Online Appendix[†]

The Impact of Unemployment Insurance and Unsecured Credit on Business Cycles

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†. The views expressed in this paper are my own and do not reflect the views of the Bank of Canada.

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1 Robustness

1.a The Fall in Income During Unemployment

I now conduct robustness exercises to match the change in income following a job separation from Ganong and Noel (2019). Specifically, I calibrate the model to match a 23% drop in income in first quarter of unemployment. There are two different parameters that can be added to the model calibration to match the drop in income: the replacement rate of UI υ_r or the max transfer of UI benefits $\overline{\upsilon}$. First, I calibrate the replacement rate to $\upsilon_r = 0.79$, which generates an average drop in income of 22.7% in the first quarter following a job separation. This calibration also eliminates the spike in bankruptcies in the first period of unemployment. In this robustness exercise, the bankruptcy rate only increases by 0.25 percentage points in the first quarter. The only issue with this calibration procedure is the after-tax replacement rate of earnings is 113%. Therefore, households who do not have their UI benefits capped by the max transfer actually see their disposable income increase during unemployment. I then calibrate the max UI transfer to equal average earnings in the model economy, which generates a drop in income of 24.5% in the first quarter of unemployment.[1]

The model still generates unsecured credit balances that are highly volatility and pro-cyclical after calibrating the model to match the drop in income following job loss from Ganong and Noel (2019). I report the untargeted business cycle moments from the robustness exercises in table 2. Let *RR Calibrated* be the model where υ_r is calibrated to be 0.79. The model still generates pro-cyclical unsecured credit balances and over 82% of the volatility in the data. The model also generates similar cyclical moments for aggregate consumption. Let *Ubar Calibrated* be the model where $\overline{\upsilon}$ is calibrated. The standard deviation of credit balances is lower in this robustness exercise, but the model still generates over 75% of the volatility in the data. The remaining cyclical moments are similar to the benchmark model economy.

The result pertaining to the welfare gains of UI also holds when calibrating the model to the average drop in income from Ganong and Noel (2019). Figure 1 depicts the CE welfare

1. When calibrating the max UI transfer, I assume the replacement rate is at the benchmark value of 0.50. Increasing the max UI transfer further has almost no effect on the average drop in income because the replacement rate for households who do not have transfers capped is not changing.

Table 1: Robustness: Untargeted Business Cycle Properties

		C	I	D	B	Q	U	P
$\sigma(X)/\sigma(GDP)$	Data	0.77	4.89	2.97	13.62	5.17	9.05	0.20
	Benchmark	0.50	2.49	2.51	13.38	1.76	8.96	0.02
	RR Calibrated	0.50	2.55	2.45	19.94	1.74	8.92	0.02
	Ubar Calibrated	0.47	2.25	2.20	12.34	1.75	8.92	0.02
Corr(X,GDP)	Data	0.86	0.90	0.32	-0.35	-0.71	-0.86	0.42
	Benchmark	0.88	0.68	0.58	-0.59	-0.85	-0.83	0.91
	RR Calibrated	0.84	0.65	0.63	-0.47	-0.64	-0.83	0.91
	Ubar Calibrated	0.88	0.72	0.54	-0.60	-0.72	-0.83	0.91

Note.— Data is from 1980Q1-2019Q4 except for credit spreads which begin in 1994Q4. Data is in logs, seasonally adjusted and HP filtered with a smoothing parameter of 1600. 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. $\sigma(X)/\sigma(GDP)$ is relative standard deviation of variable X to GDP. $Corr(X, GDP)$ is correlation coefficient of variable X with GDP. RR Calibrated is the model where υ_r is calibrated to match moments from Ganong and Noel (2019). Ubar Calibrated is model where $\overline{\upsilon}$ is calibrated.

gains from extending the duration of UI. The model where RR is calibrated still predicts that the welfare gains of counter-cyclical UI extensions are larger in the model with unsecured credit. Households would trade 0.059% of lifetime consumption to get extensions in the model with credit, and they would only trade 0.045% in the model with no credit. You see the same result in the model where the maximum threshold of UI benefits is calibrated. Households would trade 0.058% of lifetime consumption to get the UI extensions in the model with credit, and they would trade 0.047% in the model without credit. This analysis indicates that the main quantitative results of the paper hold in the robustness exercises.

