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The Impact of Unemployment Insurance and Unsecured Credit on Business Cycles

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Abstract

I study how unsecured credit affects the extent to which unemployment insurance (UI) policies smooth cyclical fluctuations in aggregate consumption. To do so, I develop a real business cycle model with incomplete asset markets, frictional labor markets, and defaultable debt. Using empirically consistent unemployment dynamics over the business cycle, the model generates the cyclical properties of unsecured revolving credit balances and consumer bankruptcies in the data. The model is used to quantify the aggregate implications of a policy that extends the duration of UI during recessions. The main quantitative result of this paper is that unsecured credit amplifies the extent to which UI policies smooth aggregate consumption fluctuations over the business cycle. Extensions in the duration of UI mitigate the rise in consumer bankruptcies during recessions. They also mitigate the rise in the risk premium on unsecured borrowing, which allows households to better smooth consumption.

Topics: Business fluctuations and cycles; Labour markets; Credit and credit aggregates; Economic models, Fiscal policy
JEL codes: E2, E21, E24, E3, E32, E44, E62

Résumé

Cette étude porte sur la façon dont le crédit non garanti influence la capacité de l'assurance-emploi à lisser les fluctuations cycliques de la consommation globale. Je crée un modèle de cycle économique réel combinant des marchés d'actifs incomplets, des marchés du travail frictionnels et des créances présentant un risque de défaut. En introduisant une dynamique du chômage empiriquement cohérente avec le cycle économique, le modèle reproduit les propriétés cycliques des soldes de crédit renouvelable non garanti et des faillites personnelles. J'utilise ensuite le modèle pour quantifier les répercussions globales d'une politique qui prolonge l'assurance-emploi pendant les récessions. Le principal résultat quantitatif de l'étude est que le crédit non garanti amplifie l'effet de lissage des politiques d'assurance-emploi sur les fluctuations de la consommation globale au cours du cycle économique. La prolongation de l'assurance-emploi atténue l'accroissement des faillites personnelles pendant les récessions, de même que la hausse de la prime de risque liée aux emprunts non garantis, ce qui permet aux ménages de mieux lisser leur consommation.

Sujets : Cycles et fluctuations économiques; Marchés du travail; Crédit et agrégats du crédit; Modèles économiques; Politique budgétaire
Codes JEL : E*2, E21, E24, E3, E32, E44, E62*

1. Introduction

Unemployment is well known to be one of the main causes of financial stress for households.[1] To help insure the economy against cyclical fluctuations in unemployment risk, the United States government automatically extends the duration of unemployment insurance (UI) benefits during recessions. UI has long been considered an automatic stabilizer of the economy, but it is unclear how unsecured credit impacts the extent to which these policies stabilize aggregate consumption fluctuations. Recent work by Hsu et al. (2014, 2018) showed evidence that extensions in the duration of UI reduce consumer defaults and increase access to consumer credit via the interest rate and borrowing limit on credit cards. This relationship between UI and credit has the potential to significantly impact aggregate consumption and borrowing behavior because almost 45% of households in the labor force report having positive balances of credit card debt after making their last payment. In this paper, I study how unsecured credit affects the extent to which UI policies smooth aggregate consumption fluctuations over the business cycle.

To answer this question, I develop a general equilibrium real business cycle model with incomplete asset markets, frictional labor markets, and unsecured defaultable debt. Relative to existing frameworks that measure the cyclical properties of consumer credit such as Nakajima and Ríos-Rull (2019), the model explains the high cyclical volatility of unsecured revolving credit balances in the data by using empirically consistent unemployment dynamics over the business cycle. There are three main results of this paper. First, unsecured credit amplifies the extent to which UI policies smooth aggregate consumption fluctuations over the business cycle. Second, extending the duration of UI during recessions has a stronger impact on aggregate fluctuations than increasing the level of benefits. Finally, the majority of the volatility in aggregate consumption, unsecured credit, and consumer bankruptcies is driven by cyclical changes to job finding rates as opposed to TFP or job separation rates.

There are two main channels that determine how unsecured credit impacts the effectiveness of UI as an automatic stabilizer: an income effect and a risk premium effect. When households become unemployed, many borrow to replace a fraction of their lost income. An

[1]Evidence of financial stress from numerous studies including Sullivan et al. (2000), Bermant and Flynn (2002), Hurd and Rohwedder (2010).

increase in the transfer of resources via UI allows households to borrow less to finance the same level of consumption. I refer to this as the income effect. In isolation, this channel could dampen the impact of UI on consumption because households are substituting one form of insurance for the other. The risk premium effect moves in the opposite direction. When the government increases the transfer of resources to households, financial intermediaries reduce the risk premium for a given level of debt because the probability of a bankruptcy falls. The risk premium effect could amplify the impact of UI on consumption because the two forms of insurance are complementing each other: improvements in UI make it cheaper to use unsecured credit. The quantitative significance of the two channels in driving cyclical fluctuations depends on default behavior and the willingness to use credit to finance consumption. When the government extends the duration of UI, it mitigates the rise in consumer bankruptcies during recessions; this mitigates the rise in the risk premium on unsecured credit which allows household to better smooth consumption. UI extensions also reduce the incentive of households to delever for precautionary reasons during recessions. These forces cause the risk premium effect to dominate, and credit amplifies the extent to which UI smooths aggregate consumption fluctuations.

The results of this paper come from a general equilibrium real business cycle model which incorporates frictional labor markets into a model with unsecured credit and consumer bankruptcy. In the style of Krusell et al. (2017), the labor market features standard labor supply forces and frictions. Flows between employment and unemployment are determined by endogenous labor supply decisions by households and by exogenous labor market frictions. The credit market is modeled in the style of Chatterjee et al. (2007) and Livshits et al. (2007), where financial intermediaries offer a menu of loan prices to households dependent on default probabilities. The theory that the price of unsecured credit depends on default behavior is supported by empirical work from Gross et al. (2021), which finds that a 1% increase in bankruptcy risk results in a 70-90 basis points increase in the interest rate of credit cards. Business cycles are driven by cyclical changes to TFP and labor market frictions. In this setting, fluctuations in bankruptcy behavior result in fluctuations in the menu of loan prices offered by financial intermediaries. To my knowledge, the only other model that combines unemployment risk and defaultable debt in an equilibrium business cycle model is Herkenhoff (2019), which studies how exogenous credit expansions impact economic recoveries from recessions. Similar to Nakajima and Ríos-Rull (2019), my model provides a theory as to why credit could expand following a recession: as unemployment risk returns to normal intermediaries increase the supply of credit to households.

The model explains the cyclical properties of unsecured revolving credit balances and consumer bankruptcies in US data even though these moments are not targeted in the calibration procedure. Most notably, the model economy generates over 80% of the standard deviation of unsecured revolving credit. This result contributes to the consumer credit literature where the model with cyclical earnings skewness shocks in Nakajima and Ríos-Rull (2019) generates about one-quarter of the standard deviation of unsecured revolving credit.[2] To better understand why my model improves in matching the data, I run a decomposition exercise where I remove cyclical changes to TFP and labor market frictions one at a time. Over 90% of the volatility in unsecured credit and over half of the volatility in consumption and consumer bankruptcies is explained by the dynamics of job finding rates for unemployed workers. Job finding rates drive aggregate fluctuations because they increase the expected duration of unemployment during recessions. UI is designed to protect households against relatively short unemployment spells, but households are more likely to default when the duration of unemployment increases. They also delever to insure themselves against the possibility of being unemployed after UI is exhausted. My model is able to generate the high volatility of unsecured revolving credit balances in the data because it is calibrated to match the share of unemployment fluctuations coming from job separation rates and job finding rates. The cyclical changes to the skewness of individual earnings risk reported in Guvenen et al. (2014) could be caused by changes to wages, job separation rates, or job finding rates, but I show that the latter is what drives aggregate fluctuations. More specifically, the persistence of a large negative income shock that is partially insured by the government generates the cyclical properties of unsecured credit and consumer bankruptcies.

The main experiment of this paper is to quantify the aggregate implications of UI policies in the benchmark economy with unsecured credit and in a counter-factual economy without

[2] They calibrate their model to match annual moments for individual earnings risk reported in Guvenen et al. (2014), which finds that earnings risk becomes more left-skewed during recessions.

credit. A policy that extends the duration of UI by 13 weeks during recessions has a strong impact on cyclical consumption fluctuations in the benchmark economy.[3] The standard deviation of aggregate consumption falls from 0.73 to 0.63 when the policy is implemented. The same policy only reduces the standard deviation of consumption by 0.08 percentage points in the economy with no credit. Unsecured credit amplifies the extent to which UI smooths consumption fluctuations because of the quantitative significance of the risk premium effect. Extending the duration of UI mitigates the equilibrium change in the risk premium during recessions; households respond by better smoothing consumption. This result adds to the literature which studies the usefulness of credit as consumption insurance. Athreya et al. (2009) finds that unsecured credit doesn't smooth consumption over the life cycle, and Nakajima and Ríos-Rull (2019) finds that it doesn't smooth aggregate consumption over the business cycle. Although unsecured credit doesn't smooth cyclical consumption fluctuations by itself, I show that it does amplify the smoothing characteristics of UI policies.

