of the bank at the end of period t.

Equation (13) implies the existence of a threshold level of deposits: if the deposits received by banks exceed this threshold, banks would have an incentive to divert funds for personal use. As a result, patient households will never deposit more than this threshold amount. This limitation on deposit financing introduces an endogenous constraint on leverage; the latter is defined as follows:

$$\phi_t = \frac{a_t}{n_t}. \tag{14}$$

Furthermore, the deposit constraint generates a wedge between the lending and deposit rates, giving rise to an endogenous interest rate spread. The bank's net worth evolves according to:

$$n_{t+1} = \left(R_t^k - \frac{R_t}{\pi_{t+1}} \right) q_t^k s_t^k + \left(\frac{R_t^\ell}{\pi_{t+1}} - \frac{R_t}{\pi_{t+1}} \right) \ell_t^b + \frac{R_t}{\pi_{t+1}} n_t, \tag{15}$$

where the first term represents the return on capital claims net of the deposit rate, the second term captures the excess return on mortgage lending over the deposit rate, and the third term is the return on the bank's own net worth. The expressions $R_t^k - \frac{R_t}{\pi_{t+1}}$ and $\frac{R_t^\ell}{\pi_{t+1}} - \frac{R_t}{\pi_{t+1}}$ are the real interest rate spreads on capital and mortgage lending, respectively.

As is standard in this class of models, bankers have a finite expected lifetime. In each period, a banker survives with probability σ, and exits with probability $1 - \sigma$. Upon exit, the banker hands over their accumulated net worth to patient households.[6] Given this structure, the objective function of the banker is:

$$V_t = E_t \sum_{i=1}^{\infty} \left[\beta_p^i \Lambda_{t,t+i} (1 - \sigma) \sigma^{i-1} n_{t+i} \right], \tag{16}$$

which can be expressed recursively as:

$$V_t = E_t \left[\beta_p \Lambda_{t,t+1} (1 - \sigma) n_{t+1} + \beta_p \Lambda_{t,t+1} \sigma V_{t+1} \right], \tag{17}$$

where $\Lambda_{t,t+i}$ denotes the stochastic discount factor between periods t and $t+i$, and β_p is the discount factor of patient households.

The bank's problem is to choose s_t^k and ℓ_t^b in order to maximize (17), subject to the following constraints: (i) the incentive constraint (13); (ii) the balance sheet identity (flow of funds constraint) (12); and (iii) the law of motion for net worth (15). Further, we define R_t^A as the weighted average return on total bank assets $R_t^A = R_t^k \frac{q_t^k s_t^k}{a_t} + \frac{R_t^\ell}{\pi_{t+1}} \frac{\ell_t^b}{a_t}$ and s_t^A as the weighed excess return (or spread) over the deposit rate $s_t^A = R_t^A - \frac{R_t}{\pi_{t+1}}$.

[6] Patient households receive the assets of exiting bankers and transfer a fraction of these assets, ω^b, to newly entering bankers.

3.2.2 Credit Policy

Following Gertler and Karadi (2011), we model the Canada Mortgage Bond Purchase (CMBP) program as an increase in the financial intermediaries' asset holdings due to purchases by the central bank. Let a_t^g denote the central bank's asset injection under the CMBP. To distinguish this from private-sector assets discussed earlier, we label those as a_t^p. The key distinction between these two types of assets is that a_t^g is not subject to the leverage constraint, while a_t^p is. Let ε_t^ψ denote the fraction of total bank assets funded by the central bank's purchases. Then, total assets held by financial intermediaries can be expressed as:

$$a_t^{\text{total}} = a_t^g + a_t^p = \varepsilon_t^\psi a_t^{\text{total}} + \phi_t n_t, \tag{18}$$

where $\phi_t n_t$ represents the leverage-constrained portion of assets financed with the bank's own net worth, and $\varepsilon_t^\psi a_t^{\text{total}}$ captures the unconstrained portion stemming from central bank intervention. Solving for a_t^{total}, we obtain:

$$a_t^{\text{total}} = \frac{\phi_t}{1-\varepsilon_t^\psi} n_t, \tag{19}$$

which shows how central bank purchases relax the leverage constraint by effectively increasing the total asset holdings without raising the required net worth proportionally. Define the "effective leverage ratio" ϕ_{ct} as the ratio of total assets held by financial intermediaries to their net worth:

$$\phi_{ct} = \frac{a_t^{\text{total}}}{n_t}. \tag{20}$$

Using the expression for total assets derived earlier, we can show that:

$$\phi_{ct} = \frac{1}{1-\varepsilon_t^\psi}\phi_t, \tag{21}$$

where ϕ_t is the leverage ratio associated with privately held, leverage-constrained assets, and ε_t^ψ denotes the fraction of assets financed by central bank purchases. We refer to ε_t^ψ as a "credit shock", since it captures the exogenous easing of financial constraints through government intervention. Later in the analysis, we will assign a sequence of values to ε_t^ψ so that the model-implied ratio of government-purchased assets to total bank assets matches the data, as shown in panel 3 of Figure 2. As in Gertler and Karadi (2011), we also assume that government intervention through the purchase of mortgage bonds entails an efficiency cost. Specifically, the cost is proportional to the volume of assets purchased, with a per-unit cost of τ. The total cost of intervention is given by $\tau\varepsilon_t^\psi a_t^{\text{total}}$. This cost is incorporated into the government budget constraint.

3.3 Government

The government purchases public goods G_t, provides transfers Tr_t to impatient households, services outstanding debt B_{t-1}, and incurs an efficiency cost associated with the asset purchase program, given by $\tau\varepsilon_t^{\psi}P_t a_t^{\text{total}}$. These expenditures are financed through lump-sum taxes T_t and the issuance of new government bonds B_t. The nominal government budget constraint is thus given by:

$$G_t + R_{t-1}B_{t-1} + Tr_t + \tau\varepsilon_t^{\psi}P_t a_t^{\text{total}} = T_t + B_t. \tag{22}$$

Following Leeper et al. (2010), we assume that taxes adjust to ensure long-run government solvency. That is, lump-sum taxes follow the rule:

$$T_t = \left(\frac{B_{t-1}}{B_{ss}}\right)^{\phi^{tax}} T_{ss}, \quad \text{with } \phi^{tax} > 0, \tag{23}$$

where B_{ss} and T_{ss} denote the steady-state levels of debt and taxes, and ϕ^{tax} governs the speed of fiscal adjustment.

Converting the budget constraint into real terms and accounting for the fact that only patient households purchase bonds and pay taxes, while only impatient households receive transfers, we obtain:

$$g_t + \alpha\frac{R_{t-1}b_{t-1}}{\pi_t} + (1-\alpha)tr_t + \tau\varepsilon_t^{\psi}a_t^{\text{total}} = \alpha t_t + \alpha b_t, \tag{24}$$

where $g_t = G_t/P_t$.

3.4 Monetary Policy

The central bank is assumed to follow a standard Taylor rule, subject to the zero lower bound (ZLB). Specifically, the central bank adjusts the nominal interest rate R_t in response to deviations of inflation π_t from its steady-state value π, and deviations of output $y_{c,t}$ (final consumption goods) from its steady-state level y_c:

$$\frac{R_t}{R} = \max\left(\frac{1}{R}, \left(\frac{R_{t-1}}{R}\right)^{\rho_r}\left[\left(\frac{\pi_t}{\pi}\right)^{\rho_\pi}\left(\frac{y_{c,t}}{y_c}\right)^{\rho_y}\right]^{1-\rho_r}\right), \tag{25}$$

where R, π, and y_c denote the steady-state values of the nominal interest rate, inflation, and output, respectively. The parameters ρ_π and ρ_y are the policy response coefficients to inflation and output, while ρ_r captures the degree of interest rate smoothing.

3.5 Resource constraints

The following market clearing conditions hold.

The goods market clears:

$$\alpha c_{p,t} + (1-\alpha)c_{ip,t} + g_t + \alpha i^h_{p,t} + (1-\alpha)i^h_{ip,t} + i^k_t + 0.5\chi^k(\frac{i^k_t}{i^k_{t-1}} - 1)^2 + 0.5\chi^h(\frac{i^h_t}{i^h_{t-1}} - 1)^2 = y_{c,t}, \quad (26)$$

and the housing market clears:

$$(1-\alpha)h_{ip,t} + \alpha h_{p,t} = h_t. \quad (27)$$

Further, the following current account condition holds

$$d^*_t f_t = R^*_{t-1}\frac{d^*_{t-1}\iota_{t-1}}{\pi^*_t} f_t + y^e_t - f_t\, y^f_t, \quad (28)$$

where y^e_t and y^f_t are the exported and imported goods, respectively, and f_t is real exchange rate.[7]

4 Calibration

In this section, we use the model to analyze the impact of the COVID-19 pandemic on the aggregate economy, with a particular focus on the housing market. As described in the previous section, we represent the pandemic as a forced-savings shock. Since the magnitude of the shock must be large in order to replicate the observed declines in output and consumption, the standard linearization approach is not appropriate for this analysis. Instead, we study the nonlinear perfect foresight paths of the model.

4.1 Calibrated parameters

The calibrated parameters are listed in Table 1. The calibration is guided by Turdaliev and Zhang (2019), although some parameter values differ due to differences in steady-state assumptions. In our model, the steady-state values are set to match either the actual values observed in 2020Q1—just prior to the onset of the pandemic—or the average levels in 2019. In contrast, the calibration in Turdaliev and Zhang (2019) is based on averages from the 1991–2015 period. Details on the data sources and construction are provided in the Appendix.

For the household sector, the discount factor for patient households is set to 0.9958, which implies an annualized steady-state deposit rate R_t of 1.68 percent—corresponding to the average policy rate in 2020Q1. The discount factor for impatient households is set to a lower value of 0.9825, reflecting their higher rate of time preference. In the literature, the share of impatient households is often calibrated using data on liquidity-constrained households. Hall (2011) and Justiniano et al. (2015), using U.S. Survey of Consumer Finances (SCF) data, suggest that the fraction of liquidity-constrained households lies between 0.6 and 0.75. Given the limited empirical evidence for Canada, we set α, the share of patient households, to 0.4—implying that 60 percent of households are impatient. This calibration is consistent with the range suggested by the two

[7] See details in Appendix.

U.S.-based studies. The habit persistence parameter for both types of households is set to 0.85, consistent with the estimates in Turdaliev and Zhang (2019) and Justiniano et al. (2011). The weight on leisure, ψ, is set to 1, as this parameter primarily affects the scale of the economy but not its dynamics. Following Turdaliev and Zhang (2019), we set $\eta = 1.01$, which implies a Frisch elasticity of labor supply close to 1—a compromise between the higher values (2–4) commonly used in the macroeconomic literature and the lower values (0–0.5) suggested by microeconomic studies. The housing preference parameter $\varkappa$ is set to 0.25, and the depreciation rate of housing δ^h is set to 0.010. These values are chosen to match the average ratio of the market value of housing stock to annual GDP, which was approximately 1.06 based on 2019 data. In Canada, mortgage loan insurance is required if the down payment is less than 20%. With mortgage insurance, households can attain a higher loan-to-value (LTV) ratio—borrowing up to 95% of the house purchase price. In this paper, we set the loan-to-value ratio θ to 0.85, which lies between the lower bound of 80% (typical for uninsured mortgages) and the upper bound of 95% (with insurance). We set the persistence parameter for mortgage loans, ρ^l, to 0.95, following Turdaliev and Zhang (2019), reflecting the fact that most mortgage contracts in Canada are renegotiated every five years.