1.b The Timing of Labor Market Transitions

In the benchmark model, all labor market transitions take place after production, and output is predetermined each period. To test the importance of this assumption, I solved the model assuming that quits occur before production. There are two main differences with the alternate assumption. First, households who quit a job do not earn labor income in the period of a quit. Second, economic agents must forecast current aggregate labor using last periods aggregate labor and this period's aggregate capital.[2] Table 2 depicts the untargetted

2. In the benchmark model, agents forecast next period's labor using this period's capital and labor.

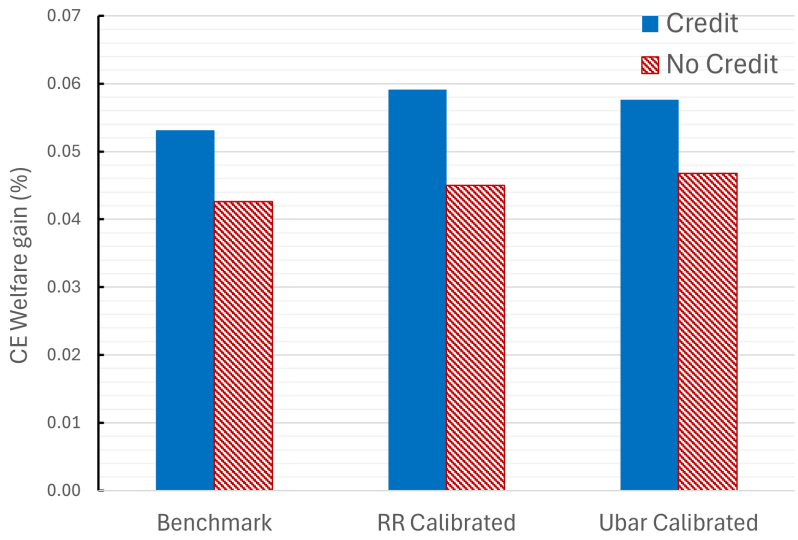


Figure 1: Welfare Gains in Robustness Exercises

Note.— RR calibrated is model with υ_r calibrated to match moments from Ganong and Noel (2019). Ubar calibrated is model with $\overline{\upsilon}$ calibrated. Average consumption-equivalent (CE) welfare gains across age 1 households: percent of lifetime consumption traded to obtain the policy which extends the duration of UI during recessions. Credit is model with unsecured credit. No credit is counterfactual economy with no credit.

cyclical moments in the two economies. There is not substantive change in the aggregate results based on this assumption. The assumption about the timing of quits has small effects in the model because few workers quit their job during a recession in the benchmark model. Most job separations that occur during a recession occur because of labor market frictions, not endogenous choices. This occurs because most households don't want to lose their job at a time when it is harder to find a new one. Furthermore, most households who are considering quitting during a recession have significant savings built up to smooth consumption without labor income. Therefore, the unconditional properties of the model are barely affected by this assumption.

1.c An Alternative Measure of Aggregate Fluctuations

This section provides robustness for the main quantitative results of the paper. In the main paper, I used the average peak-to-trough change in consumption and credit during recessions to measure how UI impacts aggregate fluctuations. I now measure the average total deviation in consumption and credit during recessions. Total deviation is the percent change from the

Table 2: Untargeted Business Cycle Properties

		C	I	D	B	Q	U	P
$\sigma(X)/\sigma(GDP)$	Data	0.77	4.89	2.97	13.62	5.17	9.05	0.20
	Model	0.50	2.49	2.51	13.38	1.76	8.96	0.02
	Alternate Model	0.50	2.51	2.48	13.59	1.90	8.85	0.03
Corr(X,GDP)	Data	0.86	0.90	0.32	-0.35	-0.71	-0.86	0.42
	Model	0.88	0.68	0.58	-0.59	-0.85	-0.83	0.91
	Alternate Model	0.87	0.61	0.60	-0.59	-0.73	-0.82	0.92

Note.— Data is from 1980Q1-2019Q4 except for credit spreads which begin in 1994Q4. Data is in logs, seasonally adjusted and HP filtered with a smoothing parameter of 1600. 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. $\sigma(X)/\sigma(GDP)$ is relative standard deviation of variable X to GDP. $Corr(X, GDP)$ is correlation coefficient of variable X with GDP. Alternate model is the model where quits take place before production.

pre-recession value summed over each period of a recession. For example, assume there is a two-period recession. If consumption is 1% below its pre-recession level in the first period, and 2% below in the second period, then the total deviation is 3pp. I then average the total deviation over all recessions in a 2000 period simulation. The takeaway from this section is that the main results detailing how UI impacts aggregate fluctuations hold whether you use the peak-to-trough change or the total deviation in aggregate variables during recessions.