I conclude my analysis by comparing the aggregate implications of the UI policy that extends the duration of benefits during recessions to a budget-neutral policy that increases the level of benefits. It is essential to understand the aggregate implications of these policies because both have been implemented in recent recessions.[4] I find that a policy which increases the replacement rate (RR) of benefits during recessions has a much smaller impact on aggregate fluctuations. Even though the policy costs the same for the government, increasing the RR of benefits only reduces the standard deviation of consumption from 0.73 to 0.70. There are similar results for unsecured credit balances: the policy which extends the duration of UI during recessions reduced the standard deviation of unsecured credit from 3.78 to 3.02. The policy that increases the RR of benefits only reduces the standard deviation to 3.71. A key force driving these results is the willingness to use credit to finance consumption. Extending the duration of benefits simultaneously transfers resources to households and reduces the incentive to delever for precautionary reasons during recessions. Alternatively, when the

[3] The policy is calibrated to be consistent with the Federal-State Extended Benefits (EB) Program. The EB Program was signed into law in 1970 to provide automatic triggers to extend the duration of UI by 13 weeks when unemployment is persistently high.

[4] The Emergency Unemployment Compensation Act extended the duration of UI up to 99 weeks during the global financial crisis. The Federal Pandemic Unemployment Compensation Program provided up to $600 of additional benefits per week to UI recipients during Covid-19.

government increases the level of benefits, households use a large share of these transfers to delever to insure themselves against the possibility of a prolonged unemployment spell

This paper contributes to the literature that studies the relationship between forms of public and private insurance. The most related empirical work is by Hsu et al. (2014, 2018), which shows evidence that more generous UI policies result in lower interest rates and higher borrowing limits on credit cards.[5] Their paper also finds that extensions in UI reduced mortgage defaults during the global financial crisis. Bornstein and Indarte (2023) finds evidence that higher levels of Medicaid lead to more credit card borrowing. Braxton et al. (2022) studies how consumer credit impacts the optimal replacement rate of UI. The most similar theoretical work is by Athreya and Simpson (2006), which studies the relationship between UI, unsecured credit, and consumer bankruptcies in an economy without aggregate fluctuations.[6] Their paper finds that increasing the generosity of UI leads to a steady-state equilibrium with higher unsecured credit balances. The intuition behind the results is similar across all of the papers in this literature: public insurance complements private insurance by reducing default incentives. My paper is the only one to show that the relationship between UI and credit plays a key role in driving cyclical fluctuations. Focusing on business cycle dynamics provides an important contribution to the literature because most changes to UI are temporary and occur during recessions.

Most of the literature which has studied the aggregate implications of UI policies has focused on employment outcomes. Recent papers that measure the impact of UI on employment outcomes during the global financial crisis (GFC) have mixed findings. Johnston and Mas (2018) uses administrative data from Missouri to show that a cut in the maximum duration of UI after the GFC led to a reduction in unemployment. In contrast, Chodorow-Reich et al. (2019) finds that the extension in the duration of benefits during the GFC had minimal effects on unemployment. The most related work in the literature is Kekre (2023), which studies how UI policies impact aggregate demand. His paper finds that extending the duration of UI during the GFC actually prevented a further rise in unemployment because

[5]Their paper uses variation in UI policies across states to study how credit card offers are impacted by the generosity of benefits.

[6]Preliminary work by Makoto Nakajima also studies the relationship between UI, unsecured credit, and consumer bankruptcies using a model economy.

the policy stabilized aggregate demand. Although I do not focus on employment outcomes, my paper adds to this result by showing that unsecured credit amplifies the impact of UI on aggregate consumption: the largest component of aggregate demand.

Much of the macroeconomics literature that studies UI has focused on the optimal construction of UI. Many papers, including Hansen and Imrohoroglu (1992) and Chetty (2008), solve for the replacement rate of UI that maximizes household welfare. Acemoglu and Shimer (1999) solves for the level of benefits that maximizes output in an economy with directed search. Recently, the literature started to consider the optimal construction of UI over the business cycle (Mitman and Rabinovich, 2015). Although I do not solve for the optimal construction of UI, I do compare the consumption-equivalent welfare gains of different counter-cyclical UI policies. I find that new households on average prefer policies that extend the duration of benefits during recessions. However, low-income households prefer policies which increase the level of benefits. These results indicate that the relative success of a policy may depend on the goal of the policy-maker. Extending the duration of benefits is more effective at smoothing aggregate fluctuations, but increasing the level of benefits is a better targeted policy for low-income households.

The rest of the paper is organized in the following way. Section 2 outlines the equilibrium model with incomplete asset markets, frictional labor markets, and unsecured credit. Section 3 maps the model to the data. Section 4 measures the impact of UI and unsecured credit on aggregate fluctuations. Section 5 provides concluding remarks.

2. Model

This section defines a general equilibrium real business cycle model with four types of economic agents. A representative firm rents capital and labor to produce a single output good. Production is subject to fluctuations in TFP over the business cycle. Overlapping generations of households choose whether or not to supply labor to the firm in a frictional labor market. They also borrow and save by purchasing securities from financial intermediaries. Debt contracts have a default option which is modeled to depict a chapter 7 bankruptcy in the United States. Idiosyncratic risk and incomplete asset markets give rise to an endogenous distribution of households in the spirit of Huggett (1993) and Aiyagari

(1994). Financial intermediaries sell securities to households at a discount price that reflects the probability of a bankruptcy occurring. Intermediaries also own capital and rent it to the firm in a competitive market. The government uses income taxes to fund transfers to households. The model is defined recursively in discrete time.

2.a) The Firm's Problem

A representative firm produces output from aggregate capital K and aggregate labor L. The firm rents capital and labor to solve the problem described below. Let $r(\Omega)$ be the price of purchasing a unit of capital from financial intermediaries in a competitive market. Similarly, $w(\Omega)$ is the price of purchasing a unit of labor from households. Equations (1) and (2) describe the solution to the firm's problem, where r depends on the marginal product of capital, and w is the marginal product of labor.

$$\max_{K,L} \; z(x)F(K,L) - \delta K - r(\Omega)K - w(\Omega)L$$

$$r(\Omega) = z(x)F_K(K,L) - \delta \tag{1}$$

$$w(\Omega) = z(x)F_L(K,L) \tag{2}$$

The aggregate state space of the model economy is $\Omega = \{x, \mu\}$, where μ is the endogenous distribution of households over individual state variables and x is the exogenous state of the economy. The exogenous state fluctuates between expansions x_g and recessions x_b, and $\pi_x(x, x')$ is the probability matrix governing the transitions. I assume that aggregate productivity $z(x)$ is a function of exogenous state such that TFP falls during recessions.

2.b) Households

There are J overlapping generations of households in the model economy. Every period, a cohort of size ϕ_J dies and is replaced by a new cohort of the same size. I assume there is a measure one continuum of households such that $\sum_{j=1}^{J} \phi_j = 1$. Age 1 households are born into the economy with good credit, zero assets, and a fraction Φ_E are employed. They retire at age J_r and die at age J. They derive utility $u(c_j)$ by consuming the single output good, and they discount future utility at rate β. Let $\Psi_j = (\epsilon_j, a_j, n_j, s_j)$ be a point in the individual state space of the household problem.

Households differ with respect to their labor productivity. Productivity has two components: an age component and a persistent component. The age component of productivity γ_j exhibits a hump-shaped life-cycle profile, which gives young households an incentive to borrow against future earnings. I assume that the persistent component of productivity ϵ_j evolves according to the stochastic AR(1) process detailed below. Let η be the innovations to the persistent process, where σ_η^2 is the variance of innovations. The persistence of individual productivity is ρ.

$$\log(\epsilon_{j+1}) = \rho \log(\epsilon_j) + \eta, \quad \textit{where} \quad \eta \in N\big(0, \sigma_\eta^2\big)$$

The labor market is modeled in the style of Krusell et al. (2017), where households have the option to supply labor to the firm in a frictional labor market. The environment simultaneously accounts for labor market frictions and standard labor supply forces that are present in the stochastic growth model. A household can be employed E, nonemployed N, or nonemployed with no UI $\tilde{N}$. Let n_j be the employment state of an age j household. An employed household chooses whether or not to quit a job, and a nonemployed household chooses whether or not to search for work. Equation (3) describes the extensive-margin labor supply decision, where $h \in \{e, u\}$ is the corresponding decision rule.[7] I assume that households pay a utility cost of χ_w to work, and they pay a utility cost χ_s to search. Therefore, households must weigh the expected future earnings of work against the costs of participating in the labor market. Let $\chi(\Psi_j)$ be a function that maps labor supply decisions to the corresponding utility costs. Employment dynamics are also impacted by labor market frictions. Let $\xi(x)$ be the involuntary separation rate, and let $\lambda(x)$ be the job finding rate, which is the probability of finding a job when searching for work. These frictions vary with the exogenous state of the economy such that the labor market becomes more frictional during recessions. I assume that all employment transitions take place after production. Figure 1 details the flows between employment states in the model economy.

[7] Let e be the decision to keep a job while employed or search for a job when not employed. Similarly, u is the decision to quit a job or refrain from search.

