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Cyclical Inequality in the Cost of Living and Implications for Monetary Policy

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ABSTRACT: This paper documents that households with higher marginal propensities to consume (MPCs) tend to consume goods with more flexible prices. Consequently, they face more cyclical and volatile inflation and experience higher inflation following an expansionary monetary policy shock. We embed this MPC-price stickiness relationship into a tractable multi-sector Two-Agent New Keynesian (TANK) model and analytically demonstrate that it dampens the effectiveness of monetary policy, reducing its efficacy by about 15% relative to a benchmark model with homogeneous consumption baskets. Introducing heterogeneous baskets also generates an inherently inefficient flexible-price equilibrium, which gives rise to a novel trade-off between stabilization and redistribution. The optimal monetary policy therefore differs qualitatively from the standard TANK policy prescription.

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WORKING PAPERS

Cyclical Inequality in the Cost of Living and Implications for Monetary Policy

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1 Introduction

Two questions remain central in monetary economics: the impact of monetary policy on aggregate consumption and the optimal design of monetary policy. Recent advances in the Heterogeneous Agent New Keynesian (HANK) literature contribute to the understanding of these questions, emphasizing the critical role of household heterogeneity. A key channel in HANK, known as the redistribution channel (Auclert, 2019; Bilbiie, 2020), shows that the effectiveness of monetary policy hinges on the relationship between households' marginal propensities to consume (MPCs) and the cyclicality of their *real* income, defined as households' nominal income adjusted by the price index they face. However, most theories and applications in the HANK literature assume that households consume the same basket of goods and therefore face the same price index. In doing so, these studies largely overlook the differential cyclicality in households' price indexes (or costs of living), concentrating instead on the cyclicality of nominal income across households with different MPCs.

In this paper, we argue that it is important to consider the relationship between households' MPCs and the cyclicality of their costs of living, both for understanding the monetary transmission and designing the optimal monetary policy. Our argument unfolds in three steps. First, we empirically document the relationship between households' MPCs and their costs of living. We find that households with higher MPCs face more cyclical and volatile inflation, and experience higher inflation following an expansionary monetary policy shock. This is because these households allocate a larger portion of their spending on product categories with more flexible prices. Second, we embed this negative relationship between households' MPCs and price stickiness in a tractable multi-sector two-agent New Keynesian (TANK) model with heterogeneous consumption baskets, demonstrating analytically that this relationship dampens the general equilibrium effect in monetary transmission. Third, we characterize the optimal monetary policy using the primal approach and show that accounting for cyclical inequality in household's costs of living is crucial for designing optimal monetary policy.

Our empirical analysis relies on four datasets: the Panel Study of Income Dynamics (PSID), the US Consumer Expenditure Survey (CEX) microdata, the item-level consumer prices data from the Bureau of Labor Statistics (BLS), and the data on frequency of price adjustment constructed by Nakamura and Steinsson (2008). As is well known, households' MPCs are typically not directly observable. Following Cloyne et al. (2020), we use housing tenure status as a qualitative proxy for households' MPCs. Specifically, we estimate household MPCs by leveraging the panel structure of the PSID and the detailed consumption information from the CEX. Our estimation strategy builds on the methodology originally developed by Gruber (1994) and extended by Patterson (2023), which identifies MPCs by examining household consumption responses to income shocks. To address potential endogeneity arising from factors that simultaneously affect income and consumption, we instrument changes in household income with exogenous income shocks. Our results show that both renters and mortgage payers exhibit higher MPCs than outright homeowners. Accordingly, we split households in the CEX into two groups based on their housing tenure status: the low-MPC group consisting of outright homeowners, and the high-MPC group including renters and mortgage payers.

Our empirical analysis offers three main findings. First, high-MPC households spend more on product categories whose prices are more flexible. Specifically, 23.4% of goods consumed by high-MPC households change prices in a given month, while this number is 19.7% for low-MPC households. Second, the inflation faced by high-MPC households is both more cyclical and more volatile. Third, the Consumer Price Index (CPI) of high-MPC households is more responsive to monetary policy shocks. For example, 24 months after an expansionary monetary policy shock, the CPI of high-MPC households responds 40% more than that of low-MPC households.

Motivated by our empirical findings, we develop a tractable multi-sector TANK model that allows for heterogeneous consumption baskets across households. In this framework, households differ in MPCs and in the composition of their consumption baskets. There are two types of households: the Keynesians (also known as hand-to-mouth consumers) and the Ricardians (also known as savers). Firms adjust prices infrequently à la Calvo, with the degree of price stickiness varying across sectors. Consequently, the Keynesians and the Ricardians consume goods that, on average, differ in the frequency of price adjustment.

Our main finding highlights that the equilibrium responses of aggregate consumption to a sequence of future real interest rate changes, denoted as $\{r_{t+s}\}_{s=0}^{\infty}$, in both the TANK model and the TANK model with heterogeneous consumption baskets (henceforth TANK-HT), can be succinctly summarized through the dampening (amplification) channel in the following two equations:

$$\text{TANK:} \qquad c_t = -\phi_r \mathbb{E}_t \sum_{s=0}^{\infty} r_{t+s}, \tag{1}$$

$$\text{TANK-HT:} \qquad c_t = -\phi_r \mathbb{E}_t \sum_{s=0}^{\infty} r_{t+s} - \phi_p (p_t^K - p_t^R), \tag{2}$$

where $\phi_r > 0$ and $\phi_p > 0$ are functions of model parameters. Compared with the benchmark TANK model, the aggregate consumption response is dampened if Keynesian households face more flexible prices, $p_t^K - p_t^R > 0$, and the aggregate consumption response is amplified if Keynesian households face stickier prices, $p_t^K - p_t^R < 0$.

This dampening (amplification) channel works through the general equilibrium effect. In a scenario where Keynesian households face more flexible prices, as suggested by the data, an expansionary monetary policy shock results in higher inflation for these households. Consequently, they receive less real income (and thus consumption). Given that Keynesian households have a higher MPC, the aggregate Keynesian multiplier weakens, leading to a dampening of the general equilibrium effect.

The dampening (amplification) effect arises from heterogeneity in inflation responses and is quantitatively significant. Unlike in the representative agent New Keynesian models (RANK) and standard TANK models, where price stickiness becomes irrelevant for aggregate demand once the path of real interest rate is fixed, our model introduces a distinctive feature. In our framework, the distribution of price stickiness across households shapes aggregate demand by dampening (amplifying) the general equilibrium effect, even *conditional* on the path of real interest rates. In the calibrated version of our model, the real effects of monetary policy, measured by the cumulative consumption response, are 15% less compared to a benchmark multi-sector TANK model with homogeneous consumption baskets. Our results suggest that ignoring the negative relationship between households' MPCs and price stickiness leads to an overstatement of the real effects of monetary policy.

We examine the implications of introducing heterogeneous consumption baskets for optimal monetary policy in our multi-sector TANK framework in three steps. First, we demonstrate that the introduction of heterogeneous consumption baskets generates an endogenous and time-varying wedge between the flexible-price equilibrium and the efficient one. That is, the flexible-price equilibrium is socially *inefficient*. This inefficiency arises because households' price indexes (or costs of living) are exposed differently to sectoral shocks, and these exposures cannot be fully insured since the Keynesians cannot trade financial assets. As a result, differences in price indexes and real wages distort households' labor supply and consumption decisions, giving rise to misallocation (or inequality). Optimal policy, therefore, necessitates striking a balance between stabilizing inequality and achieving the conventional goal of stabilizing aggregate demand and inflation. Consequently, the pursuit of output gap stabilization, as suggested in Aoki (2001), is no longer optimal.

Next, we establish a benchmark result by identifying necessary and sufficient conditions under which a sticky-price equilibrium can implement the first-best allocation. We show that closing the aggregate output gap simultaneously stabilizes prices, minimizes inequality, and achieves the social optimum *if and only if* the following conditions are satisfied: 1) prices are sticky in at most one sector and are perfectly flexible in all other sectors, and 2) households have identical consumption baskets. In other words, inequality becomes irrelevant for monetary policy when both of these conditions hold. Under these conditions, price dispersion—both across and within sectors—as well as income inequality across households are exactly proportional to the output gap. Closing the output gap is therefore socially optimal. This result generalizes the "divine coincidence" of the RANK framework to a HANK environment and includes the standard one-sector TANK model as a special case.

Finally, we formulate and solve the Ramsey problem to characterize the optimal monetary policy. Using the primal approach, we set up and solve a linear-quadratic Ramsey problem with commitment, in which the social planner directly chooses the output gap and sectoral inflation rates to maximize social welfare. The social planner's choices are subject to implementability constraints implied by the model, including the sectoral Phillips curves and the law of motion for sectoral prices. Despite the model's rich structure, we solve the Ramsey problem analytically and derive the conditions that the output gap and sectoral inflation rates must satisfy under the optimal policy.

To illustrate the policy trade-offs more transparently, we analyze a static economy and derive a closed-form optimal policy rule for an inflation-stabilization index. We first show that, in a multi-sector RANK model, the optimal index assigns greater weights to stickier-price sectors. We then demonstrate that introducing heterogeneous agents (in a TANK framework) strengthens this incentive. Stabilizing inflation in sticky-price sectors not only improves efficiency but also reduces inequality, which in the TANK model is proportional to the output gap. Finally, we discuss that introducing heterogeneous consumption baskets, by contrast, shapes the optimal inflation index through new terms in two policy motives: reducing cross-sector misallocation and mitigating inequality. The misallocation motive reflects distortions arising from differing consumption weights across households, while the inequality motive stems from disparities in their cost of living.

The net effect on the optimal inflation target is therefore ambiguous, hinging on the relative strength of these channels. In a numerical example, we show that when households face sufficiently different degrees of price stickiness, the redistributive motive can dominate. In this case, the result in Benigno (2004) is overturned, and it becomes optimal to stabilize the headline CPI rather than the core CPI.

Related Literature. This paper contributes to three strands of literature. First, it relates to the recent literature on monetary transmission in HANK models. Recent work includes empirical studies (e.g., Coibion et al. (2017); Cloyne et al. (2020); Holm et al. (2021); Amberg et al. (2022); Andersen et al. (2022); Patterson (2023)), analytical works (e.g., Galí et al. (2007); Bilbiie (2008); Werning (2015); Debortoli and Galí (2017); Auclert (2019); Acharya and Dogra (2020); Bilbiie (2020); Ravn and Sterk (2021); Bilbiie (2021)) and quantitative models (e.g., McKay et al. (2016); Kaplan et al. (2018); Auclert et al. (2020)). Our paper builds upon and contributes to this literature in two main aspects. First, we propose a new channel that demonstrates how the relationship between households' MPC and the degree of price stickiness they face affects the monetary transmission to consumption, thereby connecting heterogeneity on the supply side and demand side. Second, we present direct empirical evidence that households with different MPCs consume different baskets of goods, face different degrees of price stickiness, and consequently, experience different cyclicalities in the cost of living.

Second, this paper relates to the fast-growing literature on designing optimal policies in HANK, both analytically (e.g., Bilbiie (2008); Cúrdia and Woodford (2016); Nistico (2016); Debortoli and Galí (2017); Challe (2020); Bilbiie and Ragot (2021); Bilbiie et al. (2021); Dávila and Schaab (2022); Acharya et al. (2023); Jennifer and Morrison (2023); Olivi et al. (2025)) and quantitatively (Bhandari et al. (2021); Gornemann et al. (2021); Le Grand et al. (2021); Yang (2022); McKay and Wolf (2023)). Our paper complements these studies through an extended analytical framework. In this framework, we establish both sufficient and necessary conditions under which inequality becomes irrelevant for optimal policy, so that output gap (or price) stabilization remains optimal. We further demonstrate that the introduction of heterogeneous consumption baskets leads to an intrinsically inefficient flexible-price equilibrium, thereby giving rise to a new type of tradeoff between stabilization and redistribution.

Lastly, our paper relates to research on monetary transmission and optimal monetary policy in multi-sector models. In the existing literature, the primary focus lies in understanding how sectoral heterogeneity shapes the slope of the Phillips curve (e.g., Carvalho (2006); Nakamura and Steinsson (2010); Pasten et al. (2020); Carvalho et al. (2021)). Our paper contributes by demonstrating how mapping the distribution of price stickiness on the supply side to MPC on the demand side provides new insights into monetary transmission. Regarding optimal monetary policy, the conventional wisdom is to stabilize the output gap or, equivalently, prices in sectors with stickier prices (e.g., Mankiw and Reis (2003); Huang and Liu (2005); Li and Wu (2016); La'O and Tahbaz-Salehi (2022); Rubbo (2023); Fang et al. (2025)). Our paper demonstrates that in the presence of heterogeneous consumption baskets across households, stabilizing the output gap can generate substantial welfare losses due to the redistributive motive arising from stabilizing the cost of living faced by high-MPC households. Our paper offers a new justification for stabilizing the price of flexible-price sectors.

Outline. The paper proceeds as follows. Section 2 describes the data and presents the main empirical findings. Section 3 specifies the multi-sector TANK model. Section 4 illustrates the key mechanism. Section 5 presents the quantitative analysis. Section 6 studies the optimal monetary policy. Section 7 concludes.

2 Empirical Findings

The redistribution channel in HANK (Auclert, 2019; Bilbiie, 2020) suggests that, in the wake of a monetary expansion, if households with higher MPC receive disproportionately more *real* income, the general equilibrium (GE) effects become stronger, enhancing the efficacy of monetary policy. This channel can be succinctly summarized in a single equation, underscoring that the real impact of monetary policy hinges on the covariance between households' MPC and the exposure of their *real* income to changes in real interest rates:

$$\operatorname{cov}\left(\mathrm{MPC}_i, \chi_i\right) = \operatorname{cov}\left(\mathrm{MPC}_i, \frac{\mathrm{d}(E_i/P_i)}{\mathrm{d}R}\frac{R}{E_i/P_i}\right) = \operatorname{cov}\left(\mathrm{MPC}_i, \frac{\mathrm{d}E_i}{\mathrm{d}R}\frac{R}{E_i}\right) - \operatorname{cov}\left(\mathrm{MPC}_i, \frac{\mathrm{d}P_i}{\mathrm{d}R}\frac{R}{P_i}\right), \quad (3)$$

where R is the gross real interest rate, E_i is household i's nominal income, and P_i is the *household-specific* consumer price index (CPI), representing household i's cost of living. Thus, E_i/P_i quantifies the real income of household i, and $\chi_i = \frac{\mathrm{d}(E_i/P_i)}{\mathrm{d}R}\frac{R}{E_i/P_i}$ denotes the elasticity of household i's real income with respect to the real interest rate.

The covariance in equation (3) can be further decomposed into two terms. The first term involves nominal income E_i and the second term is associated with the cost of living P_i. Existing theories and applications in the HANK literature assume that households consume the same baskets of goods, implying that the price index P_i does not vary across households. Consequently, the second term on the right-hand side of equation (3) becomes zero. In other words, previous studies primarily focus on the first term—the heterogeneity in the cyclicality of *nominal* income of households with different MPCs—while largely ignoring the second term: the heterogeneity in households' costs of living.[1]

Motivated by equation (3), our empirical analysis examines whether households with different MPCs experience different responses in their cost of living to monetary policy shocks. Specifically, we document the following stylized facts. First, households with different MPCs differ in their consumption baskets. Second and consequently, the goods they purchase have, on average, different degrees of price stickiness. Finally, households with different MPCs experience different inflation rates—or increases in their cost of living—following an expansionary monetary policy shock.

Additionally, we show that the cost of living for high-MPC households are, on average, more cyclical and volatile. We explore the implications of this finding for social welfare and the design of optimal monetary policy in Section 6.

[1]The literature actually focuses on $\operatorname{cov}\left(\mathrm{MPC}_i, \frac{\mathrm{d}(E_i/P)}{\mathrm{d}R}\frac{R}{E_i/P}\right)$, which is equal to $\operatorname{cov}\left(\mathrm{MPC}_i, \frac{\mathrm{d}E_i}{\mathrm{d}R}\frac{R}{E_i}\right) - \operatorname{cov}\left(\mathrm{MPC}_i, \frac{\mathrm{d}P}{\mathrm{d}R}\frac{R}{P}\right)$. Since the second term is equal to 0, we have $\operatorname{cov}\left(\mathrm{MPC}_i, \frac{\mathrm{d}(E_i/P)}{\mathrm{d}R}\frac{R}{E_i/P}\right) = \operatorname{cov}\left(\mathrm{MPC}_i, \frac{\mathrm{d}E_i}{\mathrm{d}R}\frac{R}{E_i}\right)$.

2.1 Data

To address our empirical question, we leverage four data sources: first, the US Consumption Expenditure Survey (CEX) microdata, which provides detailed information on households' expenditure across different product categories, and importantly, their demographic details, such as income, gender and housing tenure status; second, the monthly price indexes on detailed product categories (item level) from the Bureau of Labor Statistics (BLS); third, the frequency of price adjustment, provided and constructed by Nakamura and Steinsson (2008); and finally, the Panel Study of Income Dynamics (PSID), which is a longitudinal survey that provides measures of both household consumption and income.

The CEX survey collects households' expenditures through two modules: the Diary and the Interview. The Diary module is designed to collect expenditures on daily and frequent purchases, while the Interview module is focused on measuring large and durable expenditures. These modules survey different households at different frequencies, making it impossible to observe the full consumption baskets of individual households.[2] Following the BLS approach of constructing household consumption basket for the consumer price index (CPI) and Cravino et al. (2020)'s approach of constructing household-specific price index, we aggregate households based on demographic characteristics.[3] Specifically, to explore the heterogeneity in consumption baskets across households with different MPCs, we adopt the approach proposed by Cloyne et al. (2020), categorizing households in the CEX into high- and low-MPC groups based on their housing tenure status. Cloyne et al. (2020) demonstrates that housing tenure status is the most effective demographic factor for categorizing households' MPC heterogeneity. In particular, they establish that renters and mortgagors are good proxies of the "poor" and "wealthy" hand-to-mouth households, while homeowners capture the permanent-income consumers.[4]

To examine the heterogeneity in household marginal propensities to consume (MPCs) across different housing tenure statuses, we estimate household MPCs by linking the CEX with the PSID, using the overlapping information of food consumption and demographic characteristics, following the approach of Patterson (2023).[5] Our results show that both renters and homeowners

[2] Households in the CEX Diary module do not appear in the Interview module, and vice versa. Please see section A.1 in the Supplementary Appendix for more details.

[3] Please refer to the Bureau of Labor Statistics Handbook of Methods: Consumer Price Index for details, https://www.bls.gov/opub/hom/cpi/home.htm.

[4] Combined with US Survey of Consumer Finance, Cloyne et al. (2020) show that households' housing tenure status predicts well their financial positions: renters typically have little wealth, being younger and poorer, and mortgagors tend to have little liquidity but own sizable illiquid assets. The homeowners own both a significant amount of liquid and illiquid assets. This is consistent with findings in Kaplan et al. (2014).

[5] The CEX surveys households for only a short period, which limits the variation in income and consumption changes, making it difficult to estimate household-level MPCs directly. To address this limitation, we link the CEX database with the PSID, which provides detailed demographic profiles and rich panel data on consumption and income over a longer horizon, allowing for more reliable estimation of MPCs.

with mortgages exhibit higher MPCs than outright homeowners. Accordingly, we assign renters and mortgage payers to the high-MPC group and outright homeowners to the low-MPC group. The MPC-group-specific consumption expenditure shares at the detailed product category level are denoted as $\omega^h_{j,t}$, where j is the product category, h indicates the household MPC group, and t refers to the time period.