The first result is that unsecured credit amplifies the extent to which UI mitigates aggregate fluctuations. Table 3 shows that this result still holds when using the average total deviation in aggregate consumption and unsecured credit during recessions. The policy which extends the duration of UI by 13 weeks during recessions reduces the average total fall in consumption by 1.33pp in the benchmark economy with credit. It only reduces the total fall during recessions by 1.19pp in the economy without credit. This result is driven by a large and persistent impact on unsecured credit. The UI policy reduces the average total fall in unsecured credit balances by 8.64pp.

The second result is that extending the duration of UI is more effective at smoothing aggregate fluctuations than increasing the level of benefits during recessions. Table 4 shows this result still holds when using the average total deviation during recessions. The policy which increases the replacement rate of benefits during recessions only reduces the average total fall in consumption by 0.54pp, compared to 1.33pp for the *Extending UI* policy. There

Table 3: Total Declines: Extending Duration of UI

	Benchmark		No Credit	
	C	D	C	D
Acyclical UI (pp)	11.29	42.75	8.88	0.00
Extending UI (pp)	9.96	34.11	7.69	0.00
Difference (pp)	1.33	8.64	1.19	0.00

Note.— Total decline in aggregate consumption (C) and credit balances (D) during a recession averaged over all recessions in a 2000 period simulation. Total decline is the deviation from the pre-recession value of a variable summed over each period of a recession. Simulation results are in logs and HP filtered with a smoothing parameter of 1600. Benchmark is the economy with unsecured credit and No Credit is the economy with no borrowing.

are also substantial differences in the response of unsecured credit. The *Increasing Level* policy only reduces the average total fall in unsecured credit balances by 2.40pp, compared to 8.64pp for the *Extending UI* policy. The mechanism driving this result is the same as what was discussed in section 5: when the government increases the level of benefits, households still have an incentive to delever to insure themselves against the possibility of not finding a job before UI expires. On the other hand, extending the duration simultaneously transfers resources to households and mitigates the incentive to delever for precautionary reasons.

Table 4: Total Declines: Increasing Level of UI

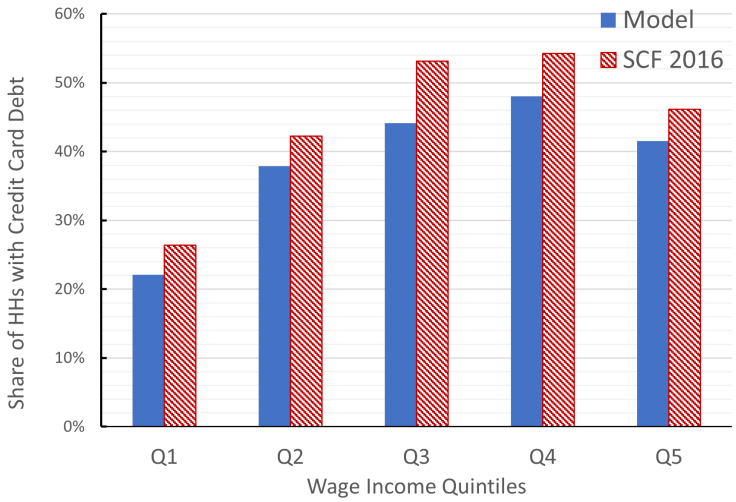
	Benchmark		No Credit	
	C	D	C	D
Acyclical UI (pp)	11.29	42.75	8.88	0.00
Increasing Level (pp)	10.75	40.35	8.44	0.00
Difference (pp)	0.54	2.40	0.44	0.00

Note.— Total decline in aggregate consumption (C) and credit balances (D) during a recession averaged over all recessions in a 2000 period simulation. Total decline is the deviation from the pre-recession value of a variable summed over each period of a recession. Simulation results are in logs and HP filtered with a smoothing parameter of 1600. Benchmark is the economy with unsecured credit and No Credit is the economy with no borrowing.