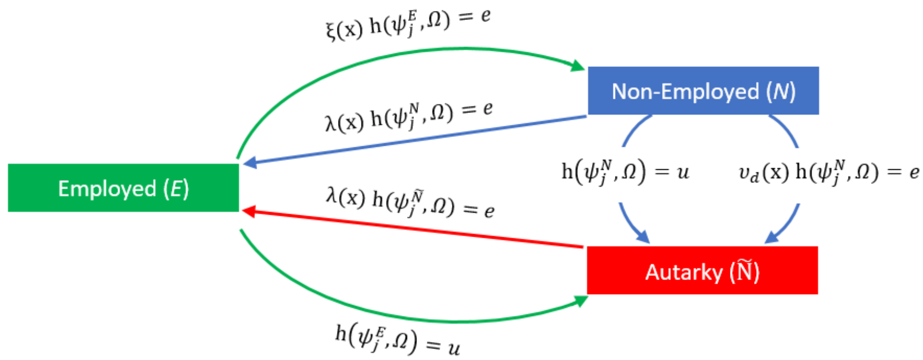

Figure 1: Labor Market Flows

Notes: Flows between three labor market states in the model economy. E is employed; N is non-employed; $\tilde{N}$ is non-employed without access to UI. Ψ_j^n is the individual state space for a household with employment state n. $h(\Psi, \Omega)$ is the household's employment decision.

$$V(\Psi_j, \Omega) = \max\left[V^e(\Psi_j, \Omega), V^u(\Psi_j, \Omega)\right] \tag{3}$$

$$h(\Psi_j, \Omega) = \begin{cases} e \quad if \quad V^e(\Psi_j, \Omega) \geq V^u(\Psi_j, \Omega) \\ u \quad otherwise \end{cases}$$

The UI regime is modeled to depict the key features of the US system. I assume that households who experience voluntary unemployment are not eligible for UI benefits. Specifically, a working household who quits a job transitions to state $\tilde{N}$, where there is no UI. Similarly, a non-employed household who doesn't search for work is ineligible for benefits and transitions to $\tilde{N}$. While receiving UI, the level of benefits is determined by the replacement rate υ_r, which is the fraction of lost labor earnings. Let $\overline{\upsilon}$ be the maximum level of benefits that an individual can receive. I also assume that $\upsilon_d(x)$ is the probability of losing access to UI while unemployed. This allows the model to replicate the average duration of benefits during an unemployment spell. The duration of UI depends on the aggregate exogenous state so the benchmark economy can be calibrated to replicate the Federal-State Extended Benefits Program (EB), which provides 13 additional weeks of benefits during recessions.

After making a labor supply decision, households make a discrete default decision with respect to accumulated debts. Let $a_j \in A$ be the current asset level, and I make the standard assumption that $a_j < 0$ is debt and $a_j > 0$ is savings. In the spirit of Chatterjee et al. (2007) and Livshits et al. (2007), the default decision is modeled to depict a chapter 7 bankruptcy filing in the US. Equation (4) describes the bankruptcy decision, where $d \in \{p, b\}$ is the subsequent decision rule.[8] I make the following assumptions about bankruptcy: all assets are immediately discharged, the household pays a utility cost χ_b, and the household cannot save in the period in which a bankruptcy occurred. Furthermore, access to credit is determined by credit status s_j. After a bankruptcy, the defaulting household moves to bad credit s_b where there is no borrowing. Let $V^{h,b}$ be the value of declaring bankruptcy and moving to bad credit. I assume that θ is the probability of transitioning back to good credit s_g, which restores access to credit markets. This assumption allows the model to replicate the average duration that a bankruptcy stays on the credit score of an individual without increasing the size of the state space. In this environment, it is possible to default with a positive value of assets, but this does not happen in practice because there is no incentive to do so.

$$V^h(\Psi_j, \Omega) = \max \left[V^{h,p}(\Psi_j, \Omega), V^{h,b}(\Psi_j, \Omega) \right] \tag{4}$$

$$d(\Psi_j, \Omega) = \begin{cases} p & if \quad V^{h,p}(\Psi_j, \Omega) \geq V^{h,b}(\Psi_j, \Omega) \\ b & otherwise \end{cases}$$

Let $q(a_{j+1}; \Psi_j, \Omega)$ be the menu of discount prices over all of the possible choices of securities. The price for a specific security a_{j+1} reflects the probability of a bankruptcy occurring next period. In this setting, the discount price decreases with the amount borrowed, and a household's borrowing limit is an endogenous outcome of the loan price schedule. The intuition for the endogenous borrowing limit is similar to a Laffer Curve: if a household tried to borrow an infinite amount of debt, intermediaries would offer a discount price of zero and households couldn't borrow any resources. Similarly, households do not borrow if they choose $a_{j+1} = 0$. Therefore, along the menu of loan prices there is a maximum amount of debt that can be borrowed. This setting allows the model to generate the micro-level relationship between UI and the interest rate and borrowing limit for credit that was shown in Hsu et al. (2014, 2018). The equilibrium menu of loan prices provides an essential feedback mechanism

[8] I define p as the decision to repay debts and b as the decision to declare bankruptcy.

for my analysis. UI affects bankruptcy behavior, which feeds back through the interest rate and borrowing limit on credit to impact the consumption decisions of households.

Households finish the model period by choosing consumption and net savings. Equation (5) details the corresponding decision problem. Let $W(\Psi_j, \Omega)$ be a function that determines the pre-tax labor earnings of a household with characteristics Ψ_j. Labor earnings are individual productivity times the equilibrium wage rate when employed. Similarly, $T^U(\Psi_j, \Omega)$ is the transfer of UI benefits dependent on the eligibility of the household. I assume that benefits are calculated using the persistent productivity ϵ_j from the most recent period of employment. This reflects the fact that UI benefits are based on an individual's labor earnings from before the unemployment spell began. Households also receive social security benefits T_j^R during retirement, and they receive a lump-sum transfer of T_j from the government during working years. Households who begin the period in bad credit still solve Bellman equations (3)-(5), except the borrowing limit $\underline{a}(\Psi_j, \Omega)$ is set to 0, and they transition to good credit next period with probability θ.

$$V^{h,p}(\Psi_j, \Omega) = \max_{c_j,\, a_{j+1}} u(c_j) - \chi(\Psi_j) + \beta \sum_{x'} \pi_x(x, x')\, E\Big[V(\Psi_{j+1}, \Omega')|\Psi_j\Big] \tag{5}$$

$$\text{s.t.} \quad c_j + q(a_{j+1}; \Psi_j, \Omega)\, a_{j+1} = a_j + (1-\tau)\, W(\Psi_j, \Omega) + (1-\tau) T^U(\Psi_j, \Omega) + T_j^R + T_j$$

$$\text{and} \quad \mu' = \Gamma(\Omega), \qquad a_{j+1} \geq \underline{a}(\Psi_j, \Omega), \qquad c_j > 0$$

Retired households are permanently out of the labor force. I choose to model retirement to create a realistic life-cycle savings motive for working households. Retirement is not of primary interest to the paper because retired households are not affected by unemployment risk or UI policies. I assume that retired households do not have access to unsecured credit. This assumption should not have a significant effect on the results of the paper because unsecured credit and default are concentrated in young households in the model and in the data.

All of the decision problems outlined in equations (3) through (5) assume households have rational expectations. Uninsurable idiosyncratic risk coupled with incomplete asset markets creates an endogenous distribution of households over state variables. In the spirit of Krusell and Smith (1998), the distribution of households follows the law of motion $\mu' = \Gamma(\Omega)$.

Agents in the model economy know the law of motion, which allows them to form rational expectations over future prices.

2.c) Financial Intermediaries

A continuum of risk-neutral financial intermediaries serves two main purposes in the model economy: they sell securities to households, and they rent capital to the firm. I assume that the market for intermediation is competitive such that zero profits are earned in expectation on each security. Equation (6) describes the menu of equilibrium prices offered to an age j household for all possible choices of a_{j+1}. I assume that the intermediary knows the productivity and employment status of a household, and the intermediary has rational expectations with respect to the future return on capital. The prices offered to an age j household depend on the probability of a bankruptcy next period at age $j+1$. All else equal, an increase in the probability of a bankruptcy reduces the expected return of the loan, and the discount price falls to ensure zero profits in expectation. I assume that ι is a proportional cost paid by the intermediary to monitor debt contracts. For savings, the discount price is always equal to the inverse of the expected return on capital because there is no default on positive assets.

$$q(a_{j+1}; \Psi_j, \Omega) = \sum_{x'} \pi_x(x, x')\, E\Big[\Big(\frac{1}{1 + r(\Omega') + \iota(a_{j+1})}\Big)\Big(1 - d(\Psi_{j+1}; \Omega')\Big)|\Psi_j\Big] \tag{6}$$

$$\text{where} \quad \mu' = \Gamma(\Omega), \quad \text{and} \quad \iota(a_{j+1}) = \iota \quad if \quad a_{j+1} < 0$$

Financial intermediaries own all of the capital in the model economy. They rent net household savings in the form of capital to the firm. Because intermediaries have both loans and capital on the balance sheet, these assets must have the same expected return in equilibrium. This has important general equilibrium implications for credit. All else equal, a fall in the return to capital increases the discount price of credit, making it cheaper to borrow. In section 3, I show that fluctuations in TFP result in general equilibrium changes to the return on capital that have a significant impact on aggregate credit balances over the business cycle.

$$
\begin{aligned}
\Pi(\Omega) = &\Big(1 + r(\Omega) - \delta\Big)K - K' \\
&+ \sum_{j=1}^{J} \int_{\Psi} \Big[q(a_{j+1}, \Psi_j, \Omega) a_{j+1} - \Big(1 - d(\Psi_j, \Omega) - \iota(a_j)\Big) a_j \Big] \mu(\Psi_j) \, d\Psi_j
\end{aligned} \tag{7}
$$

Intermediaries earn zero profits in expectation on each security, but aggregate uncertainty makes it such that they can have realized profits or losses. Equation (7) details the profits of intermediaries $\Pi(\Omega)$ in a model period. Intermediaries receive the returns to capital net of depreciation, and they invest capital with the firm for next period's production. They also pay out the net balance of securities that were sold last period. No revenue is received from debt that is in a bankruptcy claim. Intermediaries sell new securities a_{j+1}. They also pay monitoring costs for pre-existing debt contracts. The total return on past securities and the total liabilities from newly issued securities are aggregated over the distribution of households.[9] I assume that net profits are taxed fully each period by the government. Realized net profits in the calibrated model economy are quantitatively insignificant such that distributing the profits in a different way wouldn't affect the results of the paper.