The MPC-group-specific frequency of price changes is then computed by combining the MPC-group-specific expenditure shares with data on the frequency of price changes from Nakamura and Steinsson (2008). Specifically, the average frequency of price changes faced by household-type h is equal to $\alpha^h = (\sum_1^T \sum_j \omega^h_{j,t} \alpha_j)/T$, where T is the length of the sample period and α_j is the average frequency of price changes of goods in product category j.

The MPC-group-specific CPIs, denoted as $p^h_{j,t}$, can then be calculated using the monthly detailed product category level prices $\{p_{j,t}\}$ and the expenditure weights $\omega^h_{j,t}$ constructed above. When calculating these statistics, we closely follow the procedure adopted by the BLS to compute the CPI, including how the weights $\omega^h_{j,t}$ are updated. Section A.1 in the Supplementary Appendix details how we construct the expenditure weights and the group-specific CPIs.

2.2 Households with High and Low Marginal Propensities to Consume

Before examining the relationship between households' marginal propensities to consume (MPCs) and the cyclicality of their cost of living, we begin by estimating MPCs based on housing tenure status. Following the approach of Patterson (2023), we leverage the panel structure of the PSID and the detailed consumption information from the CEX to estimate the marginal propensities to consume (MPCs) for households with different housing tenure statuses.[6] Table 1 presents summary statistics of household characteristics by housing tenure. On average, outright homeowners are older than both mortgagors and renters. While they hold the highest levels of liquid wealth, their income tends to be lower than that of homeowners with mortgages.[7] Similar patterns emerge among renters, mortgagors, and outright homeowners in the CEX data. Figure F.1 in the Supplementary Appendix displays the distributions of age, education, and income by housing tenure group, based on the CEX sample.

Our estimation strategy follows the approach originally developed by Gruber (1994) and extended by Patterson (2023), which identifies MPCs by examining household consumption responses to income shocks. Since many factors can simultaneously influence both income and consumption, we address endogeneity concerns by instrumenting changes in household

[6]For most of the PSID sample, food consumption is the primary expenditure measure. However, since food expenditure responses to income shocks are not fully representative of overall consumption behavior, we impute total consumption by mapping PSID households to demographic and consumption patterns derived from the CEX.

[7]Liquid wealth is defined as checking plus stock holdings minus liquid debt.

Table 1: Characteristics of Households by Housing Tenure

		Homeowner with Mortgage	Homeowner without Mortgage	Renter
Age	75th	48	57	43
	mean	41	51	37
	50th	40	52	34
	25th	33	45	29
Income	mean	55,683	47,757	35,870
	75th	67,377	56,730	45,248
	50th	46,153	36,576	31,017
	25th	29,699	21,463	20,250
Liquid Wealth	mean	34,979	149,360	8,961
	75th	22,000	80,000	2,900
	50th	3,000	11,000	0
	25th	-2,000	47	-1,600

income with an exogenous income shock—specifically, unemployment. This approach allows us to identify the causal effect of income shocks on consumption.

Figure 1 presents the estimated marginal propensities to consume by housing tenure category.[8] The results reveal substantial heterogeneity in MPCs across tenure groups: on average, renters and mortgagors exhibit MPCs above 0.5, while outright homeowners display significantly lower MPCs. These findings lend support to our approach of using housing tenure to classify households into groups with differing marginal propensities to consume. Accordingly, in the subsequent analysis, we classify households into high- and low-MPC groups based on their housing tenure status.

[8]The estimation procedure, which follows Patterson (2023), is detailed in Supplementary Appendix B.1.

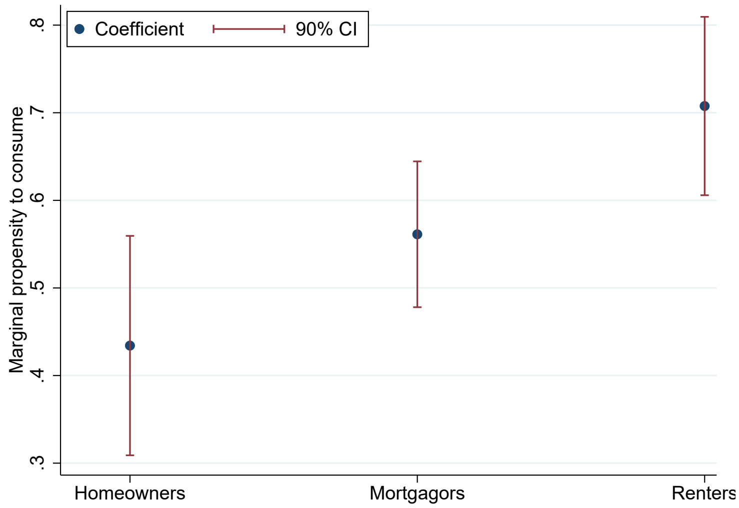


Figure 1: Marginal Propensity to Consume by Housing Tenure and Demographics

Note: Each estimate represents a separate regression including only one housing tenure group. In the regression, consumption is measured as total consumption, imputed following the approach of Blundell et al. (2008), and income is measured using the individual labor income. All regressions include year-by-state fixed effects, and the sample period is from 1985 to 2021.

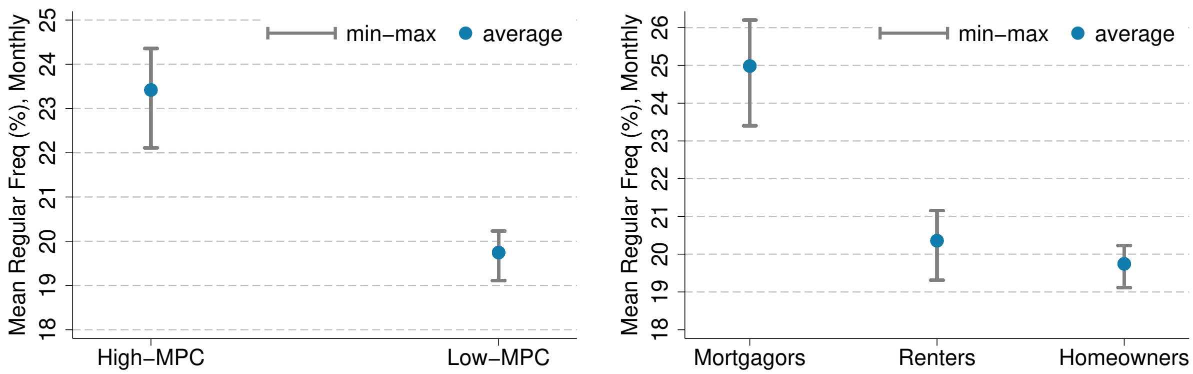
2.3 Relationship between MPC and Price Stickiness

To examine the relationship between households' MPCs and the cyclicality of their costs of living, we proceed in three steps. In the first step, we document the relationship between households' MPCs and the price stickiness of their consumption baskets. Our findings reveal that the average frequency of price changes for high-MPC households' consumption basket is 23.4%, roughly 20% higher than that of low-MPC households, which is 19.7%, as shown in the left panel of Figure 2. The right panel, on the other hand, explores the price stickiness of goods purchased by households with different housing statuses. It shows that the prices of goods purchased by mortgagors are the most flexible. On average, 25% of the prices of goods purchased by mortgagors change in a given month, compared with 20.4% for renters. Homeowners (without mortgages) face the stickiest prices, with an average frequency of regular price changes falling to 19.7% per month.[9] Based on housing tenure status, we further split the sample by demographic characteristics, including age, education level, and income. Supplementary Appendix Figure B.1 presents the average frequency of price changes by age, education level, and income for households with different housing tenure status. While there is little variation in price stickiness across income levels once we condition on housing tenure, some heterogeneity remains across age and education groups. Since the key moment of interest is the correlation between MPCs and price stickiness,

[9]Following the literature, we focus on regular price changes throughout the analysis.

irrespective of the specific demographic dimension used to proxy for MPCs, we adopt housing tenure as a proxy for MPCs, in line with Cloyne et al. (2020) and our findings in Section 2.2.

Figure 2: Regular Frequency of Price Changes and MPC Groups



Note: This figure plots the average frequency of price changes for households with different MPCs (left panel) and different housing tenures (right panel). For each year, we calculate the average frequency of price changes. The gray bar shows the minimum and maximum of these average frequencies of price changes, and the blue dot shows the mean of these averages.

The difference in the price stickiness faced by households across housing tenure groups is primarily driven by differences in their consumption patterns and the corresponding price stickiness of the goods they consume. Supplementary Appendix Table F.1 decomposes each good's contribution to the difference in the average frequency of price changes between mortgagors and homeowners, calculated as $\frac{(\omega^h_{j,t}-\omega^g_{j,t})\alpha_j}{\alpha^h-\alpha^g}$. The table highlights the top contributors and mitigators to this difference across ELI-level categories.[10] Gasoline, used cars, and vehicle leasing are the top contributors to the higher price flexibility in mortgagors' consumption baskets, as these items tend to have highly flexible prices and are more heavily consumed by mortgagors than by homeowners. In particular, gasoline stands out: it is not only one of the most frequently adjusted price categories but also among the items with the largest differences in expenditure shares between the two groups.

Conversely, the main offsetting categories are services and utilities. Homeowners tend to allocate a larger share of their consumptions to the stickiest-price categories, including general medical practice, hospital services, and motor vehicle insurance. Additionally, Table F.2 in the Supplementary Appendix summarizes the largest differences in expenditure shares between mortgagors and homeowners. The top categories consumed more by homeowners relative to

[10]To match the expenditure shares from the BLS with the frequency of price changes from Nakamura and Steinsson (2008), both expenditure weights and price stickiness are measured at the ELI level. In total, 263 ELIs are matched.

mortgagors are predominantly services—particularly medical care services like hospital services, general medical practice, and care of the elderly in the home—which are among the categories with the stickiest prices.

Overall, the analysis suggests that the households' MPC and the price stickiness they face exhibit a negative relationship.

2.4 Group-specific Price Responses to Monetary Policy Shocks

In the second step, we assess the responses of household MPC-group-specific prices to monetary policy shocks. We adopt the local projection method of Jordà (2005). In particular, we estimate a series of regressions for each MPC group h over different horizons on the monetary policy shocks in period-t, controlling for lags of shocks and inflation. Specifically, we run the following regressions:

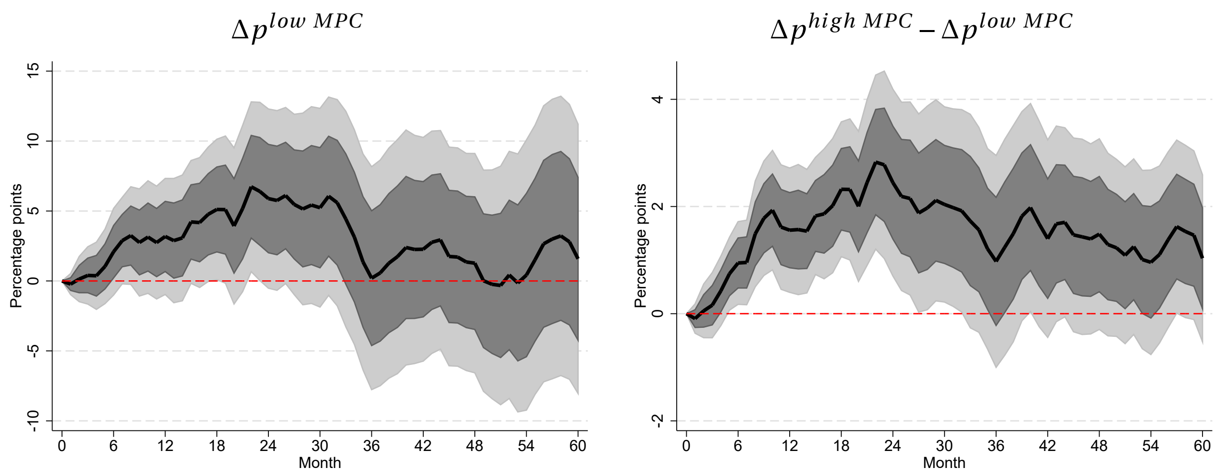
$$p^h_{t+s} - p^h_t = \eta^h_s + \theta^h_s shock_t + \sum_{j=1}^{J} \beta^h_{s,j}(p^h_{t+1-j} - p^h_{t-j}) + \sum_{i=1}^{I} \gamma^h_{s,i} shock_{t-i} + \epsilon^h_{t+s}, \tag{4}$$

where p^h_t is the log of MPC-group-specific CPIs, and $shock_t$ is the Bu et al. (2021) measure of monetary policy shocks.[11] In the Supplementary Appendix Section B.3, we also the use extended Romer and Romer (2004) monetary policy series from Coibion et al. (2017) and the high-frequency monetary policy shocks identified by Jarociński and Karadi (2020) as robustness checks. Here, θ^h_s is the coefficient of interest, measuring the changes in log prices (or inflation) at period $t+s$ relative to period t in response to a 100-basis-point monetary policy shock at period t. Following Romer and Romer (2004), the control variables contain 36 lags of the shocks ($I = 36$) and 24 lags of monthly group-specific inflation ($J = 24$). The sample is monthly from 1994m1 to 2023m12, and the impulse responses are estimated over a 60-month horizon with $s = 0, 1, \cdots, 60$.

The left panel of Figure 3 plots the impulse responses of changes in (log) CPI for low-MPC households. Following a 100-basis-point expansionary monetary policy shock, the change in (log) CPI (i.e. inflation) for these households rises by approximately 5 percentage points over an 18-24 month horizon. Our main object of interest is the differential response in changes in (log) CPI between high- and low-MPC households. To capture this, we estimate a version of equation (4) using the difference in changes in (log) CPI (i.e. the inflation differential) between the two groups as the dependent variable. The resulting estimates are shown in the right panel of Figure 3, with the dark and light gray areas representing the 1- and 1.65-standard-deviation

[11] The monetary policy shock series identified by Bu et al. (2021) provides a stable bridge between periods of conventional and unconventional policy, remains largely unpredictable, and shows no evidence of significant central bank information effects. Thus, it enables clearer causal analysis of how monetary policy affects economic outcomes.

Figure 3: Impulse responses of prices to monetary policy shocks



Note: The panel charts display the impulse response functions (IRFs) to a 100-basis-point negative monetary policy shock, with the dark and light gray shaded regions indicating the 1- and 1.65-standard-deviation confidence intervals, respectively, based on the monetary policy measure from Bu et al. (2021). The left panel displays the IRFs of changes in the log CPI (inflation) for low-MPC households, while the right panel depicts the differential inflation responses between high- and low-MPC households. The specification includes 36 lags of the shock variable ($I = 36$) and 24 lags of monthly household-specific inflation ($J = 24$).

confidence intervals, respectively. The figure shows that, following an expansionary shock, the price level for high-MPC households increases more than that for low-MPC households. The inflation differential peaks at approximately 2 percentage points around 24 months after the shock, indicating that the CPI for high-MPC households responds about 40% more than that of low-MPC households. This difference is statistically significant during the first 24 months post-shock and gradually fades thereafter. We conduct robustness checks by using alternative lag specifications in the local projection framework and alternative measures of monetary policy shocks. As discussed in Supplementary Appendix Section B.3, the estimated impulse responses remain robust across both alternative lag structures and shock measures.

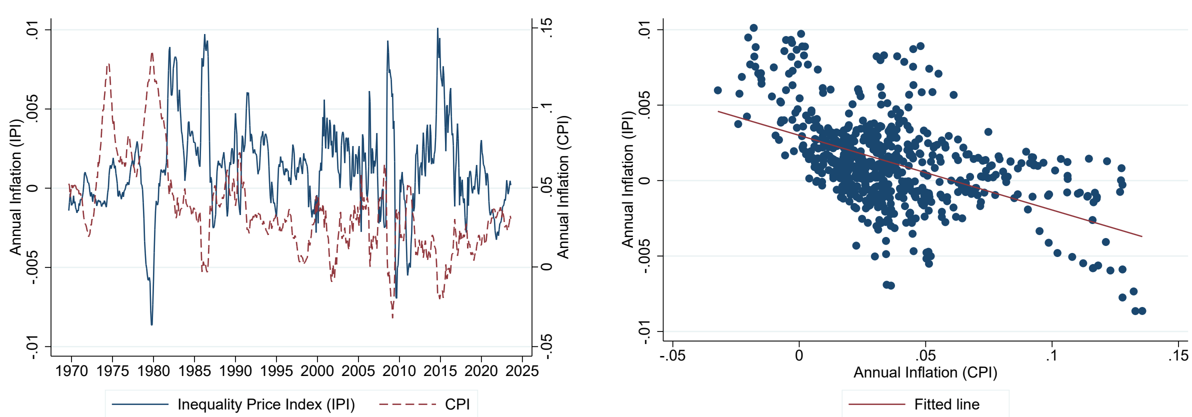
2.5 Cyclicality and Volatility of Group-Specific Inflation Rates

In the final step, we show that the inflation faced by high-MPC households is more cyclical and volatile than that of low-MPC households. The left panel of Figure 4 plots the evolution of the annual inflation for the Inequality Price Index (IPI, blue line), defined as $\pi_t^{\text{low-MPC}} - \pi_t^{\text{high-MPC}}$, alongside inflation of the Consumer Price Index (CPI, red dashed line), for the period from 1970 to 2025. A clear negative comovement is displayed between these two series. Higher aggregate inflation is associated with greater disparity in inflation between high-MPC and low-MPC households, with high-MPC households experiencing higher inflation when aggregate inflation is high, and lower inflation when it is low. This negative correlation is further illustrated in the right panel of Figure 4, where each dot represents an annual observation.

Greater cyclicality in the cost of living faced by high-MPC households implies that their inflation is also more volatile. In fact, inflation volatility faced by high-MPC households is, on average, 16% higher than low-MPC households over the period 1970-2025. This difference has become more salient in recent years, with high-MPC households' inflation being 21% more volatile since the year 2005. Supplementary Appendix B.4 provides additional evidence on the evolution of the inflation and inflation volatility faced by different households over time.

To identify the goods driving the differences in inflation volatility shown in Figure 4, we decompose the volatility of the inequality price index (IPI) by excluding one good at a time from the household consumption basket when constructing the household-specific price index and then recalculating the IPI volatility. Supplementary Appendix Table F.3 reports the top 10 items that contribute most and least to the volatility of the IPI inflation, based on a total of 183 item-level goods.[12] Consistent with the results from the decomposition of price flexibility in Section 2.3, we find that gasoline is the single largest contributor to IPI inflation volatility. In contrast, utilities and service-related items, such as utility gas service and hospital services, play a stabilizing role and help dampen volatility in the inequality price index. Section 6 highlights the importance of accounting for the differences in cyclicality and volatility of the cost of living across households in evaluating the social welfare and designing the optimal monetary policy.

Figure 4: Evolution of Inequality Price Index (IPI) and CPI



Note: The left panel plots the time series of the Inequality Price Index (IPI), defined as $\pi_t^{\text{low-MPC}} - \pi_t^{\text{high-MPC}}$, alongside the Consumer Price Index (CPI). The right panel plots the relationship between IPI and CPI, with each dot representing an annual observation. The correlation is -0.49 with a p-value smaller than 0.001.

[12]The household-specific price index is constructed using item-level price indexes from the BLS and item-level consumption expenditure shares from the CEX. Note that the classification of goods at the item level and ELI level is not perfectly aligned.

3 Framework: A Multi-Sector TANK Model

Motivated by the empirical evidence, this section develops a theoretical and quantitative framework featuring a multi-sector Two-Agent New Keynesian model with heterogeneous consumption baskets (abbreviated as TANK-HT). The TANK-HT serves as an extension of the TANK model in Bilbiie (2020). In this extension, we introduced heterogeneous consumption baskets between the Ricardian households (or savers) and the Keynesian households (or the hand-to-mouth). These two groups exhibit differences in their expenditure shares across sectors and therefore face different degrees of price stickiness.

