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Abstract

We assess the macroeconomic effects of unemployment insurance (UI) extensions in the US through a novel identification scheme based on the design of the UI policy rule. Our approach exploits differences in the effects of demand shocks across US states with different responses in UI duration. Our results indicate that UI extensions have a significant stabilization role. We then show that a New Keynesian small-open-economy model with imperfect insurance against unemployment aligns with our empirical findings. Finally, we use the model to recover the implied UI multiplier, quantify the different transmission channels of UI extensions and uncover their union-wide effects.

Keywords: unemployment insurance, UI extensions, heterogeneous agents.

JEL classification: E62, E24, E21, E30, J60, R12.

Resumen

Evaluamos los efectos macroeconómicos de las extensiones del seguro de desempleo (UI, por sus siglas en inglés) en Estados Unidos mediante un esquema de identificación basado en el diseño de la regla de política del UI. Nuestro enfoque explota las diferencias en los efectos de *shocks* de demanda entre los estados de ese país que presentan distintas respuestas en la duración del UI. Los resultados indican que las extensiones del UI desempeñan un papel significativo en la estabilización económica. Luego, mostramos que un modelo neokeynesiano de pequeña economía abierta con seguro imperfecto contra el desempleo se alinea con nuestros hallazgos empíricos. Finalmente, utilizamos el modelo para recuperar el multiplicador implícito del UI, cuantificar los diferentes canales de transmisión de las extensiones del UI y analizar sus efectos a nivel agregado.

Palabras clave: seguro de desempleo, extensiones del seguro de desempleo, agentes heterogéneos.

Códigos JEL: E62, E24, E21, E30, J60, R12.

1 Introduction

The duration of unemployment insurance (UI) benefits in the US is typically extended during recessions in response to increasing unemployment rates.[1] The employment effects of UI extensions are commonly debated in academic and policy circles. While some research has emphasized the expansionary demand-side effects that come with UI, others have warned about their detrimental supply-side effects. At the same time, the wave of empirical research triggered by the large increases in UI duration witnessed during the last recessions often arrived at mixed results.[2] Therefore, the macroeconomic consequences of UI extensions remain an open question. This paper contributes to this debate, specifically addressing the following question: What are the macroeconomic effects of *systematic* UI extensions?

It is challenging to identify the causal impacts of a systematic response of UI extensions. Ideally, one would like to observe two identical regions, with the only difference between them being that one region has a UI policy rule that systematically extends UI duration when unemployment rates increase (Region A in Figure 1) and the other does not (Region N in Figure 1). Comparing the macroeconomic behavior between both regions would then identify the treatment effects of having a *systematic* UI policy rule on macroeconomic outcomes. However, such a clean experiment is not feasible in reality. As a result, much of previous research has sought to identify exogenous changes in UI duration that are orthogonal to local economic conditions. The hope is that these exogenous changes are informative about the actual effects of the systematic policy.[3]

In this paper, we propose a different approach to approximate the experiment outlined above. Our strategy exploits the non-linear design of UI policy in the US in conjunction with identified government spending shocks. UI policy is non-linear because – as we show empirically – the pre-existing level of UI duration determines the response of UI extensions to government spending shocks across US states. Therefore, variation in the effects of fiscal shocks across different pre-existing levels of UI duration is informative about the effects of extending UI benefits. Our first results show that UI extensions provide a significant cushion against regional-level shocks. Given that our strategy is an approximation of an infeasible experiment, we explicitly address potential limitations. We argue that, conceptually, any potential threats to our identification would bias our estimate towards zero. Additional empirical analysis addressing these concerns illustrates that the stabilizing effects of UI extensions remain a robust empirical result. We then inter-

[1] For example, UI benefit duration increased four-fold during the Great Recession and three-fold during the pandemic.

[2] For example, Hagedorn *et al.* (2019) and Johnston and Mas (2018) find contractionary effects of UI, while Chodorow-Reich *et al.* (2018), Boone *et al.* (2021) and Di Maggio and Kermani (2016) find non-negative or expansionary effects. We review this literature in more detail at the end of the introduction.

[3] There are efforts in the literature that aim to infer the effects of systematic policy from exogenous shocks, e.g., Sims and Zha (2006). More recently, McKay and Wolf (2023) show that, under certain assumptions, with a sufficiently rich set of shocks, one can approximate the effects of a systematic policy.

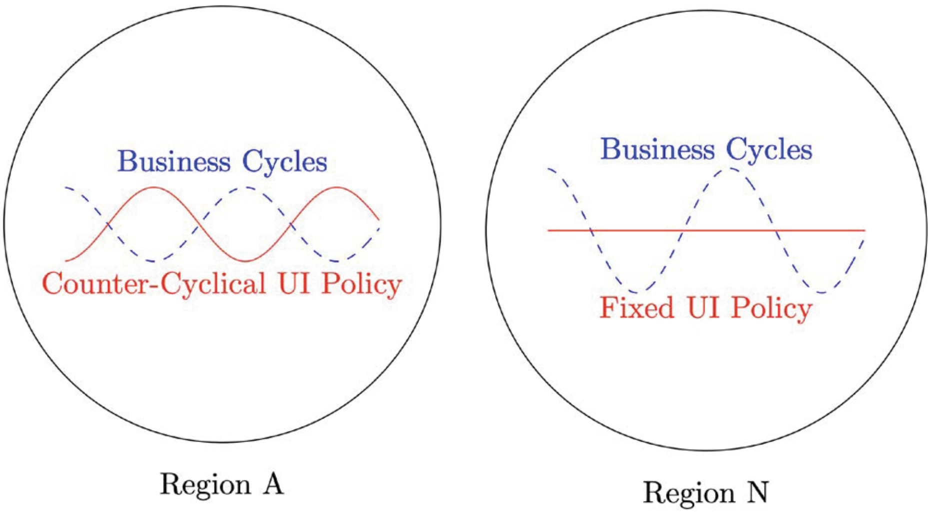

Figure 1: The Ideal Identification Strategy

pret our empirical findings through a model that resembles our empirical framework and show that it can account well for our empirical estimates. Using the model, we recover a cumulative UI multiplier of roughly -0.09, indicating that a one-quarter UI extension reduces the unemployment rate by 0.09 percentage points. Finally, we quantify the demand and supply-side transmission channels of UI extensions.

More in detail, the UI policy rule allows US states to extend UI duration beyond its regular level when unemployment exceeds a predefined threshold. This regular level is set independently of the business cycle. While the existence of UI extensions is a well-known feature, we emphasize a significant but overlooked aspect of UI policy: the non-linear response of UI duration to changes in economic conditions. For instance, a state that has previously extended UI benefits can revert to the regular duration as unemployment decreases, mimicking Region A in Figure 1. In contrast, states with regular UI duration cannot cut UI generosity in response to the same fall in unemployment, mimicking Region N in Figure 1. Furthermore, since regular UI sets a lower bound for UI duration, the reduction in UI duration can be more substantial for states with longer UI extensions. In other words, differences in the pre-existing level of UI duration result in differences in the response of UI extensions, which allows us to explore their treatment effects.

Our identification strategy exploits precisely this non-linear design of UI policy. To develop intuition, focus on the first example mentioned above. Consider two identical US states. The unemployment rate is temporarily higher in the first state, Region A, which leads to an extension of UI benefits. Now, suppose both states are hit by an equally sized positive demand shock that reduces unemployment. Region A, due to its extended UI benefits, reacts by reducing the UI duration in response to the declining unemployment rate. In contrast, UI duration remains unchanged in Region N, which had a regular duration of UI benefits. Since both states experienced the same demand shock, the difference in the estimated output response between them can be attributed to the *systematic* reaction of UI extensions.

We implement this strategy using a quarterly-frequency panel dataset at the state level in the US. Our source of demand shocks is identified government spending shocks. In order to identify these shocks, we build on the previous literature on state-level fiscal multipliers (Nakamura and Steinsson, 2014; Auerbach *et al.*, 2024; Demyanyk *et al.*, 2019) and rely on state-level military government spending from Department of Defense contracts data. Following Nakamura and Steinsson (2014), we use a Bartik-type identification approach that exploits the cross-state heterogeneous sensitivities to national military spending.

We first show that a favorable economic condition, induced by a positive government spending shock, reduces the additional duration of UI benefits and that the cut in UI duration is significantly more pronounced for those states that have longer *pre-existing* UI extensions, in line with the non-linear design of UI policy discussed above. In other words, UI extensions endogenously respond to expansionary fiscal shocks, and this endogenous response is stronger when the pre-existing level of UI extension is larger. We then compute relative state-level unemployment and earnings government spending multipliers conditioning on the *pre-existing* UI extensions by means of state-dependent local projections (Jordà, 2005).

The main empirical finding is as follows: when fiscal shocks hit a state with pre-existing UI extensions, the size of the fiscal multiplier falls significantly. In other words, the stimulus to state-level unemployment and earnings from the government spending shock is significantly smaller when it coincides with a reduction in UI duration. Therefore, our empirical estimates support the idea that UI extensions provide a substantial cushion against regional-level shocks.

Our empirical design is not an experiment. Therefore, limitations exist. In an ideal setting, the experimenter exogenously assigns the treatment (endogenous reaction of UI extensions). This is not the case in our setting. Our interpretation that a fall in UI extensions causally leads to a lower fiscal multiplier implicitly assumes that no other state-level characteristic correlated with UI duration would lead to a lower fiscal multiplier. We take two further steps to verify that this indeed holds in the data.

First, we augment our baseline specification to consider a series of "horse races" between UI duration and alternative competing state-level variables. A first one accounts for state-level economic slackness, addressing the possibility that fiscal multipliers might vary with the business cycle (Auerbach and Gorodnichenko, 2012; Bernardini *et al.*, 2020). A second one considers the fraction of unemployed workers receiving UI benefits, controlling for potential heterogeneity in the pool of unemployed workers which could affect the state-level marginal propensity to consume and hence the size of the fiscal multiplier (Birinci and See, 2023; Albertini *et al.*, 2021). A third one accounts for state-level political orientation, as more progressive states tend to have longer UI duration and political orientation may affect the effects of fiscal policy (Carlino *et al.*, 2023).

Second, we expand our baseline specification to show that our results are not driven by unobserved covariates that jointly drive the size of the fiscal multiplier and UI duration. For example, it could be that a state has temporarily higher unemployment and hence an extended UI because it has more rigid wages than the average. Such region-specific characteristics would also affect the size of the fiscal multiplier. We first note that even if this is the case, this feature would drive up the size of the multiplier, which is exactly the opposite of what we find. However, we still address this concern by relying on UI extensions due to measurement errors in tracking real-time unemployment constructed by Chodorow-Reich *et al.* (2018) as an instrument for actual UI duration. This extension of our baseline unties differences in UI duration across states to potential differences in unobserved characteristics.[4]

The estimates that we obtain under these different extensions corroborate our baseline finding – both quantitatively and qualitatively – that UI extensions reduce the response of state-level unemployment and earnings to government spending shocks.

We next present a model of a small open economy that belongs to a monetary union, which mimics our empirical setting, to interpret our empirical findings (Galí and Monacelli, 2005). We introduce search-and-matching frictions in the framework together with household heterogeneity in the İmrohoroğlu-Bewley-Hugget-Aiyagary tradition. The rich heterogeneity allows for a realistic quantitative assessment of the relative importance of demand-side vs. supply-side channels. The local fiscal authority provides federally-financed UI benefits with limited duration, which we model through stochastic expiration. We consider a UI rule that extends UI when the local unemployment rate is above some pre-defined threshold, mimicking the actual policy rule.

Our framework allows for three main transmission channels of UI extensions. First, on the supply side, we allow UI extensions to affect real wages, thereby impacting hiring. Second, on the demand side, imperfect insurance against unemployment spells means that increasing UI duration lowers households' precautionary savings and boosts demand. Third, in our non-Ricardian economy, transferring income to unemployed households with high marginal propensities to consume through UI extensions tends to increase aggregate consumption.

We calibrate the model to an average US region. We first show that the model is largely consistent with micro evidence on household behavior, such as the consumption patterns during unemployment spells documented in Ganong and Noel (2019). We then demonstrate that the model captures quantitatively and qualitatively our empirical findings, despite not being targeted: the government spending multiplier is markedly lower when the duration of UI benefits is extended. This exercise further serves as a validation of our empirical identification strategy.

[4]Note that our approach does not use the shocks to measurement error of Chodorow-Reich *et al.* (2018) to estimate the effects of UI benefits, which tend to induce very transient UI changes. Our approach in this extension still relies on the systematic response of UI policy to movements in the unemployment rate induced by government spending shocks.

We next use the model to recover the implied UI multiplier, which measures the unemployment response to a one-quarter increase in UI duration at different horizons. This serves as a useful summary statistic to gauge the unemployment effects of UI extensions. We obtain a cumulative UI multiplier of roughly -0.09, in line with previous empirical research that includes positive effects of UI extensions within their estimates (Boone *et al.*, 2021; Chodorow-Reich *et al.*, 2018).

