Durable Purchases and the Welfare Consequences of Price Increases*

Martin Beraja
UC Berkeley and NBER

Nathan Zorzi
Dartmouth

July 17th, 2025

Abstract

We show that infrequent and large durable purchases are key to understand the average and distributional welfare consequences of episodes of persistent price increases, such as those induced by supply chain disruptions or tariffs. Households' spending is much more concentrated over time when purchases are lumpy. As a result, some households incur disproportionately large losses when relative prices are high. At the same time, durable purchases are more substitutable intertemporally, which could potentially soften the blow of such price increases. We use a state-of-the-art model of households spending to quantify the net effect between these two forces and investigate how welfare losses depend on the persistence of price increases. We find that increases in durable prices not only reduce average welfare more than comparable increases in non-durable prices, but also induce a thick tail of welfare losses concentrated amongst households who could not wait out the price increases. This heterogeneity across households depends on the duration of the episode: more transitory price increases result in thicker tails. As an application, we conclude the paper by studying the welfare consequences of recent tariffs changes in general equilibrium.

*Martin Beraja: maberaja@berkeley.edu. Nathan Zorzi: nathan.g.zorzi@dartmouth.edu.

1 Introduction

Durable prices increased sharply in the aftermath of the COVID-19 pandemic. Supply chain disruptions and production bottlenecks raised the effective cost of purchasing cars, furniture, appliances and other consumer durables to levels not seen in decades. Now, the US economy faces the prospect of another episode of high durable prices — this time due heightened trade tensions and tariffs.

Durable purchases tend to be large, making such price increases particularly salient to households. Should policymarkers be specifically concerned about price increases affecting large durables? In this paper, we argue that they should: infrequent and large durable purchases are key to understand and quantify the welfare consequences of episodes of persistent price increases, such as those induced by supply chain disruptions or tariffs. In particular, existing models that abstract from durable purchases underestimate substantially not only the average welfare costs of these episodes but also their heterogeneity in the population.

When making these points, we recognize that durable purchases are specific in two respects. First, they tend to be lumpy: households typically make infrequent but large adjustments to their durable stock. In a given year, some households might spend as much as their *entire* annual income on large items purchased with credit. For instance, the average price of a new car in the US is comparable to average households income and is typically financed with a car loan repaid over several years. This lumpiness means that these welfare costs are unevenly distributed across households and concentrated among the unfortunate few whose timing of durable replacement coincides with periods of high prices.

Second, durable spending is special in that households can substitute it intertemporally. They can strategically delay purchasing durables such as vehicles or household appliances. This flexibility allows consumers to temporarily buffer themselves against high prices by relying on their existing stock of durables, effectively smoothing consumption and spending decisions over time. However, households' flexibility in timing their durable purchases is constrained by depreciation and operational needs. If durable prices remain high for a sufficiently long period of time, more and more households must bite the bullet and pay higher prices.

These two properties of durable spending have opposite effects when it comes

to the welfare consequences of higher durable prices. On the one hand, lumpy purchases means that some households will suffer large losses. This prospect raises the average welfare cost when households are risk averse. On the other hand, households' ability to substitute intertemporally can potentially soften the blow of higher prices if they are sufficiently transitory.

We resolve quantitatively the tension between these forces and investigate how the welfare consequences of higher durable prices vary as the disruption becomes more persistent. To do so, we build on the work of Beraja and Zorzi (2024), who develop a state-of-the-art quantitative model of household spending specifically designed to capture many features of households durable and non-durable spending. Our model accounts for the lumpy nature of durable adjustment while allowing for a flexible degree of time dependence that constrains households' ability to shift their durable spending intertemporally. Our model matches a large number of microeconomic moments, including the average adjustment frequency of durables, the short-run elasticity of durable spending to price changes, the average marginal propensity to spend on durables and non-durables and its distribution in the population.

We find that increases in durable prices not only reduce households' welfare more than comparable increases in non-durable prices. They also induce a thick tail of welfare losses driven by households who could not wait out the price increases. Many households experience losses more than three times as large as the average. The thickness of these tails depends on the duration of the price disruption: the longer the price increase, the thiner the tails as more and more households have to bite the bullet and consent to paying higher prices. These findings contrast sharply with those obtained in traditional models of non-durable consumption alone.

In the second part the paper, we embed our model into an open-economy general equilibrium model to assess the welfare consequences of recent tariff changes. In particular, we explore how these costs are expected to grow as tariffs stay in place for longer — giving us a sense of how much bargaining power the government retains as the negotiations unfold. While our general equilibrium model is up and running, we are still in the process of generating and exporting these results and will add them soon to this draft.

Our analysis speaks to the broader literature on lumpy adjustments in durable

goods. Berger and Vavra (2015) introduced the canonical model of lumpy durables with incomplete markets. This model has served as a foundational framework for subsequent studies exploring the effect of monetary policy (McKay and Wieland, 2021), the response to credit shocks (Gavazza and Lanteri, 2021), and the effectiveness of purchase subsidies (Berger et al., 2023). Our contribution expands this literature by focusing explicitly on the welfare implications of lumpy adjustments following durable price changes and by emphasizing the role of duration in shaping the severity of welfare losses.

Our work complements recent studies that highlight significant and heterogenous welfare costs of price increases. Del Canto et al. (2023) emphasize inflation's regressive effects, which disproportionately burdens lower-income households due to their consumption patterns and limited assets. Guerreiro et al. (2024) show that inflation erodes workers real wages, inducing costly conflict with employers. Afrouzi et al. (2024) provides a theory of how inflation-driven real wage declines lead to increased job-to-job transitions, causing substantial and uneven welfare losses. Our general equilibrium exercise also connects to a literature that studies the inflationary response to higher tariffs and the significant economic costs that they induce. Both Amiti et al. (2019) and Fajgelbaum et al. (2020) document that tariffs introduced by the Trump administration during 2018 have fallen on domestic consumers and importers, implying a substantial reduction in aggregate US real income.

The remainder of the paper is structured as follows. Section 2 presents our spending block. Section 3 discusses its calibration. Section 4 quantifies the welfare implications of increases in durable and non-durable prices. Section 5 presents a general equilibrium application of our model to tariffs.

2 Model

We use the state-of-the-art model of durable and non-durable spending of Beraja and Zorzi (2024). For completeness, we summarize the setup below and formulate the problem recursively in Appendix A. Households consume non-durables and invest in durables, and they face uninsured earnings risk. Time is discrete, and there is no aggregate uncertainty. Periods are indexed by $t \geq 0$.

2.1 Goods and Preferences

Households consume $c_t \geq 0$, and invest in durables $d_t \geq 0$. Their utility is

$$\mathcal{U}_t \equiv u\left(c_t, d_t\right) + \beta \mathbb{E}_t\left[\mathcal{U}_{t+1}\right],$$

where $\beta \in (0,1)$ is the discount factor between periods. Inter- and intra-temporal preferences are

$$u\left(c,d\right) = \frac{1}{1-\sigma} U\left(c,d\right)^{1-\sigma} \quad \text{and} \quad U\left(c,d\right) = \left[\vartheta_c^{\frac{1}{\nu}} c^{\frac{\nu-1}{\nu}} + \vartheta_d^{\frac{1}{\nu}} d^{\frac{\nu-1}{\nu}}\right]^{\frac{\nu}{\nu-1}},$$

where σ is the inverse elasticity of inter-temporal substitution, ν is the elasticity of intra-temporal substitution, and consumption weights satisfy $\vartheta_c + \vartheta_d = 1$. In every period, each household is subject to random disutility cost ϵ if it adjusts its stock of durables. These disutility shocks are idiosyncratic, independent over time, and distributed according to a logistic distribution $\mathcal{E}$.[1] The mean and variance of this distribution are controlled by $\kappa > 0$ and $\eta^2 > 0$, respectively.[2] Households therefore compare the value of adjusting net of this disutility cost to the value of holding on to the existing stock of durables

$$\mathcal{V}_t \equiv \max\left\{V_t^{\text{adjust}} - \epsilon, V_t^{\text{not}}\right\} \tag{1}$$

where V_t^{adjust} and V_t^{not} are the idiosyncratic values of adjusting and non adjusting, respectively. This discrete choice problem yields a smooth adjustment hazard (or probability)

$$\mathcal{S}_t\left(\mathbf{x}\right) = \frac{\exp\left(\frac{V_t^{\text{adjust}}(\mathbf{x})-\kappa}{\eta}\right)}{\exp\left(\frac{V_t^{\text{adjust}}(\mathbf{x})-\kappa}{\eta}\right) + \exp\left(\frac{V_t^{\text{not}}(\mathbf{x})}{\eta}\right)}. \tag{2}$$

[1] This specification is common in the literature, as discussed in our introduction. Additional references in the context of automobile demand include Rust (1985), Copeland (2014) and Gillingham et al. (2022).