2.d) The Government

The government collects income taxes from all households where τ is the tax rate. The government also facilitates transfers to households through three different programs: UI benefits, social security benefits, and lump-sum transfers. The UI program accounts for the key features of the US program outlined in section 2.b. Equation (8) describes the government budget constraint where $G(\Omega)$ is net government expenditures. Let $\hat{\tau}(\Omega)$ be the total income taxes aggregated over the distribution of households. Similarly, $\hat{T}_u(\Omega)$ is the total transfer of resources through the UI program. The total transfer of social security benefits is defined by $\hat{T}_r$. The government also makes a lump-sum transfer to all working-age households where $\hat{T}$ is the total value.[10] I assume that the government consumes the

[9] I integrate over the entire individual state space for households. I represent with this an integral over Ψ_j. A more detailed description of the aggregation process would be to sum over discrete states n and s and integrate over continuous states a and ϵ. I suppress the full notation to improve the readability of the model equations.

[10] The fraction of retired and working-age households is constant such that the total expenditures on $\hat{T}_r$

remaining goods after collecting taxes and distributing transfers. Government consumption is always positive in equilibrium.

$$G(\Omega) = \hat{\tau}(\Omega) + \Pi(\Omega) - \hat{T}_u(\Omega) - \hat{T}_r - \hat{T} \tag{8}$$

2.e) A Recursive Equilibrium

An equilibrium in the model economy occurs when economic agents behave optimally and all markets clear. Before defining the equilibrium concept, I define aggregate variables needed to solve for an equilibrium in the model economy. Aggregate labor supply is the total productivity of households who are currently employed at the market wage. Similarly, aggregate consumption is the total consumption summed over the distribution of households. Aggregate investment I is derived from the intermediaries problem as invested capital less non-depreciated capital.

$$L = \sum_{j=1}^{J_r} \int_{\Psi} \gamma_j \epsilon_j \, \mu(\Psi_j^E) \, d\Psi_j^E \tag{9}$$

$$C = \sum_{j=1}^{J} \int_{\Psi} c(\Psi_j, \Omega) \, \mu_j(\Psi_j) \, d\Psi_j \tag{10}$$

$$I = K' - (1-\delta)K \tag{11}$$

Definition 1 A recursive equilibrium is the household value function V, decision rules (a_{j+1}, c_j, h_j, d_j), prices (r, w), the menu of discount prices q, and the distribution of households μ such that

1. Factor prices (r, w) solve the firm problem as described by equations (1) and (2).

2. The decision rules (a_{j+1}, c_j, h_j, d_j) solve the household problems described by equations (3)-(5) where V is the resulting value function.

and $\hat{T}$ are also constant over the business cycle.

3. Financial intermediaries offer a menu of prices q to earn zero profits in expectation described by equation (6).

4. Net government expenditures are described by the government budget constraint in equation (8).

5. The distribution of households is consistent with individual decisions and the transition probabilities for individual state variables.

6. The market for securities clears at the menu of loan prices. The markets for capital and labor clear at the factor prices. The market for goods clear in equation (12) below where ιA^- are the resources spent to monitor debt contracts.

$$C + I + G(\Omega) + \iota A^- = zF(K, L) \tag{12}$$

3. Mapping the Model to the Data

The model is mapped to the data to depict the United States economy from 1980Q1 to 2019Q4. The specified period covers five recessions in which the federal government extended the duration of UI benefits. The US economy also experienced significant cyclical fluctuations in unsecured credit and consumer bankruptcies, making it an excellent basis to measure the impact of UI and unsecured credit on aggregate fluctuations. Mapping the model to the data proceeds in three stages. First, a group of parameters are chosen outside the model solution. A separate group of parameters are calibrated such that the model replicates a set of key moments from the data. Finally, I compare simulated results to a set of untargeted moments from the data to test the validity of the model. Specifically, I show that the model generates the cyclical variances and correlations with real GDP for numerous aggregate time series including unsecured revolving credit balances and consumer bankruptcies. I end this section with a brief description of the numerical methods used to solve the model.

3.a) Parameters Set Outside the Model Solution

The values of the aggregate exogenous transition matrix π_x are set using the average duration of expansions and recessions in the US. To this end, let the length of a period in the model economy be equal to 1 quarter. The persistence of expansions is set such that the average expansion lasts just under 7 years, and the persistence of recessions is set such that the average recession lasts 4.6 quarters. The transition values reported below make the model consistent with business cycle data on peak and trough quarters reported by the NBER from 1980Q1 to 2019Q4.

$$\pi_x = \begin{vmatrix} 0.964 & 0.036 \\ 0.217 & 0.783 \end{vmatrix}$$

The parameters governing the UI regime in the model economy are chosen to be consistent with the Regular Benefits and the Federal-State Extended Benefits (EB) Program in the US. There are four parameters that determine the level and duration of benefits: $\{\upsilon_d(x_g), \upsilon_d(x_b), \upsilon_r, \overline{\upsilon}\}$. Consistent with the median duration of Regular Benefits across states, the probability of losing UI during expansions $\upsilon_d(x_g)$ is set such that the average duration of benefits is two quarters. Similarly, $\upsilon_d(x_b)$ is set such that the average duration of benefits is three quarters during downturns. This policy is consistent with the EB Program, which provides 13 additional weeks of benefits when unemployment is high. The remaining parameters are chosen such that UI replaces 50% of lost earnings, and the maximum level of benefits is 42% of average earnings in the economy. The parameters governing the UI regime are consistent with the summary statistics on benefits reported in Hsu, et al. (2014, 2018).[11]

The parameters governing the life cycle of the household are set such that the model exhibits an empirically consistent hump-shaped earnings profile. Households are born into the economy at age 25, they retire at age 65, and they die at age 75. Due to the quarterly frequency of the model, the total number of periods in the life cycle of a household J is 200. The retirement age J_r is set to 160. The age component of productivity is parameterized such that $\gamma_j = \nu_1 j + \nu_2 j^2$. Using data on earnings from the SCF, I estimate ν_1 and ν_2 to be $4.58e^{-2}$ and $-9.36e^{-4}$ respectively.[12] Because age is only reported in one-year intervals in the SCF, I assume that γ_j changes deterministically every 4 model periods. The estimated age component of productivity generates a hump-shaped earnings profile over the life cycle,

[11] They look at data on UI in the United States from 1991-2010. They report the median duration of benefits across states to be 26 weeks. Also, the ratio of max weekly benefits to average weekly wages is 0.42.

[12] I estimate the age component of earnings in every survey from 1989 through 2019 and take the average.

which has been shown by Livshits et al. (2007) and Athreya et al. (2009) to be a significant component of the demand for borrowing by young households who have higher default rates. Young households borrow against future earnings, which are expected to be higher than current earnings. The hump-shaped earnings profile is also a key determinant of aggregate investment behavior because aging households have an incentive to invest more in capital so they can smooth consumption when their income falls later in life.

The remaining parameters are chosen to be consistent with commonly used values from the literature.[13] Households value utility with constant relative risk aversion (CRRA) preferences $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$. The coefficient of relative risk aversion σ is set to 2.0. Aggregate production follows a Cobb-Douglass function $F(K, L) = zK^{\alpha}L^{1-\alpha}$, where the capital share of production is 35%. The parameters for the AR(1) productivity process are set to be consistent with Krusell et al. (2017): the persistence of the productivity process is 0.989 and the standard deviation is 0.103. The tax rate τ is set to 30%, and the pre-tax transfer to retired households is 50% of average earnings in the model economy. The probability of leaving bad credit θ is 2.50%. Therefore, the average duration of bad credit lasts 10 years, which is the amount of time a bankruptcy remains on an individual's credit score in the US.

3.b) Model Calibration

The remaining parameters are calibrated so the model reproduces a set of key moments from the data over the time period of interest. To this end, I simulate the benchmark economy and update parameters until the model generated moments match the data. There are two stages to the calibration procedure. In stage one, a group of parameters is calibrated to match a set of first moments from the data. This ensures that households have realistic saving, borrowing, and default behavior in the benchmark economy. In stage two, the dynamic variables for TFP and labor market frictions are calibrated such that the model generates empirically consistent unemployment dynamics over the business cycle. In practice, stage one and stage two are executed simultaneously.

Table 1 details the first moments that are targeted in the calibration procedure. To simultaneously match aggregate capital holdings and revolving credit balances, I assume

[13] Appendix A includes a table compiling all parameter values.