3.1 Model

3.1.1 Households

There are two types of households in the economy: the Ricardian and the Keynesian, with measures $1-\lambda$ and λ, respectively. The Ricardian households, denoted as R, have unconstrained access to a complete financial market, while the Keynesian households, denoted as K, cannot access financial markets and spend all of their income in each period (i.e., hand-to-mouth). There is a continuum of firms distributed in I sectors. The Ricardian households own all firms in the economy, and each household has an equal share. The utility function for households of type $h\,(h \in \{R,K\})$ is given by:

$$U(C_t^h, N_t^h) = \frac{\left(C_t^h\right)^{1-\sigma^{-1}}}{1-\sigma^{-1}} - \frac{\left(N_t^h\right)^{1+\gamma}}{1+\gamma},$$

where C_t^h denotes the consumption of a composite good, N_t^h is the supply of labor, σ is the elasticity of intertemporal substitution (EIS) and γ is the inverse of Frisch elasticity. We assume that all households supply homogeneous labor in a single labor market. We allow households to consume different baskets of goods across product categories, so that the composite good consumed by household type h is aggregated according to

$$C_t^h = \prod_{i=1}^{I} \left(\frac{C_{i,t}^h}{\omega_i^h}\right)^{\omega_i^h}$$

where ω_i^h is a household-specific taste shifter that can be calibrated using household-specific expenditure shares. Correspondingly, the price index faced by household type h is given by

$$P_t^h = \prod_{i=1}^{I} \left(P_{i,t}^h\right)^{\omega_i^h} \tag{5}$$

and the inflation faced by household h is defined as $\pi_t^h = P_{t+1}^h / P_t^h - 1$.

In sector i, a continuum of monopolistically competitive firms, indexed by j, produce differentiated goods. The goods produced in sector i is defined by

$$C_{i,t} = \left[\int \left[C_{i,t}(j) \right]^{\frac{\theta-1}{\theta}} dj \right]^{\frac{\theta}{\theta-1}},$$

where θ is the (price) elasticity of substitution across differentiated goods j within sector i. The price of goods produced in sector i is an aggregation of the prices of the differentiated goods, $P_{i,t} = \left(\int \left[P_{i,t}(j) \right]^{1-\theta} dj \right)^{\frac{1}{1-\theta}}$.

Household h's demand for differentiated goods $C_{i,t}(j)$ and the sectoral composite good $C_{i,t}$ is given by

$$C_{i,t}^h(j) = \left(\frac{P_{i,t}(j)}{P_{i,t}} \right)^{-\theta} C_{i,t}^h, \tag{6}$$

and

$$C_{i,t}^h = \omega_i^h \left(\frac{P_{i,t}}{P_t^h} \right) C_t^h. \tag{7}$$

According to the Divisia index, the aggregate real value added (or real GDP) in period t is calculated by fixing nominal prices at the base period (see Vom Lehn and Winberry (2022)):

$$C_t = \lambda P^K C_t^K + (1-\lambda) P^R C_t^R,$$

where P^K and P^R are the steady-state prices. The aggregate consumer price index (CPI) in period t is defined as:

$$P_t = \left(P_t^K \right)^{\lambda} \left(P_t^R \right)^{1-\lambda}.$$

The Ricardian household maximizes its utility by choosing consumption, labor supply, and bond holdings, subject to the flow budget constraint:

$$\max_{\{C_t^R, N_t^R, B_{t+1}\}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t U\left(C_t^R, N_t^R\right)$$
$$s.t.\ P_t^R C_t^R + Q_{t,t+1} B_{t+1} \leq W_t N_t^R + B_t + D_t / (1-\lambda) + T_t^R,$$

where β is the discount factor, W_t is nominal wage in the economy, B_{t+1} is the holding of a nominal bond paying at $t+1$, $Q_{t,t+1}$ is the bond price at period t, and D_t denotes total profits of firms. We use T_t^R and T_t^K to denote the nominal amount of lump-sum government transfers per

Ricardian capita and per Keynesian capita, respectively.

In contrast, the Keynesian household maximizes its utility by choosing the intratemporal consumption and labor supply:

$$\max_{\{C_t^K, N_t^K\}} U\left(C_t^K, N_t^K\right)$$
$$s.t.\ P_t^K C_t^K = W_t N_t^K + T_t^K, \tag{8}$$

Optimality Conditions. The Ricardian households' intertemporal optimization gives rise to the Euler equation:

$$\frac{\beta \mathbb{E}_t (C_{t+1}^R)^{-\sigma^{-1}}}{(C_t^R)^{-\sigma^{-1}}} = \frac{Q_{t,t+1}\mathbb{E}_t P_{t+1}^R}{P_t^R}. \tag{9}$$

Household h's intratemporal condition yields the labor supply curve:

$$\frac{(C_t^h)^{-\sigma^{-1}}}{(N_t^h)^{\gamma}} = \frac{P_t^h}{W_t}. \tag{10}$$

3.1.2 Firms

In each sector i, there is a unit measure of monopolistically competitive firms. Firms set prices as in Calvo (1983), and the frequency of price changes among firms in section i is $1-\alpha_i$. The production function of firm j in sector i is given by

$$Y_t(j) = A_{i,t} N_{i,t}\left(j\right).$$

where $\{A_{i,t}\}$ are productivity shocks in sector i, independent across sectors and periods.

Firm j in sector i is managed by a risk-neutral manager with discount factor β, who chooses its pricing strategies to maximize the sum of its discounted profits:

$$\max_{P_{i,t}(j)} \mathbb{E}_t \sum_{s=0}^{\infty} \beta^s \alpha_i^s \left\{ \left[(1+\tau) P_{i,t}\left(j\right) - W_{t+s}\right] \left(\frac{P_{i,t}(j)}{P_{i,t+s}}\right)^{-\theta} \left(C_{i,t+s}^K + C_{i,t+s}^R\right) \right\}, \tag{11}$$

where $\tau = 1/(\theta-1)$ denotes the government subsidy rate on revenue, chosen to ensure that firms earn zero profits in the steady state. Firms take the nominal wage as given, and the wage rate is uniform across sectors and firms.

Optimality Conditions. The optimal price for the firm's problem in equation (11) is given by

$$P_{i,t}^{*}=\frac{\sum_{s=0}^{\infty}\beta^{s}\alpha_{i}^{s}\left(\frac{P_{i,t}}{P_{i,t+s}}\right)^{-\theta}\left(C_{i,t+s}^{K}+C_{i,t+s}^{R}\right)W_{t+s}/A_{i,t}}{\sum_{s=0}^{\infty}\beta^{s}\alpha_{i}^{s}\left(\frac{P_{i,t}}{P_{i,t+s}}\right)^{-\theta}\left(C_{i,t+s}^{K}+C_{i,t+s}^{R}\right)}, \tag{12}$$

The sectoral price i satisfies the following condition,

$$P_{i,t}=\left(\alpha_{i}P_{i,t-1}^{1-\theta}+(1-\alpha_{i})\left(P_{i,t}^{*}\right)^{1-\theta}\right)^{\frac{1}{1-\theta}} \tag{13}$$

The inflation of sectoral i is defined as

$$1+\pi_{i,t}=\frac{P_{i,t+1}}{P_{i,t}} \tag{14}$$

and can be expressed as follows

$$1+\pi_{i,t}=\left(\frac{\alpha}{1-(1-\alpha)\left(\frac{P_{i,t}^{*}}{P_{i,t}}\right)^{1-\theta}}\right)^{\frac{1}{1-\theta}}. \tag{15}$$

3.1.3 Government

The government conducts both fiscal and monetary policies. It levies lump-sum taxes $\sum_{i=1}^{I}\tau\int\left[P_{i,t}(j)\,C_{i,t}(j)\right]dj$ on firms to generate revenue for the subsidy mentioned earlier to the Keynesian and Ricardian households. Additionally, the government employs a transfer scheme, denoted as $\left\{T_{t}^{R},T_{t}^{K}\right\}$. This scheme involves taxing firms' profits at a rate τ_{d} and redistributing the proceeds to the Keynesian households, with the income redistribution determined by $\lambda T_{t}^{K}=-(1-\lambda)\,T^{R}=\tau_{d}D_{t}$. This type of redistribution plays an important role in shaping the income cyclicality of Keynesian and Ricardian households, and is found to be critical for monetary transmission when agents have heterogeneous MPCs (Bilbiie (2020)). This transfer scheme is simple yet flexible since any redistribution can be achieved by varying one parameter τ_{d}. For example, when $\tau_{d}=1$, all firms' profits are sent to the Keynesian households. We assume that there is no government spending and that the government balances its budget in each period.

Following Coibion and Gorodnichenko (2012), the monetary authority follows an interest rate rule subject to persistent shocks:

$$\exp(i_{t})=\exp\left[\rho_{i}i_{t-1}+\left(1-\rho_{i}\right)\bar{\imath}\right]\left[\left(\frac{P_{t}}{P_{t-1}}\right)^{\phi_{\pi}}\left(\frac{Y_{t}}{\overline{\overline{Y}}}\right)^{\phi_{y}}\right]^{1-\rho_{i}}\exp\left(\upsilon_{t}\right), \tag{16}$$

where $i_t \equiv -\log Q_{t,t+1}$ is the nominal interest rate, $\bar{\imath}$ is the steady state nominal interest rate, ρ_i is the interest-rate smoothing parameter, ϕ_π and ϕ_y represent central bank's responsiveness to aggregate inflation and aggregate output. The monetary policy shock is characterized by an AR(1) process, $v_t = \rho v_{t-1} + \zeta_{v,t}$, where $\zeta_{v,t}$ is an i.i.d process with zero mean and finite variance.

3.1.4 Equilibrium

Definition 1 (**Equilibrium**)**.** *Given the law of motion for sectoral productivity shocks $\{A_{i,t}\}$ and monetary policy shocks $\{v_t\}$, an equilibrium of the economy consists of:*

1. *Household h's demand for sectoral and differentiated goods $\left\{C^h_{i,t}\right\}$ and $\left\{C^h_{i,t}(j)\right\}$, given by equation* (6) *and* (7)*, along with aggregate consumption C^h_t and labor supply N^h_t that satisfy condition* (9) *and* (10)*.*
2. *Firms' optimal prices $\left\{P^*_{i,t}\right\}$ that solve the price-setting problem* (11) *and satisfy conditions* (12) *and* (13)*.*
3. *Aggregate prices $\{P_{i,t}\}^I_{i=1}$, P^h_t, W_t, r_t, i_t, and π^h_t, which satisfy equations* (5), (9), (10), (13), (14), (15) *and the Fisher equation $1 + i_t = (1 + r_t)\left(1 + \pi^R_{t+1}\right)$.*
4. *Labor market clearing condition $N^K_t + N^R_t = \sum^I_{i=1} \int N_{i,t}\left(j\right) dj$ and bond market clearing condition $B_t = 0$.*
5. *A monetary policy rule given by the specification* (16)*.*

Log-linearization. In the remaining part of this paper, we work with the log-linearized version of the model by approximating the equilibrium conditions around a deterministic steady state where the inflation rate is zero. Log-deviations from their steady-state counterparts are denoted by lowercase variables. In Supplementary Appendix C.1, we derive the steady-state equilibrium, and in Supplementary Appendix C.3, we present the log-linearized conditions. Conditions for determinacy of the equilibrium are provided in Supplementary Appendix C.4.

4 The Inflation Heterogeneity Channel

Armed with the theoretical framework, this section investigates how the relationship between MPC and price stickiness affects households' consumption, the aggregate MPC, and the Keynesian multiplier. In particular, it highlights a novel channel of monetary transmission: the *inflation heterogeneity* channel.

Since our focus is on the monetary transmission mechanism and the response in the demand block, we assume that the sectoral productivity remains at its steady-state level, i.e., $A_{it} = 1$. This assumption is relaxed in Section 6, where we examine the implications for optimal monetary policy. We further assume that the process of real interest rate $\{r_s\}_{s=t}^{\infty}$ is exogenous.[13] We then characterize the response of the aggregate consumption to the expected future path of changes in the real interest rate.

4.1 Inflation Heterogeneity and Consumption Response

With the model setup, the aggregate nominal profits in the economy at period t are given by

$$D_t = (1+\tau)\sum_i \int P_{i,t}(j) Y_{i,t}(j) dj - \sum_i \int W_t N_{i,t}(j) dj - \tau \sum_i \int P_{i,t}(j) Y_{i,t}(j) dj.$$

Approximating this expression around the steady state to a first-order approximation yields

$$d_t = -\left(w_t - p_t\right),$$

where d_t is defined as D_t/Y. The aggregate nominal profits d_t move inversely with the real wage rate $w_t - p_t$. By equating the aggregate labor supply ($n_t = \frac{w_t - p_t - \sigma^{-1} c_t}{\gamma}$) with the labor demand ($n_t = c_t$), we obtain the expression for the nominal wage rate:

$$w_t = p_t + \left(\gamma + \sigma^{-1}\right) c_t. \tag{17}$$

Combining the labor supply equation and budget constraint of the Keynesian household $p_t^K + c_t^K = w_t + n_t^K + \frac{\tau_d}{\lambda} d_t$, we derive the relationship between consumption, wage and nominal profits:

$$\left(\gamma + \sigma^{-1}\right) c_t^K = \left(1 + \gamma\right)\left(w_t - p_t^K\right) + \frac{\gamma \tau_d}{\lambda} d_t. \tag{18}$$

Replacing nominal wage equation (17) in expression (18), and recalling that the aggregate profits d_t satisfy $d_t = -\left(w_t - p_t\right)$, we demonstrate how the Keynesian household's real income (and consumption) y_t^K moves in tandem with the aggregate income y_t in the following equation,

$$y_t^K = \chi_y y_t - \chi_p \frac{1-\lambda}{\lambda}\left(p_t^K - p_t^R\right), \tag{19}$$

where

$$\chi_y \equiv 1 + \gamma\left(1 - \frac{\tau_d}{\lambda}\right), \quad \chi_p \equiv \lambda \frac{\gamma + 1}{\gamma + \sigma^{-1}}.$$

[13] This assumption has been widely used in the literature studying the monetary transmission mechanism in the demand block (e.g. Auclert (2019), Bilbiie (2020)). Different from these papers, we do not assume fixed or perfectly sticky prices. Instead, prices across sectors exhibit heterogeneous degrees of stickiness.

Since $y_t = \lambda y_t^K + (1-\lambda)\, y_t^R$, Ricardian's real income (consumption) is given by

$$y_t^R = \frac{1-\lambda\chi_y}{1-\lambda} y_t + \chi_p \left(p_t^K - p_t^R\right). \tag{20}$$

In this expression, $p_t^K - p_t^R$ reflects the cyclical inequality in the cost of living between households, capturing the differential responses of Ricardians' and Keynesians' price indexes (or cost of living). TANK is nested as a special case of TANK-HT when the sectoral price responses are equal (i.e., $p_t^K = p_t^R$).

The key parameter χ_y, which determines the elasticity of the Keynesians' real income (and consumption) to aggregate income in TANK and is thoroughly discussed in Bilbiie (2020), governs whether aggregate consumption in TANK is dampened or amplified relative to RANK. The underlying idea is that, following a shock to the real interest rate, if the resulting aggregate real income is disproportionally redistributed to the Keynesian households, given their higher MPC, the general equilibrium effect will be stronger, and the Keynesian multiplier will be larger. The following lemma determines the cyclicality of Keynesians' and Ricardians' real income in TANK-HT.

Lemma 1. *The elasticity of the Keynesians' real income to aggregate real income is given by*

$$\frac{dy_t^K}{dy_t} = \chi_y - \chi_p \frac{1-\lambda}{\lambda} \frac{d\left(p_t^K - p_t^R\right)}{dy_t},$$

and the elasticity of the Ricardians' real income to aggregate real income is given by

$$\frac{dy_t^R}{dy_t} = \frac{1-\lambda\chi_y}{1-\lambda} + \chi_p \frac{d\left(p_t^K - p_t^R\right)}{dy_t}.$$

The cyclicality of Keynesian's real income, denoted by $\frac{dy_t^K}{dy_t}$, is no longer exogenously determined, but endogenously determined in equilibrium. For instance, when $p_t^K - p_t^R$ is procyclical or when the Keynesian faces greater inflation after a real interest rate shock ($p_t^K > p_t^R$), the Keynesian's real income will be less cyclical relative to its counterpart in TANK. On the contrary, Ricardian's income elasticity to aggregate income is positively correlated with $p_t^K - p_t^R$.

This result is driven by the fact that the relative increase in the cost of living of the Keynesians, or the price of Keynesian's consumption baskets, further lowers Keynesian's *real* income. This is only possible when $p_t^K \neq p_t^R$, or when consumption baskets are heterogeneous across households. Unlike TANK, price responses in TANK-HT are now relevant for the cyclicality of the Ricardian's and the Keynesian's real income. This feature connects the demand side and the supply side of the economy and will play an important role in the dampening or amplifying result established below.

Combining the Ricardian's Euler equation and the intertemporal budget constraint, the Ricardian's consumption at period t can be expressed as a function of changes in real interest rates and income,

$$c_t^R = -\sigma\beta \sum_{s=0}^{\infty} \beta^s \mathbb{E}_t r_{t+s} + (1-\beta) \sum_{s=0}^{\infty} \beta^s \mathbb{E}_t y_{t+s}^R.$$

Given the path of real interest rate changes $\{r_{t+s}\}_{s=0}^{\infty}$ and the path of future income $\{y_{t+s}^R\}_{s=1}^{\infty}$, the marginal propensity to consume after a transitory income increase at period t is captured by $1-\beta$. The Ricardian's consumption function can be written in the following recursive form,

$$c_t^R = (1-\beta)\, y_t^R - \sigma\beta r_t + \beta \mathbb{E}_t c_{t+1}^R. \tag{21}$$

Proposition 1 is obtained by 1) replacing (19) into the Keynesian's consumption function ($c_t^K = y_t^K$) and plugging (20) into the Ricardian's consumption function (21), 2) aggregating these consumption functions across all households, and 3) using the market-clearing condition $c_t = y_t$.

Proposition 1. *In response to a path of real interest rate changes $\{r_{t+s}\}_{s=0}^{\infty}$, the aggregate consumption at period t in RANK, TANK and TANK-HT are given by:*

$$\text{RANK:} \qquad c_t = -\sigma \mathbb{E}_t \sum_{s=0}^{\infty} r_{t+s}, \tag{22}$$

$$\text{TANK:} \qquad c_t = -\frac{1-\lambda}{1-\lambda\chi_y} \sigma \mathbb{E}_t \sum_{s=0}^{\infty} r_{t+s}, \tag{23}$$

$$\text{TANK-HT:} \qquad c_t = -\frac{1-\lambda}{1-\lambda\chi_y} \sigma \mathbb{E}_t \sum_{s=0}^{\infty} r_{t+s} - \frac{1-\lambda}{1-\lambda\chi_y} \chi_p \left(p_t^K - p_t^R\right), \tag{24}$$

Expression (22), (23), and (24) capture the equilibrium consumption responses to a given path of real interest rate changes in RANK, TANK and TANK-HT, respectively. Expression (23) echoes the idea in Bilbiie (2020) that the cyclicality of real income inequality determines whether the aggregate consumption response is amplified or dampened in TANK relative to RANK.

One immediate observation of Proposition 1 is that in RANK and TANK, once the path of real interest rates is determined, price responses, and therefore the degrees of price stickiness, play no roles in determining the response of aggregate consumption. In contrast, the aggregate consumption response in TANK-HT depends on the heterogeneous price responses across sectors, as indicated by $(p_t^K - p_t^R)$ in expression (24).

