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Unemployment Benefits and Wage Subsidies – Effects of Labour Market Policies during a Pandemic

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Unemployment Benefits and Wage Subsidies – Effects of Labour Market Policies during a Pandemic

Yahong Zhang [*]

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Abstract

To mitigate the job and income loss due to COVID-19, the Canadian government implemented a variety of programs. Among them, the most significant initiatives include the Canada Emergency Response Benefit (CERB) and Canada Emergency Wage Subsidy (CEWS). In this paper, I use a dynamic general equilibrium model with labour market frictions to examine the effect of these two programs. In the model, a pandemic shock is captured by a combination of an exogenous rise in the separation rate and a decline in matching efficiency. I show that the shock generates a large rise in the unemployment rate and a steep decline in employment, output and consumption. I then use the model to quantify the effect of the two programs, showing that compared to the CERB program, the CEWS program is more effective in mitigating the loss of employment, output and consumption.

JEL: classification: J65; J68; H2;

Keywords: unemployment, labour market, pandemic

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1 Introduction

The Canadian labour market was under tremendous stress due to the lockdown caused by COVID-19. The unemployment rate rose from 5.6% in February 2020 to almost 14% in April 2020, staying above 10% until August 2020. Between February and April 2020, about 2 million Canadians lost their jobs. The job separation rate jumped from 3.3% in January 2020 to 9.3% in March 2020. The lockdown also made it difficult for unemployed workers to find a job. The job-finding rate declined from 43% in February to 16% in April 2020. The rise in the jobless rate was largely due to the lockdown measures imposed by the Canadian government.

To mitigate the negative economic impact of COVID-19, the Canadian government implemented multiple programs. The two principal initiatives related to the labour market include the Canada Emergency Response Benefits (CERB) and Canada Emergency Wage Subsidy (CEWS). CERB was designed to assist workers who lost jobs due to COVID-19, while CEWS was designed to help employers keep their employees on payroll or rehire workers laid off due to the pandemic. Both programs were announced in March 2020.

Compared to the Employment Insurance (EI) program – the regular program for unemployed workers in Canada – the eligibility criteria for CERB were less strict. As a result, CERB covers more workers. For example, self-employed workers are not eligible for EI, but they are eligible for CERB if they stop working due to COVID-19. CERB transfers $2,000 per month ($500 per week) to unemployed workers regardless of their previous earnings. The maximum payment period for the CERB program is 28 weeks. The program ended December 2, 2020.

CEWS is a wage subsidy program designed to target employers. When initially announced in March 2020 for eligible employers, the Canadian government covers 75% of employees' wages, with the maximum subsidy topped at $847 a week. After the first 16 weeks, the wage subsidy has been modified and become available for all eligible employers that experience a decline in revenue for a claim period. However, the size of the subsidy would depend on the magnitude of the firms' revenue loss. This means that for employers who experienced a minor decline in revenue, the subsidy rate is much lower than 75%. The Canadian government extended the CEWS program several times. The program ended in September 2021.[1]

These two programs provided much-needed help to both workers and employers, thus, it is essential to understand how these two programs operated and how effective they were. Although several studies have attempted to evaluate the two programs (Petit and Tedds, 2020; Koebel et al., 2021; Smart and Eisen, 2021), the analysis in these works is mostly descriptive. To my best knowledge, this is the first paper to use a general equilibrium dynamic model to quantify the impact of the two programs on the Canadian economy.

In this paper, I incorporate a search/matching model into a standard representative agent general equilibrium framework. Search/matching models are particularly suitable for studying the impact of

[1] The last CEWS claim period was period 21 from September 26 to October 23, 2021, with the deadline of April 21, 2022.

the two programs since labour market flows are explicitly modelled. That is, on the workers' side, an increase in unemployment benefits (CERB) increases the value of being in the unemployment state, reducing the workers' incentive to search for jobs. On the side of the firms, wage subsidies (CEWS) increase firms' profit margins. As a result, firms post more vacancies.

To quantify the effectiveness of the two programs, the model is calibrated to the Canadian economy and solved nonlinearly, assuming perfect foresight.[2] To be specific, I use data from January 2020 – the eve of the pandemic – to pin down the steady-state values of the model variables. The pandemic shock is then calibrated using data on job separation and finding rates from February to May 2020 – the height of the pandemic. Given the pandemic shock, I simulate the model under the following scenarios: no fiscal intervention, CERB only, and CEWS only. In the no-intervention case, the matching efficiency remained low until the end of 2020, and neither CERB nor CEWS was available. I show that under this case, the unemployment rate stays as high as 14% for the greater part of 2020, significantly larger than its data counterpart. This finding suggests that without the government support measures, the labour market outcome would have been much worse.

The model is then employed to quantify the effect of the two programs on unemployment/employment, output and consumption at the aggregate level. To model the CERB program, I assume a series of positive shocks impacting the unemployment benefit (causing the unemployment benefit to rise). The CERB-to-GDP ratio in the data is used to determine the magnitude of the shocks. For the CEWS program, I focus on the rehiring channel. That is, I assume that CEWS is mainly used for cases where firms rehired workers who were laid off in the early months of the pandemic. Similar to the CERB case, I assume a series of positive shocks hit the wage subsidy rate, leading wage subsidies to rise. The size of the shocks is pinned down using the CEWS-to-GDP ratio in the data.

I show that the CERB program slightly decreases the job search incentive for unemployed workers. Under CERB, the unemployment rate rises slightly more than in the no-intervention case, which leads to a slightly larger decline in output and employment. Surprisingly, the impact of CERB on consumption is negligible. This is because both unemployed and employed workers are assumed to have the same level of consumption due to the large family structure assumption in the model. On the one hand, the CERB program increases the income of unemployed workers. On the other hand, fewer workers are employed in the model due to the generosity of the CERB, leading to a decline in wage income. The two effects offset each other. As a result, average income and consumption barely change under CERB. In contrast, the CEWS program significantly dampens the impact of the pandemic shock. CEWS is quite effective in boosting employment, output and consumption. This result stems from CEWS increasing firms' incentives to rehire previously laid-off workers. For rehiring, the vacancy posting costs are much lower than for a regular hiring. Thus, firms post more vacancies and the job-finding rate for workers increases, leading to a lower unemployment rate.

[2] The exercise in this paper is particularly similar to one conducted by Faria-e Castro (2021), who studied the effect of the pandemic in the United States and its fiscal policy responses in a New Keynesian multisector model. Faria-e Castro (2021) solves the model using a perfect foresight, nonlinear method and studies the impact of the Coronavirus Aid, Relief, and Economic Security Act (CARES) on the aggregate economy.

Related Literature This paper belongs to the literature using search-matching models to study the impact of the stimulus package on labour markets during the pandemic (Albertini et al., 2021; Petrosky-Nadeau, 2020; Fang et al., 2020; Bernstein et al., 2020; Birinci et al., 2021; Boar and Mongey, 2020). Petrosky-Nadeau (2020) and Boar and Mongey (2020) use a partial equilibrium search model to study the effect of unemployment benefits (UI) in the CARES program on workers' decisions on returning to work. Both papers find that few workers would turn down an offer to return to work at the previous wage in the presence of an expanded unemployment insurance (UI) policy. Bernstein et al. (2020) use a simple labour search model to study the labour market response to a large persistent separation shock caused by the pandemic. The authors emphasize the importance of using a nonlinear method, showing that vacancy creation declines when facing a pandemic shock and that the severity of the economic impact of the pandemic depends on the persistence of the separation shock. Fang et al. (2020) and Birinci et al. (2021) incorporate an epidemiological model into a labour search model to assess how the labour policies implemented by the U.S. government affected key labour market variables during the pandemic. A crucial mechanism in these two papers is that a higher UI increases unemployment but helps mitigate the infection.[3]

Furthermore, this paper contributes to the literature studying the impact of COVID-19 on the Canadian labour market and the effect of the related policy responses from the Canadian government. For the COVID-19 impact, Lemieux et al. (2020) provide an empirical study of the initial impact of the pandemic on the Canadian labour market. Jones et al. (2021) study the key labour market aggregates during COVID-19, emphasizing unique job search behavior related to the pandemic. Cotton et al. (2022) use a dynamic output-input model to evaluate the impact of lockdown policy on GDP and aggregate hours. Beland et al. (2020) investigates the impact of the pandemic on self-employed workers. Regarding the effect of the labour market policy, Petit and Tedds (2020) study the different treatment of CERB by the income assistant program (IA) across provinces. Koebel et al. (2021) evaluate the government income support programs including CERB and CEWS based on a framework of efficiency, equity and voice. Smart and Eisen (2021) investigate the efficacy of the CEWS program and suggest that the program does not have much effect on saving jobs based on a back-of-the-envelope calculation.

