Nonlinear Income and Consumption Dynamics: Heterogeneity and Aggregate Effects

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Income and consumption

• Two related questions:

-How do shocks to household income affect their consumption?

-How does income inequality translates into consumption inequality?

• Two traditional approaches:

-Structural estimation (à la Gourinchas Parker 2002).

-Reduced form: MPCs estimated from tax reforms (à la Johnson Parker Souleles 2006); linearization of Euler equation and covariance restrictions (à la Blundell Pistaferri Preston 2008).

Quasi-structural approach

• Approach proposed in Arellano Blundell Bonhomme (2017, ABB).

• We start from the structural model, and estimate the consumption function directly; i.e. the policy rule of the model.

• We make no additional assumptions to recover primitives such as preferences.

• Hence it is not possible to conduct general counterfactuals. Yet, this approach allows us to estimate transmission parameters and dynamic impulse responses.

Part I: Heterogeneity

• Household income has a permanent-transitory representation (in logs, net of demographics): $Y_{i,t} = Y_{i,t}^P + Y_{i,t}^T$.

• The consumption function is

$$C_{i,t} = g(Y_{i,t}^P, Y_{i,t}^T, A_{i,t}, Age_{i,t}, \xi_i, \nu_{i,t}),$$

where $A_{i,t}$ are assets, and ξ_i is a latent household-specific type.

• Holds in the standard Aiyagari-Bewley incomplete markets model.

• Goal: flexibly estimate features of the function g, such as the transmission coefficients

$$\phi_{i,t} = \mathbb{E}_{\nu_{i,t}} \left[\frac{\partial g(Y_{i,t}^P, Y_{i,t}^T, A_{i,t}, Age_{i,t}, \xi_i, \nu_{i,t})}{\partial Y^P} \right].$$

Part II: Aggregate effects

- Augment the consumption function as

$$C_{i,t} = g(Y^P_{i,t}, Y^T_{i,t}, A_{i,t}, Age_{i,t}, Z^{Eco}_t, Z^{Mon}_t, \pi^A_t, \xi_i, \nu_{i,t}).$$

- The economic activity factor Z^{Eco}_t and the monetary policy factor Z^{Mon}_t are estimated using macro aggregate time series, and π^A_t are features of the distribution of assets.

- Holds in the Krussell and Smith model.

- Goal: estimate features of g, such as partial derivatives with respect to $Y^P_{i,t}$, Z^{Eco}_t, Z^{Mon}_t, and cross-derivatives.

Part I: Heterogeneity

(with Jack Light)

Consumption model

• Our starting point is a model where households act as single agents with access to a single risk-free asset.

• They receive income shocks each period, and make consumption decisions subject to a period-to-period budget constraint.

• We assume all distributions are known to households, and there is no aggregate uncertainty.

• The key implication is a consumption function of the form

$$C_{i,t} = g(Y_{i,t}^P, Y_{i,t}^T, A_{i,t}, Age_{i,t}, \xi_i, \nu_{i,t}),$$

where ξ_i may reflect household heterogeneity in preferences, discounting, and interest rate. For tractability we impose that ξ_i is scalar.

Specification of income and consumption

• $Y_{i,t} = Y_{i,t}^P + Y_{i,t}^T$, where the permanent and transitory components are

$$Y_{i,t}^P = Q^P(Y_{i,t-1}^P, Age_{i,t}, U_{i,t}^P), \quad Y_{i,t}^T = Q^T(Age_{i,t}, U_{i,t}^T),$$

for $U_{i,t}^P, U_{i,t}^T$ independent standard uniform.

• We use the quantile specification of ABB. This allows for flexible nonlinear modeling of conditional distributions.

• We specify consumption as

$$C_{i,t} = Q^C(Y_{i,t}^P, Y_{i,t}^T, A_{i,t}, Age_{i,t}, \xi_i, U_{i,t}^C),$$

with additional quantile specifications for heterogeneity ξ_i and assets $A_{i,t+1}$.

Identifying individual transmission coefficients

• We measure partial insurance using average derivatives of g:

$$\phi_{it} = \phi(age_{it}, a_{it}, \eta_{it}, \varepsilon_{it}, \xi_i) = \mathbb{E}_{\nu_{it}} \left[\frac{\partial g_t \left(a_{it}, \eta_{it}, \varepsilon_{it}, age_{it}, \xi_i, \nu_{it} \right)}{\partial \eta} \right],$$

which can be can be recovered from Q^C without restricting the dimensionality of ν_{it}:

$$\mathbb{E}_{\nu_{it}} \left[\frac{\partial g_t \left(a_{it}, \eta_{it}, \varepsilon_{it}, age_{it}, \xi_i, \nu_{it} \right)}{\partial \eta} \right] = \mathbb{E}_{u^c_{it}} \left[\frac{\partial Q_c(a_{it}, \eta_{it}, \varepsilon_{it}, age_{it}, \xi_i, u^c_{it})}{\partial \eta} \right].$$

•Thus, using quantile methods we can consistently estimate ϕ_{it}.

• A main objective is to explore the relationship between ϕ_{it} and ξ_i to document individual heterogeneity in consumption responses.