Specifically, following a sequence of real interest rate cuts, if the Keynesian households face smaller price responses on impact, the aggregate consumption response is larger in TANK-HT than that in TANK. In this case, the aggregate consumption response is *amplified* in TANK-HT.

Conversely, if the Keynesian households face greater price responses on impact, the aggregate consumption response is *dampened* in TANK-HT.

Corollary 1. *Equation* (24) *reduces to* (23) *when* $\omega_i^K = \omega_i^R, \forall i = 1, ..., I$, *and further reduces to* (22) *when* $\lambda = 0$.

More generally, Proposition 1 highlights that the correlation between households' MPC and the cyclicality of their cost of living plays a critical role in monetary transmission. Importantly, Corollary 1 states that it is *not* the heterogeneous sectoral price responses per se that drive the amplification and dampening result. In fact, the aggregate consumption response collapses to (23) once we assume that the Keynesians and Ricardians consume the same baskets of goods, even if price stickiness is still heterogeneous across sectors.

The empirical result in section 2 indicates that the Keynesian households face more flexible prices. Proposition 1 therefore suggests that our proposed channel dampens the effects of monetary policy. The magnitude of this dampening effect is ultimately a quantitative question, which we will explore in a calibrated version of our model in section 5.

4.2 The Keynesian Multiplier and Aggregate MPC

To understand the factors driving our results in Proposition 1, we decompose the aggregate consumption response into the direct effects and the general equilibrium effects. Following Bilbiie (2020), we define c_t^D as the *autonomous spending*, ω as the *aggregate marginal propensity to consume (MPC)*, and Ω as the *Keynesian multiplier* in our model. We consider a sequence of real interest rate cuts with persistence δ, $\{r_{t+s} = -\delta^s r,\ s = 0, 1, 2, ...\}$.

The *autonomous spending* in period t represents the direct response of consumption demand arising from the intertemporal substitution effect of Ricardian households. Combining Ricardians' Euler equation and their consolidated budget constraints, we obtain the autonomous spending in period t in TANK and TANK-HT, denoted by $c_t^{D,TANK}$ and $c_t^{D,TANK-HT}$,

$$c_t^{D,TANK} = c_t^{D,TANK-HT} = -\sigma\beta(1-\lambda)\sum_{s=0}^{\infty}\mathbb{E}_t\beta^s r_{t+s} = \frac{\sigma\beta(1-\lambda)}{1-\beta\delta}r. \tag{25}$$

The autonomous spending is the same in TANK and TANK-HT, as they are both generated by the intertemporal-substitution motives of the Ricardian households.

The *Keynesian multiplier* Ω is the ratio between the aggregate consumption response c_t and the amount of autonomous spending c_t^D, $\Omega = c_t / c_t^D$. The *aggregate marginal propensity to consume (MPC)* ω is defined as $c_t = c_t^D/(1-\omega)$, or equivalently $\omega = 1 - 1/\Omega$.

Proposition 2. *Suppose there is a sequence of real interest rate cuts with persistence* δ, $\{r_{t+s} = -\delta^s r,\ s = 0, 1, 2, ..\}$. *The Keynesian multipliers in period* t *in TANK and TANK-HT can be written as,*

$$\begin{aligned}
\textit{TANK:} \quad & \Omega = \frac{1-\beta\delta}{\beta(1-\delta)\left(1-\lambda\chi_y\right)}, \\
\textit{TANK-HT:} \quad & \Omega = \frac{1-\beta\delta}{\beta(1-\delta)\left(1-\lambda\chi_y\right)} - \frac{1-\beta\delta}{\sigma\beta\left(1-\lambda\chi_y\right)}\chi_p\left(p_t^K - p_t^R\right).
\end{aligned}$$

Proposition 2 is derived by substituting expression (23), (24), and (25) into the definition of the Keynesian multiplier. The aggregate MPC ω is then obtained from $\omega = 1 - 1/\Omega$.

Both the Keynesian multiplier and the aggregate MPC are decreasing functions of the cyclical inequality in the cost of living at period t, $p_t^K - p_t^R$. Therefore, they both depend on the relative degree of price stickiness between sectors. This reveals, in the New Keynesian framework, a novel channel through which the supply block interacts with the demand block. In RANK and TANK, price stickiness affects demand by first influencing inflation and, consequently, impacting the magnitude of the real interest rate through the Fisher equation. Once the path of real interest rates is fixed, price stickiness becomes irrelevant. On the contrary, in our model, the distribution of price stickiness across agents shapes aggregate demand by dampening/amplifying the general equilibrium effect, even *conditional* on the path of real interest rates. This dampening or amplification is a consequence of varied inflation responses experienced by different households and we label it as the *inflation heterogeneity channel*.

An Illustrative Example. In Appendix D.3, we illustrate the core mechanism of the model through a simple example that assumes the Ricardian and Keynesian households consume entirely disjoint sets of goods. This simplification allows us to more clearly illustrate two core mechanisms in the analysis. First, it allows us to directly link the responsiveness of each household type's cost of living to sectoral differences in price stickiness. Second, it highlights that both the strength of the amplification or dampening effect and the size of the Keynesian multiplier increase with the degree of heterogeneity in sectoral price rigidity.

Discussion. The inflation heterogeneity channel can possibly be generalized to study business cycles and the effects of fiscal policy. Intuitively, by amplifying or dampening the Keynesian multiplier, the inflation heterogeneity channel can amplify or stabilize fluctuations over business cycles.[14] Similarly, government spending exerts uneven inflationary pressure on households' cost of living. The magnitude of the fiscal multiplier can vary depending on the correlation between

[14] Patterson (2023) shows that the positive covariance between households' MPC and income cyclicality amplifies business-cycle fluctuations. Our proposed channel focuses on the covariance between households' MPC and the cyclicality of the cost of living, and can be extended to study the business-cycle fluctuations.

households' MPC and the relative price stickiness they encounter. We leave the exploration of these implications to future research.

5 Quantitative Analysis

In Section 4, we demonstrated how the relationship between MPC and price stickiness influences household consumption, the aggregate MPC, and the Keynesian multiplier through the inflation heterogeneity channel proposed in our framework. In this section, we shift from theoretical analysis to quantitative evaluations. Specifically, we calibrate the multi-sector TANK model outlined in Section 3 using the microdata discussed in Section 2. We aim to quantitatively assess the impact of the inflation heterogeneity channel on the effectiveness of monetary policy.

5.1 Calibration

The model is calibrated at a monthly frequency, and the parameters calibrated externally are based on the conventional values in the literature. The discount factor β is calibrated to be 0.9975. The elasticity of intertemporal substitution σ is set to 0.5. To achieve a Frisch labor supply elasticity of 1/3, we select $\gamma = 3$ (e.g. Chetty et al. (2011)). The Taylor rule parameters are determined as $\phi_\pi = 1.24$ and $\phi_y = 0.5/12$. For the monetary shock, we assign a monthly standard deviation and persistence of $\nu = 0.0025$ and $\rho = 0.9$, respectively.

The rest of the parameters are calibrated to match micro moments in Section 2. The number of sectors I is calibrated to be 263 to match the number of Entry Level Items (ELIs) in the data. In both TANK with heterogeneous consumption baskets (TANK-HT) and TANK with homogeneous consumption baskets, the frequency of price changes $1-\alpha_i$ in sector i is set to match the frequency of price changes of goods in ELI i. We assign mortgagors and renters to be the Keynesian households and the outright homeowners to be the Ricardian households. The corresponding consumption weight ω_i^h is set to be the expenditure share consumed on ELI i by household type h, constructed in section 2. The average frequency of price changes faced by Keynesians is 0.234, and that faced by Ricardians is 0.197. Table 2 presents the calibrated parameters. As the pricing moments documented in Nakamura and Steinsson (2008) span 1998 to 2005, our calibration uses 2005 expenditure shares.[15] In TANK, the consumption weight in sector i is set to $\omega_i = \lambda\omega_i^K + (1-\lambda)\omega_i^R$.

Calibrating λ and τ_d. Two key parameters determine the effects of monetary policy: the fraction of Keynesian households denoted by λ, and the real income cyclicality of Keynesian house-

[15] Our results are robust to using expenditure shares in other years.

Table 2: Calibrated Parameters

Externally calibrated		
Discount factor	β	0.9975
EIS	σ	0.5
Frisch elasticity	$\frac{1}{\gamma}$	1/3
Taylor rule coefficient	ϕ_π	1.24
Taylor rule coefficient	ϕ_y	0.5/12
Shock size at impact	ν	0.0025
Shock persistence	ρ	0.9
Interest-rate smoothing	ρ_i	0.9
Internally calibrated		
Number of sectors	K	263
Average freq. of price changes	$1-\overline{\alpha}$	0.208
Average freq. faced by K	$1-\alpha_K$	0.234
Average freq. faced by R	$1-\alpha_R$	0.197

holds in TANK denoted by χ_y. Bilbiie (2020) demonstrates that by adjusting these two parameters, the TANK model can accurately replicate the aggregate effects of monetary policy shocks in the existing quantitative-HANK studies, including Kaplan et al. (2018), Gornemann et al. (2021), Debortoli and Galí (2017), Hagedorn et al. (2019), and Auclert et al. (2018).[16] For the sake of robustness, we follow the calibration outlined in Bilbiie (2020), allowing for different values of λ and χ_y as detailed in Table 3. The first column lists names of the studies, and the second and third column presents the calibrated values of χ_y and λ for each study. For our baseline calibration, we pick the median value from these studies, setting $\lambda = 0.3$ and $\chi_y = 2.16$.[17]

5.2 The Effects of Monetary Policy

With the calibrated economy as our laboratory, we proceed to assess the real effects of monetary policy in TANK-HT. As discussed earlier, we set a fixed path for real interest rate changes and measure monetary non-neutrality by calculating the cumulative consumption responses.

In our baseline calibration, the cumulative aggregate consumption response is 0.0427. Of this, 58.6% is attributed to the Keynesian households, with a response of 0.0251, while the remaining 41.4%, totaling 0.0177, is consumed by the Ricardian households. In TANK, the cumulative aggregate consumption response is 0.05. The Keynesian households consume 0.0323 (64.6%),

[16] Specifically, Bilbiie (2020) set χ and λ in TANK to match the Keynesian multiplier Ω and aggregate MPC ω in the quantitative-HANK studies listed in Table 3.

[17] These values are, coincidentally, also the mean of the first and second columns.

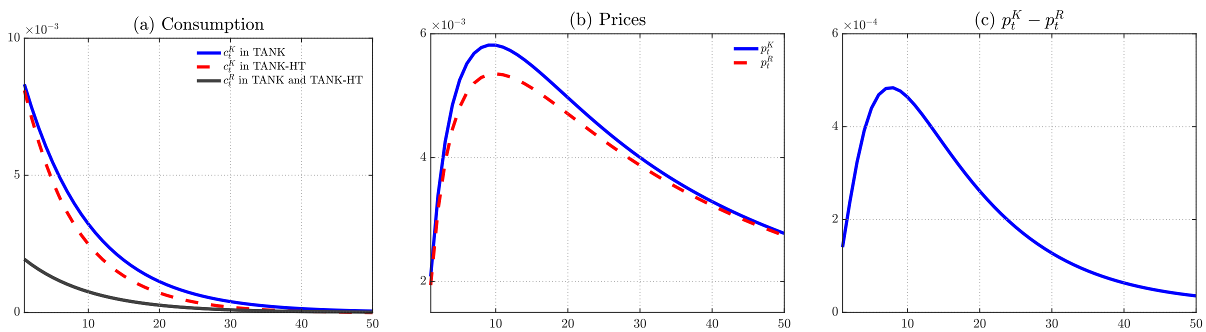
Table 3: Calibration of Parameters χ_y and λ

Studies	Parameters		Dampening effect	Targeted Moments		
	χ_y	λ		$\frac{\Omega}{\Omega^*}$	ω	Ω_{transfer}
Kaplan et al. (2018)	1.48	0.41	15%	1.5	0.8	—
Gornemann et al. (2021)	2.16	0.3	15%	2	0.9	—
Debortoli and Galí (2017)	2.55	0.21	10%	1.7	0.64	—
Hagedorn et al. (2019)	3.1	0.24	17%	—	0.77	0.66
Auclert et al. (2018)	1.51	0.36	13%	—	0.55	0.53
Baseline (This paper)	2.16	0.3	15%			

Note: "—" indicates missing or unavailable data. Here, $\frac{\Omega}{\Omega^*}$ represents the magnitude of amplification of HANK relative RANK, ω is the share of indirect effect and Ω_{transfer} is the fiscal transfer multiplier.

and the Ricardian households consume 0.0177 (34.8%). By this metric, the aggregate effects of monetary policy are 14.6% smaller in TANK-HT than those in TANK.

Figure 5: Impulse Responses to the Real Interest Rate Shock



Note: Panel (a) illustrates the impulse responses of the consumption of the Keynesians and the Ricardians in TANK-HT and TANK, respectively. Panel (b) plots the impulse responses of the prices faced by the Keynesians and the Ricardians. Panel (c) shows the difference between the two price indexes, $p_t^K - p_t^R$.

As shown in panel (a) of Figure 5, the difference in consumption response is entirely driven by the reduction in consumption of the Keynesian households. Consequently, the Keynesian multipliers, as defined in section 4, are 1.69 in TANK-HT and 2 in TANK. The corresponding aggregate MPCs are 0.41 and 0.5, respectively. Panel (b) and panel (c) plot the responses of p_t^R and p_t^K as well as their difference $p_t^K - p_t^R$. The peak response of p_t^K is approximately 9.1% higher than that of p_t^R, consistent with its empirical counterpart.[18]

In addition, we assess the robustness of our results across different calibrations of λ and χ_y listed in Table 3. The last column in Table 3 quantifies the extent to which aggregate consumption in TANK-HT is dampened relative to TANK. The dampening effect ranges from 10% calibrated to Debortoli and Galí (2017), to 17% calibrated to Hagedorn et al. (2019).

Heterogeneous Consumption Baskets or Heterogeneous Price Stickiness. To demonstrate the necessity of both heterogeneous consumption baskets across households and heterogeneous price stickiness across sectors for our results, we systematically eliminate each assumption in TANK-HT. Specifically, we investigate two scenarios: one where consumption baskets are homogeneous across households while price stickiness across sectors is heterogeneous, and the other where price stickiness is homogeneous but the consumption baskets are heterogeneous. In both scenarios, we find that the IRFs are identical to those in TANK. This finding suggests that it is crucial to connect heterogeneity in the demand side with heterogeneity in the supply side to accurately evaluate the efficacy of monetary policy.

Discussion: Nonhomothetic Price Elasticity. Recent research has highlighted the importance of nonhomothetic price elasticity, both empirically (e.g., Auer et al. (2023)) and theoretically (e.g., Fally (2022), Olivi et al. (2024), Mongey and Waugh (2025), Li (2025)). We briefly discuss the potential implications for our quantitative results. Because Keynesian households experience more cyclical income fluctuations than Ricardian households, their price elasticity of demand is likely to vary more strongly over the business cycle. In particular, following a monetary expansion, Keynesian households become less price-sensitive. In response, firms selling to these households raise their prices, dampening the increase in Keynesian households' real income. This attenuates the Keynesian multiplier and further weakens the overall transmission of monetary policy, complementing our dampening mechanism. While it is not the focus of this paper, the quantitative relevance of this channel remains an open question for future research.

6 Optimal Monetary Policy

In models with heterogeneous agents, such as TANK, the presence of imperfect insurance leads to cyclical income inequality between Ricardians and Keynesians. Our empirical evidence suggests that differences in households' cost-of-living cyclicality introduce a new form of cyclical inequality. Does this particular type of inequality affect the design of optimal policy? If so, what constitutes the optimal monetary policy? This section attempts to answer these questions.

[18] Note that the magnitude of monetary policy shock in the empirical estimation is 100 basis points, while in our quantitative model it is 25 basis points.

We begin by demonstrating that incorporating heterogeneous consumption baskets into the TANK model introduces a time-varying inefficient wedge between the flexible-price equilibrium level of output and the efficient one, thereby rendering the flexible-price equilibrium socially inefficient. The result is discussed in detail in Section 6.1. We then establish conditions under which the efficient allocation can be implemented by a sticky-price equilibrium in Section 6.2. Under these conditions, stabilizing the output gap simultaneously stabilizes prices and minimizes inequality, achieving the social optimum. We refer to this result as the "triple divine coincidence" and show that it holds in a standard one-sector TANK model. Section 6.3 derives the optimal monetary policy by formulating and solving a Ramsey problem, in which the social planner directly chooses the output gap and sectoral inflation rates to maximize the social welfare, subject to the implementability constraints.

Unless otherwise specified, we assume that household h's utility function in period t is given by

$$W_t^h = U(C_t^h) - V(N_t^h).$$

The central bank assigns equal weights to each household and the social welfare in period t is expressed as

$$W_t = \lambda U(C_t^K) + (1-\lambda)U(C_t^R) - \left[\lambda V(N_t^K) + (1-\lambda)V(N_t^R)\right]. \tag{26}$$

6.1 The Inefficiency of Flexible-Price Equilibrium: a Time-Varying Wedge

This section illustrates the inefficiency of the flexible-price equilibrium arising from heterogeneous household consumption baskets. The differing exposures of household-specific price indexes to sectoral shocks generate cyclical inequality in their cost of living, even when prices are fully flexible. The inability of Keynesian households to trade financial assets limits risk sharing across households, thereby contributing to this inefficiency.

As a benchmark, we first characterize the conditions under which the allocation is efficient (i.e., first-best), summarized in the following lemma.[19]

Lemma 2. *Consider the TANK-HT model specified in section 3. The efficient allocation*

[19] See Supplementary Appendix E.1 for a proof.

$\left\{\widetilde{C}_{i,t}^h, \widetilde{C}_t^h, \widetilde{N}_t^h\right\}$ *satisfies the following conditions:*

$$\frac{V'(\widetilde{N}_t^h)}{U'(\widetilde{C}_t^h) d\widetilde{C}_t^h / d\widetilde{C}_{i,t}^h} = A_{i,t} \tag{27}$$

$$\frac{V'(\widetilde{N}_t^K)}{V'(\widetilde{N}_t^R)} = 1, \tag{28}$$

$$\frac{U'(\widetilde{C}_t^K)}{U'(\widetilde{C}_t^R)} = \left(\frac{A_t^K}{A_t^R}\right)^{-1}, \tag{29}$$

for households $h \in \{R, K\}$ and all sectors $i = 1, .., I$, where $A_t^h = \Pi_{i=1}^I \left(A_{i,t}\right)^{\omega_i^h}$.

Condition (27) states that, in the optimal allocation, household h's marginal rate of substitution between consumption of good i and labor is equal to the marginal rate of transformation, $A_{i,t}$. This condition governs the allocation of consumption across sectors. Condition (28) implies that, for any given consumption allocation—and hence total labor supply—it is optimal to equalize N_t^K and N_t^R in order to minimize labor supply inequality, owing to the convexity of $V(\cdot)$. This condition determines the aggregate labor allocation between different households. Finally, Condition (29) indicates that the planner allocates more consumption to households whose consumption baskets, on average, are associated with higher productivity.

