

1		1
2	<b>Welfare and Spending Effects of Consumption Stimulus Policies</b>	2
3		3
4	CHRISTOPHER D. CARROLL	4
5	Department of Economics, Johns Hopkins University	5
6		6
7	EDMUND CRAWLEY	7
8	Federal Reserve Board	8
9		9
10	WILLIAM DU	10
11	Department of Economics, Johns Hopkins University	11
12		12
13	IVAN FRANKOVIC	13
14	Deutsche Bundesbank	14
15		15
16	HÅKON TRETVOLL	16
17	Statistics Norway and HOFIMAR at BI Norwegian Business School	17
18	Using a heterogeneous agent model calibrated to match spending dy-	18
19	namics over four years following an income shock (Fagereng et al.	19
20	(2021)), we assess the effectiveness of three fiscal stimulus policies im-	20
21	plemented during recent recessions. Unemployment insurance (UI)	21
22	—————	22
23	Christopher D. Carroll: <a href="mailto:ccarroll@jhu.edu">ccarroll@jhu.edu</a>	23
24	Edmund Crawley: <a href="mailto:edmund.s.crawley@frb.gov">edmund.s.crawley@frb.gov</a>	24
25	William Du: <a href="mailto:wdu9@jhu.edu">wdu9@jhu.edu</a>	25
26	Ivan Frankovic: <a href="mailto:ivan.frankovic@bundesbank.de">ivan.frankovic@bundesbank.de</a>	26
27	Håkon Tretvoll: <a href="mailto:Hakon.Tretvoll@ssb.no">Hakon.Tretvoll@ssb.no</a>	27
28	The views expressed in this paper are those of the authors and do not necessarily represent those	28
29	of the Federal Reserve Board, the Deutsche Bundesbank and the Eurosystem, or Statistics Norway.	29
30	This project has received funding from the European Research Council (ERC) under the European	30
31	Union's Horizon 2020 research and innovation programme (grant agreement No. 851891) and from	31
32	the Research Council of Norway (grant No. 326419).	32

1 extensions are the “bang for the buck” winner when the metric is ef-  
2 fectiveness in boosting utility. Stimulus checks are second-best and  
3 have two advantages (over UI): they arrive faster, and are scalable. A  
4 temporary (two-year) cut in wage taxation is considerably less effec-  
5 tive than the other policies and has negligible effects in the version of  
6 our model without a multiplier.

7 KEYWORDS. fiscal policy, unemployment insurance extensions, pay-  
8 roll tax cuts, HANK/heterogeneous agent models, marginal propen-  
9 sity to consume, spending multipliers.

10 JEL CLASSIFICATION. E21, E62, H31.

## 12 1. INTRODUCTION

13 Fiscal policies that aim to boost consumer spending in recessions have been  
14 tried in many countries in recent decades. The nature of such policies has varied  
15 widely, perhaps because traditional macroeconomic models have not provided  
16 plausible guidance about which ones are likely to be most effective—either in  
17 reducing misery (a ‘welfare metric’) or in increasing output (a ‘GDP metric’).  
18

19 But a new generation of macro models has shown that when microeconomic  
20 heterogeneity across consumer circumstances (wealth; income; education) is  
21 taken into account, the consequences of an income shock for consumer spend-  
22 ing depend on a measurable object: the intertemporal marginal propensity to  
23 consume (iMPC) introduced in [Auclert et al. \(2018\)](#). The iMPC extends the no-  
24 tion of a marginal propensity to consume to account for the speed at which  
25 households spend. Fortunately, new sources of microeconomic data, particu-  
26 larly from Scandinavian national registries, have recently allowed the first high-  
27 quality measurements of the iMPC ([Fagereng et al. \(2021\)](#)).  
28

29 Even in models that can match a given measured iMPC pattern, the relative  
30 merits of alternative policies depend profoundly both on the metric (welfare or  
31 GDP) and on the quantitative structure of the rest of the model – for example,  
32 whether multipliers exist and whether the degree of multiplication is different  
under different economic conditions. Here, after constructing a microeconomi-

1 cally credible heterogeneous agent (HA) model, we examine that model's impli- 1  
 2 cations for how effects of stimulus policies depend on the existence and timing 2  
 3 of any "multipliers," which, following Krueger et al. (2016), we model in a clean 3  
 4 and simple way, so that the interaction of the multiplier (if any) with the other 4  
 5 elements of the model is reasonably easy to understand. This partial equilib- 5  
 6 rium analysis allows us to transparently incorporate the possibility that multipli- 6  
 7 ers may be larger in recessions. But we understand that a richer general equilib- 7  
 8 rium framework could introduce transmission channels absent from the partial- 8  
 9 equilibrium-plus-multiplier analysis, so we also analyze a standard HANK-and- 9  
 10 SAM general equilibrium model modified to embed our households' consump- 10  
 11 tion responses.<sup>1</sup> 11

12 By "microeconomically credible," we mean, at a minimum, a model that can 12  
 13 match both the cross-sectional distribution of liquid wealth (following Kaplan 13  
 14 and Violante (2014)'s definition of liquid wealth) and the entire pattern of the 14  
 15 iMPC from Fagereng et al. (2021) (see Figure 1a for their data and our model's fit 15  
 16 to it). 16

17 Standard HA models can match both the pattern of spending in years 1-4 (for 17  
 18 a shock that arrives in year 0) and the initial distribution of liquid wealth.<sup>2</sup> But 18  
 19 even a brief look at the figure convinces the eye that spending in the initial pe- 19  
 20 riod when the shock arrives seems out of line with the smooth declining pattern 20  
 21 in years 1-4. The eye is not wrong: HA models that match liquid assets and the 21  
 22 spending pattern in years 1-4 seriously underpredict the amount of immediate 22  
 23 spending that occurs on receipt of the income shock. 23

24 We call this initial extra spending the 'excess initial MPC.' Below, we describe 24  
 25 a substantial and longstanding literature in which the pattern of an excess initial 25  
 26 MPC has been documented, and a vigorous recent literature confirming the fact 26  
 27 with different datasets and various theoretical explanations. 27

28

---

29 <sup>1</sup>The Econ-ARK toolkit with which the partial equilibrium model was solved constructs the Jaco- 29  
 30 bians necessary to connect a steady-state version of the model to the SSJ Toolkit. Our HANK-and-SAM 30  
 31 model builds on Ravn and Sterk (2017, 2021). 31

32 <sup>2</sup>For example, the model in Carroll et al. (2017). 32

1 If multipliers are operative only in recessions (or are more powerful in recessions), a model that fails to capture the excess initial MPC might generate the wrong answers for the effectiveness of the alternative fiscal policies. 1  
2 2  
3 3

4 The purpose of our paper is not to weigh in on which of the alternative models of an excess initial MPC is right. Instead we sought the simplest modeling device that would capture the empirical fact of an excess initial MPC and permit unambiguous welfare calculations. We accomplish this by adding to the standard model something we call “splurge” behavior, in which each household has a portion of income out of which they have a high MPC, and the remainder of their income is disposed of as in standard micro models with mildly impatient but time-consistent consumers. Because the available evidence finds high initial MPCs even among wealthy households, we assume that this splurge behavior is the same across households and independent of their liquid wealth holdings.<sup>3</sup> 4  
5 5  
6 6  
7 7  
8 8  
9 9  
10 10  
11 11  
12 12  
13 13

14 Our resulting structural model could be used to evaluate a wide variety of consumption stimulus policies. We examine three that have been implemented in recent recessions in the United States (and elsewhere): an extension of unemployment insurance (UI) benefits, a means-tested stimulus check, and a payroll tax cut. 14  
15 15  
16 16  
17 17  
18 18

19 Our first metric of policy effectiveness is “spending bang for the buck”: For a dollar of spending on a particular policy, how much multiplication is induced? 19  
20 20  
21 First, we calculate the policy-induced spending dynamics in an economy with no multiplier. We then follow Krueger et al. (2016)’s approach to modeling the aggregate demand externality, in which output depends mechanically on the level of consumption relative to steady state. But in our model, the aggregate demand externality is only switched on when the economy is experiencing a recession—there is no multiplication for spending that occurs after our simulated recession is over. 21  
22 22  
23 23  
24 24  
25 25  
26 26  
27 27

28 28

29 29

---

30 <sup>3</sup>Proponents of the theoretical models described in our literature review in section 1.1 may choose 30  
31 to think of our splurge as a reduced form for a deeper explanation; we would not necessarily resist 31  
32 such an interpretation. 32

1 Even without multiplication, a utility-based metric can justify countercyclical 1  
 2 policy on welfare grounds because the larger idiosyncratic shocks to income that 2  
 3 occur during a recession may justify a greater-than-normal degree of social insur- 3  
 4 ance. Because our model's outcomes reflect the behavior of utility-maximizing 4  
 5 consumers, we can calculate a measure of the effectiveness of alternative poli- 5  
 6 cies: their effect on consumers' welfare. We call this "welfare bang for the buck." 6

7 The principal difference between the two metrics is that what matters for 7  
 8 the degree of spending multiplication is how much of the policy-induced extra 8  
 9 spending occurs during the recession (when the multiplier matters), while effec- 9  
 10 tiveness in the utility metric also depends on who is doing the extra spending 10  
 11 (because the recession hits some households much harder than others). 11

12 Because high-MPC consumers tend to have high marginal utility, a standard 12  
 13 aggregated welfare function would favor redistribution to such consumers even 13  
 14 in the absence of a recession. We are interested in the degree of *extra* motiva- 14  
 15 tion for social insurance that is present in a recession, so we construct our social 15  
 16 welfare metric specifically to measure only the *incremental* social welfare effect 16  
 17 of alternative policies during recessions (beyond whatever redistributional logic 17  
 18 might apply during expansions – see section 4.3). 18

19 When the multiplier is active, any reduction in aggregate consumption be- 19  
 20 low its steady-state level directly reduces aggregate productivity and thus la- 20  
 21 bor income. Hence, any policy stimulating consumption will also boost incomes 21  
 22 through this aggregate demand multiplier channel. 22

23 Our results are intuitive. In the economy with no recession multiplier, the ben- 23  
 24 efit of a sustained payroll tax cut is negligible.<sup>4</sup> When a multiplier exists, the tax 24

---

25  
 26 One reason there is any (welfare) benefit at all, even for people who have not experienced an 26  
 27 unemployment spell, is that the heightened risk of unemployment during a recession increases the 27  
 28 marginal value of current income because it helps them build extra precautionary reserves to buffer 28  
 29 against the extra risk. A second benefit is that, for someone who becomes unemployed some time 29  
 30 into the recession, the temporary tax reduction will have allowed them to accumulate a larger buffer 30  
 31 to sustain them during unemployment. Finally, in a recession, there are more people who will have 31  
 32 experienced a spell of unemployment, and the larger population of beneficiaries means that the con- 32  
 sequences of the prior mechanism will be greater. But, quantitatively, all of these effects are small.

1 cut has more benefits, especially if the recession continues long enough that 1  
2 most of the spending induced by the tax cut happens while the economy is still 2  
3 in recession (and the multiplier still is in force). The typical recession, however, 3  
4 ends long before our ‘sustained’ wage tax cut is reversed—and even longer be- 4  
5 fore lower-MPC consumers have spent down most of their extra after-tax income. 5  
6 Accordingly, even in an economy with a multiplier that is powerful during reces- 6  
7 sions, much of the wage tax cut’s effect on consumption occurs when any multi- 7  
8 plier that might have existed in a recession is no longer operative. 8

9 Even leaving aside any multiplier effects, the stimulus checks improve welfare 9  
10 more than the wage tax cut, because at least a portion of such checks go to unem- 10  
11 ployed people who have both high MPCs and high marginal utilities (while wage 11  
12 tax cuts, by definition, go only to persons who are employed and earning wages). 12  
13 The greatest “welfare bang for the buck” comes from the UI insurance extension, 13  
14 because many of the recipients are in circumstances in which they have a much 14  
15 higher marginal utility than they would have had in the absence of the recession, 15  
16 whether or not the aggregate demand externality exists. 16

17 And, in contrast to the wage-tax cut, both the UI extension and the stimulus 17  
18 checks concentrate most of the marginal increment to consumption at times 18  
19 when the multiplier (if it exists) is still powerful. A disadvantage of the UI exten- 19  
20 sion relative to the stimulus checks, in terms of “spending bang for the buck,” is 20  
21 that it takes somewhat more time until the transfers reach the beneficiaries. The 21  
22 stimulus checks are assumed to be distributed immediately in the same quarter 22  
23 as the recession starts. Countering this disadvantage is the fact that the MPC of 23  
24 UI recipients is higher than that of stimulus check recipients, and, furthermore, 24  
25 the insurance nature of the UI payments reduces the precautionary saving mo- 25  
26 tive. In the end, our model says that these two forces roughly balance each other, 26  
27 so that the spending bang for the buck of the two policies is similar. In the wel- 27  
28 fare metric, however, there is considerable marginal value to UI recipients even 28  
29 if they receive some of the benefits after the recession is over (and no multiplier 29  
30 exists). Hence, in the welfare metric, the relative value of UI benefits is increased 30  
31 compared with the policy of sending stimulus checks. 31

32 32

1 We conclude that extended UI benefits should be the first weapon employed 1  
 2 from this arsenal, as they have a greater welfare benefit than stimulus checks and 2  
 3 a similar (multiplied) spending effect. But a disadvantage is that the total amount 3  
 4 of stimulus that can be accomplished with the UI extension is constrained by the 4  
 5 fact that only a limited number of people become unemployed. If more stimu- 5  
 6 lation is called for than can be accomplished via the UI extension, checks have 6  
 7 the advantage that their effects scale almost linearly in the size of the stimulus— 7  
 8 see [Beraja and Zorzi \(2023\)](#) for a more detailed exposition of the relation between 8  
 9 MPC and stimulus size. The wage tax cut is also, in principle, scalable, but its ef- 9  
 10 fects are smaller because recipients have lower MPCs and marginal utility than 10  
 11 check and UI recipients. In the real world, a tax cut is also likely the least flexi- 11  
 12 ble of the three tools: UI benefits can be further extended, and multiple rounds 12  
 13 of checks can be sent, but multiple rounds of changes in payroll tax rates would 13  
 14 likely be administratively and politically more difficult. 14

15 One theme of our paper is that which policies are better or worse, and by how 15  
 16 much, depends on both the quantitative details of the policies and the quantita- 16  
 17 tive modeling of the economy. 17

18 But the tools we are using could be reasonably easily modified to evaluate a 18  
 19 number of other policies. For example, in the COVID-19 recession in the US, not 19  
 20 only was the duration of UI benefits extended, but those benefits were also sup- 20  
 21 plemented by substantial extra payments to every UI recipient. We did not cali- 21  
 22 brate the model to match this particular policy, but the framework could accom- 22  
 23 modate such an analysis. 23

24 24

25 25

### 26 1.1 *Related literature* 26

27 27  
 28 Our paper is part of the growing literature using structural heterogeneous agent 28  
 29 models to examine effects of countercyclical fiscal policies. 29

30 Because the quantitative implications of HA models depend profoundly on 30  
 31 getting certain microeconomic details right, we begin with a brief synopsis of 31  
 32 what we view as the relevant takeaways from the micro literature. 32

1    1.1.1 *Microeconomic Evidence* For our purposes, the single most important 1  
2 kind of micro evidence is on the iMPC; we explicitly target our partial equilibrium 2  
3 model to match the microeconomic iMPC estimates of [Fagereng et al. \(2021\)](#), 3  
4 whose evidence is the gold standard because their millions of datapoints allow 4  
5 precise estimates over a long horizon (five years) and because their natural exper- 5  
6 iment is almost ideal (a lottery win is a random shock by construction). Particu- 6  
7 larly striking is their evidence on the excess initial MPC. Any worry that their Nor- 7  
8wegian evidence might not apply in other countries is allayed by results in a new 8  
9 paper by [Kotsogiannis and Sakellaris \(2024\)](#), who use data from a Greek lottery 9  
10 and find that the induced extra monthly spending in the first three months after 10  
11 the win is triple the induced extra spending in the remaining observed months. 11

12    There are, of course, many prominent papers dating all the way back to [Fried-](#) 12  
13 [man \(1963\)](#) finding that the initial spending response to shocks is vastly greater 13  
14 than implied by a representative agent model (in particular a steady stream of 14  
15 state-of-the-art papers by Jonathan Parker and his collaborators). In much of that 15  
16 literature there has been some evidence that the initial spending response was 16  
17 out of line with the subsequent effects (see, e.g., [Parker et al. \(2013\)](#); [Broda and](#) 17  
18 [Parker \(2014\)](#); [Johnson et al. \(2006\)](#)), but data limitations usually made it difficult 18  
19 to sharply pin down the temporal pattern of spending (especially beyond the six 19  
month horizon). 20

21    Another striking result in [Fagereng et al. \(2021\)](#) was that even households with 21  
22 high liquid wealth exhibited high MPC's. [Boehm et al. \(2025\)](#), [Graham and Mc-](#) 22  
23 [Dowall \(2024\)](#), [Crawley and Kuchler \(2023\)](#), and [Kueng \(2018\)](#) among others also 23  
24 provide strong evidence of high MPCs for high-liquid-wealth households.<sup>5</sup> 24  
25 25

26    1.1.2 *Microeconomic Theories* A rapidly growing recent literature has used a va- 26  
27 riety of data sources to reconfirm the high initial MPC, but with an eye to provid- 27  
28 28

---

29    <sup>5</sup>The “infrequent consumption good” model of [Melcangi and Sterk \(2024\)](#) has a similar flavor, but 29  
30 is not about MPC's. It aims at accounting for high saving rates among high-income households dur- 30  
31 ing normal times and high consumption during episodes where the infrequent consumption good 31  
32 becomes available (such as high-end health care or education expenses). 32

<sup>1</sup> ing theoretical explanations. We sketch this literature because different theories <sup>1</sup>  
<sup>2</sup> might have different implications for the spending consequences of a shock. <sup>2</sup>

<sup>3</sup> One possibility is that the burst of initial spending is rationalizable if the spend- <sup>3</sup>  
<sup>4</sup> ing is on durables (Browning and Crossley, 2009). Mankiw (1982) showed that in <sup>4</sup>  
<sup>5</sup> the frictionless case, spending on durable goods should be vastly more respon- <sup>5</sup>  
<sup>6</sup> sive to an income shock than spending on nondurables. It seems plausible that <sup>6</sup>  
<sup>7</sup> a model with a large number of goods that are durable at, say, the quarterly or <sup>7</sup>  
<sup>8</sup> annual frequency could explain the ‘excess initial MPC’ as reflecting a rational <sup>8</sup>  
<sup>9</sup> marginal propensity to eXpend (MPX).<sup>6</sup> <sup>9</sup>

<sup>10</sup> Maxted et al. (2024) combine a simplified model of durables spending with <sup>10</sup>  
<sup>11</sup> the assumption common in behavioral economics that spending decisions are <sup>11</sup>  
<sup>12</sup> influenced by “present bias” (people have time-inconsistent preferences). They <sup>12</sup>  
<sup>13</sup> present a back-of-the-envelope calculation that yields a rough estimate that the <sup>13</sup>  
<sup>14</sup> ratio of initial spending on durables to the spending that would occur if all spend- <sup>14</sup>  
<sup>15</sup> ing were nondurable is roughly three to one (not far from the ratio estimated in <sup>15</sup>  
<sup>16</sup> the Greek lottery episode studied by Kotsogiannis and Sakellaris (2024)). <sup>16</sup>

<sup>17</sup> Indarte et al. (2024) use high frequency bank account data to study spending <sup>17</sup>  
<sup>18</sup> responses to the U.S. 2021 stimulus, and find substantial “excess MPC’s” especially <sup>18</sup>  
<sup>19</sup> among low income households; like Maxted et al. (2024) they lean toward present <sup>19</sup>  
<sup>20</sup> bias as an explanation.<sup>7</sup> <sup>20</sup>

<sup>21</sup> The logic of Akerlof and Yellen (1985) and Cochrane (1989) suggests that the <sup>21</sup>  
<sup>22</sup> utility consequences of ‘near-rational’ deviations from frictionless rational be- <sup>22</sup>  
<sup>23</sup> havior is small. In that spirit, Boutros (2022) and Ilut and Valchev (2022) present <sup>23</sup>  
<sup>24</sup> models with bounded rationality and costly re-optimization. Building on this <sup>24</sup>  
<sup>25</sup>

---

<sup>26</sup> <sup>26</sup>The NIPA accounts treat as ‘durable’ those goods whose expected lifetime is 3 years or more, but  
<sup>27</sup> at the annual (or quarterly) frequency many more goods (and even services) are arguably durable – <sup>27</sup>  
<sup>28</sup> for example, Blinder and Deaton (1985) mention clothes and shoes, and Hai et al. (2020) argue that <sup>28</sup>  
<sup>29</sup> many services are durable at the annual frequency, which explains why people take vacations once a <sup>29</sup>  
<sup>30</sup> year. <sup>30</sup>

<sup>30</sup> <sup>30</sup>A related theoretical insight is provided by Lian (2023), who shows that households anticipating  
<sup>31</sup> their own future consumption mistakes can rationally exhibit higher current MPCs; this is because <sup>31</sup>  
<sup>32</sup> they know that any additional savings would be likely be disposed of suboptimally in the future. <sup>32</sup>

1 logic, [Andre et al. \(2025\)](#) argue that costs of reoptimization cause consumers to 1  
2 resort to simple “quick-fix” consumption heuristics; for small shocks, most peo- 2  
3 ple in their survey report that they anticipate that their MPC’s would be one or 3  
4 zero. 4

5 The ‘splurge’ component of our consumption model is a simple modelling de- 5  
6 vice that lets the model match the empirical evidence, regardless of what the right 6  
7 deep explanation(s) may be. As we will show, the model with our splurge compo- 7  
8 nent is consistent with all of what we described above as the key ‘takeaways’ from 8  
9 the micro literature. 9

10  
11 1.1.3 *Macroeconomic Models* Turning now to the macroeconomic setting, a 11  
12 number of papers have addressed questions that are similar in spirit to ours. For 12  
13 example, [McKay and Reis \(2016\)](#), [McKay and Reis \(2021\)](#), and [Phan \(2024\)](#) have 13  
14 examined the role of automatic stabilizers in HA models. 14

15 But we follow much of the recent literature in treating recessions as ‘MIT 15  
16 shocks’ – unanticipated events. And the policies we examine are discretionary, 16  
17 which arguably makes sense as reflecting what occurs when the automatic stabi- 17  
18 lizers have not automatically prevented a recession.<sup>8</sup> 18

19 A relevant early contribution is by [Kaplan and Violante \(2014\)](#) who build a 19  
20 model where agents save in both liquid and illiquid assets. Their model yields 20  
21 a substantial consumption response to a stimulus payment, since MPCs are high 21  
22 both for low-wealth households and for the many households (in their model) 22  
23 with high net worth but little liquid assets (the “wealthy hand-to-mouth”). 23

---

24  
25 <sup>8</sup>In our model (and most others in the literature we are contributing to) consumers do not adjust 24  
26 their labor supply in response to stimulus policies. This assumption is broadly consistent with the 25  
27 empirical findings in [Ganong et al. \(2022\)](#) and [Chodorow-Reich and Karabarbounis \(2016\)](#). However, 26  
28 the literature is conflicted on this subject; [Hagedorn et al. \(2017\)](#) and [Hagedorn et al. \(2019a\)](#) argue 27  
29 that extensions of unemployment insurance affect both search decisions and vacancy creation lead- 28  
30 ing to a rise in unemployment. [Kekre \(2022\)](#), on the other hand, evaluates the effect of extending 29  
31 unemployment insurance in the period from 2008 to 2014, and finds that this extension raised ag- 30  
32 gregate demand and implied a lower unemployment rate than without the policy. Finally, [Cohen and 31  
Ganong \(2024\)](#) conduct a meta-analysis of the literature on how unemployment benefits impact un- 32  
employment duration, and they find that the effects are modest.