We follow the seminal work of Gertler and Karadi (2011) to calibrate the following three parameters related to financial intermediaries. The weighted average diversion rate κ is set to 0.55; the survival rate of banks σ is set to 0.972; and the proportional transfer to newly entered banks ω^b is chosen to match three steady-state targets: an annualized risk premium of 155 basis points, an average bank leverage ratio of 6.2, and an average bank life horizon of 10 years. The annualized risk premium is computed as the difference between the weighted average of interest rates on business and mortgage loans and the Bank of Canada's policy rate in 2019. The average leverage ratio is calculated as the ratio of total assets to net worth for Chartered Canadian banks.

For the parameters related to production, we set the capital depreciation rate δ to 0.025, the capital share γ to 0.33, the elasticity of substitution between domestically produced goods ϵ to 11, and the probability that the goods price remains unchanged ν to 0.75. These values are commonly used in the literature. The parameters governing adjustment costs for business investment and housing investment, χ^i and χ^h, are set to 10.63 and 30, respectively, following the estimates in Turdaliev and Zhang (2019). The wage share of patient households in the production sector, α^w, is set to 0.5, which is close to the value used in Iacoviello (2005). We also set the share of domestically produced goods ω^d to 0.8 and the elasticity of substitution between sectoral goods ζ to 0.8, as in Turdaliev and Zhang (2019).

For the government sector, we set the government spending-to-GDP ratio, G_t/Y_t, to 0.2 and the government debt-to-annual-GDP ratio to 0.3. Both values are based on 2019 data. The speed of adjustment for lump-sum taxes, ϕ^{tax}, is set to 0.1, which falls within the range suggested by Leeper et al. (2010). The credit policy cost parameter τ is set to a small number, 0.001, similar to Gertler and Karadi (2011). The parameters governing the Taylor rule—ρ^π, ρ^y, and ρ^r—are set to 2.96, 0.06, and 0.58, respectively, following the estimates in Turdaliev and Zhang (2019).

4.2 Measuring the pandemic shock and its effects

To quantify the forced-savings (pandemic) shock, we proceed as follows. We assume that the significant decline in consumption between 2020Q2 and 2021Q2 was driven entirely by the forced-savings shock. Beyond 2021Q2, this shock is no longer considered the main factor affecting consumption dynamics, and by the end of 2022Q2—following widespread vaccination—it is assumed to have fully dissipated. We then estimate a time series of forced-savings shocks such that the model-simulated consumption path matches the observed data over 2020Q2–2021Q2. This approach, however, faces an identification challenge. As discussed in the previous section, this period coincided with a substantial increase in social benefits due to a range of pandemic-related fiscal programs implemented by the Government of Canada. In addition, the Canada Mortgage Bond Purchase (CMBP) program was in place from 2020Q2 to 2020Q4. These policy measures likely mitigated the decline in consumption that would otherwise have resulted from the pandemic. Consequently, the observed consumption path reflects the joint effect of forced-savings behavior and government support programs, complicating direct inference about the magnitude of the former shock.

To address this simultaneity problem, we follow the approach of Faria-e Castro (2021). In particular, we first calibrate sequences of transfer and credit shocks such that (i) the model's transfer-to-GDP ratio matches the empirical ratio of social benefits to GDP (panel 1 of Figure 2), and (ii) the model-implied ratio of government-purchased assets to total bank assets matches the data (panel 3 of Figure 2). Conditional on these policy shock sequences, we then estimate the series of forced-savings shocks that allows the model to replicate the observed consumption dynamics.

The estimated paths for consumption and the forced-savings shock are shown in Figure 3. Because the model targets the five-quarter window from 2020Q2 to 2021Q2, the model-generated consumption path closely mimics the data over this period. Beyond 2021Q2, the two series diverge, reflecting that the forced-savings shock is no longer the primary driver of consumption dynamics. The estimated shock is largest in 2020Q2 at -0.072. As discussed in Section 3, a negative forced-savings shock reduces desired consumption. For illustration, consider patient households: with a steady-state consumption level of 0.50, a shock of -0.072 implies a reduction of approximately (14.4%) in desired consumption. The shock applies equally to patient and impatient households; however, because impatient households consume less in steady state, the same absolute shock produces a larger proportional decline in their consumption, leading to a greater overall reduction for this group.

Figure 4 illustrates our baseline senario – the effects of the forced-savings shock on the aggregate economy. Overall, the shock reduces aggregate consumption by approximately 14%, lowers GDP by over 7%, triggers deflation, and causes the policy rate to hit the zero lower bound (ZLB) for four consecutive quarters. To better understand the responses of aggregate variables, below we examine the impulse responses of the two household types, firms, and financial intermediaries.

In the first quarter of 2020, consumption by patient and impatient households declines by about 12% and 15%, respectively. The weakened consumption demand leads to reductions in both hours worked and wages for both household types. For patient households, the fall in consumption demand induces an increase in savings (*HH Deposits*) and housing demand (*Housing Savers*). In contrast, for impatient households, housing demand (*Housing Borrowers*) initially falls due to the loss of labor income but subsequently rises. This recovery is driven by a decline in borrowing costs, which encourages impatient households to take on more debt. Both household debt and housing prices rise, although the magnitude of the increase is smaller than what is observed in the data. To understand the decline in borrowing costs (i.e., the mortgage rate) during the pandemic, we turn to the banking sector. The surge in household deposits resulting from the forced-savings shock relaxes the incentive constraint faced by banks. Consequently, banks are less leveraged, leading to a narrowing of the spread and a decline in the mortgage rate.

5 The role of pandemic support policies

In this section, taking the estimated forced-savings shock as given, we examine how fiscal policy (social transfers), credit policy (CMBP), and monetary policy (extended ZLB) contributed to the rise in household debt and housing prices. Note that throughout the paper, savers refer to patient households and borrowers refer to impatient households.

5.1 Fiscal policy – social transfers

Figure 5 illustrates the effects of social transfers. The dashed red line represents the model dynamics when pandemic-related transfers are implemented, while the solid blue line shows the baseline case without transfers. The transfer shock used corresponds to the one described in the previous section. The first panel confirms that the level of transfers in the model aligns with the data. Overall, transfers lead to an increase in government debt. Aggregate consumption—defined as the weighted average of consumption by patient and impatient households—as well as output, rise modestly. Additionally, transfers help mitigate the decline in inflation and allow the policy rate to exit the ZLB slightly earlier than in the baseline scenario.

To understand these aggregate changes, we examine the responses of borrowers, savers, firms, and banks, as shown in the remaining panels of Figure 5. For impatient households, social transfers raise disposable income. However, this increase in income does not translate into a substantial rise in consumption, as consumption is primarily constrained by the forced-savings shock during the pandemic. As a result, the impact of transfers on consumption is limited. Instead, impatient households allocate a larger share of the transfers toward housing. The most pronounced response in the figure is the rise in household debt (i.e., *HH Horrowing*). This increase in borrowing strengthens banks' balance sheets, leading to a reduction in the mortgage spread – the difference between the mortgage rate and policy rate. The lower spread further encourages borrowing, reinforcing the rise in household debt.

For patient households, the issuance of new government debt requires them to absorb a larger share of bonds, which leads to a reduction in both their demand for housing (*Housing Savers*) and savings in the form of deposits (*HH Deposits*). Despite this, the increase in housing demand from impatient households dominates, resulting in a greater rise in housing prices under the transfer policy relative to the baseline case. The income effect from transfers has asymmetric implications for labor supply: patient households increase their labor supply, while impatient households reduce theirs. Consequently, the wage rate for patient households declines slightly, whereas the wage rate for impatient households increases. In terms of welfare, the transfer policy benefits borrowers while harming savers.

5.2 Credit policy – CMBP

Figure 6 presents the effects of the Canada Mortgage Bond Purchase Program (CMBP). The dashed red line corresponds to the credit policy scenario, while the solid blue line represents the baseline case. To capture the size of the CMBP intervention, we calibrate a sequence of credit shocks such that the model-generated path for central bank asset purchases matches the data shown in Figure 2. Since both CMBP and transfer policies are expansionary, the responses of many macroeconomic variables are qualitatively similar across the two cases. However, a notable difference is observed in the mortgage spread: under the CMBP scenario, the decline in the mortgage spread is substantially larger during the first two quarters of 2020. This is because the CMBP program was implemented during the first two quarters following the outbreak of COVID-19. During this period, the central bank's purchases of mortgage bonds raised bond prices, thereby strengthening the balance sheets of financial intermediaries. As a result, banks operating under the CMBP framework became less leveraged, which contributed to a significantly larger decline in the mortgage spread. The improved credit conditions stimulated greater borrowing by households, leading to a more pronounced increase in both housing prices and household debt (*HH Borrowing*) compared to the baseline scenario. Overall, the CMBP program helped mitigate the declines in consumption, output, and inflationary pressure—achieving these effects without adding to government debt.

5.3 Monetary policy – Extended ZLB

As shown in Figure 4, the sharp declines in output and inflation following the pandemic shock cause the policy rate, determined by the Taylor rule, to hit the zero lower bound (ZLB) and remain there for four consecutive quarters. In the data, however, the Bank of Canada kept the policy rate at the ZLB for a longer period—seven quarters—only beginning to raise rates in 2022Q1. What is the impact of this extended period at the ZLB on the aggregate economy, particularly the housing market? In what follows, we investigate the role of maintaining the policy rate at the ZLB for an extended duration in driving the post-pandemic rise in household debt and housing prices.

Figure 7 illustrates the effect of extending the zero lower bound (ZLB) policy by one additional quarter relative to the baseline scenario (shown in Panel 1). Under perfect foresight, agents anticipate that the policy rate will remain at the ZLB for five consecutive quarters and adjust their behavior accordingly. The expectation of prolonged low interest rates discourages patient households from saving, leading to a decline in deposits (*HH Deposits*). In contrast, borrowers—impatient households—respond to the extended period of low interest rates by increasing their demand for housing (*Housing Borrowers*). As a result, both housing prices and household debt (*HH Borrowing*) rise more significantly than in the baseline case, where the central bank strictly follows the Taylor rule and exits the ZLB after four quarters. These findings suggest that keeping the policy rate at the ZLB longer than warranted plays an important role in the post-pandemic boom in the housing market.

Figure 8 presents the effects of extending the policy rate at the zero lower bound (ZLB) for two additional quarters relative to the baseline case (shown in Panel 1). Compared to the results shown in Figures 7, the responses of many macroeconomic variables are significantly amplified. Both housing prices and household debt (*HH Borrowing*) rise further. Specifically, household debt increases by approximately 5 percent relative to its steady-state level (i.e., the 2020Q1 level) by 2022Q1, while housing prices rise by nearly 7 percent relative to their 2020Q1 level by the second quarter of 2020.[8]

5.4 Policy interactions

In this section, we use impulse response functions to examine the impact of the interaction among the three types of policies.

