Heterogeneity and Aggregate Consumption: An Empirical Assessment *

Davide Debortoli
ICREA-UPF, CREI and BSE

Jordi Galí
CREI, UPF and BSE

November 2025

Abstract

We provide an empirical assessment of a central prediction of recent heterogenous agent models with idiosyncratic income risk and incomplete markets: the existence of a role for the wealth and income distributions in shaping the dynamics of aggregate consumption. We extend the empirical consumption Euler equation framework of Campbell-Mankiw (1989) to include summary statistics of the wealth and income distributions, and show that those variables have a negligible quantitative impact on aggregate consumption. This contrasts with the important role played by current disposable income.

JEL Classification Numbers: E21, E32

Keywords: idiosyncratic income risk, incomplete markets, hand-to-mouth consumers, HANK models, TANK models

*Email: `davide.debortoli@upf.edu` and `jgali@crei.cat`. We thank participants at the CREi Faculty Lunch and the NBER Summer Institute. Antonio Giribaldi provided excellent research assistance. Galí acknowledges the financial support from the European Research Council under the European Union's Horizon 2020 research and innovation program (Grant 882332-HEMPEF). Both authors acknowledge financial support from the Agencia Estatal de Investigación (AEI), through the Severo Ochoa Programme for Centres of Excellence in R&D (Barcelona School of Economics CEX2019-000915-S) and grant PID2020-116268GB-I00 (Debortoli), and from the Generalitat de Catalunya, through the CERCA Programme.

1 Introduction

The recent literature on Heterogenous Agents New Keynesian (HANK) models has spurred a renewed interest on the role of heterogeneity in aggregate fluctuations, challenging the decades-long dominance of the representative consumer as the default assumption of business cycle models.[1] In a standard HANK model heterogeneity is introduced by assuming that households experience idiosyncratic income shocks which cannot be insured against because of incomplete financial markets. Nevertheless, the possibility of borrowing and lending (e.g. through riskless bonds), though subject to some constraints, allows households to partly smooth their consumption. In that environment the cross-sectional distributions of income and wealth become state variables of the model, shaping how the economy responds to different shocks at any point in time.[2] The inclusion of these additional state variables, however, increases the model's complexity greatly and necessitates the use of numerical methods even in relatively simple setups, an aspect that can make HANK models appear somewhat like a black-box, limiting their use in certain contexts (e.g. in the classroom).

In earlier work (Debortoli and Galí 2025) we argued that a suitably designed Two-Agent New Keynesian (TANK) model can provide a good approximation to the *theoretical predictions* of different versions of HANK models regarding the response of *aggregate* variables to *aggregate* shocks. In TANK models, the absence of idiosyncratic income shocks and, hence, of a time-varying income and wealth distribution that acts as a state variable, renders those models as tractable as the benchmark representative agent model, simplifying considerably their analysis relative to their HANK counterparts.[3]

Our aim in the present paper is to asses *empirically* the extent to which observed characteristics of the income and wealth distributions have some predictive power for aggregate consumption. Thus, while our previous work sought to assess the importance for aggregate economic fluctuations of idiosyncratic income shocks and a time-varying wealth distribution *in the context of theoretical models*, the present paper seeks to uncover the relevance of those factors *in the data*.

With that objective in mind, we construct cross-sectional statistics for the U.S. income and wealth distributions using the "real-time inequality" data set of Blanchet, Saez and Zucman (2022), which contains quarterly estimates of the distribution of wealth and disposable income obtained by combining several data sources. The same dataset allows us to identify financially constrained ("hand-to-mouth") households following criteria similar to Aguiar, Bils and Boar (2025).

We estimate both reduced form Granger causality regressions as well as theory-consistent Euler equations for aggregate consumption. The latter include cross-sectional distribution statistics as explanatory variables, in addition to aggregate disposable income as in Campbell and Mankiw (1989). Our estimates show that cross-sectional distribution statistics have a *negligible quantitative impact on aggregate consumption dynamics*. This contrasts with the *significant*

[1] See, e.g. Kaplan et al (2018) and Auclert et al. (2023) for examples of such models.

[2] In the typical HANK model, the previous features are then combined with a supply block that is similar (if not fully identical) to that characterizing the standard New Keynesian model. In particular, the supply block assumes monopolistically competitive firms as well as nominal rigidities, thus allowing monetary policy to have real effects.

[3] Shabalina and Faia (2024) obtain a similar result for larger family of quantitative HANK models.

role played by current disposable income. The latter finding confirms existing evidence of hand-to-mouth behavior among a fraction of U.S. consumers, thus lending support to macro models that incorporate that assumption.

Related Literature. Our paper belongs to the large empirical literature on the determinants of *aggregate* consumption fluctuations, based on Euler equation estimations. Seminal contributions in this area include Hall (1988), who employs a representative agent framework, and Campbell and Mankiw (1989), who extend the analysis by incorporating a fraction of "rule-of-thumb" consumers. We depart from this literature by shifting the focus toward the role of cross-sectional income and wealth distributions, drawing on theoretical insights from the recent HANK literature.

In recent years, a growing body of *empirical* research has sought to quantify the implications of household heterogeneity for aggregate economic fluctuations, using a variety of different approaches. Notable contributions include Auclert et al. (2021), Bayer, Born, and Luetticke (2024), and Acharya et al. (2024), who provide structural estimates of fully-fledged HANK models, while Bilbiie, Primiceri, and Tambalotti (2024) estimate a more tractable two-agent version of the HANK framework. Fernández-Villaverde, Hurtado, and Nuño (2019), Liu and Plagborg-Moeller (2023), Chan, Chen, and Schorfheide (2024) developed general empirical strategies that integrate macroeconomic time series and micro-level data into a single framework. Differently from these studies, we adopt a limited-information approach, exploiting a (generalized) Euler equation that is valid in a broad class of heterogeneous-agent models (with two or more households).

In this respect, our approach is related to Berger, Bocola, and Dovis (2023), who employ detailed household survey data to quantify the role of precautionary savings and idiosyncratic income risk in shaping aggregate consumption volatility. However, while their focus lies primarily on income risk and precautionary motives, our analysis centers on disentangling the distinct roles of income and wealth distributions versus hand-to-mouth behavior as drivers of aggregate consumption fluctuations.