<sup>1</sup> (Though the subsequent literature finding high MPC's even by wealthy house- <sup>1</sup>  
<sup>2</sup> holds with ample liquidity casts doubt on this mechanism.) <sup>2</sup>

<sup>3</sup> [Bayer et al. \(2023\)](#) study discretionary fiscal policies implemented after a large <sup>3</sup>  
<sup>4</sup> shock, in their case the COVID-19 pandemic. They find that targeted stimulus <sup>4</sup>  
<sup>5</sup> through an increase in unemployment benefits has a much larger effect than <sup>5</sup>  
<sup>6</sup> an untargeted policy. In contrast, we find that untargeted stimulus checks have <sup>6</sup>  
<sup>7</sup> slightly larger spending effects than a targeted policy extending eligibility for <sup>7</sup>  
<sup>8</sup> unemployment insurance. The difference derives from the fact that – in our <sup>8</sup>  
<sup>9</sup> model as in the data – even middle- and high-liquid-wealth consumers have rela- <sup>9</sup>  
<sup>10</sup> tively high MPCs, which means that much more of the stimulus checks get spent <sup>10</sup>  
<sup>11</sup> quickly. <sup>11</sup>

<sup>12</sup> [Carroll et al. \(2020b\)](#) also study the U.S. fiscal response to the COVID-19 pan- <sup>12</sup>  
<sup>13</sup> demic, using a HA model similar in many respects to the one we study. They pre- <sup>13</sup>  
<sup>14</sup> dicted<sup>9</sup> the consumption response to the 2020 U.S. CARES Act that contained <sup>14</sup>  
<sup>15</sup> both an extension of unemployment benefits and a stimulus check. They resolve <sup>15</sup>  
<sup>16</sup> the tension between obtaining a realistic MPC and fitting the distribution of liq- <sup>16</sup>  
<sup>17</sup> uid wealth by estimating the distribution of *ex-ante* heterogeneity in discount <sup>17</sup>  
<sup>18</sup> factors that allows the model to match both kinds of data (discount heterogene- <sup>18</sup>  
<sup>19</sup> ity is one of several competing mechanisms for resolving that tension discussed <sup>19</sup>  
<sup>20</sup> by [Kaplan and Violante \(2022\)](#)). But the model in that paper does not match the <sup>20</sup>  
<sup>21</sup> subsequently published evidence about the iMPC ([Fagereng et al. \(2021\)](#)); does <sup>21</sup>  
<sup>22</sup> not incorporate a multiplier; and does not compare the *relative* effectiveness of <sup>22</sup>  
<sup>23</sup> alternative stimulus policies. <sup>23</sup>

<sup>24</sup> Another related paper is [Broer et al. \(2025\)](#), who analyze the output response to <sup>24</sup>  
<sup>25</sup> different fiscal policies in a HANK and SAM model similar to the one we present <sup>25</sup>  
<sup>26</sup> in our robustness exercise. As we do in Section 5, they examine the policies in a <sup>26</sup>  
<sup>27</sup> steady state rather than a recession. Unlike us, they do not calibrate their model <sup>27</sup>  
<sup>28</sup> to match the wealth distribution and the iMPCs, and they do not evaluate the <sup>28</sup>  
<sup>29</sup>

---

<sup>31</sup> “predicted” because the paper was published long before any data on the actual response were <sup>31</sup>  
<sup>32</sup> available. <sup>32</sup>

1 policies using a welfare metric as we do in our baseline partial equilibrium set- 1  
2 ting. 2

3 One criterion to rank policies is the extent to which induced spending is “mul- 3  
4 tiplied,” and our paper therefore relates to the vast literature discussing the size 4  
5 and timing of any multiplier. Our focus is on policies pursued in the Great Re- 5  
6 cession, a period when monetary policy was essentially fixed at the zero lower 6  
7 bound (ZLB). We therefore do not consider monetary policy responses to the 7  
8 policies we evaluate in our primary analysis, and our work thus relates to pa- 8  
9 pers such as [Christiano et al. \(2011\)](#) and [Eggertsson \(2011\)](#), who argue that fiscal 9  
10 multipliers are higher in such circumstances. [Hagedorn et al. \(2019b\)](#) present an 10  
11 HA model with both incomplete markets and nominal rigidities to evaluate the 11  
12 size of the fiscal multiplier and also find that it is higher when monetary policy 12  
13 is constrained. They focus on government spending instead of transfers and are 13  
14 interested in the consequences of alternative options for financing that spend- 14  
15 ing. [Broer et al. \(2023\)](#) also focus on fiscal multipliers for government spending 15  
16 and show how they differ in representative agent and HA models with different 16  
17 sources of nominal rigidities. Finally, [Ramey and Zubairy \(2018\)](#) find empirical 17  
18 evidence that multipliers are higher when there is slack in the economy or the 18  
19 ZLB binds. In any case, our concern in the versions of our model with multipliers 19  
20 is to compare the *relative* size of any *differences* in multiplication across the poli- 20  
21 cies we consider, which should thus be roughly scalable by the absolute size of 21  
22 any multiplication effect, allowing a reader to scale our results by their preferred 22  
23 estimate of the magnitude of recessionary multipliers. 23

24 Aside from the size of spending effects (whether multiplied or not), we are in- 24  
25 terested in ranking policies in terms of their welfare consequences. Thus, the 25  
26 paper relates to the recent literature on welfare comparisons in HA models. 26  
27 Both [Bhandari et al. \(2021\)](#) and [Dávila and Schaab \(2022\)](#) introduce ways of de- 27  
28 composing welfare effects. In the former case, these are aggregate efficiency, re- 28  
29 distribution and insurance, while the latter further decomposes the insurance 29  
30 part into intra- and intertemporal components. 30

31 One part of these decompositions is tricky: Under standard calibrations like the 31  
32 ones we use, any change in redistribution tends to have powerful consequences 32

1 on welfare. We presume that there are real (but unmodeled) reasons that the 1  
 2 equilibrium degree of redistribution in normal (nonrecessionary) times is much 2  
 3 less than the model would call for. We therefore develop a welfare measure that 3  
 4 abstracts from any incentive for a planner to increase redistribution in the steady 4  
 5 state (or “normal” times). 5

6 6

7 7

## 1.2 *Organization*

8 8

9 The paper is organized as follows. Section 2 presents our baseline partial equi- 9  
 10 librium model of households’ consumption and saving problem as well as how 10  
 11 we model a recession and the potential response in terms of three different con- 11  
 12 sumption stimulus policies. Section 3 describes the steps we take to parameterize 12  
 13 the model and discusses the implications for some moments that we do not tar- 13  
 14 get. In section 4 we compare the three policies implemented in a recession both 14  
 15 in terms of their multipliers and in terms of a welfare measure that we introduce. 15  
 16 Section 5 presents a general equilibrium HANK and SAM model where we com- 16  
 17 pare the multipliers of the same three policies to the partial equilibrium results. 17  
 18 Section 6 concludes. Finally, the appendix provides more details of the HANK and 18  
 19 SAM model discussed in Section 5, while an online appendix shows results from 19  
 20 a version of the model without splurge consumption. 20

21 ewcommand.. 21

22 22

## 2. MODEL

23 23

24

25 Consumers differ by their level of education and, within education group, by sub- 25  
 26 jective discount factors (calibrated to match the within-group distribution of liq- 26  
 27 uid wealth). We first describe each kind of consumer’s problem, given an income 27  
 28 process with permanent and transitory shocks calibrated to their type, as well as 28  
 29 type-specific shocks to employment. The next step describes the arrival of a re- 29  
 30 cession and the policies we study as potential fiscal policy responses. The last sec- 30  
 31 tion discusses an extension incorporating aggregate demand effects that induce 31  
 32 feedback from aggregate consumption to income and (via the marginal propen- 32

1 sity to consume) back to consumption, amplifying the effect of a recession when  
 2 it occurs.

3 A consumer  $i$  has education  $e(i)$  and a subjective discount factor  $\beta_i$ . The con-  
 4 sumer faces a stochastic income stream,  $y_{i,t}$ , and chooses to consume a fraction  
 5 of that income when it arrives—the ‘splurge’, described in the introduction.<sup>10</sup>  
 6 With what is left over, the consumer chooses to optimize consumption without  
 7 regard to the fraction that was already spent. Therefore, consumption each pe-  
 8 riod for consumer  $i$  can be written as

9

10

$$11 \quad c_{i,t} = c_{sp,i,t} + c_{opt,i,t}, \quad (1) \quad 11$$

12

13 where  $c_{i,t}$  is total consumption,  $c_{sp,i,t}$  is the splurge consumption, and  $c_{opt,i,t}$  is  
 14 the consumer’s optimal choice of consumption after splurging. Splurge con-  
 15 sumption is simply a fraction of income:

16

$$17 \quad c_{sp,i,t} = \varsigma y_{i,t}, \quad (2) \quad 17$$

18

19 while the optimized portion of consumption is chosen to maximize the perpetual-  
 20 youth lifetime expected-utility-maximizing consumption, where  $D$  is the death  
 21 probability:

$$23 \quad 24 \quad \sum_{t=0}^{\infty} \beta_i^t (1 - D)^t \mathbb{E}_0 u(c_{opt,i,t}). \quad (3) \quad 24$$

25

26 We use a standard CRRA (constant relative risk aversion) utility function, so  
 27  $u(c) = c^{1-\gamma}/(1-\gamma)$  for  $\gamma \neq 1$  and  $u(c) = \log(c)$  for  $\gamma = 1$ , where  $\gamma$  is the coefficient of  
 28 relative risk aversion. The optimization is subject to the budget constraint, given

---

30 <sup>10</sup>One attractive feature of the splurge assumption is that it is also consistent with evidence  
 31 from [Ganong and Noel \(2019\)](#), that spending drops sharply following the large and predictable drop  
 32 in income after the exhaustion of unemployment benefits; see Section 3.3.4.

<sup>1</sup> existing market resources  $m_{i,t}$  and income state, and a no-borrowing constraint:

$$\mathbf{a}_{i,t} = \mathbf{m}_{i,t} - \mathbf{c}_{i,t},$$

$$\mathbf{m}_{i,t+1} = R\mathbf{a}_{i,t} + \mathbf{y}_{i,t+1},$$

$$\mathbf{a}_{i,t} \geq 0,$$

where  $R$  is the gross interest factor for accumulated assets  $a_{i,t}$ .

## 2.1 The income process

Consumers face a stochastic income process with permanent and transitory shocks to income, along with unemployment shocks. In normal times, consumers who become unemployed receive unemployment benefits for two quarters. Permanent income evolves according to:

$$\mathbf{p}_{i,t+1} = \psi_{i,t+1} \Gamma_{e(i)} \mathbf{p}_{i,t},$$

where  $\psi_{i,t+1}$  is the shock to permanent income and  $\Gamma_{e(i)}$  is the average growth rate of income for the consumer's education group  $e(i)$ .<sup>11</sup> The realized growth rate of permanent income for consumer  $i$  is thus  $\hat{\Gamma}_{i,t+1} = \psi_{i,t+1}\Gamma_{e(i)}$ . The shock to permanent income is normally distributed with variance  $\sigma_\psi^2$ .

The actual income a consumer receives will be subject to the individual's employment status as well as transitory shocks,  $\xi_{i,t}$ :

$$y_{i,t} = \begin{cases} \xi_{i,t} p_{i,t}, & \text{if employed} \\ \rho_b p_{i,t}, & \text{if unemployed with benefits} \\ \rho_{nb} p_{i,t}, & \text{if unemployed without benefits} \end{cases} \quad (6)$$

<sup>11</sup>We model the rate of growth for permanent income for each education group and keep this rate unchanged during periods of unemployment. There is evidence, e.g. in [Davis and Wachter \(2011\)](#), that unemployment, especially in a recession, leads to permanent income loss. This finding could be added to the model—see [Carroll et al. \(2020b\)](#) for an example—but is not material to the evaluation of stimulus payments here so we have chosen to keep the model simple.

<sup>1</sup> where  $\xi_{i,t}$  is normally distributed with variance  $\sigma_\xi^2$ , and  $\rho_b$  and  $\rho_{nb}$  are the replace-<sup>1</sup>  
<sup>2</sup> ment rates for an unemployed consumer who is or is not eligible for unemploy-<sup>2</sup>  
<sup>3</sup> ment benefits, respectively.<sup>3</sup>

<sup>4</sup> A Markov transition matrix  $\Pi$  generates the unemployment dynamics where<sup>4</sup>  
<sup>5</sup> the number of states is given by 2 plus the number of periods that unemploy-<sup>5</sup>  
<sup>6</sup> ment benefits last. An employed consumer can continue being employed or<sup>6</sup>  
<sup>7</sup> move to being unemployed with benefits.<sup>12</sup> The first row of  $\Pi$  is thus given by<sup>7</sup>  
<sup>8</sup>  $[1 - \pi_{eu}^{e(i)}, \pi_{eu}^{e(i)}, 0]$ , where  $\pi_{eu}^{e(i)}$  indicates the probability of becoming unemployed<sup>8</sup>  
<sup>9</sup> from an employed state and 0 is a vector of zeros of the appropriate length. Note<sup>9</sup>  
<sup>10</sup> that we allow this probability to depend on the education group of consumer  $i$ <sup>10</sup>  
<sup>11</sup> and will calibrate this parameter to match the average unemployment rate for<sup>11</sup>  
<sup>12</sup> each education group. Upon becoming unemployed, all consumers face a prob-<sup>12</sup>  
<sup>13</sup> ability  $\pi_{ue}$  of transitioning back into employment and a probability  $1 - \pi_{ue}$  of<sup>13</sup>  
<sup>14</sup> remaining unemployed with one less period of remaining benefits. After transi-<sup>14</sup>  
<sup>15</sup> tioning into the unemployment state where the consumer is no longer eligible for<sup>15</sup>  
<sup>16</sup> benefits, the consumer will remain in this state until becoming employed again.<sup>16</sup>  
<sup>17</sup> The probability of becoming employed is thus the same for each of the unem-<sup>17</sup>  
<sup>18</sup> ployment states and education groups.<sup>18</sup>

## 2.2 Recessions and policies

<sup>21</sup> We model the arrival of a recession, and the government policy response to it, as<sup>21</sup>  
<sup>22</sup> an unpredictable event—an MIT shock. We have four types of shocks: one rep-<sup>22</sup>  
<sup>23</sup> resenting a recession and one for each of the three different policy responses we<sup>23</sup>  
<sup>24</sup> consider. The policy responses are usually modeled as in addition to the reces-<sup>24</sup>  
<sup>25</sup> sion, but we also consider a counterfactual in which the policy response occurs<sup>25</sup>  
<sup>26</sup> without a recession in order to understand the welfare effects of the policy.<sup>26</sup>

<sup>27</sup> 2.2.0.1 *Recession.* At the onset of a recession, several changes occur. First, the<sup>27</sup>  
<sup>28</sup> unemployment rate for each education group doubles: Those who would have<sup>28</sup>  
<sup>29</sup> been unemployed in the absence of a recession are still unemployed, and an ad-<sup>29</sup>  
<sup>30</sup> ditional number of consumers move from employment to unemployment. Sec-

---

<sup>31</sup><sup>32</sup> <sup>12</sup>That is, as long as we assume that there is at least one period of unemployment benefits.<sup>32</sup>

1 ond, conditional on the recession continuing, the employment transition matrix 1  
2 is adjusted so that unemployment remains at the new high level and the expected 2  
3 length of time for an unemployment spell increases. In our baseline calibration, 3  
4 discussed in detail in section 3.3.1, we set the expected length of an unemploy- 4  
5 ment spell to one and a half quarters in normal times, and this length increases to 5  
6 four quarters in a recession. Third, the end of the recession occurs as a Bernoulli 6  
7 process calibrated for an average length of recession of six quarters. Finally, at the 7  
8 end of a recession, the employment transition matrix switches back to its origi- 8  
9 nal probabilities, and, as a result, the unemployment rate trends down over time, 9  
10 back to its steady-state level. The details of how certain model parameters change 10  
11 in a recession are presented in section 3.3.2. 11

12       2.2.0.2 *Policies.* The policies we consider in response to a recession are inspired 12  
13 by the Economic Stimulus Act of 2008 and the Tax Relief, Unemployment Insur- 13  
14 ance Reauthorization, and Job Creation Act of 2010. The former included means 14  
15 tested stimulus checks in the form of tax rebates, and the latter included both an 15  
16 extension of unemployment benefits and a tax cut. Based on these examples we 16  
17 therefore consider the following stimulus policies in our framework: 17  
18

19       2.2.0.3 *1. Stimulus check.* In this policy response, the government sends money 19  
20 to every consumer that directly increases the household's market resources. The 20  
21 checks are means-tested depending on permanent income. A check for \$1,200 21  
22 is sent to every household with permanent income less than \$100,000, and this 22  
23 amount is then linearly reduced to zero for households with a permanent income 23  
24 greater than \$150,000. Similar policies were implemented in the U.S. in 2001, 24  
25 2008, and during the pandemic. 25

26       2.2.0.4 *2. Extended unemployment benefits.* In this policy response, unemploy- 27  
27 ment benefits are extended from two quarters to four quarters. That is, those who 28  
28 become unemployed at the start of the recession, or who were already unem- 29  
29 ployed, will receive unemployment benefits for up to four quarters (including 30  
30 quarters leading up to the recession). Those who become unemployed one quar- 31  
31 ter into the recession will receive up to three quarters of unemployment benefits. 32

1 These extended unemployment benefits will occur regardless of whether the re- 1  
2 cession ends, and no further extensions are granted if the recession continues. 2  
3 This policy reflects temporary changes made to unemployment benefits in the 3  
4 U.S. following the great recession. 4

5 5

6 2.2.0.5 3. *Payroll tax cut.* In this policy response, employee-side payroll taxes 6  
7 are reduced for a period of eight quarters.<sup>13</sup> During this period, which continues 7  
8 irrespective of whether the recession continues or ends, employed consumers' 8  
9 income is increased by 2 percent. The income of the unemployed is unchanged 9  
10 by this policy. Households also believe there is a 50-50 chance that the tax cut 10  
11 will be extended by another two years if the recession has not ended when the 11  
12 first tax cut expires.<sup>14</sup> The payroll tax cut introduced in the U.S. in 2010 was itself 12  
13 an extension of previously implemented cuts and had a two-year horizon. 13

14 14

15 2.2.0.6 *Financing the policies.* Some work in the HA macro literature has shown 15  
16 that if taxes are raised immediately to offset any fiscal stimulus, results can be 16  
17 very different than they would be if, as occurs in reality, recessionary policies are 17  
18 debt financed. However, typical fiscal rules assume that any increase in debt gets 18  
19 financed over a long interval. Accordingly, almost all of the effects of any partic- 19  
20 ular fiscal rule will be similar for each of our policies so long as the great majority 20  
21 of the debt is repaid after the short recessionary period that is our main focus. 21

22 To keep our analysis as simple as possible, we do not model the debt repay- 22  
23 ment. Any of a variety of fiscal rules could be imposed for the period following 23  
24 our short period of interest, but we did not want to choose any particular fiscal 24  
25 rule in order to avoid making a choice that has little consequence for our key 25  
26 question. Advocates of alternative fiscal rules likely already have intuitions about 26  
27 how such rules' economic consequences differ, but those consequences—under 27  
28 our partial equilibrium analysis—will be similar for all three policies we consider. 28