[2] The literature typically normalizes the mean of these shocks to zero (Artuç et al., 2010). By letting the mean and variance be unrestricted, we introduce one extra degree of freedom which allows us to match the micro-level evidence (Section 3).

2.2 Investment, Saving, and Down Payment

A household's durable stock depreciates at rate δ and requires a mandatory maintenance rate ι between adjustments so $d_t = (1 - (1 - \iota)\,\delta)\,d_{t-1}$ when the household does not adjust (Berger and Vavra, 2015). Households also save in a liquid asset $m \geq 0$ (i.e., cash, deposits) which interest rate r_t^m. They use this liquid asset to purchase non-durables and to make a down payment θ as a share of the value of their durable purchase.[3] They finance the rest of their durable purchases through illiquid debt $b_t \geq 0$ (i.e., car loans, furniture and appliance installments) that carries an interest rate $r_t^b \geq r_t^m$.[4] In every period, households pay the interest rate on this credit and repay the principal at a constant rate $\varphi \in (0, 1)$ as in Laibson et al. (2024). They prepay these loans in full when purchasing a new durable. The assumption that loans are illiquid is realistic: while refinancing is common for housing, it is virtually nonexistent for consumer durables which we focus on.[5]

2.3 Prices

Households purchase durables at price P_t^d.[6] We parametrize the pass-through from changes in purchasing prices ΔP_t^d onto *trade-in* prices $\Delta P_t^{d,\text{trade}}$ for the same durable by $\lambda \geq 0$. This parameter captures the fact that the trade-in price of certain large durables is either determined at the time of the previous purchase (e.g., for leased cars) or is adjusted more slowly by retailers than the price ΔP_t^d at which the

[3] Down payments are an important feature of durable goods purchases (Argyle et al., 2020) and are key to understand the response of durables to shocks (Luengo-Prado, 2006). In practice, the vast majority of down payments on cars does not exceed the minimum level required (Adams et al., 2009; Einav et al., 2012). Other types of durables can often be financed through buy-now-pay-later plans that typically require a small down payment.. Our calibration of θ will account for all these categories.

[4] In contrast, the standard formulation with a loan-to-value constraint (Luengo-Prado, 2006; Berger and Vavra, 2015; McKay and Wieland, 2021) does not make a distinction between liquid asset and illiquid credit. This standard formulation presumes that households can refinance *continuously* and extract equity from their durables. This is counterfactual in the context of consumer durables which typically results in implausibly small MPXs (McKay and Wieland, 2021) particularly for non-durables.

[5] In particular, prepayments on car loans — the largest component of households' debt excluding mortagages and students loans — are mostly unresponsive to shocks (Heitfield and Sabarwal, 2004; Ganong et al., 2024; Grunewald et al., 2023; Katcher et al., 2024). Buy-now-pay-later plans provide little incentives to prepay since they often carry no interest rate if they are repaid on time.

[6] There is no distinction between new and used durables.

durable is resold on the secondary market (e.g., used cars, electronics, furniture, appliances, etc.).[7] The price of the non-durable good is denoted by P_t^c.

2.4 Income Process

Income process. Households' labor earnings are $\exp(y_t)\, Y^{\text{inc}}$ where y_t is their log-productivity and $Y^{\text{inc}} \equiv 1$ is aggregate income. Log-productivity is

$$y_t = \omega_t + \zeta_t$$

which ω_t is a persistent component and ζ_t is a transitory component. The persistent component follows an autoregressive process

$$\omega_t = \rho \omega_{t-1} + e_t$$

with persistence $\rho \in (0,1)$ and innovations $e_t \sim N\left(0, \sigma_\omega^2\right)$ with $\sigma_\omega^2 \geq 0$. Indepedently, the transitory innovations are given by $\zeta_t \sim N\left(0, \sigma_\zeta^2\right)$ with $\sigma_\zeta^2 > 0$. We denote the transition kernel for the persistent component by $\Gamma_\omega\left(d\omega'; \omega\right)$ and the distribution for the transitory component by $\Gamma_\zeta\left(d\zeta'\right)$. Finally, households' income after taxes and benefits is

$$\mathcal{Y}_t \equiv (1-\tau) \exp\left(\omega_t + \zeta_t\right) Y^{\text{inc}}$$

where $\tau \geq 0$ is the tax rate.

3 Calibration

We interpret durables as consumer durables (cars, appliances, furniture) and abstract from housing purchases. Each period in the model is a quarter. The calibration strategy follows Beraja and Zorzi (2024). We summarize it briefly for completeness. Tables 1 and 2 summarize the parametrization.

[7] The parameter λ captures the pass-through from ΔP_t^d onto $\Delta P_t^{d,\text{trade}}$. In practice, there might be a *level* difference between these prices too due to intermediation fees. This level difference is not separately identified from the first moment of the distribution of preference shifters κ.

Table 1: External calibration

Parameter	Description	Value	Source / Target
Preferences			
σ	Inverse EIS	2	Berger and Vavra (2015)
ν	CES parameter	1	Long-run price elasticity
Durables			
δ	Depreciation rate	6.24%	NIPA
Financial assets			
θ	Down payment	41%	See text
φ	Repayment rate	6.88%	See text
r^m	Return on cash	1%	Real annual Fed funds rate
$r^b - r^m$	Borrowing spread	1.54%/4	See text
Earnings			
ρ	Persistence	0.9898	Krueger et al. (2016)
σ_ω	Volatility (persist.)	0.1015	Krueger et al. (2016)
σ_ζ	Volatility (transit.)	0.10	Guvenen and Smith (2014)
τ	Tax rate	0.3	Marginal tax rate of 30%

Notes: The sources and targets are described in more details in Section 3.1.

Table 2: Internal Calibration

Param.	Description	State-dep.	Our model	Target	Value
β	Discount factor	0.9719	0.9711	Liquid. / A inc.	26%
ϑ	Non-dur. pref.	0.7766	0.7656	d / c spending	24%
ι	Maintenance	0.1133	0.1169	Mainten. ratio	12%
κ	Location param.	0.1401	0.8824	Adjust. frequ. (A)	38%
η	Scale param.	0	0.3157	MPX (Q)	28%

Notes: The purely state-dependent model is a version of our model with $\eta \to 0$. We calibrate $\eta = 0.32$ in our model as we discuss in Section 3.2. All other targets are matched exactly. The sources are described in Section 3.2.

3.1 External Calibration

We start by calibrating externally some parameters that are either standard in the literature or measured in the data.

Preferences and depreciation. The inverse elasticity of intertemporal substitution is $\sigma = 2$, which is usual in the literature on durables (Berger and Vavra, 2015; Guerrieri and Lorenzoni, 2017). We choose an elasticity of substitution between durables and non-durables of $\nu \to 1$ to obtain a unitary long-run price elasticity for cars (Berry et al., 2004; Orchard et al., 2022). We pick the quarterly depreciation rate δ to obtain an effective annualized depreciation of 20.3% (BEA) after mandatory maintenance.