Data and methods

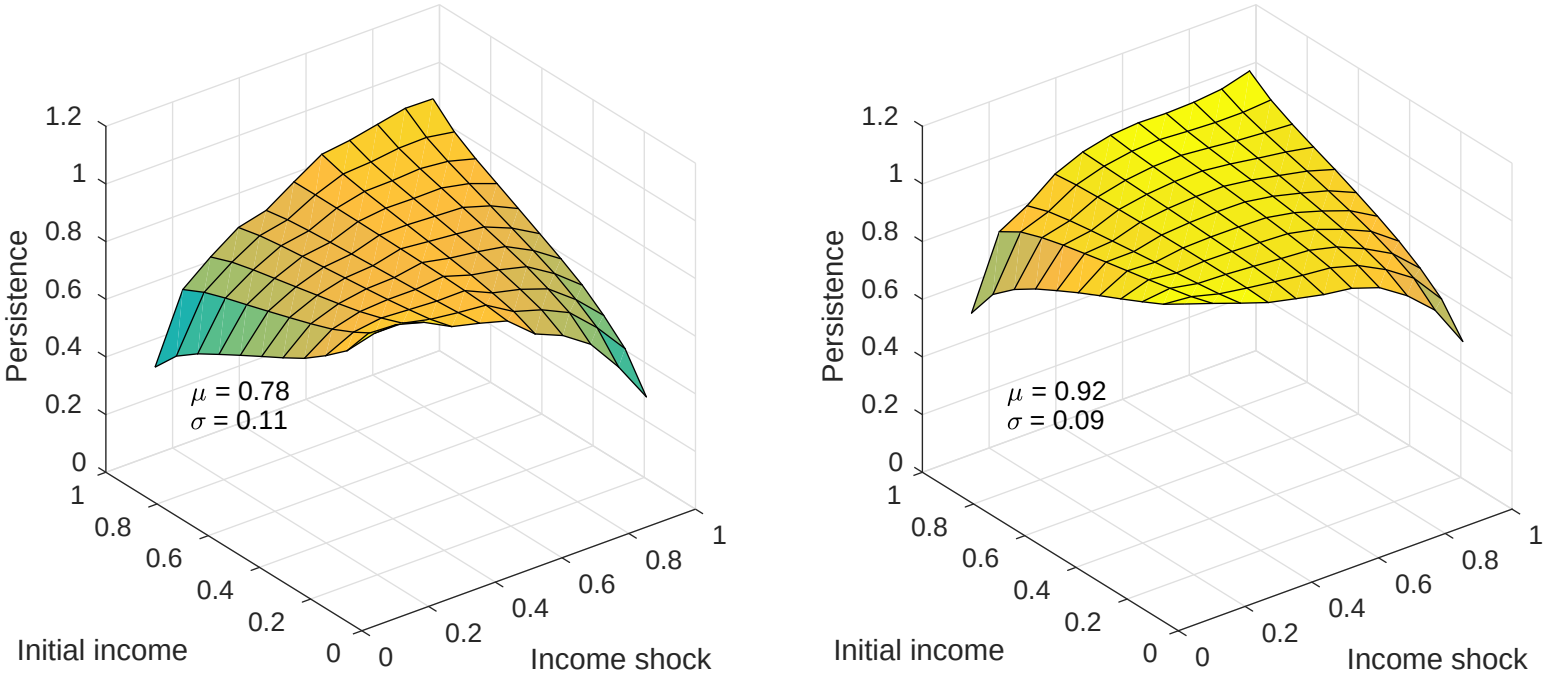
- We rely on the re-designed PSID, from 2005 to 2017, biennial.

- Since 2005, the consumption information has been enhanced, with additional categories. The recent waves include food at home and away from home, gasoline, health, transportation, utilities, clothing, and leisure activities.

- Relative to ABB, we: (1) Extend the methods to use an unbalanced panel, (2) Estimate the entire consumption and assets distributions using quantile methods, (3) Improve computation by relying on sequential importance sampling and pseudo-marginal MCMC.

Nonlinear income persistence

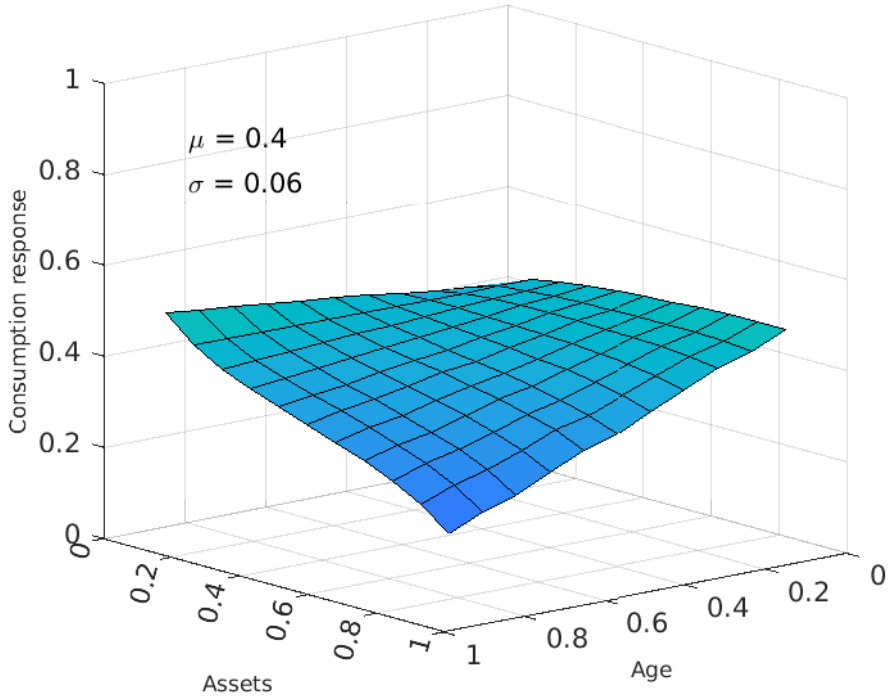
(a) Log-income $Y_{i,t}$ (b) Persistent component $Y_{i,t}^{P}$



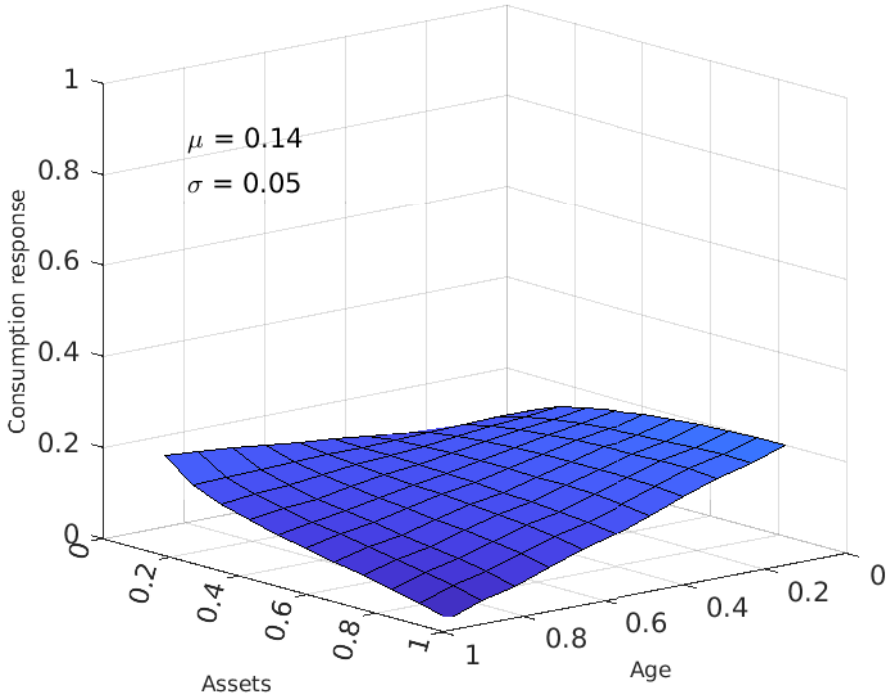
Notes: PSID, 2005-2017 sample, disposable income, dual earners.