5.4.1 Transfers and CMBP

Figure 9 illustrates the responses of household debt and housing prices when both social transfers and the CMBP policy are implemented simultaneously (dash-dotted line). For comparison, the figure also displays the baseline, transfer-only, and credit-only cases. As discussed in the previous section, although the mechanisms underlying the transfer-only and credit-only cases differ, both policies lead to an increase in household debt and housing prices. Quantitatively, the increase is more pronounced in the transfer case, likely reflecting the difference in program scale: the CMBP lasted only two quarters, whereas transfers extended over nearly two years. Another notable distinction is that transfers generate a substantially larger welfare gain for impatient households (and a greater welfare loss for patient households) than the CMBP. Overall, the two policies are mutually reinforcing: the combined policy more effectively mitigates the adverse effects of the pandemic than either policy alone. While the policy rate remains at the zero lower bound (ZLB) for four quarters—consistent with the baseline—the central bank raises the rate more sharply upon exiting the ZLB in the combined case. Both household debt and housing prices rise further under joint fiscal and credit policy implementation, highlighting the amplification effects arising from their interaction.

[8]We also experimented with extending the ZLB period by an additional three quarters—bringing the total to seven quarters to match the data. However, in this case, we encountered difficulties in solving the model under perfect foresight.

5.4.2 Transfers and extended ZLB

What is the combined effect of social transfers and extending the ZLB by one additional quarter? Figure 10 presents the results. For comparison, the figure also includes the baseline, transfer-only, and extended ZLB-only scenarios. Consistent with the earlier findings for the transfer and CMBP cases, transfers generate a larger welfare impact—characterized by a decline for patient (saver) households and an increase for impatient (borrower) households—relative to the ZLB extension alone. Overall, the two policies are mutually reinforcing: the mortgage spread narrows further under their joint implementation, thereby improving credit conditions for households. Consequently, household debt rises by approximately 2 percent by 2022Q1, and housing prices increase by about 3 percent in 2020Q2, relative to their pre-pandemic (2020Q1) levels. Note that the increase in both household debt and housing prices exceeds that observed under the combined transfer and CMBP policy scenario.

5.4.3 CMBP and extended ZLB

Figure 11 presents the combined effects of the CMBP and an extension of the ZLB by one additional quarter. As in the previous case, household debt and housing prices increase more under the combined policy than under either policy in isolation. Comparing the two single-policy scenarios, the results suggest that credit policy alone has limited scope to further reduce the mortgage spread. As a result, extending the ZLB leads to a larger increase in both household debt and housing prices, indicating that interest rate policy has a stronger influence on aggregate outcomes than mortgage-backed bond purchases. Extending the ZLB also generates a larger welfare impact across households relative to the CMBP policy. Overall, under the combined scenario, household debt rises by approximately 1.5 percent by 2022Q1, and housing prices increase by about 2.5 percent in 2020Q2, relative to their 2020Q1 levels.

5.4.4 Transfers, CMBP and extended ZLB

In this scenario, we combine all three policies—social transfers, the CMBP, and an extension of the ZLB. Figure 12 presents the results. The key takeaway is that both housing prices and household debt increase further under the combined policy scenario. In particular, household debt rises by approximately 2.5 percent by 2022Q1, while housing prices increase by 2.7 percent in early 2020. We extend the analysis further by assuming the central bank maintains the policy rate at the ZLB for two additional quarters beyond the baseline. As shown in Figure 13, this additional extension significantly amplifies the responses of all variables. Household debt rises by about 6.5 percent by 2022Q1—roughly 45 percent of the total increase observed in the data. Housing prices also increase rapidly, reaching approximately 8 percent by 2020Q2—around 40 percent of the observed increase. However, the model does not fully capture the timing of the observed dynamics: in the data, housing prices rose gradually and only reached a 21 percent increase by 2022Q2, whereas in the model, prices rise sharply and peak as early as 2020Q2.

6 Conclusions

In this paper, we employ a DSGE model to evaluate several support policies implemented by the Canadian government and assess their role in the rise of household debt and housing prices. We find that all three policies analyzed in the paper—fiscal (social transfers), credit (CMBP), and monetary (extended ZLB)—contribute to an increase in household debt and housing prices relative to the baseline scenario. Among the three, the Bank of Canada's decision to maintain the policy rate at the ZLB for longer than what a standard Taylor rule would prescribe played a more significant role than either the transfer or credit policies. Overall, we find that the joint implementation of the three policies can account for approximately 45% of the observed increase in household debt. For housing prices, the model explains about 40% of the observed rise, although it fails to replicate the gradual increase seen in the data, instead predicting a more immediate surge.

We acknowledge, however, that there are other policy explanations for the housing market boom. For example, our model does not incorporate Quantitative Easing (QE), which was one of the key programs implemented by the Bank of Canada during the pandemic and may have had a significant impact on borrowing costs, and consequently on housing prices and household debt. We leave the analysis of such channels to future research.

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Appendix

A.1 The rest of the model

A.1.1 Capital Producers

Capital producers purchase final goods i_t^k from retailers at price P_t and convert them into efficient investment goods at price P_t^k. Following Christiano et al. (2005), we assume that the production of capital is subject to investment adjustment costs. The production function for capital goods is given by:

$$f(i_t^k) = i_t^k - S(i_t^k/i_{t-1}^k)\, i_t^k. \tag{A.1}$$

Capital producers face investment adjustment costs, represented by the function $S\left(\frac{i_t^k}{i_{t-1}^k}\right)$, which satisfies the conditions: $S = S' = 0$ and $S''^k > 0$ in the steady state. The capital producers choose i_t^k to maximize the discounted stream of profits:

$$E_t \sum_{s=0}^{\infty} \beta_p^s \Lambda_{t+s,t+s+1} \left[P_{t+s}^k \left(1 - S\left(\frac{i_{t+s}^k}{i_{t+s-1}^k}\right)\right) i_{t+s}^k - P_{t+s} i_{t+s}^k \right], \tag{A.2}$$

where $\Lambda_{t+s,t+s+1} = \frac{\lambda_{1,t+s+1}^p}{\lambda_{1,t+s}^p}$ is the stochastic discount factor of patient households. We assume that the functional form for the adjustment cost function is given by:

$$S\left(\frac{i_t^k}{i_{t-1}^k}\right) = \frac{1}{2}\chi^k \left(\frac{i_t^k}{i_{t-1}^k} - 1\right)^2. \tag{A.3}$$

Define the relative price of capital goods as:

$$q_t^k = \frac{P_t^k}{P_t}. \tag{A.4}$$

The aggregate capital stock evolves according to the standard law of motion:

$$k_t = (1 - \delta^k) k_{t-1} + i_t^k, \tag{A.5}$$

where δ^k is the depreciation rate of capital.

A.1.2 House Producers

Housing production is similar to capital production. Housing producers purchase final goods i_t^h from retailers at the market price P_t and convert them into efficient units of investment goods, which are priced at P_t^h. The production process is subject to housing investment adjustment costs, denoted by $S_h\left(\frac{i_t^h}{i_{t-1}^h}\right)$, with the standard assumptions that in steady state $S_h = S_h' = 0$ and $S_h''^h > 0$. The housing producer chooses i_t^h to maximize:

$$E_t \sum_{s=0} \beta_p^s \Lambda_{t+s,t+s+1} [P_{t+s}^h h_{t+s} - P_{t+s} i_{t+s}^h], \tag{A.6}$$

where

$$h_t = \left[1 - S_h(i_t^h/i_{t-1}^h)\right] i_t^h. \tag{A.7}$$

The functional form of $S_h(i_t^h/i_{t-1}^h)$ is $S_h(i_t^h/i_{t-1}^h) = 0.5\chi^h \left(i_t^h/i_{t-1}^h - 1\right)^2$. The aggregate stock of housing evolves according to $h_t = (1-\delta^h)h_{t-1} + i_t^h$. We also assume that patient households own the housing sector.

A.1.3 Wholesale Goods Sector

Let P_t^w denote the price of wholesale goods, and define the relative price as $p_t^w = \frac{P_t^w}{P_t}$, where P_t is the price of final goods. Producers in the wholesale sector use labor from both patient and impatient households, along with capital, to produce output y_t^w.

$$y^w = z_t k_{t-1}^{\gamma} \left[(al_{p,t})^{\alpha}((1-a)l_{ip,t})^{1-\alpha}\right]^{1-\gamma}, \tag{A.8}$$

where z_t is a shock to technology that follows

$$\log z_t = \rho^z \log z_{t-1} + \varsigma_t^z. \tag{A.9}$$

The labour demand decisions are static:

$$p_t^w \alpha(1-\gamma)\frac{y_t^w}{al_{p,t}} = w_{p,t}, \tag{A.10}$$

and

$$p_t^w(1-\alpha)(1-\gamma)\frac{y_t^w}{(1-a)l_{ip,t}} = w_{ip,t}. \tag{A.11}$$

For capital, wholesale goods producers must purchase it from capital producers at the end of period $t-1$. After production takes place during period t, they sell the undepreciated portion of capital, $(1-\delta)k_t$, in the open market. To finance the capital purchase, firms issue claims s_t^k at price q_t^k, such that

$$s_t^k q_t^k = q_t^k k_{t+1}, \tag{A.12}$$

where k_{t+1} denotes the amount of capital acquired at the end of period t. At the end of each period, firms pay out the realized return to capital, R_t^k, to financial intermediaries. The return R_t^k is determined as follows:

$$E_t \frac{R_t^k}{\pi_{t+1}} = \frac{E_t[r_{t+1}^k + q_{t+1}^k(1-\delta)]}{q_t^k}, \tag{A.13}$$

where $r_{t+1}^k = p_{t+1}^w \gamma \frac{y_{t+1}^w}{k_t}$, and $q_t^k = \frac{Q_t}{P_t}$.