Target	Data	Model
Capital to GDP	224.07	224.61
Investment to Capital	7.89	7.89
Government to GDP	5.38	5.69
Credit to GDP	4.83	4.83
Credit Share	41.37	41.40
Credit Spread	11.73	11.62
Bankruptcy Rate	0.88	0.89
Participation Rate	73.73	73.79
Unemployment Duration	20.93	20.93
Unemployment Rate	6.32	6.34

Table 1: Calibration Targets: First Moments

Notes: Mean from 1980Q1-2019Q4 except for credit spreads which begin in 1994Q4. Moments are annualized and in percentages when applicable. Credit share is fraction of households in the labor force with credit card debt using SCF data starting in 1989. Government refers to expenditures on national defense. Unemployment duration is in weeks.

heterogeneity in household discount factors. Specifically, there are two types of households: patient, who discount the future at rate β_h, and impatient, who discount at rate β_ℓ. The discount factors are calibrated to match the ratios of capital and revolving credit balances to GDP. The share of impatient households π_ℓ is then set to match the fraction of households in the labor force with positive balances of credit card debt. The assumption of preference heterogeneity is supported by empirical work from Fulford and Schuh (2017), who estimate a life-cycle model of consumption, unsecured credit, and default with patient and impatient individuals. The calibrated share of impatient households in the benchmark economy is within their range of estimates. The disutility of bankruptcy χ_b and the cost of monitoring ι are then set to match the bankruptcy rate and the credit spread respectively.[14] Because the menu of loan prices offered by intermediaries depends on bankruptcy behavior, these two moments go hand in hand. The remaining parameters are calibrated to match aggregate investment, aggregate government consumption, and labor force participation.[15] I choose to target national defense spending as the measure of government consumption in the data for two main reasons: it is intuitively the closest measure to government consumption in the

[14]The unsecured credit spread in the data is the spread of the average interest rate on credit card accounts that are assessed interest over the interest rate on 1-year treasury bills.

[15]Capital depreciation is set to match aggregate investment, and the lump-sum transfer from the government is set to match government consumption.

model economy, and it ensures that government consumption is always positive in equilibrium. With regards to labor markets, I make the simplifying assumption that the disutility of work is equal to the disutility of search, and χ_w is calibrated to match the labor force participation rate. I also assume that the share of new households who are employed is equal to the average share of employed households in the model economy.

The dynamic variables from the benchmark economy are now calibrated to match unemployment dynamics over the business cycle. Specifically, the expansion and recession values for TFP and labor market frictions need to be calibrated. The expansion value of TFP is normalized to one, and the recession value is calibrated to match the standard deviation of real GDP in the US. With regards to labor market frictions, the values for involuntary job separation rates ξ are set to match the mean and standard deviation of unemployment rates in the data. The expansion value of job finding rates λ is calibrated to match the average duration of unemployment. To pin down the job finding rate during recessions, I choose to target the ratio of the standard deviation of job finding rates to the standard deviation of job separation rates in the data. To calculate these moments, I use the methodology described in Shimer (2012).[16] This methodology calculates flows into and out of unemployment using readily available aggregate time series data. As is consistent with the real business cycle literature, job separation rates are counter-cyclical because the probability of experiencing an unemployment spell goes up in recessions; job finding rates are pro-cyclical because the duration of unemployment spells also increases during recessions. Both variables are highly volatile, but the standard deviation of job finding rates is 60% higher than that of job separation rates. I choose to target this moment so that the share of cyclical unemployment risk coming from each labor market friction is consistent with the data in the benchmark economy.

3.c) Model Validation: Business Cycle Moments

I test the validity of the model by comparing simulated results to empirical moments that were not targeted in the calibration procedure. Specifically, the model-generated moments are compared to the cyclical variances and cross-correlations with real GDP of key

[16] Job finding rates are calculated using equation (4) from Shimer (2012), and job separation rates are calculated using equation (5) from the same paper.

		C	I	D	B	Q	U	P
Rel Std Dev	Data	0.77	4.89	2.97	13.62	5.17	9.05	0.20
	Model	0.50	1.91	2.41	12.92	1.78	9.01	0.02
Corr, GDP	Data	0.86	0.90	0.32	-0.35	-0.71	-0.86	0.42
	Model	0.87	0.96	0.60	-0.56	-0.85	-0.84	0.91

Table 2: Untargeted Business Cycle Properties

Notes: Data is in logs, seasonally adjusted and HP filtered with a smoothing parameter of 1600. All data is from 1980Q1-2019Q4 except for credit spreads which begin in 1994Q4. SD relative to GDP. C is aggregate consumption; I is investment; D is unsecured credit balances; B is consumer bankruptcies; Q is unsecured credit spreads; U is unemployment; P is labor force participation.

macroeconomic aggregates including unsecured credit balances and consumer bankruptcies. The empirical moments are generated using quarterly data that is seasonally adjusted, in logs, and HP filtered with a smoothing parameter of 1600.[17] All data is available from 1980Q1 except for unsecured credit spreads, which are available from 1994Q4.

Overall, the model has a lot of success replicating moments that were not targeted in the calibration procedure. The average return to capital is 1.9%, which is close to the average quarterly return of 2.3% for the S&P 500 over the time period of interest. Table 2 details the business cycle moments in the benchmark model economy and in the data. The model generates consumption that is pro-cyclical and less volatile than GDP. Also, aggregate investment is pro-cyclical and more volatile than GDP. The model underpredicts the volatility of investment, which isn't surprising because there are no adjustment costs for capital or financial frictions for firms. With regards to labor markets, the standard deviation of unemployment was targeted in the calibration procedure, but the model also generates a counter-cyclical correlation very close to the data. Labor force participation is pro-cyclical and much less volatile than GDP. The model underpredicts the volatility of labor force participation, but this should not be of first-order importance to the results of the paper because UI isn't available to individuals who are out of the labor force, and unsecured credit is largely held by employed or unemployed households.

The most important result from this section of the paper is that the model endogenously generates the cyclical properties of unsecured revolving credit balances in the data. This is

[17] Revolving credit balances, unemployment rates, and participation rates are quarterly averages of monthly data. Bankruptcy data is non-business filings.

a significant contribution to the consumer credit and default literature because the leading models have not been able to explain why unsecured credit is so volatile over the business cycle. The model with cyclical earnings skewness shocks in Nakajima and Ríos-Rull (2019) can explain about one-quarter of the total standard deviation of unsecured credit. Fieldhouse et al. (2016) studies the cyclical moments of unsecured credit and consumer bankruptcy in an endowment economy with aggregate shocks to a persistent income process. They find that the model needs intermediation shocks to generate credit that is procyclical, and their model underpredicts the volatility of unsecured credit balances. My benchmark model economy generates over 80% of the volatility in unsecured credit balances by using empirically consistent unemployment dynamics over the business cycle. The model also generates consumer bankruptcies and unsecured credit spreads that are highly volatile and counter-cyclical.[18] Reproducing the cyclical moments of unsecured credit and consumer bankruptcies is not just an important contribution to the literature, it is also a necessary step towards quantifying how unsecured credit affects the usefulness of UI as an automatic stabilizer.

3.d) Numerical Methods to Solve the Model

I conclude section 3 with a brief description of the numerical methods used to solve for an equilibrium of the model economy. I first describe the methods used to solve for individual household decision rules. I then describe the methods used to solve for an equilibrium with heterogeneous households, competitive financial intermediaries, and aggregate fluctuations.

To solve for individual household decision rules, I use a version of the Endogenous Grid Method (EGM) modified to solve problems with non-concavities in the value function. The original EGM developed in Carroll (2006) utilizes the first-order conditions to solve for decision rules in a fast and accurate way. However, the first-order conditions are not sufficient to solve for a global maximum in the current problem because discrete choices for labor supply and consumer bankruptcy create non-concavities in the household value function. Similar to Fella (2014) and Druedahl (2021), I extend the EGM with an upper envelope step to solve for a global solution. The upper envelope step I use solves for multiple candidate solutions before choosing the global optimum. However, the menu of discount

[18] Non-business bankruptcies are still highly volatile and counter-cyclical in the data if you use a shorter time period that ignores the effects of the 2005 Bankruptcy Abuse and Consumer Protection Act.

prices offered by financial intermediaries creates an additional complication for the current model. The discount price enters the first-order condition of the household problem, and the discount price function is not necessarily differentiable at every point in the state space. To deal with this complication, I only use the modified EGM to solve for a candidate solution where households save $a' \geq 0$. For borrowing decisions $a' < 0$, I solve for a candidate solution using standard discrete state space dynamic programming methods. The global optimum is the candidate solution that yields the highest utility for the household. The numerical methods utilized to solve the household problem are powerful enough to make the computation of an equilibrium feasible despite having 200 overlapping generations of households, idiosyncratic risk, and aggregate risk.

$$K' = \nu_0^k(x) + \nu_1^k(x)\log(K) + \nu_2^k(x)\log(L) \tag{13}$$

$$L' = \nu_0^\ell(x) + \nu_1^\ell(x)\log(L) + \nu_2^\ell(x)\log(K) \tag{14}$$

To solve for an equilibrium of the model economy, I use a modified version of the Krusell and Smith (1998) state space approximation method. Specifically, I approximate the infinite-dimensional distribution of households using the first moment of capital and the first moment of labor in the model economy. Households forecast the future using equations (13) and (14). The coefficients of the forecasting rules depend on the aggregate exogenous state of the economy x. I then use multi-period ahead forecasting errors to verify the accuracy of the forecasting rules. The average and maximum error for capital is 0.17% and 0.56%, and the average and maximum error for labor is 0.02% and 0.11%. These errors are highly accurate relative to the existing literature. It is necessary to include both the first moment of capital and the first moment of labor in each equation to get accurate forecasting rules in this model economy.