Down payment requirement. We assume that the down payment for cars of 15% which is a standard value (roughly 10% for new cars and 20% for used cars). The down payment share is harded to measure for other durable expenses that involve some form of illiquid consumer credit (buy-now-pay-later, retail credit). The reason is that these credits are issued by a variety of financial providers, sometimes by the stores directly, etc. The overall volume of such credit originated every year is roughly \$250bn (Flagg et al., 2024, Capital One, 2024). This figure is much smaller than the \$655bn or so in auto loans originated every year (Federal Reserve Bank of New York, 2025). Comparing the ratio of consumer credit to auto loans originated with the ratio of spending on those categories in the CEX, we conclude that households pay down about 68% of their expenses on consumer durables other than cars and repay the rest over time. Overall, we obtain an average down payment share of roughly $\theta = 41\%$.

Financial assets. We assume that auto loans are repaid with a half-life of 3 years (since the typical car loan has a duration of 6 years) and that illiquid consumer credit contracted to purchase other durables (buy-now-pay-later and retail credit which come with installment plans) are repaid with a shorter half-life of 6 months (this type of credit often has a duration of 12 months for electronics and furniture). Households hold about \$1.7tn in auto loans (Haughwout et al., 2025) and \$250bn in buy-now-pay-later and retail credit (Flagg et al., 2024; Capital One, 2024). Putting this information together implies that the average (exponential) repayment rate is

about $\varphi = 25\%$ per year. We set the real return on the liquid asset to $r^m = 1\%$ per year. The average interest on auto loans is 4.77% in nominal terms or roughly 2.77% in real terms. In turn, buy-now-pay-later plans or retail credit often come with little to no interest rate if the credit is repaid on time. We weight these interest rates using the respective share of credit originated (see above) to obtain an interest spread on credit $r^b - r^m$ of 1.54% in annualized terms.

Income process. We assume that the persistence of the annual component is 0.96 annually and that the variance of the innovations is 0.04 annually (Blundell et al., 2008a; Krueger et al., 2016; Kaplan and Violante, 2022). It is well-know that, empirically, the transitory component soaks measurement error which should not affect households' behavior. Guvenen and Smith (2014) address this issue and estimate the standard deviation of the transitory income shocks that is consistent with households' consumption response response to income shocks. They obtain a standard deviation of 0.10, which is about half the conventional estimates (meaning that measurement errors account for the remaining 50%). We convert these annual estimates into quarterly ones using the approach of Krueger et al. (2016). Finally, we set the marginal tax rate to $\tau = 30\%$ which is standard in the literature.

3.2 Internal Calibration

We calibrate five parameters internally: (i) the discount factor β; (ii) the relative weight on non-durables ϑ_c; (iii) the maintenance rate ι; (iv) the location parameter for preference shocks κ; and (v) the scale parameter for preference shocks η. We choose the discount factor to match an average stock of liquid asset holdings m of 26% of average annual income (Kaplan et al., 2018). We calibrate the relative weight on non-durables to target a ratio of durables to non-durable expenditures $x/c = 0.26$ based on CEX data.[8] We set the maintenance rate to obtain a ratio of maintenance spending to gross investment of 32.6% as in the CEX for cars, which is similar to the value used in McKay and Wieland (2021, 2022). The location pa-

[8] As discussed, we exclude housing from both durables and non-durables. Durable spending in the CEX consists of: household furnishings and equipment; vehicle purchases; maintenance and repairs on vehicles; audio and visual equipment and services; and other entertainment supplies, equipment and services. Non-durable spending consists of total spending minus the categories above and housing.

rameter κ controls the position of the hazard and we pick it to match an annual frequency of adjustment of roughly 25%. In turn, the scale parameter η controls the *shape* of the hazard, i.e., whether it is flat as in purely time-dependent models or sharply increasing as in purely state-dependent models. As in Beraja and Zorzi (2024), we calibrate the scale parameter by match a quarterly total MPX of 28%, which results in $\eta = 0.32$. This value lies between the estimates of Borusyak et al. (2024) and Boehm et al. (2025) and coincides with the preferred estimate in Orchard et al. (2022). We leave the MPX on durables as an untargeted moment since there is more empirical uncertainty about the exact split between durables and non-durables.[9] We obtain a quarterly MPX of 16% on durables and 12% on non-durables.

3.3 A Benchmark With Non-Durables Only

The next section compares the results in our model with a two-asset model of non-durables consumption based on Kaplan et al. (2018). Importantly, we calibrate the non-durables model with the same elasticity of intertemporal substitution and interest rate as in our model, and calibrate the discount factor to match the same share of hand-to-mouth households too.

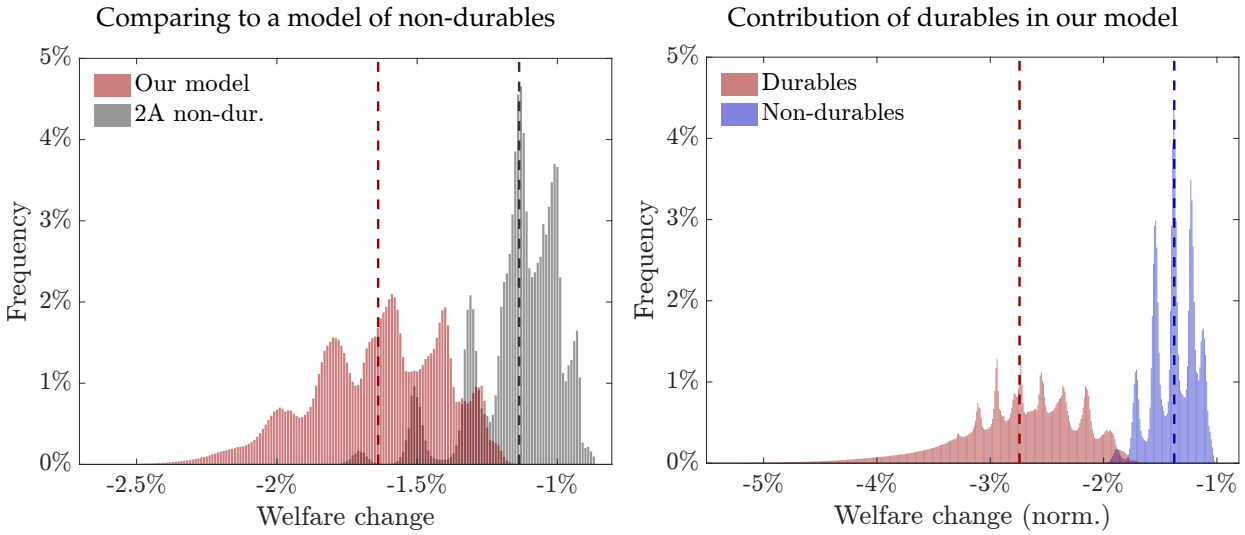
4 Welfare Losses from Price Increases

In this section, we establish three quantitative results. First, an increase in durable prices generates welfare losses that are substantially larger relative to comparable increase in non-durable prices. Second, the distribution of welfare losses has a much thicker tail when spending is lumpy — many households experience losses more than three times as large as the average. Third, these tails become thinner as the duration of price changes increases and more and more households have to bite the bullet and consent to paying higher prices. The findings contrast sharply with those obtained in traditional models of non-durable consumption alone.

[9] For instance, Orchard et al. (2025) find a smaller response of durables following the 2001 tax rebate, whereas Orchard et al. (2022) find a stronger response.

4.1 The Contribution of Durables

Figure 1: Welfare Changes



Notes: The left panel plots the distribution of welfare losses in our model (in red) and in a two-asset model of non-durables (in grey) following a 10% increase in (all). The price change mean reverts with a half-life of 1 year, according to an AR(1) process. Welfare changes are computed in consumption equivalent terms. The right panel plots the distribution of welfare losses in our model following a 10% increase in the price of durables only (in red) or non-durables only (in blue). The price change mean reverts with a half-life of 1 year, according to an AR(1) process. Welfare changes are computed in consumption-equivalent terms and normalized by the share of steady state spending on either durables or non-durables.

The left panel of Figure 1 illustrates the distribution across welfare changes (in consumption equivalent terms) of a 10% increase in both durable and non-durable goods prices simultaneously increase. The price changes mean revert with a half-life of 1 year. The figure shows that both the average loss and heterogeneity in losses are larger in our model compared to the non-durables model. Notably, while the non-durables model predicts relatively moderate and uniform impacts on welfare, our model highlights substantial heterogeneity, identifying a pronounced long-left tail of households who suffer notably large welfare losses.