The remainder of the paper is organized as follow. Section 2 describes the theoretical framework underlying the Euler equation for aggregate consumption which is at the center. In section 3 we provide a description of the data, followed by reduced from evidence in the form of Granger causality tests and, finally, empirical estimates of the augmented Euler equation for aggregate consumption, together with tests of the role of heterogeneity. Section 4 concludes.

2 Heterogeneity and the Euler Equation for Aggregate Consumption

In this section we review the theory underlying the Euler equation for aggregate consumption used in the empirical exercise shown below. Our theoretical framework is meant to capture the main channels through which heterogeneity may affect aggregate consumption in recent heterogeneous agent models. In accordance with empirical evidence, we allow for positive trend growth in aggregate consumption.

Consider an economy with a continuum of infinitely-lived consumers, indexed by $j \in [0,1]$. Each consumer seeks to maximize utility $\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t U(C_t(j))$ where $C_t(j)$ is an index of the quantity of goods consumed by j.[4] We assume $U(C) \equiv \frac{C^{1-\sigma}-1}{1-\sigma}$, where σ is the coefficient of relative risk aversion. The period budget constraint is given by:

$$C_t(j) + \frac{B_t(j)}{P_t} = \Xi_t(j) W_t N_t(j) + D_t(j) + F_t(j) - T_t(j) + \frac{(1+i_{t-1})B_{t-1}(j)}{P_t}$$

where $B_t(j)$ denotes holdings of one-period nominally riskless bonds yielding an interest rate i_t. P_t is the price level. $\Xi_t(j)$ is a measure of idiosyncratic productivity (expressed in efficiency units per hour), W_t is the real wage per efficiency unit, and $N_t(j)$ denotes the number of hours worked. $D_t(j)$ are dividends from firms' stocks. $F_t(j)$ denotes the (net) cash-flows from the sales and/or purchases of assets other than bonds, net of any transaction costs. $T_t(j)$ are taxes paid (net of transfers received). In our stylized framework bonds stand in for *liquid* assets, to which the following borrowing constraint applies

$$\frac{B_t(j)}{P_t} \geq -\Psi_t(j)$$

where $\Psi_t(j) > 0$ is the borrowing limit, which is possibly time varying and idiosyncratic. Note that the inclusion of the term $F_t(j)$ in the budget constraint above allows for the availability of assets other than bonds (e.g. stocks), which may be subject to their own constraints (e.g. non-negative holdings) and/or transaction costs on the adjustment of their holdings (thus allowing for different degrees of liquidity).

Note that in any period we can partition the set of consumers into two subsets on the basis of whether their borrowing constraint is binding or not in that period. We refer the two types as unconstrained and hand-to-mouth. Next we discuss their consumption behavior in turn.

2.1 Unconstrained Consumers

Let $\mathcal{U}_t \equiv \{j \in [0,1] : B_t(j)/P_t > -\Psi_t(j)\}$ denote the subset of consumers for whom the borrowing constraint is not binding in period t. Then the optimality condition

$$1 = \beta(1+i_t)\mathbb{E}_t\{(C_{t+1}(j)/C_t(j))^{-\sigma}\Pi_{t+1}^{-1}\}$$

must hold for all $j \in \mathcal{U}_t$, where $\Pi_t \equiv P_t/P_{t-1}$ denotes gross inflation. We assume $\mathcal{U}_t$ has measure $1-\lambda_t$. Henceforth we refer to these consumers as *the unconstrained.*

As shown in the Appendix, a second-order Taylor expansion of the previous equation along a balanced growth path in which consumption grows at a rate γ yields the approximate relation:

$$\mathbb{E}_t\left\{\frac{C_{t+1}(j)}{(1+\gamma)C_t(j)} - 1\right\} = \frac{1}{\sigma}\left(1 - \frac{(1+\gamma)^{\sigma}}{\beta R_t}\right) + \frac{\sigma+1}{2} v_t(j) \tag{1}$$

where $R_t \equiv (1+i_t)\mathbb{E}_t\left\{\Pi_{t+1}^{-1}\right\}$ is the gross ex-ante real interest rate, and $v_t(j) \equiv \mathbb{E}_t\left\{\left(\frac{C_{t+1}(j)}{(1+\gamma)C_t(j)} - 1\right)^2\right\}$. Note that $v_t(j)$ is a measure of individual consumption risk which can be approximated by

[4] An additive term representing disutility of labor could be added, allowing for an endogenous choice of hours worked, without affecting any of the subsequent analysis.

$v_t(j) \simeq var_t\{c_{t+1}(j)\}$, the conditional variance of $c_t(j) \equiv \log C_t(j)$. By including the "second order" term $v_t(j)$ we are implicitly allowing its variations to be of the same order of magnitude as variations in the macro variables of interest, in particular, aggregate consumption and the real interest rate. In the absence of idiosyncratic income risk, $v_t(j) = v_t = var_t\{c_{t+1}\}$, whose variations are by construction an order of magnitude smaller than those in aggregate consumption, and are thus generally ignored when deriving an approximate Euler equation for aggregate consumption.

Integrating (1) over $j \in \mathcal{U}_t$ we obtain:[5]

$$\mathbb{E}_t\left\{\frac{C^U_{t+1|t}}{(1+\gamma)C^U_t} - 1\right\} = \frac{1}{\sigma}\left(1 - \frac{(1+\gamma)^\sigma}{\beta R_t}\right) + \frac{\sigma+1}{2}v^U_t \tag{2}$$

where $C^U_t = \frac{1}{1-\lambda_t}\int_{j\in\mathcal{U}_t} C_t(j)dj$ and $C^U_{t+1|t} = \frac{1}{1-\lambda_t}\int_{j\in\mathcal{U}_t} C_{t+1}(j)dj$ respectively denote average consumption in period t and $t+1$ among households who are unconstrained in period t, and $v^U_t \equiv \frac{1}{1-\lambda_t}\int_{j\in\mathcal{U}_t}\frac{C_t(j)}{C^U_t}v_t(j)dj$ is a consumption-weighted average of individual consumption risk among unconstrained consumers, which in our earlier work we referred to as a *risk shifter*.

