ON THE CYCLICALITY OF DURABLE CONSUMPTION RESPONSES*

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Abstract

Aggregate durable consumption responses are procyclical due to the combined effect of aggregate shocks persistence and micro-level lumpiness (Bachmann et al. (2006); Berger and Vavra (2015)). This paper introduces a novel portfolio choice model designed to estimate fundamental adjustment frictions and assess the cyclicality of durable consumption responses. The estimation leverages two innovations relative to the existing literature: the observed size distribution of durable adjustment in PSID data and the equilibrium one-to-one mapping between adjustment hazards and the distribution of desired adjustments.

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1 Introduction

Does micro-level lumpy behavior have aggregate implications? Research on capital investment dynamics argues that a key consequence of micro lumpiness is history dependence of impulse responses (Bachmann et al., 2006). Namely, investment responses to further shocks are larger during booms than during recessions. Similar results have been shown for durable goods demand (Berger and Vavra, 2015). This paper continues that line of inquiry by studying the cyclicality of durable consumption responses through the lens of a novel heterogeneous-agent portfolio choice model.

The model is built around the empirical observation that the size of durable adjustments—the value of the newly acquired durable relative to the old one—is highly heterogeneous across agents. The estimation strategy leverages two innovations relative to the existing literature: (i) it targets the observed distribution of durable adjustment sizes using Panel Study of Income Dynamics (PSID) data, and (ii) it exploits a structural one-to-one mapping between adjustment hazards (i.e., Poisson jump intensities) and the distribution of desired durable adjustments. This mapping enables the estimation of deep parameters governing adjustment frictions.

Model summary. The model embeds durable adjustment into a continuous-time portfolio choice framework with utility over non-durable consumption and durables. Households face both proportional transaction costs and unobserved idiosyncratic switching costs that make them reluctant to adjust their durable holdings frequently. Adjustment opportunities arrive randomly, but agents optimally choose when to exercise them. Thanks to homotheticity, the problem can be normalized by the stock of durables, reducing the state-space to the ratio of financial to durable wealth. A recursive formulation yields tractable policy functions for consumption, risky asset shares, and adjustment hazards.

The model generates sharp predictions for the frequency and size distribution of durable adjustments in a stationary economy. These predictions are mapped into observables by linking the adjustment hazard and the stationary distribution of wealth-to-durable ratios to the observable distribution of adjustment sizes. Specifically, each agent's state determines a unique desired adjustment size, and the aggregate distribution of observed adjustments arises from the combination of individual hazard rates and the population density over states.

The structural model successfully reproduces key features of the empirical distribution of durable adjustment sizes observed in the PSID data. Notably, it captures the fat-tailed and bimodal shape of the distribution—an empirical feature that is difficult to reconcile with models featuring only fixed transaction costs. In the model, this heterogeneity arises endogenously from variation in idiosyncratic switching costs. Households facing higher adjustment costs wait longer and execute larger adjustments when they do move, while those with lower costs adjust more frequently and by smaller amounts. This mechanism allows the model to match the observed dispersion in housing mobility without invoking heterogeneity in preference parameters or credit conditions.

Results. TO BE COMPLETED FOR FINAL SUBMISSION

2 Model

This section lays out the individual agent's economic problem under a sequential formulation exploiting the homogeneity of preferences and budget constraints with respect to durable values and arrives to a useful recursive formulation. The model builds on Stokey (2009) formulation of Grossman and Laroque (1990).

2.1 Preliminaries

Time is continuous and runs from date 0 to infinity. The agent derives utility from non-durable consumption C and durable D, with Cobb-Douglas preferences over the two goods.

The utility function is given by

$$E_0\Big[\int_0^\infty e^{-\rho t}\frac{\left(C_t^\alpha D_t^{1-\alpha}\right)^{1-\gamma}}{1-\gamma}dt\Big],$$

where ρ denotes the discount rate, α the (desired) expenditure share on non-durables, and γ the risk aversion parameter (which is also the inverse of the intertemporal elasticity of substitution).

The agent's only source of income is portfolio returns.[1] He invests in a risk-free asset yielding rate r and allocates a proportion $\theta > 0$ in a risky asset with excess return r_e and volatility σ. Durable purchases require a down payment share ϵ, with the remaining $1-\epsilon$ financed at a borrowing rate with credit spread $s > 0$. For simplicity, depreciation and maintenance are assumed to be zero.