Average consumption responses, models without filtering (i.e., $Y_{i,t} = Y_{i,t}^P$)

(a) No heterogeneity

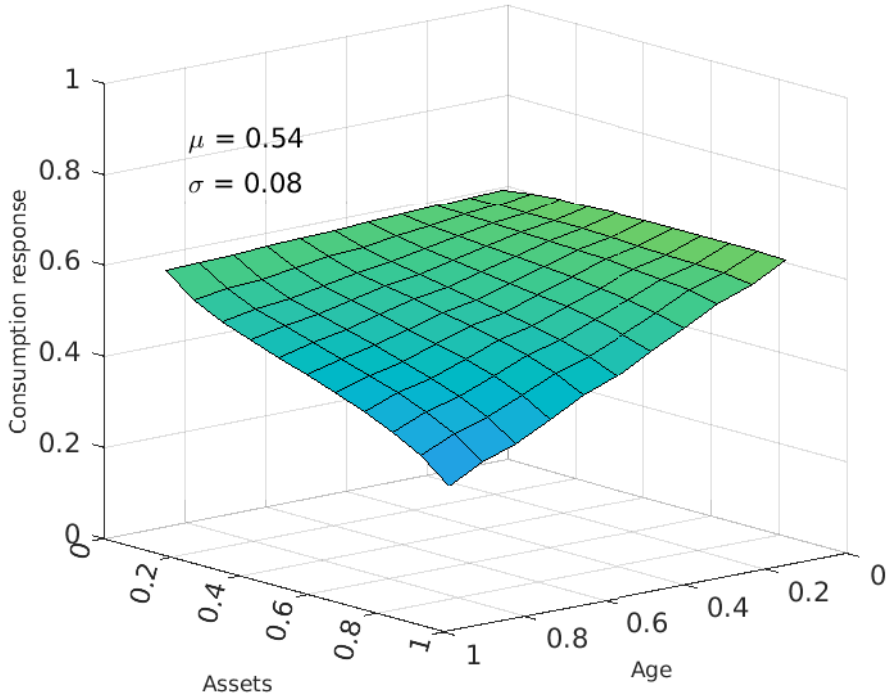


(b) Heterogeneity

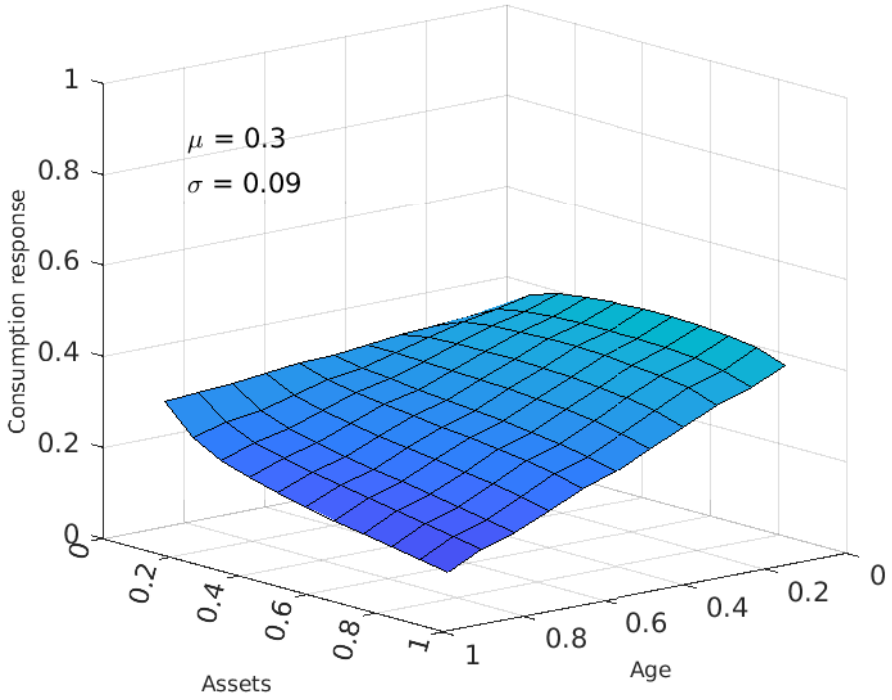


Average consumption responses, models with filtering (i.e., $Y_{i,t} = Y_{i,t}^P + Y_{i,t}^T$)