A.1.4 Retailers for Domestic Goods

There is a continuum of retailers of mass 1, indexed by $j \in [0, 1]$. Retailers purchase intermediate goods from wholesale goods producers at the price P_t^w, differentiate them into domestic final goods $y_{d,t}(j)$ at no cost, and sell them at price $P_{d,t}(j)$. The aggregate domestic final good $y_{d,t}$ is a CES composite of the differentiated varieties, given by:

$$y_{d,t} = \left[\int_0^1 y_{d,t}(j)^{\frac{\varepsilon-1}{\varepsilon}} dj\right]^{\frac{\varepsilon}{\varepsilon-1}}, \tag{A.14}$$

where $\varepsilon > 1$ denotes the elasticity of substitution between varieties. The corresponding price index that minimizes the cost of producing $y_{d,t}$ is:

$$P_{d,t} = \left[\int_0^1 P_{d,t}(j)^{1-\varepsilon} dj\right]^{\frac{1}{1-\varepsilon}}. \tag{A.15}$$

Following Calvo (1983), in each period only a fraction $1 - \nu$ of retailers are able to reset their prices, while the remaining fraction ν must keep their prices unchanged. Given this nominal rigidity, a retailer j that is allowed to optimize at time t chooses $P_{d,t}(j)$ to maximize the expected discounted sum of profits over the periods during which its price remains fixed:

$$\max_{P_{d,t}(j)} E_t \sum_{i=0}^{\infty} \nu^i \Delta_{t,t+i} \left[P_{d,t}(j) y_{d,t+i}(j) - P_{t+i}^w y_{d,t+i}(j)\right], \tag{A.16}$$

where the stochastic discount factor is given by $\Delta_{t,t+i} = \beta_p \frac{\lambda_{p,t+i}}{\lambda_{p,t}} \frac{P_t}{P_{t+i}}$.[9] We further define $\tilde{\Delta}_{t,t+i} = \beta_p \frac{\lambda_{p,t+i}}{\lambda_{p,t}}$. Then the stochastic discount factor can be expressed as $\Delta_{t,t+i} = \tilde{\Delta}_{t,t+i} \frac{P_t}{P_{t+i}}$. Let $\tilde{P}_{d,t}$ be the optimal price chosen by all firms adjusting at time t. Then the first-order condition yields

$$\tilde{P}_{d,t} = \left(\frac{\varepsilon}{\varepsilon - 1}\right) \frac{E_t \sum_{i=0}^{\infty} \nu^i \tilde{\Delta}_{t,t+i} p_{t+i}^w y_{d,t+i} (\frac{1}{P_{d,t+i}})^{-\varepsilon}}{E_t \sum_{i=0}^{\infty} \nu^i \tilde{\Delta}_{t,t+i} \frac{P_{d,t+i}}{P_{t+i}} y_{d,t+i} (\frac{1}{P_{d,t+i}})^{1-\varepsilon}}, \tag{A.17}$$

where $p_{t+i}^w = \frac{P_{t+i}^w}{P_{t+i}}$. It can be shown that he aggregate price for domestic final goods is:

$$P_{d,t} = [\nu P_{d,t-1}^{1-\varepsilon} + (1 - \nu)(\tilde{P}_{d,t})^{1-\varepsilon}]^{\frac{1}{1-\varepsilon}}. \tag{A.18}$$

A.1.5 Import and Export

Import Similar to the previous section, there is a continuum of importers of mass 1, indexed by $j \in [0, 1]$. Importers purchase imported intermediate goods at the price $e_t P_t^*$ in a competitive market, differentiate them at no cost into varieties $y_{f,t}(j)$, and sell these at the price $P_{f,t}(j)$. The aggregate imported final good $y_{f,t}$ is a CES composite of individual varieties:

$$y_{f,t} = \left[\int_0^1 y_{f,t}(j)^{\frac{\varepsilon-1}{\varepsilon}} dj\right]^{\frac{\varepsilon}{\varepsilon-1}}, \tag{A.19}$$

[9] Since patient households own the retail firms, the firms discount future profits using the same rate and marginal utility as patient households.

where $\varepsilon > 1$ is the elasticity of substitution across imported varieties. The associated price index that minimizes the cost of producing $y_{f,t}$ is:

$$P_{f,t} = \left[\int_0^1 P_{f,t}(j)^{1-\varepsilon} dj\right]^{\frac{1}{1-\varepsilon}}. \tag{A.20}$$

Following Calvo pricing, we assume that in each period only a fraction $1-\nu$ of importers are allowed to reset their prices, while the remaining ν fraction keep their prices unchanged. An importer j that can reset its price at time t chooses $P_{f,t}(j)$ to maximize its expected real total profit over the duration in which its price remains fixed:

$$E_t \Sigma_{i=0}^{\infty} \nu^i \Delta_{i,t+i} \left[P_t^f(j) y_{t+i}(j)^f - e_t P_t^* y_{t+i}^f(j)\right]. \tag{A.21}$$

Let $\tilde{P}_{f,t}$ be the optimal price chosen by all firms adjusting at time t in the imported goods sector. Define $f_t = \frac{e_t P_t^*}{P_t}$. Then the first-order condition for the optimal price is:

$$\tilde{P}_{f,t} = \left(\frac{\varepsilon}{\varepsilon - 1}\right) \frac{E_t \sum_{i=0}^{\infty} \nu^i \tilde{\Delta}_{i,t+i} f_{t+i} y_{t+i} \left(\frac{1}{P_{f,t+i}}\right)^{-\varepsilon}}{E_t \sum_{i=0}^{\infty} \nu^i \tilde{\Delta}_{i,t+i} y_{t+i} \frac{P_{f,t+i}}{P_{t+i}} \left(\frac{1}{P_{f,t+i}}\right)^{1-\varepsilon}}. \tag{A.22}$$

The aggregate price $P_{f,t}$ is:

$$P_{f,t} = \left[\nu P_{f,t-1}^{1-\varepsilon} + (1-\nu) \tilde{P}_{f,t}^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}}. \tag{A.23}$$

Export Let y_t^e denote the quantity of domestic final goods that are exported, and let y_t^* denote foreign output. The aggregate foreign demand for domestic exports is assumed to be:

$$y_t^e = \varpi \left(\frac{P_t}{e_t P_t^*}\right)^{-\varsigma} y_t^*, \tag{A.24}$$

where $\varsigma > 0$ is the elasticity of substitution between foreign and domestic goods, and $\varpi > 0$ is a parameter that governs the share of foreign spending allocated to domestically produced goods.

A.1.6 Aggregate final goods producers

The final consumption good $y_{c,t}$ is produced using a combination of domestically produced goods $y_{d,t}$ and imported goods $y_{f,t}$, according to the following CES aggregator:

$$y_{c,t} = \left[(\omega_d)^{\frac{1}{\zeta}} y_{d,t}^{\frac{\varsigma-1}{\varsigma}} + (\omega_f)^{\frac{1}{\varsigma}} y_{f,t}^{\frac{\varsigma-1}{\varsigma}}\right]^{\frac{\varsigma}{\varsigma-1}}, \tag{A.25}$$

where ω_d and ω_f represent the shares of domestic and imported composite goods in final consumption, respectively, with $\omega_d + \omega_f = 1$, and $\zeta > 0$ is the elasticity of substitution between domestic and foreign goods. The corresponding aggregate price index is:

$$P_t = \left[\omega_d P_{d,t}^{1-\varsigma} + \omega_f P_{f,t}^{1-\varsigma}\right]^{\frac{1}{1-\varsigma}}. \tag{A.26}$$

A.2 Data description

A.2.1 Data used in Figure 1

1. **GDP:** Real Gross Domestic Product.
   Source: Statistics Canada, Table: 36-10-0104-01 (formerly CANSIM 380-0064).

2. **Consumption:** Real consumption, including non-durable goods, semi-durable goods, and services.
   Source: Statistics Canada, Table: 36-10-0104-01 (formerly CANSIM 380-0064).

3. **Inflation:** Computed using the monthly Consumer Price Index (CPI), based on all-items excluding the eight most volatile components as defined by the Bank of Canada, and adjusted to exclude the effect of changes in indirect taxes.
   Source: Statistics Canada, Table: 18-10-0256-01 (formerly CANSIM 326-0023).

4. **Policy Rate:** Bank rate.
   Source: Statistics Canada, Table: 10-10-0122-01 (formerly CANSIM 176-0043).

5. **Mortgage Rate:** Interest rates charged for new and existing residential mortgage lending by chartered banks—insured mortgages (series V122667787).
   Source: Bank of Canada.

6. **Household Debt:** Real total mortgage debt, calculated as total mortgage outstanding adjusted by the GDP deflator.
   Sources: Bank of Canada, Chartered Banks Mortgage Loans Report (end of period, in millions); Statistics Canada, Table: 10-10-0134-01 (formerly CANSIM 176-0014).

7. **Housing Price:** Total housing price (including house and land), based on the monthly New Housing Price Index.
   Source: Statistics Canada, Table: 18-10-0205-01 (formerly CANSIM 327-0056).

A.2.2 Data used in Figure 2

Social Benefit: Total government social benefit expenditures.
Source: Statistics Canada, Table: 10-10-0015-01, *Statement of Government Operations and Balance Sheet, Government Finance Statistics* (in millions of dollars).

Social benefits include social security benefits, social assistance benefits, and employer-provided benefits.

- *Social security benefits* consist of:
  - *In cash:* Employment insurance, Canada Pension Plan (CPP), and other transfers.

- *In kind:* Publicly provided goods and services related to social insurance.

- *Social assistance benefits* consist of:
  - *In cash:* Child care benefits, veteran benefits, general social aid or financial assistance, and others.
  - *In kind:* Programs such as provincial drug plans and other non-cash assistance.

The model variable Tr (Transfer) is constructed based on the aggregate of these social benefit components.

A.3 Figures and Tables

Table 1: Calibrated Parameters

Household		
Discount factor of patient households	β^p	0.9958
Discount factor of impatient households	β^{ip}	0.9825
Fraction of patient households	α	0.400
Habit persistence parameter	b	0.850
Relative weight for labor in preferences	ψ	1.000
Inverse Frisch elasticity of labour supply	η	1.010
Relative weight for housing in preferences	$\varkappa$	0.250
Depreciation rate for houses	δ^h	0.01
Collateral constraint	θ	0.850
Persistence of mortgage debt	ρ^l	0.950
Financial intermediaries		
Survival rate of banks	σ	0.972
Fraction of bank assets can be diverted	κ	0.550
Start-up funds for newly entered banks	ω^b	0.002
Steady state weighted average spread	s^A	0.0038
Goods Producers		
Depreciation rate of capital	δ	0.025
Capital share	γ	0.330
Elasticity of substitution	ϵ	11.000
Prob. of not changing prices	ν	0.750
Adj. cost parameter – housing investment	χ^h	30.000
Adj. cost parameter – capital investment	χ^k	10.63
Wage share of patient households	α^w	0.5
Share of domestic goods in production	ω^d	0.800
Elas. of subs. between domestic and foreign goods	ζ	0.800
Government and central bank		
SS Government spending to GDP ratio	$\frac{g}{y}$	0.200
SS Government debt to annual GDP ratio	$\frac{\alpha b}{y}$	0.3
Tax adjustment parameter	ϕ^{tax}	0.100
Credit policy cost parameter	τ	0.001
Taylor rule interest rate smoothing	ρ^r	0.58
Taylor rule inflation	ρ^π	2.960
Taylor rule output	ρ^y	0.060