Upon adjustment, the agent sells the existing durable of value D and acquires a new durable of value $\hat{D}$, incurring dealer fees fD and receives net sales proceeds $\epsilon\big(D-\hat{D}\big)$. As a result, the jump in financial wealth is $-fD+\epsilon(D-\hat{D})$

Financial wealth evolution. Let W denote financial wealth, the agent's wealth evolves as

$$dW = \big[rW + r_e\theta W - C - (1-\epsilon)(r+s)D\big]dt + \theta W\sigma dZ_t + \big[-fD+\epsilon(D-\hat{D})\big]dN_t, \quad (1)$$

where Z_t is a Wiener process representing idiosyncratic shocks and N_t is an optimally chosen Poisson counter representing adjustment events.

2.2 Sequential Problem

Adjustment opportunities arrive at random times τ, governed by a Poisson process with exogenous intensity $\kappa > 0$. However, because adjustment incurs costs, the agent may optimally

[1] Similar results follow for a model with constant labor income. The key assumption to exploit the homogeneity properties of the problem is the absence of idiosyncratic labor income risk.

choose not to adjust when given the opportunity. Specifically, at each adjustment date, the agent faces two types of costs: proportional transaction costs fD and a utility switching cost $\psi D^{1-\gamma}$, where ψ is drawn from a distribution F with non-negative support and assumed i.i.d. across agents and over time.

The agent selects a cutoff $\bar{\psi}$ –the maximum switching cost he is willing to "pay"– thereby determining the endogenous jump intensity $\lambda_w = \kappa F(\bar{\psi})$. Allowing κ to be arbitrarily large nests a pure fixed cost model as a limiting case.

At each point in time, the agent chooses the non-durable consumption rate C_t, the risky portfolio share θ_t, the desired new durable stock $\hat{D}$ if adjusting, and a adjustment hazard $\lambda_{w,t} = \kappa F(\bar{\psi}_t) \in [0, \kappa]$.

The agent's value function satisfies

$$V(W, D) = \max_{\{C_t, \theta_t, \bar{\psi}_t\}} E_0\Big[\int_0^\tau e^{-\rho t} \frac{\left(C_t^\alpha D^{1-\alpha}\right)^{1-\gamma}}{1-\gamma} dt + e^{-\rho\tau}(1 - F(\bar{\psi}_t))V(W_\tau, D) \tag{2}$$
$$+ e^{-\rho\tau} F(\bar{\psi}_t) \left\{ \max_{\hat{D}} V[W_\tau - fD + \epsilon\big(D - \hat{D}\big), \hat{D}] - E[\psi|\psi < \bar{\psi}_t] D^{1-\gamma} \right\} \Big],$$

Optimal adjustment hazard. The optimal cutoff $\bar{\psi}^*$ equates the switching cost to the benefit of adjustment

$$\bar{\psi}^* = y(W, D) \equiv \big(V(\hat{W}, \hat{D}) - V(W, D)\big)/D^{1-\gamma}, \tag{3}$$

where $\hat{W}$ is post-adjustment financial wealth and y is the durable-scaled benefit of adjustment. This condition highlights the state-dependence, that agents with greater benefits from adjustment will select higher hazard rates.

Discussion of assumptions. What economic forces do the idiosyncratic switching costs ψ represent? These costs capture non-monetary frictions—such as cognitive, habit-based, or amenity-related attachments—that lead households to prefer their current durable good beyond its market valuation. This assumption is directly motivated by empirical patterns in the PSID data. There, households display substantial heterogeneity in the size of durable adjustments: some transition to slightly larger homes, while others leap to significantly larger ones. This pattern is difficult to reconcile with standard models featuring only fixed transaction costs. In contrast, the present framework accommodates such heterogeneity in a natural and disciplined way. Variation in observed adjustment sizes arises from underlying differences in switching costs across households. Agents facing higher switching cost ψ wait longer to adjust, and as a result, make larger, more discrete changes when the gains outweigh the friction. As a result, this mechanism allows for richer, empirically grounded modeling of durable consumption dynamics.