29 \_\_\_\_\_  
30 30  
31 <sup>13</sup>Although payroll taxes are paid by both the employer and the employee, the payroll tax cuts in 31  
the U.S. have been applied only the employee side. 31

32 <sup>14</sup>The belief that the payroll tax cut may be extended makes little difference to the results. 32

1 Alternative choices of fiscal rules will therefore not affect the ranking of policies 1  
 2 that is our principal concern.<sup>15</sup> 2

3 3

4           2.3 *Aggregate demand effects* 4

5 5

6 Our baseline model is a partial equilibrium model that does not include any 6  
 7 feedback from aggregate consumption to income. In an extension to the model, 7  
 8 we add aggregate demand effects during the recession. The motivation for this 8  
 9 specification comes from the idea that spending in an economy with substantial 9  
 10 slack and in which the central bank is unable to prevent a recession will result 10  
 11 in higher utilization rates and greater output. By contrast, government spending 11  
 12 in an economy running at potential with an active monetary policy will not suc- 12  
 13 ceed in increasing output. The recent inflation experience of the U.S. provides 13  
 14 some evidence that output responds highly non-linearly to aggregate demand. 14  
 15 This idea is explored in a recent revival of research into non-linear Phillips curves, 15  
 16 such as [Benigno and Eggertsson \(2023\)](#) and [Blanco et al. \(2024\)](#). 16

17 With this extension, any changes in consumption away from the steady-state 17  
 18 consumption level feed back into labor income. Aggregate demand effects are 18  
 19 evaluated as 19

20 20

$$21 AD(C_t) = \begin{cases} (C_t/\tilde{C})^\kappa, & \text{if in a recession} \\ 22 1, & \text{otherwise,} \end{cases} \quad (7) \quad 21$$

23 23

24 where  $\tilde{C}$  is the level of consumption in the steady state. Idiosyncratic income in 24  
 25 the aggregate demand extension is multiplied by  $AD(C_t)$ : 25

26 26

27            $\mathbf{y}_{AD,i,t} = AD(C_t)\mathbf{y}_{i,t}.$  27

28 28

29 The series  $\mathbf{y}_{AD,i,t}$  is then used for each consumer's budget constraint. 29

30 30

---

31       <sup>15</sup>In our general equilibrium analysis in section 5, we apply a fiscal rule that assumes debt is slowly 31  
 32 paid back over time. 32

## 1                   3. PARAMETERIZING THE MODEL 1

2     This section describes how we set the model's parameters. First, we estimate the 2  
3     extent to which consumers 'splurge' when receiving an income shock. Given the 3  
4     lack of empirical evidence on the marginal propensity to consume over time for 4  
5     the US, we instead use Norwegian data to estimate the splurge. Specifically, we 5  
6     calibrate our model to the Norwegian economy and match evidence from Nor- 6  
7     way on the profile of the marginal propensity to spend over time and across dif- 7  
8     ferent wealth levels, as provided by Fagereng et al. (2021).<sup>16</sup> 8

9     Second, we set up the full model on U.S. data, taking the splurge factor as given 9  
10    from the Norwegian estimation. In the full model, agents differ according to their 10  
11    level of education and their subjective discount factors. A subset of the param- 11  
12    eters in the model are calibrated equally for all types, and some parameters are 12  
13    calibrated to be specific to each education group. Finally, a distribution of subjec- 13  
14    tive discount factors is estimated separately for each education group to match 14  
15    features of each within-group liquid wealth distribution. 15

16                   3.1 *Estimation of the splurge factor* 16

17    The splurge allows us to capture the shorter- and longer-term response of con- 17  
18    sumption to income shocks, especially for consumers with significant liquid 18  
19    wealth. The main aim of this paper, however, is to rank consumption stimulus 19  
20    policies, not to provide a microfoundation for the splurging behavior. We view the 20  
21    splurge factor as a model device that enables us to rank the policies in a model 21  
22    that is consistent with the best available micro-evidence of spending patterns 22  
23    over time after a transitory income shock. In Appendix ?? we provide results from 23  
24    our model without a splurge factor. There we show that such a model provides 24  
25    a worse fit to the moments in the data that we are interested in, but not dra- 25  
26    matically so, and that our conclusions regarding the ranking of the policies are 26  
27    not affected. However, in our view, this version of the model requires households 27  
28    with unreasonably low discount factors. 28

---

29                   <sup>16</sup>Appendix ?? discusses an alternative calibration method, which solely relies on US data. The 29  
30    main results derived in that calibration are in line with those discussed in the main text. 30

1 The specific exercise we carry out in this section, is to show that our model 1  
 2 can account well for the results of Fagereng et al. (2021), who study the effect of 2  
 3 lottery winnings in Norway on consumption using millions of records from the 3  
 4 Norwegian population registry. We calibrate our model to reflect the Norwegian 4  
 5 economy and, using their results, estimate the splurge factor, as well as the distri- 5  
 6 bution of discount factors in the population, to match two empirical moments. 6

7 First, we take from Fagereng et al. (2021) the marginal propensity to consume 7  
 8 out of a one-period income shock. We target not only the initial (aggregate) re- 8  
 9 sponse of consumption to the income shock, but also the subsequent effect on 9  
 10 consumption in years one through four after the shock. We also target the initial 10  
 11 consumption response in the cross-section, i.e. across the quartiles of the liquid 11  
 12 wealth distribution, for which empirical estimates are also provided. The shares 12  
 13 of lottery winnings expended at different time horizons, as found in Fagereng 13  
 14 et al. (2021), are plotted in figure 1a. Table 1 (second row) shows the initial con- 14  
 15 sumption response across liquid wealth quartiles. 15

16 Second, we match the steady-state distribution of liquid wealth in the model to 16  
 17 its empirical counterpart. Because of the lack of data on the liquid wealth distri- 17  
 18 bution in Norway, we use the corresponding data from the United States, assum- 18  
 19 ing that liquid wealth inequality is comparable across these countries.<sup>17</sup> Specifi- 19  
 20 cally, we impose as targets the cumulative liquid wealth shares for the entire pop- 20  
 21 ulation at the 20th, 40th, 60th, and 80th income percentiles, which, in data from 21  
 22 the Survey of Consumer Finances (SCF) in 2004 (Board of Governors of the Fed- 22  
 23 eral Reserve System, 2004) (see section 3.2 for further details), equal 0.03 percent, 23  
 24 0.35 percent, 1.84 percent, and 7.42 percent, respectively. Hence, 92.6 percent of 24  
 25 the total liquid wealth is held by the top income quintile. We also target the mean 25  
 26 liquid wealth to income ratio of 6.60. The data are plotted in figure 1b. 26

27  
28  
29

---

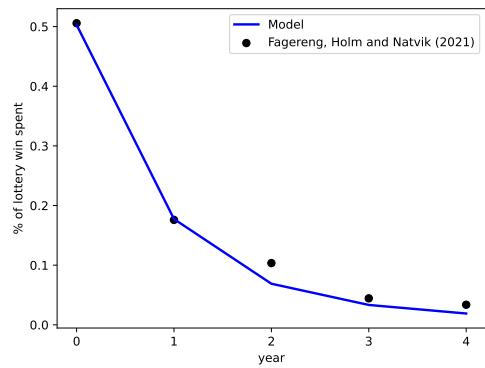
30     <sup>17</sup>Data from the Norwegian tax registry contains information on liquid assets, but not liquid debt. 30  
 31 Only total debt is reported – which is mainly mortgage debt. Therefore, we cannot construct liquid 31  
 32 wealth as Kaplan and Violante (2014) can for the U.S. 32

1 TABLE 1. PREGENERATED: MPC's across wealth quartiles and in total

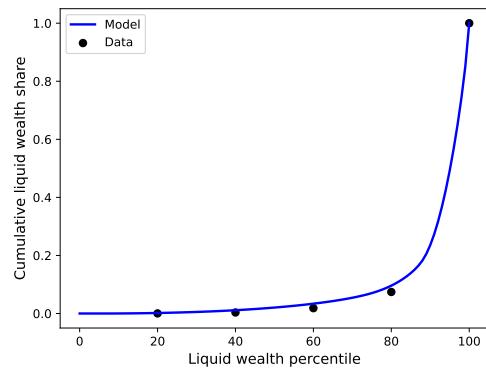
2 Targeting  $K/Y$  and avg MPC by quartile

	MPC					
	1st WQ	2nd WQ	3rd WQ	4th WQ	Agg	K/Y
Model	0.27	0.48	0.60	0.66	0.50	6.58
Data	0.39	0.39	0.55	0.66	0.51	6.60

8 FIGURE 1. PREGENERATED: Model fit to spending behavior and wealth distribution



18 (a) Spending dynamics after lottery win



18 (b) Liquid wealth distribution

20 **Note:** This figure demonstrates the calibration of the splurge factor (Section 3.1). Panel (a) shows  
21 the model's fit to the dynamic consumption response following lottery wins in Norway, as estimated  
22 by Fagereng et al. (2021) using millions of population registry records. The splurge factor of  $\varsigma = 0.249$   
23 allows the model to match both the high initial MPC and the gradual spending over subsequent years.  
24 Panel (b) shows the model's fit to the U.S. liquid wealth distribution from the 2004 SCF, with 92.6% of  
25 liquid wealth held by the top income quintile. See Section 3.2 for the liquid wealth definition following  
Kaplan and Violante (2014).

26 For this estimation exercise, the remaining model parameters are calibrated  
27 to reflect the Norwegian economy. Specifically, we set the real interest rate to 2  
28 percent annually and the unemployment rate to 4.4 percent, in line with Aurs-  
29 land et al. (2020). The quarterly probability to survive is calibrated to  $1 - 1/160$ ,  
reflecting an expected working life of 40 years. Aggregate productivity growth is  
set to 1 percent annually, following Kravik and Mimir (2019). The unemployment  
net replacement rate is calibrated to 60 percent, following OECD (2020). Finally,

<sup>1</sup> we set the real interest rate on liquid debt to 13.6 percent, following data from the <sup>1</sup>  
<sup>2</sup> Norwegian debt registry [Gjeldsregistret \(2022\)](#).<sup>18</sup> <sup>2</sup>

<sup>3</sup> Estimates of the standard deviations of the permanent and transitory shocks <sup>3</sup>  
<sup>4</sup> are taken from [Crawley et al. \(2024\)](#), who estimate an income process on admin- <sup>4</sup>  
<sup>5</sup> istrative data for Norwegian males from 1971 to 2014. The estimated annual vari- <sup>5</sup>  
<sup>6</sup> ances for the permanent and transitory shocks are 0.004 and 0.033, respectively.<sup>19</sup> <sup>6</sup>  
<sup>7</sup> As in [Carroll et al. \(2020a\)](#), these are converted to quarterly values by multiplying <sup>7</sup>  
<sup>8</sup> the permanent and transitory shock variances by 1/4 and 4, respectively. Thus, <sup>8</sup>  
<sup>9</sup> we obtain quarterly standard deviations of  $\sigma_\psi = 0.0316$  and  $\sigma_\xi = 0.363$ . <sup>9</sup>

<sup>10</sup> Using the calibrated model, we simulated unexpected lottery winnings and <sup>10</sup>  
<sup>11</sup> calculate the share of the lottery spent in each year. Specifically, each simulated <sup>11</sup>  
<sup>12</sup> agent receives a lottery win in a random quarter of the first year of the simula- <sup>12</sup>  
<sup>13</sup> tion. The size of the lottery win is itself random and spans the range of lottery <sup>13</sup>  
<sup>14</sup> sizes found in [Fagereng et al. \(2021\)](#). The estimation procedure minimizes the <sup>14</sup>  
<sup>15</sup> distance between the target and model moments by selecting the splurge factor <sup>15</sup>  
<sup>16</sup> and the distribution of discount factors in the population, where the latter are <sup>16</sup>  
<sup>17</sup> assumed to be uniformly distributed in the range  $[\beta - \nabla, \beta + \nabla]$ . We approximate <sup>17</sup>  
<sup>18</sup> the uniform distribution of discount factors with a discrete approximation and <sup>18</sup>  
<sup>19</sup> let the population consist of seven different types. <sup>19</sup>

<sup>20</sup> The estimation yields a splurge factor of 0.246 and a distribution of discount <sup>20</sup>  
<sup>21</sup> factors described by  $\beta = 0.968$  and  $\nabla = 0.0578$ . Given these estimated parameters <sup>21</sup>  
<sup>22</sup> and the remaining calibrated ones, the model is able to replicate the time path of <sup>22</sup>  
<sup>23</sup> consumption in response to a lottery win from [Fagereng et al. \(2021\)](#) and the tar- <sup>23</sup>  
<sup>24</sup> geted distribution of liquid wealth well, see Figure 1. Also, the targeted moments <sup>24</sup>  
<sup>25</sup>

---

<sup>26</sup><sup>18</sup>Specifically, we determine the average volume-weighted interest rate on liquid debt, which con- <sup>26</sup>  
<sup>27</sup>sists of consumer loans, credit and payment card debt and all other unsecured debt. We use data from <sup>27</sup>  
<sup>28</sup>December 2019. Note that although these data let us pin down aggregate quantities, they do not solve <sup>28</sup>  
<sup>29</sup>the issue referred to in footnote 17, since we cannot link them to the tax registry at the individual <sup>29</sup>  
<sup>30</sup>level. We set the borrowing limit on liquid debt to zero.

<sup>30</sup><sup>19</sup>As shown in [Crawley et al. \(2024\)](#), an income process of the form that we use here is more accu- <sup>30</sup>  
<sup>31</sup>rately estimated using moments in levels not differences. Hence, we take the numbers from column <sup>31</sup>  
<sup>32</sup>3 of Panel C in their table 4. <sup>32</sup>

1 discussed in Table 1 are captured well. In particular, the model is able to account 1  
2 for the empirical fact, in the first column, that the MPC for high-wealth agents is 2  
3 far above the near-zero value predicted by a model without a splurge. 3

4 4

5 5

6 *3.2 Data on permanent income, liquid wealth, and education* 6

7 7

8 Before we move on to the parameterization of the full model, we describe in detail 8  
9 the data that we use to get measures of permanent income, liquid wealth, and the 9  
10 division of households into educational groups in the United States. We use data 10  
11 on the distribution of liquid wealth from the 2004 wave of the SCF ([Board of Gov-](#) 11  
[ernors of the Federal Reserve System, 2004](#)). We restrict our attention to house- 12  
holds where the head is of working age, which we define to be in the range from 13  
14 25 to 62. The SCF-variable “normal annual income” is our measure of the house- 14  
15 hold’s permanent income, and, to exclude outliers, we drop the observations that 15  
16 make up the bottom 5 percent of the distribution of this variable. The smallest 16  
17 value of permanent income for households in our sample is thus \$16,708. 17

18 Liquid wealth is defined as in [Kaplan and Violante \(2014\)](#) and consists of cash, 18  
19 money market, checking, savings, and call accounts; directly held mutual funds; 19  
20 and stocks and bonds. We subtract off liquid debt, which is the revolving debt on 20  
21 credit card balances. Note that the SCF does not contain information on cash 21  
22 holdings, so these are imputed with the procedure described in Appendix B.1 22  
23 of [Kaplan and Violante \(2014\)](#), which also describes the credit card balances that 23  
24 are considered part of liquid debt. We drop any households that have negative 24  
25 liquid wealth. 25

26 Households are classified into three educational groups. The first group, 26  
27 “Dropout,” applies to households where the head of household has not obtained 27  
28 a high school diploma; the second group, “Highschool,” includes heads of house- 28  
29 holds who have a high school diploma and those who, in addition, have some 29  
30 years of college education without obtaining a bachelor’s degree; and the third 30  
31 group, “College,” consists of heads of households who have obtained a bachelor’s 31  
32 degree or higher. With this classification of the education groups, the Dropout 32

<sup>1</sup> group makes up 9.3 percent of the population, the Highschool group 52.7 per-  
<sup>2</sup> cent, and the College group 38.0 percent.

<sup>3</sup> With our sample selection criteria, we are left with a sample representing about  
<sup>4</sup> 61.3 million U.S. households.

### <sup>5</sup> 3.3 *Parameters in the full model* <sup>6</sup>

<sup>7</sup> With households classified into the three education groups using the SCF data,  
<sup>8</sup> we proceed to set the parameters of the model as follows. First, we calibrate a  
<sup>9</sup> set of parameters that apply to all types of households in the model. Second, we  
<sup>10</sup> calibrate another set of parameters that are specific to each education group to  
<sup>11</sup> capture broad differences across these groups. Finally, given the calibrated pa-  
<sup>12</sup> rameters we estimate discount factor distributions for each education group that  
<sup>13</sup> allow us to match the distribution of liquid wealth in each group.

<sup>14</sup> The model is a simplified model for households in that we do not take into ac-  
<sup>15</sup> count heterogeneity across household size or composition. The households are  
<sup>16</sup> ex-ante heterogeneous in their subjective discount factors as well as their level of  
<sup>17</sup> education. We classify the education level of the household based on the educa-  
<sup>18</sup> tion of the head of the household, and we typically think of individual character-  
<sup>19</sup> istics as applying to that person.

<sup>20</sup> A period in the model is one quarter. This choice makes it realistic to consider  
<sup>21</sup> stimulus policies that are implemented in the same period as a recession starts.  
<sup>22</sup>

<sup>23</sup> 3.3.1 *Calibrated parameters — Normal times* Table 2 presents our calibration  
<sup>24</sup> of the model parameters in normal times. Panel A lists parameters that are cali-  
<sup>25</sup> brated equally across all types in the model, and Panel B lists parameters in the  
<sup>26</sup> model that are education specific. In the next subsection we present how certain  
<sup>27</sup> model parameters change when the economy enters a recession.

<sup>28</sup> **Preferences, survival and interest rates.** All households are assumed to have a  
<sup>29</sup> coefficient of relative risk aversion equal to  $\gamma = 2$ . We also assume that all house-  
<sup>30</sup> holds have the same propensity to splurge out of transitory income gains and set  
<sup>31</sup>  $\varsigma = 0.246$ , the value estimated in section 3.1. However, each education group is di-  
<sup>32</sup> vided into types that differ in their subjective discount factors. The distributions

1 of discount factors for each education group are estimated to fit the distribution 1  
2 of liquid wealth within that group, and this estimation is described in detail in 2  
3 section 3.3.3. Regardless of type, households face a constant survival probability 3  
4 each quarter. This probability is set to  $1 - 1/160$ , reflecting an expected working 4  
5 life of 40 years. The real interest rate on households' savings is set to 1 percent per 5  
6 quarter. 6

7 **Labor market risk while employed.** When consumers are born, they receive an 7  
8 initial level of permanent income. This initial value is drawn from a log-normal 8  
9 distribution that depends on the education level the household is born with. For 9  
10 each education group, the parameters of the distribution are determined by the 10  
11 mean and standard deviation of log-permanent income for households in that 11  
12 group where the head of the household is of age 25 in the SCF 2004. For the 12  
13 Dropout group, the mean initial value of quarterly permanent income is \$6,200; 13  
14 for the Highschool group, it is \$11,100; and for the College group, it is \$14,500. 14  
15 The standard deviations of the log-normal distributions for each group are, re- 15  
16 spectively, 0.32, 0.42, and 0.53. 16

17 While households remain employed, their income is subject to both perma- 17  
18 nent and transitory idiosyncratic shocks. These shocks are distributed equally 18  
19 for the three education groups. The standard deviations of these shocks are taken 19  
20 from Carroll et al. (2020a), who set the standard deviations of the transitory and 20  
21 permanent shocks to  $\sigma_\xi = 0.346$  and  $\sigma_\psi = 0.0548$ , respectively. 21

22 Permanent income also grows, on average, with a growth factor  $\Gamma_{e(i)}$  that de- 22  
23 pends on the level of education. These average growth rates are based on num- 23  
24 bers from Carroll et al. (2020b), who construct age-dependent expected perma- 24  
25 nent income growth factors using numbers from Cagetti (2003) and fit the age- 25  
26 dependent numbers to their life-cycle model. We construct the quarterly growth 26  
27 rates of permanent income in our perpetual-youth model by taking the average 27  
28 of the age-dependent growth rates during a household's working life. The aver- 28  
29 age gross quarterly growth rates that we obtain for the three education groups 29  
30 are then  $\Gamma_d = 1.0036$ ,  $\Gamma_h = 1.0045$ , and  $\Gamma_c = 1.0049$ . 30

31 31

32 32

1 TABLE 2. Calibrated Model Parameters — Normal times  
 2 Panel A: Parameters that apply to all types

3 Parameter	Notation	Value
Risk aversion	$\gamma$	2.0
Splurge	$\varsigma$	0.25
Survival probability, quarterly	$1 - D$	0.994
Risk free interest rate, quarterly (gross)	$R$	1.01
Standard deviation of transitory shock	$\sigma_\xi$	0.346
Standard deviation of permanent shock	$\sigma_\psi$	0.0548
Unemp. benefits replacement rate (share of PI)	$\rho_b$	0.7
Unemp. income w/o benefits (share of PI)	$\rho_{nb}$	0.5
Avg. dur. of unemp. benefits in normal times (quarters)		2
Avg. dur. of unemp. spell in normal times (quarters)		1.5
Prob. of leaving unemp.	$\pi_{ue}$	0.667
Consumption elasticity of aggregate demand effect	$\kappa$	0.3

15 Shows parameters calibrated the same for all types.

17 Panel B: Parameters calibrated for each education group

19	Dropout	Highschool	College
20 Percent of population	9.3	52.7	38.0
21 Avg. quarterly PI of “newborn” agent (\$1000)	6.2	11.1	14.5
22 Std. dev. of log(PI) of “newborn” agent	0.32	0.42	0.53
23 Avg. quarterly gross growth factor for PI ( $\Gamma_e$ )	1.0036	1.0045	1.0049
24 Unemp. rate in normal times (percent)	8.5	4.4	2.7
25 Prob. of entering unemp. ( $\pi_{eu}^e$ , percent)	6.2	3.1	1.8

25 Shows parameters calibrated for each education group. (“PI” is permanent income).

27  
 28 **Unemployment.** Consumers also face the risk of becoming unemployed and  
 29 will then have access to unemployment benefits for a certain period. The param-  
 30 eters describing the unemployment benefits in normal times are based on the  
 31 work of [Rothstein and Valletta \(2017\)](#), who study the effects on household in-  
 32 come of unemployment and of running out of eligibility for benefits. The unem-

1 ployment benefits replacement rate is thus set to  $\rho_b = 0.7$  for all households, and 1  
 2 when benefits run out, the unemployment replacement rate without any benefits 2  
 3 is set to  $\rho_{nb} = 0.5$ . These replacement rates are set as a share of the households' 3  
 4 permanent income and are based on the initial drop in income upon entering an 4  
 5 unemployment spell, presented in figure 3 in [Rothstein and Valletta \(2017\)](#).<sup>20</sup> 5

6 The duration of unemployment benefits in normal times is set to two quarters, 6  
 7 so that our Markov transition matrix  $\Pi$  has four states. This length of time corre- 7  
 8 sponds to the mean duration of unemployment benefits across U.S. states from 8  
 9 2004 to mid-2008 of 26 weeks, reported by [Rothstein and Valletta \(2017\)](#). 9

10 The probability of transitioning out of unemployment is set to match the aver- 10  
 11 age duration of an unemployment spell in normal times. In data from the Bureau 11  
 12 of Labor Statistics, this average duration was 19.6 weeks or 1.5 quarters in 2004. 12  
 13 We do not have data on education-specific duration rates, however, so we set the 13  
 14 average duration of unemployment to 1.5 quarters for all households. This im- 14  
 15 plies that the transition probability from unemployment to employment is set to 15  
 16  $\pi_{ue} = 2/3$ . 16

17 The Bureau of Labor Statistics provide data on unemployment rates for differ- 17  
 18 ent education groups, and we match the average rate in each group in 2004 by 18  
 19 setting an education-specific probability of transitioning from employment into 19  
 20 unemployment. Note that this calibration strategy is consistent with the results 20  
 21 in [Mincer \(1991\)](#) who finds that the main difference between education groups 21  
 22 is in the incidence of unemployment, and not its duration.<sup>21</sup> More recent work 22  
 23 by [Elsby and Hobijn \(2010\)](#) includes data up to 2009 and echoes [Mincer's](#) results. 23

---

24 <sup>20</sup>See the lines for their UI exhaustee sample including and excluding UI income. [Rothstein and](#) 24  
 25 [Valletta \(2017\)](#) also point out that “UI benefits replace about 40 percent of the lost earnings on aver- 25  
 26 age” (page 894). For a household with two income earners with equal income, these findings would 26  
 27 mean that income drops to 70 percent when one earner becomes unemployed and to 50 percent 27  
 28 when benefits run out. In this paper we ignore several of the channels studied by [Rothstein and Val- 28  
 29 letta \(2017\)](#) such as within household insurance and other social programs that can provide income 29  
 even after UI benefits have run out.