Figure 1: Impact of the Pandemic on Key Aggregate Variables

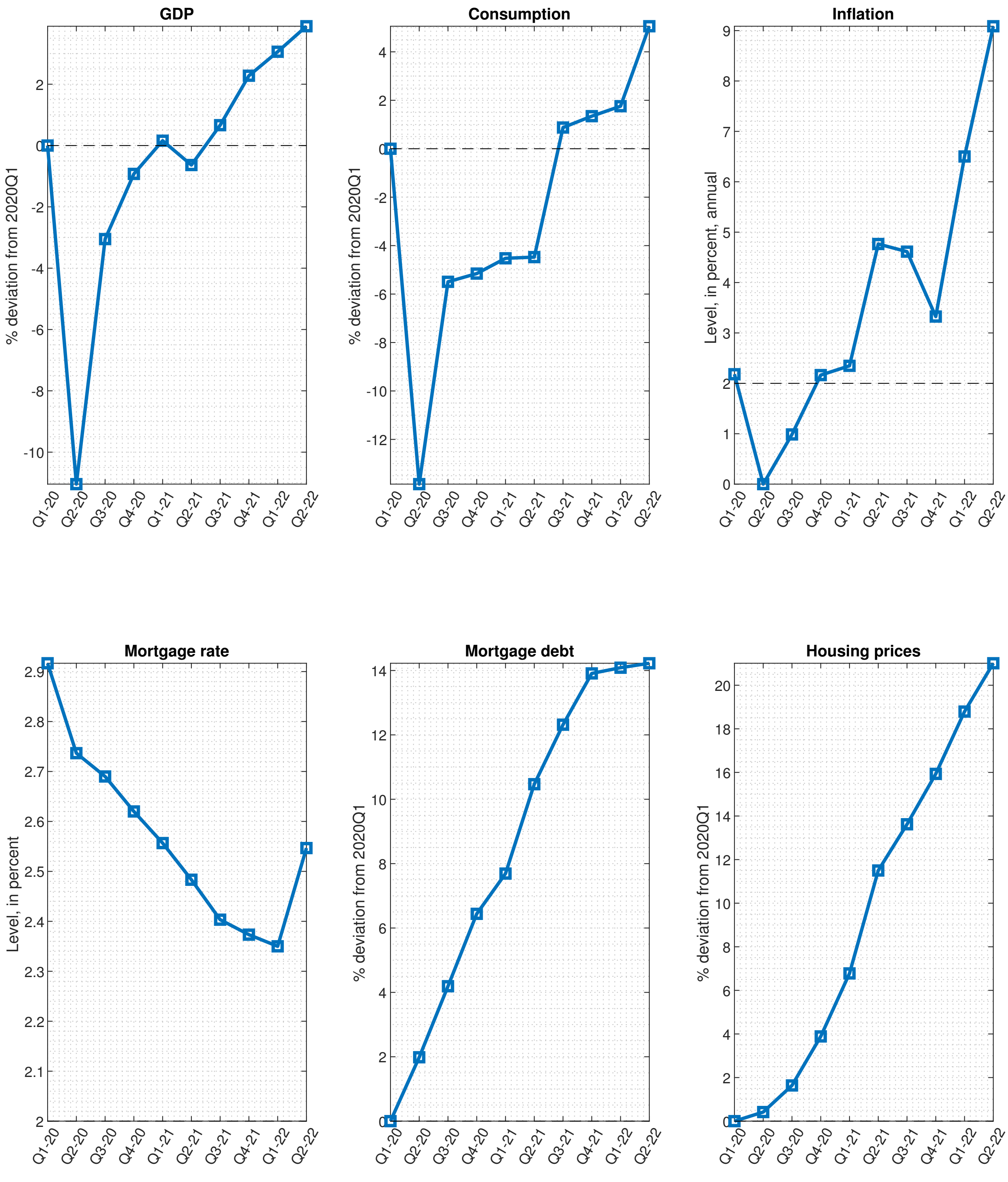

Figure 2: Fiscal, Monetary and Credit Policies

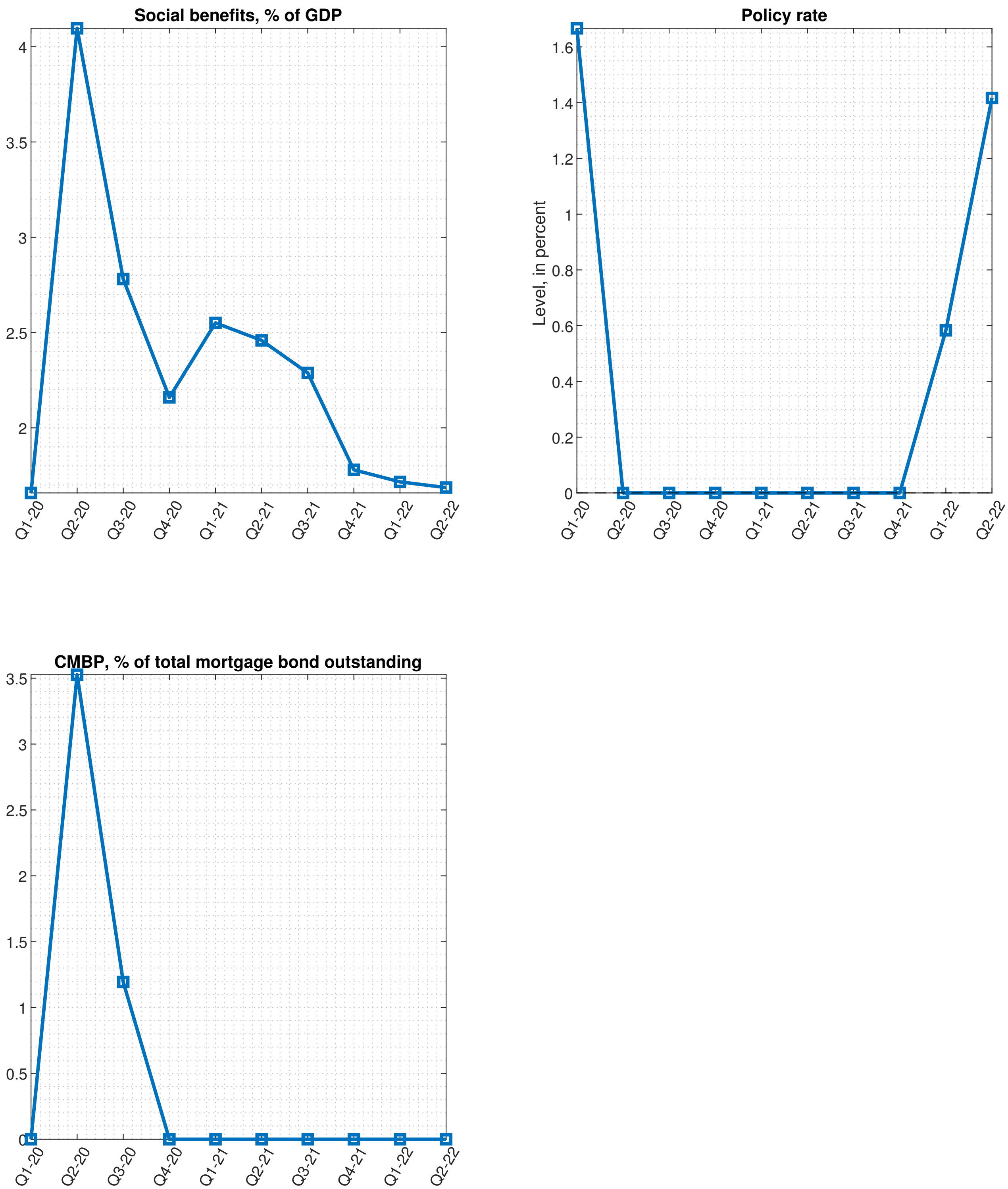

Figure 3: Forced-savings Shocks

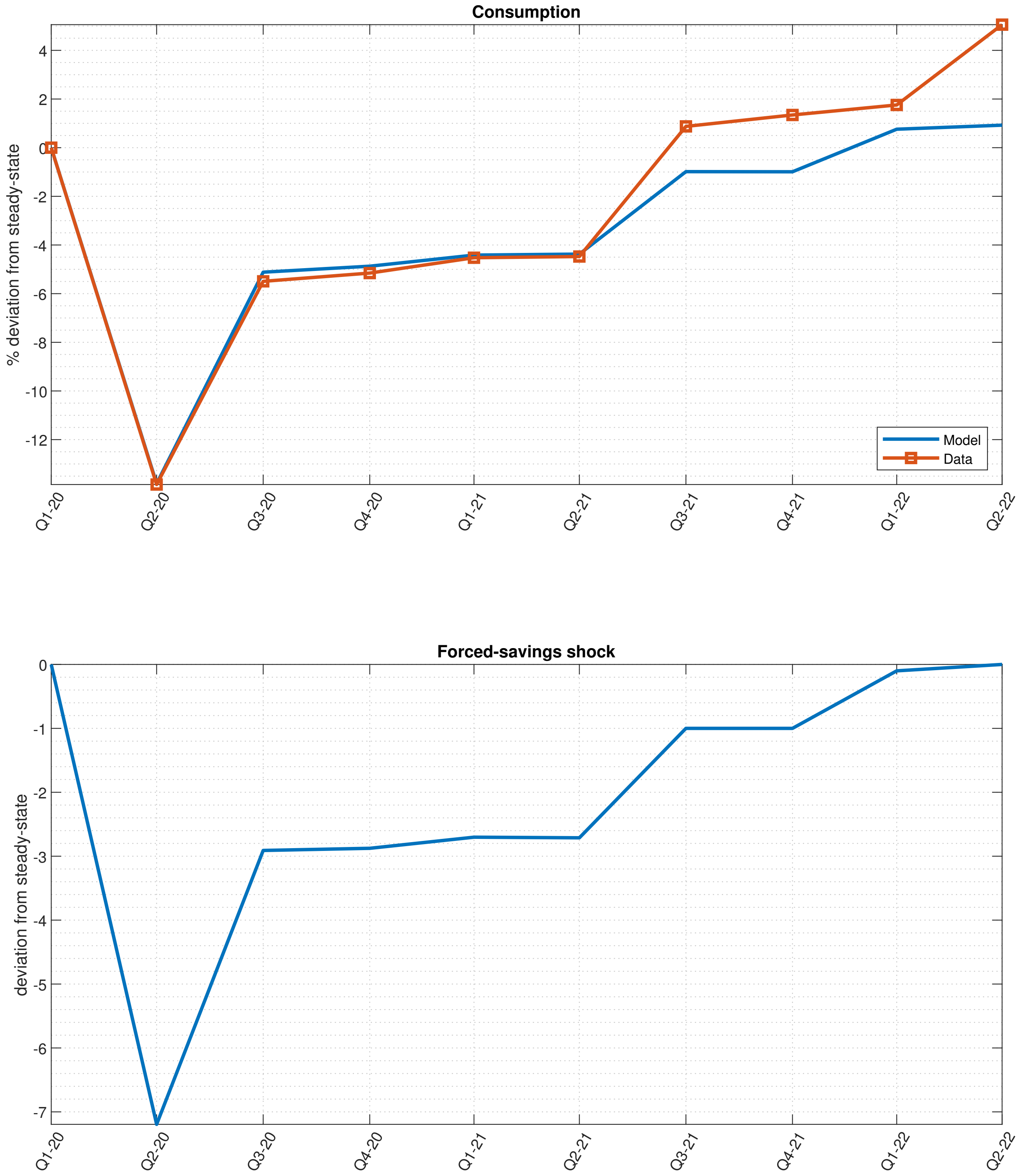

Figure 4: Baseline