Finally, we quantify the different transmission channels shaping the stabilizing effects of UI extensions. We find that both demand channels play an important role, with the precautionary savings channel being somewhat stronger. On the other hand, shutting down the response of wages would have increased the expansionary effects of UI extensions considerably. To conclude, we use our model to estimate the union-wide effects of UI extensions. Our findings indicate that the monetary policy response tends to mitigate the stabilizing consequences of UI extensions.

Literature Review The main contribution of the paper is to study the macroeconomic effects of endogenous reactions in UI duration. This is achieved by offering a new identification scheme based on the non-linear design of UI policy and by a quantitative model that incorporates both the demand and supply-side effects to rationalize and extend empirical results. In doing so, our paper contributes to several strands of the literature.

First, we expand the empirical literature exploring the macroeconomic consequences of unemployment benefits.[5] Chodorow-Reich *et al.* (2018) construct exogenous variation in UI extensions using measurement error in real-time unemployment. Hagedorn *et al.* (2019), Boone *et al.* (2021), and Dieterle *et al.* (2020) compare adjacent counties that straddle state borders, where the identifying assumption is that UI policy changes discontinuously but economic fundamentals do not.[6] Johnston and Mas (2018) employ a regression discontinuity design to estimate the effects of a UI duration cut in Missouri. Di Maggio and Kermani (2016) focuses on variation in time-invariant replacement rates across US states together with the assumption that these are orthogonal to current local conditions. More recently, Acosta *et al.* (2023) propose to use variation in the adoption of optional UI trigger rules across US states to identify the effects of extensions, under the assumption that state-level adoption does not depend on regional economic characteristics.

At a general level, all of these papers propose identification strategies that aim to identify *exogenous changes* in UI duration. Our identification strategy, however, exploits the non-linear design of UI policy together with the variation of fiscal multipliers across different levels of UI duration to study the effects of *endogenous* UI duration extensions. This difference in approaches implies differences in identification assumptions. The identification of exogenous changes in UI duration adopted in the literature requires the as-

[5]Several papers estimate empirically the micro-level effects of UI extensions. See, for example, Rothstein (2011), Farber *et al.* (2015), and Marinescu (2017).

[6]Lalive *et al.* (2015) also use a difference-in-differences approach to estimate the effects of UI in Austria.

sumption that identified changes in UI duration are orthogonal to county or state-level economic conditions. Our approach bypasses this assumption; instead, our approach requires that no other state-level characteristic is *correlated* with pre-existing UI duration *while simultaneously* altering the transmission of shocks (fiscal multiplier) in the *same direction* as the endogenous UI duration policy does.

Our paper is also related to the literature examining the theoretical consequences of unemployment benefits. In frameworks with flexible prices, Mitman and Rabinovich (2015), Jung and Kuester (2015), and Landais *et al.* (2018) study the optimal design of UI; and Nakajima (2012), Mitman and Rabinovich (2019), and Krusell *et al.* (2010) its positive implications. Our paper, instead, highlights the demand consequences of UI extensions that come with redistribution and precautionary savings. We share such channels with Kekre (2022), McKay and Reis (2021), and Gorn and Trigari (2024). Relative to these papers, we regard our monetary union model with an endogenous UI duration rule as better suited to theoretically analyze the effects of UI policy, given its state-level dimension.

Finally, we contribute to an emerging literature that explores the consequences of household heterogeneity in open-economy models. Papers on this front include, for example, de Ferra *et al.* (2020), Auclert *et al.* (2021), Cugat (2019), and Guo *et al.* (2020). We complement this literature by extending the previous frameworks to incorporate search-and-matching frictions in the labor market. Our open economy model features unemployment risk, making it well-suited for analyzing UI policies.[7]

The remainder of the paper is structured as follows. Section 2 describes UI policy in the US and how our identification strategy exploits its design, together with the data we use to implement our identification strategy. Section 3 provides our main empirical results. Section 4 outlines the model. In section 5 we calibrate the environment to the US economy. Section 6 provides the model results. A final section concludes.

2 Empirical Strategy and Data

This section outlines our identification strategy. Section 2.1 describes the identification strategy within the ideal scenario where experiments with macroeconomic policies in different states or countries could be conducted. Section 2.2 introduces the institutional background for UI policy, and Section 2.3 explains our identification strategy, which seeks to approximate the ideal scenario. We describe in detail the data we use to implement our identification strategy in Section 2.4.

2.1 Identification Strategy: The Ideal Scenario

What are the macroeconomic effects of endogenous reactions of UI duration to changes in the unemployment rate? Ideally, one would like to observe the following scenario that

[7] See Krusell *et al.* (2010), Ravn and Sterk (2017), Challe (2020), Gornemann *et al.* (2021) for models incorporating search-and-matching frictions and heterogeneous agents in a closed economy.

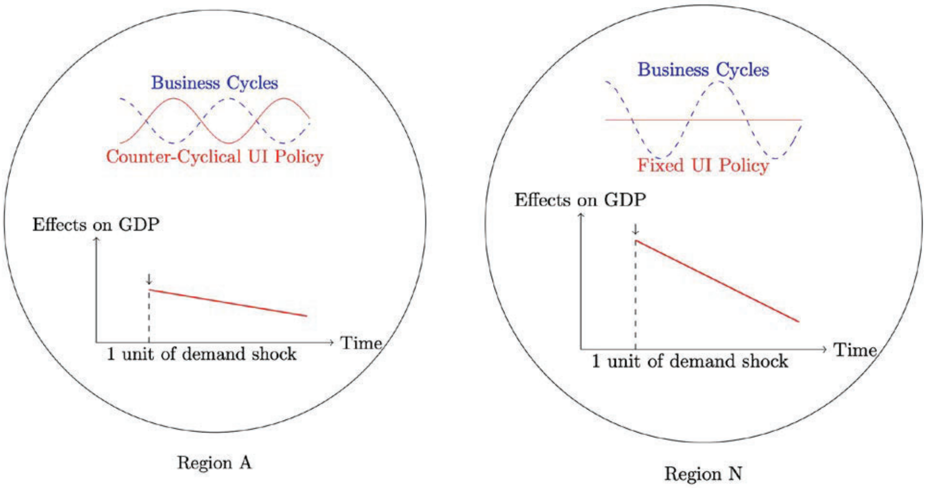

Figure 2: The Identification Strategy in the Ideal Scenario

resembles an experiment-like setting. Consider two regions, Region A and Region N, as shown in Figure 2. These two regions are identical and only differ in their UI policy rule. Region A has a countercyclical UI policy rule that extends UI duration when unemployment increases. This would be the treatment group. On the other hand, region N keeps UI duration fixed over the business cycle, representing the control group.

The objective is to uncover the macroeconomic effects of implementing a countercyclical UI duration policy, as in Region A. Towards this end, in addition to the policy treatment, one must take into account that the underlying macroeconomic shocks driving the business cycle in Region A could be different from the shocks in Region N. Therefore, the experimenter would introduce a demand shock of the same size to both regions.

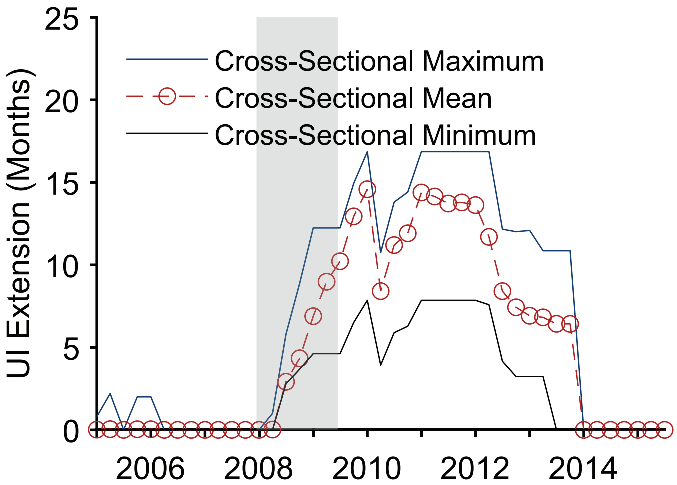

Figure 3: Duration of UI extensions

Notes: Duration UI benefits extensions in US states. The dashed red line with circles shows the cross-sectional average duration of UI extensions. The blue (black) solid line marks the actual maximum (minimum) duration of UI extensions across US states.

The bottom part of Figure 2 shows the effect on GDP of that equally sized demand shock in each region. Since the only difference between both regions is how UI duration policy is conducted, any difference in the GDP responses can be traced back to the endogenous reaction of UI duration. Namely, one can observe – anticipating our empirical findings – that the expansion in GDP is smaller in Region A than in Region N. This means that curtailing UI duration also reduces economic activity, since in Region A that positive demand shock induces a cut in UI duration while in Region N it does not.

In sum, this ideal experimental scenario would allow one to uncover the macroeconomic effects of a systematic UI duration policy. However, such a neat experiment is not available in practice. In the next sections, we first describe some relevant institutional features of the UI duration policy in the United States, and then we discuss how we leverage these features to approximate the ideal scenario outlined previously.

2.2 Unemployment Insurance in the United States: Background

In the United States, most states offer a regular duration of UI benefits of 26 weeks. This regular duration of UI benefits is set irrespective of the regional unemployment rate.[8] During downturns, however, US states can extend the duration of UI benefits when unemployment is above some predetermined threshold. Namely, the Extended Benefits program (EB) allows US states to provide an additional duration of UI benefits of up to 20 weeks, depending on their unemployment rate. In addition to this, the Emergency Unemployment Compensation program activated during the Great Recession allowed states to extend UI duration by 53 weeks in addition to previous extensions.

The various UI programs have led to substantial variability in the duration of UI benefits, both over time and among states. Figure 3 illustrates this heterogeneity using UI duration data from Chodorow-Reich *et al.* (2018). The dashed red line represents the average duration of UI extensions across US states, while the solid blue and black lines indicate the maximum and minimum duration in the cross-section, respectively. The figure shows that, before the financial crisis, most states did not offer additional UI extensions. However, the average UI extension duration markedly increased from 2008 onwards. It's important to note that this increase was not uniform across states, as evident from the disparities between the maximum and minimum actual duration of UI benefits.

2.3 Identification Strategy

The idea behind our identification strategy exploits the overtime and cross-sectional variation in UI duration described above, together with the non-linear design of UI policy.

[8] The duration of regular UI duration offered by US states has been constant over time since 1960. However, starting in 2011 a few states decided to reduce regular UI duration due to fiscal reasons. These changes have been permanent and therefore not a response to business-cycle considerations, our object of interest. Yet, as a robustness exercise, we have redone our main analysis dropping these states from the sample. Our main results remain unaffected. For a detailed discussion of UI policy see Isaacs (2019).

UI policy is non-linear because the same change in the unemployment rate can affect UI extensions differently depending on the pre-existing duration of UI. For example, a state that has extended UI duration can return to regular UI duration if unemployment falls (recall Region A in Figure 2), while a state that has not extended UI would not cut UI duration in response to the same drop in unemployment (recall Region N in Figure 2). Furthermore, as we show later, there is substantial cross-sectional variation in UI changes induced by a fall in unemployment, even among states that have positive UI extensions. For example, states with longer pre-existing UI extensions – and hence are further away from regular UI – could implement larger cuts of UI duration.

To gain a deeper understanding, consider two identical US states. The unemployment rate temporarily rises in the first state, leading to an extension of UI benefits. Now, assume both states face a positive demand shock that reduces unemployment — a government spending shock in our application. The first state, which has extended UI benefits, curtails UI duration in response declining unemployment, resembling the dynamics in Region A in Figure 2. In contrast, UI duration remains unchanged in the second state, which originally had a regular duration of UI benefits, mirroring Region N in Figure 2. Since both states have encountered the same demand shock, the disparities in the estimated output response can be attributed to the differences in UI extension responses.

Our identification strategy leverages differences not only between states with extended UI benefits and those with regular UI duration but also among states that have extended UI benefits of varying duration. For instance, in one scenario, which we subsequently verify empirically using data, different UI responses to the same demand shock can be observed among states with different pre-existing UI durations. To illustrate, consider a third state in the earlier example. This state has also extended UI duration, but the extension is more substantial than that of the first state. When faced with declining unemployment, this third state has more room to reduce UI duration before reaching regular UI status than the first state.

The key identification assumption is that potential variation in state-level responses to government spending shocks across pre-existing levels of UI duration depends solely on the variation in the responses of UI extensions. In Section 3.2, we discuss threats to this identification. Anticipating this discussion, we will argue that while certain concerns are theoretically valid, they generally bias our estimates towards zero, and we address these concerns explicitly in the data.

2.4 Data

In order to implement our identification strategy we construct a panel dataset for US states at quarterly frequency running from 2000 to 2015. We obtain the measure of actual UI duration and the time series of the state-level unemployment rate from Chodorow-Reich *et al.* (2018). From the same source we also obtain a state-level time series of the

Reich *et al.* (2018). From the same source we also obtain a state-level time series of the fraction of unemployed workers that receive UI payments. In addition, we obtain from the Regional Economic Accounts of the Bureau of Economic Analysis state-level earnings, defined as pre-tax wages and salaries, which we take as a proxy of state-level economic activity. We complete these state-level variables with the political dataset of Carlino *et al.* (2023), which contains for each state the vote distribution in Gubernatorial Elections of the US.