The remainder of the paper is organized as follows. Section 2 offers some background regarding the Canadian labour market during the COVID-19 period and details regarding the two programs. Section 3 describes the model, and Section 4 presents the model calibration and Section 5 describes the effects of the two programs on the key macro variables. Section 6 offers concluding remarks.

[3]More broadly, this paper belongs to the fast- growing literature examining the economic impact of the pandemic in a macroeconomic framework (Eichenbaum et al., 2021; Guerrieri et al., 2022). In particular, this paper is related to the literature assessing the effect of government fiscal responses to the pandemic (Gomme, 2022; Albertini et al., 2021; Auerbach et al., 2022; Faria-e Castro, 2021).

2 Background

2.1 The impact of COVID-19 on labour market

To describe the impact of the pandemic on the aggregate Canadian labour market, data on the employment rate, unemployment rate, job separation rate and job finding rate are used from January 2019 to May 2022. The shaded area in Figure 1 indicates the period from March 2020 to May 2020, when the pandemic was in its full force. The period after May 2020 (June 2020 to May 2022) is the recovery period.

Employment and Unemployment The first two panels of Figure 1 describe the impact of COVID-19 on the employment and unemployment rates in the Canadian labour market. Before COVID-19, the employment rate fluctuates little and its average in 2019 is about 62%. COVID-19 led to an almost 10 percentage-point drop from 61.8% in February 2020 to 52.8% in April 2020. Similarly, before the pandemic, the monthly unemployment rate does not fluctuate much – the average unemployment rate for 2019 is 5.77%. In the first month of the pandemic, the unemployment rate jumps from 5.6% in February 2020 to 8% in March 2020. It continued to rise to 13.4% in April and peaked at 14% in May 2020.

Job Separation and Job Finding Rates To understand the dynamics of the unemployment rate, it is essential to understand the dynamics of job separation and job finding rates. Because no ready-to-use data exist for these two rates, I use the method in Shimer (2005) to construct the two rates using data on the number of unemployed workers u_t, the number of short-term unemployed workers u_t^s (workers who have been unemployed for one to four weeks), and the number of employed workers e_t.[4] The bottom panels of Figure 1 display the two rates. The impact of the lockdown is reflected in the significant change in the job separation and job finding rates in the early part of 2020. The monthly job separation rate barely changed during 2019, averaging about 3.24%, suggesting that on average, job tenure is 2.5 years, or 30 months. Job separation rose sharply, however, from 3.3% in January 2020 to 6.7% in February and 9.3% in March. The monthly job finding rates fluctuated around 38% in 2019, implying that on average it took unemployed workers less than three months to find a job. The job finding rates reached as high as 43% in February 2020 but declined sharply to 26% in March and 16% in April due to the pandemic. This contraction suggests that the pandemic made job searching more difficult, causing the job finding rate to decline sharply.

Figure 1 also shows that the pandemic recovery is rapid. By May 2022, the Canadian labour market had almost fully recovered. The levels of all four variables have reached (or exceeded) levels prior to the pandemic.

[4]The formula for computing the job finding rate f_t is $f_t = 1 - \frac{u_t - u_t^s}{u_{t-1}}$. The job separation rate is constructed using $s_t = \frac{u_{t+1}^s}{e_t(1-0.5f_t)}$.

2.2 CERB and CEWS

In contrast to the EI program – the regular unemployment insurance program in Canada – CERB was an emergency measure. To receive EI, an unemployed worker must meet certain eligibility criteria. The amount of EI a worker can receive and how long the worker can stay on EI vary depending on multiple factors such as the worker's earnings before a layoff and the average unemployment rate in the worker's region. In general, EI lasts from 14 to 45 weeks and the maximum amount of EI that an unemployed worker can receive is $547 per week. In contrast, the eligibility criteria for CERB are much less strict. Due to this, CERB covers more workers. For example, self-employed workers are not eligible for EI, but they are eligible for CERB as long as they stopped working due to COVID-19. CERB transferred $2,000 per month ($500 per week) to unemployed workers regardless of their prior earnings before they stopped working.[5]

When initially announced in March 2020, the benefits were available to workers from March 15 to September 26, 2020, and the maximum term a worker could receive the CREB was 16 weeks. On June 16, 2020, the government announced that CERB would be extended an additional 8 weeks, bringing the maximum to 24 weeks total. On August 20, 2020, the Canadian government further extended the program another four weeks, bringing the maximum payment period to 28 weeks. The CERB program ended on December 2, 2020, and the Canadian government introduced two different programs to replace it. One is the newly expanded EI program and the other is the new Canada Recovery Benefits for self-employed and contract workers, who are ineligible for the EI program. As of December 2020, as suggested in a CBC report – "The largest single expenditure thus far has been the $81.64 billion spent on the Canada emergency response benefit (CERB), the monthly $2,000 payments that were offered to Canadians who were unable to work during the pandemic, with 8.9 million people – a third of all adults in the country – having received them."[6]

CEWS is designed to help employers keep or rehire workers. When initially announced in March 2020, CEWS was only for a period of up to 12 weeks, starting retroactively on March 5 and ending on June 6. Similar to CERB, however, CEWS was further extended until October 2021. The overall period totalled 64 weeks (16 four-week periods).

Compared to CERB, the rules of CEWS were more complex. To be eligible for CEWS during the first 16 weeks (from March 15, 2020, to July 4, 2020), firms needed to experience at least a 10% decline in March and a 30% decline in both April and May. For the eligible employers, the Canadian government cover 75% of employees' wages, with the maximum subsidy topped at $847 a week. After the first 16 weeks, the wage subsidy has been modified to be available for all eligible employers that experience a decline in revenue for a claim period. However, the size of the subsidy will depend on the magnitude of the firms' revenue loss. This means that for employers

[5] Workers eligible for EI on and after March 15, 2020, can have CERB first and EI later. For example, if a worker is eligible for $300 per week for 15 weeks, the worker would receive $500 per week CERB for the first 24 weeks, and subsequently, the worker will be on EI for 15 weeks.

[6] https://www.cbc.ca/news/canada/ottawa-has-spent-240b-fighting-covid-19-in-just-8-months-a-cbc-investigation-follows-the-money-1.5827045

who experienced a minor decline in revenue, the subsidy rate is much smaller than 75%. CERB covers both small businesses and large firms – "A total of 380 companies received more than $5 million each in CEWS assistance, while close to 3,500 businesses received between $1 million and $5 million. The largest CEWS beneficiary appears to have been Air Canada, which has reported $492 million in wage subsidies ... To date, the federal government has doled out more than $77 billion in CEWS to approximately 443,000 companies, making it one of the largest relief programs in the country's history."[7] For employers such as Air Canada, CEWS seems to be used mainly for rehiring – "Air Canada to rehire 16,500 laid-off workers with help of the federal government's wage subsidy." [8]

According to the Government of Canada website, as of December 2020, the total fiscal costs for CERB and CEWS are $80 billion and $83 billion, respectively.[9] Given that the total COVID-19 Economic Response Plan from the Government of Canada is $324 billion, the two programs took about half of the 2020 stimulus package.