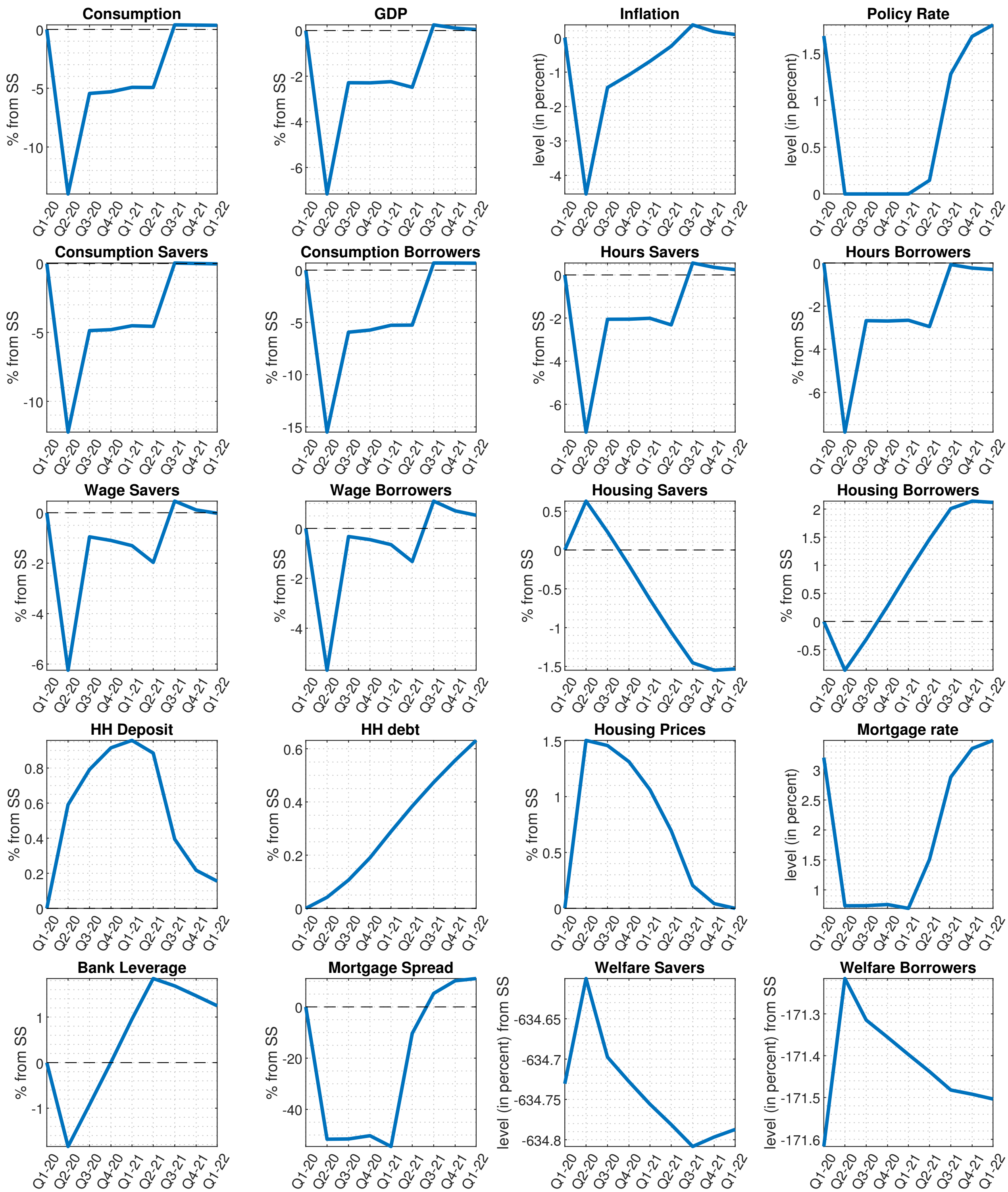

Figure 5: Transfers vs. Baseline

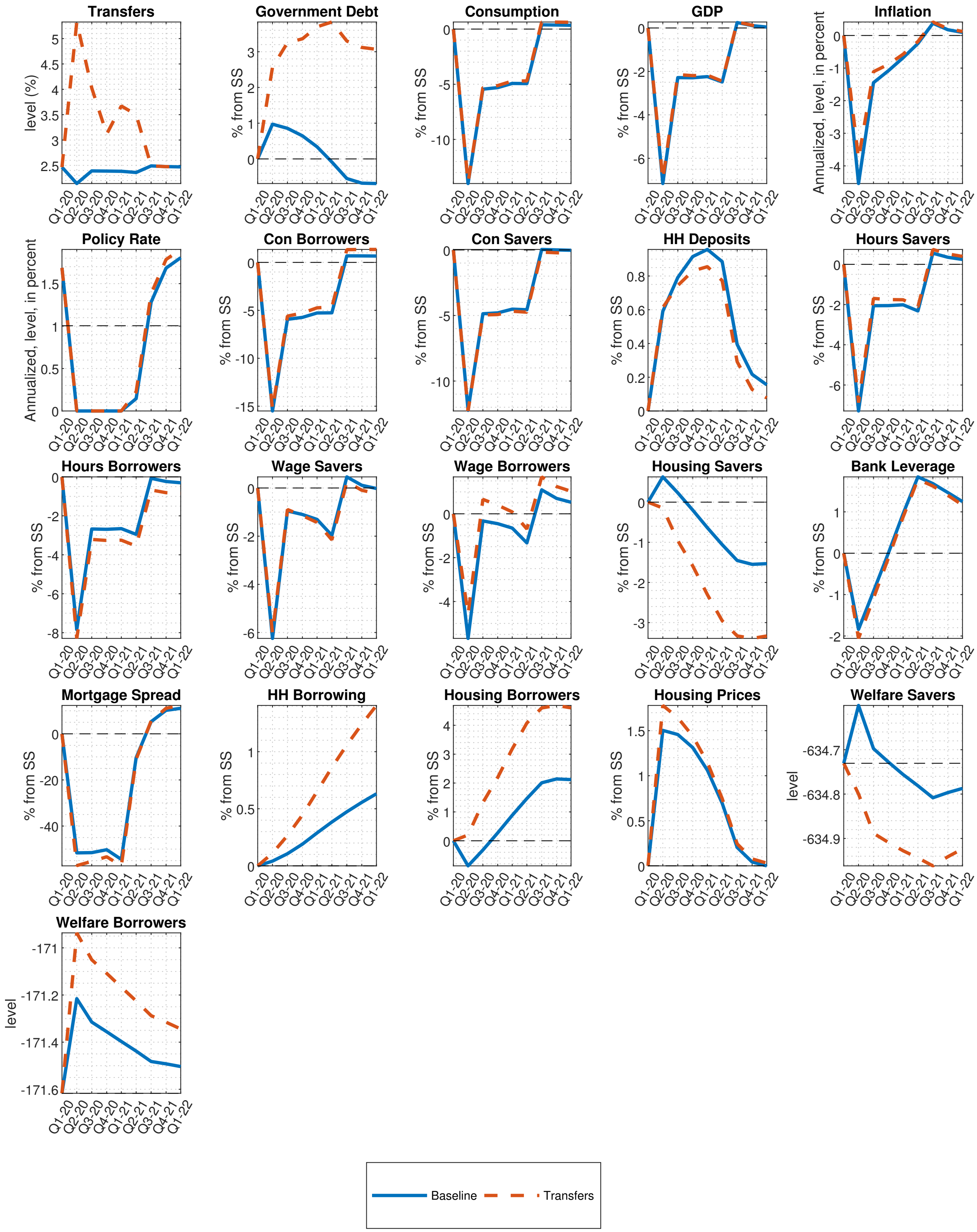

Figure 6: Credit Policy vs. Baseline

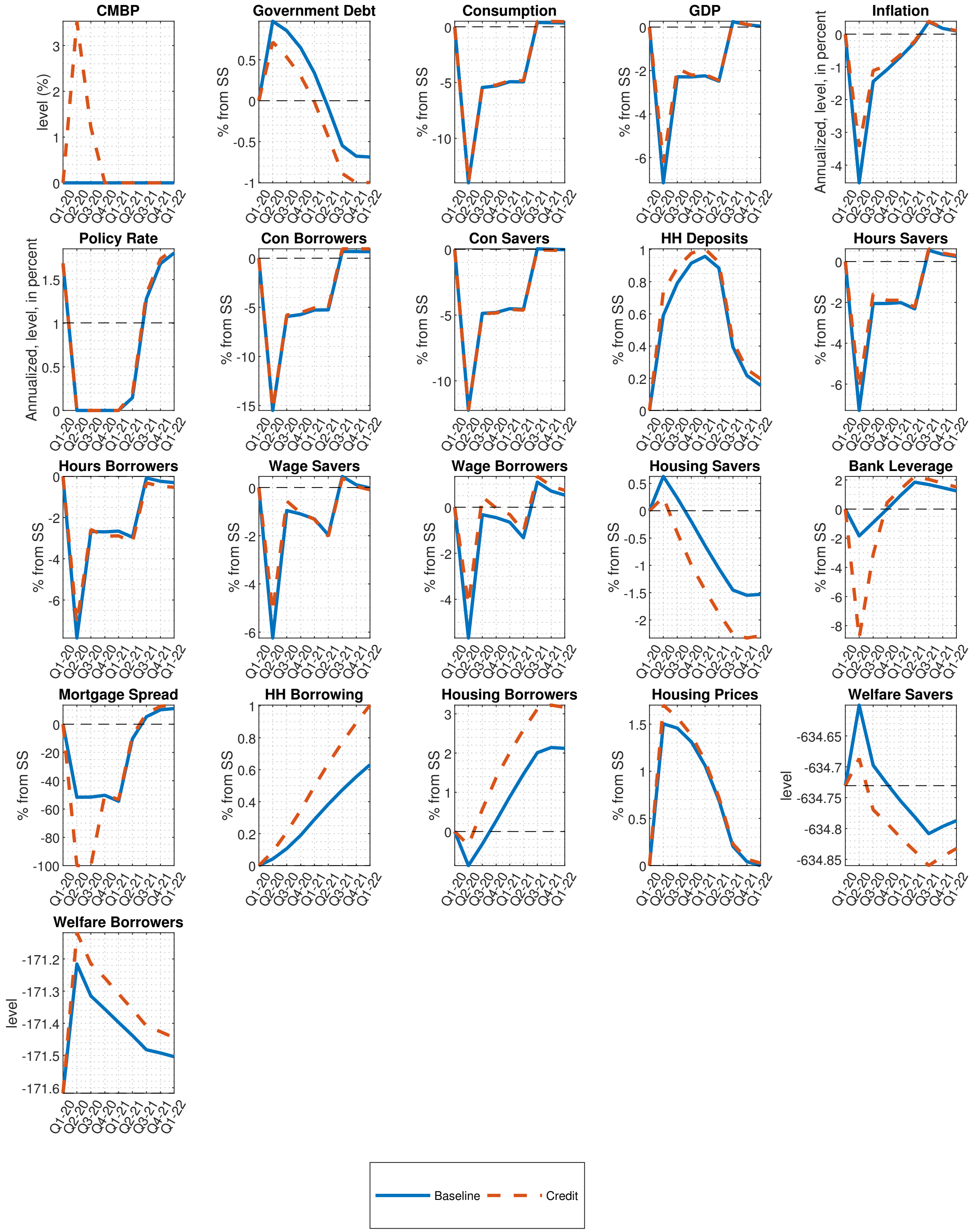

Figure 7: Extended ZLB I vs. Baseline

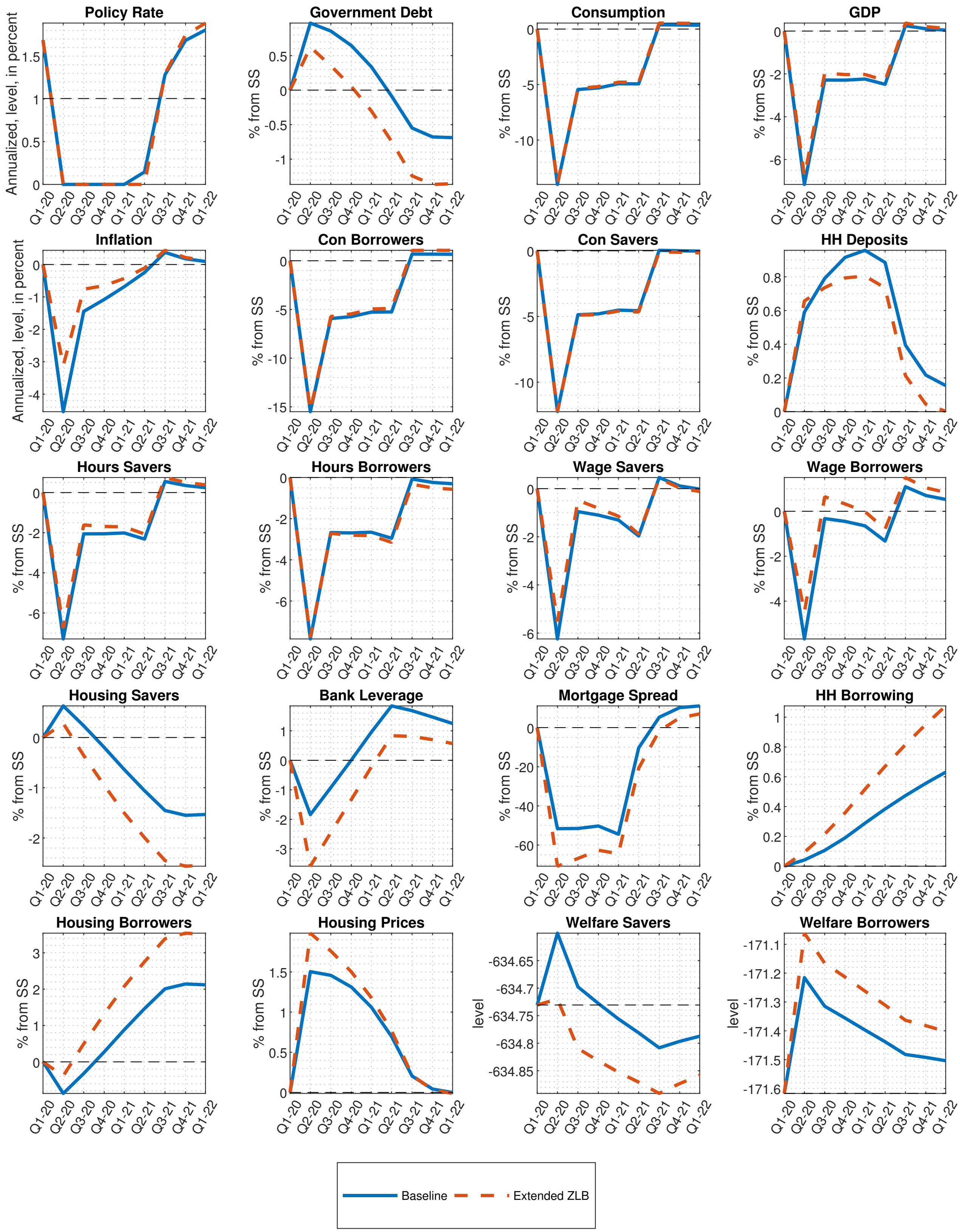