30 <sup>21</sup>[Mincer \(1991\)](#) states that “the reduction of the incidence of unemployment [at higher education

31 levels] is found to be far more important than the reduced duration of unemployment in creating the

32 educational differentials in unemployment rates” (page 1).

1 The average unemployment rate in 2004 was 8.5 percent for the Dropout group,  
 2 4.4 percent for the Highschool group, and 2.7 percent for the College group. These  
 3 values imply that the probabilities of transitioning into unemployment in nor-  
 4 mal times are  $\pi_{eu}^d = 6.2$  percent,  $\pi_{eu}^h = 3.1$  percent, and  $\pi_{eu}^c = 1.8$  percent, respec-  
 5 tively.<sup>22</sup>

6 Finally, the strength of the aggregate demand effect in recessions is determined  
 7 by the consumption elasticity of productivity. We follow Krueger et al. (2016) and  
 8 set this to  $\kappa = 0.3$ .

9  
 10 3.3.2 *Calibrated parameters — Recession* Table 3 shows the model parameters  
 11 that change when a recession hits. Panel A shows the change in two parameters  
 12 that apply to all types, and Panel B shows changes in some parameters that differ  
 13 across education groups. For completeness, panel C summarizes the remaining  
 14 parameters describing how we model a recession and the three policies we con-  
 15 sider as potential responses to a recession.

16 The two immediate changes that occur at the outset of a recession is that the  
 17 unemployment rate doubles for all education groups, and the expected duration  
 18 of an unemployment spell increases from 1.5 to 4 quarters. The duration of un-  
 19 employment is the same across the three education groups, and this implies that  
 20 the probability of leaving unemployment is set to  $\pi_{ue} = 0.25$  in a recession.

21 The increase in the expected duration of unemployment combined with the  
 22 doubling of the education-specific unemployment rates pin down new values  
 23 for the probabilities of transitioning from employment to unemployment dur-  
 24 ing the recession. Due to the large increase in the unemployment duration, the  
 25 values that we obtain end up being slightly smaller than those transition proba-  
 26 bilities in normal times. The probability  $\pi_{eu}$  in a recession is set to 5.1 percent for

---

27   <sup>22</sup>Also note that the probability of transitioning from employment to unemployment is the proba-  
 28 bility of a job separation times the conditional probability of unemployment given a job separation.  
 29 Mincer (1991) reports that both of these are lower for higher education levels. For our calibration, this  
 30 means that a higher job finding rate *within* the quarter of the job separation for more educated work-  
 31 ers translates into a lower probability of transitioning from employment to unemployment during a  
 32 quarter. In that sense, our calibration is consistent with short-term job-finding rates being higher for  
 33 more educated workers.

1 the Dropout group, 2.4 percent for the Highschool group, and 1.4 for the College 1  
2 group. 2

3 Our calibration of the transition probabilities between employment and un- 3  
4 employment during a recession are thus broadly in line with the results of Elsby 4  
5 and Hobijn (2010). They find that unemployment duration does not vary much 5  
6 between education groups and that the flow from unemployment to employment 6  
7 drops sharply for all groups in a recession. The flow into unemployment is more 7  
8 stable, but they find that it tends to increase a little bit in recessions.<sup>23</sup> This differs 8  
9 from the small decrease in the transition probabilities from employment into un- 9  
employment that our calibration strategy implies, which follows from our choice 10  
10 of targeting a doubling of the unemployment rate for each group rather than an 11  
11 even larger increase. 12

13 3.3.3 *Estimating the discount factor distributions* Discount factor distributions 13  
14 are estimated separately for each education group to match the distribution of 14  
15 liquid wealth for households in that group. To do so, we let each education group 15  
16 consist of types that differ in their subjective discount factor,  $\beta$ . The discount fac- 16  
17 tors within each group  $e \in \{d, h, c\}$  are assumed to be uniformly distributed in the 17  
18 range  $[\beta_e - \nabla_e, \beta_e + \nabla_e]$ . The parameters  $\beta_e$  and  $\nabla_e$  are chosen for each group sep- 18  
19 arately to match the median liquid-wealth-to-permanent-income ratio and the 19  
20 20th, 40th, 60th, and 80th percentile points of the Lorenz curve for liquid wealth 20  
21 for that group. We approximate the uniform distribution of discount factors with 21  
22 a discrete approximation and let each education group consist of seven different 22  
23 types. 23

24 Panel A of table 4 shows the estimated values of  $(\beta_e, \nabla_e)$  for each education 24  
25 group. The panel also shows the minimum and maximum values of the dis- 25  
26 count factors we actually use in the model when we use a discrete approximation 26  
27 with seven values to approximate the uniform distribution of discount factors. 27  
28 Panel B of table 4 shows that with these estimated distributions, we can exactly 28  
29 match the median liquid-wealth-to-permanent-income ratios for each educa- 29  
30 tion group. Figure 2 shows that with the estimated distributions, the model quite 30  
31

---

32 <sup>23</sup>See the bottom row of Figure 8 in Elsby and Hobijn (2010) for these results. 32

1 TABLE 3. Calibrated Model Parameters — Recession  
 2 Panel A: Parameters that apply to all types

3 Parameter	4 Notation	5 Value
4 Avg. duration of unemp. spell in a recession (quarters)		4
5 Prob. of leaving unemployment in a recession	$\pi_{ue}$	0.25
8 Panel B: Parameters calibrated for each education group		
10		
11 Unemp. rate at the start of a recession (percent)	17.0	8.8
12 Prob. of entering unemployment ( $\pi_{eu}^e$ , percent)	5.1	2.4
14 Panel C: Parameters describing policy experiments		
16 Parameter		16 Value
17 Average length of recession		17 6 quarters
18 Size of stimulus check		18 \$1,200
19 PI threshold for reducing check size		19 \$100,000
20 PI threshold for not receiving check		20 \$150,000
21 Extended unemployment benefits		21 4 quarters
22 Length of payroll tax cut		21 8 quarters
23 Income increase from payroll tax cut		22 2 percent
24 Belief (probability) that tax cut is extended		23 50 percent
24 Note: "PI" refers to Permanent Income		
26		
27		
28		
29		
30		
31 closely matches the distribution of liquid wealth within each education group as		
32 well as for the population as a whole. Thus, our model does not suffer from the		

1 TABLE 4. PREGENERATED: Estimated discount factor distributions and estimation tar- 1  
 2 gets 2

3 Panel A: Estimated discount factor distributions 3

	Dropout	Highschool	College
$(\beta_e, \nabla_e)$	(0.719, 0.318)	(0.925, 0.077)	(0.983, 0.014)
(Min, max) in approximation	(0.447, 0.991)	(0.859, 0.990)	(0.971, 0.995)

8 Panel B: Estimation targets 8

	Dropout	Highschool	College
Median LW/ quarterly PI (data, percent)	4.64	30.2	112.8
Median LW/ quarterly PI (model, percent)	4.64	30.16	112.80

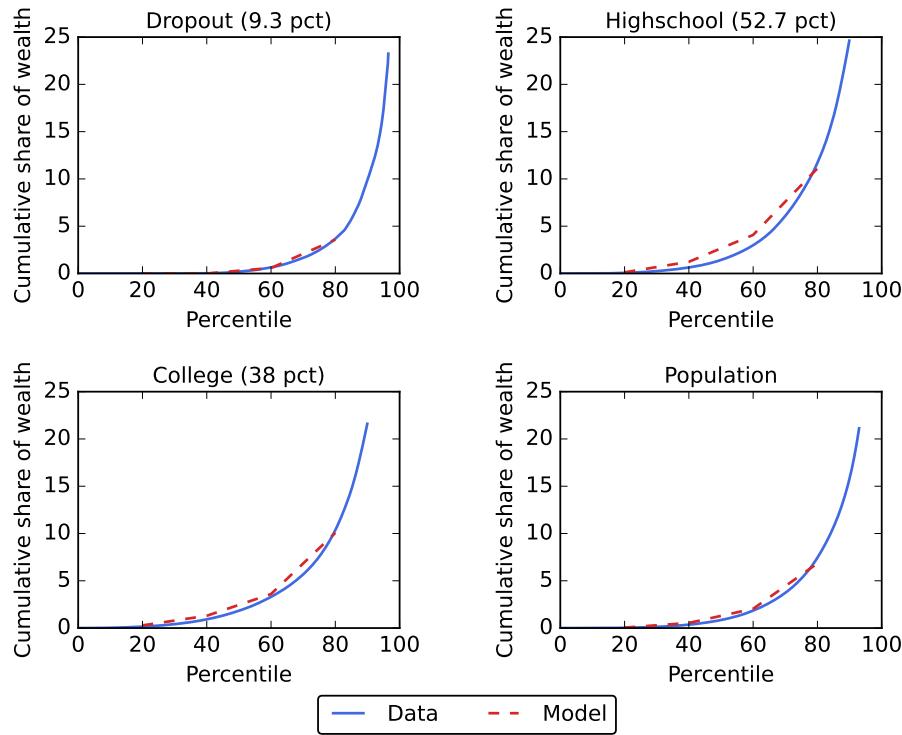
13 Note: Panel (A) shows the estimated parameters of the discount distributions for each education 13  
 14 group. It also shows the minimum and maximum values we use in our discrete approximation to 14  
 15 the uniform distribution of discount factors for each group. Panel (B) shows the weighted median 15  
 16 ratio of liquid wealth to permanent income from the 2004 SCF and in the model. In the annual data 16  
 17 from the SCF, the annual PI is divided by 4 to obtain a quarterly number. 17

20 “missing middle” problem, identified in [Kaplan and Violante \(2022\)](#), in which the 20  
 21 middle of the wealth distribution has too little wealth.<sup>24</sup> 21

23 Note that several of the types in the Dropout group are estimated to have quite 23  
 24 low discount factors (they are very impatient). In this way, the model fits the 24  
 25 feature of the data for the Dropout group that the bottom quintiles accumulate 25

---

27 <sup>24</sup>One technical point to note about our estimation, is that we impose the constraint that the 27  
 28 Growth Impatience Condition (GIC), discussed in [Carroll \(2022\)](#), is never violated. (The GIC is re- 28  
 29 quired to prevent the ratio of total wealth to total income of any group from approaching infinity. It 29  
 30 does this by making sure that the growth of wealth of the group is less than or equal to the growth 30  
 31 of income.) The constraint is imposed by calculating an upper bound for the discount factors  $\beta^{\text{GIC}}$  31  
 32 where the GIC holds with equality. The estimation procedure ensures that no type ends up with a 32  
 discount factor higher than this upper bound.

1 FIGURE 2. PREGENERATED: Wealth distribution fit by education group  
2

18 **Note:** This figure validates the discount factor estimation methodology (Section 3.3.3). Separate dis-  
19 count factor distributions  $\beta_e \pm \nabla_e$  are estimated for each education group to match the median  
20 liquid-wealth-to-permanent-income ratio and the 20th, 40th, 60th, and 80th percentile points of the  
21 Lorenz curve for liquid wealth. The model successfully avoids the “missing middle” problem identi-  
22 fied by Kaplan and Violante (2022), where insufficient wealth accumulation occurs in the middle of  
23 the distribution. The “Population” panel demonstrates that pooling the three calibrated education  
24 groups produces a realistic aggregate liquid wealth distribution.

25 hardly any liquid wealth. Such low estimates for discount factors are in line with  
26 those obtained in the literature on payday lending.<sup>25</sup>

27  
28 <sup>25</sup>See, for example, Skiba and Tobacman (2008), who estimate two-week discount rates of 21 per-  
29 cent, and Allcott et al. (2021), who estimate an initial period discount factor between 0.74 and 0.83 in  
30 a model where a period is eight weeks long. Both of these papers use quasi-hyperbolic preferences, so  
31 the estimates are not directly comparable with parameters in our model. Nevertheless, they support  
32 the point that high discount rates are necessary to model the part of the population that takes out  
payday loans at very high interest rates.

1    3.3.4 *Implications for non-targeted moments* Before we move on to compare 1  
2 different consumption stimulus policies in the calibrated model, we also report 2  
3 implications of the model for some non-targeted moments. Panel A of table 5 3  
4 shows the wealth distribution across the three education groups in the data and 4  
5 in the model. The model matches these shares quite closely, which may not be 5  
6 surprising given that we calibrate the size of each group and we manage to fit the 6  
7 wealth distribution within each group separately. The panel also reports the aver- 7  
8 age marginal propensity to consume for the different groups. To be comparable 8  
9 to numbers reported in Fagereng et al. (2021), these are calculated as the average 9  
10 MPC in the year of a lottery win. Lottery wins occur in a random quarter of the 10  
11 year that differs across individuals. The MPC for an individual depends on the 11  
12 spending pattern after the win, and these are averaged across individuals within 12  
13 each education group. 13

14    Panel B of table 5 shows similar numbers to Panel A, sorted by quartiles of 14  
15 the liquid wealth distribution instead of education groups. Our model yields a 15  
16 slightly more concentrated liquid wealth distribution than in the data. However, 16  
17 it does produce a fairly high MPC even for households in the highest quartile of 17  
18 the liquid wealth distribution. This is consistent with the results found in the Nor- 18  
19wegian data by Fagereng et al. (2021), but also with recent results in Graham and 19  
20 McDowell (2024). In an administrative dataset from a large US financial institu- 20  
21 tion, they find that the spending response to an income receipt is large across 21  
22 the distribution of liquid asset holdings. In our model, we obtain this result due 22  
23 to the inclusion of the splurge factor. As shown in Appendix ??, the model is not 23  
24 able to generate a high MPC for the highest wealth quartile without splurge con- 24  
25 sumption. 25

26    Finally, we consider the implications of our model for two different patterns of 26  
27 spending over time. The first pattern is the dynamics of spending after a lottery 27  
28 win from Fagereng et al.. This pattern was used in the estimation of the splurge 28  
29 factor in section 3.1, but was not targeted when estimating the discount factor 29  
30 distributions for each education group in section 3.3.3. Figure 3a shows that the 30  
31 model that is estimated taking the value of the splurge as given, results in a dis- 31  
32

1 TABLE 5. PREGENERATED: Model fit with respect to non-targeted moments  
23 Panel A: Non-targeted moments by education group  
4

	Dropout	Highschool	College	Population
Percent of liquid wealth (data)	0.8	17.9	81.2	100
Percent of liquid wealth (model)	1.2	16.8	82.0	100
Avg. lottery-win-year MPC	0.78	0.61	0.38	0.54

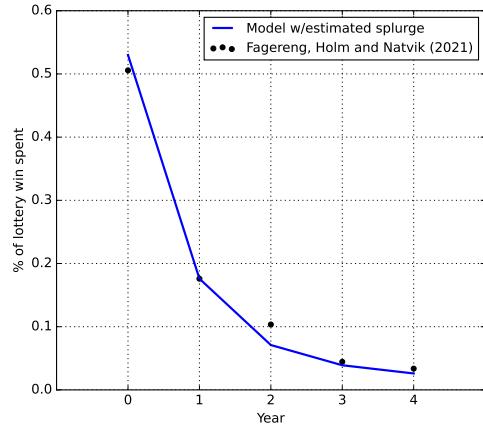
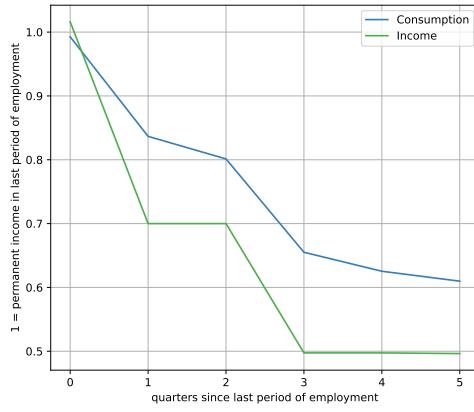
8 Panel B: Non-targeted moments by wealth quartile  
9

	WQ 4	WQ 3	WQ 2	WQ 1
Percent of liquid wealth (data)	0.14	1.60	8.51	89.76
Percent of liquid wealth (model)	0.12	0.98	3.85	95.06
Avg. lottery-win-year MPC	0.32	0.47	0.61	0.74

14 **Note:** Percent of liquid wealth held by each group in the 2004 SCF and in the model, and average  
 15 MPCs after a lottery win for each group. MPCs are calculated for each individual for the year of a  
 16 lottery win, taking into account that the win takes place in a random quarter of the year that differs  
 17 across individuals.

24 tribution of spending over time that is very similar to the one found in the Nor-  
 25 wegan data.

26 The second pattern concerns the dynamics of income and spending for house-  
 27 holds that become unemployed and remain unemployed long enough for unem-  
 28 ployment benefits to expire. Figure 3b shows the pattern of income and spend-  
 29 ing for such households. [Ganong and Noel \(2019\)](#) report the empirical result that  
 30 nondurable spending drops by 12 percent the month when benefits expire. Our  
 31 quarterly model is broadly consistent with this as the drop in spending the quar-  
 32 ter after the expiry of UI benefits is 18 percent.