2.3 Government debt

The average government debt-to-GDP ratio in 2019 is 30%. As of September 2020, the total size of Canada's COVID-19 Economic Response is about $320 billion, which was equivalent to 14% of the nominal GDP in 2019. Due to the pandemic stimulus package, accumulated government debt increased from $691 billion in March 2020 to $923 billion. In September 2020, the debt-to-GDP ratio increased from about 30% to about 40%.

Among all the programs, CERB and CEWS are the two main ones, each costing about $80 billion (3.5% of 2019 nominal GDP). In contrast, prior to the pandemic, according to the Canadian government's 2019 budget, the average annual expenditure on the EI program is about $20 billion during the 2017 – 2019 period, which is about 1% of 2019 GDP. The total government subsidies in a typical year before the pandemic are also about $20 billion, or equivalent to 1% of the GDP.[10] However, it is unclear what fraction of the total subsidy is wage subsidy. The government incentives include subsidies on products and imports as well as subsidies on production. Before the pandemic, on average, about one-third of subsidies are on production and two-thirds on products and imports. Given that wage subsidies belong to subsidies on production, the wage subsidies-to-GDP ratio before the pandemic should be less than 0.3%.

[7] https://www.cbc.ca/news/canada/ottawa-has-spent-240b-fighting-covid-19-in-just-8-months-a-cbc-investigation-follows-the-money-1.5827045

[8] https://www.cbc.ca/news/business/air-canada-hiring-wage-subsidy-1.5525926

[9] COVID-19 Economic Response Plan – Overview (https://www.canada.ca/en/department-finance/economic-response-plan/fiscal-summary.html)

[10] Note that to keep the measurements consistent, the 2019 nominal GDP is used for computing the size of the program in this section.

3 The Model

The model consists of a representative household, firms and a government. The household consists of both employed and unemployed household members. The household consumes, saves government bonds and provides labour. The employed household members bring back wage income to the family and the unemployed workers have unemployment benefits. Firms post vacancies, and the only production input is labour. Firms also receive wage subsidies from the government. To finance unemployment benefits and wage subsidies, the government collects labour income tax and lump-sum taxes, and the government can also run deficits by issuing government debt. The model is solved nonlinearly using Dynare 4.6.4.

3.1 The representative household

Time is discrete. As in Merz (1995) and Andolfatto (1996), the household can be thought of as a large family. A fraction n_t of the family members are employed, and a percentage of them $1 - n_t$ are unemployed. When employed, they earn wages w_t. For the unemployed workers, they received unemployment benefits b_t, which is time-varying. The household's utility function is given by

$$E \sum \beta^t U(c_t), \tag{1}$$

where

$$U(c_t) = \ln(c_t - hc_{t-1}),$$

c_t denotes consumption, h is the habit persistence parameter. The household is subject to the following budget constraint

$$c_t + B_t = r_t B_{t-1} + w_t(1 - \tau_t)n_t + b_t(1 - n_t) + \pi_t - T_t, \tag{2}$$

where B_t is the household's holding of risk-free government bond, and r_t is the gross interest rate. π_t is the household's share of firms' profits. τ_t is the labour income tax rate. T_t is lump-sum tax. Both w_t and n_t are determined in the labour market. Taking w_t and n_t as given, the household chooses c_t to maximize equation (1) subject to equation (2).

3.2 Labour market

The labour market is modelled using the Diamond-Mortensen–Passarides (DMP) framework. The unemployed household members search for jobs and firms post vacancies to look for workers. Once a worker is matched with a vacancy, production begins. The aggregate matching function is

$$m_t = f(u_t, v_t) = \mu_t u_t^{\alpha} v_t^{1-\alpha},$$

where $u_t = 1 - n_t$ is the fraction of unemployed workers. v_t is the number of vacancies posted by firms, μ_t is the time-varying matching efficiency parameter, and α is the elasticity of matches concerning unemployment. The law of motion for employment is

$$n_{t+1} = n_t(1 - \delta_t) + m_t,$$

where δ_t is the separation rate, which is assumed to be time-varying.

Value functions

The value of being unemployed includes the unemployment benefits b_t, plus the continuation value: with probability f_t, the worker matches with a vacancy and with probability $1 - f_t$, the worker remains unemployed.

$$U_t = b_t + \beta E_t\{f_t W_{t+1} + (1 - f_t)U_{t+1}\}. \tag{3}$$

Equation (3) clearly shows the effect of an increase in b_t on U_t – an overly generous unemployment income would increase the value of staying unemployed and reducing workers' incentives to search for jobs.

The job finding rate f_t is given by

$$f_t = \frac{m_t}{u_t} = \mu_t \theta_t^{1-\alpha},$$

where θ_t is the labour market tightness. The value of being employed W_t includes wage w_t and the continuation value: with probability δ_t, the worker separates from the firm and returns to the unemployment state, and with probability $1 - \delta_t$, the match survives. The value function for an employed worker is given by

$$W_t = (1 - \tau_t)w_t + \beta E_t\{\delta_t U_{t+1} + (1 - \delta_t)W_{t+1}\}. \tag{4}$$

For firms, the value of posting a vacancy V_t includes a vacancy posting costs κ_t, and the continuation value: with the probability q_t, the vacancy is filled and with the probability, $1 - q_t$, the vacancy remains vacant. The value function is as follows.

$$V_t = -\kappa_t + \beta E_t\{q_t J_{t+1} + (1 - q_t)V_{t+1}\}, \tag{5}$$

where $q_t = \frac{m_t}{v_t}$ is the job filling rate. Finally, the value of a job is

$$J_t = y_t - (1 - s_t)w_t + \beta E_t\{\delta_t V_{t+1} + (1 - \delta_t)J_{t+1}\}. \tag{6}$$

y_t is the output of the match. w_t is the wage rate determined by the Nash Bargaining described in the next section. s_t is the time-varying wage subsidy rate.

The number of vacancies is determined by the free entry condition:

$$V_t = 0.$$

Given the free entry condition, the job creation equation (5) is

$$\frac{\kappa_t}{q_t} = \beta E_t\{y_{t+1} - (1 - s_{t+1})w_{t+1} + (1 - \delta_t)\frac{\kappa_{t+1}}{q_{t+1}}\}. \tag{7}$$

Equation (7) suggests that a rise in subsidy, s_{t+1}, increases the expected value of posting a vacancy $E_t\{y_{t+1} - (1 - s_{t+1})w_{t+1} + (1 - \delta_t)\frac{\kappa_{t+1}}{q_{t+1}}\}$, which in turn encourages the firms to post vacancies.

Wage determination

As in the standard DMP framework, the wage is determined by Nash Bargaining. That is, the optimal wage maximizes

$$(W_t - U_t)^\eta (J_t - V_t)^{1-\eta},$$

where η is workers' bargaining power. With free entry condition $V_t = 0$, $\frac{dW_t}{dw_t} = 1 - \tau_t$ and $\frac{dJ_t}{dw_t} = -(1 - s_t)$, we can show that

$$\frac{J_t(1 - \tau_t)}{(1 - \eta)(1 - s_t)} = \frac{W_t - U_t}{\eta}.$$

Given $\frac{f_t}{q_t} = \theta_t$ and $\frac{\kappa_t}{q_t} = \beta E_t J_{t+1}$, the bargaining wage w_t satisfies the following equation

$$w_t = \frac{1 - \eta}{1 - \tau_t} b_t + \frac{\eta}{1 - s_t}(y_t + \kappa_t\theta_t). \tag{8}$$

Equation (8) suggests that w_t increases when there is a rise in b_t or s_t. A rise in b_t increases the value of unemployment, thus unemployed workers demand higher wages; while a rise in s_t increases firms' profit margin. As a result, firms can afford to offer higher wages.