In turn, the right panel of Figure 1 decomposes the welfare changes in our model into the contributions from durable and non-durable price increases separately, each normalized by their steady-state spending shares. This decomposition confirms that increases in durable prices carry larger welfare costs on average than comparable increases in non-durable prices. The figure also confirms that the in-

crease in durable prices is primarily responsible for the pronounced long-left tail observed in Figure 1.

These results imply that policymakers should be particularly concerned about durable price changes. When trying to address supply chain bottlenecks or when deciding which tariffs to raise, the government prioritize alleviating the price pressure from durable industries compared to non-durable industries of the same size.

4.2 The Role of Large Durable Expenses

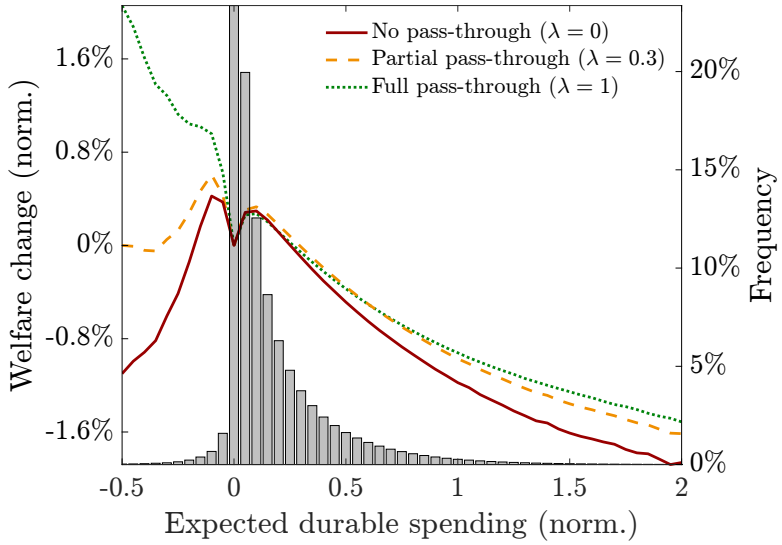
Figure 2 investigates the source of the pronounced long-left tail of welfare losses identified earlier, attributing it primarily to households planning large, or "big ticket," durable good purchases. By comparing a household with no intended durable purchase (expected durable spending $x = 0$) against one intending to make a large durable purchase (large and positive x) in the very first period, we find that the latter suffers approximately a 1.5 percentage point greater welfare loss.[10] Quantitatively, this behavior explains the substantial thickness of the welfare loss distribution tail observed in Figure 1.

Figure 2 also explores how the pass-through λ to trade-in prices affects the heterogeneity in these welfare losses. Our benchmark calibration with $\lambda = 30\%$ corresponds to the orange curve. We consider alternative scenarios with $\lambda = 0\%$ (the trade-in price is fixed, in red) and $\lambda = 100\%$ (there is full pass-through, in green). The higher λ, the larger the trade-in price will be following an increase in P_t^d. Households can leverage up these higher trade-in prices since they only need to pay down a share θ of their durable purchases. Following an increase ΔP_t^d in durable prices, households can thus extract $(\lambda/\theta - 1)\,\Delta P_t^d$ in equity. Our benchmark calibration ensures that this term is relatively small, i.e., households do not rush to sell their old durables and purchase new ones when $\Delta P_t^d > 0$.

The different scenarios that we consider make very little difference for the heterogeneity in welfare losses among households with $x > 0$ who plan on purchasing durables. They have different implications, however, for households with $x < 0$ who plan on *selling* durables. The higher the pass-through onto trade-in

[10] Even the first household experiences a welfare loss since it will need to purchase a new durable at some point in the future. To facilitate the comparison, Figure 2 expresses welfare changes in deviations from the one experienced by this household.

Figure 2: The Role of Large Durable Expenses



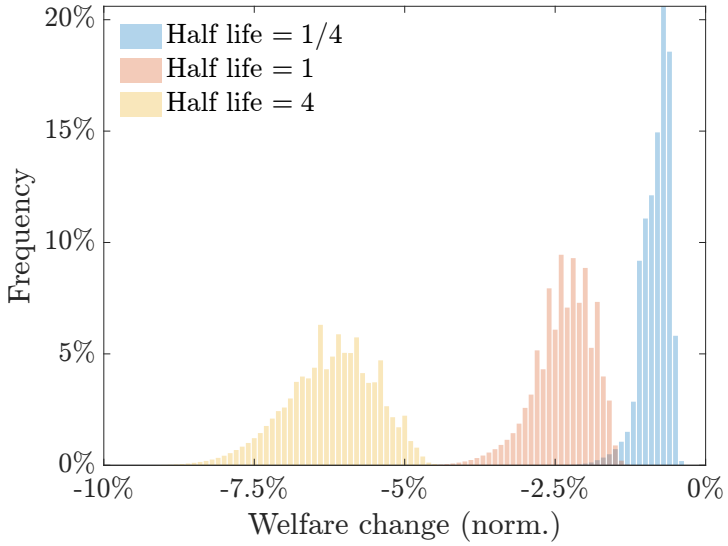
Notes: This figure plots welfare changes as a function of expected durable spending $\mathcal{S}(\mathbf{x}) \times x^{\text{gap}}(\mathbf{x})$ before the shock, where $x^{\text{gap}}(\mathbf{x})$ denotes investment conditional on adjustment. To account for differences in income and wealth across households, we normalize expected durable spending by non-durable consumption $c(\mathbf{x})$ before the shock. In the benchmark scenario (in orange), the pass-through to trade-in prices is $\lambda = 30\%$. We consider alternative scenarios with no pass-through ($\lambda = 0\%$, in red) and full pass-through ($\lambda = 100\%$, in green). Welfare changes are computed following a 10% increase in the price of durables only (in red) or non-durables only (in blue). The price change mean reverts with a half-life of 1 year. To facilitate the comparison across the three scenarios, we normalize welfare changes to 0 when expected (normalized) durable spending is zero. The grey bars correspond to the distribution of (normalized) durable spending before the shock.

prices, the more equity they can extract and hence the lower the welfare losses — some of these households even benefit from higher prices despite having to repurchase a more expensive one. That said, this possibility seems more relevant for assets like housing rather than typical consumer durables (e.g., toys, appliances, books, cars).

4.3 Duration and Welfare

Figure 3 plots the distribution of welfare losses as we vary the persistence of the price increase for durables from a half-life 1 quarter to 4 years. The rightmost distribution (in blue), corresponding to the shortest duration, shows relatively smaller welfare losses clustered near zero. As the duration increases, the distribution shifts to the left since households are confronted with higher prices for longer. However,

Figure 3: Persistence of Price Increase



Notes: This figure plots the distribution of welfare losses in our model following a 10% increase in the price of durables. Each distribution represents a price change that mean reverts with a different half-life, according to an AR(1) process. Welfare changes are computed in consumption-equivalent terms.

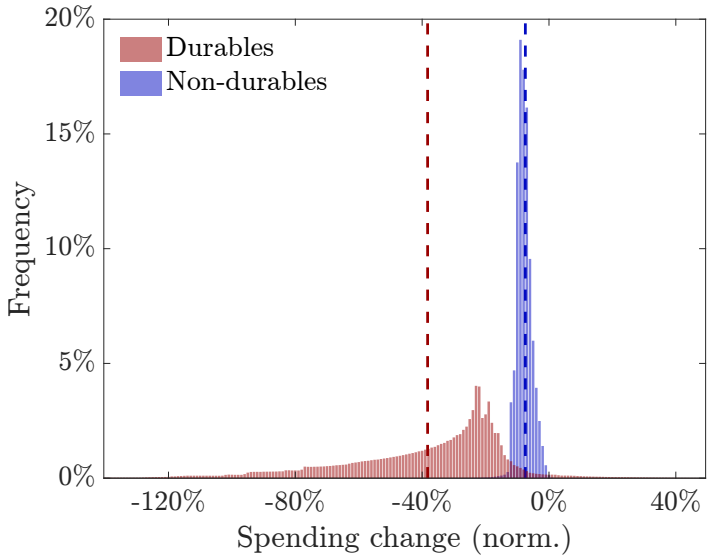
the incidence is uneven across the distribution — the welfare losses are not multiplied uniformly by the same factor. Instead, the distribution becomes less skewed as exhibits less excess kurtosis (or thiner tails) as the duration of the price change increases. Put it differently, welfare become proportionately *less* heterogenous as the price change persists for longer. This result is intuitive: most households can substitute intertemporally when the price hike is temporary, with only a few unfortunate households who cannot avoid adjusting their durables; as the price change becomes permanent, households cannot avoid it by substituting intertemporally, they bite the bullet and consent to paying the higher price, therefore incurring a welfare loss.