Figure 8: Extended ZLB II vs. Baseline

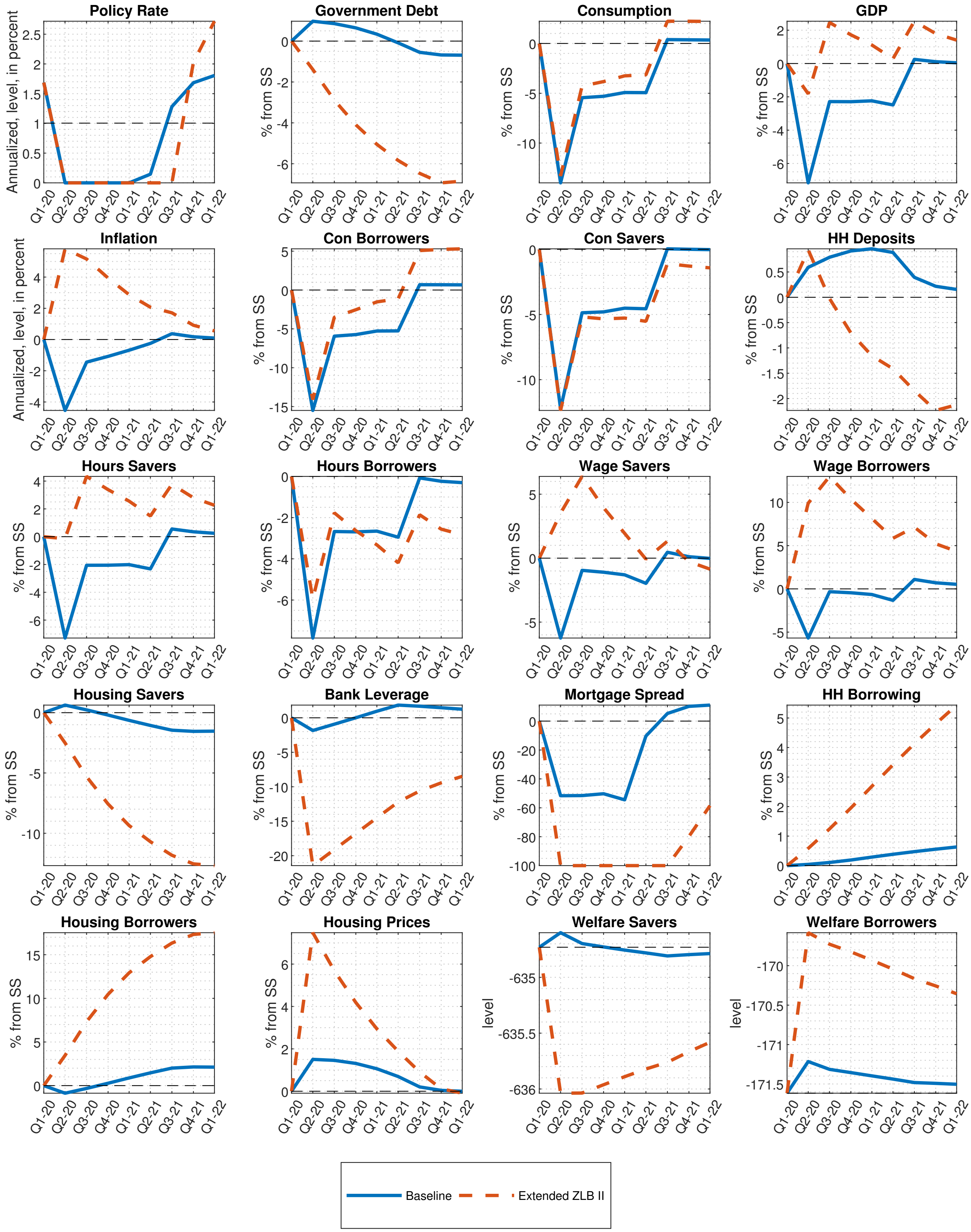

Figure 9: Combined Policies – Transfer and Credit

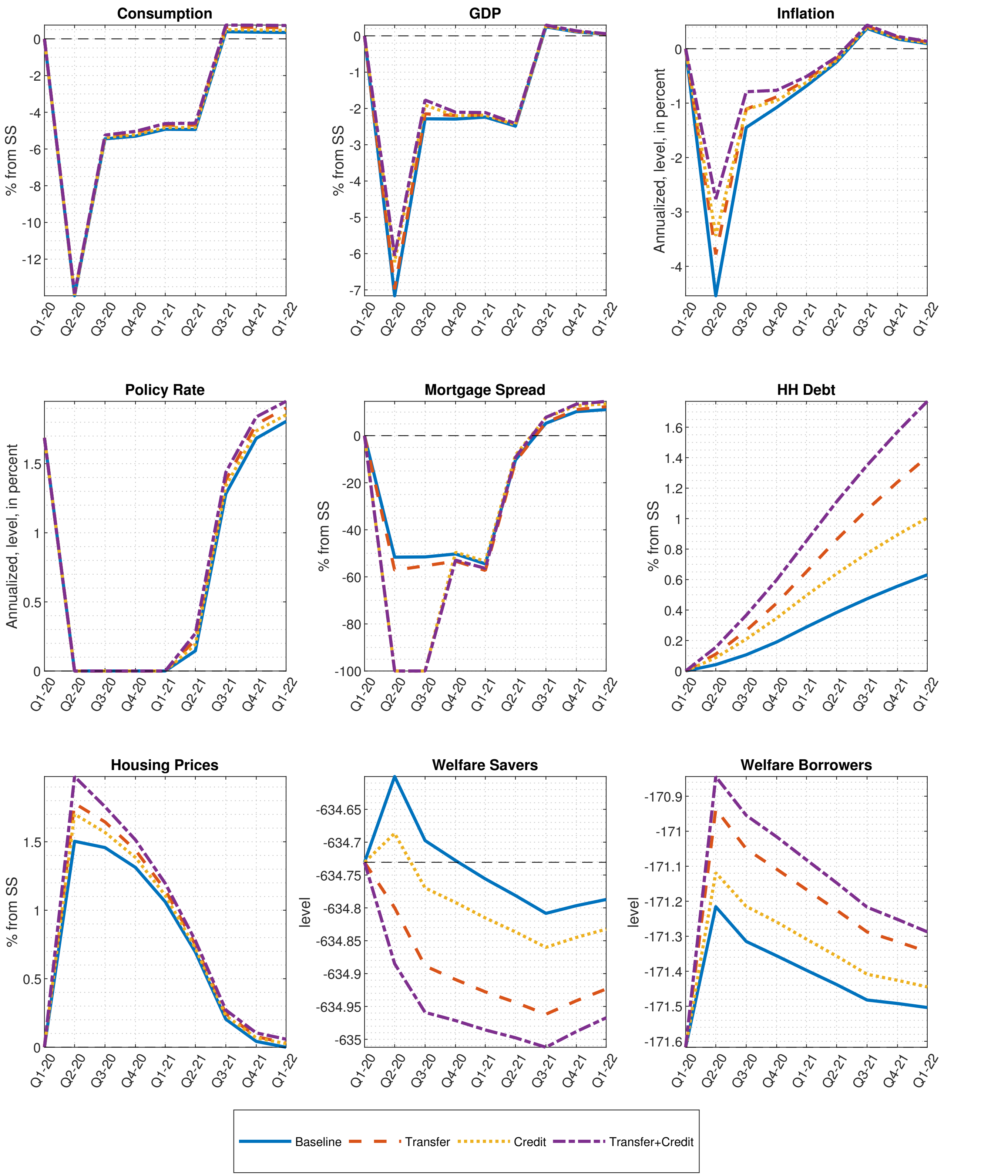

Figure 10: Combined Policies – Transfers and Extended ZLB I

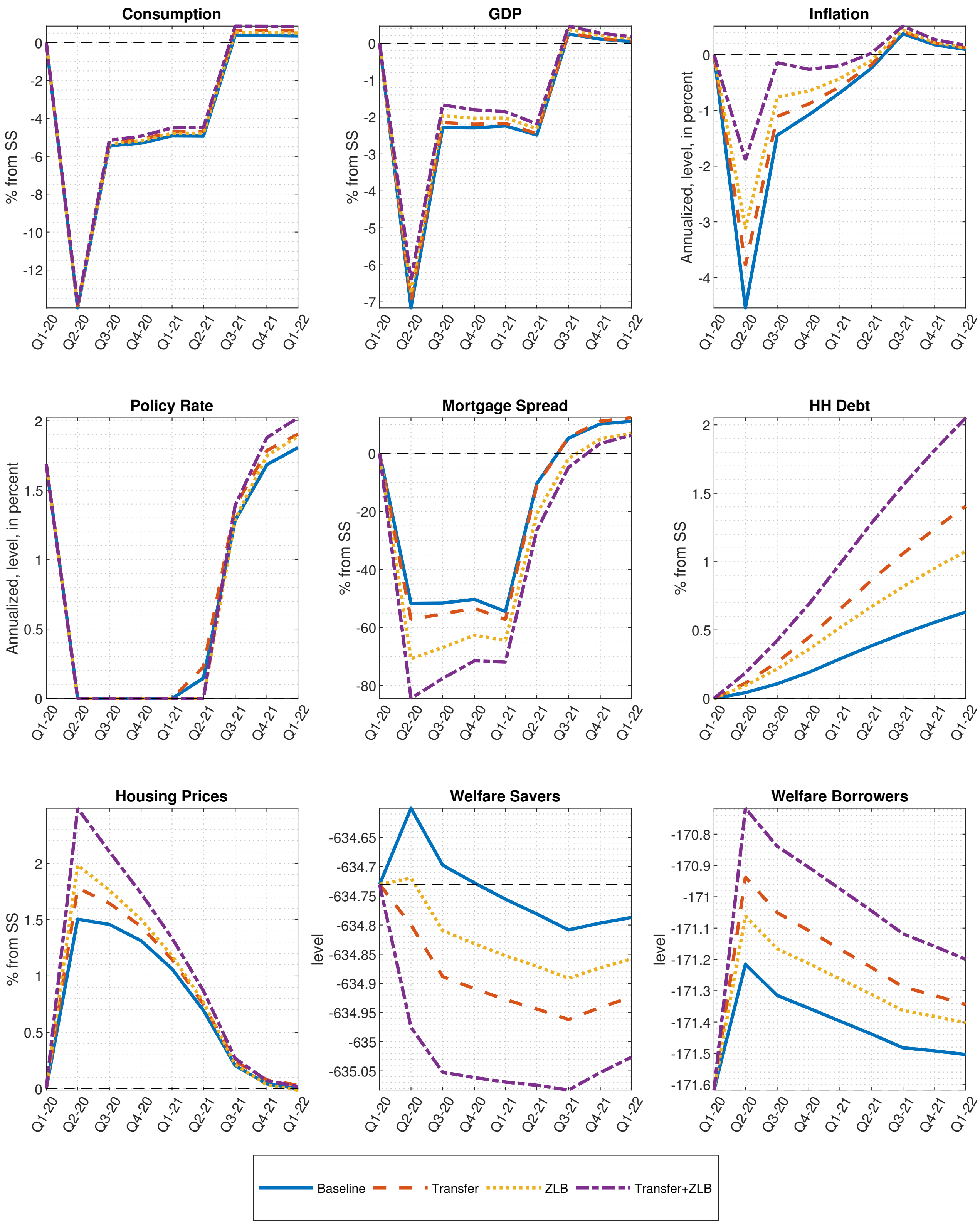