Equivalently, we can write:

$$\mathbb{E}_t\left\{\frac{C^U_{t+1}}{(1+\gamma)C^U_t} - 1\right\} \simeq \frac{1}{\sigma}\left(1 - \frac{(1+\gamma)^\sigma}{\beta R_t}\right) + \frac{\sigma+1}{2}v^U_t + h^U_t \tag{3}$$

where $h^U_t \equiv \frac{\mathbb{E}_t\{C^U_{t+1} - C^U_{t+1|t}\}}{(1+\gamma)C^U_t}$. Note that h^U_t emerges as a result of changes in the composition of $\mathcal{U}_t$, which imply that some households who are unconstrained at t become constrained at $t+1$, and viceversa, so that in general we have $C^U_{t+1} \neq C^U_{t+1|t}$.

Note that variations over time in v^U_t and h^U_t result from aggregate shocks interacting with the initial wealth and income distribution, since the latter determines (i) the proximity of each consumer to his borrowing constraint, which affects his marginal propensity to consume and his implied consumption risk, and (ii) the measure and identity of consumers that are unconstrained in any given period. In particular we would expect v^U_t to be decreasing in the mean of the cross-sectional distribution of wealth and income, and increasing in its standard deviation and skewness.[6]

Log-linearizing (3) around a balanced growth path yields the approximate relation:

$$\mathbb{E}_t\{\Delta c^U_{t+1}\} = \frac{1}{\sigma}\widehat{r}_t + \frac{\sigma+1}{2}\widehat{v}^U_t + \widehat{h}^U_t \tag{4}$$

where $c^U_t \equiv \log C^U_t$, $r_t \equiv i_t - \mathbb{E}_t\{\pi_{t+1}\}$ and $\pi_{t+1} \equiv \log(P_{t+1}/P_t)$, where a "hat" denotes deviations from steady state values.[7] Note that we can rewrite (4) more conveniently as

$$\Delta c^U_t = \gamma + \frac{1}{\sigma}\widehat{r}_{t-1} + \frac{\sigma+1}{2}\widehat{v}^U_{t-1} + \widehat{h}^U_{t-1} + \xi^U_t \tag{5}$$

[5]In order to derive (2) we multiply both sides of (1) by $C_t(j)$ before integration. After integration we divide both sides by C^U_t. See Appendix for details.

[6]See Debortoli and Galí (2024) for a discussion.

[7]As shown in the Appendix, the coefficient on the real interest rate equals $\frac{1}{\sigma}\left[1 + \frac{\sigma(\sigma+1)}{2}v^U + \sigma h^U\right]$ which is approximately equal to $\frac{1}{\sigma}$ for plausibly small values of v^U and h^U.

where $\xi_t^U \equiv c_t^U - \mathbb{E}_{t-1}\{c_t^U\}$ is the period t innovation in unconstrained consumption. Below we use equation (5) as a block in the derivation of our empirical equation for aggregate consumption.

2.2 Hand-to-Mouth Consumers

Let $\mathcal{H}_t \equiv \{j \in [0,1] : B_t(j)/P_t = -\Psi_t(j)\}$ denote the subset of consumers who are against their borrowing constraint in period t. Henceforth we refer to these consumers as *hand-to-mouth* (or HtM for short). The measure of $\mathcal{H}_t$ is denoted by λ_t. For all $j \in \mathcal{H}_t$ we have

$$C_t(j) = Y_t(j) + \Phi_t(j)$$

where $Y_t(j) \equiv \Xi_t(j)W_tN_t(j) + D_t(j) - T_t(j) + \frac{i_{t-1}B_{t-1}(j)}{P_t}$ is disposable income and $\Phi_t(j) \equiv F_t(j) + \frac{B_{t-1}(j)}{P_t} + \Psi_t(j)$ measures the net cashflow from the eventual sales and purchases of assets (bonds and other) between $t-1$ and t. Thus, our formulation implies that the hand-to-mouth category may also include the *wealthy hand-to-mouth*, i.e. consumers who cannot issue more liquid debt, but who may own some less liquid assets which they can sale at some cost.[8]

Integrating over $j \in \mathcal{H}_t$ we obtain an expression for average hand-to-mouth consumption $C_t^H \equiv \frac{1}{\lambda_t}\int_{j\in\mathcal{H}_t} C_t(j)dj$

$$C_t^H = Y_t^H + \Phi_t$$

where $Y_t^H \equiv \frac{1}{\lambda_t}\int_{j\in\mathcal{H}_t} Y_t(j)dj$ and $\Phi_t^H \equiv \frac{1}{\lambda_t}\int_{j\in\mathcal{H}_t} \Phi_t(j)dj$.

Assuming stationarity of Φ_t^H/Y_t^H with a mean close to zero we can write the approximate relation

$$\Delta c_t^H \simeq \Delta y_t^H + \Delta\phi_t^H \tag{6}$$

where $y_t^H \equiv \log Y_t^H$ and $\Delta\phi_t^H \equiv \frac{\Delta\Phi_t^H}{Y_{t-1}}$

2.3 Aggregation

Aggregate consumption $C_t = \int_0^1 C_t(j)dj$ can be written as:

$$C_t = \lambda_t C_t^H + (1-\lambda_t)C_t^U$$

Letting $\Theta_t \equiv C_t^H/C_t$ and assuming stationarity of both Θ_t and λ_t, we can write:

$$\Delta c_t \simeq \lambda\Theta\Delta c_t^H + (1-\lambda\Theta)\Delta c_t^U - \delta\Delta\lambda_t \tag{7}$$

where $\delta \equiv \frac{C^U - C^H}{C} = \frac{1-\Theta}{1-\lambda}$ is the (normalized) steady state gap between unconstrained and hand-to-mouth consumption. Though not required in what follows, it is plausible to assume $C^H < C^U$ which implies $\Theta < 1$ and $\delta > 0$.