3.3 Government

The government purchases public goods, G_t, pays the unemployment benefits $b_t(1 - n_t)$, gives out wage subsidies $s_t w_t n_t$, and pays back government debt B_{t-1}. The expenses are financed by labour tax $w_t\tau_t n_t$, lump-sum tax T_t and government debt $\frac{B_t}{r_t}$. The government budget constraint is

$$G_t + b_t(1 - n_t) + s_t w_t n_t + B_{t-1} = w_t\tau_t n_t + T_t + \frac{B_t}{r_t},$$

Following Leeper et al. (2010), to ensure the solvency of the government in the long run, I assume that T_t, the lump-sum tax, follows

$$T_t = (\frac{B_{t-1}}{B_{ss}})^\phi T_{ss},$$

where $\phi > 0$ captures the speed of the adjustment.

3.4 Resource constraint

The aggregate output is given by

$$Y_t = n_t y_t,$$

and it is consumed by the household (c_t) and government (G_t), and used for vacancy costs by firms (κv_t),

$$Y_t = c_t + G_t + \kappa v_t.$$

4 Calibration

In this section, I use the model to study the impact of the pandemic on the labour market and the effect of the two programs. Given the nature of the pandemic – a once-in-a-century event – I assume that the pandemic shock and the related programs are unexpected. I follow Faria-e Castro (2021) to study the nonlinear perfect foresight paths of the model. With perfect foresight, shocks in the model are unexpected; however, once the shocks hit the economy, the path of the shocks is perfectly anticipated. Different from the model with stochastic shocks, the aggregate uncertainty does not play a role in the model. In the paper, I model the pandemic shock as a combination of shocks to job separation rate δ_t and matching efficiency μ_t.

4.1 Calibrated parameters

The calibrated parameters are listed in Table 1. For model variables, their steady-state values are set either to the values of their data counterparts in January 2020, the eve of the pandemic or the data average in 2019. To better capture the labour market dynamics, one period in the model is set to one month. The monthly discount factor, β, is set to 0.9967, matching the average 10-year Canadian government bond yield in 2019. The steady-state unemployment rate is set to 5.6%, which is the unemployment rate in January 2020. The steady-state job separation rate is set to 3%, the level in January 2020, implying that the average job tenure is 2.5 years or 30 months. The steady-state value of the labour market tightness, θ_t, is set to 0.56, the data average in 2019. I set the income tax rate τ_t to 12%, the data average in 2019. For government spending, I set the government spending-to-GDP ratio G_t/Y_t to 0.25 and the government debt-to-GDP ratio to 0.3. Both numbers are based on the 2019 data. The habit persistence parameter, h, is set to 0.85, and the bargaining power parameter is set to 0.5. Both values are standard in the literature. The speed of adjustment for lump-sum tax is set to 0.25, within the range suggested by Leeper et al. (2010).

The steady-state values of the replacement ratio, b_{ss}, and the subsidy rate, s_{ss}, are the key values for calibrating the impact of CERB and CEWS. I set b_{ss} to 0.2 to match the EI-to-GDP ratio of 1% in the data. Note that setting b_{ss} to 0.4, a typical value used in the literature, would lead a EI-to-GDP ratio much higher than the data. For the subsidy rate s_{ss}, I set it to a very small number $s_{ss} = 0.003$, the upper limit of wage subsidies-to-GDP ratio in the data prior to the pandemic.

Table 1: Calibrated Parameter Values

	Description	Value	Target
β	Monthly discount factor	0.9967	10 year Government Bond Yield
u_{ss}	Steady state unemployment rate	5.6%	Unemployment rate in Jan. 2020
y_{ss}	Steady state output	1	Normalization
τ	Income tax rate	12%	2019 data average
$\frac{G_{ss}}{y_{ss}}$	Government spending to GDP ratio	0.25	2019 data average
$\frac{debt_{ss}}{y_{ss}}$	Government debt to GDP ratio	0.30	2019 data average
h	Habit persistence parameter	0.85	Literature
θ_{ss}	Labour market tightness	0.56	2019 data average
ϕ	Lump sum tax adjustment parameter	0.25	Literature
α	Matching elasticity	0.5	Literature
η	Workers' bargaining power	0.5	Literature
b_{ss}	Replacement ratio	0.2	EI-to-GDP ratio, 2017-19 data average
s_{ss}	Wage subsidy rate	0.003	Subsidy-to-GDP ratio, data average

4.2 The effect of increasing unemployment benefits and wage subsidies

CERB (a rise in b_t) and CEWS (a rise in s_t) affect both workers' job search behaviour and firms' hiring practice during the pandemic. With the calibrated values, I use Figures 2 and 3 to illustrate the basic mechanism about how a rise in b_t and s_t affect the labour market outcome. I assume that there is a shock leading to a one percent increase in b_t in period 1, and the persistence of the shock is 0.9. Figure 2 displays the responses of the labour market key variables to the shock. The rise in unemployment benefits increases the value of being unemployed and in turn, decreases the capital gain of transiting from unemployment to employment $(W_t - U_t)$. The decline in $(W_t - U_t)$ suggests that the value of having a job is lower for unemployed workers when unemployment benefits are more generous. As a result, unemployed workers demand higher wages, causing the equilibrium wage w_t to rise. The rise in wages shrinks the profit margin and firms post fewer vacancies. Fewer vacancies and higher reservation wages for the unemployment workers lead to a higher unemployment rate. The labour market is less tight and the job finding rate is lower. Since fewer workers are employed, the output is lower. Consumption, however, rises since higher b_t increases workers' income. Finally, the rise in government transfer leads to a higher debt-to-GDP ratio.

Figure 3 illustrates the effect of rising wage subsidies on the labour market. A rise in s_t increases firms' profits, leading the capital gain of having a filled vacancy $J_t - V_t$ to rise. Firms can afford to offer higher wages to workers and post more vacancies. As a result, the number of unemployed workers declines. This leads to a tighter labour market and a higher job-finding rate. More workers are employed and output rises. Consumption, however, declines on impact because more resources are used to post vacancies (consumption rises after a few periods due to the rise in output). Furthermore, similar to the case of increasing b_t, the rise in wage subsidies leads to a rise in the debt-to-GDP ratio.

5 The pandemic shock and effects of CERB and CEWS

In this section, I first discuss how I calibrate the pandemic shock. I then use the calibrated pandemic shock to simulate the no-intervention scenario. In the no-intervention scenario, the pandemic shock lasts until the early 2021 and there is no government support programs such as CERB and CEWS. Next, I simulate the economy under CERB and CEWS and quantify the impact of the two programs on the aggregate economy.

5.1 The pandemic shock and worst-case scenario – no fiscal policy interventions

In the literature, there are two ways to model the pandemic. One approach is to combine an epidemiology model with a standard economic model (for example, an RBC model or a DSGE model). With this approach, the infection from one agent to the other is explicitly modelled – the infection causes lockdowns, leading to a rise in the unemployment rate (Birinci et al., 2021). The other approach is a reduced-form approach – modelling the pandemic as an exogenous shock. For example, Albertini et al. (2021) uses a combination of job separation shock and matching efficiency shock to model a COVID-19 shock. In Faria-e Castro (2021) the pandemic shock is a shock to marginal utility – the shock reduces the demand for consumption goods, in turn, reduces the demand for labour to produce this type of goods. Given the simple labour search model used in this paper, a natural choice for modelling the pandemic is the reduced-form approach.