Subsequently, we turn to the set of conditions characterizing the flexible-price equilibrium, as presented in the following proposition.[20]

Proposition 3. *The allocation $\{\widehat{C}_{i,t}^h, \widehat{C}_t^h, \widehat{N}_t^h\}$ in flexible-price equilibrium in TANK-HT satisfies the following conditions:*

$$\frac{V'(\widehat{N}_t^h)}{U'(\widehat{C}_t^h) d\widehat{C}_t^h / d\widehat{C}_{i,t}^h} = A_{i,t}, \tag{30}$$

$$\frac{\widehat{V}'(N_t^K)}{\widehat{V}'(N_t^R)} = \varepsilon_t \times \frac{V'(\widetilde{N}_t^K)}{V'(\widetilde{N}_t^R)}, \tag{31}$$

$$\frac{U'(\widehat{C}_t^K)}{U'(\widehat{C}_t^R)} = \varepsilon_t \times \frac{U'(\widetilde{C}_t^K)}{U'(\widetilde{C}_t^R)}, \tag{32}$$

where

$$\varepsilon_t = \left(\frac{\widehat{P}_t^R}{\widehat{P}_t^K}\right)^{\frac{(\sigma-1)\gamma}{1+\sigma\gamma}}, \tag{33}$$

$$\widehat{P}_t^K = \left(A_t^K\right)^{-1}; \ \widehat{P}_t^R = \left(A_t^R\right)^{-1},$$

[20]Supplementary Appendix 3 proves this proposition.

for households $h \in \{R, K\}$ and all sectors $i = 1, .., I$, where A_t^K and A_t^R are defined in Lemma 2, and $\left\{\widetilde{C}_{i,t}^h, \widetilde{C}_t^h, \widetilde{N}_t^h\right\}$ denotes the first-best allocation. The flexible-price equilibrium is generically inefficient, except when $\sigma = 1$.[21]

Equation (30) in Proposition 3 is identical to equation (27) in Lemma 2, indicating that, conditional on aggregate consumption $\widehat{C}_t^h$ and labor supply N_t^h, household h's sectoral consumption allocation $C_{i,t}^h$ remains efficient. In contrast, conditions (31) and (32) introduce a distortionary wedge ε_t relative to conditions (28) and (29).

This time-varying wedge ε_t, defined in equation (33) as a function of the ratio of price indexes P_t^K / P_t^R. The inefficiency arises from sectoral productivity shocks causing fluctuations in sectoral prices $\{P_{i,t}\}_{i=1}^I$, which generate variation in household-specific cost-of-living indexes P_t^h due to differences in consumption baskets between Keynesian and Ricardian households. As a result, real wages W_t / P_t^h vary across households. Given incomplete markets, these households cannot fully insure against such idiosyncratic risk. The resulting divergence in real wages distorts both labor supply and consumption decisions, leading to misallocation and cyclical inequality.

It is important to note that, as implied by equations (31) and (32), the direction of the inefficiency depends on which sectors are affected by the productivity shock. For instance, equation (33) shows that Keynesian households consume too little and supply too much labor if—and only if—the productivity of the goods they consume is relatively low compared to the Ricardians'.

Importantly, unlike the exogenous wedges often assumed in the literature, ε_t is endogenous to monetary policy. This endogeneity introduces a novel redistribution motive: to mitigate fluctuations in inequality and inefficiency, monetary policy should seek to reduce disparities in the cost of living across household types.

6.2 Implementing Efficient Allocations: the Triple Divine Coincidence

The flexible-price equilibrium in our baseline model is inefficient, raising a natural question: Can a sticky-price equilibrium implement the efficient allocation? To address this, we first define the sticky-price equilibrium and then characterize the conditions under which it can support the efficient allocation.

Definition 2 (Sticky-price Equilibrium). *Let monetary policy shocks $\nu_t = 0$ for all t. A sticky-price equilibrium consists of allocations $\left\{C_t^h, C_{i,t}^h, C_{i,t}(j)^h, N_t^h, N_{i,t}(j), B_t\right\}$ and prices $\left\{\{P_{i,t}\}_{i=1}^I, P_t^h, P_{i,t}^*, W_t, r_t, i_t, \pi_t^h, \pi_t\right\}$ that satisfy conditions 1-5 in equilibrium definition 1.*

With the sticky-price equilibrium defined, we now characterize the conditions under which it can implement the efficient allocation. A classical result in RANK is the "divine coincidence":

[21] Consistent with the business cycle literature, we assume that $\sigma < 1$ in the subsequent analysis.

stabilizing the aggregate output gap simultaneously stabilizes prices and, therefore, achieves the social optimum (Galí (2015), Woodford (2003)). We revisit this result in our multi-sector TANK framework, which allows for household heterogeneity (two household types), imperfect insurance, heterogeneous price stickiness across sectors, and heterogeneous consumption baskets across households. Within this flexible framework, we identify the conditions under which the sticky-price equilibrium can implement the efficient allocation. Or put differently, we explore the conditions under which the divine coincidence result holds, specifically, when stabilizing the aggregate output gap leads to efficient allocations. The following proposition provides the answer and serves as a benchmark for our subsequent discussion on optimal monetary policies. Additionally, it provides an irrelevance result to a question central to the recent policy debate: when should inequality matter for conducting monetary policy?

Proposition 4 (**Triple Divine Coincidence**). *The first-best allocation can be implemented by the sticky-price equilibrium if and only if the following conditions are both satisfied:*

1. *Prices are sticky within at most one sector, and are perfectly flexible in all other sectors.*
2. *Households have the same consumption baskets:* $\omega_i^K = \omega_i^R$ *for all* $i = 1, 2, ..., I$.

Proposition 4 suggests that breaking the irrelevance result, or in other words, making inequality relevant for monetary policy, can be achieved through two avenues. The first one involves assuming sticky prices in more than one sector. This is known as a result of the "lack of instrument" argument: with only one instrument at their disposal, monetary policymakers face limitations in implementing efficient allocation in a multi-sector economy. Alternatively, the second approach involves assuming heterogeneity in consumption baskets across households.

In the subsequent section, we will delve into the consequences of introducing heterogeneous consumption baskets—a novel assumption in the existing literature. It's noteworthy that, when the "triple divine coincidence" result holds, the optimal policy aligns with replicating the flexible-price equilibrium, which is inherently efficient. However, the introduction of heterogeneous consumption baskets gives rise to a time-varying inefficient wedge between the flexible-price equilibrium and the efficient one. The flexible-price equilibrium, while traditionally considered efficient, now exhibits social inefficiency, and this inefficiency itself is time-varying. This dynamics introduces a fundamental shift in the nature of optimal monetary policy.

6.2.1 Robustness to Alternative Assumptions

Our baseline model builds on several simplifying assumptions, including homogeneous labor that is perfectly substitutable across household types, and a uniform wage response across sectors. In this subsection, we relax these assumptions and show that our main result is robust under a range of alternative assumptions. Detailed proofs are provided in Supplementary Appendix E.4.

Welfare weights. Our results remain robust under the alternative assumption that the social planner assigns welfare weights to different households, rather than weighting them by population shares. Under this assumption, the social welfare function is given by $\widetilde{\lambda}[U(C_t^K) - V(N_t^K)] + (1-\widetilde{\lambda})[U(C_t^K) - V(N_t^K)]$, where $\widetilde{\lambda} \neq \lambda$, the social welfare weight $\widetilde{\lambda}$ differs from the population weight λ. In Appendix E.4.1, we characterize the first-best allocation under this modified welfare function and show that the flexible-price equilibrium remains inefficient. Consequently, Proposition 4 continues to hold.

Local labor market with specialized labor. Proposition 4 continues to hold under the assumption of specialized labor. Specifically, we assume that each firm produces output using sector-specialized labor supplied by both Keynesian and Ricardian households. The sectoral production function given by

$$Y_{i,t}(j) = A_{i,t}\left(N_{i,t}^K(j)\right)^{\epsilon_i}\left(N_{i,t}^R(j)\right)^{1-\epsilon_i},$$

where the input share of Keynesian labor, ϵ_i, varies by sector, and the remainder is supplied by the Ricardians. We allow ϵ_i to be sector-specific and show in Supplementary Appendix E.4 that Proposition 4 remains valid under this specialized labor assumption (with an additional condition that $\epsilon_i = 1/2$ for all i).

Heterogeneous stickiness of nominal wages. Our baseline analysis focuses solely on the heterogeneous stickiness of prices. However, given the heterogeneous nominal wage stickiness documented in the literature (Fehr and Goette, 2005; Barattieri et al., 2014), the underlying mechanism can be naturally extended to models featuring heterogeneous nominal wage stickiness alongside flexible prices. For example, consider a Calvo-type sticky-wage model as in Erceg et al. (2000), where households supply differentiated labor across sectors. In such a setting, the "lack of instrument" argument implies that achieving efficient allocation requires nominal wages to be sticky in at most one sector. Additionally, the uninsurable cyclical real wages induced by different exposures to sectoral shocks generate idiosyncratic risks, which in turn give rise to a time-varying inefficient wedge under a flexible-wage equilibrium.

6.3 Optimal Monetary Policy: the Ramsey Problem

In the remainder of this section, we formulate and solve the Ramsey problem to characterize the optimal monetary policy. To keep the analysis tractable, we employ a linear-quadratic approximation to the social welfare function and the equilibrium conditions. This approach delivers a closed-form solution that enables a sharp, transparent characterization of the optimal monetary policy.

6.3.1 Social Welfare Function

To set up the Ramsey's problem, we first define the social welfare function and derive the sectoral Phillips Curve. The social welfare is a function of the aggregate output gap $\widetilde{y}_t$, the vector of sectoral inflation rates $\boldsymbol{\pi}_t = (\pi_{1,t}, \pi_{2,t}, ..., \pi_{I,t})$, and the vector of last-period sectoral prices $\boldsymbol{p}_{t-1} = (p_{1,t-1}, p_{2,t-1}, ..., p_{I,t-1})$, as presented in Proposition 5. For clarity, all vectors are denoted in boldface, and Supplementary Table E.1 provides a detailed summary of the notations used in the Ramsey problem.

Proposition 5. *The approximated social welfare function at period t is given by*

$$W_t = -\frac{1}{2}\Bigg[\underbrace{\left(\gamma+\sigma^{-1}\right)\widetilde{y}_t^2}_{\textit{output gap}} + \underbrace{\boldsymbol{\pi}_t^T \mathcal{H}^{within} \boldsymbol{\pi}_t}_{\textit{within-sector dispersion}} + \underbrace{\boldsymbol{\delta}_t^T \mathcal{H}^{across} \boldsymbol{\delta}_t}_{\textit{cross-sector dispersion}} + \underbrace{\psi_{wc}\left(c_t^K - c_t^R\right)^2}_{\textit{Inequality}}\Bigg], \quad (34)$$

where

$$\boldsymbol{\delta}_t = \underbrace{\Phi^{-1}(1-\Phi)(\boldsymbol{\pi}_t - \beta\mathbb{E}_t \boldsymbol{\pi}_{t+1})}_{\textit{RANK term}} + \underbrace{\widetilde{\boldsymbol{\omega}}_K \psi_{cy} \widetilde{y}_t + \widetilde{\boldsymbol{\omega}}_K (1-\psi_{c\pi})(\boldsymbol{\omega}_K^T - \boldsymbol{\omega}_R^T)(\boldsymbol{\pi}_t + \boldsymbol{p}_{t-1})}_{\textit{TANK-HT term}}, \quad (35)$$

$$c_t^K - c_t^R = \underbrace{\psi_{cy}\widetilde{y}_t}_{\textit{TANK term}} - \underbrace{\psi_{c\pi}\left(\boldsymbol{\omega}_K^T - \boldsymbol{\omega}_R^T\right)\left(\boldsymbol{\pi}_t + \boldsymbol{p}_{t-1}\right)}_{\textit{TANK-HT term}}, \quad (36)$$

and Φ is the sectoral price-stickiness (diagonal) matrix, $\mathcal{H}^{within}$ and $\mathcal{H}^{across}$ are the within-sector and across-sector aggregators to capture the within and cross-sector dispersion. The ψ_{cy} and $\psi_{c\pi}$ are coefficients for consumption inequality and ψ_{wc} is the coefficient for welfare. The i'th element of the vector $\widetilde{\boldsymbol{\omega}}_K = (\widetilde{\omega}_1^K, \widetilde{\omega}_2^K, ..., \widetilde{\omega}_I^K)^T$ is defined as $\widetilde{\omega}_i^K = \frac{\lambda\omega_i^K}{\lambda\omega_i^K + (1-\lambda)\omega_i^R}$.

Proof of Proposition 5 is provided in Supplementary Appendix E.5. The social welfare function (34) comprises two main components: the stabilization component and the inequality component.[22] The stabilization component consists of three terms. The first term, $\left(\gamma+\sigma^{-1}\right)\widetilde{y}_t^2$, is proportional to the volatility of the output gap. The second term, $\boldsymbol{\pi}_t^T \mathcal{H}^{\text{within}} \boldsymbol{\pi}_t$, quantifies the welfare loss from price dispersion within sectors, capturing the misallocation arising from nonzero inflation, as emphasized in standard New Keynesian models. The third term, $\boldsymbol{\delta}_t^T \mathcal{H}^{\text{across}} \boldsymbol{\delta}_t$, arises from the misallocation of output across sectors, where $\{\delta_{i,t} = y_{i,t} - a_{i,t}\}$ measure the deviation of sectoral outputs from their efficient levels.

[22] A scalar version of the social welfare function is provided in Appendix E.5.

To build intuition, we re-express $\delta_{i,t}$ in matrix form, as shown in (35), and decompose it into two terms. The first term is conventional in RANK models and captures average sectoral markups. Together with the output gap term, $\left(\gamma+\sigma^{-1}\right)\tilde{y}_t^2$, and within-sector dispersion term, $\boldsymbol{\pi}_t^T \mathcal{H}^{\text{within}} \boldsymbol{\pi}_t$, it constitutes the conventional welfare components found in a RANK framework (see Rubbo (2023)). The second term captures the misallocation of output across sectors arising from heterogeneous consumption baskets.

Finally, as shown in (36), the cyclical inequality term $c_t^K - c_t^R$ is a function of the output gap $\tilde{y}_t^2$ and the difference in price indexes, $(\boldsymbol{\omega}_K^T - \boldsymbol{\omega}_R^T)\boldsymbol{p}_t$.[23] The inequality term can be decomposed into a component common to TANK models and a component unique to our framework. In standard TANK models, cyclical inequality arises primarily from its comovement with the aggregate output gap. In contrast, our model identifies an additional channel: inequality in the cost of living driven by differences in households' exposure to sectoral price changes that stem from heterogeneous consumption baskets.

A critical implication of heterogeneous consumption baskets is the emergence of interaction (covariance) terms between the output gap, $\tilde{y}_t$, and sectoral inflation rates, $\boldsymbol{\pi}_t$. These terms are absent from the social welfare function in both RANK and standard TANK models. However, once the heterogeneous consumption baskets are introduced, they appear in the social welfare function (34), showing up in both the cross-sector dispersion term (35) and the inequality term (36) . Their presence in the inequality component follows directly from our earlier result that cyclical inequality depends on the output gap and sectoral inflation (equation (36)). For the cross-sector dispersion term, the covariance arises from the structure of demand. Specifically, aggregate sectoral demand, $y_{i,t} = \tilde{\omega}_i^K y_{i,t}^K + \tilde{\omega}_i^R y_{i,t}^R$ depends on household-specific demand, $y_{i,t}^h = -(p_{it} - p_t^h) + y_t^h$. Consequently, cross-sector misallocation, $(y_{i,t} - y_{j,t}) - (a_{i,t} - a_{j,t})$, is a function not only of relative sectoral inflation but also of consumption inequality and differences in households' cost of living.

6.3.2 Ramsey Problem with Commitment

To solve for the optimal monetary policy under commitment, we adopt the tractable Ramsey framework using the primal approach. In this formulation, the social planner directly chooses allocations $(\{\tilde{y}_t, \pi_t\})$ to maximize social welfare, subject to a set of implementability constraints. We begin by presenting these constraints and then proceed to characterize the Ramsey allocation under commitment.

Lemma 3 (**Implementability Conditions**). *The set of implementability conditions includes the*

[23] Since labor supply inequality is proportional to consumption inequality in our model—specifically, $nt^K - n_t^R = -\sigma^{-1}\left(c_t^K - c_t^R\right)/\gamma$—it is embedded within the consumption inequality term.

sectoral Phillips curves,

$$\boldsymbol{\pi}_t = \mathcal{K}\tilde{y}_t - \mathcal{J}\left(\boldsymbol{a}_t + \boldsymbol{p}_{t-1}\right) + \beta\left(I - \mathcal{J}\right)\mathbb{E}_t\boldsymbol{\pi}_{t+1}, \tag{37}$$

as well as the law of motion for sectoral prices

$$\boldsymbol{p}_t = \boldsymbol{\pi}_t + \boldsymbol{p}_{t-1}, \tag{38}$$

where coefficient vector $\mathcal{K}$ and matrix $\mathcal{J}$ are given by

$$\mathcal{K} = \left(\sigma^{-1} + \gamma\right)\frac{\Phi\mathbf{1}}{1 - \boldsymbol{\omega}^T\Phi\mathbf{1}}, \tag{39}$$

$$\mathcal{J} = \Phi - \frac{1}{\left(\sigma^{-1} + \gamma\right)}\mathcal{K}\boldsymbol{\omega}^T(I - \Phi). \tag{40}$$

Expression (39) shows that the slope of the sectoral Phillips curve is inversely related to the degree of price stickiness in that sector. The detailed derivation of the sectoral Phillips curves (37) is provided in Appendix C.2. The implementability conditions in Lemma 3 do not include the nominal interest rate i_t—the monetary instrument—which can be recovered from the Euler equation once the optimal paths of the output gap and sectoral inflation rates are determined.

Definition 3 (**Ramsey Problem with Commitment**)**.** *A Ramsey planner chooses the path of aggregate output gap and sectoral inflation rates ($\{\tilde{y}_t, \boldsymbol{\pi}_t\}$) to maximize the social welfare function:*

$$\mathcal{W}_0 = \max_{\{\tilde{y}_t, \boldsymbol{\pi}_t\}} \sum_{t=0}^{\infty} \beta^t W_t,$$

subject to the implementability conditions (37) and (38), taken as given the initial prices $\boldsymbol{p}_{-1}$. The flow social welfare function W_t is given by (34).

In this Ramsey problem, the choice variables for the social planner are the output gap $\tilde{y}_t$ and sectoral inflation rates $\boldsymbol{\pi}_t$. The predetermined (or state) variable is the vector of last period prices $\boldsymbol{p}_{t-1}$, whose law of motion is given by (38).

With Ramsey's problem set up, we next lay out the optimality conditions that characterize the optimal monetary policy.

6.3.3 Optimal Monetary Policy: Optimality Conditions

The linear-quadratic Ramsey problem defined in Definition 3 satisfies conditions for certainty equivalence and can be solved by minimizing the Lagrangian.[24] Proposition 6 characterizes the

[24]The Lagrangian is defined in equation (E.43) in the Appendix.

conditions required to implement the optimal policy.

Proposition 6 (Optimality Conditions). *The necessary first-order conditions that characterize the optimal monetary policy are given by the Phillips Curves (37), the price dynamics (38), and the following equation:*

$$\left(\gamma+\sigma^{-1}\right)\widetilde{y}_t + B_\pi \boldsymbol{\pi}_t + B_\delta \boldsymbol{\delta}_t + B_C(c_t^K - c_t^R) = \mathcal{K}^T (I-\mathcal{J})^T \boldsymbol{\xi}_{t-1} + \mathcal{K}^T \boldsymbol{\vartheta}_t + B_{-1,\delta}\boldsymbol{\delta}_{t-1}, \tag{41}$$

where the coefficients $\{B_\pi, B_\delta, B_C\}$ are defined by equations (E.48) in Appendix E.6, as well as the conditions involving the dynamics of Lagrangian multipliers on Phillips curves ($\{\boldsymbol{\xi}_t\}$) and on price dynamics ($\{\boldsymbol{\vartheta}_t\}$), defined in equation (E.44) and (E.46) in the Appendix E.6. The initial condition for $\boldsymbol{p}_{-1}$ is given, and the initial conditions for the multipliers on sectoral Phillips curves satisfy $\boldsymbol{\xi}_{-1}=\mathbf{0}$.