Combining (7) with (5) and (6) we can write

$$\Delta c_t \simeq (1-\lambda\Theta)\gamma + \lambda\Theta\Delta y_t^H + \frac{1-\lambda\Theta}{\sigma}\widehat{r}_{t-1} + d_{t-1} + \xi_t \tag{8}$$

[8] The coexistence of poor and wealthy hand-to-mouth is a feature of recent HANK models with multiple assets which seems to be consistent by the evidence as well. See, e.g. Kaplan et al. (2018).

where

$$d_{t-1} \equiv (1-\lambda\Theta)\left[\frac{\sigma+1}{2}\widehat{v}_{t-1}^{U}+\widehat{h}_{t-1}^{U}\right]+\lambda\Theta\mathbb{E}_{t-1}\{\Delta\phi_t^H\}-\delta\mathbb{E}_{t-1}\{\Delta\lambda_t\}$$

and

$$\xi_t \equiv (1-\lambda\Theta)\xi_t^U+\lambda\Theta(\phi_t^H-\mathbb{E}_{t-1}\{\phi_t^H\})-\delta(\lambda_t-\mathbb{E}_{t-1}\{\lambda_t\})$$

Note that d_{t-1} collects all the terms that capture the impact of incomplete markets and idiosyncratic shocks on the anticipated component of consumption growth, and which should thus be a function of the income and wealth distributions, the model state variables. On the other hand, the error term ξ_t in (8) satisfies the martingale difference property by construction, so that $\mathbb{E}_t\{\xi_t \mathbf{z}_{t-1}\}=0$ for any variable $\mathbf{z}_{t-1}$ observed in period $t-1$.

Equation (8) nests the representative agent model ($\lambda_t=\lambda=0$, for all t) as well as two-agent models with no idiosyncratic risk and a constant debt limit ($\lambda_t=\lambda>0$, and $d_t=\Delta\phi_t^H=0$ for all t).

Below we use equation (8) as the theoretical benchmark for our empirical work. In particular, we seek to uncover the role of variations in the cross-sectional moments of the income and wealth distributions as a factor behind fluctuations in x_t and, hence, in aggregate consumption.

3 Heterogeneity and Aggregate Consumption: Empirical Evidence

In the present section we present evidence on the predictive power of cross-sectional distributions of income and wealth. We start with a brief description of the data, followed by reduced from evidence in the form of Granger causality tests and, finally, empirical estimates of the augmented Euler equation derived above.

3.1 Data

Our empirical approach makes use of household-level data on wealth and disposable income for the U.S. economy from the "Real-Time Inequality" data set described in Blanchet, Saez and Zucman (2022). That dataset combines the information contained in several high-frequency public data sources, as well as the quarterly national accounts statistics.[9]

The information contained in that dataset allows us to construct time series for a number of statistics describing the cross-sectional distribution of disposable income, as well as total and liquid wealth (net of the corresponding liabilities) for all households, or for a subset of households meeting some criterion. For both the income and wealth distributions we compute for each quarter the standard deviation and the skewness (both relative to the cross sectional mean of the corresponding variable). For the wealth distributions we compute, in addition, the detrended (log) mean, using a second order polynomial of time to fit the trend.

We use criteria similar to those proposed in Aguiar, Boar and Bils (2024), to identify the set of *hand-to-mouth* households in any given period, and compute their average disposable income, which we use as a proxy for Y_t^H in the theoretical framework above.

[9]Data can be downloaded from the *realtimeinequality.org* website.

In addition to the household-level data described above, our empirical analysis also uses time series for aggregate consumption of nondurables and services and aggregate disposable income (both expressed in constant prices and per capita terms), the nominal yield on 3-month Treasury Bills, and the consumer price index for all urban consumers. We use the latter two variables to construct a time series for the realized real interest rate, $i_t - \pi_{t+1}$. These macro data were drawn from the Fred database hosted by the St. Louis Fed.

The data frequency is quarterly and spans the period 1976Q1-2019Q4. We leave out the COVID episode since it clearly distorts all of our estimates due to the unusual comovements between disposable income and consumption.

3.2 Reduced Form Evidence

In this section we report some basic reduced form evidence on the role of income and wealth distributions in shaping the dynamics of aggregate consumption. Table 1 focuses on Granger-causality tests based on an OLS regression of the first-difference of log of (per capita) consumption on its own lag, as well as the lags of the additional variables listed on each row of the Table. The (ex-post) real interest rate and the first-differenced log per capita disposable income are included as explanatory variables in all the regressions. The regressions described in the second to fourth rows of the Table also include, separately and jointly by turn, the moments of the income and wealth distributions (denoted by $\{y\}$ and $\{w\}$, respectively). For each specification we report the corresponding R^2 and the p-value for the null of no Granger-causality from the variables listed in square brackets.

As shown in the first row, lagged interest rates and disposable income growth Granger-cause consumption growth, with a significance level below 5 percent. By contrast, the statistics reported in rows two to four point to the lack of predictive power for consumption of the income and wealth distribution moments, beyond that of the interest rate and disposable income. This is reflected in inability to reject the null of no Granger causality at conventional significance levels, as well as in the tiny increase in the R^2 statistic resulting from the addition of the distribution moments.

3.3 Empirical Euler Equations

In this subsection we report estimates of alternative versions of the following equation for aggregate consumption:

$$\Delta c_t = \alpha_0 + \alpha_r(i_{t-1} - \pi_t) + \alpha_y \Delta y_t^H + \boldsymbol{\alpha}_x' \mathbf{x}_{t-1} + \varepsilon_t \tag{9}$$

where c_t denotes (log) per capita consumption of nondurables and services, y_t denotes (log) per capita disposable income, i_t is the interest rate on 3-month Treasury Bills, π_t is CPI inflation between $t-1$ and t, and $\mathbf{x}_t$ is a vector of statistics describing the cross-sectional distribution of wealth and income at time t. Implicit in the previous specification is the maintained assumption that one or more of the variables in $\mathbf{x}_t$ are correlated with d_t, i.e. the term in (8) which captures the impact on consumption of variations in cross-sectional distributions resulting from the interaction of aggregate and idiosyncratic shocks. Under the previous assumption, $\mathbf{x}_{t-1}$ should have some explanatory power for Δc_t (i.e., $\boldsymbol{\alpha}_x$ will be significant) as long as variations in income and wealth distributions have a non-negligible role in shaping the dynamics of aggregate consumption, the hypothesis that is the focus of the present investigation. Finally, note that the error term in (9) can be viewed as a composite of the disturbance ξ_t in (8) and the surprise in inflation, i.e. $\varepsilon_t \equiv \xi_t + \pi_t - \mathbb{E}_{t-1}\{\pi_t\}$, with $\mathbb{E}_t\{\xi_t \mathbf{z}_{t-1}\} = 0$ for any variable $\mathbf{z}_{t-1}$ observed in period $t-1$.[10]