(a) No heterogeneity

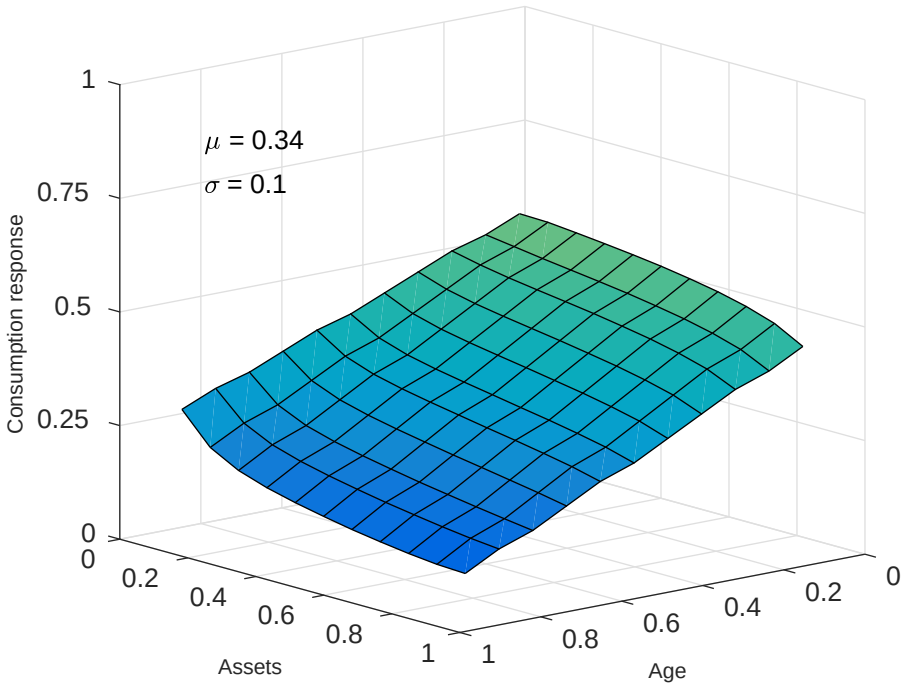


(b) Heterogeneity

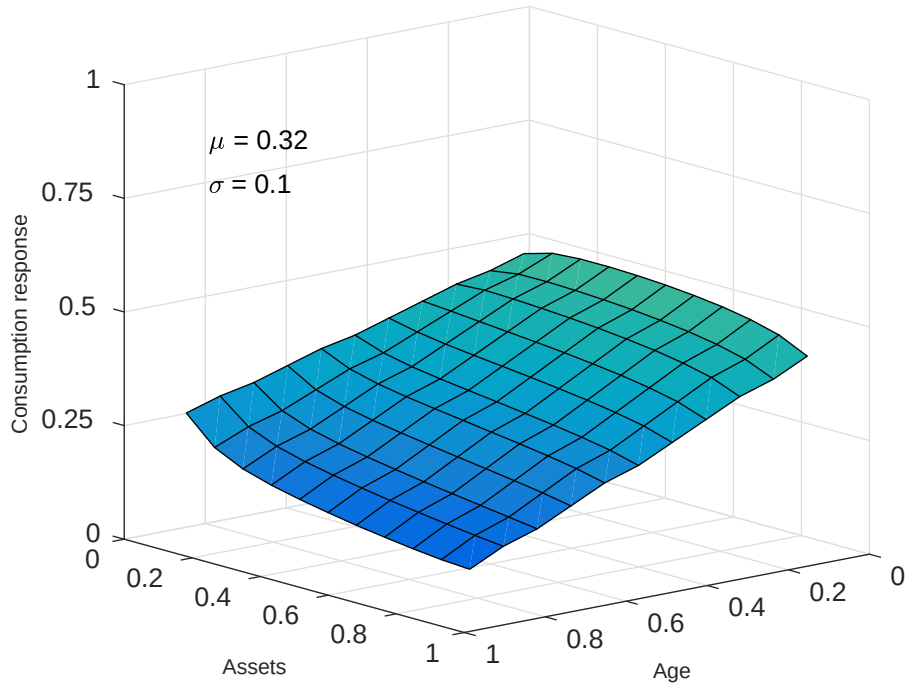


Heterogeneity in consumption responses, lower ξ_i percentiles

(a) 10th percentile

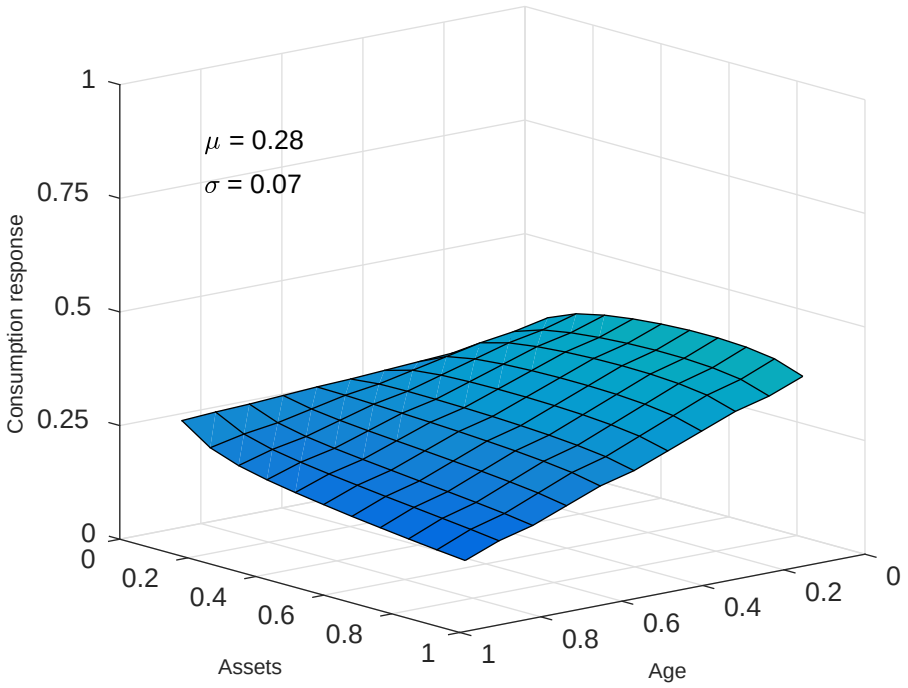


(b) 25th percentile

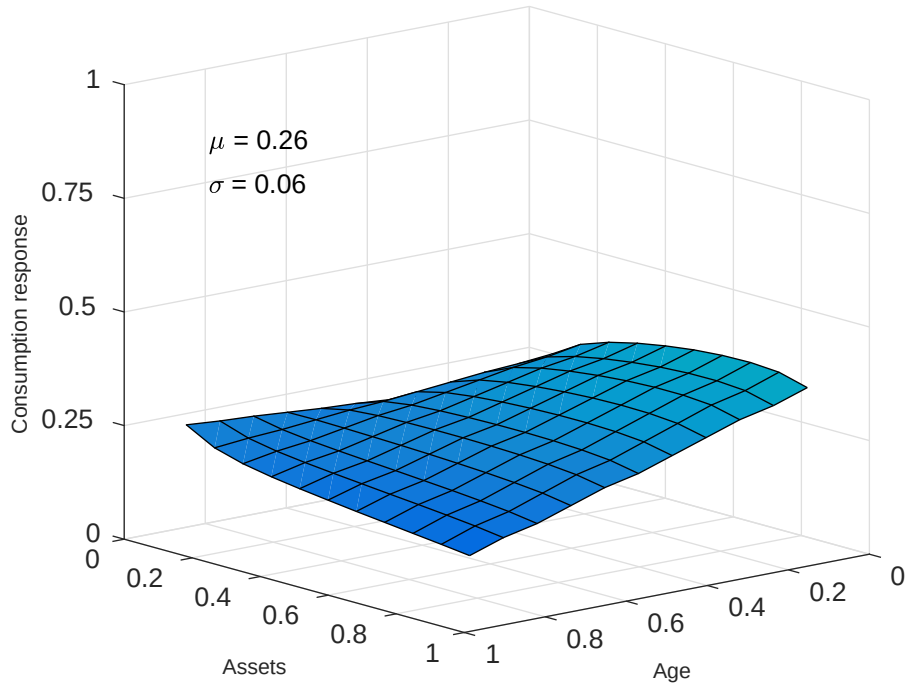


Heterogeneity in consumption responses, upper ξ_i percentiles

(a) 75th percentile



(b) 90th percentile



Heterogeneity: three candidate mechanisms

• Preferences and discounting: Unlikely to be dominant, since high-type households who consume more also hold more assets.

• Returns to assets: Results of a specification with heterogeneity in assets and consumption suggest some heterogeneity in assets returns, yet consumption heterogeneity is unaffected.