4.4 The Response of Spending

The partial equilibrium analysis that we presented so far likely underestimates the true welfare costs of price changes for durables. The reason is that increases in durable prices lead to a sharper contraction of aggregate demand relative to comparable increases in non-durable spending, as illustrated by Figure 4. This would amplify welfare losses in general equilibrium where the larger decline in

aggregate spending translates into a larger decline in incomes. This observation motivates our general equilibrium analysis in the next section, in which we attempt to estimate accurately assess the welfare implications of recent tariffs hikes.

Figure 4: Spending Changes



Notes: This figure plots the distribution of spending changes in our model following a 10% increase in the price of durables only (in red) or non-durables only (in blue). The price change mean reverts with a half-life of 1 year. Spending changes are normalized by the share of steady state spending on either durables or non-durables.

5 A General Equilibrium Application to Tariffs

In the rest of this paper, we use our model to evaluate the effect of tariffs increases in general equilibrium, motivated by the recent hikes following "Liberation Day." We extend the heterogeneous-agent New-Keynesian model setup of Beraja and Zorzi (2024) to an open-economy and introduce tariffs on imported goods.[11] Our model accounts for endogeneous changes in incomes and prices in response to these tariffs changes. We describe the the environment in Section 5.1 and the parameterization in Section 5.2. We quantify the general equilibrium response of welfare in Section 5.3. We provide more details in Appendix B.

[11] The revised version of that paper assumes a closed economy.

5.1 Environment

The economy has two sectors. The first produces a non-durable good and the second an investment good. The non-durable good can be used for consumption or as an intermediate for producing the investment good. The investment good can be used to build up the stock of durables. The non-durable good is produced with labor. The investment good is produced with non-durables (as in McKay and Wieland, 2021).

Households. The household block of the economy is identical to the one introduced in Section 2. The only difference is that we allow for inflation and relative price movements between durables and non-durables over time, as well as imports and exports of goods.

Households import part of their non-durable and investment goods. Accounting for imports is important to quantify the effect of stimulus checks accurately, as part of the extra spending from checks leaks abroad. This is especially important for durables for which the import share in US expenditures is roughly one fourth. Non-durable consumption c_t and investment x_t are given by

$$c_t = \left[\sum_{j\in\{H,F\}} \left(\alpha_j^c\right)^{\frac{1}{\rho}} \left(c_t^j\right)^{\frac{\rho-1}{\rho}}\right]^{\frac{\rho}{\rho-1}} \quad \text{and} \quad x_t = \left[\sum_{j\in\{H,F\}} \left(\alpha_j^d\right)^{\frac{1}{\rho}} \left(x_t^j\right)^{\frac{\rho-1}{\rho}}\right]^{\frac{\rho}{\rho-1}}, \quad (3)$$

where c_t^H and c_t^F are the consumptions of the home and foreign non-durable goods, respectively, and the weights $\alpha_H^c + \alpha_F^c = 1$ capture the corresponding spending shares.[12] The terms x_t^j and α_j^d are defined similarly for investment in durables. In the following, we let P_t^c and P_t^d denote the price of the consumption and investment baskets (3) expressed in terms of the home non-durable good. All other prices and real quantities are also expressed in terms of that good (Appendix B.1).

The demands from the rest of the world are similar to (3). *Total* consumption of non-durables $c_t^\star$ and investment in durables $x_t^\star$ in the rest of the world are constant and equal to the steady state levels at home, so there are no net imports in steady state. However, countries can run a current account surplus or deficit after an aggregate shock. Domestic and foreign prices are normalized to 1 initially.

[12] We will contrast the responses in closed ($\alpha_F^c = \alpha_F^d = 0$) and open ($\alpha_F^c, \alpha_F^d > 0$) economies.

Domestic prices respond to an aggregate shock, while foreign nominal prices are fixed throughout. Finally, the nominal exchange rate is pinned down by purchasing power parity in the long-run, and uncovered interest rate parity during the transition (Appendix B.1).

Tariffs. The government can levy tariffs τ_t^d and τ_t^c on imported durable and non-durable goods, respectively. Accordingly, the home price indices are

$$P_t^z \equiv \left[\alpha_z \left(p_t^z\right)^{1-\rho} + (1-\alpha_z)\left(\left(1+\tau_t^z\right) e_t\right)^{1-\rho}\right]^{\frac{1}{1-\rho}}, \tag{4}$$

for each good $z \in \{c, d\}$, where τ_t^z is the tariff levied on each good, e_t is the real exchange rate and p_t^z is the price of the domestic good relative to the non-durable one, and where are using the fact that the nominal prices of foreign goods are normalized to 1.

Price setting. A firm produces non-durables using labor. Inflation in the price of the non-durable good (π_t) is given by a Phillips curve

$$\pi_t = \kappa \log\left(\frac{Y_t^{\text{dom}}}{Y_t^{\text{potent}}}\right) + \beta \pi_{t+1}, \tag{5}$$

where Y_t^{dom} is the aggregate demand for the non-durable good, Y_t^{potent} is potential output in that sector, and $\kappa > 0$ is the slope of the Phillips curve.[13]

A firm can produce $F(M) = A_0 M^{\frac{\zeta}{1+\zeta}}$ units of the investment good using M units of non-durables as in McKay and Wieland (2021, 2022), where $1/\zeta > 0$ governs the decreasing returns in production (and hence the inverse supply elasticity) and $A_0 > 0$ is productivity. Profit maximization implies that, in equilibrium, the relative price of the investment good is

$$p_t^d \equiv \left(\frac{X_t^{\text{dom}}}{X_t^{\text{potent}}}\right)^{1/\zeta}, \tag{6}$$

[13] See McKay and Wieland (2021) for a microfoundation. This Phillips curve can result from sticky prices or wages. Distinguishing between the two would require taking a stance on workers' labor supply, which is not the focus of this paper.

where X_t^{dom} is the aggregate demand for durables produced domestically and X_t^{potent} is potential output in that sector.

Policy. The government imposes tariffs on imported goods. The government's flow budget constraint is

$$B_t^g + P_t^c G_t = \frac{1+r_t}{1+\pi_t} B_{t-1}^g + \mathcal{M}_t + \mathcal{T}_t + \Sigma_t, \tag{7}$$

where B_t^g are real asset holdings, G_t is government spending on non-durables, $\mathcal{M}_t$ are revenues from tariffs, $\mathcal{T}_t \equiv \int \left(y Y_t^{\text{inc}} - \psi_{0,t} (y Y_t^{\text{inc}})^{1-\psi_1} \right) d\mu_{t-1}$ are the revenues from progressive income taxation (Heathcote et al., 2017) with Y_t^{inc} denoting households' aggregate real income, Σ_t are credit payments from households.[14] Real spending is constant $G_t \equiv G > 0$. Monetary policy follows a standard rule $r_t^m = \max\{r^m + \phi_\Pi \pi_t, \underline{r}\}$ where r^m is the steady state interest rate on the liquid asset, ϕ_Π is the coefficient on inflation, and $\underline{r}$ is the effective lower bound.[15]

Outputs and incomes. Market clearing requires that the amounts spent on the non-durable and durable goods equal the value of the production in these sectors

$$P_t^c (C_t + G_t) + F^{-1}\left(X_t^{\text{dom}}\right) + \text{NX}_t^{c,\text{real}} = Y_t^{\text{dom}}, \tag{8}$$

and

$$P_t^d X_t + p_t^d I_t + \text{NX}_t^{d,\text{real}} = p_t^d X_t^{\text{dom}}, \tag{9}$$

where C_t and X_t are the households' aggregate demands for the non-durable and investment good, respectively, $F^{-1}\left(X_t^{\text{dom}}\right)$ is the demand for intermediates used to produce X_t^{dom} units of the investment good, $\text{NX}_t^{c,\text{real}}$ and $\text{NX}_t^{d,\text{real}}$ are real net exports (Appendix B.1), and Y_t^{dom} and X_t^{dom} are the sectoral outputs. Households' aggregate income before interest and tax payments is $Y_t^{\text{inc}} = Y_t^{\text{dom}} + \text{Div}_t$, where

[14] Instead of assuming that the government claims Σ_t, we could have introduced a separate financial sector. We assume that the government spends G_t on domestic and foreign varieties using the same aggregator (3) as the households.