Our proposed identification strategy requires the identification of demand shocks at the state level. In order to obtain these we build on the previous literature on state-level fiscal multipliers (Nakamura and Steinsson, 2014; Auerbach *et al.*, 2024; Demyanyk *et al.*, 2019) and rely on state-level military government spending.

More precisely, our measure of government spending at the state level is constructed using the Department of Defense (DOD) contracts available on *USASpending.gov*.[9] This data source provides comprehensive details on contracts signed since 2000. It also supplies detailed information on the name and location (zip code) of the primary contractor, the total contracted amount (obligated funds), and the contract duration. In most instances, the primary zip code where the contracted work was carried out is also available. The detailed geographic and timing structure of this dataset makes it well-suited for our analysis.

The information on the duration of each contract allows us to construct a proxy for spending outflows associated with each contract over time by equally allocating the obligated amount throughout the contract's duration (Auerbach *et al.*, 2024). Then we aggregate spending across contracts in a location at each point in time, leaving us with a state-level panel dataset of military government spending at quarterly frequency.

In addition to new contract obligations, the dataset also contains modifications to existing contracts, including downward revisions to contract amounts (de-obligations) that appear as negative entries. Many of these de-obligations are very large and occur after large obligations of similar magnitude. Following Auerbach *et al.*, 2020, 2024, when consecutive obligations and de-obligations with magnitudes within 0.5% of each other, we consider both contracts null and void. This restriction removes 2.8% of contracts from the sample.

3 Empirical Results

This section presents our main empirical results. We first estimate the response of UI duration to changes in economic activity and confirm that it is non-linear, in line with our previous reasoning. We then show that an extended UI duration significantly mitigates the unemployment and earnings responses to government spending shocks, resulting

[9] In the context of fiscal multipliers, these data have been previously used in, for example, Auerbach *et al.* (2020, 2024) and Demyanyk *et al.* (2019).

in a smaller fiscal multiplier. We finally show that our results hold robustly in several alternative specifications that address potential threats to identification.

3.1 Fiscal Multipliers and UI Duration

Throughout our analysis, we make use of local projections (Jordà, 2005) to infer the effects of UI extensions. Local projections provide a flexible alternative to structural vector autoregressions, allowing for a direct estimation of impulse response functions without imposing dynamic restrictions. Furthermore, local projections can be easily extended to study state-dependent responses, rendering them well-suited for our analysis.

More precisely, we estimate the additional effect of having extended UI of the impulse variable $X_{i,t+h}$ on the outcome variable $Y_{i,t+h}$ at horizon h through regressions of the following form:

$$
\begin{aligned}
\sum_{j=0}^{h} Y_{i,t+j} &= \alpha_{i,h} + \delta_{t,h} + \beta_h \sum_{j=0}^{h} X_{i,t+j} + \gamma_h (L) Z_{i,t-1} \\
&\quad + T^*_{i,t-1} \left(\beta_h^{UI} \sum_{j=0}^{h} X_{i,t+j} + \gamma_h^{UI} (L) Z_{i,t-1} \right) + \eta_h T^*_{i,t-1} + \varepsilon_{i,t+h}, \quad h \geq 0, \qquad (1)
\end{aligned}
$$

where $T^*_{i,t+j}$ is the additional duration of UI benefits, expressed in months, in state i of the US at time $t + j$. $\alpha_{i,h}$ denotes state-fixed effects that allow us to control for state-specific characteristics that are constant over time. $\delta_{t,h}$ are time-fixed effects that control for shocks and policy changes (such as the monetary stance) that hit the US as a whole at a particular point in time. $Z_{i,t-1}$ is a set of control variables, discussed in more detail below.

The regression model (1) allows us to compute the endogenous response of $Y_{i,t+h}$ to a given change in $X_{i,t+h}$ during *normal times* by estimating β_h, and the additional response of $Y_{i,t+h}$ with previously *extended UI* by estimating β_h^{UI}. That is, β_h^{UI} is our main object of interest.

In our following exercises, we will consider two forms of the regression (1). The first one estimates the response of UI duration to changes in the unemployment rate. That is, the outcome variable $Y_{i,t+j}$ will be UI duration and the impulse variable $X_{i,t+j}$ will be the unemployment rate. Such specification tests the non-linear response of UI duration to changes in the unemployment rate, at the core of our identification strategy. The second one estimates fiscal multipliers, with the outcome variable $Y_{i,t+j}$ being either state unemployment or earnings and the impulse variable $X_{i,t+j}$ being state-level government military spending.

In either case, there is the simultaneity issue: there are exogenous shocks in (contained in $\varepsilon_{i,t+h}$) that drive both the policy instrument $T^*_{i,t+j}$ and $X_{i,t+j}$. Hence, the OLS estimates for β_h and β_h^{UI} are biased. To address this issue we use government spending shocks as instruments.

We identify government spending shocks through a Bartik-type identification strategy (see, for example, Nakamura and Steinsson 2014; Auerbach *et al.* 2020), that exploits cross-state heterogeneous sensitivities to national military spending. Namely, we instrument the cumulative changes of $X_{i,t+j}$ using the cumulative changes of total national government military spending interacted with a state dummy.[10] In the case of $X_{i,t+j}$ being state government spending, the "first stage" interpretation of this instrumental variable strategy is to regress changes in state spending on changes in aggregate spending, fixed effects, and controls. Hence, this first stage isolates the state-level systematic sensitivity to national military spending from changes in state-level government spending that could be due to political or regional business cycle reasons.

In the case of $X_{i,t+j}$ being state unemployment and the outcome variable $Y_{i,t+j}$ UI duration, the first stage captures changes in the state-level unemployment rate that are due to government spending shocks. In this case, the identifying assumption is that government spending affects UI duration only to the extent that it moves the unemployment rate. This is a natural assumption, as by law UI duration is linked to the evolution of the unemployment rate.

Our set of controls, Z_{t-1}, always includes eight lags of the outcome variable, $Y_{i,t+j}$, the impulse variable, $X_{i,t+j}$, and lags of state-level change of unemployment, earnings and, government military spending. In addition, we include the lags of two additional controls that aim to account for time-varying state characteristics that could be simultaneously correlated with fiscal multipliers and pre-existing UI duration. On the one hand, Carlino *et al.* (2023) shows that partisanship of state governors affects the efficacy of fiscal policy, while we observe that more progressive states tend to have longer UI durations. Therefore, we also include as a control the lags of a dummy for political leadership, which takes value one if the share of republican votes in the last Gubernatorial Elections was larger than fifty percent. Moreover, Birinci and See (2023) shows that there could be considerable cross-state heterogeneity along eligibility and receipt of unemployment insurance among the unemployed, potentially affecting the effects of UI extensions. Hence, we also include among our set of controls the fraction of unemployed workers who receive UI benefits.

Non-Linear UI Duration We first verify that the core idea underlying our identification strategy holds in the data. Specifically, we illustrate the non-linear response of UI duration to a given change in the unemployment rate through the estimation of regression (1).

As outlined above, in this case, the outcome variable is the cumulative change in total UI duration measured in months, $\sum_{j=0}^{h}(\mathrm{T}_{i,t+j} - \mathrm{T}_{i,t-1})$, and the impulse variable is the change in the unemployment rate, $\sum_{j=0}^{h} \frac{(\mathrm{U}_{i,t+j} - \mathrm{U}_{i,t-1})}{\mathrm{U}_{i,t-1}}$, instrumented with the cumula-

[10]Naturally, for the interaction term $T^*_{i,t-1} \cdot X_{i,t+j}$, we also interact total national government military spending with dummies and pre-existing UI duration, $T^*_{i,t-1}$.

	Dependent Variable		
	UI Duration	Unemployment	Earnings
β	-0.01	-5.53***	1.47**
	(0.59)	(1.71)	(0.60)
β^{UI}	1.38***	0.73**	-0.29***
	(0.13)	(0.32)	(0.05)
F-statistic	422.10	10527.75	10527.75
Observations	2300	2300	2300

Note: Cumulative 8-quarter ahead ($h = 8$) responses of UI duration, unemployment, and earnings during normal times (β) and the additional effects when UI is extended (β^{UI}). Driscoll and Kraay (1998) standard errors are in parentheses. All regressions include state and time-fixed effects, and are estimated by two-stage least squares. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 1: Extended UI vs. Normal Times

tive change in national government military spending normalized by national earnings, $\sum_{j=0}^{h} \frac{(G_{t+j}-G_{t-1})}{E_{t-1}}$, interacted with state dummies. As in Nakamura and Steinsson (2014), in what follows, we focus on 8-quarter ahead ($h = 8$) cumulative responses as a summary statistic of the dynamic effects. We report in Appendix A the cumulative responses for different horizons.

The first column of Table 1 shows the estimated responses of total UI duration to a given change in the unemployment rate induced by government spending shocks. Driscoll and Kraay (1998) standard errors are reported in parenthesis, that correct for potential residual correlations across US regions and for serial correlation and heteroskedasticity over time.

The estimated coefficients shown in Table 1 make clear that the response of UI duration to a given change in the unemployment rate is highly non-linear in the pre-existing level of UI extensions. Namely, when UI duration is at its regular level, the estimated response of UI duration to a 1% increase in the unemployment rate, measured by the coefficient β, is essentially zero. However, UI duration strongly increases in response to an increase in the unemployment rate when UI has been previously extended, measured by the coefficient β^{UI}, as one could expect from the design of the UI policy rule. This effect is estimated with a high degree of precision, being statistically significant at the 1% level.

In sum, the empirical evidence presented here shows that UI duration responds endogenously to changes in unemployment induced by government spending shocks and that such response is significantly stronger when the pre-existing duration of UI benefits is longer. This non-linear endogenous response of UI extensions illustrates how our empirical setting approximates the ideal scenario presented in Figure 2, with some states endogenously changing UI duration more strongly in response to shocks than others.

Fiscal Multipliers We next show that the response of UI duration affects the effects of demand shocks. Towards this end, we consider as outcome variable either the cumulative change in the state unemployment rate, $\sum_{j=0}^{h} \frac{(\mathrm{U}_{i,t+j}-\mathrm{U}_{i,t-1})}{\mathrm{U}_{i,t-1}}$, or the cumulative change in state-level earnings, $\sum_{j=0}^{h} \frac{(\mathrm{E}_{i,t+j}-\mathrm{E}_{i,t-1})}{\mathrm{E}_{i,t-1}}$. The impulse variable is the change in state government military spending normalized by state-level earnings, $\sum_{j=0}^{h} \frac{(\mathrm{G}_{i,t+j}-\mathrm{G}_{i,t-1})}{\mathrm{E}_{i,t-1}}$. As before, we instrument this with the cumulative change in national government military spending normalized by national earnings interacted with state dummies.

We show the estimated cumulative unemployment and earnings multipliers in the second a third columns of Table 1. Independently of the outcome variable that we look at, we find that fiscal multipliers are systematically smaller when UI duration has been previously extended. As we have shown previously (see the first column of Table 1), these are precisely those times when the more favorable economic conditions induced by the fiscal shock come with an endogenous reduction in UI duration.

More precisely, the estimated coefficient of β of the second column shows that an increase in government military spending reduces the unemployment rate when UI is at its regular level, with the associated multiplier being roughly -5.53. Extended UI dampens this estimated positive impact on unemployment, as indicated by the coefficient β^{UI}: it reduces the unemployment multiplier by 0.79. Similarly, the third column of Table 1 shows that the earnings multiplier is 1.47 during normal times (β), while it is reduced by approximately -0.29 when UI duration has been extended (β^{UI}). All these effects are statistically different from zero at the, at least, 5% level.

The empirical findings presented so far are supportive of the idea that longer UI duration can help stabilize the economy against regional-level shocks. Namely, the empirical evidence presented in Table 1 shows that the stimulus to state-level unemployment and earnings from the fiscal shock is significantly smaller when this comes with an endogenous fall in UI duration.

3.2 Addressing Threats to Identification

The causal interpretation running from a cut in UI duration to a fall in the fiscal multipliers implicitly assumes that no other state-level characteristic correlated with UI duration leads to a lower fiscal multiplier. We next enrich the specification (1) in several dimensions to verify that this indeed holds in the data.

Horse races First, we consider a series of "horse races" between the UI duration $T^*_{i,t-1}$ and alternative competing state-level variables, $R_{i,t-1}$. More specifically, we augment augment equation (1) as follows:

$$\sum_{j=0}^{h} Y_{i,t+j} = \alpha_{i,h} + \delta_{t,h} + \beta_h \sum_{j=0}^{h} X_{i,t+j} + \gamma_h(L) Z_{i,t-1} + T^*_{i,t-1}\left(\beta_h^{UI}\sum_{j=0}^{h} X_{i,t+j} + \gamma_h^{UI}(L) Z_{i,t-1}\right)$$
$$+ \eta_h T^*_{i,t-1} + R_{i,t-1}\left(\beta_h^{R}\sum_{j=0}^{h} X_{i,t+j} + \gamma_h^{R}(L) Z_{i,t-1}\right) + \nu_h R_{i,t-1} + \varepsilon_{i,t+h}, \quad h \geq 0. \tag{2}$$

Above, β_h^R captures the additional effect of the competing variable $R_{i,t-1}$, while β_h^{UI} measures the additional effect of extended UI while controlling for the state variable $R_{i,t-1}$. We consider three of such competing explanatory variables, discussed next.