To estimate the pandemic shock, information on the job separation and job finding rates is used from 2020M1 to 2020M5. I assume that the sharp rise of the separation rate and steep decline of the job finding rate during 2020M1 to 2020M5 are completely due to the lockdown caused by the pandemic; while the dynamics of the two rates during 2020M6-M12 reflect the combination of effects from lockdown, emergency response package, and the self-recovery of the labour market. Given this, I construct a series of shocks hitting the job separation rate δ_t and matching efficiency parameter μ_t so that the model-generated job separation and job finding rates match the corresponding data series from 2020M1 to 2020M5 (the first two panels of Figure 4).[11] The last panel of Figure 4 compares the model-generated unemployment rate with its data counterparts. It shows that the simulated unemployment rate largely matches the path of the empirical data from 2020M1 to M5.

Next, I construct the worst-case scenario – no-intervention case – for the period 2020M6-M12. I assume that the size of the two shocks remain the same during 2020M6-M12 as the one in May

[11] Note that although the dynamics of the model-predicted job finding rate match its empirical counterpart from February to December 2020. The model predicted steady-state job finding rate is higher than that in the data (0.50 in the model vs. 0.38 in the data). The empirical job finding rate is calculated using both the unemployed population and short-term unemployed population while in the model there is no short-term unemployment. Due to this, to match the steady-state unemployment rate in the data, the model requires a higher steady-state job-finding rate.

2020. That is, in the worst case scenario, the economy is under a strict lockdown for the second half of 2020 and there are no policy interventions such as CERB and CEWS. I further assume that from 2021M1 both the job separation and finding rates started to recover and are back to the prior-pandemic level (the steady-state level) at the end of 2021. This assumption is based on the Canadian government starting the vaccination campaign in January 2021 and by the end of 2021, about 84% of the Canadian population had the first dose and 77% of the The Canadian population is fully vaccinated.[12] Figure 4 illustrates that under this worst-case scenario, the unemployment rate would stay above 14% until the end of 2020, well above the unemployment rate observed in the data, suggesting the government intervention could have played an vital role in economic recovery.

Figure 5 further shows the responses of the other key macro variables in the worst-case scenario. A strict lockdown without any support programs would lead employment and output to stay about 9% lower compared to the steady-state employment level for the most parts of 2020. The decline in consumption is even larger, reaching almost 19%. The high unemployment rate leads to a sharp rise of government transfer, causing the debt-to-GDP ratio to rise from 30% to almost 34% by the end of 2021.

5.2 CERB and CEWS

CERB The CERB program is captured by the rise of the government expenditure on employment benefits $u_t b_t$ in the model. I engineer a sequence of shocks hitting b_t so that the CERB-to-GDP ratio (unemployment benefit-to-GDP ratio) is about 3.5% from March to December 2020, as suggested by the data. Figure 6 compares the effect of CERB with the no-intervention case. Note that in the worst-case scenario, the unemployment benefit-to-GDP ratio still rises by about 3% (the first panel). Since in this case, $b_t = b_{ss}$, the rise of the unemployment benefit-to-GDP ratio is completely due to the rise in u_t. This means that the Canadian government extends unemployment benefits to all the workers who lost jobs due to the pandemic while keeping $b_t = b_{ss}$.

The first panel demonstrates that to reach to the unemployment benefit-to-GDP ratio of 3.5%, the average unemployment benefit per unemployed worker must be larger during the pandemic. That is, $b_t > b_{ss}$. the rise in b_t leads to a slightly higher unemployment rate compared to the no-intervention case. This is consistent with the result from Figure 2. The rise in b_t decreases the incentive for workers to search for jobs. As a result, both employment and output decline slightly more compared to the no-intervention case. Surprisingly, the impact of CERB on consumption is negligible. This is because in the model, the consumption of the unemployed and employed workers is assumed to be the same due to the large family structure. On the one hand, the CERB program increases the income of the unemployed workers, which potentially increases their consumption; on the other hand, fewer workers are employed due to the generosity of the CERB, causing the wage income to decline. The two effects cancel out each other and thus total income and consumption

[12]Data on vaccination rates are based on https://www.google.com/search?q=vaccination+rate+in+canada&rlz=1C1CHZL_enCA751CA
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barely changes under CERB.[13] Note that under CERB, the government debt-to-GDP ratio rises about two percentage points more compared to the no-intervention case.

CEWS Similar to the CERB case, I use the CEWS-to-GDP ratio in the data to calibrate the shocks to s_t. As of December 2020, the amount of government spending on the CEWS program is about \$80 billion, which is equivalent 3.5% of the nominal GDP in 2019. Based on this, I engineer a series of shocks to s_t so that the subsidy-to-GDP ratio equals to 3.5% from March 2020 to December 2020. To capture that CEWS is used to rehire workers laid off in the early part of the pandemic and that vacancy posting costs are much lower for this type of hiring than regular hiring, I assume that a series of negative shocks affected the vacancy posting cost parameter κ_t. The size of the shocks are pinned down as follows. Based on a CBC report dated December 2020, about 3.9 million workers benefited from CEWS.[14] This is about 23% of the total number of employed workers of 17 million in 2019. As it is challenging to know the exact fraction of the 3.9 million workers who benefited from CEWS due to rehiring, I simply assume that the half of them are hired back to their previous employer with the help of CEWS. This assumption would suggest that about 11.5% of the workforce from March 2020 to December 2020 is associated with the CEWS rehiring. Normalizing regular hiring costs to 1 and assuming the vacancy posting costs is zero for rehiring, the average vacancy posting costs become 0*0.11+1*0.89=0.89, which results in about a 10% reduction in average vacancy costs due to CEWS.

Figure 7 shows the effect of CEWS. As previously shown in Figure 3, wage subsidies increase the incentive of the firms to post vacancies, leading the job finding rate to rise. This reduces the unemployment rate – the peak of the unemployment rate declines from about 14% to 13%. Since more workers remain in the labour force, the decline in output is smaller than that in the no-intervention case (about 8% decline under CEWS vs. 8.5% under no-intervention). The decline in consumption is also dampened due to CEWS – a 17% decline under CEWS vs. an 19% decline under no-intervention.

6 Conclusions

In this paper, I quantify the effect of the two most important labour market programs implemented by the Canadian government during the pandemic – CERB and CEWS. I use a simple representative agent model with explicitly modelled labour market frictions. I show that the CERB program slight decreases workers' incentive to search for a job, resulting a slightly higher unemployment rate. I also find that although the CERB program increases the income for unemployed household members, aggregate consumption barely changes. For CEWS, I find that it is very effective in terms of increasing the job finding rate and mitigating the pandemic impact on unemployment.

[13] This does not conflict with the fact that consumption increases in Figure 2 after the rise in unemployment benefits. Consumption rises in Figure 2 is simply because the wage income effect dominates the unemployment benefits effect under the shock used in Figure 2.

[14] https://www.cbc.ca/news/canada/montreal/cews-wage-subsidy-jobs-covid-1.5834790

Given the simplicity of the model, the paper is abstract from many important features related to the pandemic. For example, there are two channels for CEWS to play a role in maintaining the workforce: use the subsidies to keep the workers on the payroll (instead of laying off workers) or rehire the workers laid off during the pandemic. In the paper, I focus on the second channel – the rehiring channel, completely being abstract from the first channel. Incorporating endogenous separation into the model is one direction to go to capture the first channel. Moreover, I use a representative agent framework to evaluate the two programs and the analysis in this paper is completely abstract from the fact that there is a significant amount of heterogeneity in terms of the impact of the pandemic. For example, among all the sectors, workers employed in the sector that requires more intensive in-person contact (restaurants, hotels) are more likely to lose their jobs. As a result, the two programs play a more important role in such sectors. To study the effects of the two programs, introducing heterogeneity at the sector level is another direction for future research.