4. Quantifying the Impact of UI and Unsecured Credit

In this section, I use the general equilibrium model to measure the impact of UI and unsecured credit on aggregate fluctuations over the business cycle. I begin with a decomposition

		C	I	D	B	Q	U
Std Dev	(1) Benchmark	0.63	2.39	3.02	16.15	2.22	11.26
	(2) Acyclical z	0.47	1.75	3.79	14.69	1.65	11.22
	(3) Acyclical ξ	0.51	2.07	2.02	13.26	1.33	6.70
	(4) Acyclical λ	0.27	2.74	0.20	5.10	1.35	4.96
Corr, GDP	(1) Benchmark	0.87	0.96	0.60	−0.56	−0.85	−0.84
	(2) Acyclical z	0.25	0.50	0.85	−0.17	−0.51	−1.00
	(3) Acyclical ξ	0.94	0.97	0.51	−0.47	−0.74	−0.75
	(4) Acyclical λ	0.98	0.98	−0.65	−0.76	−0.89	−0.74

Table 3: Decomposition of Aggregate Fluctuations

Notes: Standard deviation and correlation with GDP when removing fluctuations in dynamic variables. z is TFP; ξ is job separation rate; λ is job finding rate. C is consumption; I is investment; D is unsecured credit balances; B is average bankruptcy rate; Q is average spread of credit over capital returns.

exercise to better understand what is driving the cyclical properties of aggregate time series data. I then answer the main research question of this paper: how does unsecured revolving credit impact the extent to which UI smooths aggregate consumption fluctuations over the business cycle? I conclude this section by comparing two different UI policies: extensions in the duration of UI and increases in the level of benefits during recessions.

4.a) The Sources of Aggregate Fluctuations

I now conduct a decomposition exercise to quantify the sources of aggregate fluctuations over the business cycle. To this end, I simulate the model economy removing cyclical changes to TFP, job separation rates, and job finding rates one at a time. Specifically, I remove the labor market frictions that impact separation rates and finding rates; I do not remove endogenous labor supply decisions. This methodology allows me to isolate the impact of each dynamic variable in driving aggregate fluctuations. Table 3 details the standard deviation and correlation with GDP of aggregate and financial variables for each simulation in the decomposition exercise.

Changes in TFP do not explain the cyclical properties of unsecured credit and consumer bankruptcies. Simulation (2) in table 3 shows that unsecured credit balances are actually more volatile when TFP is held constant. This result is driven by general equilibrium price movements. During a recession, TFP falls, which reduces the equilibrium return on capital. Financial intermediaries pass capital returns through to the debt price offered to households. All else equal, it is cheaper to borrow when TFP falls. A partial equilibrium model that ignores price changes in the real return on capital would overpredict the volatility of unsecured credit balances. Furthermore, TFP cannot explain why credit balances fall during recessions. This result is consistent with the results from Nakajima and Ríos-Rull (2019), who show that a model with only TFP shocks cannot explain the cyclical properties of unsecured credit and consumer bankruptcies. The impact of TFP on consumption and investment is standard in the real business cycle literature. When TFP falls, households invest less because the returns to capital fall, and they consume less because real wages fall. I incorporate cyclical changes to TFP in the benchmark economy because they help the model generate realistic consumption and investment dynamics over the business cycle. The results from simulation (2) are not entirely novel, but they do serve as a good validity test of the model mechanics.

The main result from the decomposition exercise is that job finding rates for unemployed workers are the main driver of aggregate fluctuations over the business cycle. As seen in simulation (4) of table 3, the majority of the volatility in consumption, unsecured credit, and consumer bankruptcies is explained by job finding rates: the standard deviation of all three variables falls by more than half when job finding rates are held constant. Additionally, unsecured credit balances would be counter-cyclical, which is inconsistent with the data. Comparing the results to simulation (3), it is easy to see that job separation rates have a smaller impact on aggregate fluctuations. Part of this result is simply explained by the fraction of unemployment that is caused by each labor market friction. Consistent with results from Shimer (2012), the majority of the volatility in unemployment is driven by job finding rates. However, this does not fully explain why job finding rates have a stronger impact on aggregate fluctuations. The main mechanism driving these results is the precautionary motives of households. When job separation rates increase during a recession, there is a much smaller impact on consumption and credit decisions because UI protects households against relatively short unemployment spells. When job finding rates fall, households have a strong incentive to reduce consumption and delever to insure themselves against the possibility of being unemployed after UI is exhausted. Credit plays an important role in understanding this mechanism because in an economy with defaultable debt, indebted households want to delever to avoid bankruptcy if they experience a prolonged unemployment spell. This adds to the mechanism present in any incomplete markets model where households have an incentive to delever (or save) to insure themselves against income risk.

The results from the decomposition exercise highlight why the model is able to generate the cyclical properties of aggregate consumption, unsecured credit, and consumer bankruptcies. The most important contribution to the consumer credit literature is that the model explains over 80% of the standard deviation of unsecured revolving credit balances in the data. The model with cyclical skewness shocks to an autoregressive earnings process in Nakajima and Rìos-Rull (2019) generates about one-quarter of the same volatility. Their earnings process is calibrated to match annual moments from Guvenen et al. (2014), which shows that earnings risk becomes more left-skewed during recessions. Cyclical changes to earnings skewness in the data could be caused by changes to wages, job separation rates, or job finding rates, but I show that the latter is what drives aggregate fluctuations. UI is designed to protect households against relatively short unemployment spells. However, when job finding rates fall during recessions, default risk increases and households have an incentive to delever to insure themselves against the possibility of being unemployed after UI is exhausted. Calibrating an earnings process to annual tax return data can miss some of the key details that result in large aggregate fluctuations in consumption and unsecured credit balances because you cannot determine which earnings shocks are partially insured by the government. The key component of earnings risk needed to generate the cyclical moments of unsecured revolving credit balances is the persistence of a large negative earnings shock that is partially insured by the government.

The insight that job finding rates have a larger impact on aggregate fluctuations highlights the importance of studying business cycles in an environment with incomplete asset markets. If asset markets were complete, separation rates and finding rates would have the same impact on macroeconomic aggregates if they caused the same change in unemployment. The results from the decomposition exercise clearly show that fluctuations in unemployment can have a vastly different impact on the aggregate economy depending on which labor market friction is driving the change.

4.b) The Amplifying Effects of Unsecured Credit

UI has long been considered an automatic stabilizer of the economy, but it is unclear how unsecured revolving credit impacts the extent to which UI policies smooth cyclical consumption fluctuations. The result depends on whether credit acts as a substitutable or complementary form of insurance. If households substitute UI for credit, then unsecured credit will dampen the impact of UI on consumption. However, if the relationship is complementary, credit will amplify the stabilizing effects. To answer this question, I quantify the aggregate implications of a policy which extends the duration UI during recessions. I compare the results from the benchmark economy with unsecured credit to a counter-factual economy with no credit. The main quantitative result from this section is that unsecured credit amplifies the extent to which UI policies smooth cyclical fluctuations in aggregate consumption.

I begin by measuring the aggregate implications of counter-cyclical extensions in the duration of UI in the benchmark economy with unsecured credit. As stated in section 3, the benchmark model is calibrated to depict the Federal-State Extended Benefits (EB) Program, which extends the duration of benefits by 13 weeks during recessions. To quantify the impact of this policy, I simulate a counter-factual policy where the duration of UI is held constant in expansions and recessions. By comparing simulations (1) and (5) in table 4, it is easy to see that the UI policy has a significant impact on aggregate consumption and unsecured credit. The volatility of consumption would be 0.10 percentage points higher without the policy. Moreover, the volatility of unsecured credit balances would be 0.76 percentage points higher. Both of these variables are pro-cyclical, meaning that the UI policy mitigates the fall in consumption and unsecured credit during recessions.

To answer the main research question of this paper, I simulate the same change in UI policy in a counter-factual economy without credit. The first result coming from this exercise is that aggregate consumption is less volatile without credit. This result is consistent with the result from Nakajima and Ríos-Rull (2019) that unsecured revolving credit does not smooth aggregate consumption fluctuations over the business cycle. The main result from this section is that unsecured credit amplifies the extent to which UI smooths cyclical fluctuations in consumption. Specifically, extending the duration of UI during recessions

		C	D	B	Q
Credit	(1) Extending UI	0.63	3.02	16.15	2.22
	(5) Acyclical UI	0.73	3.78	16.95	2.39
No Credit	(6) Extending UI	0.45	0.00	0.00	0.00
	(7) Acyclical UI	0.53	0.00	0.00	0.00

Table 4: The Impact of Unsecured Credit and UI Policies

Notes: Standard deviation of aggregate variables. C is consumption; D is unsecured credit balances; B is average bankruptcy rate; Q is average spread of credit over capital returns. Simulations (6) and (7) have no unsecured credit. Simulations (5) and (7) have no extension of UI during recessions.

only reduces the volatility of consumption by 0.08 percentage points in the economy without credit. Unsecured credit amplifies the effectiveness of UI because it acts as a complementary form of insurance. When the government extends the duration of UI, it mitigates the rise in consumer bankrupticies during recessions; this also mitigates the rise in the risk premium on unsecured credit offered by financial intermediaries. It follows that it is cheaper for households to use unsecured credit to smooth consumption during recessions because there are smaller changes to the risk premium. Evidence of this channel is seen in table 4: both consumer bankruptcies B and credit spreads Q are less volatile when the government extends the duration of UI during recessions. This mechanism is supported by empirical evidence from the literature. Hsu et al. (2014, 2018) showed evidence that extensions in the duration of UI increase the borrowing limit and reduce in the interest rate on credit cards in the US. Gross et al. (2021) also provided evidence of this mechanism by showing that a 1 percent reduction in bankruptcy probability translates to a 70-90 basis point decrease in the interest rate on credit cards in the US.