[15] We assume that the Taylor coefficient on the output gap is zero, as in Auclert et al. (2021). We also assume that monetary policy responds to inflation in non-durables π_t, as in McKay and Wieland (2021), since this is the only good produced with labor. We have experimented with a version where the Taylor rule depends on CPI (or PPI inflation) instead of non-durable inflation π_t, and obtained similar results.

Y_t^{dom} are the payments from the firm producing the non-durable good and Div_t are the dividends disbursed by the firm producing the investment good.[16] Finally, households' real net income before interest payments is $E_t^{\text{net}}(\mathbf{x}) = (1-\tau)\, y Y_t^{\text{inc}}$,where y are idiosyncratic income shocks, and $\psi_{0,t}$ and ψ_1 parametrize the tax schedule.

5.2 Parametrization

As in our baseline calibration (Section 3), the real interest rate is $r^m = 1\%$ in the stationary equilibrium, aggregate income is $Y_t^{\text{inc}} \equiv 1$, the government maintains a constant ratio of debt to annual aggregate income of 26%, and the tax intercept ψ_0 ensures that the marginal tax rate is 30% in the long-run. Households import 23% of their durable spending at the steady state, and 9% of their non-durable spending (Hale et al., 2019). We set the elasticity of substitution between home and foreign varieties to $\rho \to 1$. This value lies between the short-run and long-run estimates of Boehm et al. (2023). We normalize the productivity A_0 in the sector producing the investment good so the relative price of durables is $p^d \equiv 1$ at the initial steady state. The slope of the Phillips curve is $\kappa = 0.0031$ based on the evidence of Hazell et al. (2022).[17] For now, we focus on the case $\zeta \to +\infty$ where the relative price of durables is acyclical. The Taylor coefficient on inflation is $\phi_\Pi = 1.5$. The effective lower bound on the interest rate is 3 percentage points lower than the steady state (real) interest rate r^m, assuming a 3% nominal return on the liquid asset. Therefore, we set the effective lower bound to $\underline{r} = -2\%$. The government issues debt, and repays it slowly by raising the tax intercept $\psi_{0,t}$ uniformly over 15 years and letting it decay to its long-run value ψ_0 over the next 5 years.

5.3 Welfare Losses from Tariffs

Coming soon

[16] Households claim the revenue of the firm producing non-durables. We do not make a distinction between the wage bill and profits of that firm for the reasons discussed in footnote 13.

[17] Hazell et al. (2022) estimate that this slope is -0.0062 in terms of unemployment since 1980. The semi-elasticity of unemployment with respect to output is roughly -0.5 over that period.

References

Adams, William, Liran Einav, and Jonathan Levin, "Liquidity Constraints and Imperfect Information in Subprime Lending," *American Economic Review*, March 2009, *99* (1), 49–84.

Afrouzi, Hassan, Andres Blanco, Andres Drenik, and Erik Hurst, "A Theory of How Workers Keep Up with Inflation," Technical Report, National Bureau of Economic Research 2024.

Amiti, Mary, Stephen J Redding, and David E Weinstein, "The impact of the 2018 tariffs on prices and welfare," *Journal of Economic Perspectives*, 2019, *33* (4), 187–210.

Argyle, Bronson S, Taylor D Nadauld, and Christopher J Palmer, "Monthly Payment Targeting and the Demand for Maturity," *The Review of Financial Studies*, 01 2020, *33* (11), 5416–5462.

Artuç, Erhan, Shubham Chaudhuri, and John McLaren, "Trade Shocks and Labor Adjustment: A Structural Empirical Approach," *American Economic Review*, June 2010, *100* (3), 1008–1045.

_ , Bence Bardóczy, Matthew Rognlie, and Ludwig Straub, "Using the Sequence-Space Jacobian to Solve and Estimate Heterogeneous-Agent Models," *Econometrica*, September 2021, *89* (5), 2375–2408.

_ and Nathan Zorzi, "Durables and size-dependence in the marginal propensity to spend," Technical Report, National Bureau of Economic Research 2024.

_ and _ , "Consumption Dynamics During Recessions," *Econometrica*, January 2015, *83*, 101–154.

_ , Tianfang Cui, Nicholas Turner, and Eric Zwick, "Stimulating Durable Purchases," In preparation 2023.

_ , _ , and _ , "Differentiated Products Demand Systems from a Combination of Micro and Macro Data: The New Car Market," *Journal of Political Economy*, February 2004, *112* (1), 68–105.

Blundell, Richard, Luigi Pistaferri, and Ian Preston, "Consumption Inequality and Partial Insurance," *American Economic Review*, December 2008, *98* (5), 1887–1921.

Boehm, Christoph E., Andrei A. Levchenko, and Nitya Pandalai-Nayar, "The Long and Short (Run) of Trade Elasticities," *American Economic Review*, April 2023, *113* (4), 861–905.

Boehm, Johannes, Etienne Fize, and Xavier Jaravel, "Five Facts about MPCs: Evidence from a Randomized Experiment," *American Economic Review*, January

2025, *115* (1), 1–42.

Borusyak, Kirill, Xavier Jaravel, and Jann Spiess, "Revisiting Event-Study Designs: Robust and Efficient Estimation," *The Review of Economic Studies*, 02 2024, *91* (6), 3253–3285.

Canto, Felipe N Del, John R Grigsby, Eric Qian, and Conor Walsh, "Are Inflationary Shocks Regressive? A Feasible Set Approach," Technical Report, National Bureau of Economic Research 2023.

Capital One, "Buy Now Pay Later Statistics," Technical Report December 2024.

Copeland, Adam, "Intertemporal substitution and new car purchases," *RAND Journal of Economics*, September 2014, *45* (3), 624–644.

Einav, Liran, Mark Jenkins, and Jonathan Levin, "Contract Pricing in Consumer Credit Markets," *Econometrica*, July 2012, *80* (4), 1387–1432.

Fajgelbaum, Pablo D, Pinelopi K Goldberg, Patrick J Kennedy, and Amit K Khandelwal, "The return to protectionism," *The Quarterly Journal of Economics*, 2020, *135* (1), 1–55.

Federal Reserve Bank of New York, "Household Debt Balances Continue Steady Increase; Delinquency Transition Rates Remain Elevated for Auto and Credit Cards," Press Release 2025.

Flagg, Jessica N., Simona M. Hannon, Cisil Sarisoy, and Mark J. Wicks, "Estimating Retail Credit in the U.S.," FEDS Notes, Washington: Board of Governors of the Federal Reserve System June 2024.

Ganong, Peter, Fiona Greig, Pascal Noel, Daniel M. Sullivan, and Joseph Vavra, "Spending and Job-Finding Impacts of Expanded Unemployment Benefits: Evidence from Administrative Micro Data," *American Economic Review*, September 2024, *114* (9), 2898–2939.

Gavazza, Alessandro and Andrea Lanteri, "Credit Shocks and Equilibrium Dynamics in Consumer Durable Goods Markets," *The Review of Economic Studies*, 03 2021, *88* (6), 2935–2969.