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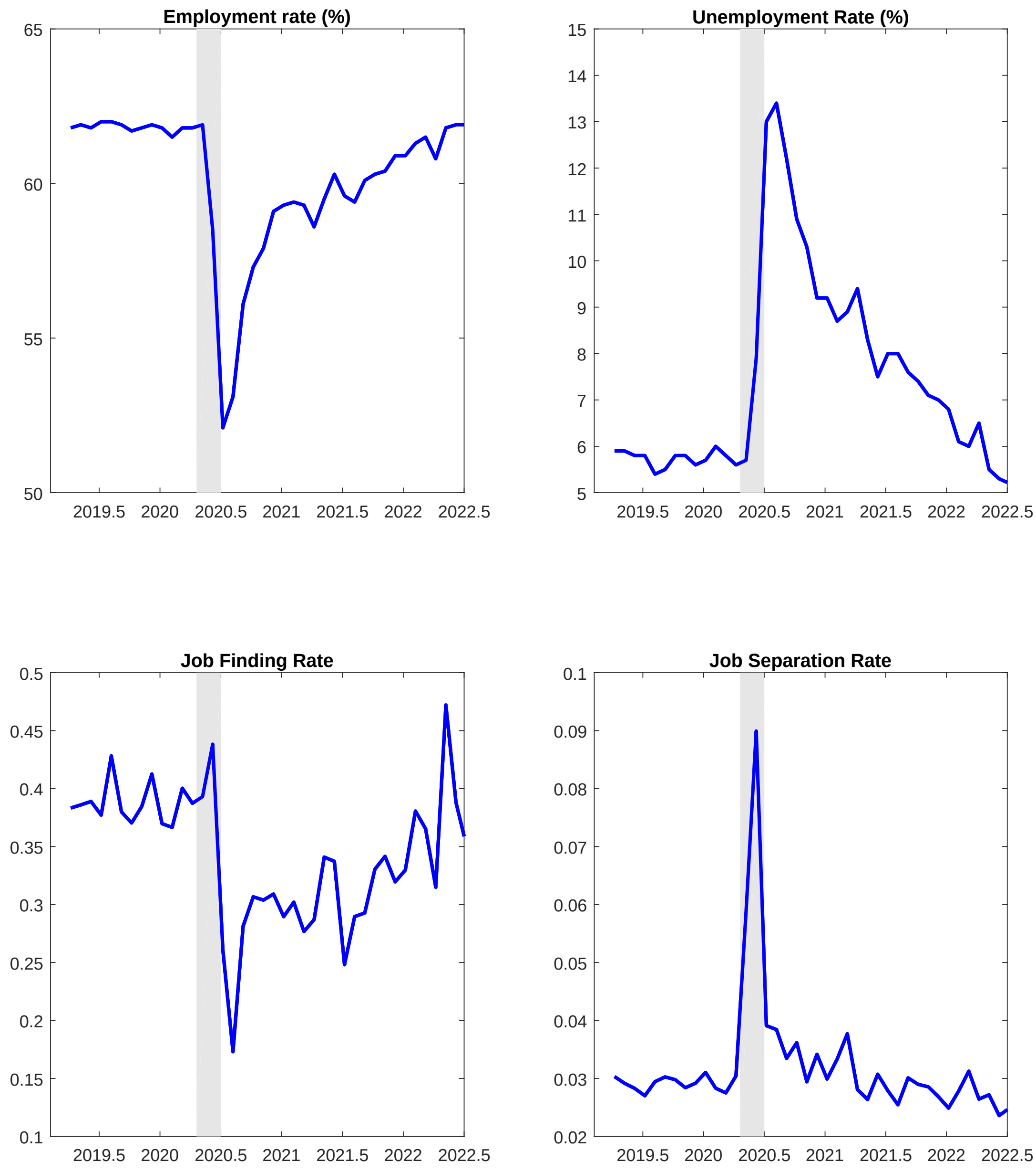
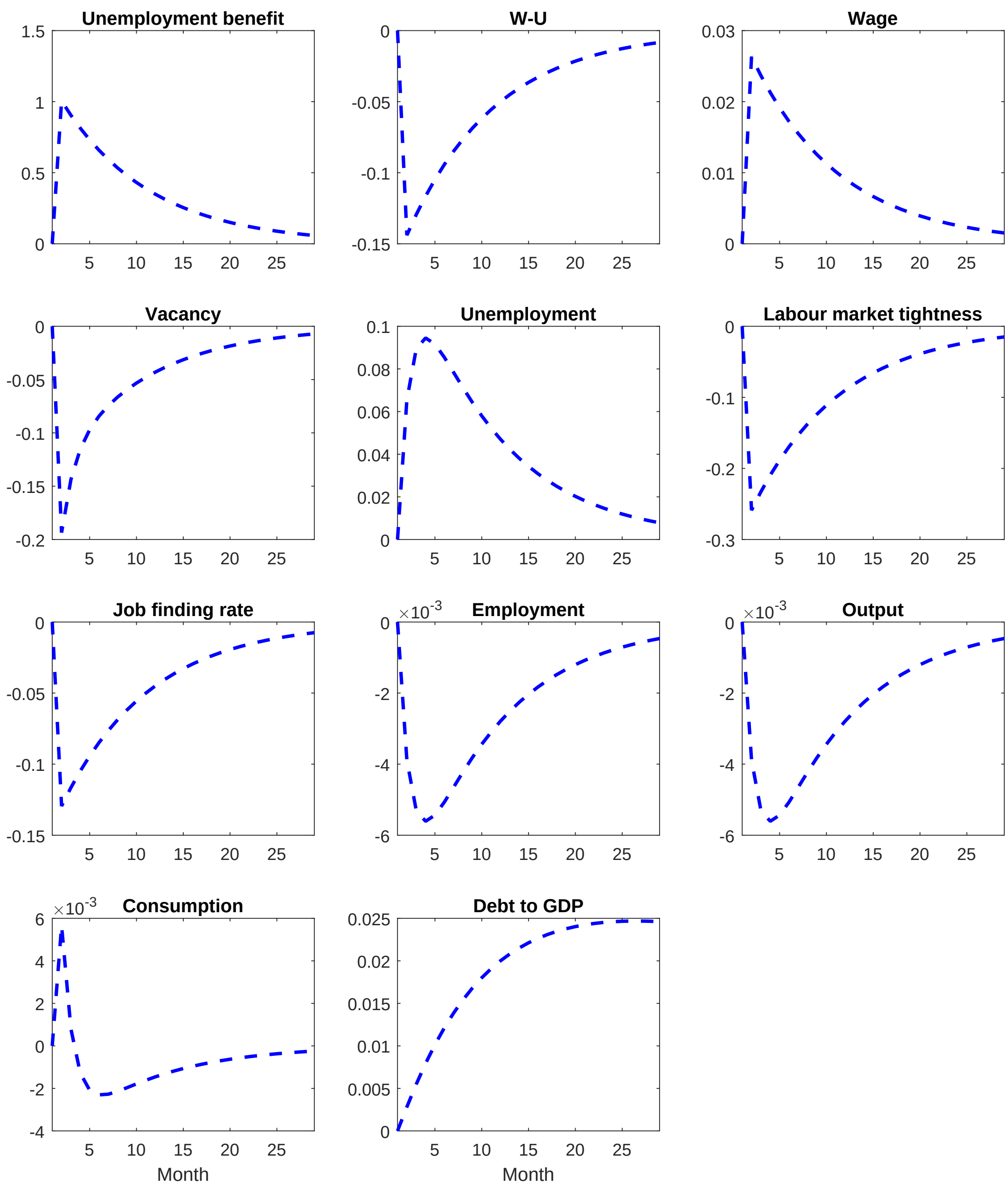
Figure 1: Impact of Covid on Canadian Labour Market