Sequential Problem: Homothetic Formulation

Thanks to the assumption of no idiosyncratic labor income risk, the agent's state space can be reduced to a single dimension: the ratio of financial to durable wealth $w \equiv W/D$.[2] The value function $V(W, D)$ is homogeneous of degree $1-\gamma$ in D which motivates the normalization $v(w) \equiv V(w, 1)$. Let $c \equiv C/D$ represent the ratio of non-durable to durable consumption, the wealth-to-durable ratio w evolves as

$$dw = \big[\underbrace{rw + r_e\theta w - c - (1-\epsilon)(r+s)}_{\equiv \mu_w(w,c,\theta)}\big]dt + \underbrace{\theta w \sigma}_{\equiv \sigma_w(w,\theta)} dZ_t + \big[\hat{w} - w\big]dN_t, \tag{4}$$

where $\hat{w} \equiv \hat{W}/\hat{D} = (w - f + \epsilon)D/\hat{D} - \epsilon$. Since there exists a one-to-one mapping between $\hat{w}$ and $\hat{D}$, we formulate the adjustment choice in terms of $\hat{w}$. The normalized value function

[2] Labor income can be added with no problem to this framework. It is possible to interpret W as total (ex-durable) wealth if we include the capitalized value of labor income into W. However, idiosyncratic labor income risk does breaks the homogeneity of the value function.

v satisfies

$$v(w) = \max_{\{c_t,\theta_t,\bar{\psi}_t\}} E_0\Big[\int_0^\tau e^{-\rho t}\frac{\left(c_t^\alpha\right)^{1-\gamma}}{1-\gamma}dt + e^{-\rho\tau}(1-F(\bar{\psi}_t))v(w_\tau)$$
$$+ e^{-\rho\tau}F(\bar{\psi}_t)\left\{\max_{\hat{w}}\left(\frac{w-f+\epsilon}{\hat{w}+\epsilon}\right)^{1-\gamma}v(\hat{w}) - E[\psi|\psi<\bar{\psi}_t]\right\}\Big], \tag{5}$$

where the adjustment activity scales the continuation value by $(\hat{D}/D)^{1-\gamma} = [(w-f+\epsilon)/(\hat{w}+\epsilon)]^{1-\gamma}$ due to homogeneity.

2.3 Recursive Formulation

The recursive formulation offers a more compact and analytically tractable characterization of the agent's decision problem. Let $y(w) \equiv (w-f+\epsilon)^{1-\gamma}\max_{\hat{w}}\frac{v(\hat{w})}{(\hat{w}+\epsilon)^{1-\gamma}} - v(w)$ denote the (durable-scaled) benefit of adjustment (also defined in equation (3)), then the normalized value function $v(w)$ satisfies the following Hamilton-Jacobi-Bellman (HJB) equation

$$\rho v(w) = \max_{c,\theta}\left\{\frac{c^{\alpha(1-\gamma)}}{1-\gamma} + \mu_w(w,c,\theta)v'(w) + \frac{\sigma_w(w,\theta)^2}{2}v''(w)\right\} + H[y(w)], \tag{6}$$

where μ_w, σ_w are defined in equation (4).[3] The impulse control term H encodes the value of optimally exercising the option to adjust and is defined as [4]

$$H(y) \equiv \max_{\bar{\psi}}\kappa F(\bar{\psi})\left[y - E\big(\psi|\psi<\bar{\psi}\big)\right], \qquad \text{with} \qquad \lambda_w(w) = H'(y(w)) = \kappa F(y(w)).$$

It is useful to note that the impulse control term nests a pure fixed cost model for the case of switching costs ψ equal to zero arriving with probability one, i.e. $F(0) = 1$, and $\kappa \uparrow \infty$.

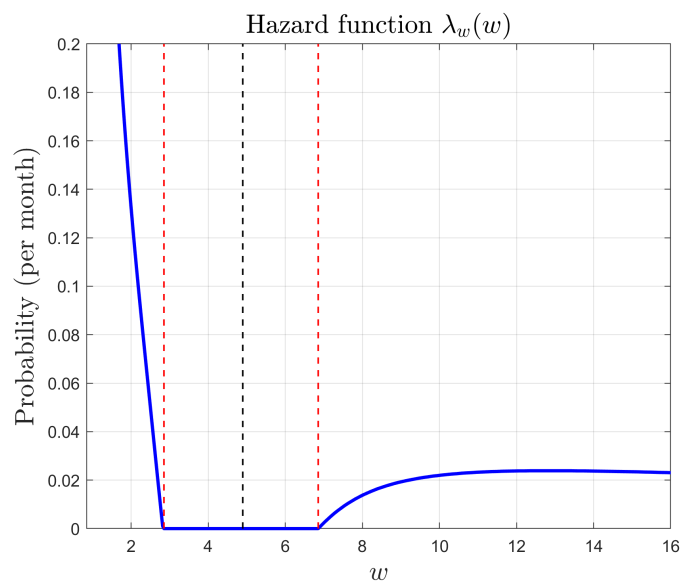
Looking at the structure of the continuation value upon adjustment, it is evident that the target ratio $\hat{w}$ is the same across agents. Finally, optimal non-durable consumption

[3] Note that in equation (3) the new durable value is not factorized out which is the only visual difference between these two representations.