The first competing variable that we consider is a measure of state-level slackness which mimics the definition of a recession, measured as a dummy variable that takes value one if state-level unemployment has been increasing for at least two consecutive quarters.

This horse race accounts for the fact that the amount of slackness in the economy and UI extensions are naturally correlated. This correlation could bias our results to the extent that fiscal multipliers depend on the phase in the business cycle. Namely, our finding that longer UI duration reduces state-level fiscal multipliers could be explained if the economy is less sensitive to demand shocks when the level of local slackness is higher. Note, however, if anything, previous literature has found exactly the opposite. That is, previous research has documented that government spending multipliers are typically larger during recessions (Auerbach and Gorodnichenko, 2012; Bernardini *et al.*, 2020).

The second competing variable that we consider is the deviation of the fraction of unemployed workers receiving UI duration from its average. Even though we previously included the fraction of UI recipients in our set of controls, considering it as a competing "horse" allows us to formally account for the fact that heterogeneity among the pool of unemployed workers could affect the size of the fiscal multiplier. For example, as illustrated in Birinci and See (2023), UI recipients tend to have lower wealth holdings than unemployed workers that do not receive UI benefits. To the extent that lower wealth comes with marginal propensities to consume, a state with a higher share of UI recipients could also imply a higher fiscal multiplier (see, for example, Auclert *et al.* 2018; Albertini *et al.* 2021).

The third competing explanatory variable that we account for is the political orientation of the state, as measured by our political leadership dummy – already included in the set of controls in our baseline – that takes value one if the share of republican votes in the last Gubernatorial Elections was larger than a half. Including this as a competing variable in (2) allows to account for the fact the political party of the state might affect the effects of fiscal policy (Carlino *et al.*, 2023) and that more progressive states tend to have longer UI duration.

Accounting for Unobserved Covariates Second, in addition to the competing explanatory variables explained above, we consider an additional instrument for the pre-existing

UI duration $T^*_{i,t-1}$ to address a more general potential concern that some underlying unobserved covariate could be jointly driving UI extensions and the size of the fiscal multiplier when UI is extended.

For example, it could be that two states have different additional UI durations at a given point in time not because they have faced a different history of shocks but rather because they have faced the same shock which has been amplified in the state with a UI extension. Common sources of shock amplification are, for example, differences in wage rigidity (Hall, 2005) or financial constraints (Bernanke *et al.*, 1999). We first note that this is likely to be biasing our estimates of the effects of UI duration towards zero. Namely, suppose that a state has temporarily higher unemployment, and hence longer UI duration because local wages are more rigid. By the same logic, we would expect that fiscal shocks are amplified in that state, leading to larger fiscal multipliers when UI is extended. What we find in the data is exactly the opposite.

Nevertheless, we address the previous concern by using the measurement-error approach of Chodorow-Reich *et al.* (2018). These authors identify variations in the duration of UI benefits that are driven by unemployment measurement errors. Namely, Chodorow-Reich *et al.* (2018) relies on revisions of the unemployment rate to decompose the variation in the duration of UI benefits T^*_t into two parts. The first part comes from differences in economic conditions. The second part arises from measurement error in the real-time data used to determine UI benefits extensions and is, therefore, orthogonal to economic conditions or region-specific characteristics. Following the notation of these authors, we label the part of UI extensions due to pure measurement error as $\widehat{T}_{i,t-1}$.

We rely on the part of UI extensions driven by measurement error, $\widehat{T}_{i,t-1}$, to untie differences in UI duration from potential differences in unobserved characteristics. Namely, instead of instrumenting the interaction term $T^*_{i,t-1} \cdot X_{i,t+j}$ with the interaction of total national government military spending with state dummies and pre-existing actual UI duration, $T^*_{i,t-1}$, we instrument it with $\widehat{T}_{i,t-1}$ correspondingly interacted with national spending and state dummies.[11]

Results Table 2 reports the additional effect of pre-existing extended UI duration (β^{UI}, the coefficient of interest) on earnings, unemployment, and UI duration. Each column considers a different specification, with the first column reproducing our baseline results from Table 1 for reference.

The second column shows that our baseline results are robust to include state-level slackness as competing explanatory variable in the horse-race regression (2). In particular, when UI duration is extended, earning and unemployment multipliers associated with military government spending are still reduced (see first two rows), while UI duration

[11] Formally, if $\widehat{T}_{i,t-1}$ and the national-level military spending measure interacted with the state dummies labeled $DoD_{i,t}$, are (jointly) exogenous. That is $\mathbb{E}[\varepsilon_{i,t} \mid \widehat{T}_{i,t-1}, DoD_{i,t}] = 0$. Then by the law of iterated expectations, we obtain $\mathrm{Cov}(\widehat{T}_{i,t-1}\, DoD_{i,t}, \varepsilon_{i,t}) = 0$. Therefore, the product $\widehat{T}_{i,t-1}\, DoD_{i,t}$ is a valid instrument for the interaction term of interest.

	Baseline	Horse Races			
		Slackness	Slackness and $\widehat{T}$ Instrument	UI Receip. and $\widehat{T}$ Instrument	Political and $\widehat{T}$ Instrument
Earnings (β^{UI})	-0.29***	-0.36***	-0.44***	-0.31**	-0.30***
	(0.05)	(0.08)	(0.13)	(0.15)	(0.11)
Unemployment (β^{UI})	0.73**	0.88***	0.74***	0.54**	0.76**
	(0.32)	(0.30)	(0.25)	(0.26)	(0.30)
UI Duration (β^{UI})	1.38***	1.34***	1.00***	0.80***	1.22***
	(0.13)	(0.11)	(0.09)	(0.10)	(0.09)

Note: Cumulative 8-quarter ahead ($h = 8$) additional effects when UI is extended (β^{UI}) to the responses of UI duration, unemployment, and earnings. Driscoll and Kraay (1998) standard errors are in parentheses. All regressions include state and time fixed effects, and are estimated by two-stage least squares. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. The first column reproduces our baseline results (see Table 1). The second to last column consider alternative competing explanatory variables (see equation (2)). The third to last column, in addition, incorporate UI extensions due to measurement error (Chodorow-Reich *et al.*, 2018) as an instrument for actual UI duration.

Table 2: Extended UI vs. Normal Times

still increases significantly more upon an increase in the state-level unemployment rate induced by the military government spending shock.

In the third column, we also consider state-level slackness as a competing explanatory variable and, in addition, we employ UI duration due to measurement error ($\widehat{T}_{i,t-1}$) as an instrument for actual UI duration extensions ($T^*_{i,t-1}$). The results reveal that including this instrument does not meaningfully alter our baseline results, leading us to conclude that there is a limited role for the argument that there might be some underlying unobserved factor driving our empirical findings on the stabilization consequences of UI extensions. More precisely, UI duration (third row) still increases more strongly when UI duration is extended, and the earnings and unemployment multipliers are still dampened significantly (first two rows).

The fourth and fifth columns keep $\widehat{T}_{i,t-1}$ as an instrument for actual UI duration and state-level slackness as a competing variable, but consider either the share of UI recipients or the political leadership dummy as additional competing variables. The estimated effects arising from these extended specifications show that pre-existing extended UI leads to a dampening of the unemployment and fiscal multiplier and to an amplification of the UI response itself, in line with our baseline results.

Overall, Table 2 reveals that the empirical findings presented in section 3.1 hold robustly across the different extensions considered, both qualitatively and quantitatively. Namely, the empirical evidence in these sections robustly shows that fiscal multipliers tend to be lower when UI duration is extended, precisely at those times when UI itself responds the most.

Lastly, the findings presented above are based on government expenditure shocks constructed using the Bartik instrument. In an earlier version of the paper, we documented the same set of results using government value added shocks identified through Blanchard and Perotti (2002) timing restrictions.

4 Model

Our empirical evidence uncovers a significant macroeconomic stabilization role of UI extensions against regional-level demand shocks. We next interpret these findings through the lenses of a quantitative model, which mimics the empirical setting, where extensions of UI benefits can have both detrimental and stabilization consequences for the macroeconomy. Namely, we first show that the model can match well the empirical relationship between fiscal multipliers and the endogenous response of UI duration. Therefore, the model helps to validate our empirical identification strategy. We next use the model to back out the implied UI multiplier and quantify the different channels affecting it.

Towards this end, we extend the New Keynesian small-open-economy model of Galí and Monacelli (2005) to incorporate heterogeneous agents (Aiyagari, 1994; Huggett, 1993; Bewley, 1983) and equilibrium unemployment (Mortensen and Pissarides, 1994). Our economy is composed of two regions, Home and Foreign. We model Home as a small open economy and Foreign as the rest of the economy. Since the Home region has a negligible size with respect to the whole economy, economy-wide variables are exogenous from the viewpoint of Home. In line with our empirical setting, we will assume that the monetary authority at Home adopts a fixed exchange rate with respect to Foreign. This allows us to interpret Home as a region of the US economy. Financial markets are incomplete both domestically and internationally, and households at Home can only save into a domestic and a foreign bond through assets issued by a representative mutual fund. Regarding notation, we use the subscripts H and F for Home and Foreign variables, respectively.

4.1 Labor Market Transitions and UI Eligibility

Employment transitions are determined in a frictional labor market. At the end of period $t-1$, there is a mass N_{t-1} of employed households, and a mass $U_{t-1} = 1 - N_{t-1}$ of unemployed households. At the start of period t, an exogenous fraction δ of employed households separates from firms and instantaneously joins the pool of unemployed households. Therefore, unemployment at the beginning of the period is given by $1 - (1-\delta)N_{t-1}$. Firms must open vacancies V_t to be matched with a currently unemployed worker. New matches M_t are formed according to the function:

$$M_t = \chi V_t^{\gamma} \left(1 - (1-\delta) N_{t-1}\right)^{1-\gamma}, \tag{3}$$

where $\gamma \in (0,1)$ and χ marks the matching efficiency.

We define labor-market tightness as the ratio of vacancies over unemployment $\theta := {}^{V_t}/_{(1-(1-\delta)N_{t-1})}$. An unemployed household finds a job with probability $f_t := {}^{M_t}/_{(1-(1-\delta)N_{t-1})}$, and a firm fills a vacancy with probability $q_t := {}^{M_t}/_{V_t}$. The law of motion for employment is given by:

$$N_t = (1-\delta) N_{t-1} + M_t. \tag{4}$$

UI eligibility. Households can be either eligible or non-eligible to receive unemployment benefits. We assume that the transition between eligibility states is stochastic (Chodorow-Reich *et al.*, 2018; Mitman and Rabinovich, 2019). The probability of losing eligibility is endogenously set by the government and described in more detail below. Therefore, policy influences the idiosyncratic risk faced by households as the UI system provides them with direct insurance against income drops during unemployment spells.

More precisely, consider a household that is unemployed and eligible to receive unemployment benefits at the end of the period $t-1$. Next period t, conditional on remaining unemployed, the household remains eligible with time-varying probability $(1 - pe_t)$. With complementary probability, pe_t, the household loses eligibility for the remainder of the unemployment spell. Therefore, the expected duration of UI benefits is given by pe_t^{-1}. The stochastic expiration of unemployment benefits captures, in a parsimonious way, the limited duration of unemployment benefits present in the UI system of the US. Once the non-eligible unemployed household finds a job, it regains eligibility probability with constant probability pr for the rest of the employment spell. This assumption captures the fact that it takes several months for a recently hired worker to regain UI eligibility. We denote by $\{N_t^e, N_t^{ne}\}$ the mass of employed households that are respectively eligible and non-eligible at the end of the period. We define $\{U_t^e, U_t^{ne}\}$ analogously for unemployed households. The laws of motion for each of these states are provided in Appendix B.1.

4.2 Households

There is a continuum of infinitely-lived households of measure one indexed by i. We summarize the idiosyncratic states of a household by $s = \{a, h, n, e, \beta\}$. A household can be either employed or unemployed, denoted by $n \in \{1, 0\}$, respectively. If a household falls into unemployment, it can be either eligible or non-eligible to receive unemployment benefits, $e \in \{1, 0\}$. Next to these, households differ in their idiosyncratic labor income productivity h, which follows an exogenous $AR(1)$ process in logs.[12] Additionally, we allow for permanent differences in households' discount factors $\beta \in \{\beta_1, \beta_2\}$, a modeling strategy commonly used in the literature to match the high degree of wealth inequality

[12]Namely, $\log h_{i,t} = \rho_h \log h_{i,t-1} + \varepsilon_{i,t}^h$, where ε^h is normally distributed with mean zero and variance σ_h^2.

and the large marginal propensities to consume present in the data (Carroll *et al.*, 2017). Finally, a marks households' savings in assets issued by a representative mutual fund.