Gillingham, Kenneth, Fedor Iskhakov, Anders Munk-Nielsen, John Rust, and Bertel Schjerning, "Equilibrium Trade in Automobiles," *Journal of Political Economy*, 2022, *130* (10), 2534–2593.

Grunewald, Andreas, Jonathan A. Lanning, David C. Low, and Tobias Salz, "Auto Dealer Loan Intermediation: Consumer Behavior and Competitive Effects," Mimeo, Massachusetts Institute of Technology February 2023.

Guerreiro, Joao, Jonathon Hazell, Chen Lian, and Christina Patterson, "Why Do Workers Dislike Inflation? Wage Erosion and Conflict Costs," *NBER Working Paper*, 2024, (w32956).

Guerrieri, Veronica and Guido Lorenzoni, "Credit Crises, Precautionary Savings, and the Liquidity Trap," *The Quarterly Journal of Economics*, 2017, *132* (3), 1427–1467.

Guvenen, Fatih and Anthony A. Smith, "Inferring Labor Income Risk and Partial Insurance From Economic Choices," *Econometrica*, November 2014, *82*, 2085–2129.

Hale, Galina, Bart Hobijn, Fernanda Nechio, and Doris Wilson, "How Much Do We Spend on Imports?," *FRBSF Economic Letter*, 2019.

Haughwout, Andrew, Donghoon Lee, Daniel Mangrum, Joelle Scally, and Wilbert van der Klaauw, "Breaking Down Auto Loan Performance," Liberty Street Economics, Federal Reserve Bank of New York February 2025.

Hazell, Jonathon, Juan Herreño, Emi Nakamura, and Jón Steinsson, "The Slope of the Phillips Curve: Evidence from U.S. States," *The Quarterly Journal of Economics*, 2022, *137* (3), 1299–1344.

Heathcote, Jonathan, Kjetil Storesletten, and Giovanni L Violante, "Optimal Tax Progressivity: An Analytical Framework," *The Quarterly Journal of Economics*, 2017, *132* (4), 1693–1754.

Heitfield, Erik and Tarun Sabarwal, "What Drives Default and Prepayment on Subprime Auto Loans?," *The Journal of Real Estate Finance and Economics*, December 2004, *29* (4), 457–477.

_ **and** _ , "The Marginal Propensity to Consume in Heterogeneous Agent Models," *Annual Review of Economics*, 2022, *14* (1), 747–775.

_ **, Benjamin Moll, and Giovanni L. Violante**, "Monetary Policy According to HANK," *American Economic Review*, March 2018, *108* (3), 697–743.

Katcher, Bradley, Geng Li, Alvaro Mezza, and Steve Ramos, "One Month Longer, One Month Later? Prepayments in the Auto Loan Market," Finance and Economics Discussion Series 2024-056, Board of Governors of the Federal Reserve System (U.S.) July 2024.

Krueger, D., K. Mitman, and F. Perri, "Macroeconomics and Household Heterogeneity," in J. B. Taylor and Harald Uhlig, eds., *Handbook of Macroeconomics*, Vol. 2 of *Handbook of Macroeconomics*, Elsevier, 2016, chapter 0, pp. 843–921.

_ **,** _ **, and** _ , "Present Bias Amplifies the Household Balance-Sheet Channels of Macroeconomic Policy," *The Quarterly Journal of Economics*, 2024.

Luengo-Prado, Maria Jose, "Durables, nondurables, down payments and consumption excesses," *Journal of Monetary Economics*, October 2006, *53* (7), 1509–1539.

_ **and Johannes F. Wieland**, "Lumpy Durable Consumption Demand and the

Limited Ammunition of Monetary Policy," *Econometrica*, November 2021, *89* (6), 2717–2749.

_ **and** _ , "Forward Guidance and Durable Goods Demand," *American Economic Review: Insights*, March 2022, *4* (1), 106–22.

Orchard, Jacob D, Valerie A Ramey, and Johannes F Wieland, "Using Macro Counterfactuals to Assess Plausibility: An Illustration using the 2001 Rebate MPCs," *The Economic Journal*, 06 2025, p. ueaf039.

Orchard, Jacob, Valerie A. Ramey, and Johannes F. Wieland, "Micro MPCs and Macro Counterfactuals: The Case of the 2008 Rebates," Technical Report, UCSD Mimeo 2022.

Rust, John, "Stationary Equilibrium in a Market for Durable Assets," *Econometrica*, July 1985, *53* (4), 783–805.

Online Appendix

A Recursive Formulation

We now state the household's problem recursively. At the begining of the period, households are indexed by six idiosyncratic states $\mathbf{x} \equiv (d, m, b, \boldsymbol{y})$, i.e., their stock of durables d, their cash-on-hand m, their outstanding credit b, and the three components of income $\mathbf{y} \equiv (\alpha, \omega, \zeta)$.

The household first chooses whether to adjust its stock of durables or not. The value associated to the discrete choice problem is

$$\mathcal{V}_t(\mathbf{x}; \epsilon) = \max\left\{V_t^{\text{adjust}}(\mathbf{x}) - \epsilon, V_t^{\text{not}}(\mathbf{x})\right\},$$

where $V_t^{\text{adjust}}(\mathbf{x})$ and $V_t^{\text{not}}(\mathbf{x})$ are the value of adjusting and not adjusting the stock of durables, respectively, and ϵ is a random disutility cost of adjustment. These taste shocks ϵ are independent over time and distributed according to a logistic distribution $\mathcal{E}$.[18] The mean and variance of this distribution are controlled by $\kappa > 0$ and $\eta^2 > 0$, respectively.[19] This discrete choice problem yields a smooth adjustment hazard (or probability)

$$\mathcal{S}_t(\mathbf{x}) = \frac{\exp\left(\frac{V_t^{\text{adjust}}(\mathbf{x})-\kappa}{\eta}\right)}{\exp\left(\frac{V_t^{\text{adjust}}(\mathbf{x})-\kappa}{\eta}\right) + \exp\left(\frac{V_t^{\text{not}}(\mathbf{x})}{\eta}\right)}. \tag{10}$$

[18] This specification is common in the literature, as discussed in our introduction. Additional references in the context of automobile demand include Rust (1985), Copeland (2014) and Gillingham et al. (2022).

[19] The literature typically normalizes the mean of these shocks to zero (Artuç et al., 2010). By letting the mean and variance be unrestricted, we introduce one extra degree of freedom which allows us to match the micro-level evidence (Section 3). Random monetary fixed costs of adjustment also produce a smooth hazard, although they do not have a clear economic interpretation in the context of consumer durables.

When the household adjusts its stock of durables, its value is given by

$$V_t^{\text{adjust}}(\mathbf{x}) = \max_{c,d',m'} u(c,d') + \beta \int \mathcal{V}_{t+1}(d',m',b',\mathbf{y}';\epsilon') \, d\mathcal{E}(\epsilon') \, \Gamma_\zeta(d\zeta') \, \Gamma_\omega(d\omega';\omega)$$
$$\text{s.t. } \theta P_t^d d' + m' + c \leq \hat{m}_t(\mathbf{x}) + (1-\delta) P_t^{d,\text{second}} d - b$$
$$m' \geq 0 \, , \; b' = (1-\theta) P_t^d d'$$

i.e., the household decides how much to consume c and how much durables to purchase d' subject to their budget constraint and borrowing constraint. Adjusting the stock of durables resets the stock of outstanding credit to $b' = (1-\theta) P_t^d d'$. Cash-on-hand before adjustment, stimulus check and credit pre-payment is

$$\hat{m}_t(\mathbf{x}) \equiv (1-\tau) \exp(\alpha + \omega + \zeta) Y_t^{\text{inc}} + \left(1 + r_{t-1}^m\right) m - r_{t-1}^b \times b, \tag{11}$$

i.e., the household earns some income, pays taxes whose schedule is parametrized by ψ_0 and ψ_1, receives a return on its holdings of liquid asset m, and pays an interest rate r_t^b on its debt. In addition to this cash-on-hand, the household sells its stock of durables $(1-\delta) P_t^{d,\text{trade}} d$, and prepays its oustanding credit b. The resale price on the secondary market is

$$P_t^{d,\text{trade}} \equiv \bar{P}^d + \lambda \left(P_t^d - \bar{P}^d \right),$$

where $\bar{P}^d$ is the steady state price of durables and λ denotes the pass-through from purchasing prices ΔP_t^d to trade-in prices $\Delta P_t^{d,\text{trade}}$.