[4] H also called Impulse Hamiltonian, first introduced by Alvarez et al. (2024), has several other useful properties not exploited in this study.

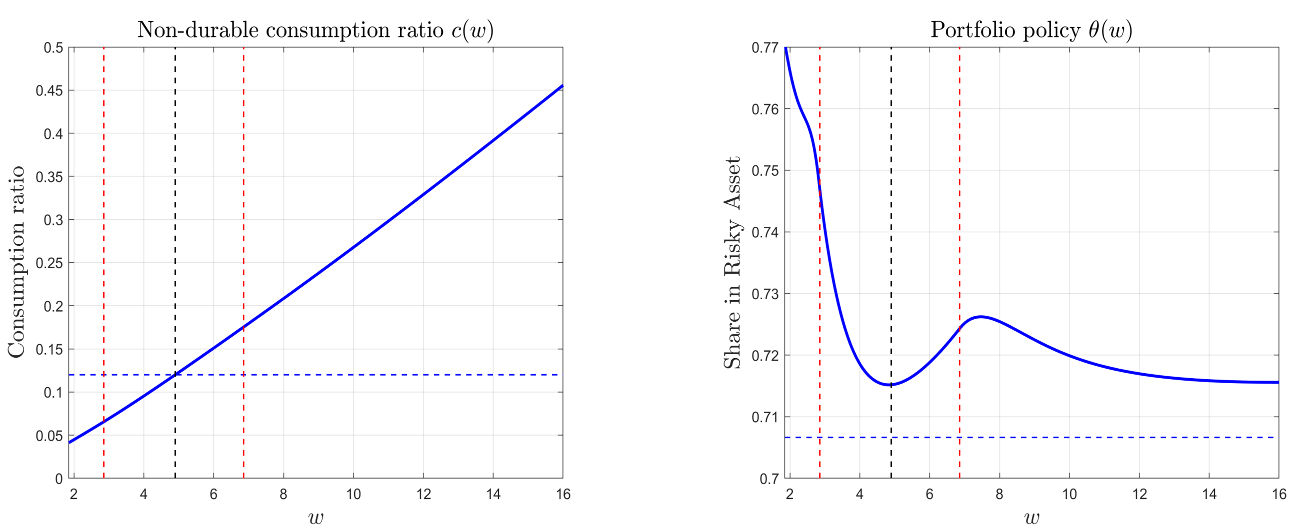
and portfolio rules $c(w), \theta(w)$, together with $\lambda_w(w)$, fully characterize the agent's optimal behavior.

Figure 1: Adjustment hazard function λ_w



Note: See model calibration in Table 1

Figure 2: Policy functions c and θ



Note: See model calibration in Table 1

2.4 Policy Functions

Adjustment hazard. Figure 1 displays the endogenous hazard function λ_w, interpreted as the monthly probability of durable adjustment. The agent's policy features a region of pure inaction –bounded by the two dashed red lines– where adjustment is strictly suboptimal. In this region, the utility gains from changing the durable stock are insufficient to outweigh the transaction cost fD, leading the agent to remain inactive.

Outside the inaction region, the probability of adjustment becomes positive and increases with the benefits $y(w)$. Notably, even in these regions, adjustment remains probabilistic due to the presence of idiosyncratic switching costs. Upon adjustment, the wealth ratio jumps to a target level $\hat{w}$, shown by the dashed black line, which lies in the interior of the inaction region.

A distinctive feature of the hazard function is its asymmetry: the incentive to downsize after negative financial shocks is significantly stronger than the incentive to upscale following positive shocks. This asymmetry arises from the concavity of CRRA utility. Marginal utility declines steeply with increases in non-durable consumption so the relative gain from upsizing is muted compared to the benefit from downsizing.