A household characterized by its idiosyncratic state vector s at time t, chooses consumption c_t and next-period savings a_t to solve:

$$V_t(s) = \max_{c_{Ht}, c_{Ft}, a_t} \frac{c\left(c_{Ht}, c_{Ft}\right)^{1-\sigma}}{1-\sigma} + \beta \mathbb{E}_t V_{t+1}\left(s'\right) \tag{5}$$

$$\text{s.t.} \quad \frac{P_{Ht}}{P_t} c_{Ht} + \frac{P_{Ft}}{P_t} c_{Ft} + a_t = (1-\tau_t) h_t \left(d_t + \mathbb{I}_{n=1} w_t + \mathbb{I}_{(n=0,e=1)} b_t + \mathbb{I}_{(n=0,e=0)} \tilde{b}_t\right)$$
$$+ (1 + r_t^a) a_{t-1}, \quad a_t \geq 0,$$

where $\sigma > 0$ marks the inverse of the intertemporal elasticity of substitution and c is a composite consumption index consisting of consumption of Home and Foreign goods:

$$c := \left[(1-\alpha)^{1/\eta} c_H^{\frac{\eta-1}{\eta}} + \alpha^{1/\eta} c_F^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}}, \tag{6}$$

where $\eta > 0$ marks the elasticity of substitution between Home and Foreign goods and $\alpha \in [0,1]$ measures the degree of home bias. c_H and c_F are themselves CES aggregators over intermediate good varieties j with elasticity ε, $c_k := \left(\int_0^1 c_{jk}^{\frac{\varepsilon-1}{\varepsilon}} dj\right)^{\frac{\varepsilon}{\varepsilon-1}}$ for $k \in \{H, F\}$.

Households optimally divide their consumption expenditures between Home and Foreign goods according to:

$$c_{Ht}(s) = (1-\alpha)\left(\frac{P_{Ht}}{P_t}\right)^{-\eta} c_t(s); \quad c_{Ft}(s) = \alpha \left(\frac{P_{Ft}}{P_t}\right)^{-\eta} c_t(s), \tag{7}$$

where $P_{Ht} := \left(\int_0^1 P_{jHt}^{1-\varepsilon} dj\right)^{\frac{1}{1-\varepsilon}}$ marks the price index of domestic goods and $P_{Ft} := \left(\int_0^1 P_{jFt}^{1-\varepsilon} dj\right)^{\frac{1}{1-\varepsilon}}$ is the price of foreign goods in units of the domestic currency. P_t is the consumer price index, given by:

$$P := \left[(1-\alpha) P_H^{1-\eta} + \alpha P_F^{1-\eta}\right]^{\frac{1}{1-\eta}}. \tag{8}$$

As in McKay and Reis (2021), we assume that firm dividends d_t are rebated lump-sum to households according to their idiosyncratic productivity h_t. Next to firms' dividends, the income of a household depends on the joint idiosyncratic state over employment and eligibility status (n, e). A currently employed household, $n = 1$, earns the real wage w_t regardless of its eligibility status e. A household that is unemployed and eligible, $(n, e) = (0, 1)$, receives unemployment benefits b_t from the government. An unemployed household that has exhausted its unemployment benefits, $(n, e) = (0, 0)$, receives transfers from the government $\tilde{b}_t \leq b_t$. These capture safety-net transfers provided by the government such as food stamps. All sources of income are subject to a tax rate τ_t.

The ex-post real return on households' holdings of mutual fund's assets a_{t-1} is given by r^a_t. We provide a detailed description of the mutual fund problem in Appendix B.3, which follows the modeling strategy of Auclert *et al.* (2021). There, we show that the mutual fund problem equates the expected return on household assets to the ex-ante real interest rate $r_{t+1} = \frac{1+i_t}{1+\pi_{t+1}}$, where i is nominal interest rate and π_t is consumer price inflation. Additionally, since the mutual fund trades domestic and foreign bonds it yields the familiar UIP condition, but is otherwise inconsequential. In Appendix B.2 we also provide Foreign households' demand for Home goods.

4.3 Firms

The supply side of the economy has two layers of production. Producers of labor goods produce homogeneous goods using labor hired in a frictional labor market as a production input. A unit mass of producers of differentiated goods indexed by j differentiates labor goods and set prices subject to adjustment costs à la Rotemberg (1982).

Producers of differentiated goods. Differentiated goods producers operate under monopolistic competition. They set prices subject to quadratic adjustment costs (Rotemberg, 1982) and buy labor goods at price MC_t to transform them into differentiated goods. The solution to the maximization problem, described in more detail in Appendix B.4, yields the conventional non-linear Phillips Curve:

$$\log(1+\pi_{H,t}) = \kappa_p \left(\frac{MC_t}{P_{Ht}} - \frac{\varepsilon - 1}{\varepsilon} \right) + \mathbb{E}_t \frac{1}{1+r^a} \log(1+\pi_{H,t+1}) \frac{Y_{t+1}}{Y_t}, \tag{9}$$

where $1+\pi_{Ht} := P_{Ht}/P_{Ht-1}$ denotes gross domestic inflation and Y_t is aggregate output.

Producers of labor goods. Producers of labor goods are composed of a single worker and use a linear technology to produce homogeneous labor goods. We denote by J^L_t the value of a firm with a worker, given by:

$$J^L_t = Z \frac{MC_t}{P_t} - w_t + \mathbb{E}_t \frac{1}{1+r^a} (1-\delta) J^L_{t+1}, \tag{10}$$

where MC_t is the price of labor goods and Z marks steady-state aggregate productivity.

Hiring a worker involves posting vacancies at cost κ_v per vacancy. In equilibrium and with free entry, firms post vacancies until the expected gains from not doing so are zero:

$$\kappa_v = q_t J^L_t. \tag{11}$$

The presence of matching frictions in the labor market means that multiple wages are bilaterally efficient (Hall, 2005). We resolve this indeterminacy by assuming the following rule for the real wage w_t:

$$\log\left(w_t/w\right) = \phi^w \log\left(w_t^{\text{Nash}}/w^{\text{Nash}}\right), \tag{12}$$

where variables without a time subscript mark steady-state values. $\phi^w \in [0,1]$ measures the degree of real wage flexibility.

We denote by w_t^{Nash} the Nash-bargained wage. Wage bargaining in our model is carried out between the firm and a worker union that negotiates the wage on behalf of workers. Namely, the Nash-bargained wage is given by:

$$w_t^{\text{Nash}} = argmax_w \left(J_t^L\right)^{\varepsilon^w} \left(\Delta_t^{N,U}\right)^{1-\varepsilon^w}, \tag{13}$$

where $\Delta_t^{N,U}$ is the surplus of moving from unemployment to employment. We assume that the worker union maximizes the surplus of the average worker, such that $\Delta_t^{N,U}$ represents the surplus aggregating over different idiosyncratic states. We relegate the details of the bargain problem to Appendix B.5. The wage-setting assumptions that we entertain mean that UI benefits and duration can affect real wages through their impact on workers' outside option, as in for example Chodorow-Reich *et al.* (2018) or Mitman and Rabinovich (2019). At the same time, our assumption that bargaining takes place at the average rather than at the individual level keeps our framework computationally tractable.

4.4 Government

The government is comprised of a monetary authority and a fiscal authority. Consistent with our empirical setting, we assume that the monetary authority sets the domestic nominal interest rate to credibly fix the nominal exchange rate $\mathcal{E}_t = \mathcal{E}$.

The fiscal authority is subject to the following budget constraint:

$$\frac{P_{Ht}}{P_t} G_t + (1+r_t)B_{H,t-1} + b_t U_t^e + \tilde{b}_t U_t^{ne} = B_{H,t} + \tau_t\left(w_t N_t + b_t U_t^e + \tilde{b}_t U_t^{ne} + d_t\right) + \text{TR}_t. \tag{14}$$

Above, G_t marks government consumption of domestic goods. We assume that it follows a $AR(1)$ process in log-deviations from steady state with persistence ρ_G.

Next to expenditures on the consumption of domestic goods, the government runs a UI system. This is defined by both the unemployment benefits provided to eligible households b_t, and the probabilities of losing and regaining eligibility $\{pe_t, pr\}$. As regards the level of unemployment benefits, we assume that it is defined by a constant replacement rate b over the prevailing real wage:[13]

$$b_t = b w_t. \tag{15}$$

[13]The functional form that we entertain for unemployment benefits captures, in a parsimonious form, that unemployment benefits in the US are typically indexed to past earning.

We assume that the local government keeps government debt constant at its steady-state value, $B_{H,t} = B_H$. Therefore, it finances its expenditures by adjusting the income tax rate τ_t and through transfers that it receives from the federal government TR_t. As regards the latter, we assume that transfers increase to cover expenditures in UI payments above their steady-state level. This assumption is consistent with the financing of the UI system in our sample period, where UI extensions were financed through the federal budget during the Great Recession (Isaacs, 2019). Formally, TR_t obeys the following rule:

$$\mathrm{TR}_t = (b_t U_t^e + \tilde{b}_t U_t^{ne}) - (bU^e + \tilde{b}U^{ne}). \tag{16}$$

A central feature of the UI system in the United States is that the duration of UI benefits is highly non-linear. Namely, as highlighted in the empirical section, US regions can extend the duration of UI benefits during times of high unemployment. At the same time, during times of low unemployment, the duration of UI benefits is not reduced but rather kept at its baseline level. We capture these features in a parsimonious way by assuming that the average duration of UI benefits in our model, $T_t^* = pe_t^{-1}$, is set as follows:

$$\mathrm{T}_t^* = \begin{cases} \mathrm{T}^* & \text{if} \quad U_t \leq \tilde{U}, \\ \mathrm{T}^* \left(\frac{U_t}{\tilde{U}}\right)^{\phi_U} & \text{else.} \end{cases} \tag{17}$$

Above, $T^* = pe^{-1}$ marks the steady-state average duration of UI benefits. The average duration of UI benefits is endogenous to the business cycle. Namely, the government increases the average duration of UI benefits whenever the unemployment rate is above some pre-defined threshold $\tilde{U} \in (U, 1)$.

Next to the UI system, the government provides safety-net transfers $\tilde{b}_t$ to the unemployed households that are not entitled to receive unemployment benefits:

$$\tilde{b}_t = \tilde{b} w_t, \quad \tilde{b} \leq b. \tag{18}$$

That is, we also assume that safety-net transfers are characterized by a constant replacement rate $\tilde{b}$. Appendix B.6 provides a formal definition of the equilibrium.

5 Calibration

We calibrate the model to a representative region of the US. One period in the model is one quarter. The calibrated parameters are summarized in Table 3.

Household. We set the coefficient of relative risk aversion σ to a standard value of 2. We jointly calibrate the discount factors $\{\beta_1, \beta_2\}$ to hit an annual debt-to-GDP ratio of 0.45, which is the average federal public debt held by the public to GDP ratio observed in the data, and a quarterly aggregate marginal propensity to consume of 0.20 (Parker *et al.*, 2013). The elasticity of substitution between intermediate goods ε is set to 7. Next, we follow Nakamura and Steinsson (2014) and set the share of imported goods α equal to 0.3 and the trade elasticity η equal to 2. The parameter values for the idiosyncratic productivity process follow the estimates provided in Bayer *et al.* (2019).

Firms. The vacancy-posting cost κ_v is set equal to 4.5% of the quarterly real wage, in line with Silva and Toledo (2009). We set the bargaining power of the firm in the Nash-bargained wage (13) to target a vacancy-filling rate of 0.71, as in Den Haan *et al.* (2000). The degree of wage rigidity, ϕ^w, targets an impact elasticity of the real wage to output of 0.45 in response to government spending shocks (Hagedorn and Manovskii, 2008). The calibrated slope of the Phillips Curve κ_p implies an average price duration of 5 quarters in a Calvo setting. The steady-state value of productivity Z is set such that steady-state aggregate consumption is equal to one.

Parameter	Description	Value	Target / Source
Households			
$1/\sigma$	IES	0.50	Standard value
β_1	Discount factor high	0.98	$B_H/4Y = 0.45$
β_2	Discount factor low	0.93	MPC = 0.20
ρ_h	Persistence h	0.98	Bayer *et al.* (2019)
σ_h	Std. innovations to h	0.06	Bayer *et al.* (2019)
ε	Elast. subs. intermediate goods	7	Standard value
η	Elast. subs. H and F goods	2	Nakamura and Steinsson (2014)
α	Share imported goods	0.30	Nakamura and Steinsson (2014)
Firms			
κ_v	Vacancy posting cost	0.05	4.5% of quarterly wage
ε^W	Bargaining power firm	0.18	$q = 0.71$
ϕ^w	Wage rigidity	0.35	Hagedorn and Manovskii (2008)
Z	St-st. productivity	1.23	$C = 1$
κ_p	Slope NKPC	0.05	Mean price duration of 5 q.
Labor market			
δ	Separation rate	0.10	Standard value
χ	Matching efficiency	0.66	$N = 0.94$
γ	Curvature matching function	0.50	Petrongolo and Pissarides (2001)
Government			
τ	Steady-state tax rate	0.20	$G/Y = 0.14$
$1+i$	Steady-state nominal rate	1.01	Real rate 4% p.a.
b	Replacement rate UI	0.83	Income drop unemployment
$\tilde{b}$	Replacement rate safety-net	0.54	Income drop UI exhaustion
pe	Prob. loosing eligibility	0.50	Avg. duration UI of 2 q.
pr	Prop. regaining eligibility	0.50	2 q. to regain eligibility
$\tilde{U}$	UI extension threshold	0.06	Normalization
ϕ^U	UI duration rule	3.88	Average UI extension

Table 3: Calibrated parameters.