1 FIGURE 3. PREGENERATED: Model validation for non-targeted spending patterns  
211 (a) Dynamic spending after lottery win  
1213 (b) Spending upon UI benefit expiry  
14

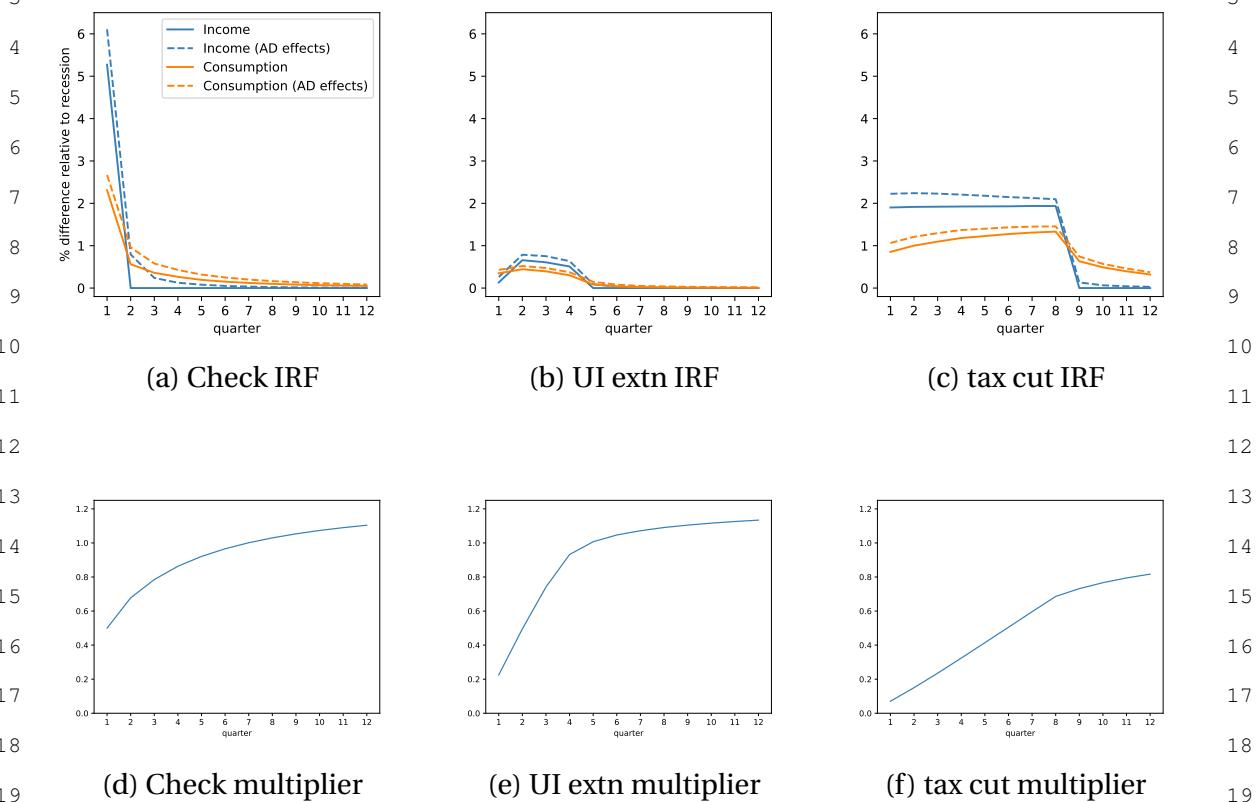
15 **Note:** This figure demonstrates model performance on non-targeted validation moments (Section  
16 3.3.4). Subfigure (a) shows the model's dynamic consumption response compared to Fagereng  
17 et al. (2021) estimates using the discount factor distributions estimated separately for each education  
18 group. Subfigure (b) validates the model against Ganong and Noel (2019), who find that nondurable  
19 spending drops by 12% the month when UI benefits expire; our quarterly model predicts an 18% drop  
the quarter after benefit expiry, demonstrating broad consistency with this empirical pattern.

21 **4. COMPARING FISCAL STIMULUS POLICIES**  
22

23 In this section, we present our results where we compare three policies to provide  
24 fiscal stimulus in our calibrated model. The policies we compare are a means-  
25 tested stimulus check, an extension of unemployment benefits, and a payroll tax  
26 cut. Each policy is implemented at the start of a recession, and we compare re-  
27 sults both with and without aggregate demand effects being active during the re-  
28 cession. First, we present impulse responses of aggregate income and consump-  
29 tion after the implementation of each policy. Then we compare the policies in  
30 terms of their cumulative multipliers and in terms of their effect on a welfare  
31 measure that we introduce. Finally, based on these comparisons, we can rank the  
32 three policies.

1	<b>4.1 Impulse responses</b>	1
2		2
3		3
4	The impulse responses that we present for each stimulus policy are constructed	4
5	as follows:	5
6	• A recession hits in quarter one.	6
7	• We compute the subsequent path for the economy without any policy intro-	7
8	duced in response to the recession.	8
9	• We also compute the subsequent path for the economy with a given policy	9
10	introduced at the onset of the recession in quarter one.	10
11	• The impulse responses we present are then the <i>difference</i> between these two	11
12	paths for the economy and show the effect of a policy relative to a case where	12
13	no policy was implemented.	13
14	• The solid lines show these impulse responses for an economy where the ag-	14
15	gregate demand effects described in section 2.3 are not active, and the dashed	15
16	lines show impulse responses for an economy where the aggregate demand	16
17	effects are active during the recession.	17
18	• Red lines refer to aggregate labor and transfer income, and blue lines refer to	18
19	consumption.	19
20		20
21	All graphs show the average response of income and consumption (averaged	21
22	over recessions of different lengths). Specifically, we simulate recessions lasting	22
23	from only one quarter up to 20 quarters. We then take the sum of the results	23
24	across all recession lengths weighted by the probability of this recession length	24
25	occurring (given our assumption of an average recession length of six quarters).	25
26		26
27		27
28		28
29		29
30		30
31	<b>4.1.1 Stimulus check</b> Figure 4a shows the impulse response of income and con-	31
32	sumption when stimulus checks are issued in the first quarter of a recession.	32

1 FIGURE 4. PREGENERATED: Policy effectiveness during recessions with aggregate de-  
 2 mand effects



**Note:** This figure compares policy effectiveness during recessions (Section 2.2). Recession periods are characterized by higher unemployment rates and increased economic uncertainty. The model demonstrates that UI extensions become particularly effective during recessions due to better targeting of high-MPC households. Stimulus checks maintain effectiveness but with diminished relative performance compared to UI extensions. Payroll tax cuts show the least effectiveness across all economic conditions, confirming the robustness of the main policy rankings.

In the model without a multiplier, the stimulus checks account for 5 percent of the first quarter's income. In the following quarters, there are no further stimulus payments, and income remains the same as it would have been without the stimulus check policy. Consumption is about 2.5 percent higher in the first quarter, which includes the splurge response to the stimulus check. Consumption then drops to less than 1 percent above the counterfactual, and the remainder of the

1 stimulus check money is then spent over the next few years. In the model with 1  
 2 aggregate demand effects, income in the first quarter is 6 percent higher than the 2  
 3 counterfactual, as the extra spending feeds into higher incomes. Consumption 3  
 4 in this model jumps to a higher level than without aggregate demand effects and 4  
 5 comes down more slowly as the feedback effects from consumption to income 5  
 6 dampen the speed with which income—and hence the splurge—return to zero. 6  
 7 After a couple of years, when the recession is most likely over and aggregate de- 7  
 8 mand effects are no longer in place, income is close to where it would be without 8  
 9 the stimulus check policy, although consumption remains somewhat elevated. 9

10    4.1.2 *UI extension* The impulse responses in Figure 4b show the response to a 10  
 11 policy that extends unemployment benefits from 6 months to 12 months for a 11  
 12 period of a year. In the model without aggregate demand effects, the path for in- 12  
 13 come now depends on the number of consumers who receive the extended un- 13  
 14 employment benefits. These consumers are those who have been unemployed 14  
 15 for between 6 and 12 months. In the first quarter of the recession, the newly 15  
 16 unemployed receive unemployment benefits regardless of whether they are ex- 16  
 17 tended or not. Therefore, it is in the second and third quarters, when the effects 17  
 18 of the recession on long-term unemployment start to materialize, that the ex- 18  
 19 tended UI payments ramp up, amounting to an aggregate increase in quarterly 19  
 20 income by 0.7 percent. By the fifth quarter, the policy is no longer in effect, and 20  
 21 income from extended unemployment goes to zero. Consumption in the first 21  
 22 quarter jumps by more than income (by 0.3 percent), prompted by both the in- 22  
 23 crease in expected income and the reduced need for precautionary saving given 23  
 24 the extended insurance. In the model without aggregate demand effects, con- 24  
 25 sumption is only a little above the counterfactual by the time the policy is over. 25  
 26 In the model with aggregate demand effects, there is an extra boost to income 26  
 27 of about the same size in the first and second quarters. As this extra aggregate 27  
 28 demand induced income goes to employed consumers, more of it is saved, and 28  
 29 consumption remains elevated several quarters beyond the end of the policy. 29  
 30

31    4.1.3 *Payroll tax cut* The final impulse response graph, Figure 4c, shows the im- 31  
 32 pulse response for a payroll tax cut that persists for two years (eight quarters). In 32

1 the model without aggregate demand effects, income rises by close to 2 percent 1  
 2 as the take-home pay for employed consumers goes up. After the two-year pe- 2  
 3 riod, income drops back to where it would have been without the payroll tax cut. 3  
 4 Consumption jumps close to 1 percent in response to the tax cut. Over the pe- 4  
 5 riod in which the tax cut is in effect, consumption rises somewhat as the stock 5  
 6 of precautionary savings goes up. Following the drop in income, consumption 6  
 7 drops sharply because of the splurge and then decreases over time as consumers 7  
 8 spend out the savings they built up over the period the tax cut was in effect. In the 8  
 9 model with aggregate demand effects, income rises by about 2.3 percent above 9  
 10 the counterfactual and then declines steadily as the probability that the recession 10  
 11 remains active—and hence the aggregate demand effects in place—goes down 11  
 12 over time. Following the end of the policy, the savings stock in the model with ag- 12  
 13 gregate demand effects is high, and consumption remains significantly elevated 13  
 14 through the period shown. 14

15 15

## 4.2 Multipliers

17 In this section, we compare the fiscal multipliers across the three stimulus poli- 17  
 18 cies. Specifically, we employ the cumulative multiplier, which captures the ratio 18  
 19 between the net present value (NPV) of stimulated consumption up to horizon  $t$  19  
 20 and the full-horizon NPV of the cost of the policy. We thus define the cumulative 20  
 21 multiplier up to horizon  $t$  as 21

$$22 M(t) = \frac{NPV(t, \Delta C)}{NPV(\infty, \Delta G)}, \quad (9)$$

23 where  $\Delta C$  is the additional aggregate consumption spending up to time  $t$  in the 23  
 24 policy scenario relative to the baseline and  $\Delta G$  is the total government expen- 24  
 25 diture caused by the policy. The NPV of a variable  $X_t$  is given by  $NPV(t, X) = 25$   
 $26 \sum_{s=0}^t \left( \prod_{i=1}^s \frac{1}{R_i} \right) X_s$ . 26  
 27 28

29 The multiplier hence captures the amount of induced consumption at differ- 29  
 30 ent horizons relative to the total (i.e. full-horizon) cost of the policies.<sup>26</sup> 30

---

31 <sup>26</sup>In the case that there is no aggregate demand effect, these multipliers converge to 1 as  $t$  goes to 31  
 32 infinity. 32

1 The second row in Figure 4 plots the cumulative multipliers at different hori- 1  
 2 zons, and table 6 shows the 10y-horizon multiplier for each policy. The stimulus 2  
 3 check, which is paid out in quarter one, exhibits the largest multiplier on impact. 3  
 4 About 50 percent of the total policy expenditure is immediately spent by con- 4  
 5 sumers. After two years, and because of the aggregate demand effects, consump- 5  
 6 tion has increased cumulatively by more than the cost of the stimulus check. Over 6  
 7 time, the policy reaches a total multiplier of 1.234. Without AD effects the policy 7  
 8 only generates a multiplier of 0.879. The last two rows in table 6 show the ex- 8  
 9 pected share of the policy expenditures and stimulated consumption that occurs 9  
 10 during a recession. For the stimulus check all of the policy expenditures occur 10  
 11 in the first quarter and thus with certainty during the recession. However, since 11  
 12 induced consumption also takes place during later periods at which time the re- 12  
 13 cession may have already ended, the share of stimulated consumption during the 13  
 14 recession is lower at 74.2 percent. 14

15 Since spending for the UI policy is spread out over four quarters (and peaks 15  
 16 in quarters two to three), the multiplier in the first quarter is considerably lower 16  
 17 than in the case of the stimulus check. However, the UI extension policy is tar- 17  
 18 geted in the sense that it provides additional income only to those consumers 18  
 19 who have large MPCs, because of unemployment. Also, over the medium-term 19  
 20 UI extension expenditures are more likely to induce consumption spending dur- 20  
 21 ing the recession compared to the check stimulus, see the last row in table 6. This 21  
 22 is because UI extension expenditures affect agents who spend the additional in- 22  
 23 come relatively quickly once it reaches them. Therefore, the cumulative muliti- 23  
 24 plier of the UI extension exceeds that of the stimulus check after about one year. 24

25 The payroll tax cut has the lowest multiplier irrespective of the considered hori- 25  
 26 zon. A multiplier of close to 1 is reached only after 10 years with AD effects. These 26  
 27 relatively small numbers reflect that policy spending lasts for a long time and is 27  
 28 thus more likely to occur after the recession has ended. Moreover, only employed 28  
 29 consumers, often with relatively low MPCs, benefit directly from the payroll tax 29  
 30 cut. Therefore, the policy is poorly targeted if the goal is to provide short-term 30  
 31 stimulus. 31

32 32

1 TABLE 6. PREGENERATED: Comparing fiscal stimulus policy effectiveness 1

		Stimulus check	UI extension	Tax cut
3	10y-horizon Multiplier (no AD effect)	0.879	0.906	0.847
4	10y-horizon Multiplier (AD effect)	1.234	1.211	0.978
5	10y-horizon (1st round AD effect only)	1.157	1.148	0.951
6	Share of policy expenditure during recession	100.0%	79.6%	57.8 %
7	Share of policy cons. stimulus during recession	74.2%	81.1%	42.1 %

8 Note: Policies are implemented during a recession with or without the aggregate demand effect active.  
 9 Multipliers show cumulative consumption response over 10 years relative to total policy cost. Share  
 10 percentages indicate the proportion of policy expenditure and induced consumption stimulus occur-  
 11 ring during the recession period. The row “1st round AD effect only” captures the direct consumption  
 12 impact of the policies and the additional boost to consumption resulting from the aggregate demand  
 13 effect acting on the direct consumption impact. It does not include higher-round aggregate demand  
 14 effects materializing on aggregate demand effects acting on indirectly stimulated consumption.

15  
 16  
 17  
 18 Table 6 contains an additional (middle) row with results for an economy where  
 19 we only consider a “first-round” aggregate demand effect. To understand these  
 20 values note that the policies initially increase the income of consumers directly,  
 21 which leads to a boost in consumption. As a consequence, this boost triggers an  
 22 aggregate demand effect which increases the income of everyone and in turn  
 23 leads to an additional boost to consumption. We refer to the sum of this initial  
 24 and the indirect boost to consumption as the first-round AD effect. However, the  
 25 AD effect continues as the indirect boost to consumption triggers another round  
 26 of income increases which further boost consumption and so on. One might ar-  
 27 gue that these higher-order rounds of the AD effect are not likely to be anticipated  
 28 by consumers. Since higher-order consumption boosts only materialize if con-  
 29 sumers anticipate them and act accordingly, the overall increase in consumption  
 30 might turn out to be smaller than suggested by the full AD effect. As shown in the  
 31 middle row of the table, the multipliers are smaller when excluding higher-order  
 32 rounds. Nevertheless, the ranking of the policies remains unchanged.

### 4.3 Welfare

In this section, we look at the welfare implications of each stimulus policy. To do so, we need a way to aggregate welfare in our model with individual utility functions. In our model, some households consume much less than other households, and a social planner with equal weights on each household could substantially increase welfare through redistribution across households even in normal times. We are interested in the benefit of carrying out fiscal policies in a recession, so we do not want our results to reflect the benefits of redistribution inherent in our model in normal times.

Our welfare measure weights the felicity of a household at time  $t$  by the inverse of the marginal utility of the same household in a counterfactual simulation in which neither the recession occurred nor the fiscal policy was implemented, discounted by the real interest rate.<sup>27</sup> This weighting scheme means that in normal times the marginal benefit or cost to a social planner of moving a dollar of consumption from one household at one time period to another household at the same or a different time period is zero. Hence, in normal times, any redistributive policy has zero marginal benefit. However, in a recession when the average marginal utility is higher than in normal times, there can be welfare benefits to government borrowing to allow households to consume more during the recession.

As with all social welfare measures, ours is not without ethical issues. We have chosen our welfare measure over one with equal weights because an equal-weights measure would be increasing with the size of any redistributive policy.<sup>28</sup> However, similar to Negishi weights, our welfare measure gives greater weight to

<sup>27</sup>Discounting at the real interest rate accounts for the fact that a redistributive policy over time will require borrowing or lending at the real interest rate. The preference discount factors of households would appear in both the numerator and the denominator—the utility and marginal utility—and therefore cancel and do not play a role in our welfare measure.

<sup>28</sup>Using a version of an equal-weights measure results in an even greater welfare benefit to extended unemployment insurance—see the previously distributed draft of this paper, Carroll et al. (2023). However, because the size of the extended unemployment benefits policy is much larger in a recession compared to normal times, while the size of the other two policies does not change signif-

1 households that are well off.<sup>29</sup> Furthermore, our welfare measure distinguishes 1  
 2 between households that would have suffered unemployment in normal times 2  
 3 and households that are made unemployed as a result of the recession—giving 3  
 4 the latter a higher weight in the social welfare function. 4

5 Let  $c_{it,normal}$  be the consumption—inclusive of the splurge—of household  $i$  5  
 6 at time  $t$  in the baseline simulation with no recession and no fiscal policy. The 6  
 7 (undiscounted) marginal utility of an extra unit of consumption for this house- 7  
 8 hold in this time period is  $u'(c_{it,normal})$ . 8

9 Let  $c_{it,policy,Rec,AD}$  be the consumption of the same household under the fis- 9  
 10 cal policy,  $policy$ , possibly a recession,  $Rec \in \{0, 1\}$ , and in an economy with or 10  
 11 without aggregate demand effects,  $AD \in \{0, 1\}$ .<sup>30</sup> 11

12 We also denote the net present value of the government expenditures of the 12  
 13 policy as  $NPV(policy, Rec, AD)$ . With this notation, we can now define the wel- 13  
 14 fare bang for the buck of a policy as: 14

$$15 \\ 16 \quad \mathcal{W}(policy, Rec, AD) = \frac{\sum_{i=1}^N \sum_{t=0}^{\infty} \frac{1}{R^t} \frac{u(c_{it,policy,Rec,AD}) - u(c_{it,none,Rec,AD})}{u'(c_{it,normal})}}{NPV(policy, Rec, AD)}. \quad (10) \\ 17 \\ 18 \\ 19$$

20 In normal times, this welfare measure will be exactly equal to one for any 20  
 21 small-scale fiscal expansion. To see this, note that the numerator,  $u(c_{it,policy,0,0}) -$  21  
 22  $u(c_{it,none,0,0})$ , is equal to the change in consumption multiplied by the marginal 22

---

23 significantly in a recession, this equal-weights measure almost mechanically favored the extended unem- 23  
 24 ployment benefits policy. 24

25 Negishi weights have been used in the climate literature as a way to separate the welfare benefits 25  
 26 of climate mitigation policies from broader questions about global income redistribution. Our prob- 26  
 27 lem of separating the welfare benefits of recession mitigation policies from income redistribution in 27  
 28 normal times is similar, but complicated by our incomplete markets setup. With complete markets, 28  
 29 under which there is no potential benefit to redistributing consumption across time for any individ- 29  
 30 ual household, our measure is identical to Negishi weights. 30

31 In the simulations, household  $i$  experiences the same permanent and transitory shock sequence, 30  
 32 but in the recession simulation some households experience unemployment during periods in which 31  
 32 the same household is employed in the baseline simulation. 32

1 TABLE 7. PREGENERATED: Welfare effectiveness: policy “bang for the buck” comparison 1

	Stimulus check	UI extension	Tax cut
$\mathcal{W}(\text{policy}, \text{Rec} = 0, \text{AD} = 0)$	0.96	0.85	0.99
$\mathcal{W}(\text{policy}, \text{Rec} = 1, \text{AD} = 0)$	1.00	1.83	0.97
$\mathcal{W}(\text{policy}, \text{Rec} = 1, \text{AD} = 1)$	1.35	2.15	1.11

6 Note: Welfare “bang for the buck” measures for each policy as defined by equation (10). Values near  
 7 1.0 in normal times ( $\text{Rec}=0$ ) are expected by definition for marginal policies. In recession scenarios,  
 8 UI extension emerges as the clear winner with dramatically higher welfare effectiveness (1.83 without  
 9 aggregate demand effects, 2.15 with), reflecting its superior targeting to high-MPC, high-marginal-  
 10 utility households.  $\text{Rec}=0$  indicates normal times,  $\text{Rec}=1$  indicates recession.  $\text{AD}=0$  and  $\text{AD}=1$  indi-  
 11 cate whether aggregate demand effects are inactive or active, respectively.

12 utility in normal times. As the total change in consumption is equal to the net  
 13 present value of the policy, which we divide by, the total welfare measure is equal  
 14 to one. Note that for large increases in consumption, this measure may be less  
 15 than one because the utility function is concave.

17 Table 7 shows the welfare measure for each policy as defined by equation (10).  
 18 The top row of the table shows the welfare measure for implementing each policy  
 19 in normal times. For marginal policies, this is equal to one by definition. Indeed,  
 20 the value for both the stimulus check and the tax cut policy is very close to one.  
 21 However, the welfare measure for the extended unemployment policy in normal  
 22 times is noticeably less than one. This is because, although this policy is smaller  
 23 in absolute size than the other policies, its consumption effects are concentrated  
 24 on a small number of households that remain unemployed long enough to re-  
 25 ceive the extended benefits. For these households, the effect on consumption is  
 26 large enough such that the non linearity of the consumption function leads to  
 27 smaller welfare benefit than the marginal utility of consumption would other-  
 28 wise imply.