3.3.1 Campbell-Mankiw Revisited

In their seminal paper, Campbell and Mankiw (1989) provided estimates of an Euler equation for aggregate consumption, allowing for a contemporaneous impact of disposable income. Their baseline specification was given by

$$\Delta c_t = \alpha_0 + \alpha_r(i_{t-1} - \pi_t) + \alpha_y \Delta y_t + \varepsilon_t \tag{10}$$

which can be interpreted as being nested in (9), with first-differenced log per capita disposable income Δy_t as a proxy for Δy_t^H, and excluding cross-sectional distribution statistics as explanatory variables.

In the present subsection we take the previous specification as a benchmark and re-estimate it for the sample period 1976Q1-2019Q4. Other than the sample period, we follow Campbell-Mankiw as closely as possible and, in particular, we use lags 2 through 4 of both consumption growth and the right-hand variables as instruments. Excluding the first lag is justified on the grounds of potential correlation between ε_t and $i_{t-2} - \pi_{t-1}$, Δc_{t-1}, and Δy_{t-1} due to time aggregation.

Column (1) of Table 2 reports estimates of a restricted version of (10) with $\alpha_y = 0$ That specification is consistent with the representative agent model and was originally estimated by Hall (1988). The estimates of α_r are positive and significant at the 1 percent level, in a way consistent with the theory. Through the lens of the representative agent model the observed estimate implies a relatively low elasticity of substitution, consistent with a value for σ around 4.

Estimates of the benchmark Campbell-Mankiw model (10) are reported in column (2) of Table 2. Both the interest rate and disposable income growth display positive coefficients. The estimate of α_y suggests that about a third of aggregate consumption is carried out by hand-to-mouth households. This estimate lies somewhat below the range of estimates reported in Campbell and Mankiw (1989), but still it points a substantial role for hand-to-mouth behavior. This implies a clear rejection of the representative consumer model. Under the plausible assumption that $\Theta \leq 1$, that estimate should be interpreted as a lower bound on the fraction of constrained households. Interestingly the estimate of α_r is little affected by the inclusion of Δy_t in the estimated equation. Yet, through the lens of the TANK model, α_r no longer corresponds to the elasticity of intertemporal substitution $1/\sigma$, as equation (8) makes clear. Instead we have $1/\sigma = \alpha_r/(1-\alpha_y)$ which is roughly 0.35, corresponding to $\sigma \simeq 3$, a plausible value.

The remaining columns of Table 2 report estimates of an augmented Campbell-Mankiw regression, with several moments of the cross-sectional distributions of wealth and/or income

[10] Strictly speaking, the previous property will hold under the null of $d_t = 0$ for all t, implying $\boldsymbol{\alpha}_x = 0$. Otherwise we have

$$\varepsilon_t \equiv \xi_t + (\pi_t - \mathbb{E}_{t-1}\{\pi_t\}) + (d_{t-1} - \boldsymbol{\alpha}_x' \mathbf{x}_{t-1})$$

which may be correlated with lagged variables.

included as additional explanatory variables. In none of the three specifications considered –augmented with wealth moments (column 3), income moments (column 4) and both (column 5)– we find any significant explanatory power for any of the additional variables, as reflected in the t-statistic for the each individual variable as well as in the p-values for their joint significance. In these additional regressions the point estimates of α_r and α_y remain largely unchanged.

An additional perspective on the limited role played by the cross-sectional distribution statistics as a source of consumption dynamics can be obtained by looking at the correlation between two times series for fitted consumption growth: one based on the estimated baseline Campbell-Mankiw regression against one generated by the estimates of each of the augmented models in columns (3)-(5). That correlation, reported on the bottom row of Table 2, is near unity for each of those augmented models, suggesting a negligible quantitative role for the distribution moments. We further illustrate this point by showing in Figure 1 the fitted consumption growth from the baseline model and from the model augmented with both wealth and income moments corresponding to column (5).[11] By contrast, we see that the correlation between fitted consumption growth from the baseline model and that from the restricted Hall (1988) model is only 0.61, a much lower value, which highlights the substantial quantitative impact of current income in shaping aggregate consumption dynamics.

3.3.2 Alternative Estimates using a Measure of Hand-to-Mouth Disposable Income

In the previous subsection we have reported estimates of several versions of the Campbell-Mankiw model. A common feature of all the estimated models, shared by the original Campbell-Mankiw paper, is the use of the growth rate of *aggregate* disposable income per capita (Δy_t) as a proxy for the growth rate of average disposable income *of the hand-to-mouth* (Δy_t^H). The latter variable should clearly be the relevant one according to the analysis above (see equation (8)), but the fact that it is not readily observed explains the use of its aggregate counterpart in Campbell and Mankiw (1989) and subsequent applications.

In the present section we re-do the empirical analysis above using an alternative proxy for Δy_t^H. We construct our new variable by aggregating household-level disposable income data for households we identify as hand-to-mouth in each period, using data from the "Real Time Inequality" dataset described above combined with the criteria set by Aguiar et al. (2025) to determine to determine who are the hand-to-mouth.

Aguiar et al. (2025) propose two alternative criteria to identify the hand-to-mouth, based on total wealth and liquid wealth, respectively. Under the first criterion they label a household as hand-to-mouth if its total net wealth is less than two months of its disposable income. Under the second criterion hand-to-mouth households are those with net liquid wealth (liquid assets minus non-mortgage debt) less than one week of disposable income. The first criterion is more restrictive and can be viewed as selecting "overall poor" households, while the second identifies as hand-to-mouth also wealthier households with limited liquid assets. We construct measures of Δy_t^H based on each criterion and use them to estimate (8).