2 Additional Model Validation

With regards to the impact of UI on reemployment wages, my model is consistent with the estimates in the literature which predict that UI has a limited impact on reemployment

Figure 2: Distribution of Households with Credit Card Debt



Note.— Share of households with a positive balance on credit cards over the income distribution. Data from the SCF 2016 for households in the labor force. Income is wage income. Drop self-employed households. Credit card debt is the balance on bank cards after making the most recent payment. Moments from the model are calculated during a prolonged expansion: 50 quarters since the most recent recession.

wages. Overall, the literature that estimates the impact of UI on reemployment wages finds contradicting results. Earlier work by Card, Chetty, and Weber (2007) uses panel data from Austria to find that UI extensions have a limited impact on match quality measured by mean wages or the duration of subsequent jobs. Specifically, they estimate that the additional search induced by benefit extensions raises mean reemployment wages by less than 1% at the upper bound of the 95% confidence interval. Schmieder, Wachter, and Bender (2016) uses German data to estimate small negative effects of UI on wages, job duration, and other job outcomes for middle-aged workers. In contrast, Nekoei and Weber (2017) finds that UI extensions have a positive effect on reemployment wages by raising reemployment firm quality. Because the literature finds opposing empirical results, I choose a model structure in the middle-ground. In my model environment there will be a limited impact of UI on reemployment wages. Changes to UI policies can affect whether an unemployed worker searches for a job, but it will have a relatively small effect because the only workers who decide to not search for work are those who have saved up enough assets to smooth consumption without labor earnings.

I also compare the distribution of unsecured credit over income in the model to micro-

level data. Figure 2 details the share of households with a positive balance on credit cards in each quintile of the income distribution. This provides a robust test of the model because the distribution of income is simultaneously accounting for persistent productivity, age, and employment status. The model has a lot of success generating the key patterns seen in the data. Credit card debt is the least prevalent among low-income households. This occurs in the model because low-income households are high-risk borrowers, and financial intermediaries charge them a high default-risk premium. Furthermore, the distribution of credit over income is hump-shaped where credit card debt is most prevalent in income quintiles 3 and 4. These results show that the model is able to generate key macro-level moments in an environment that is consistent with micro-level data.

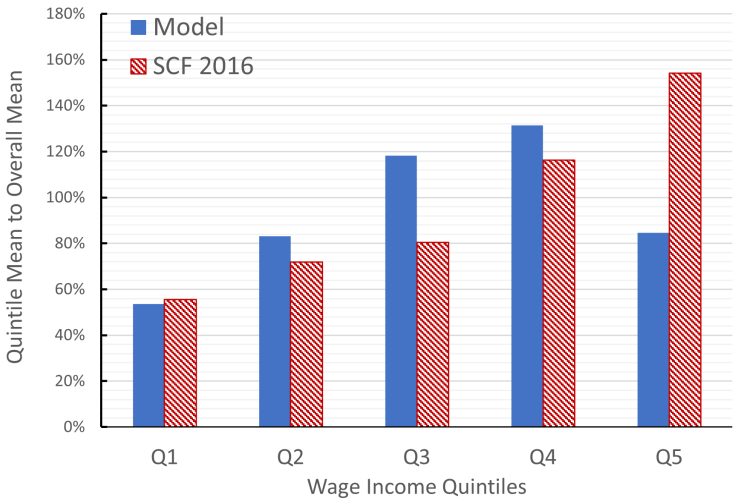
I also look at the distribution of unsecured credit over income by looking at the intensive margin of credit card debt. Figure 3 depicts the average credit card debt held by households over the distribution of wage income. Specifically, I look at the ratio of the average credit card debt held by households in an income quintile to the average credit card debt held by households in the entire economy. I divide by the average credit card debt in the economy to make it easy to compare model results to the data. The model has moderate success generating the intensive margin of the distribution of credit card debt over income. Households hold progressively more debt on average in quintiles 1 through 4. The model is furthest from the data in quintile 5. The data suggests that a relatively small number of high-income households hold very high balances of credit card debt. The model does not currently have a mechanism that can replicate this fact. However, this should not have a significant effect on the results of the paper because a small share of high-income households will not drive the consumption response to a change in UI.

3 Additional Results and Figures

3.a The Impact of Precautionary Savings and Investment

A key driving force in models with incomplete markets is precautionary savings. In my model economy, changes in precautionary savings result in changes in investment, and therefore, the

Figure 3: Average Credit Card Debt by Income



Note.— Ratio of the average credit card debt in an income quintile to the overall average credit card debt in the economy. Data from the SCF 2016 for households in the labor force. Income is wage income. Drop self-employed households. Credit card debt is the balance on bank cards after making the most recent payment. Moments from the model are calculated during a prolonged expansion: 50 quarters since the most recent recession.

resources available for consumption in future periods. Although this channel is operative, it is not the key mechanism driving results in my paper. In this section, I quantify the significance of this channel for the results pertaining to the aggregate implications of job finding rates and UI policies.