The results from this section make a significant contribution to the real business cycle literature and to the unsecured credit literature. Athreya et al. (2009) shows that unsecured credit doesn't smooth consumption for households over the life cycle. Nakajima and Ríos-Rull (2019) shows that unsecured credit does not smooth aggregate fluctuations in consumption over the business cycle. Similar to their work, I also find that unsecured credit does not smooth consumption on its own. However, I find that unsecured credit amplifies the smoothing characteristics of UI policies. The mechanism driving this result is that extensions in the duration of UI promote more unsecured credit during recessions.

	C	D	B	Q
(1) Benchmark	0.63	3.02	16.15	2.22
(5) Acyclical UI	0.73	3.78	16.95	2.39
(8) Increase RR	0.70	3.71	16.89	1.86

Table 5: The Impact of UI on Aggregate Fluctuations

Notes: Standard deviation of aggregate time series. Economy (1) has extensions in the duration of UI during recessions; (5) has no change in UI during recessions; (8) has increases the replacement rate during during recessions. C is consumption; D is unsecured credit balances; B is average bankruptcy rate; Q is average spread of credit over capital returns.

4.c) Extending the Duration of UI vs. Increasing the Level

Is it more effective to extend the duration of UI during recessions or to increase the level of benefits? Both policies have been used during recent recessions, but little is known about which is a more efficient use of government resources. To answer this question, I compare the benchmark UI policy which extends the duration of benefits during recessions to a budget-neutral policy which increases the replacement rate (RR) of benefits.[19] The policy is budget-neutral in the sense that it generates the same average level of government expenditures. The relative success of each policy may depend on the goal of the policy-maker. In this section, I compare the UI policies using three different metrics. I quantify which policy is better at stabilizing aggregate consumption. I also measure which policy is better at stabilizing unsecured credit markets. And finally, I study which policy is preferred by households.

The main result from this section is that extending the duration of UI during recessions has a larger impact on aggregate fluctuations than increasing the level of benefits. As seen in simulation (8) of table 5, increasing the RR of UI during recessions only reduces the standard deviation of aggregate consumption by 0.03 percentage points. This policy also has a much smaller effect on the volatility of unsecured credit balances and consumer bankruptcies when compared to the benchmark policy which extends the duration of UI during recessions. The main force that causes extensions to have a larger impact on aggregate fluctuations is the precautionary behavior of households. When the government increases the level of benefits, households still have a strong incentive to delever (or save) to insure themselves against

[19]The replacement rate increases from 0.50 to 0.62 during recessions with the budget-neutral policy.

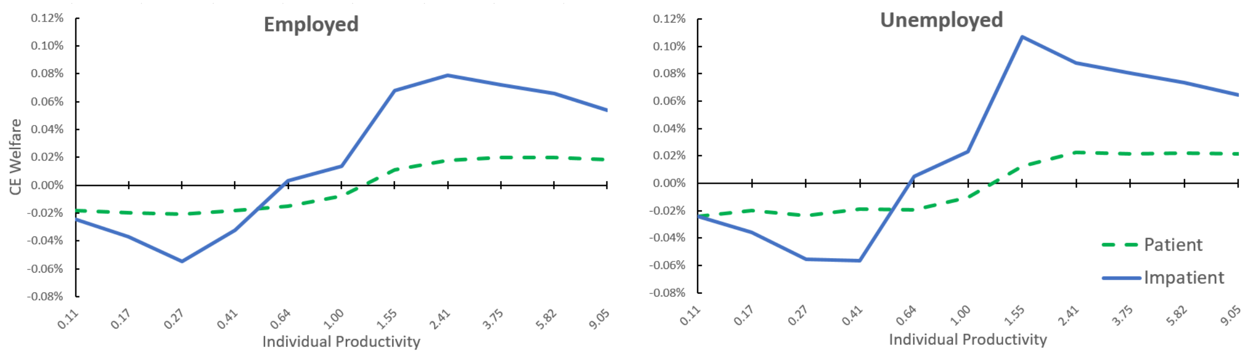

Figure 2: Welfare from UI Policies

Note: Consumption-equivalent (CE) welfare across initial productivity. Measures counter-cyclical increase in RR of UI relative to counter-cyclical extension in duration. Positive value means household prefers extensions. Measured for age 25 ($j = 1$) households. Median productivity normalized to 1.0.

the possibility of a prolonged unemployment spell. Extensions in the duration of UI have a strong impact on consumption and credit because they make households more willing to use credit to finance consumption. Therefore, a larger fraction of the transfers are used for consumption as opposed to being used to pay back debt. The only variable that is more stable when the government increases the RR is the unsecured credit spread. The credit spread is more stable because households delever enough such that they move to a region on the menu of loan prices with a higher discount price.

On average, households prefer to have extensions in the duration of UI, but the welfare gains differ significantly across the distribution of households. To study which policy is preferred by households, I use a consumption-equivalent (CE) welfare analysis. Households prefer counter-cyclical extensions in the duration of UI, but on average they are almost indifferent with counter-cyclical increases in the level of benefits. Specifically, in the economy where the government increases the RR of benefits during recessions, households would on average trade 0.01% of their lifetime consumption to have extensions. However, the results vary significantly across the productivity distribution of households.[20] Low-income households prefer policies which increase the level of benefits, but high-income households prefer policies which extend the duration. These results show that extending the duration of benefits is better at smoothing aggregate fluctuations, but increasing the level of benefits

[20]Because new households in the model economy have zero assets, productivity maps directly to income for this subset of the distribution.

is preferred by low-income households. Therefore, increasing the level of benefits may be considered a more effective policy if the goal of the policy-maker is to help low-income housholds.

5. Conclusion

The United States government regularly increases the duration of UI during recessions. It is unclear whether unsecured consumer credit amplifies or dampens the extent to which these policies smooth aggregate consumption fluctuations over the business cycle. The result depends on whether households use unsecured credit as a substitutable or complementary form of insurance. The relationship between UI and credit has the potential to significantly impact aggregate fluctuations because nearly 45% of US households report having positive balances on their credit cards after making their last payment.

To address this research question, I developed a general equilibrium real business cycle model with incomplete asset markets, frictional labor markets, and consumer credit that has a default option. The model endogenously generates the cyclical properties of unsecured revolving credit balances and consumer bankruptcies in US data. There were three main results. Unsecured credit amplifies the extent to which UI smooths aggregate consumption fluctuations over the business cycle. Second, extending the duration of UI during recessions has a stronger impact on aggregate fluctuations than increasing the level of benefits. Finally, job finding rates drive aggregate fluctuations in consumption, unsecured credit, and consumer bankruptcies. This paper makes a significant contribution to the literature which measures the usefulness of unsecured credit as consumption insurance. Previous papers found that unsecured credit does not smooth consumption over the life cycle, and it does not smooth aggregate consumption over the business cycle. Although unsecured credit doesn't smooth consumption by itself, I show that it does amplify the extent to which UI policies smooth cyclical consumption fluctuations.

The work in this paper is part of a broad research agenda that studies the aggregate implications of public and private insurance. Future work could focus on additional details of the UI system. For example, the Emergency Unemployment Compensation Program and the Federal Pandemic Unemployment Compensation Program were both unanticipated policy changes. Anticipated and unanticipated UI policies could have significantly different aggregate implications because they could have differential effects on the incentive to save or delever for precautionary reasons. I leave this question for future work. It is also important to study the optimal construction of UI over the business cycle in an environment with consumer credit markets. My results suggest that extending the duration of UI is more efficient than increasing the level of benefits, but more work would be needed to find the optimal policy.

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Appendix

A. Model to Data

This section provides additional information regarding how the the model is mapped to the data to depict the United States economy from 1980Q1 through 2019Q4. The model is disciplined by data from numerous different sources. NBER recession dates are used to pin down the aggregate transition matrix of the model economy. The Survey of Consumer Finances (SCF) is used to match the hump-shaped life cycle earnings profile for households. Data collected by the Bureau of Labor Statistics from the Current Population Survey (CPS) is used to calculate flows into and out of unemployment. I conclude this section with Table 8, which summarizes the relevant parameter values that were discussed in section 3.

There are five recessions that occur between 1980Q1 and 2019Q4. Table 6 outlines the peak and trough dates for each of these recessions. The average duration of a recession over this time period is 4.6 quarters. The average duration of the expansions that lie between these recessions is 27.4 quarters. An alternate way of mapping the model to the data would be to combine the 1980 and 1981 recessions. The justification for doing so is that unemployment rates never returned to normal during the short-lived expansion at the end of 1980. If these recessions were combined, then the persistence of recessions would increase from 0.78 to 0.82. The corresponding persistence of expansions would increase from 0.96 to 0.97. Constructing the aggregate transition matrix using four recessions as opposed to five has a small effect on the results of the paper.