[11] In order to facilitate a visual comparison, the figure displays year-on-year growth rates, constructed using fitted quarter-to-quarter growth rates. A very similar picture emerges when the estimated models reported in columns (3) and (4) are used to fit comsumption growth.

While this alternative measure may be a better proxy for Δy_t^H than its aggregate counterpart, it is bound to be measured with error given the unavoidable arbitrariness of the criteria used to identify the hand-to-mouth. Under the assumption that any measurement error in the new constructed variable is orthogonal to aggregate disposable income growth, we can use lags of the latter variable as instruments.[12]

Table 3 reports the estimates of (8) using the measure of Δy_t^H based on the total wealth criterion. Column (1) shows estimates with no additional distribution-related regressors, whereas columns (2) through (4) include the moments of the cross-sectional distributions of wealth, income, and both wealth and income, respectively. The picture that emerges is very similar to that in Table 2. Firstly, both the coefficients on the interest rate and disposable income growth are positive and significant across specifications, and their values are economically plausible (and in the ballpark of those shown in Table 2). Most importantly for our purposes, the additional variables are never significant at the 10 percent level, either individually or jointly. In addition, the correlation of fitted consumption growth from the augmented models with the same fitted variable generated by the baseline model is near unity in all cases.

Table 4 displays the corresponding estimates using the measure of Δy_t^H based on the liquid wealth criterion. Once again the results are very similar to those shown in Table 3, except for the fact that the coefficients on the interest rate and on the alternative income measure are estimated much less precisely in all the specifications and are generally shown as insignificant at conventional levels. On the other hand the moments of the cross-sectional distributions are always insignificant, and the correlations of fitted consumption generated by the different specifications are again close to unity, in a way consistent with the evidence above.

4 Concluding Remarks

In the present paper we offer an empirical assessment of the potential role of wealth and income distributions in shaping the dynamics of aggregate consumption. That role is a hallmark of recent heterogenous agent models with idiosyncratic income risk and incomplete markets

Our estimates are based on reduced form regressions as well as on estimated Euler equations for aggregate consumption, both augmented to include moments for the cross-sectional distributions of wealth and income. In all our specifications the cross-sectional moments are shown to be statistically insignificant and to have a negligible quantitative explanatory power for aggregate consumption. This contrasts with the important role uncovered for current disposable income, thus confirming (and updating) a central result in Campbell and Mankiw (1989).

Our findings can be interpreted as providing support for the class of tractable TANK models. The latter abstract from the presence of idiosyncratic shocks and the implied role of wealth and income distributions as state variables, while stressing the importance of hand-to-mouth consumers.

[12]Note that this is preferable to using lagged values of Δy^H itself as instruments since the latter would not be valid in the likely event of persistent (auto-correlated) measurement error. The remaining instruments are as in the analysis above.

References

Aguiar, Mark, Mark Bils and Corina Boar (2025): "Who are the Hand-to-Mouth?," *Review of Economic Studies* 92(3), 1293-1340.

Auclert, Adrien, Matthew Rognlie, and Ludwig Straub (2023): "The Intertemporal Keynesian Cross," *Journal of Political Economy* 132(12), 4068-4121.

Bayer, Christian, Benjamin Born, and Ralph Luetticke (2024): "Shocks, Frictions, and Inequality in U.S. Business Cycles," *American Economic Review* 114(5), 1212-1247.

Berger, David, Luigi Bocola, and Alessandro Dovis (2023): "Imperfect Risk Sharing and the Business Cycle," *Quarterly Journal of Economics* 138(3), 1765-1815.

Bilbiie, Florin, Giorgio Primiceri and Andrea Tambalotti (2023): "Inequality and Business Cycles," mimeo

Blanchet, Thomas, Emmanuel Saez, Gabriel Zucman (2022): "Real-Time Inequality," NBER WP# 30229.

Campbell, John Y. and N. Gregory Mankiw (1989): "Consumption, Income, and Interest Rates: Reinterpreting the Time Series Evidence," *NBER Macroeconomics Annual,* 4, 185-216.

Debortoli, Davide and Jordi Galí (2024): "Idiosyncratic Income Risk and Aggregate Fluctuations," *American Economic Journal: Macroeconomics* 16(4), 279-310.

Debortoli, Davide and Jordi Galí (2025): "Heterogeneity and Aggregate Fluctuations: Insights from TANK Models," *NBER Macroeconomics Annual,* 39(1), 307-357

Farhi, Emmanuel and Iván Werning (2017): "Monetary Policy, Bounded Rationality and Incomplete Markets," *American Economic Review* 109(11), 3887-3928.

Faia, Ester and Ekaterina Shabalina (2024): "What Central Bankers Can Learn from Models with Idiosyncratic Risk," mimeo.

Gimeno-Ribes, Jaime (2024): "A Model of Consumption with Mental Accounting and Incomplete Markets," unpublished manuscript.

Hall, Robert E. (1988): "Intertemporal Substitution in Consumption," *Journal of Political Economy* 96(2), 339-357.

Kaplan, Greg, Giovanni L.Violante and Justin Weidner (2014): "The Wealthy Hand-to-Mouth " *Brooking Papers on Economic Activity*, 1, 77-153.

Kaplan, Greg, Benjamin Moll, and Giovanni L.Violante (2018): "Monetary Policy according to HANK," *American Economic Review* 108(3), 697-743.