Notes: Variables without time subscripts indicate steady-state values. The main text provides further details.

Labor market The separation rate δ is set to 0.10, a common value in the literature; see, for example, Shimer (2005). The elasticity of new matches with respect to vacancies γ is set equal to 0.5, within the range estimated in Petrongolo and Pissarides (2001). The matching efficiency χ is calibrated to target a steady-state employment rate of 0.94.

Government. We set the nominal rate to hit an annualized real rate of 4%. The tax rate is set to target a ratio of government consumption to GDP of 0.14. The replacement rate of UI b is equal to 0.83 to target the income drop upon unemployment estimated in Ganong and Noel (2019). Similarly, we set the replacement rate of the safety-net transfers $\tilde{b}$ to target the income drop upon UI exhaustion estimated in Ganong and Noel (2019). We set the baseline probability of losing UI eligibility, pe, to target an average baseline duration of UI benefits of two quarters, the most common duration of UI benefits in most US regions. Following Mitman and Rabinovich (2019) we set the probability of regaining UI while employed equal to 0.5. This implies that, on average, it takes two quarters for an employed household to regain UI eligibility. We set the response of UI duration T_t^* to changes in the unemployment rate, ϕ^U, such that it mimics the average increases of UI extensions in response to the average increase in the unemployment rate observed during the Great Recession in our dataset. Given that in our dataset UI duration increases on average by roughly 3.3 quarters and the unemployment rate increased to 7.7%, this leads to $\phi^U = 3.88$. Finally, we that the unemployment threshold for the extension of UI benefits equals the steady-state unemployment rate, 6.0%.

Steady-state Untargeted Moments: Data vs. Model. Our model incorporates several channels through which changes in UI benefits duration can have an aggregate impact.

Moment	Model	Data	Data Source
1. Marginal Propensities to Consume (MPC)			
Quarterly Agg. MPC (targeted)	0.20	0.20	Parker and Broda (2013)
Annual MPC Employed	0.49	0.47	Kekre (2022)
Annual MPC Unemployed	0.64	0.72	Kekre (2022)
2. Consumption and Unemployment			
Cons. drop during unemp. w/ UI benefits	6pp	8pp	Ganong and Noel (2019)
Cons. drop during unemp. w/o UI benefits	19pp	24pp	Ganong and Noel (2019)
Employed's cons. response to job loss risk	-0.62%	-0.70%	Graves (2023)

Table 4: Untargeted Moments: Data vs. Model

Notes: Comparison between steady-state untargeted moments in the model versus the data. See the text for details.

On the demand side, these are the households' precautionary savings responses to changes in UI duration (Graves, 2020; Gorn and Trigari, 2024) as well as the fact that unemployed households tend to have larger than average marginal propensities to consume (MPC), meaning that increasing the transfers allocated to these households may increase aggregate demand (Kekre, 2022). Table 4 reports several key steady-state moments that shape these aggregate demand channels in the model and compares them with the data.

The first set of moments looks at the average MPC and its heterogeneity between employed and unemployed households. As explained above we target an average quarterly MPC of 0.20, in line with the estimates of Parker *et al.* (2013). The next two rows report the annual MPC of employed and unemployed households, which are 0.49 and 0.64 respectively.[14] These values are remarkably close to the empirical estimates reported in Kekre (2022), which draws from the 2010 Survey of Household Income and Wealth administered in Italy to compute these the annual MPCs by employment status.[15]

The second set of moments looks at the consumption responses through unemployment spells and the precautionary savings response of households. Comparing these statistics to the data is relevant to make sure that the model does not overstate the consumption consequences of going through unemployment spells. The first row here reports the average consumption drop upon unemployment while receiving UI benefits. The next row shows the average consumption drop after UI exhaustion. Despite that we do not target these moments, the model replicates quite well the empirical estimates of Ganong and Noel (2019).[16] The final row measures the partial equilibrium consumption response of employed households to an increase in job loss risk. This serves as a good measure of how reasonable the precautionary savings motive of households is. More specifically, we follow Graves (2020) and consider an average increase in the job separation rate of 20% over the course of a year and then we compute the average consumption drop of employed households on impact. The model delivers a consumption response that is just slightly below the empirical value estimated in Graves (2020) using data from the Survey of Consumer Expectations administered by the New York Fed.

In sum, the moments discussed above show that the model captures remarkably well the behavior of households observed in the data, despite its relative parsimony. The successful micro predictions of the model provide a solid starting point to evaluate the aggregate effects of UI extensions in general equilibrium, to which we turn next.

[14] We compute the MPCs in the model by simulating the partial equilibrium consumption response in a panel of households to a $500 transfer (in model-equivalent units), as in Kaplan and Violante (2014) and Kekre (2022).

[15] Unfortunately, US-based evidence on MPC heterogeneity by employment group is scant. The use of this Italian data is common in the literature, see for example Jappelli and Pistaferri (2014).

[16] Both consumption drops are measured relative to pre-unemployment consumption levels, as in the empirical estimates of Ganong and Noel (2019). As in the data, the averages are taken over the first two quarters in which households receive UI benefits and over the next two subsequent quarters over which households remain unemployed but lose UI eligibility.

6 The Stabilizing Effects of UI extensions

In this section, we examine the stabilizing effects of UI extensions through the lenses of the model. First, we show that the model matches reasonably well the dampening effects of UI extensions on state-level fiscal multipliers, as documented in section 3. Second, we use the model to recover the implied UI multiplier and quantify the different transmission channels of changes in UI duration. As to account for the non-linear UI duration rule described by (17) we compute the non-linear perfect-foresight responses of the economy to aggregate shocks. In particular, we use a shooting algorithm. When updating our guess, we employ the version of Newton's method developed in McKay *et al.* (2016).

6.1 Fiscal Multipliers

We assess the effects of UI extensions on fiscal multipliers, and hence their stabilizing effects, in light of theory. Towards this end, we consider the following experiments that approximate our empirical set-up.[17]

First, we compute fiscal multipliers during normal times, when UI duration does not respond. To do so, we consider a government spending shock starting from the steady state of the model. We see this as approximating our empirical estimates without extended UI, as UI duration in the model – as in the data – does not respond here to the fiscal expansion (recall Region A in Figure 2).

Second, we compute fiscal multipliers when UI has been extended. In order to do so we consider two additional experiments. In the first one, we generate a demand-driven recession via an increase in households' discount factor. During such a recession, UI duration increases endogenously in response to a rising unemployment rate. [18] In the second one, we consider the same recession but accompanied by a government spending shock. This fiscal expansion – occurring at a time with extended UI – induces an endogenous fall in UI duration (recall Region N in Figure 2), relative to the recession without the fiscal shock. The difference in responses between these two experiments serves us to compute the fiscal multiplier with extended UI, mimicking our empirical setting.

Finally, we compute the additional effect of UI duration by subtracting fiscal multipliers during normal times from fiscal multipliers with extended UI.

Table 5 shows the model counterpart of the empirical fiscal multipliers and additional effects of UI duration presented in Table 1, computed as described previously. The first row shows the size of the fiscal multipliers during normal times, when UI has not been extended. In the case of unemployment, we obtain a model-based multiplier of -6.47, just slightly larger than the -5.53 obtained from the data. We also compute the fiscal multiplier for earnings, defined in the model as aggregate pre-tax labor earnings of em-

[17]See Appendix B.7 for the impulse responses underlying these experiments and further details.

[18]We pick the size of the discount factor shock such that UI duration increases, in line with the data, by about a month on impact and assume a shock of the same size for the government spending shock.

	Unemployment		Earnings	
	Model	Data	Model	Data
Multiplier Normal Times	-6.47	-5.53	0.59	1.47
Additional Effect UI Extensions	0.74	0.73	-0.23	-0.29

Note: Comparison of employment and earning multipliers between model and data. Data values refer to the baseline empirical estimates presented in Table 1. See the main text for further details on the model-based simulations.

Table 5: Model vs. Data

ployed workers. In this case, the model delivers a fiscal multiplier of 0.59, somewhat smaller than the earnings multiplier uncovered in our empirical section.

The second row of Table 5 shows that the results implied by the model are consistent, both quantitatively and qualitatively, with the stabilizing effects of UI extensions that we infer from our empirical analysis. Namely, the model-implied additional effect of UI extensions on the fiscal multiplier for unemployment is 0.74 and -0.23 for earnings, quite close to the 0.73 and -0.29 that we found in the data. When UI has been previously extended, the fiscal expansion leads to an endogenous fall in UI duration. This fall in UI duration, given households' precautionary savings and the higher MPCs of unemployed households – channels that we quantify in the next section – mitigates the expansion in demand caused by the increase in government spending, resulting in the reported dampening of fiscal multipliers.

Overall, the counterfactual exercises conducted above show that the quantitative model can replicate the empirical results obtained in this paper quite well, further serving as validation of our empirical identification strategy.

6.2 UI Multiplier

We next use the model to recover the UI multiplier and quantify the main channels that affect it. Similarly to the fiscal multiplier, we define the UI multiplier as the cumulative change in the unemployment rate induced by the cumulative change in UI duration:

$$\mathrm{UI}_h^{\mathrm{M}} = \frac{\sum_{t=0}^{h} U_{t|T^*>0} - U_{t|T^*=0}}{\sum_{t=0}^{h} T^*_{t|T^*>0} - T^*_{t|T^*=0}}. \tag{19}$$

The UI multiplier measures how much the unemployment rate changes as a consequence of a one-quarter increase in UI duration at horizon h. This serves as a useful summary statistic to gauge the unemployment effects of UI duration. The denominator in (19) is the response of UI duration to the government spending shock when UI has been extended, $T^*_{t|T^*>0}$, minus the response of UI to the fiscal shock when UI has not been extended, $T^*_{t|T^*=0}$. Similarly, the numerator, $U_{t|T^*>0} - U_{t|T^*=0}$, is the differential response of unemployment.

Figure 4 shows that the data-consistent stabilizing effects of UI extensions reported in section 6.1 are associated with a cumulative UI multiplier at horizon $h = 8$ of -0.09, with a mean of -0.25 across horizons. In order words, according to the model, a one-quarter increase in UI duration induces a decrease in the unemployment rate of 0.09 percentage points in cumulative terms.

The UI multiplier tends to be larger at shorter horizons because of the forward-looking behavior of households in our model. Namely, as described previously, the change in UI duration induces a shift in households' precautionary savings and consumption, leading to a demand expansion. Such a demand expansion, in turn, lowers the unemployment rate, further reducing the need for precautionary savings. Since the change in UI duration is persistent over time – a consequence of the fiscal shock being persistent too –,

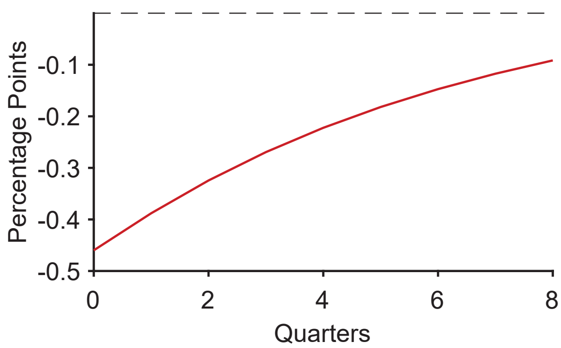

Figure 4: Cumulative UI Multiplier

Notes: Cumulative UI multipliers at different horizons, see the main text for details on the counterfactuals. The UI multiplier measures how much the unemployment rate changes (in p.p.) in response to a one-quarter increase in UI duration.

households already anticipate the future changes in UI duration and incomes, leading to an expansion of economic activity today than what would be implied by only the current UI duration change. As the change in UI duration vanishes over time, the precautionary savings channel also weakens at longer horizons, leading to a decline in the UI multiplier.

To put the previous UI multiplier in perspective, it is useful to compare it to previous empirical estimates of the macroeconomic effects of UI extensions. The estimates of Chodorow-Reich *et al.* (2018) and Boone *et al.* (2021) incorporate positive effects of UI extensions of employment, while on the other hand Hagedorn *et al.* (2019), Dieterle *et al.* (2020) and Acosta *et al.* (2023) estimate effects of UI extensions that are negligible or negative. Our estimates clearly sit in the positive range, more in line with the first two papers. Namely, Boone *et al.* (2021) estimate that an extension of UI duration of one additional quarter could increase the employment rate up to 0.24 p.p., while Chodorow-Reich *et al.* (2018) find that it could reduce the unemployment rate by up to 0.09 p.p.[19]

The cumulative UI multiplier of -0.09 that we recover from the model lies well within the previous set of empirical estimates. In light of this and given that the model is also consistent with our empirical estimates, we regard the implied stabilization effects of endogenous UI extensions that we uncover empirically as reasonable.