29 The second row of table 7 shows the welfare benefit of each policy in a reces-  
 30 sion without any aggregate demand effects. Again, the stimulus check and tax  
 31 cut policies have measures that are close to one—pulling forward consumption  
 32 has little welfare benefit for the average household because the average marginal

1 utility of consumption is only a little higher than in normal times. By contrast, 1  
2 the policy sees benefits of 1.8 dollars for every dollar spent on extended UI ben- 2  
3 efits during a recession. This is because many of the households who are unem- 3  
4 ployed for many quarters in the recession would have never been unemployed, 4  
5 or quickly reemployed, in normal times and hence their marginal utility of con- 5  
6 sumption is much higher in the recession than in normal times. 6

7 The third row of the table shows the welfare measure for each policy in a reces- 7  
8 sion in the version of the model with aggregate demand effects during the reces- 8  
9 sion. The payroll tax cut now has a noticeable benefit, as some of the tax cut gets 9  
10 spent during the recession, resulting in higher incomes for all consumers. How- 10  
11 ever, the tax cut is received over a period of two years, and much of the relief may 11  
12 be after the recession—and hence the aggregate demand effect—is over. Further- 12  
13 more, because the payroll tax cut goes only to employed consumers who have 13  
14 lower MPCs than the unemployed, the spending out of this stimulus will be fur- 14  
15 ther delayed, possibly beyond the period of the recession. By contrast, the stimu- 15  
16 lus check is received in the first period of the recession and goes to both employed 16  
17 and unemployed consumers. The earlier arrival and higher MPCs of the stimulus 17  
18 check recipients mean more of the stimulus is spent during the recession, lead- 18  
19 ing to greater aggregate demand effects, higher income, and higher welfare. The 19  
20 extended UI arrives, on average, slightly later than the stimulus check. However, 20  
21 the recipients, who have been unemployed for at least six months, spend most of 21  
22 the extra benefits within 1-2 quarters, resulting in substantial aggregate demand 22  
23 effects during the recession. In contrast to the payroll tax cut, extended UI has 23  
24 the benefit of automatically reducing if the recession ends early, making fewer 24  
25 consumers eligible for the benefit. 25

26 26

#### 27 4.4 Comparing the policies 27

28 The results presented in sections 4.2 and 4.3 indicate that the extension of un- 29  
employment benefits is the clear “bang for the buck” winner. The extended UI 30  
payments are well targeted to consumers with high MPCs and high marginal 31  
utility, giving rise to large multipliers and welfare improvements. The stimulus 32

1 checks come in slightly higher when measured by their short-term multiplier ef- 1  
 2 fect but are a distant second when measured by their welfare effects. The stim- 2  
 3 ulus checks have large initial multipliers because the money gets to consumers 3  
 4 at the beginning of the recession and therefore induce aggregate demand effects 4  
 5 more quickly. However, the checks are not well targeted to high-MPC consumers, 5  
 6 so even though the funds arrive early in the recession, they are spent out more 6  
 7 slowly than the extended unemployment benefits.<sup>31</sup> Furthermore, the average 7  
 8 recipient of a stimulus check has a much lower marginal utility than consumers 8  
 9 receiving unemployment benefits, so the welfare benefits of this policy are sub- 9  
 10 stantially muted relative to UI extensions. 10

11 The payroll tax cut policy does poorly by both measures: It has a low overall 11  
 12 multiplier and negligible welfare benefits. The reasons are that the funds are slow 12  
 13 to arrive, so the subsequent spending often occurs after the end of the recession, 13  
 14 and that the payments are particularly badly targeted—they go only to employed 14  
 15 consumers. 15

16 While it is clear from the analysis that the extended unemployment benefits 16  
 17 should be the first tool to use, a disadvantage of them is that they are limited 17  
 18 in their size. If a larger fiscal stimulus is deemed appropriate, stimulus checks 18  
 19 provide an alternative option that will stimulate spending during the recession 19  
 20 even if the welfare benefits are lower than the UI extension. 20

21 21

#### 22       4.5 *Results in a model without the splurge* 22

23 We introduce the splurge in our model with the aim of matching empirical evi- 23  
 24 dence on the dynamics of spending in response to transitory income shocks. The 24  
 25 splurge acts as a stand-in for competing theories for why agents may spend more 25  
 26 out of those shocks than suggested by a simple model in which forward-looking 26  
 27 agents solely maximize utility. However, it is natural to consider to what extent 27  
 28 the splurge is in fact necessary to match the empirical patterns and the impli- 28  
 29 29

---

30       <sup>31</sup>Theoretically, stimulus checks could be targeted to the highest-MPC households which, for small- 30  
 31 sized policies, would mean households with an MPC of one. However, data limitations and other 31  
 32 practicalities make means-testing stimulus checks by income the extent of targeting in practice. 32

1 cations for our results ranking the different policies. To assess this we reestimate 1  
2 the model without the splurge and recompute all our results regarding the rela- 2  
3 tive effectiveness of the policies in this version of the model. 3

4 The details of this exercise are in Appendix ???. There we discuss how the es- 4  
5 timation of the Norwegian model in section 3.1 is affected if we do not include 5  
6 splurge consumption, and the estimation of the discount factor distributions for 6  
7 each education group in the US economy without taking the splurge as given. The 7  
8 general result is that the we can match the liquid wealth distributions that we tar- 8  
9 get also in models that do not include a splurge. The models do so by estimating 9  
10 wider distributions of discount factors than we found in section 3.1 and 3.3.3. 10

11 Without the splurge the models do struggle to exactly match the dynamics of 11  
12 spending after a temporary income shock, however. In particular, for the esti- 12  
13 mation of the Norwegian model, we can compare the model's implications for 13  
14 MPCs for different wealth quartiles to empirical estimates. Without the splurge, 14  
15 the model leads to an MPC for the top wealth quartile that is far lower than in the 15  
16 data. In the US model this MPC is also markedly lower compared to the model 16  
17 with splurge consumption, but for the US we do not have an empirical estimate 17  
18 to compare to. 18

19 To evaluate the impact of splurge consumption on our ranking of the policies, 19  
20 we simulate the three fiscal policies in the reestimated model without the splurge. 20  
21 There are only minor shifts in the multipliers of the policies, but the lower average 21  
22 MPCs reduces multipliers for the check and tax cut policy relative to the model 22  
23 with the splurge. In contrast, the UI extension becomes slightly more effective in 23  
24 stimulating consumption as the wider distribution of discount factors implies a 24  
25 larger share of the population that hits the borrowing constraint upon expiry of 25  
26 UI benefits. Hence, the extension of UI benefits affects agents more strongly in 26  
27 the model without the splurge. 27

28 More importantly for the main conclusion of our paper, table 8 compares the 28  
29 welfare implications of the policies in the two models. Generally, the welfare met- 29  
30 ric varies only marginally across the models. When aggregate demand effects are 30  
31 active, we see slightly larger differences in the welfare evaluation, with the check 31  
32 policy losing ground against the UI extension. This is because the welfare im-

1 TABLE 8. PREGENERATED: Welfare for policies both out of and in a recession,  
 2 with/without AD effects

3		Stimulus check	UI extension	Tax cut	3
4	$\mathcal{W}(\text{policy}, Rec = 0, AD = 0)$	0.97(0.96)	0.84(0.85)	0.99(0.99)	4
5	$\mathcal{W}(\text{policy}, Rec = 1, AD = 0)$	1.00(1.00)	1.80(1.83)	0.97(0.97)	5
6	$\mathcal{W}(\text{policy}, Rec = 1, AD = 1)$	1.27(1.35)	2.12(2.15)	1.09(1.11)	6

7 Note: The values outside of the brackets capture the welfare in the model without the splurge, while  
 8 those inside the brackets are welfare with the splurge.  $Rec=0$  indicates normal times,  $Rec=1$  indicates  
 9 recession.  $AD=0/1$  indicates aggregate demand effects inactive/active.

10 pact of the check in the model with the splurge is contingent on the checks be-  
 11 ing spent quickly due to a high average MPC and thus generating strong aggre-  
 12 gate demand effects while the recession is still ongoing. In the absence of the  
 13 splurge only liquidity-constrained agents spend the check money quickly, such  
 14 that recession-induced aggregate demand effects are smaller.

15 Overall, we can conclude that the ranking of the policies remains unaffected by  
 16 the splurge. The splurge is thus helpful in matching available empirical evidence,  
 17 but does not affect the assessment of the effectiveness of the considered policies.

## 19 5. ROBUSTNESS IN A HANK AND SAM MODEL

20 The main results of this paper are presented in a partial equilibrium setup with  
 21 aggregate demand effects that do not arise from general equilibrium effects. We  
 22 think there are many advantages to studying the welfare and multiplier effects in  
 23 this setting without embedding the model in general equilibrium. First, general  
 24 equilibrium models often struggle to adequately capture the feedback mecha-  
 25 nisms between consumption and income, particularly the asymmetric nature of  
 26 these relationships during recessionary versus expansionary periods. Addition-  
 27 ally, a complete general equilibrium treatment would necessitate the analysis  
 28 of numerous complex channels including investment dynamics, firm ownership  
 29 structures and dividend distribution policies, inventory management, and inter-  
 30 national trade flows—elements that, while important in their own right, would  
 31 potentially obscure the core mechanisms we aim to investigate.

1 Despite the advantages of our partial equilibrium approach, here we comple- 1  
2 ment our analysis with a general equilibrium HANK and SAM model, as standard 2  
3 as possible, that is able to capture supply-side effects that are absent from the 3  
4 partial equilibrium model. In particular, fiscal policies can generate labor market 4  
5 responses that our partial equilibrium analysis does not address. These supply- 5  
6 side channels can affect both the welfare implications and the fiscal multipliers of 6  
7 different policy interventions. Furthermore, standard to the HANK and SAM lit- 7  
erature, the general equilibrium model generates a self-reinforcing precau- 8  
9 tionary saving channel that amplifies business cycles. During a recession, height- 9  
10 ened unemployment risk prompts households to increase savings and reduce 10  
11 consumption which in turn weakens both aggregate and labor demand. The re- 11  
12 sulting decline in labor demand further raises unemployment risk, reinforcing 12  
13 precautionary savings. 13

14 We embed the consumption choices of our households—with heterogene- 14  
15 ity over education type and discount factors—in a New Keynesian model with 15  
16 search and matching frictions that closely follows [Du \(2024\)](#), which, in turn, is in 16  
17 spirit of the seminal work of [Ravn and Sterk \(2017, 2021\)](#). Aside from the house- 17  
18 hold block of the model, the framework is standard and follows from the HANK 18  
19 and SAM literature. The model features nominal price rigidities à la Rotemberg, a 19  
20 monetary authority that sets the nominal interest rate following a standard Taylor 20  
21 rule that responds to inflation, and a fiscal authority that taxes labor income and 21  
22 borrows debt from households to fund unemployment insurance and interest on 22  
23 past debt. As in [Gornemann et al. \(2021\)](#), [Bardoczy \(2024\)](#), and [Graves \(2024\)](#), 23  
24 households randomly search for jobs and match with a labor agency that sells la- 24  
25 bor to intermediate good producers. Complete details of the model are provided 25  
26 in appendix A. 26

27 The general equilibrium structure generates fiscal multipliers through an 27  
28 intertemporal Keynesian cross mechanism, which becomes particularly pro- 28  
29 nounced when monetary policy is passive. Moreover, the search and matching 29  
30 framework allows the employment rate to respond to policy interventions, al- 30  
31 lowing us to capture both demand and supply effects of fiscal policies. 31

32 32

1 Our approach in this section relies on linearizing the macro dynamics of the 1  
 2 model and employs the Sequence Space Jacobian methods developed by Auclert 2  
 3 et al. (2021). This linearization imposes certain constraints on our analysis. No- 3  
 4 tably, we cannot evaluate the effects of different policies starting from a deep re- 4  
 5 cessionary state, as we do in our main results.<sup>32</sup> This limitation prevents us from 5  
 6 conducting welfare comparisons between recessionary periods and the steady 6  
 7 state. Additionally, the Keynesian cross mechanism embedded in the model ex- 7  
 8 hibits uniform behavior regardless of the degree of economic slack—a feature 8  
 9 that stands in contrast to the state-dependent multipliers we apply in our partial 9  
 10 equilibrium analysis.<sup>33</sup> 10

11 The consumption response in this general equilibrium model to each of the 11  
 12 three policies is shown in the top row of Figure 5. For each of the three fiscal poli- 12  
 13 cies, we have shown the consumption response under three different monetary 13  
 14 policy rules: 1) an active Taylor rule with a coefficient of 1.5 on inflation; 2) a fixed 14  
 15 nominal rate (simulating an effective lower bound); and 3) a fixed real rate (clos- 15  
 16 est in spirit to our partial equilibrium analysis). 16

17 17

18 18

19 19

20 20

21 21

22 22

23 23

24 24

25 25

26 26

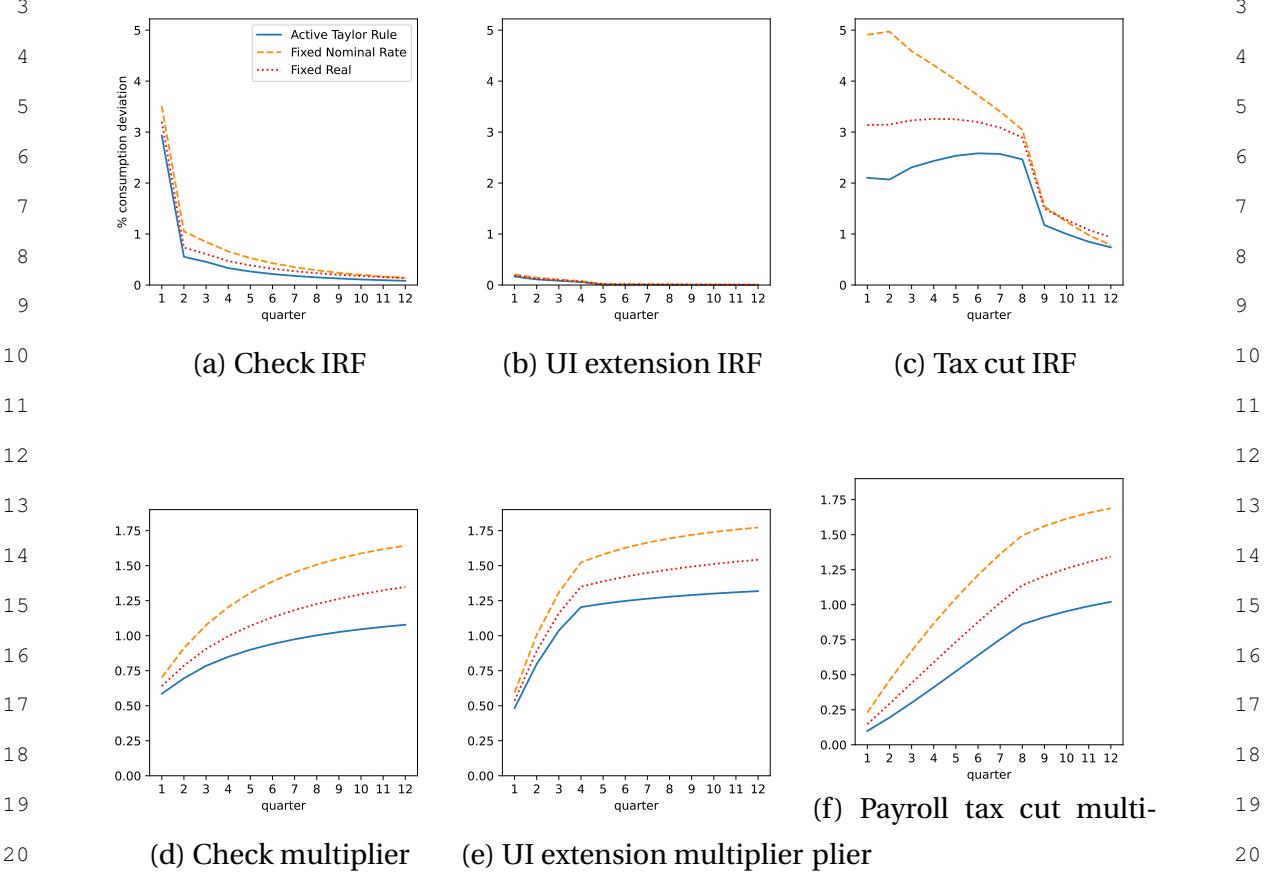
27 27

---

28 <sup>32</sup>One approach to overcome this limitation, which could be used in future work, is described 28  
 29 in Boppart et al. (2018). 29

30 <sup>33</sup>We note two additional technical limitations of our general equilibrium implementation. First, 30  
 31 stimulus payments in the model are specified as proportional to permanent income, rather than as 31  
 32 means-tested fixed dollar amounts as implemented in practice and in our partial equilibrium frame- 32  
 work. Second, splurge behavior only occurs out of equilibrium.

1 FIGURE 5. PREGENERATED: General equilibrium policy comparison in HANK-SAM  
 2 model



**Note:** This figure presents general equilibrium results from the HANK-SAM model (Section 5). Subfigures (a)-(c) show consumption impulse responses under three monetary policy rules: active Taylor rule, fixed nominal rate (ZLB), and fixed real rate. Subfigures (d)-(f) show corresponding cumulative multipliers over time. The general equilibrium framework generates multipliers through an intertemporal Keynesian cross mechanism, particularly pronounced when monetary policy is passive. Results validate the partial equilibrium findings that UI extensions achieve the highest multipliers across all policy environments.

Overall, the IRFs from this model are similar to those from the partial equilibrium analysis, especially under the fixed real-rate rule. Note that the magnitude of the consumption response to the UI extension is lower than in our main analysis—a consequence of lower long-term unemployment in this HANK exer-

1 cise of deviating from the steady state.<sup>34</sup> Furthermore, although we are unable 1  
 2 to repeat our welfare analysis under a recession in this model, the distributional 2  
 3 effects of the policies are similar. Most importantly, the mechanism leading to far 3  
 4 greater welfare benefits for the UI extension, namely that the newly unemployed 4  
 5 have high marginal utility, are robust to the supply-side effects of a general equi- 5  
 6 librium HANK and SAM model. 6

7 The bottom row of Figure 5 shows the corresponding cumulative multipliers 7  
 8 for each policy and monetary policy rule. Figure 6 compares these consump- 8  
 9 tion multipliers over different horizons under a fixed real rate rule to those in 9  
 10 our baseline partial equilibrium model. The multipliers are bigger in the HANK 10  
 11 and SAM model. Nevertheless, in both models, the relative ranking of the con- 11  
 12 sumption multipliers over time horizons are similar, with the effect of the tax cut 12  
 13 substantially smaller than the stimulus check or UI extension policies, despite 13  
 14 the inclusion of supply-side effects in this HANK model. However, in contrast to 14  
 15 the partial equilibrium model, towards the end of the period shown the tax cut 15  
 16 consumption multiplier is near that of the stimulus check. This is because the 16  
 17 aggregate demand effects in our partial equilibrium model do not continue be- 17  
 18 yond the recession, dampening the benefits of the tax cut policy—in which much 18  
 19 of the extra spending occurs after the recession is over—relative to the stimulus 19  
 20 check and extended UI policies. 20

21 As discussed in the literature review, Broer et al. (2025) also compute fiscal 21  
 22 multipliers for commonly implemented stimulus policies in a HANK and SAM 22  
 23 framework. A key distinction is that our model exhibits more spending out of 23  
 24 income shocks in the quarters following the quarter of the shock. As shown 24  
 25 in Auclert et al. (2018), accounting for the path of iMPCs beyond the first quar- 25  
 26 ter significantly amplifies cumulative fiscal multipliers. By capturing this per- 26  
 27 27

---

28  
 29 <sup>34</sup>By contrast, our main analysis considers deviations from a recessionary scenario. Note that the 29  
 30 dynamics of the UI extension IRF are also somewhat faster acting. This is because, under the recession 30  
 31 that we study in the partial equilibrium analysis, the large mass of newly-unemployed households do 31  
 32 not start receiving extended UI for six months. 32

<sup>1</sup> FIGURE 6. PREGENERATED: Multiplier comparison: partial equilibrium vs. HANK model <sup>1</sup>

<sup>2</sup>

<sup>3</sup>

<sup>4</sup>

<sup>5</sup>

<sup>6</sup>

<sup>7</sup>

<sup>8</sup>

<sup>9</sup>

<sup>10</sup>

<sup>11</sup>

<sup>12</sup>

<sup>13</sup>

<sup>14</sup>

<sup>15</sup>

<sup>16</sup>

<sup>17</sup>

<sup>18</sup>

<sup>19</sup>

<sup>20</sup>

<sup>21</sup>

<sup>22</sup>

<sup>23</sup>

<sup>24</sup>

<sup>25</sup>

<sup>26</sup>

<sup>27</sup>

<sup>28</sup>

<sup>29</sup>

<sup>30</sup>

<sup>31</sup>

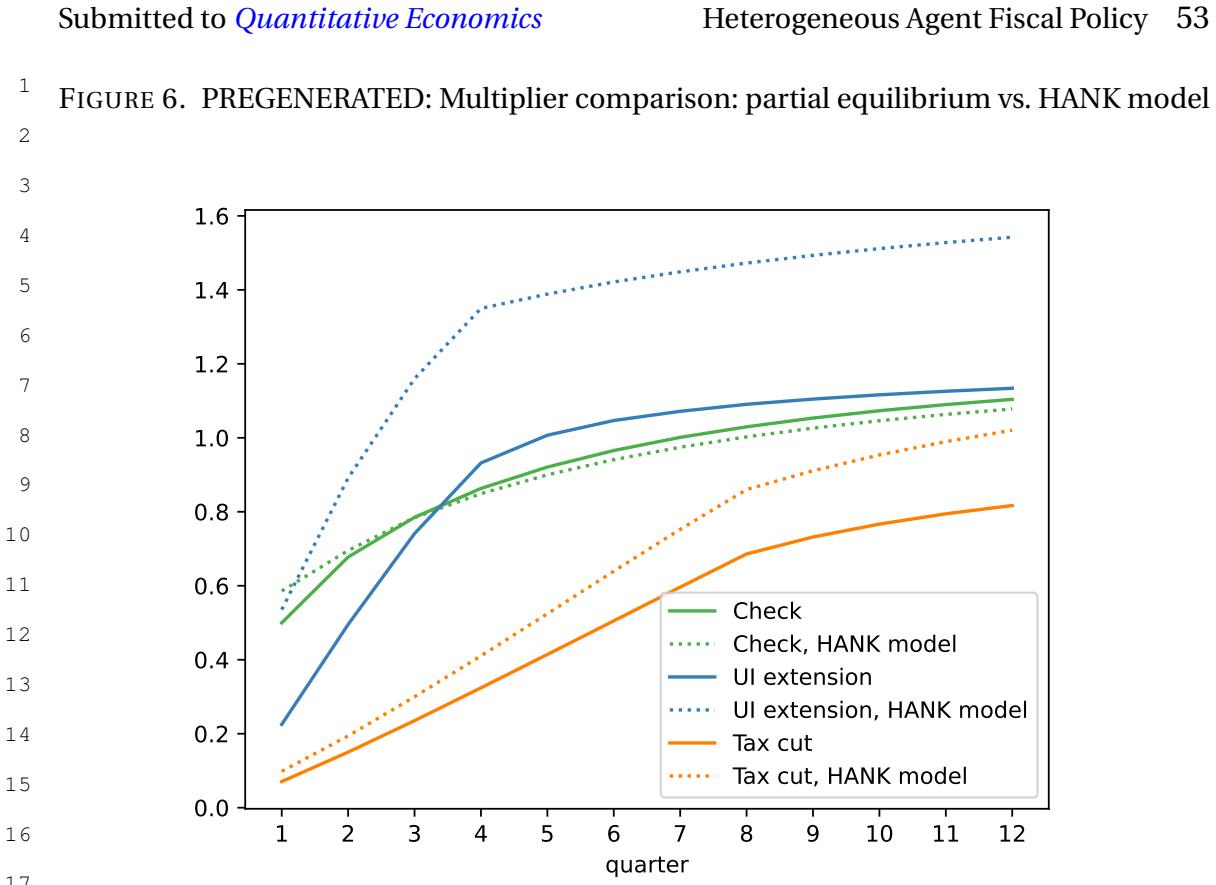
<sup>32</sup>

<sup>18</sup> Note: This figure compares consumption multipliers across model frameworks (Section 5). The com-  
<sup>19</sup> parison shows multipliers over different time horizons under a fixed real rate rule between the base-  
<sup>20</sup> line partial equilibrium model (with state-dependent multipliers during recessions) and the general  
<sup>21</sup> equilibrium HANK-SAM model (with uniform Keynesian cross mechanism). Both models show the  
<sup>22</sup> tax cut policy substantially underperforming relative to stimulus checks and UI extensions, validat-  
<sup>23</sup> ing the robustness of policy rankings across modeling approaches. The HANK model produces larger  
<sup>24</sup> overall multipliers due to general equilibrium effects.