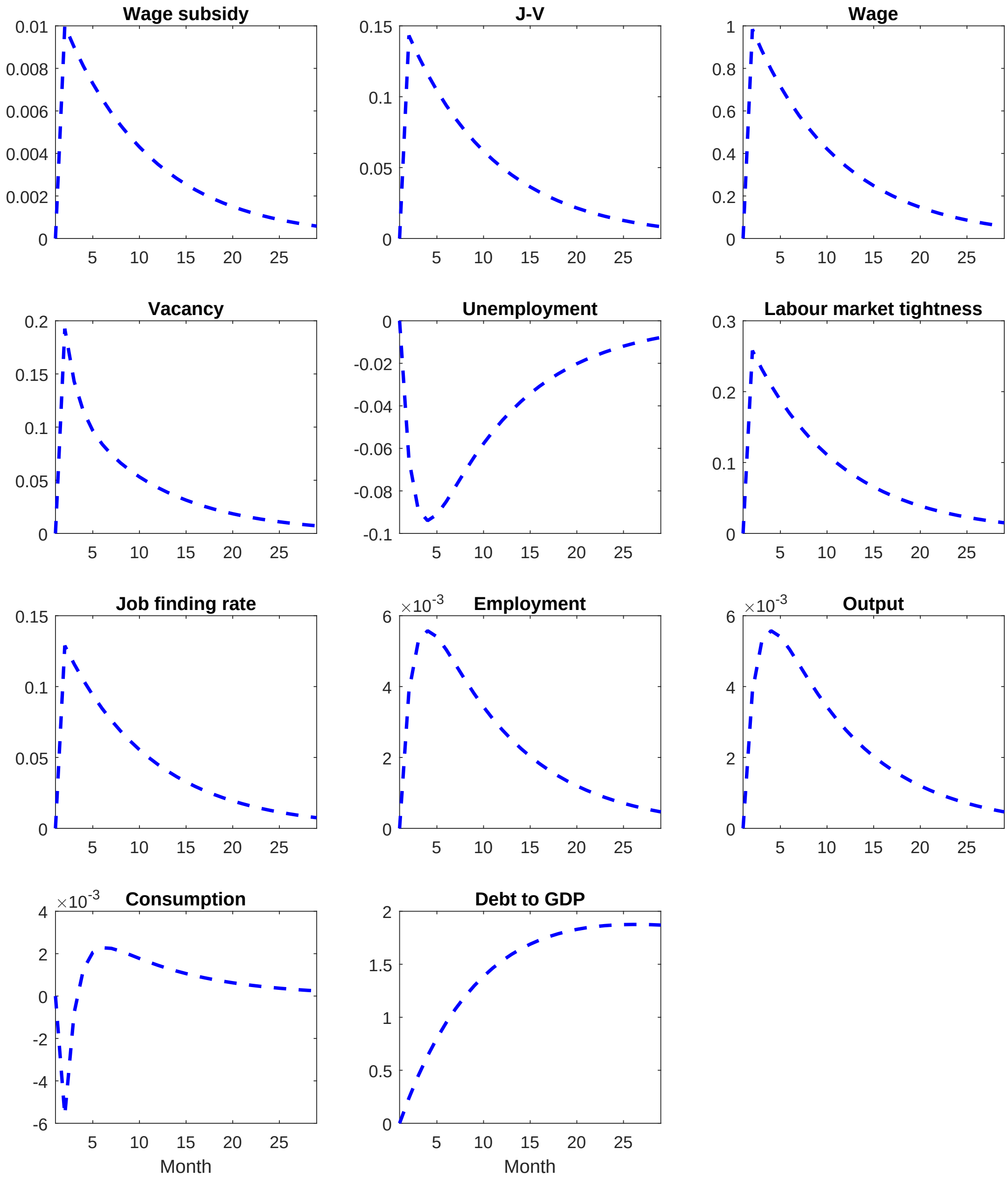
Notes: The shaded area indicate the period from 2020M3 to 2020M5.

Figure 2: Effect of increasing unemployment benefits



Notes: All variables are expressed as percentage deviation from their steady-state values.

Figure 3: Effect of increasing wage subsidy



Notes: All variables are expressed as percentage deviation from their steady-state values.