• Access to external resources (e.g., parental insurance): We take advantage of the intergenerational linkages available in the PSID to match households to their parents. We find that parental income and consumption correlate positively with the type ξ_i, suggesting it may partly reflect heterogeneity in parental insurance.

Part II: Aggregate effects

(with Tincho Almuzara)

Preliminary and incomplete

The macro side: factor model

• We postulate a dynamic factor model relating macro aggregates W_t to latent factors Z_t:

$$W_t = \Lambda Z_t + U_t, \quad Z_t = \Psi Z_{t-1} + V_t,$$

with normal i.i.d. U_t, V_t.

• Z_t has two components: Z_t^{Eco} is based on GDP (loading=1), GDI, average productivity, employment rate, and wages; Z_t^{Mon} is based on real interest rates (Fed funds with loading=1, 3-months treasury bill, 5-year treasury bond). We assume no feedback from the micro data to the macro aggregates.

• Estimating the factors externally (as opposed to within the PSID) is important since nation-wide aggregates are the relevant indicators of macroeconomic conditions.

The micro side: income

• Using the PSID, 1970-1997, we construct a sequence of 4-year rotating sub-panels, following Storesletten Telmer Yaron 2004.

• We also use recent waves of the PSID as a check (not today).

• In this talk: we do not distinguish between permanent and transitory components, and specify

$$Y_{i,t} = Q^Y(Y_{i,t-1}, Age_{i,t}, Z_t^{Eco}, U_{i,t}^Y).$$

• We also use the model to estimate the predictive distribution of $Y_{i,t}$ given $Y_{i,t-1}$, $Age_{i,t}$, and Z_{t-1}^{Eco}. This is relevant to measure the income risk faced by the household.

The micro side: consumption

- We use the recent waves of the PSID, 1999-2017.

- We specify

$$C_{i,t} = Q^C(Y_{i,t}, A_{i,t}, Age_{i,t}, Z_t^{Eco}, Z_t^{Mon}, U_{i,t}^C).$$

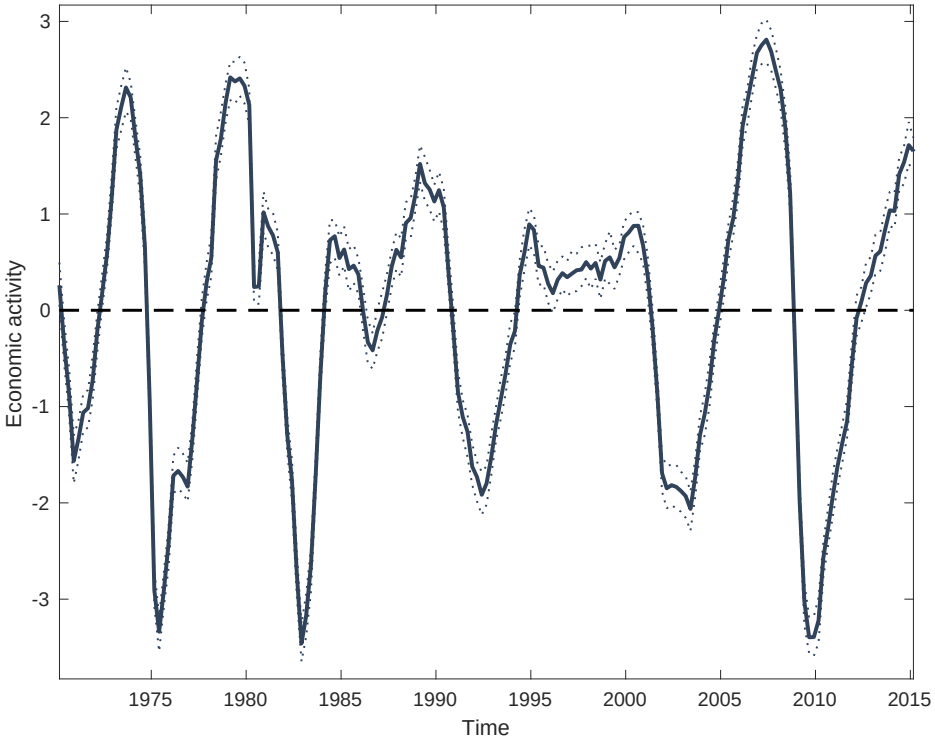
- We use a two-step estimation strategy:

1. We first estimate Z_t^{Eco}, Z_t^{Mon} as posterior means using the aggregate data.

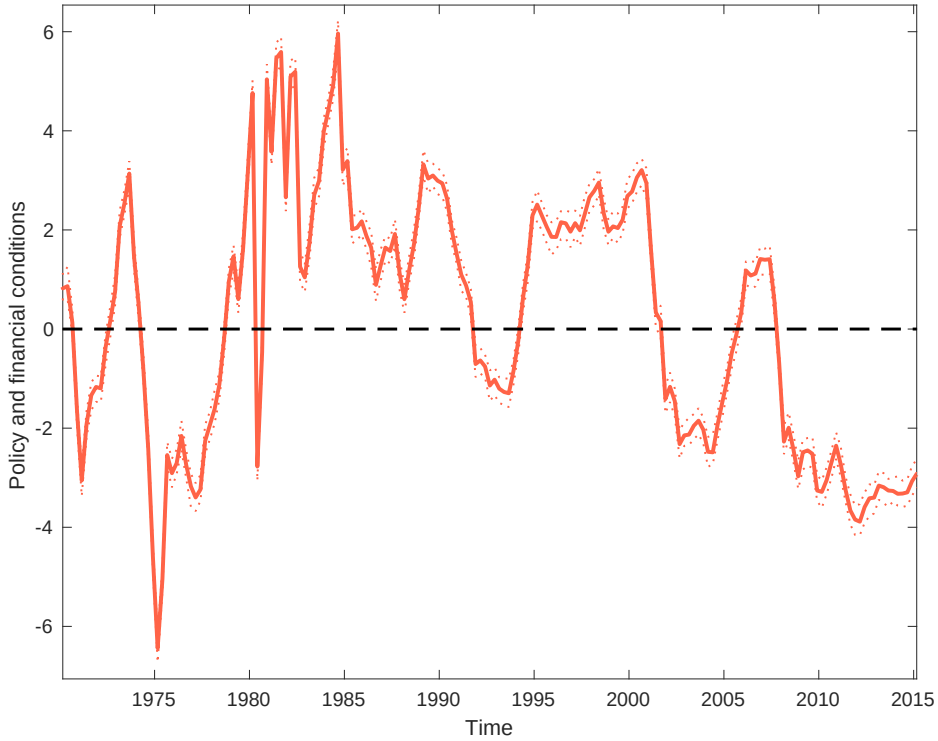
2. We then estimate the functions Q^Y and Q^C using the PSID micro data.