Figure 4 details the impact of fixed job finding rates on aggregate variables during an example recession. Specifically, I look at a 5-quarter recession beginning in period 1301 of the model simulation. The figure highlights the benchmark model and the model with fixed job finding rates that was recalibrated to match the same volatility in unemployment. Panel (a) shows that investment actually ticks upward in the first quarter of the recession in the benchmark model. This occurs because households want to save more for precautionary reasons at the beginning of a recession. After the first quarter, investment falls because the fall in the returns to savings outweighs the precautionary motives. In the model with fixed job finding rates, investment is consistently lower throughout the recession because the precautionary motives are weakened. This causes capital balances to be lower throughout the recession. The impact on output is quantitatively small, and it mitigates the differences between the benchmark economy and the fixed job finding rate economy. The peak difference

in capital balances is 0.14, which translates to a difference in output of 0.0054.[3] This means that the difference in aggregate consumption between the two economies could be up to 0.0054 units larger at the end of the recession.

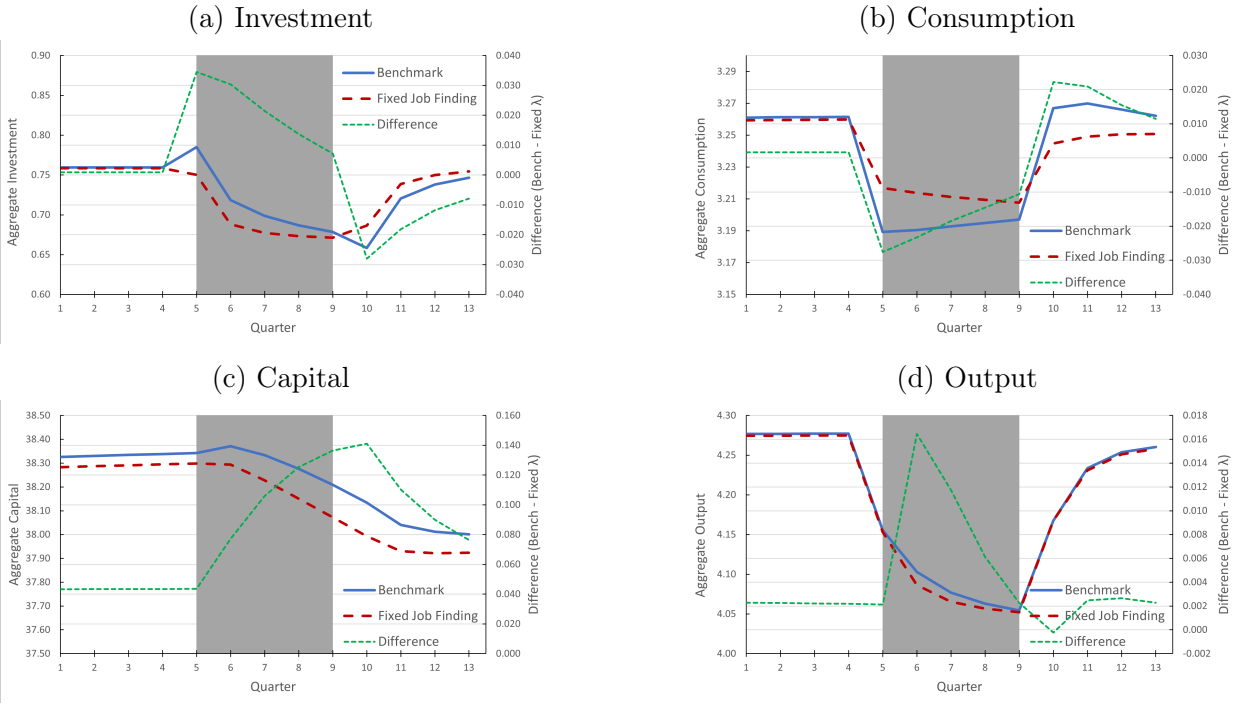


Figure 4: Fixed Job Finding Rates During a Recession

Note.— A five period recession starting in quarter 5. This corresponds to period 1301 in the aggregate simulation. Benchmark is the economy where job finding, job separation, and TFP all vary during a recession. Fixed job finding is the economy with fixed job finding rates and the same volatility in unemployment.