Figure 4: Simulating the Pandemic Shock

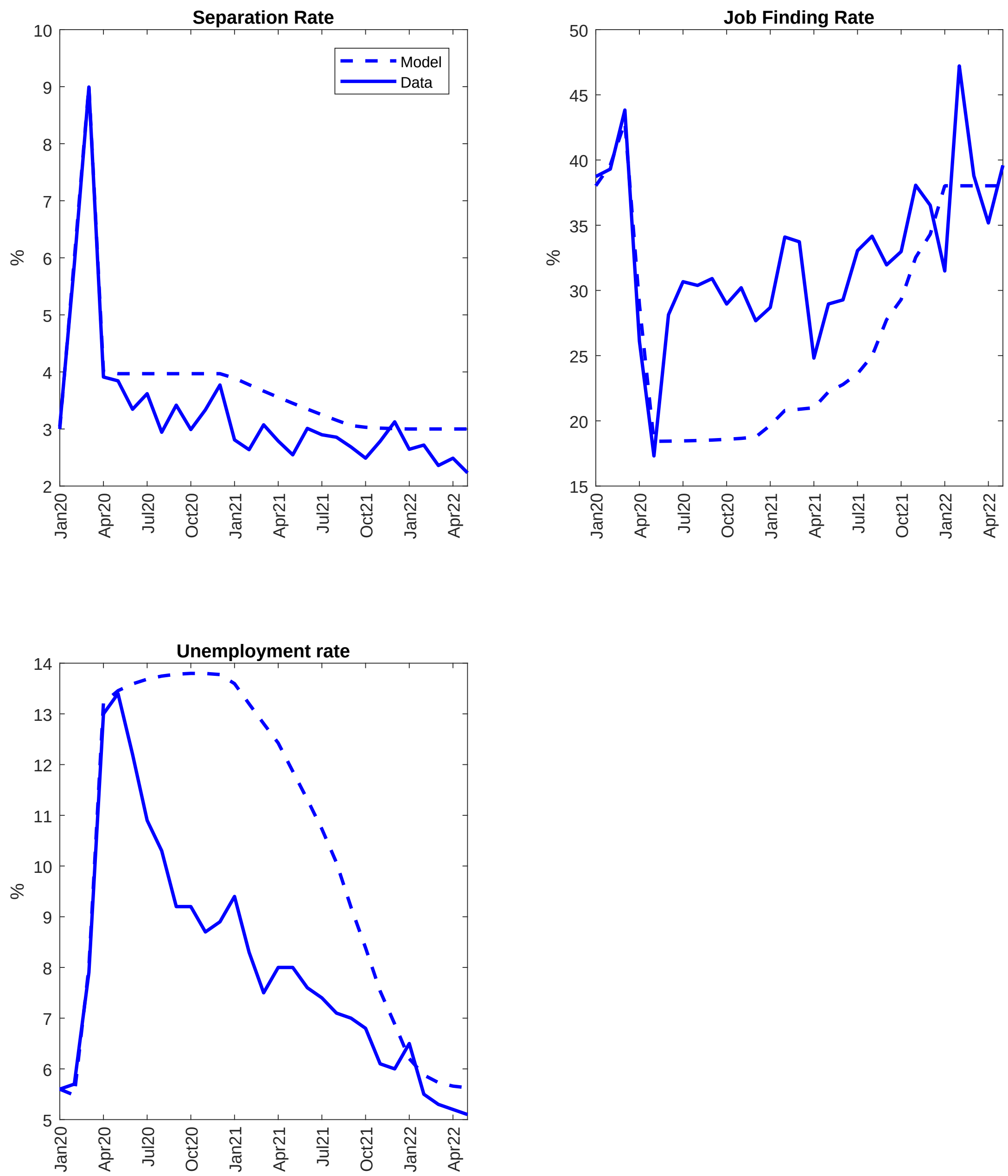


Figure 5: Impact of Pandemic – No Policy Intervention

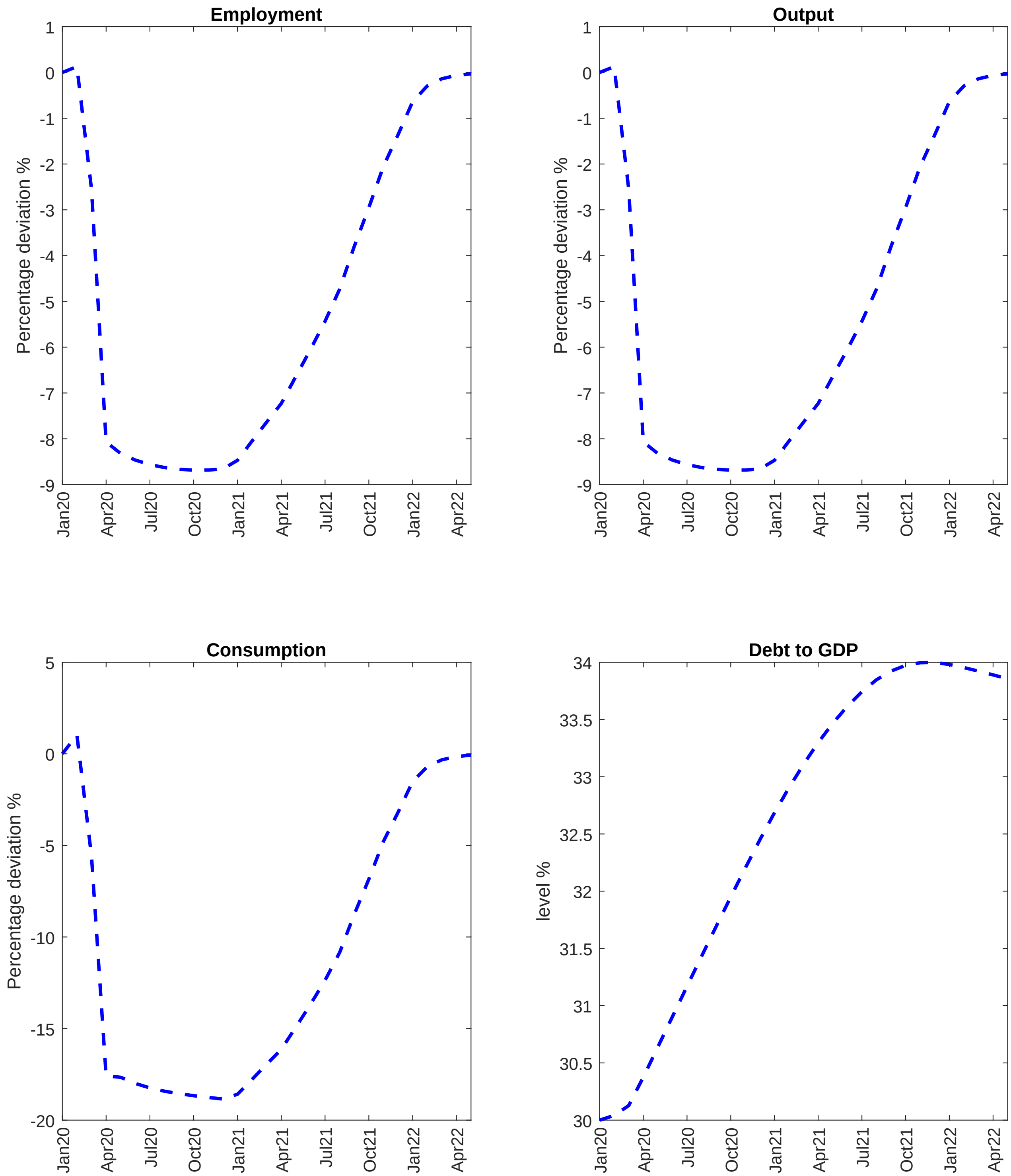


Figure 6: Effects of CERB

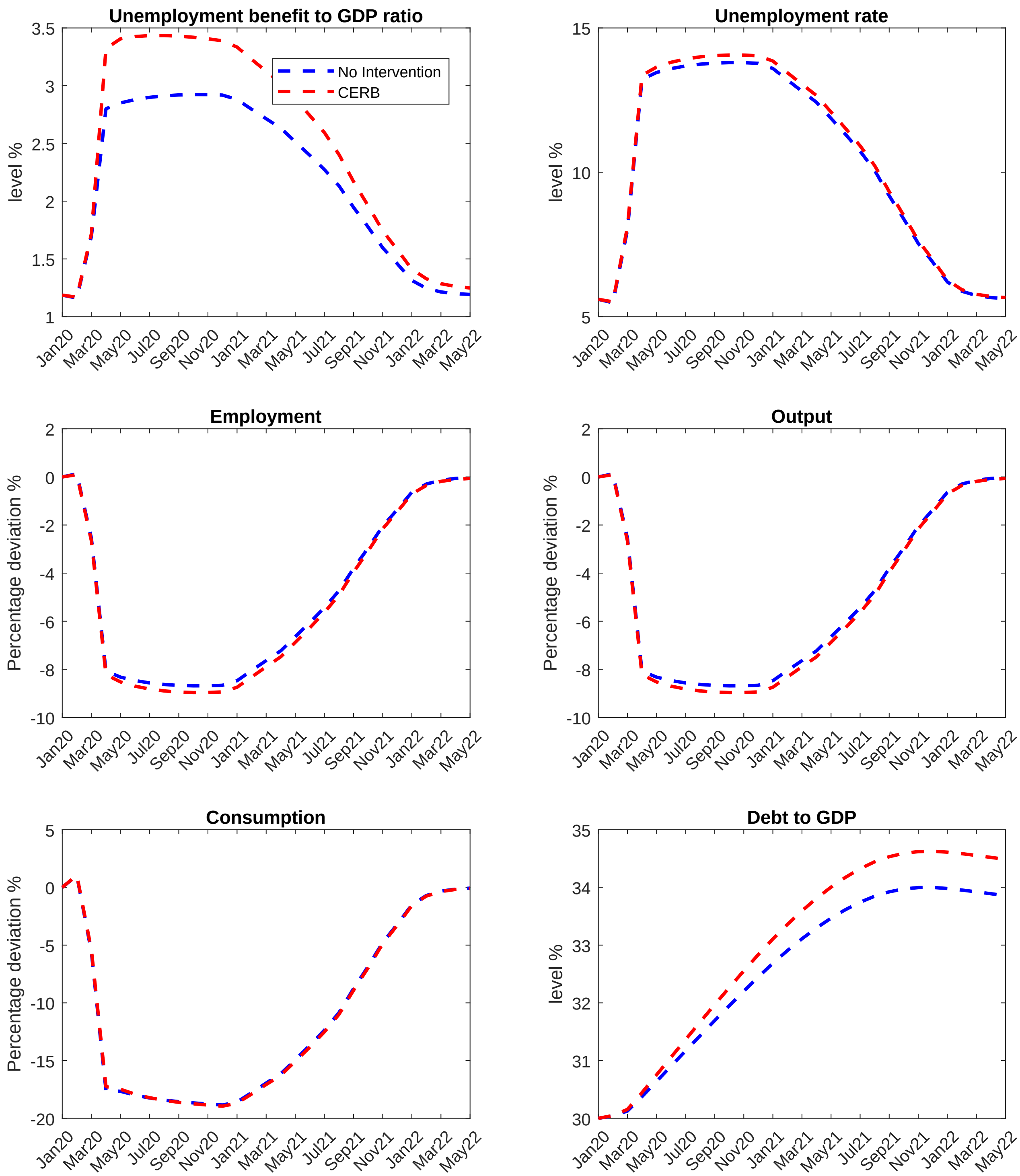


Figure 7: Effects of CEWS