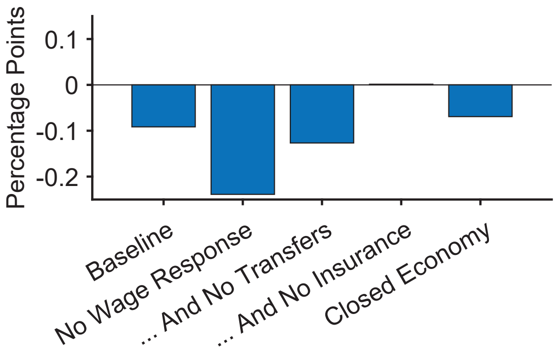

Figure 5: Cumulative UI Multiplier

Notes: Cumulative UI multipliers at horizon $h = 8$ in the baseline model and in different counterfactuals that illustrate the channels at work, see the main text for details on the counterfactuals. The UI multiplier measures how much the unemployment rate changes (in p.p.) in response to a one-quarter increase in UI duration.

6.3 Transmission Channels of UI Extensions

We next quantify the different transmission channels of UI duration, shutting them off sequentially by means of a series of counterfactuals. Namely, in our model, UI duration affects firms' and households' choices, and hence economic activity, mainly through the following channels. First, the Nash bargaining protocol means an improved outside option for workers, and hence higher wages, which tends to depress firms' hiring. Second, a longer UI duration implies that on average there is a fiscal redistribution towards unemployed households, which tend to have larger marginal propensities to consume (recall Table 4). Third, longer UI duration reduces households' need to precautionary save, allowing them to increase consumption and hence aggregate demand.

Wages. First, UI duration improves the outside option of households putting upward pressure on wages and hence restraining hiring. We measure the strength of this channel by repeating our set of experiments outlined in section 6.1 but under the assumption that real wages remain fixed. The second column in Figure 5 shows that the cumulative UI multiplier raises to -0.24 with fixed wages. That is, had wages not responded to the

[19]In order to make the estimates of these papers comparable to ours we follow Kekre (2022), who also converts the original estimates to the implied effects of a three-month UI extension.

increase in UI duration, UI extensions would be nearly three times more expansionary than in our baseline, which recall features a cumulative UI multiplier of -0.09.

Transfers to high MPCs Second, higher UI duration means that there is a redistribution towards high-MPC unemployed households through transfers, which tend to increase aggregate demand. Starting from the economy with fixed wages, we measure this channel as follows. We consider an alternative counterfactual where households do expect UI duration to change in response to the fiscal shock that occurs during the demand-driven recession but such a change never occurs. [20] The third column of Figure 5 shows that this transmission channel of UI extensions mitigates significantly the UI multiplier. Namely, the UI multiplier falls from -0.24 in the economy with only fixed wages to -0.13 in the economy where in addition we shut down transfers.

Insurance. Third, a longer UI duration mitigates the consumption risk of unemployment spells. This leads to a fall in precautionary savings and a corresponding increase in aggregate demand. To show the relevance of this channel we consider a final counterfactual where, in addition to rigid wages and the transfer channel being shut down as explained above, households do not expect UI duration to change in response to the fiscal shock that occurs during the demand-driven recession. Effectively this shuts down the final channel considered and hence it would be equivalent to a scenario where UI duration is not allowed to respond to the fiscal expansion, remaining instead at the same level as in the recession without the fiscal shock. The third column of Figure 5 shows that once we shut down this final channel the UI multiplier would be essentially zero, thereby precautionary savings reducing the size of the multiplier from -0.13, in the case of rigid wages and no transfers, to 0.

Closed Economy. Finally, our results so far regard the stabilizing effects of UI extensions in response to state-level shocks. This is the relevant case for policy-making given the local dimension of UI policy, as it speaks to the ability of UI extensions to mitigate asymmetric shocks (or asymmetric transmission of union-wide shocks) which might be hard to stabilize with union-wide policies such as monetary policy. However, given that the increase in UI duration documented in Section 2.2 was quite broad across states, it is natural to ask what the union-wide effects of UI extensions are.

We compute the union-wide effects of UI extensions by considering a closed-economy version of our model. The last column of Figure 5 shows that in this case the UI multiplier remains different from zero but it falls meaningfully, to -0.07. The reason for this result is that the central bank raises the nominal rate to fight the inflationary pressures generated

[20] At the more technical level, this amounts to computing the consumption policy function from the household problem under the assumption that the UI duration that enters the Euler equations is the same as in the baseline exercise, but computing the distribution across eligibility states as if UI duration did not respond to the fiscal shock.

by UI extensions. This, in turn, dampens the expansionary transmission channels operating through aggregate demand, reducing the UI multiplier. Notwithstanding this, the stabilizing effects of UI extensions that we document in the paper still operate here.

7 Conclusion

We document that UI duration can provide a significant cushion against regional-level shocks. We first provide new empirical evidence that UI extensions reduce the sensitivity of regional-level unemployment and earnings to government spending shocks – a type of demand shock. We then interpret these findings through a small-open-economy model with heterogeneous households and equilibrium unemployment. After showing that the model can account well for the empirical facts, thus validating our empirical strategy, we use it to recover a cumulative UI multiplier of roughly -0.09 and quantify the different transmission channels shaping it.

We have restricted to a positive analysis, but our findings suggest that accounting for the stabilization consequences of UI extensions that we uncover could have important implications for the design of UI policy over the business cycle. Furthermore, although our conclusion is based on historical UI extensions implemented in the U.S., we consider these findings informative for any country aiming to systematically implement a countercyclical UI policy.

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A Empirical appendix

The results presented in section 3.1 of the main text show that pre-existing UI duration reduced unemployment and earnings fiscal multipliers, at the same time that it amplified the response of UI duration itself to a change in the unemployment rate induced by a military government spending shocks.

As a summary statistic of the overall effects, we focused on the cumulative responses at horizon $h = 8$ in the main text, following Nakamura and Steinsson (2014). Table A.1 complements that evidence by showing the estimated coefficients for different horizons, from $h = 5$ to $h = 8$. The left panel shows the baseline effects (β_h), while the right panel shows the additional effects when UI is extended (β_h^{UI}). The table confirms that pre-existing extended UI leads to a statistically significant dampening of earnings and unemployment multipliers and to an amplification of the UI duration response to changes in the unemployment rate. These effects become stronger as the horizon increases, with the largest effects observed at $h = 8$, consistent with the evidence discussed in the main text.

	Earnings	Unemployment	T^*		Earnings	Unemployment	T^*
β_5	1.43***	-4.63***	1.78	β_5^{UI}	-0.25***	0.60*	1.18***
	(0.52)	(1.65)	(1.49)		(0.06)	(0.34)	(0.32)
β_6	1.46**	-4.97***	0.87	β_6^{UI}	-0.28***	0.62*	1.26***
	(0.58)	(1.72)	(1.02)		(0.07)	(0.35)	(0.22)
β_7	1.46**	-5.27***	0.29	β_7^{UI}	-0.28***	0.66**	1.35***
	(0.60)	(1.75)	(0.74)		(0.06)	(0.33)	(0.15)
β_8	1.47**	-5.53***	-0.01	β_8^{UI}	-0.29***	0.73**	1.38***
	(0.60)	(1.71)	(0.59)		(0.05)	(0.32)	(0.13)

Note: Cumulative responses at horizons $h = 5, \ldots, 8$. Driscoll and Kraay (1998) standard errors are in parentheses. All regressions include state and time-fixed effects and are estimated by two-stage least squares. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table A.1: Extended UI vs. Normal Times

B Model appendix

B.1 UI eligibility

The law of motion for each eligibility state is given by:

$$N_t^e = (1 - \delta + \delta f_t) N_{t-1}^e + pr(1 - \delta + \delta f_t) N_{t-1}^{ne} + f_t \left(U_{t-1}^e + prU_{t-1}^{ne} \right) \tag{20}$$

$$N_t^{ne} = (1 - pr)(1 - \delta + \delta f_t) N_{t-1}^{ne} + (1 - pr) f_t U_{t-1}^{ne} \tag{21}$$

$$U_t^e = (1 - f_t)(1 - pe_t)\left(U_{t-1}^e + \delta N_{t-1}^e\right) \tag{22}$$

$$U_t^{ne} = (1 - f_t)\left(U_{t-1}^{ne} + \delta N_{t-1}^{ne}\right) + (1 - f_t) pe_t \left(U_{t-1}^e + \delta N_{t-1}^e\right) \tag{23}$$

B.2 Foreign Households

We assume that demand from Foreign households for a variety j of domestically-produced goods is given by:

$$C_{jHt}^* = \left(\frac{P_{jHt}^*}{P_{Ht}^*}\right)^{-\varepsilon} C_{Ht}^*, \tag{24}$$

where P_{Ht}^* is the price of home goods denominated in unit of Foreign currency and C_{Ht}^* marks aggregate foreign demand for Home goods. The latter is assumed to be given by:

$$C_{Ht}^* = \alpha \left(\frac{P_{Ht}^*}{P_t^*}\right)^{-\eta} C_t^*, \tag{25}$$

where P_t^* is the economy-wide price index and C_t^* denotes aggregate Foreign consumption.

We assume that the law of one price holds at all times, meaning that $P_{Ht} = \mathcal{E}_t P_{Ht}^*$ and $P_{Ft} = \mathcal{E}_t P_{Ft}^*$. Here, $\mathcal{E}_t$ marks the nominal exchange rate defined as units of domestic currency per unit of foreign currency. That is, an increase in $\mathcal{E}_t$ marks a depreciation of the domestic currency. We define the real exchange rate Q_t as:

$$Q_t := \frac{\mathcal{E}_t P_t^*}{P_t}, \tag{26}$$

and the terms of trade S_t as the price of imports P_{Ft} over the price of exports P_{Ht}:

$$S_t := \frac{P_{Ft}}{P_{Ht}}. \tag{27}$$

B.3 Mutual Fund

A representative risk-neutral fund issues one-period real bonds A_t to households to finance purchases of risk-free domestic government bonds B_{Ht} and foreign bonds B_{Ft}:[21]

$$A_t = B_{Ht} + Q_t B_{Ft} \tag{28}$$

The ex-post return r_t^a is given by the beginning-of-period flow constraint of the mutual fund:

$$(1 + r_t^a) A_{t-1} = (1 + r_t) B_{H,t-1} + (1 + r_t^*) Q_t B_{F.t-1}. \tag{29}$$

[21] We follow Auclert *et al.* (2021) in modeling the mutual fund. The mutual fund assumption is a common modeling strategy in the literature that features multiple assets and heterogeneous agents; see, for example, Gornemann *et al.* (2021) and Kaplan *et al.* (2018).

Here r_t marks the ex-post real return on domestic government bonds B_{Ht}. This is linked to the nominal interest rate set by the monetary authority i_t through the standard Fisher equation:

$$1 + r_t := \frac{1 + i_{t-1}}{1 + \pi_t}, \tag{30}$$

where $1 + \pi_t := {}^{P_t}/_{P_{t-1}}$ marks the gross consumer price inflation. Analogously, $1 + r_t^*$ denotes the real gross return on foreign bonds, denoted in units of the foreign currency. Similarly, r_t^* is linked to the nominal interest rate i_t^* on foreign bonds through $r_t^* = \frac{1+i_t^*}{1+\pi_t^*}$, where $1 + \pi_t^* := {}^{P_t^*}/_{P_{t-1}^*}$.

The first-order conditions of the mutual fund's problem deliver the non-arbitrage condition between domestic and foreign bonds, the real uncovered-interest-parity condition:

$$\mathbb{E}_t \frac{1 + i_t}{1 + \pi_{t+1}} = \mathbb{E}_t \frac{1 + i_t^*}{1 + \pi_{t+1}^*} \frac{Q_{t+1}}{Q_t}, \tag{31}$$

and the non-arbitrage condition between the return received on government bonds and the return paid on liabilities:

$$\mathbb{E}_t 1 + r_{t+1}^a = \mathbb{E}_t 1 + r_{t+1} \tag{32}$$

B.4 Producers of differentiated goods.

Differentiated goods producers operate under monopolistic competition and set prices subject to quadratic adjustment costs (Rotemberg, 1982). A firm j purchases X_{jt} homogeneous goods from labor good producers at price MC_t and transforms them into differentiated goods using a linear technology $Y_{jt} = X_{jt}$. A typical producer of differentiated goods j solves:

$$\max_{\{P_{jHt+k}\}_{k=0}^{\infty}} \mathbb{E}_t \sum_{k=0}^{\infty} (1 + r^a)^{-k} \left[\left(P_{jHt+k} - MC_{t+k}\right) Y_{jt+k}^D - \frac{\kappa_p}{2\varepsilon} \log \left(\frac{P_{jHt+k}}{P_{jHt+k-1}} \right)^2 P_{Ht+k} Y_{t+k}^D \right],$$

$$\text{subject to} \quad Y_{jt}^D = \left(\frac{P_{jHt}}{P_{Ht}} \right)^{-\varepsilon} \left(C_{Ht} + C_{Ht}^* + G_t \right). \tag{33}$$

Above, Y_{jt}^D marks aggregate demand for variety j and $Y_t^D = C_{Ht} + C_{Ht}^* + G_t$ denotes aggregate demand for domestically-produced goods. Here, G_t is government consumption of Home goods and C_{Ht}^* is Foreign's demand of Home goods. The first-order condition of the above problem yields the New Keynesian Phillips Curve in the main text (9).