APPENDIX: Derivation of the Aggregate Euler Equation

Our starting point is the individual Euler equation

$$1 = \beta(1+i_t)\mathbb{E}_t\left\{\left(\frac{C_{t+1}(j)}{C_t(j)}\right)^{-\sigma}\frac{P_t}{P_{t+1}}\right\} \tag{11}$$

which we can conveniently rewrite as follows:

$$\frac{(1+\gamma)^{\sigma}}{\beta R_t} = \mathbb{E}_t\left\{\left(\frac{C_{t+1}(j)}{(1+\gamma)C_t(j)}\right)^{-\sigma}\frac{\Pi_{t+1}^{-1}}{\mathbb{E}_t\left\{\Pi_{t+1}^{-1}\right\}}\right\} \tag{12}$$

where $\Pi_t \equiv P_t/P_{t-1}$ denotes gross inflation, $R_t \equiv (1+i_t)\mathbb{E}_t\left\{\Pi_{t+1}^{-1}\right\}$ is the gross real interest rate and γ is the rate of growth for aggregate consumption along a balanced growth path:

Consider the following approximation of the right hand side of (12) for fluctuations in a neighborhood of a balanced growth path with constant inflation:

$$\begin{aligned}\left(\frac{C_{t+1}(j)}{(1+\gamma)C_t(j)}\right)^{-\sigma}\frac{\Pi_{t+1}^{-1}}{\mathbb{E}_t\left\{\Pi_{t+1}^{-1}\right\}} \simeq\ & 1+\left(\frac{\Pi_{t+1}^{-1}}{\mathbb{E}_t\left\{\Pi_{t+1}^{-1}\right\}}-1\right) \\ & -\sigma\left(\frac{C_{t+1}(j)}{(1+\gamma)C_t(j)}-1\right)+\frac{\sigma(\sigma+1)}{2}\left(\frac{C_{t+1}(j)}{(1+\gamma)C_t(j)}-1\right)^2\end{aligned}$$

where we have dropped all the terms of order higher than that of fluctuations in aggregate variables. In particular, we drop the terms involving $\left(\frac{C_{t+1}(j)}{(1+\gamma)C_t(j)}-1\right)\left(\frac{\Pi_{t+1}^{-1}}{\mathbb{E}_t\left\{\Pi_{t+1}^{-1}\right\}}-1\right)$ and $\left(\frac{\Pi_{t+1}^{-1}}{\mathbb{E}_t\left\{\Pi_{t+1}^{-1}\right\}}-1\right)^2$.

Taking conditional expectations, substituting into (12) and rearranging we obtain:

$$\mathbb{E}_t\left\{\frac{C_{t+1}(j)}{(1+\gamma)C_t(j)}-1\right\} = \frac{1}{\sigma}\left(1-\frac{(1+\gamma)^{\sigma}}{\beta R_t}\right)+\frac{\sigma+1}{2}v_t(j)$$

where $v_t(j) \equiv \mathbb{E}_t\left\{\left(\frac{C_{t+1}(j)}{(1+\gamma)C_t(j)}-1\right)^2\right\} \simeq var\{\xi_{t+1}(j)\}$ with $\xi_t(j) = c_t(j)-\mathbb{E}_{t-1}\{c_t(j)\}$ and $c_t(j) \equiv \log C_t(j)$.

Rearranging terms:

$$\mathbb{E}_t\left\{C_{t+1}(j)-(1+\gamma)C_t(j)\right\} = \frac{1}{\sigma}(1+\gamma)C_t(j)\left(1-\frac{(1+\gamma)^{\sigma}}{\beta R_t}\right)+\frac{\sigma+1}{2}(1+\gamma)C_t(j)v_t(j)$$

Integrating the previous equation over $j \in \mathcal{U}_t$ and dividing by $(1-\lambda_t)(1+\gamma)C_t^U$

$$\mathbb{E}_t\left\{\frac{C_{t+1|t}^U-(1+\gamma)C_t^U}{(1+\gamma)C_t^U}\right\} = \frac{1}{\sigma}\left(1-\frac{(1+\gamma)^{\sigma}}{\beta R_t}\right)+\frac{\sigma+1}{2}v_t^U$$

where $C_t^U = \frac{1}{1-\lambda_t}\int_{j\in\mathcal{U}_t} C_t(j)dj$, $C_{t+1|t}^U = \frac{1}{1-\lambda_t}\int_{j\in\mathcal{U}_t} C_{t+1}(j)dj$, and $v_t^U \equiv \frac{1}{1-\lambda_t}\int_{j\in\mathcal{U}_t}\frac{C_t(j)}{C_t^U}v_t(j)dj$. Equivalently, we can write:

$$\mathbb{E}_t\left\{\frac{C_{t+1}^U-(1+\gamma)C_t^U}{(1+\gamma)C_t^U}\right\}=\frac{1}{\sigma}\left(1-\frac{(1+\gamma)^\sigma}{\beta R_t}\right)+\frac{\sigma+1}{2}v_t^U+h_t^U \tag{13}$$

where $h_t^U \equiv \mathbb{E}_t\left\{\frac{C_{t+1}^U-C_{t+1|t}^U}{(1+\gamma)C_t^U}\right\}$. Note that h_t^U emerges as a result of changes in the composition of $\mathcal{U}_t$, which imply that some households who are unconstrained a t become constrained at $t+1$, and viceversa, so that in general we have $C_{t+1}^U \neq C_{t+1|t}^U$.

Note that in the stochastic steady state

$$\frac{1}{\sigma}\left(1-\frac{(1+\gamma)^\sigma}{\beta R}\right)+\frac{\sigma+1}{2}v^U+h^U=0$$

thus implying $\beta R<(1+\gamma)^\sigma$. Wealthy households (with high consumption) will have $v_t(j)>v$ and hence will experience lower consumption growth (on average). The opposite will be true for poor households, whose consumption will tend to grow faster. Consistently with that property, the stochastic steady state is characterized by a well defined distribution of consumption across households (which also corresponds to the ergodic distribution of individual consumption).

A first order Taylor expansion of (13) around the stochastic steady state yields the approximate relation in the text:

$$\mathbb{E}_t\{\Delta c_{t+1}^U\}=\gamma+\frac{(1+\gamma)^\sigma}{\sigma\beta R}\widehat{r}_t+\frac{\sigma+1}{2}\widehat{v}_t^U+\widehat{h}_t^U$$

where $c_t^U \equiv \log C_t^U$ and $r_t \equiv \log R_t$. Note that $\frac{(1+\gamma)^\sigma}{\sigma\beta R}=\frac{1}{\sigma}+\frac{\sigma+1}{2}v^U+h^U \simeq \frac{1}{\sigma}$ for plausible values of v^U, h^U and σ, thus justifying the approximate relation used in the text.