Non-durable consumption. Figure 2 presents the non-durable consumption ratio c and the risky portfolio share θ. In the absence of adjustment frictions, the agent would continuously rebalance the durable stock to maintain a constant expenditure ratio $c^* = \alpha(r+s)/(1-\alpha)$, depicted by the dashed blue line.[5] Note that such value coincides with the policy at the target wealth ratio $\hat{w}$.

With frictions, however, the agent tolerates deviations from this benchmark. For low values of w, non-durable consumption falls below the frictionless level due to lower permanent income, the constant mortgage expenditures and the inability to adjust the durable stock.

[5] For the result on the frictionless problem see equation 6 in Stokey (2009)

Portfolio choice. Turning to the portfolio policy θ, the agent selects risky asset shares that are strictly above the frictionless benchmark, depicted by the dashed blue line. This arises because, although the agent faces frictions in adjusting durables, she retains full flexibility over financial portfolio choices. In the frictionless model, risk aversion is constant. Here, relative risk aversion becomes endogenous and state-dependent: it is lowest near the boundaries of the inaction region, where the agent is close to adjusting, and highest at the target point $\hat{w}$.[6]

The asymmetry in portfolio behavior is particularly interesting. At low wealth ratios, the agent increases his exposure to risky assets, effectively "gambling for redemption." This reflects two reinforcing forces. First, larger risky shares raise the expected return on financial wealth, helping the agent escape low-wealth states through higher portfolio drift. This investment income effect makes risk-taking more attractive when liquid resources are scarce. Second, the agent dislike for negative shocks is dampened because of the adjustment optionality. While large positive shocks are desired at low wealth ratios, negative shocks raise the probability of an adjustment. In either case, the agent is pushed towards its target $\hat{w}$. This option mechanism —where downside risk is partially cushioned by endogenous exercise— flattens the value function locally and lowers risk aversion. A similar, though attenuated, effect operates at higher wealth ratios but as w increases further, the marginal utility of consumption declines, reducing the benefits of further risk exposure and pulling the portfolio share back down.

3 Mapping the Model to the Steady-State Data

The model generates sharp predictions about household durable adjustment behavior, which can be contrasted empirically. This section derives the model's implications for the frequency and size distribution of durable adjustments in a stationary environment i.e. absent aggregate

[6]Note that what matters is the expected time until an adjustment and not the adjustment hazard *per se*. The adjustment hazard is constant and equal to zero within the pure inaction region.

shocks.

Aggregation and Stationary Distribution. A key object for linking the model to the data is the stationary distribution of wealth-to-durable ratios $m_w(w)$ which satisfies a stationary Kolmogorov Forward equation (KFE)

$$\lambda_w(w)m_w(w) + \frac{d}{dw}\big(\mu_w[w, c(w), \theta(w)]\, m(w)\big) = \frac{1}{2}\frac{d^2}{dw^2}\big(\sigma_w[w, \theta(w)]m_w(w)\big), \qquad w \neq \hat{w}, \quad (7)$$

with boundary conditions $\lim_{w\downarrow 0} m_w(w) = 0, \lim_{w\uparrow\infty} m_w(w) = 0, \lim_{w\uparrow\hat{w}} m_w(w) = \lim_{w\downarrow\hat{w}} m_w(w)$ and $\int_0^\infty m_w dw = 1$. The equation balances inflows and outflows of probability density at each point in the wealth ratios space. The left-hand side represents exits from state w due to endogenous adjustment (first term) and drift (second term), while the right-hand side captures arrivals due to stochastic portfolio shocks.

A critical modeling choice is the interpretation of the stochastic process dZ_t in equation (4). To ensure meaningful heterogeneity across agents, I treat the risky asset as a purely idiosyncratic investment—such as ownership in a private firm or entrepreneurial venture.

From States to Observables: Frequency and Size Distribution. To connect the state variable w with observed durable adjustment behavior, we define the log size of the desired durable change as