6.3.4 Understanding Optimal Monetary Policy

The optimality conditions in Proposition 6 involve a high-dimensional dynamic system. To illustrate the policy trade-offs in a transparent way, we examine a simple case by assuming that the discount factor $\beta=0$ and the economy remains in steady state at period $t-1$. This implies that $\boldsymbol{p}_{t-1}=0$, $\boldsymbol{\delta}_{t-1}=0$ and $\boldsymbol{\xi}_{t-1}=0$. It then follows immediately from equation (E.46) that $\boldsymbol{\vartheta}_t=0$.

Substituting these conditions into equation (41) yields the following expression, highlighting the policy trade-offs:

$$\left(\gamma+\sigma^{-1}\right)\widetilde{y}_t + B_\pi \boldsymbol{\pi}_t + B_\delta \boldsymbol{\delta}_t + B_C\left(c_t^K - c_t^R\right) = 0 \tag{42}$$

Additionally, with $\beta=0$, the output gap can be expressed as,[25]

$$(\gamma+\sigma^{-1})\widetilde{y}_t = \boldsymbol{\omega}^T(1-\Phi)\Phi^{-1}\boldsymbol{\pi}_t. \tag{43}$$

Substituting equation (35), (36), and (43) into (42), we can express the optimal policy as an inflation-targeting rule. The sectoral weight of the optimal inflation index is denoted as $\boldsymbol{\varphi}^T = (\varphi_1, \varphi_2, ..., \varphi_I)$, which satisfies

$$\boldsymbol{\varphi}^T \boldsymbol{\pi}_t = 0 \tag{44}$$

The following proposition characterizes the optimal inflation index by decomposing it into three distinct terms.

[25]Appendix E.5.2 provides detailed derivation of the divine coincidence Phillips curve $\pi_t^{\mathrm{DC}} = \beta\mathbb{E}_t\pi_{t+1}^{\mathrm{DC}} + \frac{\sigma^{-1}+\gamma}{\sum_{i=1}^I \omega_i \frac{1-\phi_i}{\phi_i}}\widetilde{y}_t$ with $\pi_t^{\mathrm{DC}} \equiv \sum_{i=1}^I \frac{\omega_i\frac{1-\phi_i}{\phi_i}}{\sum_{j=1}^I \omega_j \frac{1-\phi_j}{\phi_j}}\pi_{it}$.

Proposition 7 (**Optimal Inflation-stabilization Policy**)**.** *Assuming that the discount factor* $\beta = 0$ *and* $\boldsymbol{p}_{t-1} = 0$*, the optimal monetary policy in period* t *can be implemented by an inflation-stabilization policy of the form*

$$\boldsymbol{\varphi}^T \boldsymbol{\pi}_t = 0, \quad with \quad \boldsymbol{\varphi} = \boldsymbol{\varphi}^{RANK} + \boldsymbol{\varphi}^{TANK} + \boldsymbol{\varphi}^{TANK\text{-}HT},$$

where the optimal policy weight for sector i *is given by*

$$\varphi_i = \varphi_i^{RANK} + \varphi_i^{TANK} + \varphi_i^{TANK\text{-}HT}.$$

The detailed expressions for φ_i*,* φ_i^{RANK}*,* φ_i^{TANK} *and* $\varphi_i^{TANK\text{-}HT}$ *are provided in Appendix E.7.*

The term $\boldsymbol{\varphi}^{\text{RANK}}$ captures the classic policy trade-offs in a multi-sector RANK framework—balancing output gap stabilization, within-sector price dispersion, and cross-sector misallocation. Previous studies have shown that the optimal policy involves stabilizing the price index of sectors with stickier prices (e.g. Aoki (2001),Benigno (2004),Rubbo (2023)).[26] The following corollary revisits their insights.

Corollary 2. *Denote* $\widetilde{\boldsymbol{\varphi}}^{RANK}$ *as the optimal policy weight in the counterpart multi-sector RANK model. We have* $\widetilde{\boldsymbol{\varphi}}^{RANK} = \boldsymbol{\varphi}^{RANK}$*, and*

$$\frac{\widetilde{\varphi}_i^{RANK}}{\omega_i} > \frac{\widetilde{\varphi}_j^{RANK}}{\omega_j}$$

if prices are more sticky in sector i $(\phi_i < \phi_j)$*.*

The component $\boldsymbol{\varphi}^{\text{TANK}}$ captures the additional effects on sectoral weight by introducing heterogeneous agents. Corollary 3 clarifies how the introduction of heterogeneous agents strengthens the central bank's incentive to stabilize sectors with stickier prices. Compared to the optimal inflation index in the multi-sector RANK framework, the policy in the TANK setting reflects additional benefits from reducing inequality—since in TANK models, inequality is directly linked to the output gap. This added motive reinforces the weight placed on stabilizing sticky-price sectors in the optimal inflation index.

Corollary 3. *Denote* $\widetilde{\boldsymbol{\varphi}}^{TANK}$ *as the optimal policy weight in the counterpart multi-sector TANK model. We have* $\widetilde{\boldsymbol{\varphi}}^{TANK} = \boldsymbol{\varphi}^{RANK} + \boldsymbol{\varphi}^{TANK}$*, and*

$$\frac{\widetilde{\varphi}_i^{TANK}}{\omega_i} > \frac{\widetilde{\varphi}_j^{RANK}}{\omega_j}$$

[26] This index is often referred to as the "core" CPI. The consumer price index (CPI) uses sectoral consumption shares $\boldsymbol{\omega}^T = (\omega_1, \omega_2, ..., \omega_I)$ as weights for prices.

if prices are more sticky in sector i $(\phi_i < \phi_j)$.

The component $\boldsymbol{\varphi}^{\text{TANK-HT}}$ captures how heterogeneous consumption baskets shape the optimal inflation index by introducing new terms in two policy motives: reducing cross-sector misallocation and mitigating inequality. The misallocation motive arises because differing consumption weights across household types can distort resource allocation across sectors. The inequality motive addresses disparities in the cost of living across different households.

The net effect of $\boldsymbol{\varphi}^{\text{TANK-HT}}$ is theoretically ambiguous, as it depends on the relative strength of these underlying channels. Corollary 5 in Appendix E.7 provides a detailed characterization of the forces that determine its sign and magnitude. In Section 6.3.6, we present a numerical example–revisiting the framework of Benigno (2004)–in which stabilizing flexible-price sectors becomes more desirable.

6.3.5 Discussion: Alternative Model Assumptions

We examine the robustness of our results under alternative model specifications, focusing on steady-state inequality, arbitrary welfare weights, and the role of MPC heterogeneity. Detailed discussions are provided in Appendix E.8.

Steady-state inequality. In our baseline model, the assumption of a revenue subsidy ensures that firms earn zero profits in the steady state, resulting in no steady-state inequality in consumption or labor across households. Introducing steady-state inequality would render the steady state inefficient. As extensively discussed in the New Keynesian literature (e.g., Woodford (2003)), small steady-state distortions can induce inflationary biases and generate time inconsistency, as the central bank may be tempted to exploit the time-0 initial condition to engineer an early expansion.[27] To abstract from these redistribution motives arising outside the steady state, we adopt the timeless perspective. Under this approach, the optimal policy under commitment derived in our baseline model remains valid even in the presence of steady-state inequality between Ricardian and Keynesian households.

Welfare weights. How does optimal monetary policy change when the central bank assigns welfare weights that differ from population weights? In Appendix E.8.1, we show that with arbitrary welfare weights $(\widetilde{\lambda}, 1-\widetilde{\lambda})$, the welfare function takes the form:

$$\widetilde{W}_t = -\frac{1}{2}\Big[\left(\gamma+\sigma^{-1}\right)\widetilde{y}_t^2 \ + \boldsymbol{\pi}_t^T \mathcal{H}^{\text{within}} \boldsymbol{\pi}_t \ + \boldsymbol{\delta}_t^T \mathcal{H}^{\text{across}} \boldsymbol{\delta}_t \ + \ \psi_{wc} \left[\left(c_t^K - c_t^R\right) - \underbrace{\left((1+\sigma^{-1})(\widetilde{\lambda}-\lambda)/\psi_{wc}\right)^{1/2}}_{\text{new target}} \right]^2 \Big] \tag{45}$$

[27] See Woodford (2003), Chapter 6, for a detailed discussion of steady states with small distortions.

This welfare function implies that the central bank now optimally targets a non-zero level of inequality, equal to $\left[(1+\sigma^{-1})(\widetilde{\lambda}-\lambda)/\psi_{wc}\right]^{1/2}$. This objective introduces an inflation bias, implying that the optimal monetary policy under time-0 commitment may differ from our baseline results. However, the optimal commitment policy under the timeless perspective remains unchanged.

MPC heterogeneity. It is important to note that our findings on the monetary transmission mechanism in Sections 4 and 5 rely on the presence of heterogeneity in marginal propensities to consume (MPC). However, the qualitative insights regarding optimal monetary policy extend to more general settings. To illustrate, consider an otherwise identical economy with two types of Ricardian households. Markets remain incomplete, and the two Ricardian types cannot trade financial assets with each other. As in our baseline model, heterogeneity in consumption baskets leads to differential volatility in real wages across households in response to sectoral shocks. We can show that Propositions 3 and 4 continue to hold in this extended setting, as the key intuitions and proof strategies remain unchanged. Importantly, the welfare function and the sectoral Phillips curves underlying the optimal policy do not explicitly depend on MPC heterogeneity. As a result, although the volatility of endogenous variables may differ relative to the baseline model, the structure of the optimal monetary policy remains the same.

6.3.6 Revisiting Benigno (2004) in TANK-HT

We conclude this section by revisiting the classical result regarding optimal monetary policy in Benigno (2004) and provide a numerical example to illustrate the optimal monetary policy in our model. In a two-sector representative-agent model with sticky prices in both sectors, Benigno (2004) shows that monetary policy cannot achieve the socially efficient outcome due to a lack of instruments. While output gap stabilization is no longer optimal, it remains close to optimal.[28] Additionally, he studies the optimal inflation index among the set of inflation-targeting policies and concludes that the central bank should assign a larger weight to the sector with more sticky prices.

In the following example, we revisit this result and demonstrate that stabilizing the aggregate output gap can lead to substantial welfare loss relative to the optimal policy. Consequently, the optimal inflation index should assign a larger weight to the flexible-price sector than in Benigno (2004).

Households allocate consumption between two sectors, denoted as sector 1 and sector 2, with different frequencies of price changes represented by $1-\alpha_1$ and $1-\alpha_2$, respectively. The consumption weights on sector 1 and sector 2 are denoted by ω_1^K and ω_2^K for Keynesian households,

[28] Chapter 4.3 in Woodford (2003) provides a more detailed and comprehensive discussion. The welfare loss from output gap stabilization policy relative to optimal monetary policy is minimal.

and ω_1^R and ω_2^R for Ricardian households.

In the subsequent discussion of this section, we explore three sets of policies: 1) the optimal monetary policy, 2) the policy to completely stabilize the aggregate output gap, and 3) inflation-targeting policies. Among the inflation targeting policies, the central bank chooses an inflation index, denoted as $\pi_t^O = \phi_1\pi_{1,t} + \phi_2\pi_{2,t}$ and satisfying the constraint $\{\phi_1, \phi_2 : \phi_1 + \phi_2 = 1\}$, to maximize the social welfare subject to the following zero-inflation constraint:

$$\phi_1\pi_{1,t} + \phi_2\pi_{2,t} = 0.$$

numerical example. We set $\alpha_1 = 0.75$, $\alpha_2 = 0.85$, $\lambda = 0.5$, and use $\Delta\omega = \omega_1^K - \omega_2^K = \omega_2^R - \omega_1^R$ to measure the degree of heterogeneity in households' consumption baskets.

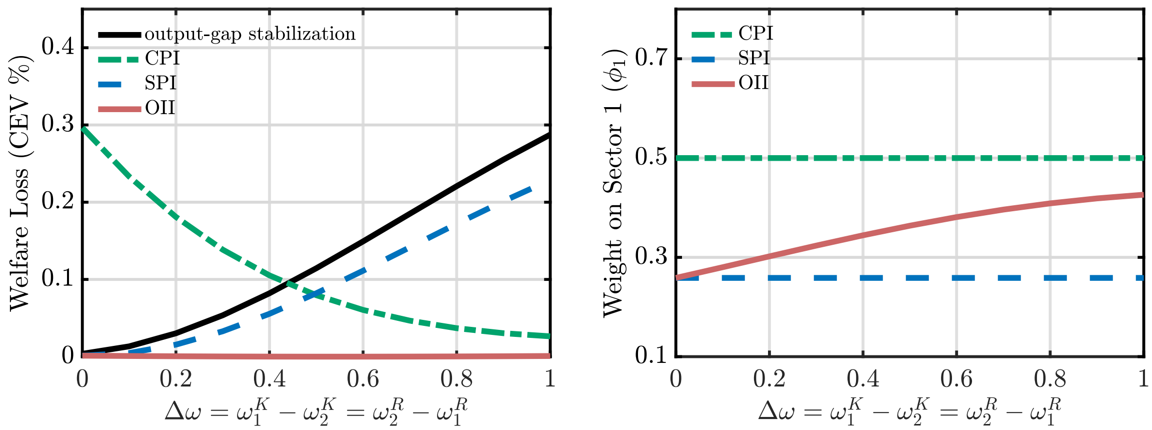
We examine the output-gap stabilization policy along with three sets of inflation targeting policies: stabilizing the Consumer Price Index (CPI), stabilizing the Sticky Price Index (SPI), and stabilizing the Optimal Inflation Index (OII). We intentionally choose a symmetric structure to keep the CPI and SPI unchanged as $\Delta\omega$ varies. For each $\Delta\omega \in [0,1]$, the weight of the CPI is given by $\{0.5, 0.5\}$, and the SPI is obtained by calculating the optimal inflation index, assuming households have the same consumption baskets with weights given by $\{\lambda\omega_1^K + (1-\lambda)\omega_1^R, \lambda\omega_2^K + (1-\lambda)\omega_2^R\}$.[29] The OII is defined as the optimal inflation index with heterogeneous consumption baskets under TANK-HT.

Panel (a) in Figure 6 plots the welfare loss (relative to that of the optimal monetary policy) under different policies. As the difference in expenditure share $\Delta\omega$ increases, the welfare loss of stabilizing the output gap becomes more substantial. This contrasts with RANK and TANK, where output gap stabilization is nearly optimal. Stabilizing the SPI results in a similar magnitude of welfare loss. However, stabilizing OII implements the optimal monetary policy almost perfectly. Interestingly, when $\Delta\omega$ is sufficiently large, stabilizing CPI becomes more desirable than stabilizing the output gap and SPI. For example, when $\Delta\omega = 1$, or the Keynesians only consume goods produced in sector 1, output-gap stabilization leads to welfare loss that is an order of magnitude larger than stabilizing CPI.

Panel (b) in figure 6 illustrates how the weight on the more-flexible-price sector 1, denoted as ϕ_1, varies with the difference in expenditure share, $\Delta\omega$, when the central bank aims to stabilize one of the three inflation indexes. In line with Benigno (2004), the SPI allocates more weight to the sticky-price sector compared to the CPI ($\phi_1^{SPI} < \phi_1^{CPI}$). When $\Delta\omega$ equals zero ($\omega_1^K = \omega_2^K = \omega_2^R = \omega_1^R = 0.5$), the OII and SPI are essentially identical in terms of inflation weights and welfare

[29] It is essentially the optimal price index in TANK with homogeneous consumption baskets, as in Benigno (2004). We refer to it as the sticky price index.

Figure 6: Monetary Policies in TANK-HT



Note: This figure plots the variations in welfare loss (relative to optimal policy) and the weight on the flexible-price sector 1 with the difference in expenditure shares, $\Delta\omega = \omega_1^K - \omega_2^K$, under the output-gap stabilization policy and three different inflation-targeting policies — stabilizing the CPI, stabilizing the optimal inflation index in Benigno (2004) under TANK (SPI), and stabilizing the optimal inflation index under TANK-HT (OII). We set $\gamma = 0.5$ and $\sigma = 3$ to generate reasonable degree of strategic complementarity and slope of Phillips curves, as suggested by the empirical evidence.

losses. However, as Keynsians spend more on goods from the more-flexible-price sector ($\Delta\omega > 0$, with $\omega_1^K > \omega_2^K$ and $\omega_1^R < \omega_2^R$), ϕ_1^{OII} becomes greater than ϕ_1^{SPI} due to a stronger redistributive motive. To reduce inequality, the central bank should assign more weight to the flexible-price sector, disproportionately consumed by the Keynesians, to stabilize its inflation.

Furthermore, ϕ_1^{OII} increases with $\Delta\omega$. This is because, as the degree of heterogeneity in consumption baskets increases, the difference in price flexibility faced by different households becomes larger. Consequently, the inequality in consumption and labor supply, driven by heterogeneous price indexes, also increases. Therefore, the central bank places greater weight on stabilizing inflation in the flexible-price sector to mitigate inequality.

In Appendix E.9, we demonstrate that our results are not driven by the assumption of heterogeneous agents, but by the assumption of heterogeneous consumption baskets of K and R agents.

7 Conclusion

This paper documents the existence of cyclical inequality in the cost of living, as well as a negative relationship between households' marginal propensity to consume (MPC) and the price stickiness of goods they consume. We argue that this negative relationship is essential for understanding the monetary transmission mechanism and optimal monetary policy in HANK.

Our framework intentionally abstracts from (the cyclicality of) idiosyncratic risks faced by households when studying the monetary transmission mechanism. This deliberate simplification is motivated by our focus on the redistribution channel, and the Two-Agent framework is chosen for its parsimony and tractability in examining this specific channel. It's worth noting that our results can potentially be extended to models with idiosyncratic risks (e.g., Werning (2015) and Acharya and Dogra (2020)), as these models often rely on the cyclicality of real spending. However, we leave the exploration of this extension to future research.

Our analysis underscores the importance of accounting for cyclical inequality in the cost of living when central banks conduct monetary policy. First, ignoring this statistic may lead to overestimating the effectiveness of monetary policy. Second, this statistic can also serve as a measure for assessing the degree of inefficiency inherent in the flexible-price equilibrium.

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Supplementary Appendix

Cyclical Inequality in the Cost of Living and

Implications for Monetary Policy

Ting Lan   Lerong Li   Minghao Li

A Data Appendix

A.1 Constructing Group-Specific CPIs

A.1.1 Consumer Expenditure Survey

The Consumer Expenditure Survey (CEX), conducted by the U.S. Census Bureau, is the major source of constructing the weights for the U.S. Consumer Price Index, due to its extensive information on households' expenditures.

The CEX contains two modules, the Diary and the Interview. The Diary is designed to measure households' non-durable consumption and services, such as groceries and other frequent purchases. So it is surveyed weekly and therefore contains weekly expenditures. The Interview is designed to measure households' durable consumptions, such as vehicles and other large infrequent purchases. It records expenditures over the previous three months. The Diary and Interview modules together collect households' expenditures on approximately 600 Universal Classification Code (UCC) categories, 250 UCCs in the Diary module and 350 UCCs in the Interview module.

The Diary and Interview modules survey different households, so it is impossible to observe the full consumption baskets of an individual household. We instead split households into different groups and compute the group-specific expenditure shares across consumption categories, as we do next.