Table 1. Granger Causality for Δc_t

Lagged predictors	*p-value*	R^2
$\Delta c, [r, \Delta y]$	0.044	0.237
$\Delta c, r, \Delta y, [\{w\}]$	0.260	0.250
$\Delta c, r, \Delta y, [\{y\}]$	0.532	0.242
$\Delta c, r, \Delta y, [\{w\}, \{y\}]$	0.515	0.256

Table 2. Empirical Euler Equations: Campbell-Mankiw Revisited

	Aggregate Disposable Income				
	(1)	(2)	(3)	(4)	(5)
r_{t-1}	0.275^{***} (0.065)	0.225^{***} (0.071)	0.185 (0.115)	0.238^{***} (0.081)	0.204^{*} (0.118)
Δy_t		0.363^{***} (0.119)	0.355^{***} (0.119)	0.351^{***} (0.119)	0.351^{**} (0.120)
Wealth					
mean			0.001 (0.005)		−0.001 (0.006)
s.d.			−0.296 (0.893)		−0.104 (1.039)
skewness			0.070 (0.544)		−0.140 (0.753)
Income					
s.d.				−1.302 (1.822)	−1.210 (2−301)
skewness				0.364 (0.499)	−0.398 (0.730)
p-value			0.945	0.763	0.984
correlation	0.601	**1.00**	0.996	0.997	0.996

Table 3. Empirical Euler Equations: Alternative Income Measure

Hand-to-Mouth Disposable Income (Total Wealth Criterion)

	(1)	(2)	(3)	(4)
r_{t-1}	0.261***	0.154	0.217**	0.218*
	(0.077)	(0.131)	(0.093)	(0.13′)
Δy_t^H	0.224**	0.241**	0.237**	0.215*
	(0.096)	(0.117)	(0.099)	(0.115)
Wealth				
mean		−0.005		−0.005
		(0.007)		(0.007)
s.d.		−0.787		−0.565
		(1.103)		(1.136)
skewness		0.042		0.466
		(0.615)		(0.878)
Income				
s.d.			−1.402	−1.847
			(2.018)	(2.535)
skewness			0.070	0.161
			(0.587)	(0.815)
p-value		0.737	0.350	0.836
correlation	**1.00**	0.979	0.983	0.979

Table 4. Empirical Euler Equations: Alternative Income Measure

Hand-to-Mouth Disposable Income (Liquid Wealth Criterion)

	(1)	(2)	(3)	(4)
r_{t-1}	0.199^{**}	0.104	0.196^{*}	0.152
	(0.089)	(0.123)	(0.104)	(0.115)
Δy_t^H	0.364^{*}	0.267	0.326	0.166
	(0.225)	(0.209)	(0.213)	(0.192)
Wealth				
mean		0.001		0.002
		(0.006)		(0.005)
s.d.		−1.215		−0.989
		(0.919)		(1.018)
skewness		0.385		0.515
		(0.533)		(0.913)
Income				
s.d.			−1.356	0.088
			(1.983)	(2.288)
skewness			0.240	−0.164
			(0.572)	(0.810)
p-value		0.475	0.664	0.755
correlation	**1.00**	0.973	0.994	0.917

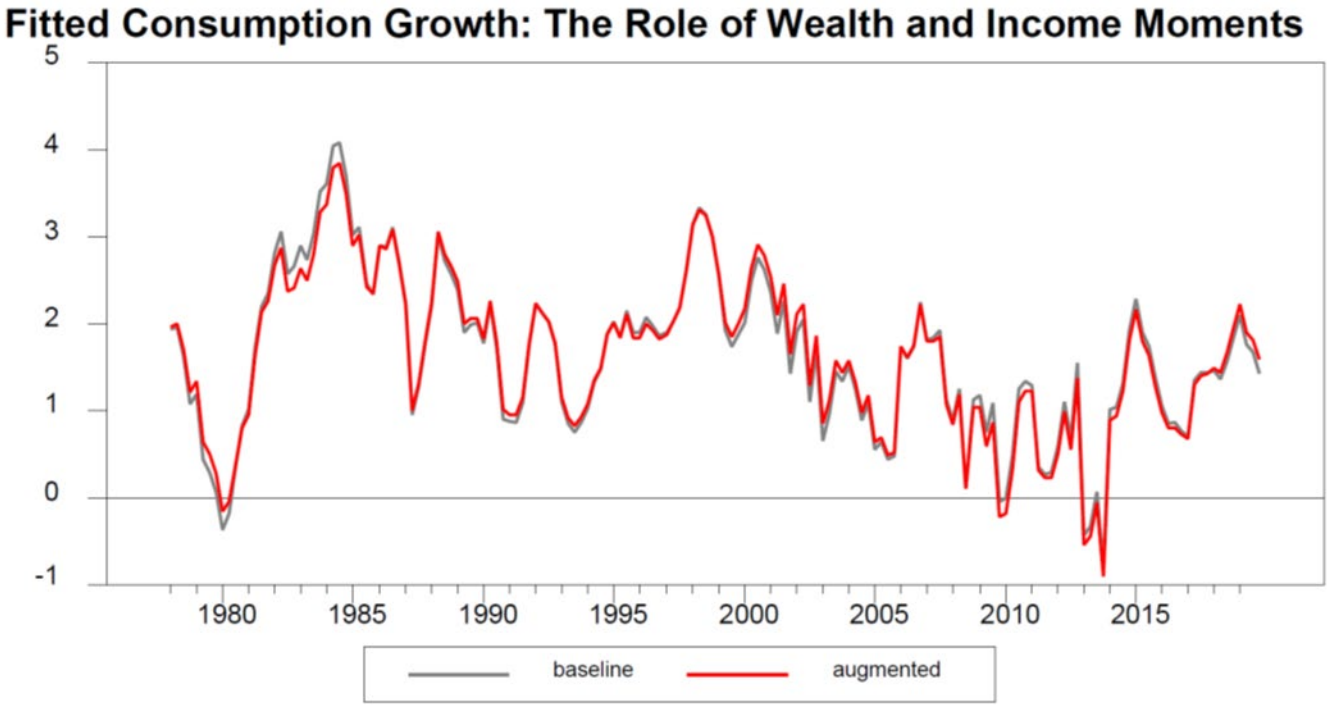
Fitted Consumption Growth: The Role of Wealth and Income Moments
5
4
3
2
1
0
-1
1980
1985
1990
1995
2000
2005
2010
2015
baseline
augmented

FIGURE 1