<sup>24</sup> sistence—consistent with microeconomic evidence—our model produces larger  
<sup>25</sup> multipliers for the untargeted stimulus check than those in Broer et al. (2025).  
<sup>26</sup>

## 6. CONCLUSION

<sup>27</sup>  
<sup>28</sup> For many years leading up to the Great Recession, a widely held view among  
<sup>29</sup> macroeconomists was that countercyclical policy should be left to central banks,  
<sup>30</sup> because fiscal policy responses were unpredictable in their timing, their content,  
<sup>31</sup> and their effects. Nevertheless, even during this period, fiscal policy responses to  
<sup>32</sup>



1 recessions were repeatedly tried, perhaps because the macroeconomists' advice 1  
2 to fiscal policymakers — “don't just do something; stand there” — is not politically 2  
3 tenable. 3

4 This paper demonstrates that macroeconomic modeling has finally advanced 4  
5 to the point where we can make reasonably credible assessments of the effects 5  
6 of alternative policies like those that have been tried. The key developments 6  
7 have been both (1) the advent of national registry datasets that can measure cru- 7  
8 cial microeconomic phenomena, and (2) the creation of tools of heterogeneous 8  
9 agent macroeconomic modeling that can match those micro facts and glean their 9  
10 macroeconomic implications. 10

11 We examine three fiscal policy experiments that have actually been imple- 11  
12 mented in the past: an extension of UI benefits, a stimulus check, and a time- 12  
13 limited tax cut on labor income. Our model suggests that the extension of UI 13  
14 benefits is a clear “bang for the buck” winner. While the stimulus check arrives 14  
15 faster and generates multiplier effects more quickly, it is less well targeted to high- 15  
16 MPC households than an extension of UI benefits. By contrast, the welfare gains 16  
17 from extended UI benefits are significantly greater than those from a stimulus 17  
18 check. The chief drawback of the UI extension is that its size is limited by the fact 18  
19 that a relatively small share of the population are unemployed at any given time. 19  
20 In contrast, stimulus checks are easily scalable while exhibiting only slightly less 20  
21 recession-period stimulus (in a typical recession). However, since some of the 21  
22 stimulus checks flow to well-off consumers, such checks do worse than UI ex- 22  
23 tensions when we evaluate welfare consequences. Finally, the payroll tax cut is 23  
24 the least effective in terms of both the multiplier and welfare effect, since it tar- 24  
25 gets only employed consumers and, for a typical recession, more of its payouts 25  
26 are likely to occur after the recessionary period (when multipliers may exist) has 26  
27 ended. 27

28 The tools we are using could be easily modified to evaluate a number of other 28  
29 policies. For example, in the COVID-driven recession, not only was the duration 29  
30 of UI benefits extended, but those benefits were also supplemented by substan- 30  
31 tial payments to all UI recipients. We did not calibrate the model to match this 31  
32 particular policy, but the framework could easily accommodate such an analysis. 32

1	REFERENCES	1
2	Akerlof, George A and Janet L Yellen (1985), “A near-rational model of the busi-	2
3	ness cycle, with wage and price inertia.” <i>The Quarterly Journal of Economics</i> , 100	3
4	(Supplement), 823–838. []	4
5		5
6	Allcott, Hunt, Joshua J Kim, Dmitry Taubinsky, and Jonathan Zinman (2021), “Are	6
7	high-interest loans predatory? Theory and evidence from payday lending.” <i>NBER</i>	7
8	<i>Working paper</i> , no. 28799. NBER Working paper, no. 28799. []	8
9		9
10	Andre, Peter, Joel Flynn, Georgios Nikolakoudis, and Karthik Sastry (2025),	10
11	“Quick-fixing: Near-rationality in consumption and savings behavior.” <i>SSRN</i>	11
12	<i>Electronic Journal</i> , URL <a href="http://www.nber.org/papers/w33464.pdf">http://www.nber.org/papers/w33464.pdf</a> . []	12
13		13
14	Auclert, Adrien, Bence Bardóczy, Matthew Rognlie, and Ludwig Straub (2021),	14
15	“Using the sequence-space jacobian to solve and estimate heterogeneous-agent	15
16	models.” <i>Econometrica</i> , 89 (5), 2375–2408, URL <a href="https://onlinelibrary.wiley.com/doi/abs/10.3982/ECTA17434">https://onlinelibrary.wiley.com/doi/abs/10.3982/ECTA17434</a> . []	16
17		17
18	Auclert, Adrien, Matthew Rognlie, and Ludwig Straub (2018), “The intertemporal	18
19	keynesian cross.” Working Paper 25020, National Bureau of Economic Research,	19
20	URL <a href="http://www.nber.org/papers/w25020">http://www.nber.org/papers/w25020</a> . []	20
21		21
22	Auclert, Adrien, Matthew Rognlie, and Ludwig Straub (2020), “Micro jumps,	22
23	macro humps: Monetary policy and business cycles in an estimated hank	23
24	model.” Technical report, Stanford University, URL <a href="https://scholar.harvard.edu/straub/publications/jumps-humps">https://scholar.harvard.edu/straub/publications/jumps-humps</a> . Revise and resubmit at American Economic	24
25	Review. []	25
26		26
27	Aursland, Thor Andreas, Ivan Frankovic, Birol Kanik, and Magnus Sæsgaard	27
28	(2020), “State-dependent fiscal multipliers in NORA - A DSGE model for fiscal	28
29	policy analysis in Norway.” <i>Economic Modelling</i> , 93, 321–353, URL <a href="https://www.sciencedirect.com/science/article/pii/S0264999320304156">https://www.sciencedirect.com/science/article/pii/S0264999320304156</a> . []	29
30		30
31	Bardoczy, Bence (2024), “Spousal insurance and the amplification of business cy-	31
32	cles.” Manuscript, Board of Governors of the Federal Reserve System. []	32

- <sup>1</sup> Bayer, Christian, Benjamin Born, Ralph Luetticke, and Gernot J Müller (2023),  
<sup>2</sup> “The coronavirus stimulus package: How large is the transfer multiplier?” *The*  
<sup>3</sup> *Economic Journal*. []  
<sup>4</sup> Benigno, Pierpaolo and Gauti B Eggertsson (2023), “It’s baaack: The surge in in-  
<sup>5</sup> flation in the 2020s and the return of the non-linear phillips curve.” Working Pa-  
<sup>6</sup> per 31197, National Bureau of Economic Research, URL <http://www.nber.org/papers/w31197>. []  
<sup>7</sup>  
<sup>8</sup> Beraja, Martin and Nathan Zorzi (2023), “On the size of stimulus checks: How  
<sup>9</sup> much is too much?” Technical report, MIT. Working paper. []  
<sup>10</sup>  
<sup>11</sup> Bhandari, Anmol, David Evans, Mikhail Golosov, and Thomas Sargent (2021), “Ef-  
<sup>12</sup> ficiency, insurance, and redistribution effects of government policies.” Technical  
<sup>13</sup> report, tomsargent.com. []  
<sup>14</sup>  
<sup>15</sup> Blanchard, Olivier and Jordi Galí (2010), “Labor markets and monetary pol-  
<sup>16</sup> icy: A new keynesian model with unemployment.” *American Economic Journal:*  
<sup>17</sup> *Macroeconomics*, 2 (2), 1–30, URL <https://www.aeaweb.org/articles?id=10.1257/mac.2.2.1>. []  
<sup>18</sup>  
<sup>19</sup>  
<sup>20</sup> Blanco, Andres, Corina Boar, Callum J Jones, and Virgiliu Midrigan (2024), “Non-  
<sup>21</sup> linear inflation dynamics in menu cost economies.” Working Paper 32094, Na-  
<sup>22</sup> tional Bureau of Economic Research, URL <http://www.nber.org/papers/w32094>.  
<sup>23</sup> []  
<sup>24</sup>  
<sup>25</sup> Blinder, Alan S. and Angus S. Deaton (1985), “The Time Series Consumption  
Function Revisited.” *Brookings Papers on Economic Activity*, 1985:2, 465–521, URL  
<sup>26</sup> <http://www.jstor.org/stable/2534444>. []  
<sup>27</sup>  
<sup>28</sup> Board of Governors of the Federal Reserve System (2004), “Survey of con-  
<sup>29</sup> sumer finances, 2004.” <https://www.federalreserve.gov/econres/scfindex.htm>.  
<sup>30</sup> Data files: Summary Extract Public Data (rscfp2004.dta) and Full Public Data Set  
<sup>31</sup> (p04i6.dta). Available at [https://www.federalreserve.gov/econres/scf\\_2004.htm](https://www.federalreserve.gov/econres/scf_2004.htm).  
<sup>32</sup> Accessed November 2025. []

- 1 Boehm, Johannes, Etienne Fize, and Xavier Jaravel (2025), “Five facts about mpes: 1  
2 Evidence from a randomized experiment.” *American Economic Review*, 115 (1), 2  
3 1–42, URL <https://www.aeaweb.org/articles?id=10.1257/aer.20240138>. [] 3
- 4 Boppart, Timo, Per Krusell, and Kurt Mitman (2018), “Exploiting mit shocks in 4  
5 heterogeneous-agent economies: The impulse response as a numerical deriva- 5  
6 tive.” *Journal of Economic Dynamics and Control*, 89 (C), 68–92. [] 6
- 7 Boutros, Michael (2022), “Windfall income shocks with finite planning horizons.” 7  
8 Technical report, Bank of Canada. [] 8
- 9 Broda, Christian and Jonathan A Parker (2014), “The economic stimulus pay- 9  
10 ments of 2008 and the aggregate demand for consumption.” *Journal of Monetary 10  
11 Economics*, 68, S20–S36. [] 11
- 12 Broer, Tobias, Jeppe Druedahl, Karl Harmenberg, and Erik Öberg (2025), “Stim- 12  
13 ulus effects of common fiscal policies.” Discussion Paper 19823, Center for Eco- 13  
14 nomic Policy Research. [] 14
- 15 Broer, Tobias, Per Krusell, and Erik Öberg (2023), “Fiscal multipliers: A 15  
16 heterogenous-agent perspective.” *Quantitative Economics*, 14 (3), 799–816. [] 16
- 17 Browning, Martin and Thomas F. Crossley (2009), “Shocks, stocks, and socks: 17  
18 Smoothing consumption over a temporary income loss.” *Journal of the Euro- 18  
19 pean Economic Association*, 7 (6), 1169–1192, URL <https://onlinelibrary.wiley.com/doi/abs/10.1162/JEEA.2009.7.6.1169>. [] 19
- 20 Cagetti, Marco (2003), “Wealth accumulation over the life cycle and precau- 20  
21 tionary savings.” *Journal of Business & Economic Statistics*, 21 (3), 339–353. [] 21
- 22 Carroll, Christopher, Edmund Crawley, Ivan Frankovic, and Håkon Tretvoll 22  
23 (2023), “Welfare and spending effects of consumption stimulus policies.” Finance 23  
24 and Economics Discussion Series 2023-002, Board of Governors of the Federal 24  
25 Reserve System, Washington. [] 25
- 26 Carroll, Christopher D (2022), “Theoretical foundations of buffer stock saving.” 26  
27 *Department of Economics*, URL <https://econ-ark.github.io/BufferStockTheory/>. 27
- 28 Working paper. [] 28
- 29 29
- 30 30
- 31 31
- 32 32

- 1 Carroll, Christopher D., Edmund Crawley, Jiri Slacalek, Kiichi Tokuoka, and Matt- 1  
2 hew N. White (2020a), "Sticky Expectations and Consumption Dynamics." *Ameri-* 2  
3 *cian Economic Journal: Macroeconomics*, 12 (3), 40–76, URL <http://www.nber.org/papers/w24377>. [] 3  
4
- 5 Carroll, Christopher D, Edmund Crawley, Jiri Slacalek, and Matthew N White 5  
6 (2020b), "Modeling the consumption response to the CARES act." *Covid Eco-* 6  
7 *nomics*, 10, 62–86. [] 7  
8
- 9 Carroll, Christopher D., Jiri Slacalek, Kiichi Tokuoka, and Matthew N. White 9  
10 (2017), "The distribution of wealth and the marginal propensity to consume." 10  
11 *Quantitative Economics*, 8 (3), 977–1020, URL <http://onlinelibrary.wiley.com/doi/10.3982/QE694/pdf>. At <https://llorracc.github.io/cstwMPC>. [] 11  
12
- 13 Chodorow-Reich, Gabriel and Loukas Karabarbounis (2016), "The limited 13  
14 macroeconomic effects of unemployment benefit extensions." Technical report, 14  
15 National Bureau of Economic Research. [] 15  
16 Christiano, Lawrence, Martin Eichenbaum, and Sergio Rebelo (2011), "When is 16  
17 the government spending multiplier large?" *Journal of Political Economy*, 119 (1), 17  
18 78–121. [] 18  
19
- 20 Christiano, Lawrence J., Martin S. Eichenbaum, and Mathias Trabandt (2016), 20  
21 "Unemployment and business cycles." *Econometrica*, 84 (4), 1523–1569, URL 21  
22 <https://onlinelibrary.wiley.com/doi/abs/10.3982/ECTA11776>. [] 22  
23 Cochrane, John H (1989), "The sensitivity of tests of the intertemporal allocation 23  
24 of consumption to near-rational alternatives." *The American Economic Review*, 24  
25 319–337. [] 25  
26 Cohen, Jonathan and Peter Ganong (2024), "Disemployment effects of unem- 26  
27 ployment insurance: A meta-analysis." *SSRN Electronic Journal*, URL <https://www.nber.org/papers/w32832>. [] 27  
28
- 29 Crawley, Edmund, Martin B. Holm, and Håkon Tretvoll (2024), "A parsimonious 30  
30 model of idiosyncratic income." *Board of Governors of the Federal Reserve System*. 31  
31 [] 32

- 1 Crawley, Edmund and Andreas Kuchler (2023), "Consumption heterogeneity: 1  
2 Micro drivers and macro implications." *American Economic Journal: Macroeconomics*, 15 (1), 314–41, URL <https://www.aeaweb.org/articles?id=10.1257/mac.20200352>. [] 4
- 5 Dávila, Eduardo and Andreas Schaab (2022), "Welfare assessments with hetero- 5  
6 geneous individuals." *Available at SSRN* 4102027. [] 6
- 7 Davis, Steven J. and Till Von Wachter (2011), "Recessions and the costs of job 7  
8 loss." *Brookings Papers on Economic Activity*, 1–72, URL <http://www.jstor.org/stable/41473597>. [] 9
- 10 den Haan, Wouter J., Garey Ramey, and Joel Watson (2000), "Job destruction and 11  
11 propagation of shocks." *The American Economic Review*, 90 (3), 482–498, URL 12  
13 <http://www.jstor.org/stable/117339>. [] 13
- 14 Du, William (2024), "The macroeconomic consequences of unemployment scar- 14  
15 ring." Manuscript, The Johns Hopkins University. [] 15
- 16 Eggertsson, Gauti B (2011), "What fiscal policy is effective at zero interest rates?" 16  
17 *NBER Macroeconomics Annual*, 25 (1), 59–112. [] 17
- 18 Elsby, Michael W L and Bart Hobijn (2010), "The labor market in the great reces- 19  
19 sion." *Brookings Papers on Economic Activity*. [] 20
- 21 Fagereng, Andreas, Martin B. Holm, and Gisle J. Natvik (2021), "MPC Hetero- 21  
22 geneity and Household Balance Sheets." *American Economic Journal: Macroeconomics*, 13 (4), 1–54, URL <https://www.aeaweb.org/articles?id=10.1257/mac.20190211>. [] 23
- 22 Friedman, Milton A. (1963), "Windfalls, the 'horizon,' and related concepts in the 25  
25 permanent income hypothesis." In *Measurement in Economics* (Carl Christ, ed.), 26  
26 1–28, Stanford University Press. [] 27
- 27 Ganong, Peter, Fiona E Greig, Pascal J Noel, Daniel M Sullivan, and Joseph S Vavra 29  
29 (2022), "Spending and job-finding impacts of expanded unemployment benefits: 30  
30 Evidence from administrative micro data." Working Paper 30315, National Bu- 31  
31 reau of Economic Research, URL <http://www.nber.org/papers/w30315>. [] 32

- 1 Ganong, Peter and Pascal Noel (2019), "Consumer spending during unemployment: Positive and normative implications." *American Economic Review*, 109 (7),  
2 2383–2424, URL <https://www.aeaweb.org/articles?id=10.1257/aer.20170537>. []  
3
- 4 Gjeldsregistret (2022), "Nokkeltall fra Gjeldsregisteret." *Gjeldsregistret nettside*,  
5 URL <https://www.gjeldsregisteret.com/pages/nokkeltall>. []  
6
- 7 Gornemann, Nils, Keith Kuester, and Makoto Nakajima (2021), "Doves for the  
8 rich, hawks for the poor? distributional consequences of systematic monetary  
9 policy." ECONtribute Discussion Papers Series 089, University of Bonn and  
10 University of Cologne, Germany, URL <https://ideas.repec.org/p/ajk/ajkdps/089.html>. []  
11
- 12 Graham, James and Robert McDowall (2024), "Mental accounts and consumption sensitivity across the distribution of liquid assets." Available at SSRN 12  
13 4793885. []  
14
- 15 Graves, Sebastian (2024), "Does unemployment risk affect business cycle dynamics?" *American Economic Journal Macroeconomics*, URL <https://www.federalreserve.gov/econres/ifdp/files/ifdp1298.pdf>. []  
16
- 17 Hagedorn, Marcus, Fatih Karahan, Iourii Manovskii, and Kurt Mitman (2019a),  
18 "Unemployment benefits and unemployment in the great recession: The role of macro effects." Technical report, National Bureau of Economic Research. Working paper 19499. []  
19
- 20 Hagedorn, Marcus, Iourii Manovskii, and Kurt Mitman (2017), "The impact of  
21 unemployment benefit extensions on employment: The 2014 employment miracle?" Technical report, National Bureau of Economic Research. Working paper 20884. []  
22
- 23 Hagedorn, Marcus, Iourii Manovskii, and Kurt Mitman (2019b), "The fiscal multiplier." Working paper, National Bureau of Economic Research. []  
24
- 25 Hai, Rong, Dirk Krueger, and Andrew Postlewaite (2020), "On the welfare cost of consumption fluctuations in the presence of memorable goods." *Quantitative economics*, 11 (4), 1177–1214, URL <http://dx.doi.org/10.3982/qe1173>. []  
26
- 27
- 28
- 29
- 30
- 31
- 32