A.1.2 Constructing group-specific expenditure weights

The CEX also contains information on households' tenure status. To construct CPIs for households with different housing tenure status (or MPCs), we first combine the information on housing tenure with the Diary and Interview Survey to obtain the group-specific expenditure weights.

However, the item-level prices to construct the CPI are provided by the BLS using a different classification system, with 8 major groups, 70 expenditure classes, 211 item strata (item level), and 303 entry-level items (ELI). Hence, before constructing the expenditure weights across consumption categories, we follow Cravino et al. (2020) to build a concordance between UCC categories, item strata, and ELIs. The concordance between UCCs and item strata is used to compute the group-specific CPIs. The concordance between UCCs and ELIs is used to compute the group-specific average frequency of price adjustment.

Armed with the concordance, we are able to compute the group-specific expenditure weights. To do so, we follow closely the procedure in the BLS document "*CPI requirements for CE*". In particular, we first make adjustments on housing, medical care and transportation, to meet BLS's requirements for constructing CPI expenditure weights. We then follow the BLS manual to calculate the annualized average expenditure for each UCC category for high- and low-MPC households respectively, denoted by $X^h_{i,t}$, where i is UCC category and h is the household type.

We then aggregate the expenditures to the item strata and ELI level using the concordance above, denoted by $X^h_{j,t}$. The corresponding expenditure weights are given by $\omega^h_{j,t} = \frac{X^h_{j,t}}{\sum_j X^h_{j,t}}$.

A.1.3 Constructing group-specific CPIs

The BLS releases item-level consumer price data every month. Among their releases. We use the seasonally adjusted data for all urban consumers. We follow the formula from the BLS manual "*Chapter 17. The Consumer Price Index*" to construct the group-specific CPIs:

$$PIX^h_t = PIX^h_v \cdot \sum_j (\omega^h_{j,\phi} \times \frac{P_{j,t}}{P_{j,t}}),$$

where PIX^h_t is the CPI for household type h in month t, v is the pivot year and month (usually December), α is the expenditure weight reference period determined by the BLS, $P_{j,t}$ is the price of item j at month t and $\omega^h_{j,\phi}$ is the expenditure weight of household type h for item j during the expenditure weight reference period ϕ.

B Additional Empirical Results

B.1 Estimating Marginal Propensities to Consume (MPC)

We estimate marginal propensities to consume (MPCs) for households with different housing tenure statuses by leveraging the panel structure of the PSID and the detailed consumption information from the CEX. Our estimation strategy follows the approach originally developed by Gruber (1994) and extended by Patterson (2023), which identifies MPCs by examining consumption responses to income shocks, particularly unemployment. Specifically, the MPC is estimated by measuring the decline in consumption following a job loss. The estimation equation is specified as follows:

$$\Delta C_{i,t} = \sum_{x} (\beta_x \Delta E_{i,t} \times x_{i,t-1} + \alpha_x x_{i,t-1}) + \gamma_{state,t} + \epsilon_{i,t} \tag{B.1}$$

where $C_{i,t}$ denotes the total household consumption of individual i at time t, imputed from the CEX.[30] $E_{i,t}$ represents the labor income of household i,[31] $\gamma_{state,t}$ denotes state-by-year fixed effects, and $x_{i,t-1}$ indicates the housing-tenure status of the household in the previous period. Time t is measured in two-year intervals, reflecting the biennial survey structure of the PSID beginning in 1997.

The MPC of households with housing tenure status $x_{i,t}$ is then estimated as the coefficient on the interaction between income shocks and housing tenure in the following specification:

$$\widehat{MPC_{i,t}} = \sum_{x} \hat{\beta}_x x_{i,t} \tag{B.2}$$

Given that many factors can simultaneously affect both income and consumption, we instrument changes in household income $\Delta \log E_{i,t}$ with an exogenous income shock $\mu_{i,t-1}$ to identify the causal effect of income on consumption. Specifically, we follow the literature in using unemployment as the primary income shock. To ensure data quality and reduce the influence of outliers, we exclude PSID observations where food consumption or income changes by more than 400 percent over any two-year period.

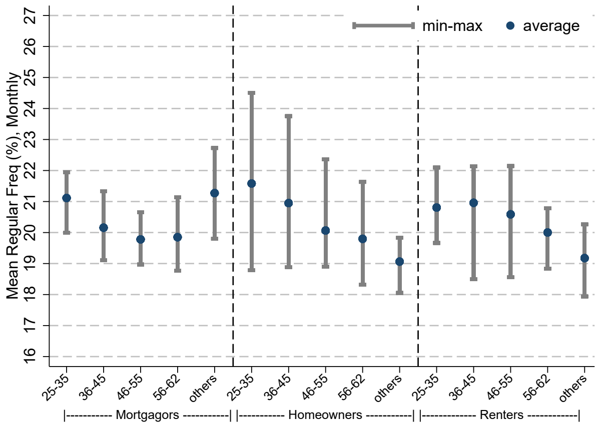
B.2 Price Stickiness by Demographics Conditional on Housing Tenure Status

We further split the sample by demographic characteristics, conditional on housing tenure. Figure B.1 reports the average frequency of price changes by age, education level, and income. Conditional on housing tenure, households of different income levels display little variation in price stickiness, whereas some heterogeneity remains across age and education groups. Since the key moment for our analysis is the correlation between MPCs and price stickiness—regardless of which demographic characteristic best proxies for MPCs—we focus on housing tenure as a particularly suitable proxy, following Cloyne et al. (2020) and supported by our estimates in Section 2.2.

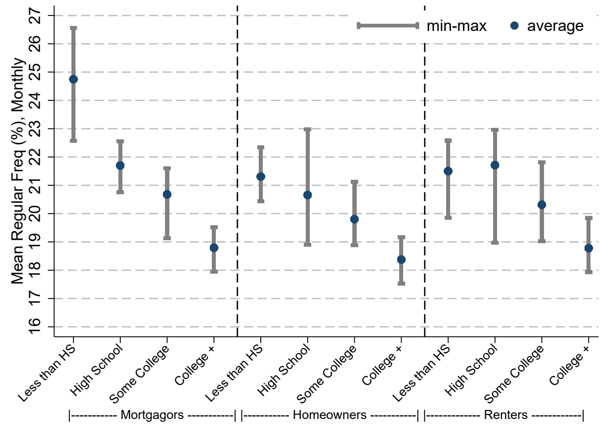
[30] The PSID records food expenditure but lacks comprehensive measures of total consumption. We therefore impute total expenditure by combining the PSID with the CEX, using overlapping information on food spending and household demographics, following Blundell et al. (2008) and Guvenen and Smith (2014).

[31] We use the term household for convenience, and the MPC estimation is carried out at the individual level.

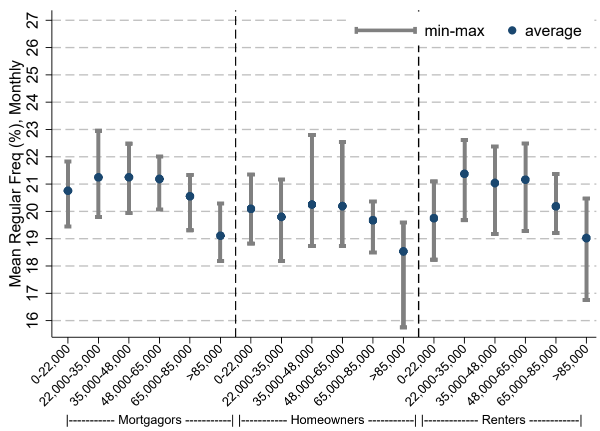
Figure B.1: Price Stickiness by Demographics Conditional on Housing Tenure Status



(a) Age



(b) Education



(c) Income

Note: Panels (a), (b), and (c) plot the average frequency of price changes by household age, education, and income, respectively, conditional on housing tenure status. The average frequency of price changes for each household is calculated at the annual level. The gray bars indicate the minimum and maximum of these annual averages, while the blue dots represent the mean across years. The underlying sample of households may vary slightly across panels, as some households might not report all of these demographic characteristics.

B.3 Robustness Checks on Impulse Responses of Prices to Monetary Policy Shocks

We conduct two robustness checks on the impulse responses of prices to monetary policy shocks: (1) we examine alternative lag specifications in the local projection framework; and (2) we re-estimate the impulse responses using the Romer and Romer (2004) measure of monetary policy shock series, extended by Coibion et al. (2017), as well as the high-frequency monetary surprises identified by Bauer and Swanson (2023).

Figure B.2 presents the impulse responses of low-MPC household inflation and inflation differentials between high- and low-MPC households using Bu et al. (2021) measure of monetary policy shocks estimated under alternative lag specifications. Panels (a) and (b) include 36 lags of the shock variable ($I = 36$) and 12 lags of monthly household-specific inflation ($J = 12$). Panels (c) and (d) extend the specification to ($I = 48$) and ($J = 24$). The estimated impulse responses remain robust across these alternative lag structures. Following an expansionary monetary policy shock, the price index for low-MPC households rises, and the price index for high-MPC households exhibits an even stronger response. The inflation differential peaks around 24 months after the shocks and gradually faded thereafter.

Figure B.3 presents the impulse responses of prices to the monetary policy shocks constructed by Romer and Romer (2004), estimated using the baseline specification in Equation 4 over the sample period 1969m1 to 2007m12.[32] The estimated price responses, as well as the differences in responses across household types, are smaller using the Romer and Romer (2004) shock measure. The change in (log) CPI for low-MPC households increases by approximately 2 percentage points 36 months after a 100-basis-point expansionary monetary shock. The corresponding difference between high- and low-MPC households reaches about 0.2 percentage points after 36 months, indicating that prices faced by high-MPC households respond about 10% more than those faced by low-MPC households.

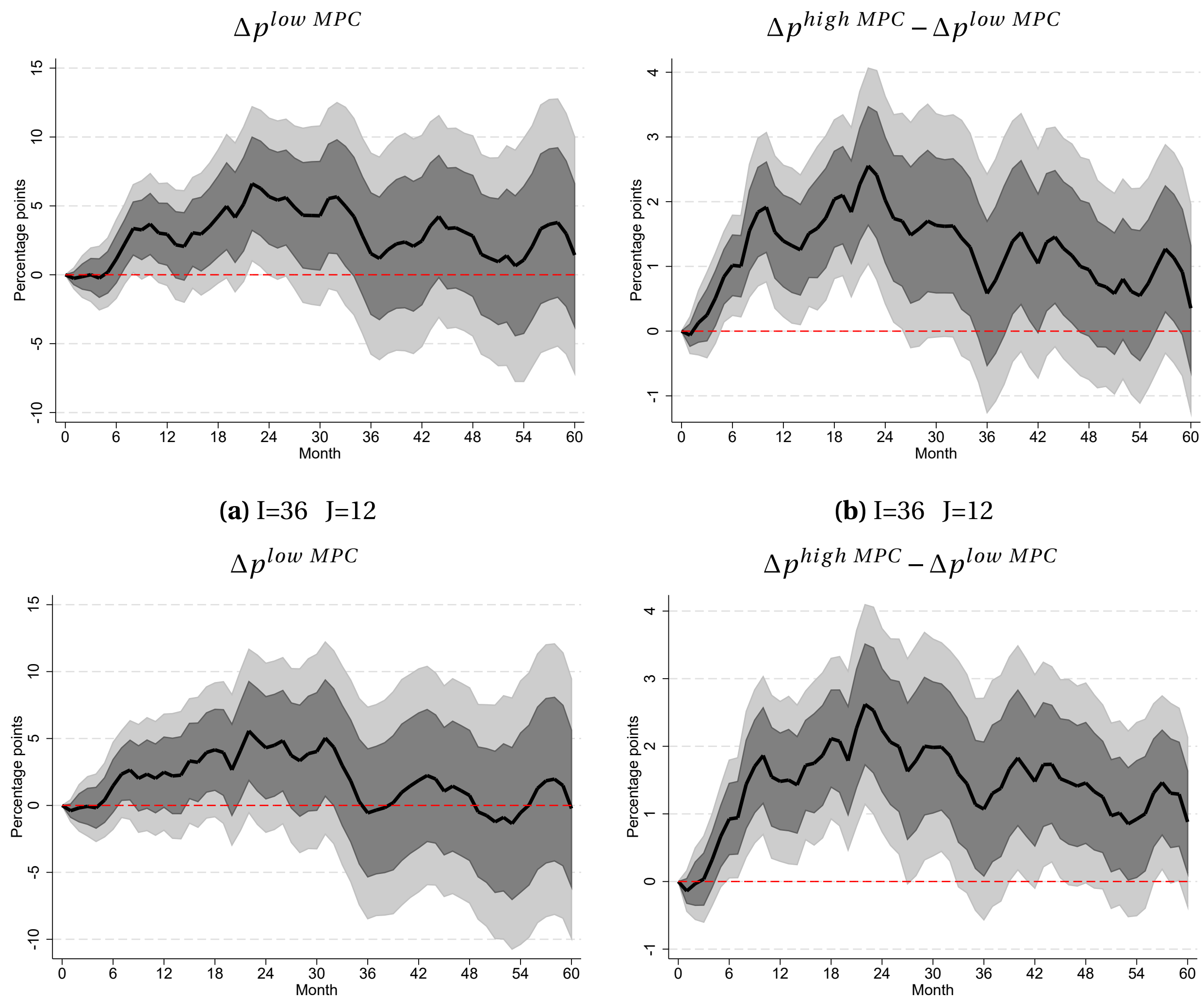
Alternatively, Figure B.4 reports the impulse responses of prices to the high-frequency monetary policy shocks identified by Jarociński and Karadi (2020), estimated using the same specification over the sample period 1990m2-2023m12. The estimated price responses and the differences across household types display similar patterns to those obtained using the Romer and Romer (2004) shock series, although they are estimated with somewhat lower precision. Following a 100-basis-point expansionary shock, the change in (log) CPI for low-MPC households increases by about 1 percentage point after 36 months. The difference in change in (log) CPI between high- and low-MPC households reaches roughly 0.5 percentage points, indicating that prices faced by high-MPC households rise about 50 percent more than those faced by low-MPC households. Overall, these results remain robust when alternative measures of monetary policy shocks are used, suggesting that expansionary monetary policy consistently leads to higher prices for all households, with more pronounced effects among those with higher MPCs.

B.4 Volatility of Group-specific Inflation Rates

The left panel in Figure B.5 plots the annual inflation of group-specific CPIs. As illustrated in the figure, the annual inflation is more volatile for households with high MPCs. We next compute

[32] Given that U.S. monetary policy was constrained by the zero lower bound from 2008 to 2015, our sample ends in 2007m12 when using the narrative monetary policy shock series from Romer and Romer (2004).

Figure B.2: Inflation Responses to Monetary Policy Shocks: Alternative Lag Structures



(a) I=36 J=12

(b) I=36 J=12

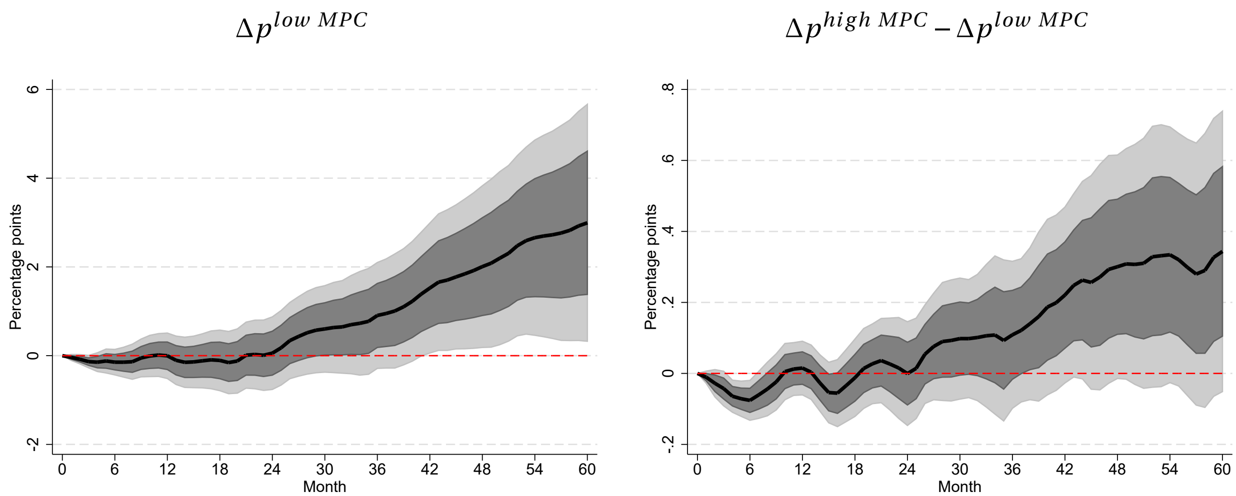
(c) I=48 J=24

(d) I=48 J=24

Note: The panel charts display the impulse response functions (IRFs) to a 100-basis-point negative interest rate shock under alternative lag specifications, with the dark and light gray shaded regions indicating the 1- and 1.65-standard-deviation confidence intervals, respectively. Panels (a) and (b) include 36 lags of the shock variable ($I = 36$) and 12 lags of monthly household-specific inflation ($J = 12$). Panels (c) and (d) extend the specification to ($I = 48$) and ($J = 24$). The left panels plot the IRFs of changes in the log CPI (inflation) for low-MPC households, while the right panels show the difference in inflation responses between high- and low-MPC households.

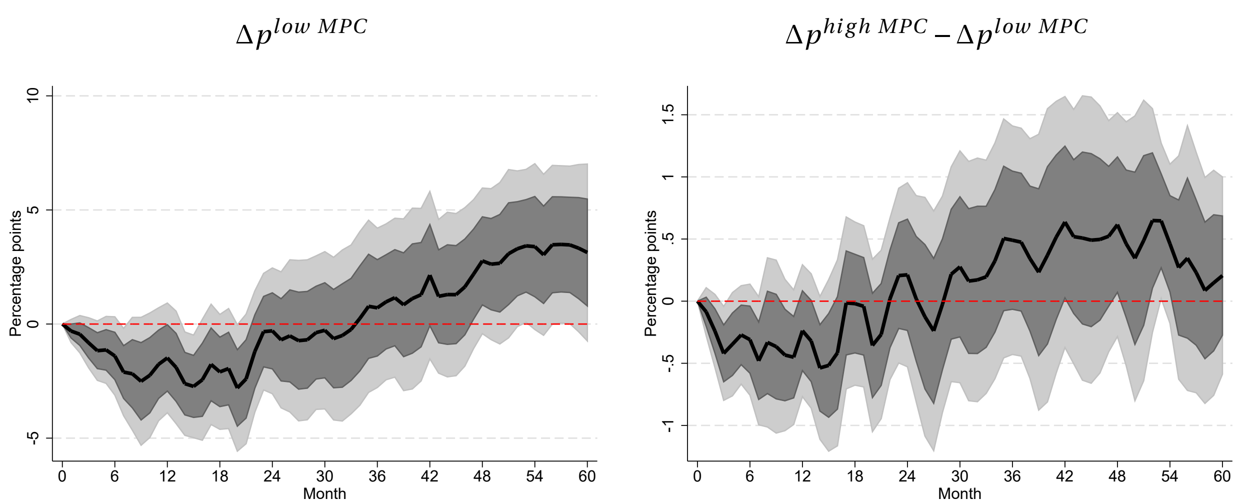
the annual standard deviation of monthly inflation. The right panel in Figure B.5 plots this standard deviation of monthly inflation. The volatility of high-MPC households is greater than that of low-MPC households in every year. On average, the standard deviation of annualized monthly inflation is 0.464% for high-MPC households, 9% greater than that of low-MPC households, whose is 0.426%.