Aggregate states

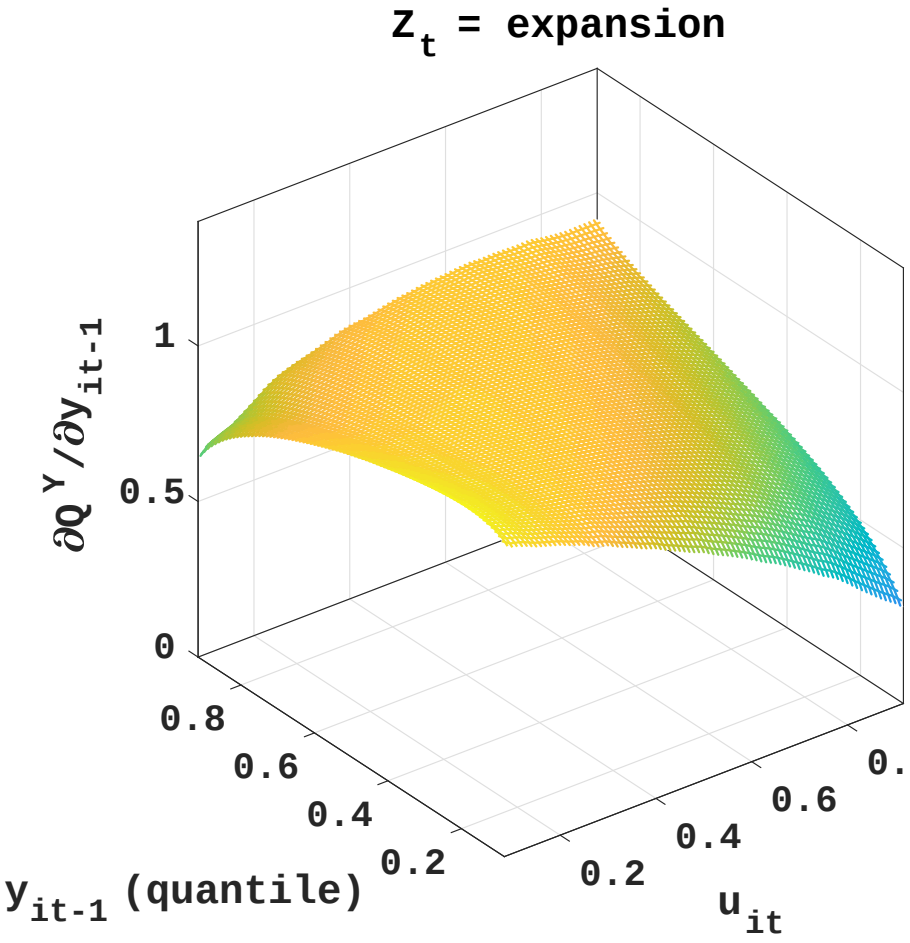
Z_t^{Eco}

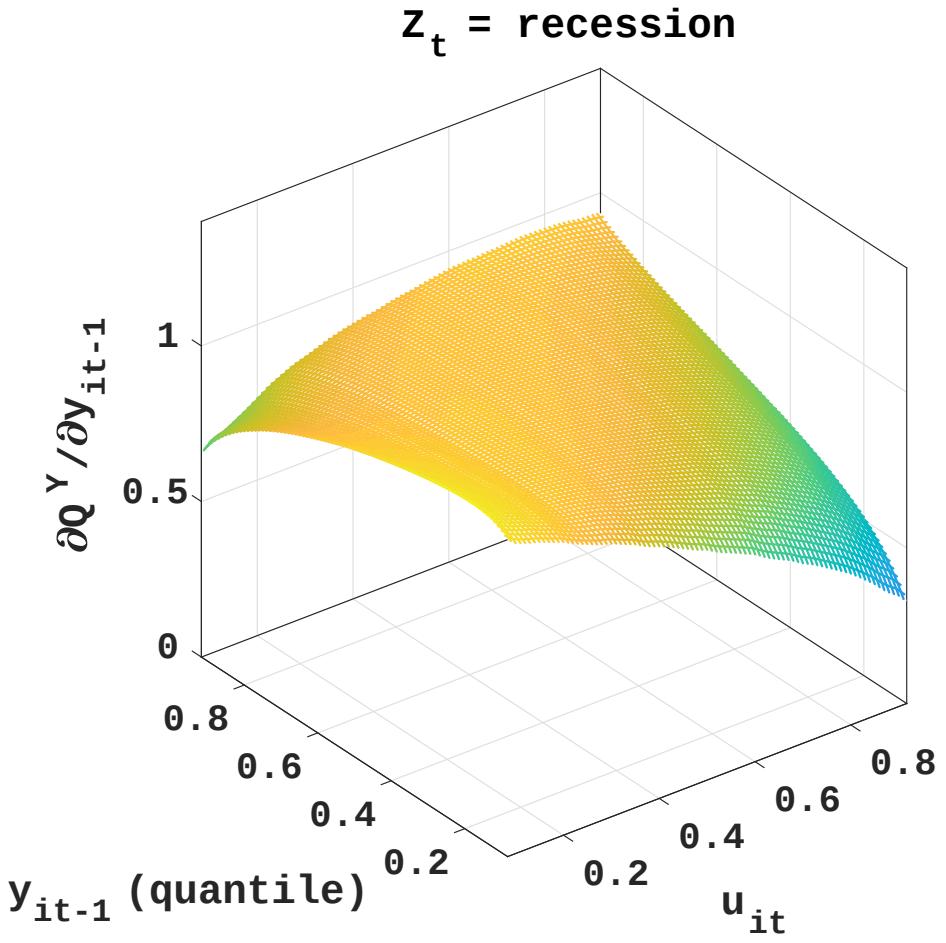


Z_t^{Mon}

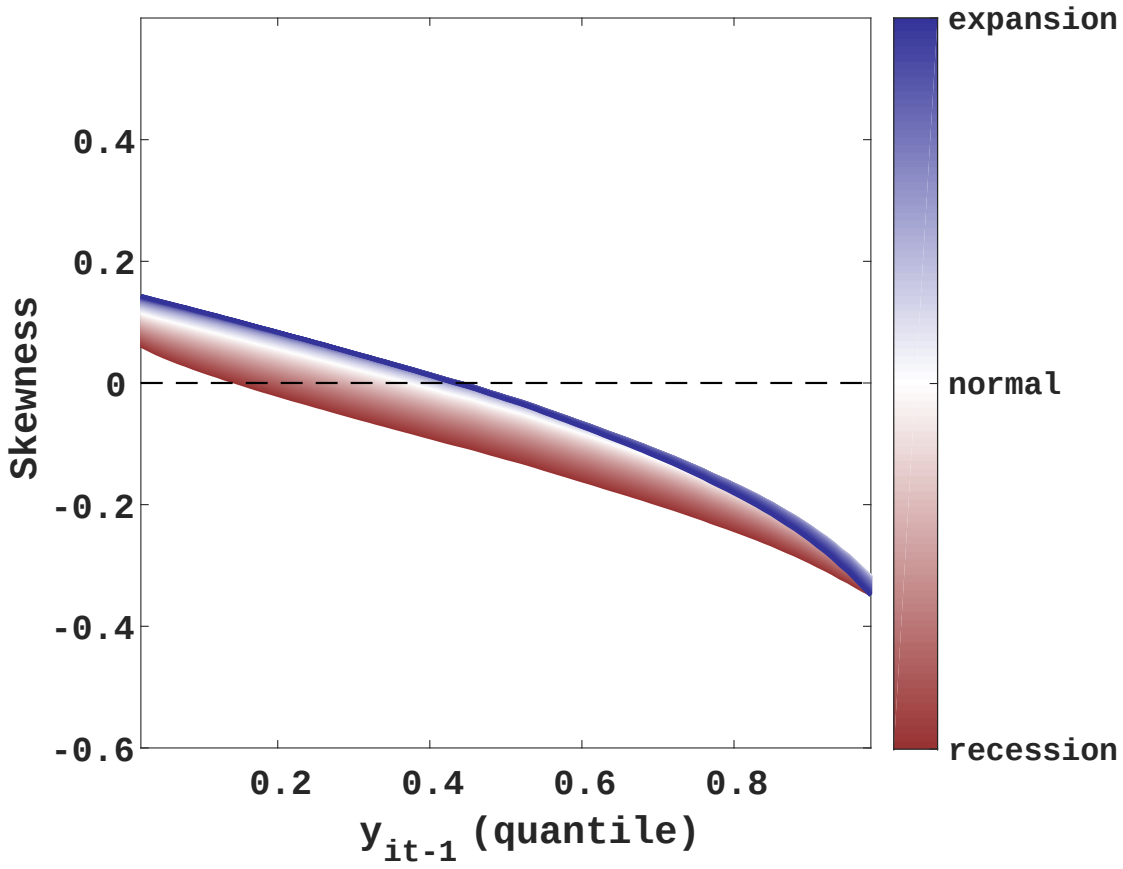


Nonlinear income persistence





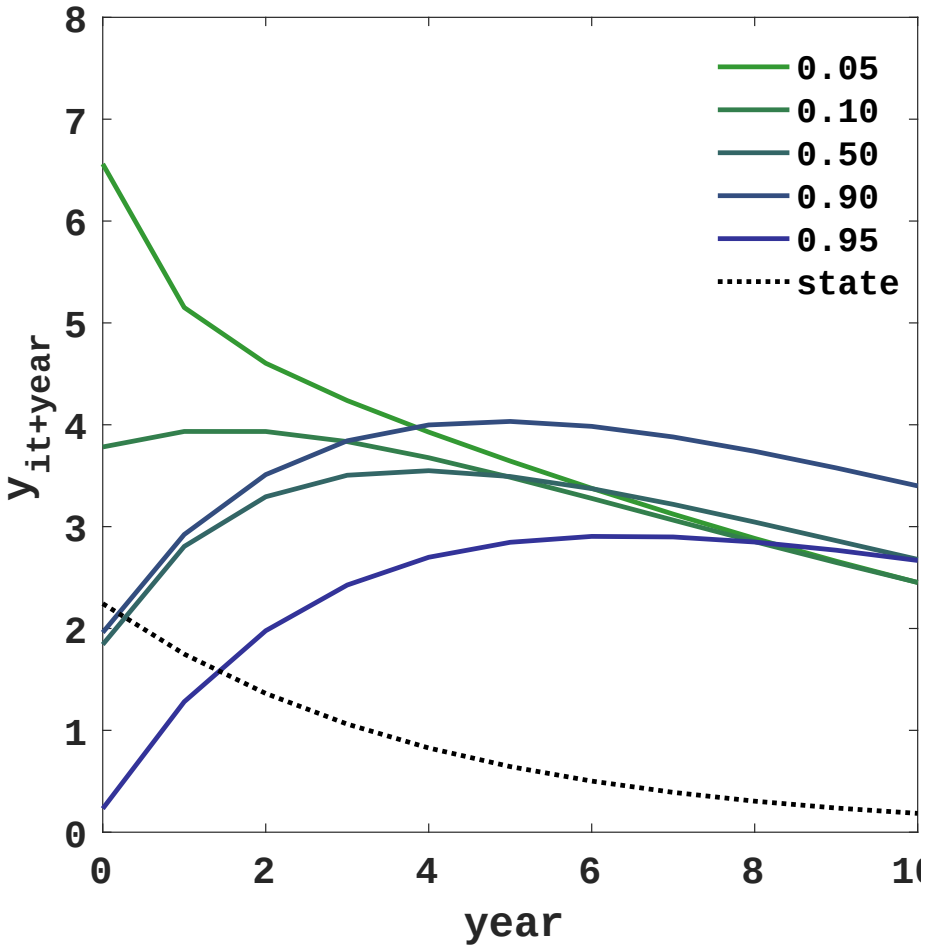
A tale of two skewnesses



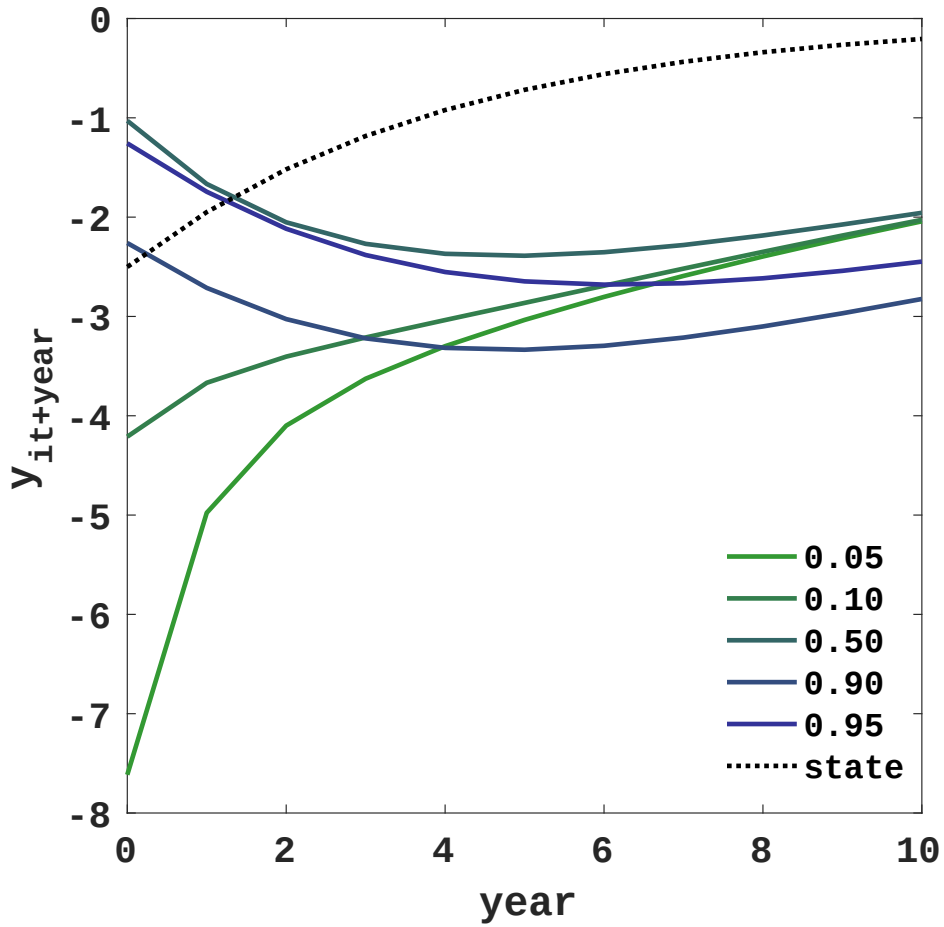
Notes: PSID, 1970-1997 sample. Kelley's skewness for different values of $Y_{i,t-1}$ *and the aggregate state* Z_t^{Eco}.