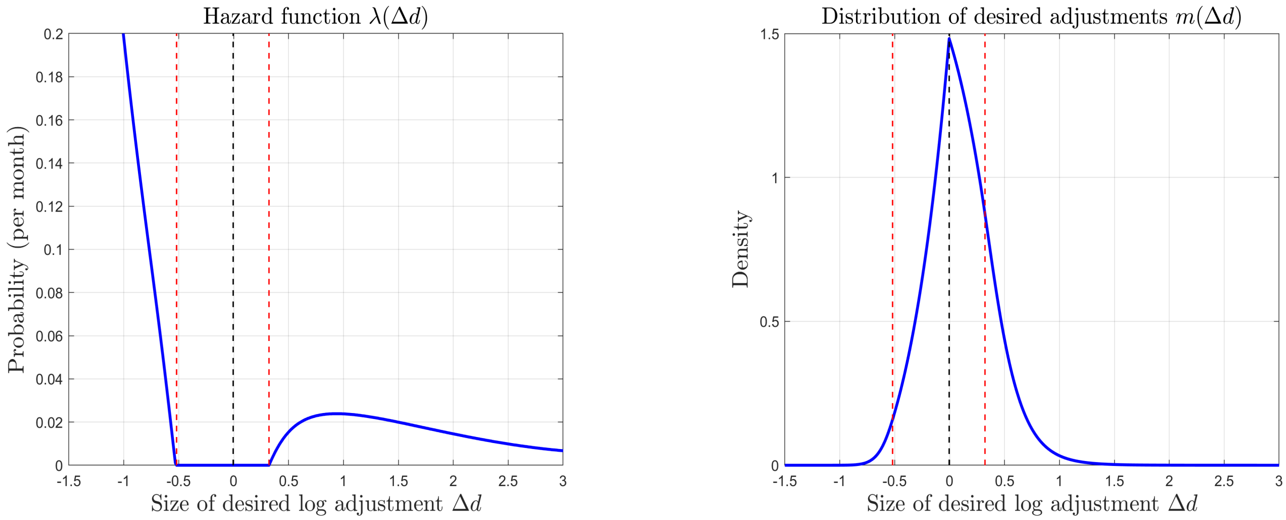
$$\Delta d = \log(\hat{D}/D) = \log(w - f + \epsilon) - \log(\hat{w} + \epsilon) \equiv g(w),$$

where the map g is monotonic and invertible. In other words, because the target wealth ratio $\hat{w}$ is constant across agents, each w maps uniquely to a desired adjustment size Δd.

Using this bijection, we transform the adjustment hazard and stationary distribution from $w-$space to $\Delta d-$ space

$$\lambda = \lambda_w \circ g^{-1}, \qquad m = m_w \circ g^{-1}.$$

Figure 3: Policy function λ and distribution m



Note: See model calibration in Table 1

The (total) frequency of durable adjustment is then given by

$$N = \int_{-\infty}^{\infty} \lambda(\Delta d)\, m(\Delta d)\, \mathrm{d}\Delta d,$$

which aggregates across the population by weighting each agent's hazard rate by the density of agents with that desired adjustment. We similarly define upward and downward adjustment frequencies as

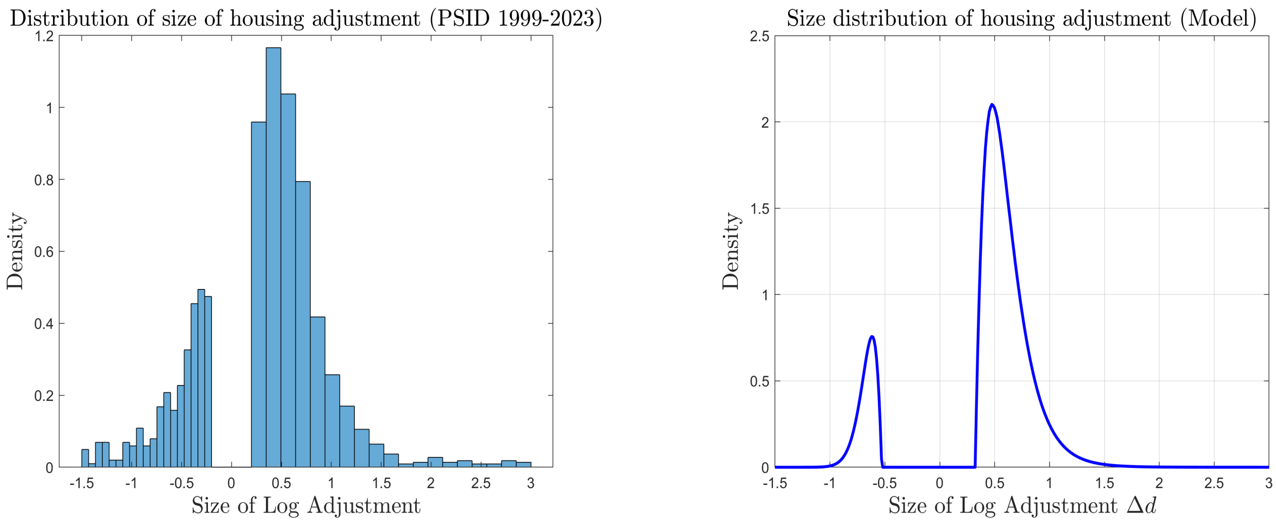
$$N_{+} = \int_{0}^{\infty} \lambda(\Delta d)\, m(\Delta d)\, \mathrm{d}\Delta d, \quad N_{-} = \int_{-\infty}^{0} \lambda(\Delta d)\, m(\Delta d)\, \mathrm{d}\Delta d.$$