- 1 Ilut, Cosmin and Rosen Valchev (2022), “Economic agents as imperfect problem 1  
2 solvers.” *Q.J. Econ.*, 138 (1), 313–362, URL <https://www.nber.org/papers/w27820>. 2  
3 [] 3
- 4 Indarte, Sasha, Raymond Kluender, Ulrike Malmendier, and Michael Stepner 4  
5 (2024), “What explains the consumption decisions of low-income households?” 5  
6 *Department of Economics*. [] 6  
7  
8 Johnson, David S., Jonathan A. Parker, and Nicholas S. Souleles (2006), 7  
9 “Household expenditure and the income tax rebates of 2001.” *American Eco-* 8  
*nomic Review*, 96 (5), 1589–1610, URL <http://ideas.repec.org/a/aea/aecrev/v96y2006i5p1589-1610.html>. [] 9  
10  
11 Kaplan, Greg and Giovanni L Violante (2014), “A model of the consumption re- 12  
12 sponse to fiscal stimulus payments.” *Econometrica*, 82 (4), 1199–1239. [] 13  
13  
14 Kaplan, Greg and Giovanni L Violante (2022), “The marginal propensity to con- 14  
15 sume in heterogeneous agent models.” Working Paper 30013, National Bureau of 15  
16 Economic Research, URL <http://www.nber.org/papers/w30013>. [] 16  
17  
18 Kekre, Rohan (2022), “Unemployment insurance in macroeconomic stabiliza- 18  
19 tion.” *The Review of Economic Studies*, URL <https://doi.org/10.1093/restud/rdac080>. [] 19  
20  
21 Kotsogiannis, Christos and Plutarchos Sakellaris (2024), “MPCs Estimated from 21  
22 Tax Lottery, Survey and Administrative Data.” Technical report, Athens Univer- 22  
23 sity of Economics and Business, URL <https://tarc.exeter.ac.uk/collaboration/directstimuluspayments/>. [] 23  
24  
25 Kravik, Erling Motzfeldt and Yassin Mimir (2019), “Navigating with NEMO.” 25  
26 *Norges Bank Staff Memo*, 5, URL <https://www.norges-bank.no/en/news-events/news-publications/Papers/Staff-Memo/2019/52019/>. [] 26  
27  
28 Krueger, Dirk, Kurt Mitman, and Fabrizio Perri (2016), “Macroeconomics and 29  
29 household heterogeneity.” In *Handbook of Macroeconomics*, volume 2, 843–921, 30  
30 Elsevier, URL <https://linkinghub.elsevier.com/retrieve/pii/S1574004816300039>. 31  
31  
32 [] 32

- 1 Kueng, Lorenz (2018), "Excess sensitivity of high-income consumers\*." *The Quar-* 1  
2 *terly Journal of Economics*, 133 (4), 1693–1751, URL <https://doi.org/10.1093/qje/qjy014>. [] 2  
3 3
- 4 Lian, Chen (2023), "Mistakes in future consumption, high MPCs now." *American* 4  
5 *Economic Review: Insights*, 5 (4), 563–581. [] 5  
6 6
- 7 Mankiw, N. Gregory (1982), "Hall's consumption hypothesis and durable goods." 7  
8 *Journal of Monetary Economics*, 10 (3), 417–425. [] 8  
9 9
- 10 Maxted, Peter, David Laibson, and Benjamin Moll (2024), "Present bias amplifies 10  
11 the household balance-sheet channels of macroeconomic policy." *The Quarterly* 11  
12 *Journal of Economics*, qjae026. [] 12
- 13 McKay, Alisdair and Ricardo Reis (2016), "The role of automatic stabilizers in the 13  
14 us business cycle." *Econometrica*, 84 (1), 141–194. [] 14  
15 15
- 16 McKay, Alisdair and Ricardo Reis (2021), "Optimal automatic stabilizers." *The Re-* 16  
17 *view of Economic Studies*, 88 (5), 2375–2406. [] 17
- 18 Melcangi, Davide and Vincent Sterk (2024), "Stock market participation, inequal- 18  
19 ity, and monetary policy." *Review of Economic Studies*, rdae068. [] 19  
20 20
- 21 Mincer, Jacob (1991), "Education and unemployment." *NBER Working Paper* 21  
22 w3838, URL <https://www.nber.org/papers/w3838>. [] 22
- 23 23
- 24 OECD (2020), "Net replacement rate in unemployment." *OECD statistics* 24  
25 "Social Protection and Well-being", URL [Url:https://stats.oecd.org/Index.aspx?DataSetCode=NRR](https://stats.oecd.org/Index.aspx?DataSetCode=NRR). [] 25
- 26 26
- 27 Parker, Jonathan A, Nicholas S Souleles, David S Johnson, and Robert McClel- 27  
28 land (2013), "Consumer spending and the economic stimulus payments of 2008." 28  
29 *American Economic Review*, 103 (6), 2530–53. [] 29  
30 30
- 31 Phan, Nam (2024), "The welfare consequences of countercyclical fiscal transfers." 31  
32 Manuscript, Queens Economics Department. [] 32

- 1 Ramey, Valerie A and Sarah Zubairy (2018), “Government spending multipliers 1  
2 in good times and in bad: evidence from us historical data.” *Journal of political 2  
3 economy*, 126 (2), 850–901. [] 3
- 4 Ravn, Morten O. and Vincent Sterk (2017), “Job uncertainty and deep recessions.” 4  
5 *Journal of Monetary Economics*, 90, 125–141, URL <https://www.sciencedirect.com/science/article/pii/S0304393217300806>. [] 5
- 6 Ravn, Morten O and Vincent Sterk (2021), “Macroeconomic Fluctuations with 6  
7 HANK & SAM: an Analytical Approach.” *Journal of the European Economic As- 7  
8 sociation*, 19, 1162–1202. [] 8
- 9 10 Ravn, Morten O and Vincent Sterk (2021), “Macroeconomic Fluctuations with 9  
10 HANK & SAM: an Analytical Approach.” *Journal of the European Economic As- 10  
11 sociation*, 19, 1162–1202. [] 11
- 11 Rotemberg, Julio J. (1982), “Sticky prices in the united states.” *Journal of Political 11  
12 Economy*, 90 (6), 1187–1211, URL <http://www.jstor.org/stable/1830944>. [] 12
- 13 Rothstein, Jesse and Robert G Valletta (2017), “Scraping by: Income and program 13  
14 participation after the loss of extended unemployment benefits.” *Journal of Pol- 14  
15 icy Analysis and Management*, 36 (4), 880–908. [] 15
- 16 Silva, José and Manuel Toledo (2009), “Labor turnover costs and the cyclical 16  
17 behavior or vacancies and unemployment.” *Macroeconomic Dynamics*, 13 (S1), 17  
18 76–96, URL [https://EconPapers.repec.org/RePEc:cup:macdyn:v:13:y:2009:i:s1:p:76-96\\_08](https://EconPapers.repec.org/RePEc:cup:macdyn:v:13:y:2009:i:s1:p:76-96_08). [] 18
- 19 20 Silva, José and Manuel Toledo (2009), “Labor turnover costs and the cyclical 19  
20 behavior or vacancies and unemployment.” *Macroeconomic Dynamics*, 13 (S1), 20  
21 76–96, URL [https://EconPapers.repec.org/RePEc:cup:macdyn:v:13:y:2009:i:s1:p:76-96\\_08](https://EconPapers.repec.org/RePEc:cup:macdyn:v:13:y:2009:i:s1:p:76-96_08). [] 21
- 22 Skiba, Paige Marta and Jeremy Tobacman (2008), “Payday loans, uncertainty and 22  
23 discounting: Explaining patterns of borrowing, repayment, and default.” *Vander- 22  
24 bilt Law and Economics Research Paper*, 08 (33). [] 23
- 25 24
- 26 25
- 27 26
- 28 27
- 29 28
- 30 29
- 31 30
- 32 31
- 33 32

64 APPENDICES

1 APPENDICES

2 APPENDIX A: DETAILS OF THE HANK AND SAM MODEL  
3

4 A.1 *Households*

5 The household block follows closely to the main text with a few exceptions.  
6 First, the splurge only occurs out of equilibrium—that is, the steady state of the  
7 model is calculated without the splurge behavior. Second, the level of perma-  
8 nent income of all newborns is equal to one. Furthermore, all households face the  
9 same employment to unemployment and unemployment to employment prob-  
10 abilities. The probabilities are calibrated to the transition probabilities of high  
11 school graduates from the main text. Lastly, following the notation of Auclert et al.  
12 (2020),  $r_t^a$  will denote the economy wide ex-ante real interest rate.  
13

14  
15 A.2 *Goods Market*  
16

20 A continuum of monopolistically competitive intermediate goods producers, in-  
dexed by  $j \in [0, 1]$ , produces intermediate goods  $Y_{jt}$ , which are sold to a final  
21 goods producer at price  $P_{jt}$ . Each period, these producers fully consume their  
22 profits.  
23

24 A.3 *Final Goods Producer*

25 A perfectly competitive final goods producer purchases intermediate goods  $Y_{jt}$   
from intermediate good producer  $j$  at price  $P_{jt}$  and produces the final good  $Y_t$   
26 using a CES production function:  
27

28  
29       
$$Y_t = \left( \int_0^1 Y_{jt}^{\frac{\epsilon_p - 1}{\epsilon_p}} dj \right)^{\frac{\epsilon_p}{\epsilon_p - 1}},$$
  
30  
31

where  $\epsilon_p$  is the elasticity of substitution.

Given  $P_{jt}$ , the price of intermediate good  $j$ , the final goods producer maximizes profits by solving:<sup>2</sup>

$$\max_{Y_{jt}} P_t \left( \int_0^1 Y_{jt}^{\frac{\epsilon_p - 1}{\epsilon_p}} dj \right)^{\frac{\epsilon_p}{\epsilon_p - 1}} - \int_0^1 P_{jt} Y_{jt} dj.$$

The first order condition leads to demand for good  $j$  given by

$$Y_{jt} = \left( \frac{P_{jt}}{P_t} \right)^{-\epsilon_p} Y_t,$$

and the price index

$$P_t = \left( \int_0^1 P_{jt}^{1-\epsilon_p} dj \right)^{\frac{1}{1-\epsilon_p}}.$$

#### A.4 *Intermediate Goods Producers*

Intermediate goods producers produce according to a production function linear in labor  $L_t$ :

$$Y_{jt} = Z L_{jt},$$

where  $Z$  is total factor productivity.

Each intermediate goods producer hires labor  $L_t$  from a labor agency at cost  $h_t$ . Given this labor cost, each producer sets  $P_{jt}$  to maximize profits while facing price stickiness à la [Rotemberg \(1982\)](#). In HANK models with sticky prices, profits tend to be countercyclical, and when households have high MPCs, this can generate countercyclical consumption responses to dividends. To simplify, we assume that intermediate goods producers fully consume their profits rather than distributing them to households, thereby abstracting from consumption responses to firm profits. Each producer maximizes profits by solving:

$$J_t(P_{jt}) = \max_{\{P_{jt}\}} \left\{ \frac{P_{jt} Y_{jt}}{P_t} - h_t L_{jt} - \frac{\varphi}{2} \left( \frac{P_{jt} - P_{jt-1}}{P_{jt-1}} \right)^2 Y_t + J_{t+1}(P_{jt+1}) \right\},$$

where  $\varphi$  determines the cost of adjusting the price and, hence, the degree of price stickiness.

## 66 APPENDICES

The problem can be rewritten as the standard New Keynesian maximization problem:<sup>2</sup>

$$\max_{\{P_{jt}\}} \mathbb{E}_t \left[ \sum_{s=0}^{\infty} M_{t+s}^A \left( \left( \frac{P_{jt+s}}{P_{t+s}} - MC_{t+s} \right) Y_{jt+s} - \frac{\varphi}{2} \left( \frac{P_{jt+s}}{P_{jt+s-1}} - 1 \right)^2 Y_{t+s} \right) \right],$$

where  $MC_t = \frac{h_t}{Z}$ .<sup>6</sup>

Given that all firms face the same adjustment costs, there exists a symmetric equilibrium where all firms choose the same price with  $P_{jt} = P_t$  and  $Y_{jt} = Y_t$ .<sup>7</sup>

The resulting Phillips Curve is<sup>9</sup>

$$\epsilon_p MC_t \stackrel{11}{=} \epsilon_p - 1 + \varphi(\Pi_t - 1)\Pi_t - M_{t+1} \varphi(\Pi_{t+1} - 1)\Pi_{t+1} \frac{Y_{t+1}}{Y_t}$$

where  $\Pi_t = \frac{P_t}{P_{t+1}}$ .<sup>13</sup>

### A.5 *Labor market*

A risk-neutral labor agency supplies labor  $N_t$  to intermediate goods producers at cost  $h_t$  by hiring households at wage  $w_t$ . To hire workers, the agency posts vacancies  $v_t$ , which are filled with probability  $\phi_t$ . Household job search is random. Following Bardoczy (2024), we assume the labor agency cannot observe individual household productivity. Instead, it only observes the average productivity of all employed workers, which is normalized to one.

**Labor agency.** The labor agency determines how many vacancies to post and how much labor to sell by solving the following problem:

$$J_t(N_{t+1}) = \max_{N_t, v_t} \left\{ (h_t - w_t)N_t - \kappa v_t + \mathbb{E}_t \left[ \frac{J_{t+1}(N_t)}{1 + r_t^a} \right] \right\},$$

subject to

<sup>28</sup>

<sup>29</sup>  
<sup>30</sup>

$$N_t = (1 - \omega)N_{t-1} + \phi_t v_t.$$

The parameters  $\kappa$  and  $\omega$  are, respectively, the cost of posting a vacancy, and the job separation rate.<sup>32</sup>

The resulting job creation curve is:

$$\frac{2}{3} \frac{\kappa}{\phi_t} = (h_t - w_t) + (1 - \omega) E_t \left[ \frac{\kappa}{(1 + r_t^a) \phi_{t+1}} \right].$$

**Matching.** The matching process between households and the labor agency follows a Cobb-Douglas matching function:

$$\frac{7}{8} m_t = \chi e_t^\alpha v_t^{1-\alpha},$$

where  $m_t$  is the mass of matches,  $e_t$  is the mass of job searchers,  $\alpha$  is the matching function elasticity, and  $\chi$  is a matching efficiency parameter.

The vacancy filling probability  $\phi_t$  and the job finding probability  $\eta_t$  evolve as follows:

$$\frac{13}{14} \eta_t = \chi \Theta_{it}^{1-\alpha}$$

$$\frac{15}{16} \phi_t = \chi \Theta_t^{-\alpha}$$

where  $\Theta_t = \frac{v_t}{e_t}$  is labor market tightness.

**Wage Determination.** Following Gornemann et al. (2021) and Blanchard and Galí (2010), we assume the real wage evolves according to the following rule:

$$\log \frac{w_t}{w_{ss}} = \phi_w \log \left( \frac{w_{t-1}}{w_{ss}} \right) + (1 - \phi_w) \log \left( \frac{N_t}{N_{ss}} \right),$$

where  $\phi_w$  dictates the extent of real wage rigidity.

## 25 26 A.6 *Fiscal Policy*

27 The government issues long term bonds  $B_t$  at price  $q_t^b$  in period  $t$  that pays  $\delta^s$  in  
28 period  $t+s+1$  for  $s \in \{0, 1, 2, \dots\}$ .

29 The bond price satisfies the no arbitrage condition:

$$\frac{31}{32} q_t^b = \frac{1 + \delta E_t[q_{t+1}^b]}{1 + r_t^a}.$$

## 68 APPENDICES

The government funds its expenditures through debt and taxes, subject to the following budget constraint:

$$^3 \quad ^4 \quad (1 + \delta q_t^b)B_{t-1} + G_t + S_t = \tau_t w_t N_t + q_t^b B_t,$$

where  $S_t$  are payments<sup>5</sup> for unemployment insurance and other transfers.

For all stimulus<sup>6</sup> policies, except tax cuts, we follow [Auclert et al. \(2020\)](#) and allow the tax rate to adjust in order to stabilize the debt-to-GDP ratio:

$$^8 \quad ^9 \quad \tau_t - \tau_{ss} = \phi_B q_{ss}^b \frac{B_{t-1} - B_{ss}}{Y_{ss}}$$

$$^{10}$$

where  $\phi_B$  governs the speed of adjustment.

For the tax cuts, we assume government expenditures adjust following:

$$^{13} \quad ^{14} \quad G_t - G_{ss} = \phi_G q_{ss}^b \frac{B_{t-1} - B_{ss}}{Y_{ss}}$$

where  $\phi_G$  governs the speed of adjustment of government spending in response to debt.

<sup>16</sup>

<sup>17</sup>

<sup>18</sup>

### A.7 *Monetary Policy*

The central bank follows a standard Taylor rule that responds solely to inflation:

$$^{21} \quad i_t = r^* + \phi_\pi \pi_t,$$

$$^{22}$$

where  $\phi_\pi$  is the coefficient on inflation. Inflation is given by  $\pi_t = P_t / P_{t-1} - 1$ , and  $r^*$  is the steady state interest rate.

<sup>25</sup>

<sup>26</sup>

### A.8 *Equilibrium*

An equilibrium in this economy is a sequence of:

<sup>28</sup>

- Policy Functions  $(c_{it}(m))_{t=0}^\infty$  normalized by permanent income.
- Prices  $(r_{t+1}^d, i_t, q_t^b, w_t, h_t, \pi_t, \tau_t)_{t=0}^\infty$ .
- Aggregates  $(C_t, Y_t, N_t, \Theta_t, B_t, A_t)_{t=0}^\infty$ .

Such that:

<sup>1</sup>

- $(c_{it}(m))_{t=0}^{\infty}$ <sup>2</sup> solves the household's maximization problem given  $(w_t, \eta_t, r_t^a, \tau_t)_{t=0}^{\infty}$ .
- The final goods producer and intermediate goods producers both maximize their respective objective functions.
- The nominal interest rate is determined by the central bank's Taylor rule.<sup>3</sup>
- The tax rate is set according to the fiscal rule, ensuring that the government budget constraint is satisfied.
- The value of assets is equal to the value of government bonds:<sup>4</sup>

<sup>13</sup>

$$A_t = q_t^b B_t.$$

<sup>14</sup>

- The goods market clears<sup>35</sup>:

<sup>16</sup>

$$C_t = w_t N_t + G_t,$$

<sup>17</sup>

where  $C_t \equiv \int_0^1 \mathbf{c}_{it} di$ .

- The labor demand of intermediate goods producers equals labor supply of labor agency:<sup>19</sup>

<sup>20</sup>

<sup>21</sup>

$$L_t = N_t.$$

<sup>23</sup>

### <sup>24</sup>A.9 Calibration of Non-Household Blocks

The elasticity of substitution is set to 6, and the price adjustment cost parameter is set to 96.9 as in Ravn and Sterk (2017, 2021). The vacancy cost is set to 7 percent of the real wage as in Christiano et al. (2016).<sup>36</sup> The matching elasticity is

---

<sup>35</sup>Note if profits were not held by firms then the goods market condition would be  $C_t + G_t = Y_t - \kappa v_t - \frac{\varphi}{2} \left( \frac{P_t}{P_{t-1}} - 1 \right)^2 Y_t$ . In particular, since firm profits are  $D_t = Y_t - w_t N_t - \kappa v_t - \frac{\varphi}{2} \left( \frac{P_t}{P_{t-1}} - 1 \right)^2 Y_t$ , then the goods market condition would become  $C_t + G_t = w_t N_t + D_t = Y_t - \kappa v_t - \frac{\varphi}{2} \left( \frac{P_t}{P_{t-1}} - 1 \right)^2 Y_t$ .

<sup>36</sup>The range of plausible values lie between 4percent and 14percent Silva and Toledo (2009)

70 APPENDICES

1 TABLE 9. Calibration

2 Description	Parameter	Value	Source/Target
Elasticity of Substitution	$\epsilon_p$	6	Standard
Price Adjustment Costs	$\varphi$	96.9	Ravn and Sterk (2017, 2021)
Vacancy Cost	$\kappa$	0.056	$\frac{\kappa}{w\phi} = 0.071$
Job Separation Rate	$\omega$	0.092	Match $\pi(eu)$ for Highschool group
Matching Elasticity	$\alpha$	0.65	Ravn and Sterk (2017, 2021)
Job Finding Probability	$\eta_{ss}$	0.67	$\pi(ue)$ in section 3.3.1
Vacancy Filling Rate	$\phi_{ss}$	0.71	den Haan et al. (2000)
Real Wage Rigidity parameter	$\phi_w$	0.837	Gornemann et al. (2021)
Government Spending	$G$	0.38	Gov. budget constraint
Decay rate of Gov. Coupons	$\delta$	0.95	5 Year Maturity of Debt
Response of Tax Rate to Debt	$\phi_B$	0.015	Auclert et al. (2020)
Taylor Rule Inflation Coefficient	$\phi_\pi$	1.5	Standard

0.65 following Ravn and Sterk (2017, 2021). The job separation rate is set to 0.092. As in section 3.3.1 we set the job finding probability in the steady state for the unemployed  $\eta_{ss}$  to 0.67. Along with the job separation rate, this gives a probability of transitioning from employment to unemployment within a quarter of 3.1 percent which is the value we use for the Highschool group in section 3.3.1. The quarterly vacancy filling rate is 0.71 as in den Haan et al. (2000) (and together with our other choices, this pins down the matching efficiency  $\chi$ ). The degree of wage rigidity  $\phi_w$  is set to 0.837 following Gornemann et al. (2021). The tax rate is set to 0.3 and government spending is set to clear the government budget constraint. The parameters that dictate the speed of fiscal adjustment,  $\phi_B$  and  $\phi_G$ , are set to

0.015, the lower bound of the estimates in Auclert et al. (2020).<sup>37</sup> Furthermore, the decay rate of government coupons is set to  $\delta = 0.95$  to match a maturity of 5 years.<sup>38</sup> Finally, the Taylor rule coefficient on inflation is set to the standard value of  $\phi_\pi = 1.5$ .

4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29

---

<sup>37</sup>The speed of adjustment parameter is set to the lower bound to ensure that the policies evaluated in the HANK and SAM model are almost entirely deficit financed.

<sup>38</sup>The duration of bonds in the model is  $\frac{(1+r)^4}{(1+r)^4 - \delta}$