B.5 Wage bargaining

As described in Section 4.3 of the main text the prevailing real wage follows a rule that depends on the Nash-bargained wage. This, in turn, is the outcome of the wage bargaining between a firm and a union that bargains on behalf of workers. More specifically, the Nash-bargained wage is given by:

$$w_t^{\text{Nash}} = argmax_w \left(J_t^L\right)^{\varepsilon^w} \left(\Delta_t^{N,U}\right)^{1-\varepsilon^w}, \tag{34}$$

where J_t^L is the value of the firm with a worker and $\Delta_t^{N,U}$ represents the average surplus of moving from unemployment to employment for the union. This, in turn, is given by the weighted average of the surplus of moving from unemployment to employment for eligible workers, $\Delta_{t,e=1}^{N,U}$, and non-eligible workers, $\Delta_{t,e=0}^{N,U}$:

$$\Delta_t^{N,U} = (n_t^e + u_t^e)\Delta_{t,e=1}^{N,U} + (n_t^{ne} + u_t^{ne})\Delta_{t,e=0}^{N,U} \tag{35}$$

The surplus of moving from unemployment to employment for eligible workers, $\Delta_{t,e=1}^{N,U}$, is given by:

$$\Delta_{t,e=1}^{N,U} = U(C_{t,e=1}^N) - U(C_{t,e=1}^U) + \beta \mathbb{E}_t (1-\delta)(1-f_{t+1})(\Delta_{t+1,e=1}^{N,U} + pe_{t+1}\Delta_{t+1,n=0}^{E,NE}). \tag{36}$$

This has three main components. First, moving one eligible unemployed worker into employment is valued by the union by the contemporaneous utility gain in the increase in consumption, where this is represented by the gain in the utility of moving from consuming the average consumption of eligible unemployed workers, $C_{t,e=1}^U$, to the average consumption of eligible employed workers, $C_{t,e=1}^N$. The second part in (36) represents the expected discounted future gains from moving to employment. The second term, $(1-\delta)(1-f_{t+1})\Delta_{t+1,e=1}^{N,U}$, represents the future surplus of employment conditional for an eligible worker on keeping the job next period – which happens with probability $(1-\delta)(1-f_{t+1})$. The third term, $pe_{t+1}\Delta_{t+1,n=0}^{E,NE}$, is the average loss for an unemployed worker of losing UI eligibility. Namely, this represents the fact that a current eligible worker remains eligible if she finds a job, while she could lose eligibility with probability pe_{t+1} next period if she did not have a job. Moving to employment today avoids such loss going forward.

Similarly, the average surplus of moving from unemployment to employment for non-eligible workers is given by:

$$\Delta_{t,e=0}^{N,U} = U(C_{t,e=0}^N) - U(C_{t,e=0}^U) + \beta \mathbb{E}_t (1-\delta)(1-f_{t+1})(\Delta_{t+1,e=0}^{N,U} + pr\Delta_{t+1,n=1}^{E,NE}). \tag{37}$$

The intuition for equation (37) is similar to the one described previously. It is worth noting that, in this case, the gain from moving into employment also incorporates the possibility of regaining eligibility through the employment spell, which happens with probability pr. This is captured by the third term in (37), given by $pr\Delta_{t+1,n=1}^{NE,E}$, where $\Delta_{t+1,n=1}^{NE,E}$ is the gain of moving from non-eligibility to eligibility which only can happen at the employment state.

The average surplus of eligibility for unemployed workers is given by:

$$\Delta^{E,NE}_{t,n=0} = U(C^U_{t,e=1}) - U(C^U_{t,e=0}) + \beta\mathbb{E}_t\left[(1-f_{t+1})(1-\text{pe}_{t+1})\Delta^{E,NE}_{t+1,n=0} + f_{t+1}(1-\text{pr})\Delta^{E,NE}_{t+1,n=1}\right], \quad (38)$$

where the first term represents that eligible unemployed workers consume more on average than non-eligible unemployed workers. The second term marks the future value of keeping eligibility while being unemployed, which happens with probability $(1 - f_{t+1})(1-\text{pe}_{t+1})$. The final term represents the fact that an eligible unemployed worker who finds a job with probability f_{t+1} next period will enjoy a higher value than a non-eligible unemployed worker who also finds a job but does not regain eligibility, which happens with probability $(1 - pr)$.

Finally, the average surplus of eligibility for an employed worker is given by:

$$\Delta^{E,NE}_{t,n=1} = U(C^N_{t,e=1}) - U(C^N_{t,e=0}) + \beta\mathbb{E}_t\left[(1-\delta(1-f_{t+1}))(1-\text{pr})\Delta^{E,NE}_{t+1,n=1} + \delta(1-f_{t+1})(1-\text{pe}_{t+1})\Delta^{E,NE}_{t+1,n=0}\right]. \quad (39)$$

The second term above is the value that an eligible employed worker keeps her job, with probability $(1-\delta(1-f_{t+1}))$, relative to the value of a non-eligible employed worker that also keeps her job but does not regain eligibility, which happens with probability $1 - pr$. The final term represents the fact that when a non-eligible worker moves into unemployment – with probability $\delta(1-f_{t+1})$ – she will not be entitled to receive UI benefits, while an eligible employed worker that becomes unemployed will receive benefits with probability $(1-\text{pe}_{t+1})$.

B.6 Equilibrium

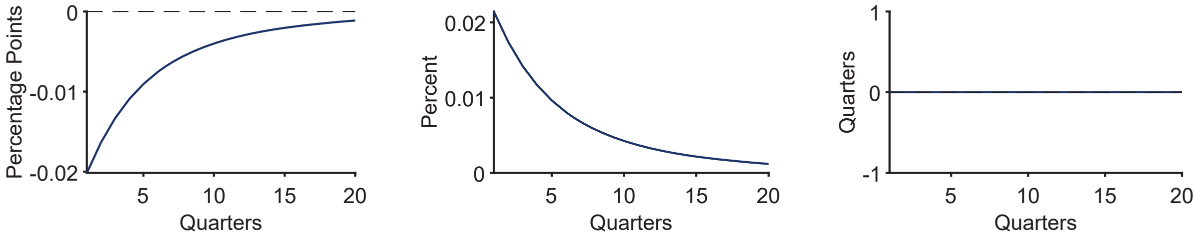
A *competitive equilibrium* is a set of households' policy functions $\{c_{Ht}(s), c_{Ft}(s), c_t(s), a_t(s)\}$, aggregates $\{C_t, C_{Ht}, C_{Ft}, Y_t, Y_t, N_t\}$, prices $\{P_{Ht}, P_{Ft}, P_t, d_t, \mathcal{E}, Q_t, r^a_t, i_t, w_t, mc_t\}$, and distributions $\{\mu_t\}$ such that given aggregate shocks households optimize, firms optimize, the government budget constraint holds, the market for labor services clears $Y_t = Z_t N_t$, the labor market clears $N_t = \int_S n d\mu_t$, and the market for domestic goods clears:

$$Y_t = C_{H,t} + C^*_{H,t} + G_t. \quad (40)$$

Since we are primarily interested in the joint interaction between government spending and the generosity of unemployment insurance in the domestic economy, we abstract from shocks happening abroad. Given that Home is atomistic with respect to the whole economy, economy-wide variables are constant and equal to their steady-state values. Namely, $P^*_t = P^*$, $C^*_t = C^*$, $i^*_t = i^*$. Furthermore, we focus on a symmetric steady state where all domestic savings are invested in domestic government bonds $A = B_H$.

B.7 Additional Model Results

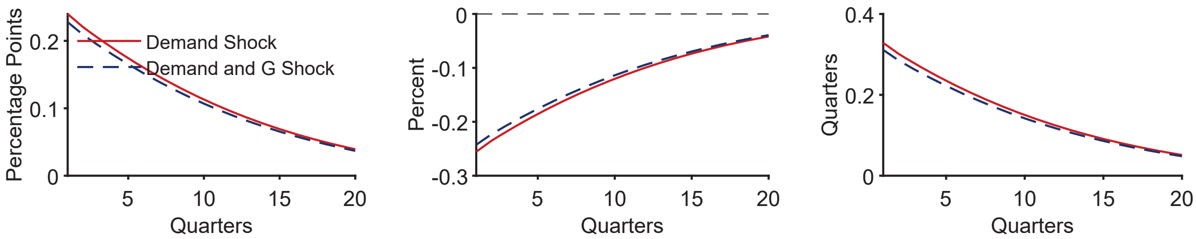
In this section, we first report the set of impulse responses to the shocks that underlie our computation of fiscal multipliers discussed in the main text (Section 6.1). Next, we report the dynamic UI multipliers underlying the different counterfactuals shown in Section 6.3 of the main text.



(a) Unemployment **(b)** Output **(c)** UI duration

Figure B.1: Impulse responses to a government spending shock

Notes: Impulse responses to a government spending shock in the model starting from the steady state.



(a) Unemployment **(b)** Output **(c)** UI duration

Figure B.2: Impulse responses in a demand-driven recession

Notes: Red solid lines: impulse responses to a discount-factor shock. Blue dashed lines: impulse responses to the same discount-factor shock together with a government spending shock.

Government Spending Shock. Figure B.1 shows the aggregate consequences of an exogenous increase in government spending starting from the steady state. We set the persistence of government spending ρ_G to 0.93.[22] Panel (a) and panel (b) show that the fiscal shock induces an output expansion and a decline in the unemployment rate. Importantly this fall in the unemployment rate does not translate into a cut of UI duration (observe panel c), since UI duration had not been previously extended.

Demand-driven recession and Government spending shock. Our second experiment considers a demand-driven recession that mimics the average situation with extended UI in our data. Specifically, we consider a discount-factor shock β_t that induces households to be more patient, reducing consumption. We pick the size of the shock such that UI

[22]We obtain the persistence of government spending by regressing our aggregate measure of government spending on its lag. The estimated persistence is identical to the one estimated in Nakamura and Steinsson (2014)

duration increases by roughly one month, which is the size of the state variable in our empirical regressions.

Red solid lines in Figure B.2 show the impulse responses to the demand shock. Output declines significantly and the unemployment rate increases by roughly 0.25 percentage points. The increase in slackness in the labor market induces the local authority to endogenously extend UI duration (panel c). More precisely, as the unemployment rate increases UI duration rises by about one month, as targeted.

Our third experiment considers the same demand-driven recession as previously described in conjunction with a government spending shock that occurs simultaneously.

Blue dashed lines in Figure B.2 show the impulse responses underlying this third experiment. The increase in government spending now means that output falls less and the increase in the unemployment rate is mitigated (compare to red solid lines). Importantly, and contrary to what we observed in Figure B.1, this dampened response of the unemployment rate now comes with a smaller increase in UI duration; compare solid red line and blue dashed line in panel (c). That is, when UI has been extended, the fiscal expansion induces a cut in UI duration, consistent with our empirical evidence (recall Table 1).

UI multipliers. Figure B.3 shows the UI multipliers at different horizons for each of the counterfactuals considered in Section 6.3. Overall, it can be observed that the main messages contained in Figure 5 are robust across horizons. Namely, fixing real wages would uniformly increase the UI multiplier (blue dashed line with circles). Sequentially

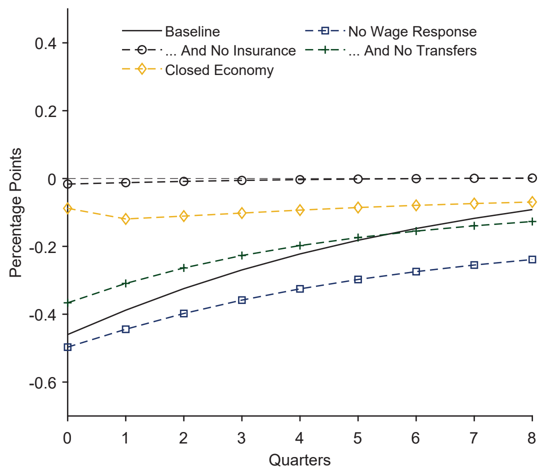


Figure B.3: Cumulative UI Multiplier

Notes: Cumulative UI multipliers at different horizons for the baseline model ad in different counterfactuals that illustrate the channels at work. The UI multiplier measures how much the unemployment rate changes (in p.p.) in response to a one-quarter increase in UI duration.

shutting off the transfers channel (green dashed line with stars) and the insurance channel (black dashed line with circles) significantly reduces the UI multiplier. Finally, the closed-economy UI multiplier is uniformly smaller than in the baseline (observe dashed yellow line with diamonds).

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