Income impulse responses (in deviation from no shock)

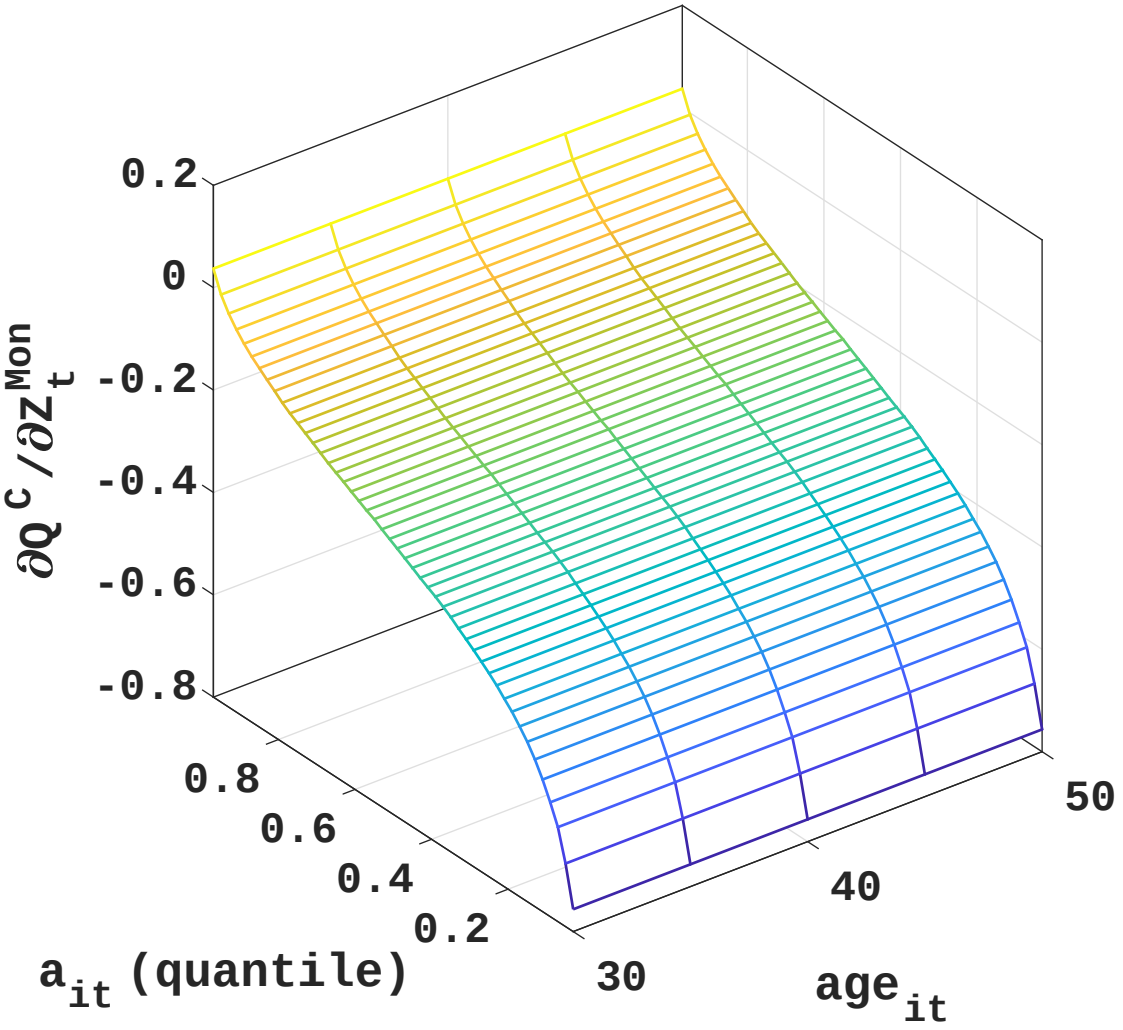
Positive shock $Z_t^{Eco} > Z_{t-1}^{Eco}$



Negative shock $Z_t^{Eco} < Z_{t-1}^{Eco}$



Average derivative of consumption with respect to Z_t^{Mon}



Ongoing research agenda

• Our goal is to document how idiosyncratic and aggregate shocks shape the dynamics of consumption responses.

• For this purpose, we develop flexible empirical methods that are closely linked to economic models.

• In particular, we provide a framework to study the distributional consequences of aggregate shocks, which are of great interest to macroeconomists and policy-makers.

• Next steps: (1) Enrich the micro side in our study of aggregate effects, (2) Incorporate heterogeneity in the income process, correlated with consumption heterogeneity, (3) Model extensive and intensive labor supply choices of household members.