Peak	Trough	Quarters
1980Q1	1980Q3	3
1981Q3	1982Q4	6
1990Q3	1991Q1	3
2001Q1	2001Q4	4
2007Q4	2009Q2	7

Table 6: Peak and Trough Quarters

Notes: Recessions in the US from 1980Q1 through 2019Q4. Recession dates in NBER public use data archive.

Survey Year	ν_1	ν_2
1989	$5.72e^{-2}$	$-1.24e^{-3}$
1992	$4.42e^{-2}$	$-8.91e^{-4}$
1995	$4.11e^{-2}$	$-7.55e^{-4}$
1998	$5.07e^{-2}$	$-1.02e^{-3}$
2001	$4.15e^{-2}$	$-9.00e^{-4}$
2004	$4.27e^{-2}$	$-8.18e^{-4}$
2007	$4.11e^{-2}$	$-8.56e^{-4}$
2010	$4.70e^{-2}$	$-9.54e^{-4}$
2013	$4.98e^{-2}$	$-1.07e^{-3}$
2016	$4.86e^{-2}$	$-1.01e^{-3}$
2019	$3.95e^{-2}$	$-7.86e^{-4}$
Average	$4.58e^{-2}$	$-9.36e^{-4}$

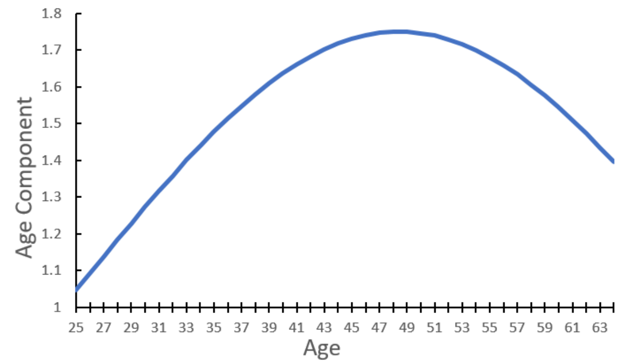

Figure 3: Age Component of Earnings

The SCF is a cross-sectional survey of US households that occurs triennially. The survey includes relevant information about the earnings, assets, and debts of households. I utilize the information in the survey to pin down the age component of productivity in the model economy. As stated in section 3, the age component of productivity takes the form $\gamma_j = \nu_1 j + \nu_2 j^2$. To estimate the age component of earnings in the data, I regress log earnings on age, age-squared, and numerous control variables. Earnings in the survey is income from wages plus two-thirds of business income. The control variables include sex of the head of households, race, education, education of the spouse, and multiple dummy variables for occupation types. Figure 3 details the regression coefficients for age and age-squared for each survey year. The R-squared value is 0.39 on average, and each reported coefficient is significant to 1.0%. In the right-panel of this figure, we can see how these coefficients translate to the age component of earnings γ_j in the model. Households experience hump-shaped earnings where they earn more each year through age 49 (model period 96). After this age, there are decreased earnings each year until retirement.

The SCF also contains rich data on household borrowing behavior. I utilize the survey to find the fraction of households in the US with credit card debt. Table 7 details the share of households in the labor force with credit card debt. Debt share is the fraction of respondents who report having positive balances of credit card debt after making their last payment. Credit share is the fraction of respondents who have at least one credit card

Survey Year	Debt Share	Credit Share
1983	27.44%	47.81%
1989	36.43%	61.15%
1992	40.06%	68.34%
1995	45.19%	71.77%
1998	43.91%	71.90%
2001	45.53%	77.15%
2004	46.74%	75.02%
2007	46.52%	72.27%
2010	39.13%	66.90%
2013	36.85%	66.64%
2016	43.60%	73.54%
2019	44.99%	77.74%
Average	41.37%	69.19%

Table 7: Share of Households with Credit Card Debt

Notes: Data from the SCF. Debt share is the share of households with debt after making their last payment. Credit share is share of households with at least one credit card. I restrict attention to households where the head is in the labor force.

account. To calculate both moments, I focus on bank credit cards (Visa, Mastercard, etc.) and observations where the head of the household is currently in the labor force. I choose to restrict attention to households in the labor force because workers who are out of the labor force are not eligible for UI. An alternate approach would be to use observations where either the head of household or spouse are in the labor force, but this has a negligible effect on results.

Data organized by the Bureau of Labor Statistics is used to pin down unemployment dynamics in the model economy. Monthly data from the CPS on employment, unemployment, and short-term unemployment (5 weeks or less) is used to calculate job separation rates and job finding rates. Job separation rates are calculated in continuous time using the methodology described in Shimer (2012), who shows that alternate methods that ignore the time aggregation problem overstate the importance of job separation rates in driving unemployment fluctuations over the business cycle. All statistics for job separation rates and job finding rates are quarterly averages of monthly data. To calculate business cycle properties, log data is HP filtered with a smoothing parameter of 1600. Detrended job separation rates have a standard deviation of 4.75 and a correlation coefficient with real GDP of -0.58. Job finding rates have a standard deviation of 7.68 and a correlation with real GDP of 0.83. As stated in section 3, I use the ratio of the volatility of job finding rates to the volatility of job separation rates to calibrate the labor market frictions in the model economy.

	Description	Parameter	Value
	Risk Aversion	σ	2.00
	Capital Share	α	0.35
	Income Tax	τ	0.30
	Duration Bad Credit	θ	2.5%
	Earnings Persistence	ρ	0.99
	Earnings SD	σ_η	0.10
	Patient Discount	β_h	0.99
	Impatient Discount	β_ℓ	0.86
	Share of Patient	π_ℓ	0.50
	Bankruptcy Disutility	χ_b	1.20
	Credit Markup	ι	0.02
	Work Disutility	χ_w	0.14
	Capital Depreciation	δ	0.02
	Transfer	T	0.33
	TFP	$z(x_g)$	1.00
Expansion Values	Separation Rate	$\xi(x_g)$	0.04
	Finding Rate	$\lambda(x_g)$	0.65
	TFP	$z(x_b)$	0.97
Recession Values	Separation Rate	$\xi(x_b)$	0.05
	Finding Rate	$\lambda(x_b)$	0.48

Table 8: Model Parameters

B. Full Results

Table 9 summarizes the key moments for each simulation used in the paper. Simulation (9) is not used in the main body of the paper, but it shows that an economy without UI would have a significant drop in aggregate consumption, unsecured credit balances, and consumer bankruptcies on average.

		C	I	D	B	Q	U
Mean	(1) Benchmark	3.22	0.75	0.82	0.22	11.62	6.34
	(2) Acyclical z	3.24	0.76	0.83	0.22	11.65	6.34
	(3) Acyclical ξ	3.22	0.75	0.86	0.24	11.84	6.09
	(4) Acyclical λ	3.23	0.75	0.92	0.22	11.50	6.01
	(5) Acyclical UI	3.22	0.75	0.80	0.22	11.51	6.34
	(6) No Credit	3.25	0.77	0.00	0.00	0.00	6.34
	(7) Acyclical UI	3.25	0.77	0.00	0.00	0.00	6.34
	(8) RR Increase	3.22	0.75	0.80	0.21	11.39	6.34
	(9) No UI	3.18	0.75	0.35	0.13	10.28	6.30
Std Dev	(1) Benchmark	0.63	2.39	3.02	16.15	2.22	11.26
	(2) Acyclical z	0.47	1.75	3.79	14.69	1.65	11.22
	(3) Acyclical ξ	0.51	2.07	2.02	13.26	1.33	6.70
	(4) Acyclical λ	0.27	2.74	0.20	5.10	1.35	4.96
	(5) Acyclical UI	0.73	2.39	3.78	16.95	2.39	11.24
	(6) No Credit	0.45	2.96	0.00	0.00	0.00	11.22
	(7) Acyclical UI	0.53	2.85	0.00	0.00	0.00	11.19
	(8) RR Increase	0.70	2.36	3.71	16.89	1.86	11.25
	(9) No UI	0.83	2.83	7.95	29.21	1.95	11.23
Corr, GDP	(1) Benchmark	0.87	0.96	0.60	−0.56	−0.85	−0.84
	(2) Acyclical z	0.25	0.50	0.85	−0.17	−0.51	−1.00
	(3) Acyclical ξ	0.94	0.97	0.51	−0.47	−0.74	−0.75
	(4) Acyclical λ	0.98	0.98	−0.65	−0.76	−0.89	−0.74
	(5) Acyclical UI	0.85	0.90	0.62	−0.55	−0.87	−0.84
	(6) No Credit	0.96	0.99	0.00	0.00	0.00	−0.84
	(7) Acyclical UI	0.94	1.00	0.00	0.00	0.00	−0.84
	(8) RR Increase	0.85	0.89	0.62	−0.45	−0.76	−0.84
	(9) No UI	0.84	0.85	0.71	−0.41	−0.65	−0.83

Table 9: Full Results

Notes: Mean, standard deviation, and correlation with GDP. C is consumption; I is investment; D is unsecured credit balances; B is average bankruptcy rate; Q is average spread of credit over capital returns; U is unemployment rate.