Figure 11: Combined Policies – Credit and Extended ZLB I

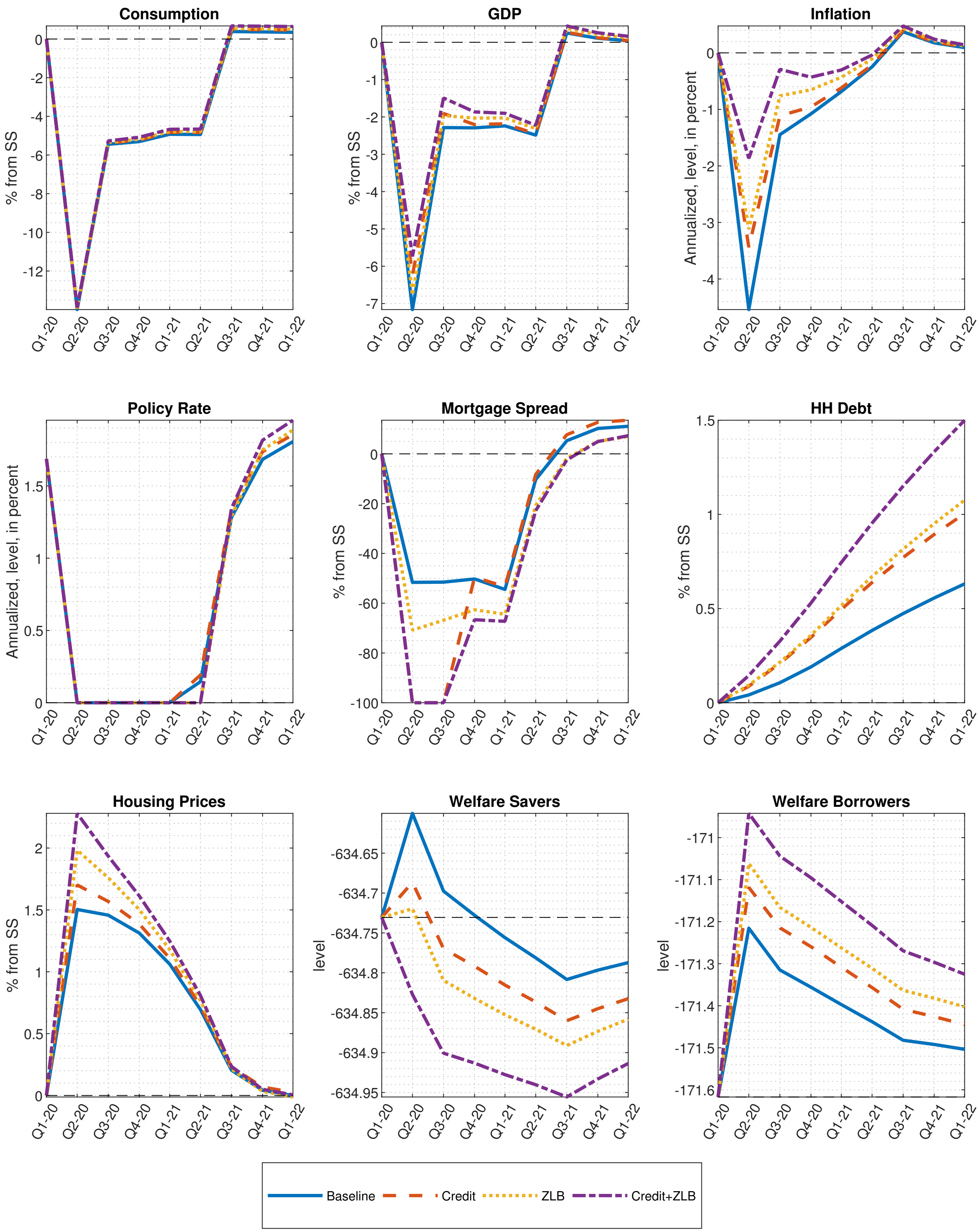

Figure 12: Combined Policies – Transfers, Credit and Extended ZLB I

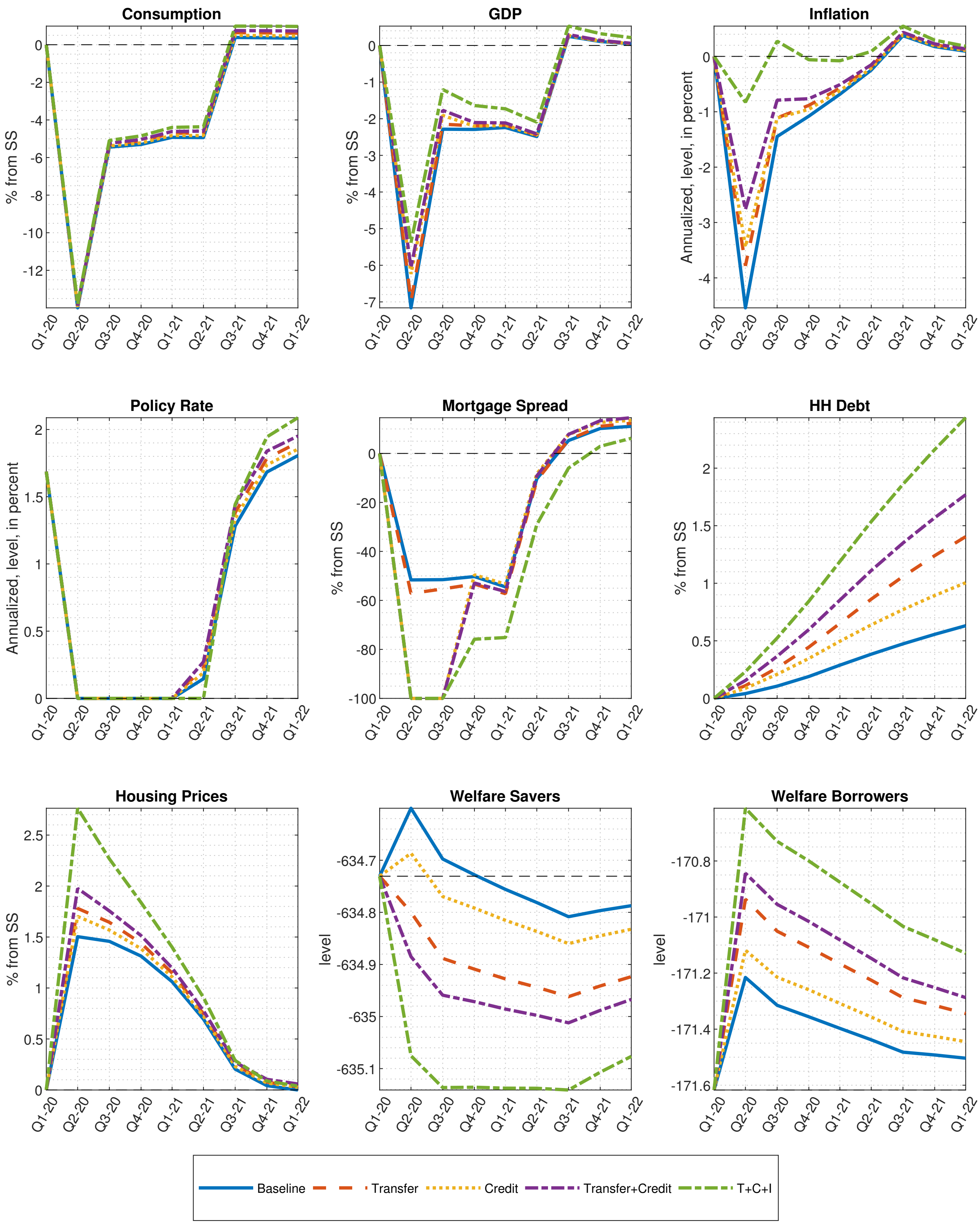

Figure 13: Combined Policies – Transfers, Credit and Extended ZLB II