The channel where precautionary savings impacts investment and the resources available for future consumption also does not drive the results pertaining to UI extensions. Figure 5 details the impact of UI policies on aggregate variables during a 5-quarter recession. Without the counter-cyclical extensions in UI, households invest more for precautionary reasons at the beginning of a recessions. This leads to more capital and more output throughout the entire recession. However, the result is quantitatively small. The maximium difference in accumulated capital between the two economies is approximately 0.04 units, which results

3. To calculate the difference in output resulting from the difference in accumulated capital, I impute what output would be with aggregate labor from the fixed job finding rate simulation and aggregate capital from the benchmark economy. Most of the peak difference in output in figure 4 is from a difference in aggregate labor, so it is important to isolate how much is coming from capital balances in order to quantify the precautionary savings effects.

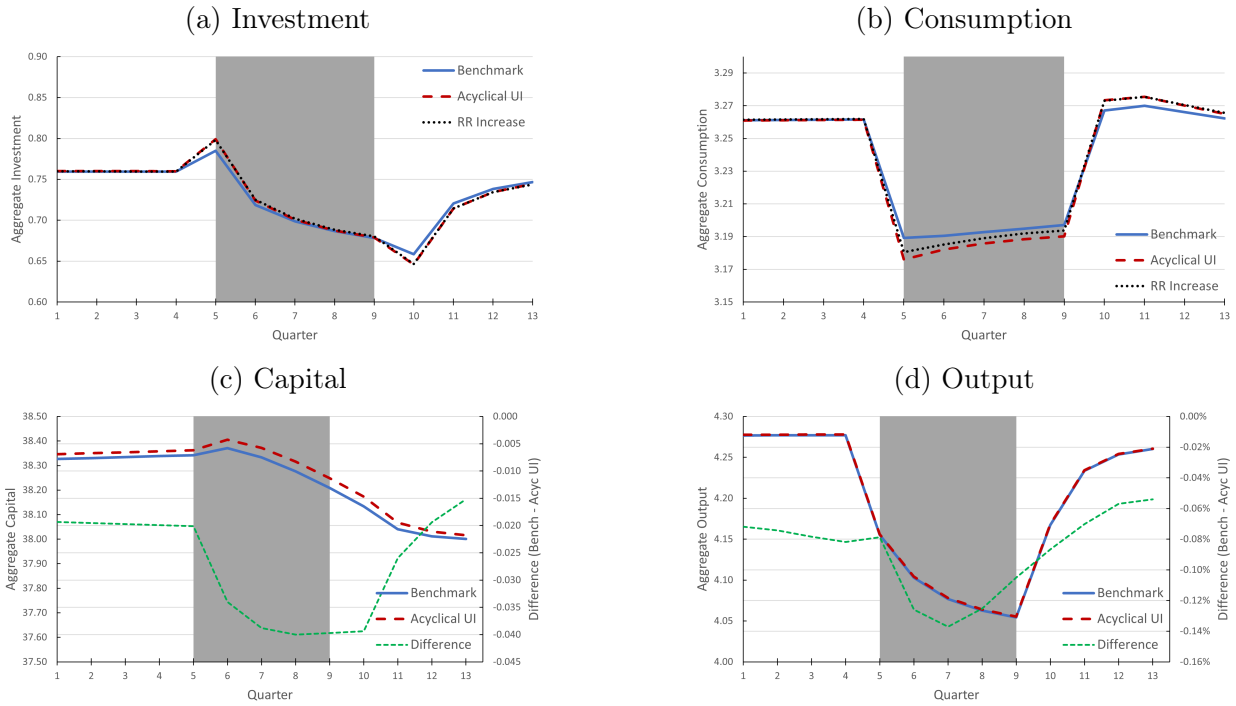


Figure 5: UI Policies During a Recession

Note.— A five period recession starting in quarter 5. This corresponds to period 1301 in the aggregate simulation. Benchmark is the economy with UI extensions during recessions. Acyclical UI is the economy with no change in UI policies during recessions.

in a difference in output of 0.0015 units. This channel actually dampens the difference in aggregate consumption between the two economies. The difference in aggregate consumption between the two UI policies could be up to 0.0014 units larger if it were not for the capital accumulated because of a difference in precautionary savings motives. The key takeaway is that this channel is not driving the main results of the paper.

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