When the household instead holds on to its existing stock of durables, its value is given by

$$V_t^{\text{not}}(\mathbf{x}) = \max_{c,m'} u(c,d') + \beta \int \mathcal{V}_{t+1}(d',m',b',\mathbf{y}';\epsilon') \, d\mathcal{E}(\epsilon') \, \Gamma_\zeta(d\zeta') \, \Gamma_\omega(d\omega';\omega)$$
$$\text{s.t. } m' + c \leq \hat{m}_t(\mathbf{x}) + \left(b' - b\right) + T_t - \iota \delta P^d d$$
$$d' = (1 - (1-\iota)\delta) d$$
$$m' \geq 0 \, , \; b' = (1-\varphi) b$$

i.e., i.e., the household decides how much to consume c and maintains its stock of

durable at cost $\iota\delta P_t^d d$. The household repays the principal on its credit at rate φ. Beraja and Zorzi (2024) explains how to solve this recursive problem numerically.

B General Equilibrium

In this appendix, we describe the general equilibrium setup in more details. Section B.1 describes the price indices and the open economy features of our model (net exports, the real exchange rate, etc.). Section B.2 discusses fiscal policy.

B.1 Price Indices, Trade Balance and Exchange Rate

This appendix provides the expressions for the price indices, the trade balance, and the equilibrium exchange rate.

Price indices. We express the domestic prices and price indices, the exchange rate, and the trade balance relative to the price of the domestic non-durable good.[20] The real exchange rate is the cost of acquiring a non-durable good from the foreign country. The price indices at home for the non-durable and investment goods baskets are

$$P_t^c \equiv \left[\alpha_c + (1-\alpha_c)\,(e_t)^{1-\rho}\right]^{\frac{1}{1-\rho}} \quad \text{and} \quad P_t^d \equiv \left[\alpha_d \left(p_t^d\right)^{1-\rho} + (1-\alpha_d)\,(e_t)^{1-\rho}\right]^{\frac{1}{1-\rho}}, \tag{12}$$

where e_t is the real exchange rate and p_t^d is the relative price of the domestic investment good, using the fact that the nominal prices of foreign goods are normalized to 1 (Section 5.1). Similarly, the price indices abroad are

$$P_t^{c,\star} \equiv \left[\alpha_c + (1-\alpha_c)\,(1/e_t)^{1-\rho}\right]^{\frac{1}{1-\rho}} \quad \text{and} \quad P_t^{d,\star} \equiv \left[\alpha_d + (1-\alpha_d)\left(p_t^d/e_t\right)^{1-\rho}\right]^{\frac{1}{1-\rho}} \tag{13}$$

Net exports and trade balance. Let

$$\text{IM}_t^c \equiv (1-\alpha_c)\left(\frac{e_t}{P_t^c}\right)^{-\rho}(C_t+G_t) \quad \text{and} \quad \text{IM}_t^d \equiv (1-\alpha_d)\left(\frac{e_t}{P_t^d}\right)^{-\rho} X_t \tag{14}$$

[20] Similarly, we express the foreign price indices (13) relative to the foreign non-durable good.

denote the quantities imported of the non-durable and investment good, respectively, using the fact that the nominal prices of foreign goods are normalized to 1. Similarly, let

$$\mathrm{EX}_t^c \equiv (1-\alpha_c)\left(\frac{1/e_t}{P_t^{c,\star}}\right)^{-\rho}(C^\star+G^\star) \quad \text{and} \quad \mathrm{EX}_t^d \equiv (1-\alpha_d)\left(\frac{p^d/e_t}{P_t^{d,\star}}\right)^{-\rho} X^\star \tag{15}$$

denote the quantities exported, where consumption $C^\star$, government spending $G^\star$ and investment $X^\star$ in the rest of the world are constant and equal to the steady state levels at home, i.e., $C^\star = C$, $G^\star = G$ and $X^\star = X$, so there are no net imports initially. The quantity indices for net exports are $\mathrm{NX}_t^z \equiv \mathrm{EX}_t^z - \mathrm{IM}_t^z$ for the non-durable and investment goods $z \in \{c,d\}$. The quantity index for the trade balance is $\mathrm{TB}_t \equiv \mathrm{NX}_t^c + \mathrm{NX}_t^d$. Net exports in real terms are $\mathrm{NX}_t^{z,\mathrm{real}} \equiv p_t^z \mathrm{EX}_t^z - e_t \mathrm{IM}_t^z$ for the non-durable and investment goods $z \in \{c,d\}$. Finally, the trade balance in real terms is $\mathrm{TB}_t^{\mathrm{real}} \equiv \mathrm{NX}_t^{c,\mathrm{real}} + \mathrm{NX}_t^{d,\mathrm{real}}$.

Exchange rate. The nominal exchange rate satisfies uncovered interest parity. Therefore, the real exchange rate follows

$$e_t = (1+\pi_{t+1})\,\frac{1+r^\star}{1+r_t^m} e_{t+1} \tag{16}$$

where $r^\star$ is the foreign interest rate, which is constant and equal to the steady state level at home $r^m = 1\%$. The terminal condition is $\lim_{t\to+\infty} e_t = 1$ by purchasing power parity and using the fact that the foreign nominal price is normalized to 1.[21]

B.2 Fiscal Policy

Budget constraint. The government's budget constraint is

$$B_t^g + P_t^c G + \frac{T_t}{1+\pi_t} = \frac{1+r_{t-1}}{1+\pi_t} B_{t-1}^g + \mathcal{M}_t + \int \tau_t \exp(\omega+\zeta)\, Y_t^{\mathrm{inc}} d\mu_{t-1} + \Sigma_t \tag{17}$$

where $\mathcal{M}_t$ is the proceedings from tariffs. Instead of introducing passive financial intermediaries, we suppose that the government claims the net payments on credit

[21] We work with a finite horizon in our simulation and assume that $e_t = 1$ after 20 years.

from households Σ_t,

Taxes. The tax rate is $\tau_t = \bar{\tau} + \Psi_t \hat{\tau}$, where $\bar{\tau} = 0.3$ is the tax rate in steady state and $\{\Psi_t\}$ takes the value 1 over 15 years and then decreases linearly to 0 over the next 5 years (Section 5.2). The change $\hat{\tau}$ ensures that the government's tax revenues are equal to its spending in present discounted value. Therefore, the tax rate is

$$\tau_t = \bar{\tau} - \Psi_t \frac{\sum_t Q_t \Omega_t + \frac{1+r_{-1}}{1+\pi_0} B^g_{-1}}{\sum_t Q_t \Psi_t \int \exp(\omega + \zeta) E_t d\mu_{t-1}} \tag{18}$$

where

$$\Omega_t \equiv \bar{\tau} \int \exp(\omega + \zeta) E_t d\mu_{t-1} + \mathcal{M}_t + \Sigma_t - \frac{T_t}{1+\pi_0} - P^c_t G_t \tag{19}$$

Artuç, Erhan, Shubham Chaudhuri, and John McLaren, "Trade Shocks and Labor Adjustment: A Structural Empirical Approach," *American Economic Review*, June 2010, *100* (3), 1008–1045.

_ **and Nathan Zorzi**, "Durables and size-dependence in the marginal propensity to spend," Technical Report, National Bureau of Economic Research 2024.

Copeland, Adam, "Intertemporal substitution and new car purchases," *RAND Journal of Economics*, September 2014, *45* (3), 624–644.

Gillingham, Kenneth, Fedor Iskhakov, Anders Munk-Nielsen, John Rust, and Bertel Schjerning, "Equilibrium Trade in Automobiles," *Journal of Political Economy*, 2022, *130* (10), 2534–2593.

Rust, John, "Stationary Equilibrium in a Market for Durable Assets," *Econometrica*, July 1985, *53* (4), 783–805.