Finally, the implied distribution of adjustment sizes among those who actually adjust is given by

$$q(\Delta d) = \frac{\lambda(\Delta d) m(\Delta d)}{N}$$

which we compare to empirical data in Figure 4.

Figure 4: Distribution of adjustment sizes in PSID Data and Model



Note: See model calibration in Table 1

4 Data and Estimation

4.1 Data Description

The empirical analysis relies on data from the Panel Study of Income Dynamics (PSID), with particular focus on housing and mobility behavior reported biennially. The primary variable of interest is the self-reported value of owner-occupied housing.

Following Berger and Vavra (2015), I restrict the sample to homeowners whose household heads are aged 65 or younger. Durable adjustment events are identified using a stringent definition to ensure that observed changes reflect true behavioral responses rather than passive asset revaluation or measurement error. Specifically, a household is classified as adjusting its durable stock if:

1. It reports a residential move relative to the previous PSID wave,

2. It reports having sold its prior home, and

3. The reported change in home value exceeds 20%.

To isolate active up-sizing or down-sizing from mechanical price movements, all housing values are normalized using the NIPA housing services price index. I follow this procedure exactly as described in Berger and Vavra (2015).

The first panel of Figure 4 displays the empirical distribution of housing adjustment sizes (log changes in normalized value) observed between 1999 and 2023. The distribution is markedly heterogeneous and exhibits a bimodal structure. The heterogeneity in adjustment sizes is at odds with a fixed transaction cost model. In particular, the presence of both small and large adjustments suggests a role for unobserved heterogeneity in adjustment costs.[7] The distribution is bimodal which is a hallmark of the fixed transaction costs in the housing market, small house adjustments are not worth the monetary moving costs.

The second panel of Figure 4 displays the distribution of adjustment sizes generated by the structural model. The model fits the right tail of the distribution well and captures the broad heterogeneity in observed adjustment behavior. Notably, the model reproduces the empirical bimodality, which emerges naturally from the idiosyncratic switching cost mechanism embedded in the hazard function.

4.2 Calibration

To illustrate the model's mechanisms, I adopt a preliminary calibration based on Stokey (2009), with modest modifications to parameters for risk aversion γ, down payment requirements ϵ and the transaction cost f. Table 1 summarizes the full set of baseline parameters.

Of note, the arrival rate of adjustment opportunities is set to once per week. This high arrival frequency ensures that any inaction observed in the model is not driven by infrequent opportunities, but rather by endogenous optimal inaction due to switching costs.

The calibration is not intended as a final estimation but as a transparent benchmark to explore model behavior and its consistency with the PSID evidence. Future versions of the

[7] In general, some unobserved heterogeneity (UH) is necessary to match this empirical fact. In this paper I model this UH as idiosyncratic switching costs. Further research should explore whether heterogeneity in risk aversion, access to different financial instruments or other sources of differences across agents has meaningful potential to confront this pattern.

paper will implement a formal estimation strategy.

Parameter	Value	Description
ρ	2.5%	Discount rate
γ	3.1	Risk aversion
α	0.8	Expenditure share in non-durables (desired)
r	1%	Risk-free interest rate
r^e	6%	Risk premium
σ	16.55%	Idiosyncratic risk
s	2%	Mortgage rate spread
ϵ	20%	Home equity requirement
f	2%	Transaction cost
κ	1 per week	Arrival of adjustment opportunities
Ψ	15000	Upper bound of random utility cost: $F \sim U([0, \Psi])$

Table 1: Baseline parameters

4.3 Estimation

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5 Responses to Aggregate Shocks

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5.1 Responses in Recessions

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5.2 Responses in Low Loan-to-Value Economies

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5.3 Responses in High Mortgage Spread Economies

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6 Concluding Remarks

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