Figure B.3: Inflation Responses to Monetary Policy Shocks: Romer and Romer Measure of Monetary Policy Shocks



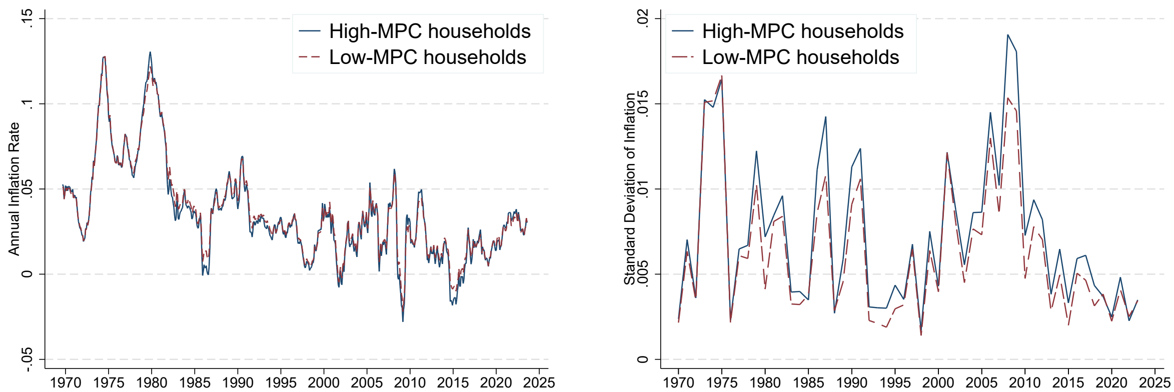
Note: The panel charts display the impulse response functions (IRFs) to a 100-basis-point negative monetary policy shock, with the dark and light gray shaded regions indicating the 1- and 1.65-standard-deviation confidence intervals, using the monetary policy measure from Romer and Romer (2004). The left panel displays the IRFs of changes in the log CPI (inflation) for low-MPC households, while the right panel depicts the differential inflation responses between high- and low-MPC households. The specification includes 36 lags of the shock variable ($I = 36$) and 24 lags of monthly household-specific inflation ($J = 24$).

Figure B.4: Inflation Responses to Monetary Policy Shocks: High-frequency Monetary Policy Shocks



Note: The panel charts display the impulse response functions (IRFs) of the log CPI to a 100-basis-point negative high-frequency monetary policy shock identified by Jarociński and Karadi (2020), with the dark and light gray shaded regions indicating the 1- and 1.65-standard-deviation confidence intervals, respectively. The left panel displays the IRFs of changes in the log CPI (inflation) for low-MPC households, while the right panel depicts the differential inflation responses between high- and low-MPC households. The specification includes 36 lags of the shock variable ($I = 36$) and 24 lags of monthly household-specific inflation ($J = 24$).

Figure B.5: Group-specific Inflation and Inflation Volatility



C Appendix for Section 3

C.1 Steady state

We use variables with an upper bar to denote steady-state variables. Under a zero inflation steady state, there are no price changes, and prices are constant. Firm j in sector i sets price:

$$\begin{aligned}\overline{P}_i(j) &= \frac{\theta}{\theta-1}\frac{1}{1+\tau}\overline{W} \\ &= \overline{W}\end{aligned}$$

where $\tau = \frac{1}{\theta-1}$. The government imposes lump-sum taxes on profits to provide a subsidy. The equilibrium profits are zero. Thus we have $\overline{W} = \overline{P}^K = \overline{P}^R$. Combining first order condition $\frac{\overline{W}}{\overline{P}^h} = (\overline{C}^h)^{\sigma^{-1}}(\overline{N}^h)^{\gamma}$and households' budget constraint $\overline{W}\overline{N}^h = \overline{P}^h\overline{C}^h$ yields:

$$\overline{C} = \overline{C}^K = \overline{C}^R = 1, \overline{N}^K = \overline{N}^R = 1.$$

Where $\overline{C}^K$ and $\overline{C}^R$ are consumption per capita. We also notice that, this is the only steady state equilibrium where profits are zero, and the amount of subsidies equals the lump-sum taxes on profits.

C.2 Deriving the Sectoral Phillips Curve

The optimal price set by firms in sector i is given by

$$p^*_{i,t} = (1-\alpha_i\beta)mc_{i,t} + \alpha_i\beta\mathbb{E}_t p^*_{i,t+1}$$

where $mc_{i,t} = w_t - a_{i,t}$ denotes the nominal marginal cost for firms in sector i. Subtracting $p_{i,t-1}$ from both sides and substituting the following expression

$$\pi_{i,t} = (1-\alpha_i)(p^*_{i,t} - p_{i,t-1})$$

into the equation above, we have

$$\frac{\pi_{it}}{1-\alpha_i} = (1-\alpha_i\beta)mc_{i,t} + \frac{\alpha_i\beta}{1-\alpha_i}\mathbb{E}_t\pi_{i,t+1} + \alpha_i\beta\pi_{it} + (\alpha_i\beta - 1)p_{i,t-1},$$

which can be further simplified to

$$\pi_{i,t} = \frac{(1-\alpha_i)(1-\alpha_i\beta)}{1-(1-\alpha_i)\alpha_i\beta}\left(mc_{i,t} - p_{i,t-1}\right) + \frac{\alpha_i\beta}{1-(1-\alpha_i)\alpha_i\beta}\mathbb{E}_t\pi_{i,t+1}$$

Let

$$\phi_i = \frac{(1-\alpha_i)(1-\alpha_i\beta)}{1-(1-\alpha_i)\alpha_i\beta}$$

The Phillips curve in sector i can be written as

$$\pi_{i,t} = \phi_i(mc_{i,t} - p_{i,t-1}) + (1-\phi_i)\beta\mathbb{E}_t\pi_{i,t+1} \tag{C.1}$$

In vector form,

$$\boldsymbol{\pi}_t = \Phi(\boldsymbol{mc}_t - \boldsymbol{p}_{t-1}) + \beta(I-\Phi)\mathbb{E}_t\boldsymbol{\pi}_{t+1} \tag{C.2}$$

where $\boldsymbol{\pi}_t = (\pi_{1,t}, \pi_{2,t}, ..., \pi_{I,t})'$, $\Phi = \text{diag}(\phi_1, \phi_2, ..., \phi_I)$. The marginal cost vector $\boldsymbol{mc})_t$ is given by

$$\boldsymbol{mc}_t = \mathbf{1}w_t - \boldsymbol{a}_t,$$

where $\mathbf{1} = (1, 1, ..., 1)'$ is the unit vector. Recall that the real wage is determined by equating the aggregate labor supply equation and the labor demand equation,

$$w_t - \boldsymbol{\omega}^T\boldsymbol{p}_t = (\sigma^{-1} + \gamma)\tilde{y}_t + \boldsymbol{\omega}^T\boldsymbol{a}_t,$$

where $\boldsymbol{\omega} = (\omega_1, \omega_2, ..., \omega_I)$ and $\omega_i = \lambda\omega_i^K + (1-\lambda)\omega_i^R$, so that $\boldsymbol{\omega}^T\boldsymbol{p}_t$ represents the CPI price index. Here $\tilde{y}_t^n = y_t - y_t^n$ represents the output gap and y_t^n is the natural rate of output,

$$y_t^n = \frac{\gamma+1}{\gamma+\sigma^{-1}}\boldsymbol{\omega}^T\boldsymbol{a}_t$$

We then obtain the following expression,

$$(I-\Phi\mathbf{1}\boldsymbol{\omega}^T)\boldsymbol{\pi}_t=\Phi\left[(\sigma^{-1}+\gamma)\mathbf{1}\tilde{y}_t+(\mathbf{1}\boldsymbol{\omega}^T-I)(\boldsymbol{p}_{t-1}+\boldsymbol{a}_t)\right]+\beta(I-\Phi)\mathbb{E}_t\boldsymbol{\pi}_{t+1} \tag{C.3}$$

Applying the Woodbury matrix identity

$$(I-\Phi\mathbf{1}\boldsymbol{\omega}^T)^{-1}=I+\frac{\Phi\mathbf{1}\boldsymbol{\omega}^T}{1-\boldsymbol{\omega}^T\Phi\mathbf{1}},$$

and multiplying to both sides of equation (C.3), we finally obtain the sectoral Phillips curve

$$\boldsymbol{\pi}_t=(\sigma^{-1}+\gamma)\mathcal{K}\tilde{y}_t-\mathcal{J}(\boldsymbol{a}_t+\boldsymbol{p}_{t-1})+\beta(I-\mathcal{J})\mathbb{E}_t\boldsymbol{\pi}_{t+1}$$

where

$$\mathcal{K}=\frac{\Phi\mathbf{1}}{1-\boldsymbol{\omega}^T\Phi\mathbf{1}}$$
$$\mathcal{J}=\Phi-\mathcal{K}\omega^T(I-\Phi)$$

C.3 Log-linearized Equilibrium Conditions

Since steady-state profits are zero, before listing all the log-linearized equations, we use $d_t=\ln(d_t/C)$ to denote firms' total profits. We now collect all linearized equilibrium conditions.

Euler equation:

$$c_t^R=\mathbb{E}_t c_{t+1}^R-\sigma r_t \tag{C.4}$$

Labor supply:

$$\gamma n_t^K=w_t-p_t^K-\sigma^{-1}c_t^K \tag{C.5}$$
$$\gamma n_t^R=w_t-p_t^R-\sigma^{-1}c_t^R \tag{C.6}$$

where

$$p_t^K=\boldsymbol{\omega}_K^T\boldsymbol{p}_t;\;\; p_t^R=\boldsymbol{\omega}_R^T\boldsymbol{p}_t$$

Labor demand:

$$n_t=\lambda y_t^K+(1-\lambda)y_t^R$$

Labor market clearing condition:

$$\lambda n_t^K+(1-\lambda)n_t^R=n_t$$

Goods market-clearing condition:

$$c_t^K=y_t^K;\; c_t^R=y_t^R$$

Keynesian households' budget constraint:

$$p_t^K + c_t^K = w_t + n_t^K + \frac{\tau_d d_t}{\lambda}$$

Sectoral Phillips curves:

$$\boldsymbol{\pi}_t = (\sigma^{-1} + \gamma)\mathcal{K}\widetilde{y}_t - \mathcal{J}(\boldsymbol{a}_t + \boldsymbol{p}_{t-1}) + \beta(I - \mathcal{J})\mathbb{E}_t\boldsymbol{\pi}_{t+1} \tag{C.7}$$

where

$$\mathcal{K} = \frac{\Phi\mathbf{1}}{1 - \boldsymbol{\omega}^T\Phi\mathbf{1}}$$
$$\mathcal{J} = \Phi - \mathcal{K}\omega^T(I - \Phi)$$

Law of motion of inflation rates:

$$\boldsymbol{\pi}_t = \boldsymbol{p}_t - \boldsymbol{p}_{t-1} \tag{C.8}$$

Fisher equation:

$$r_t = i_t - \mathbb{E}_t\pi_t^R$$

where

$$\pi_t^R = \boldsymbol{\omega}_R^T\boldsymbol{\pi}_t$$

Monetary policy rule:

$$i_t = \phi_\pi\pi_t + v_t$$

C.4 Equilibrium determinacy

The following lemma provides sufficient and necessary conditions under which the equilibrium exists and is locally unique. Without loss of generality, we assume that the sectoral shocks are independent across sectors and follow AR(1) processes: $\boldsymbol{a}_t = \mathcal{A}\boldsymbol{a}_{t-1} + \boldsymbol{\zeta}_{a,t}$.

Lemma 4. (determinacy) *Given any set of parameters, to first order, there exists a locally unique equilibrium if and only if the number of eigenvalues of $F^{-1}G$ outside of the unit circle is equal to $I+1$, where*

$$F = \begin{bmatrix} 1 & -\frac{1+\gamma}{\gamma+\sigma^{-1}}\lambda(\boldsymbol{\omega}_R^T - \boldsymbol{\omega}_K^T) & 0 & 0 & \frac{1-\lambda}{1-\lambda\chi_y}\sigma \\ 0 & \beta(I-\Phi) & 0 & I - \gamma\mathbf{1}\boldsymbol{\omega}^T & 0 \\ 0 & 0 & I & 0 & 0 \\ 0 & 0 & 0 & I & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \tag{C.9}$$

$$G = \begin{bmatrix} 1 & \frac{1-\lambda}{1-\lambda\chi_y}\sigma[\phi_\pi \boldsymbol{\omega}^T - \boldsymbol{\omega}_R^T] & 0 & 0 & 0 \\ -(\gamma+\sigma^{-1})\boldsymbol{\Phi 1} & I - \Phi \mathbf{1}\boldsymbol{\omega}^T & \mathbf{1}\boldsymbol{\omega}^T - I & 0 & 0 \\ 0 & I & I & 0 & 0 \\ 0 & 0 & 0 & I & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \tag{C.10}$$

Proof. The Sectoral Phillips curves, the law of motion of sectoral inflation rates (C.8), the law of motion of exogenous shocks, along with the aggregate IS curve, pin down the dynamics of the economy.[33] We can rearrange these equations into the VAR(1) representation:

$$F \begin{bmatrix} \mathbb{E}_t y_{t+1} \\ \mathbb{E}_t \boldsymbol{\pi}_{t+1} \\ \boldsymbol{p}_t \\ \boldsymbol{a}_t \\ v_t \end{bmatrix} = G \begin{bmatrix} y_t \\ \boldsymbol{\pi}_t \\ \boldsymbol{p}_{t-1} \\ \boldsymbol{a}_{t-1} \\ v_t \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 0 \\ \boldsymbol{\zeta}_t^a \\ \zeta_t^v \end{bmatrix}$$

where F is given by (C.9) and G is given by (C.10). As matrix F is upper-triangular and the diagonal elements are all non-zero, it is invertible. We thus obtain a first-order system of difference equations:

$$\begin{bmatrix} \mathbb{E}_t y_{t+1} \\ \mathbb{E}_t \boldsymbol{\pi}_{t+1} \\ \boldsymbol{p}_t \\ \boldsymbol{a}_t \\ v_t \end{bmatrix} = F^{-1} G \begin{bmatrix} y_t \\ \boldsymbol{\pi}_t \\ \boldsymbol{p}_{t-1} \\ \boldsymbol{a}_{t-1} \\ v_t \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 0 \\ \boldsymbol{\zeta}_t^a \\ \zeta_t^v \end{bmatrix}$$

In the system of equations, there are a number of $I+1$ jump variables $\{\boldsymbol{\pi}_t, y_t\}$ and a number of $2I+1$ pre-determined variables $\boldsymbol{p}_t, \boldsymbol{a}_t, v_t$. According to the Blanchard-Kahn condition (Blanchard and Kahn (1980)), the system has a unique stable solution if and only if the number of eigenvalues of $F^{-1}G$ outside of the unit circle is equal to $I+1$.

□

[33] Here we use a different version of the Phillips curve. We substitute the expression of the output gap $\tilde{y}_t$ into (C.7) to obtain a Phillips curve with y_t.

D Appendix for Section 4

D.1 Proof of Proposition 1

Replacing (19) into K's consumption function $c_t^K = y_t^K$ and (20) into R's consumption function (21), and aggregating these consumption functions across all households, yields the following lemma.

Lemma 5. *The aggregate consumption functions at period t in RANK, TANK, and TANK-HT are:*

$$\begin{aligned}
&\textit{RANK}: && c_t^{RANK} = (1-\beta)y_t - \beta\sigma r_t + \beta\mathbb{E}_t c_{t+1}, && \text{(D.1)}\\
&\textit{TANK}: && c_t^{TANK} = \left[1-\beta(1-\lambda\chi_y)\right] y_t - (1-\lambda)\beta\sigma r_t + \beta(1-\lambda\chi_y)\mathbb{E}_t c_{t+1}, && \text{(D.2)}\\
&\textit{TANK-HT}: && c_t^{TANK-HT} = \left[1-\beta(1-\lambda\chi_y)\right] y_t - (1-\lambda)\beta\sigma r_t + \beta(1-\lambda\chi_y)\mathbb{E}_t c_{t+1} && \text{(D.3)}\\
& && \qquad - \beta\chi_p(1-\lambda)\mathbb{E}_t(\pi_{t+1}^R - \pi_{t+1}^K).
\end{aligned}$$

Since in equilibrium the aggregate consumption c_t in equation (D.3) is equal to the aggregate income y_t, we obtain the aggregate Euler equation in TANK-HT:

$$c_t = \mathbb{E}_t c_{t+1} - \frac{1-\lambda}{1-\lambda\chi_y}\sigma r_t - \frac{1-\lambda}{1-\lambda\chi_y}\chi_p(\mathbb{E}_t\pi_{t+1}^R - \mathbb{E}_t\pi_{t+1}^K), \tag{D.4}$$

Iterating equation (D.4) forward, we prove Proposition 1.

D.2 Aggregate MPC Decomposition in Partial Equilibrium

To begin with, consider an economy with heterogeneous agents in partial equilibrium, where the aggregate real output is exogenously increased by $\mathrm{d}Y$, and prices are adjusted infrequently in response to this shock. The aggregate MPC of this economy can be decomposed into three distinct terms:

$$MPC = \sum_i \frac{\mathrm{d}(MPC_i E_i/P_i)}{\mathrm{d}Y} = \sum_i \underbrace{\left(MPC_i \frac{1}{P_i}\frac{\mathrm{d}E_i}{\mathrm{d}Y}\right)}_{\text{Agg. MPC with prices fixed}} - \underbrace{\frac{\mathrm{d}\log P}{\mathrm{d}\log Y}}_{\text{Agg. inflation}} - \underbrace{\mathrm{Cov}\left(MPC_i, \frac{E_i}{P_i Y}\frac{\mathrm{d}\log P_i}{\mathrm{d}\log Y}\right)}_{\text{Covariance}},$$

where E_i is household i's nominal expenditure, P_i is the household-specific price index. In this decomposition, the first term is the aggregate MPC if prices are fixed at their pre-shock value. The second term captures the negative effect of aggregate inflation on aggregate MPC if nominal expenditure E_i remains unchanged. This term equals zero if prices are perfectly sticky. The sum of the first two terms equals the aggregate MPC in the corresponding TANK model with homogeneous consumption baskets. The last term captures the covariance between households' MPC and the inflation response of the household-specific price index. This term arises from heterogeneity in price stickiness across households with different MPCs.

While it is generally difficult to extend this analytical result to general equilibrium, thanks to our tractable framework, in the main text, we show that in general equilibrium the effect of the covariance term on the aggregate consumption is simply summarized by the inflation of the relative price faced by the Keynesian households, expressed as $p_t^K - p_t^R$.

D.3 Transmission Mechanism: An Illustrative Example

In this section, we illustrate the core mechanism of the model through a simple example. To make the channels transparent, we adopt two simplifying assumptions: 1) the number of sectors, denoted by I, is set equal to 2, and 2) Ricardian and Keynesian households consume entirely disjoint sets of goods. Without loss of generality, we assume that Keynesian households consume only the composite good produced in sector 1, while Ricardian households consume only that produced in sector 2—that is, $\omega_1^R = \omega_2^K = 0$ and $\omega_2^R = \omega_1^K = 1$. With slight abuse of notation, we refer to these composite goods as the "K good" and the "R good," respectively.

The model is essentially a two-sector TANK model with heterogeneous consumption baskets, which we call T-TANK. We intentionally keep the model simple to isolate the emphasized channel, and this simplification allows us to obtain sharp analytical results.

D.3.1 Connecting Price Responses to Price Stickiness

Proposition 1 implies that the cyclical inequality in the cost of living $p_t^K - p_t^R$ is informative on the efficacy of monetary policy. However, $p_t^K - p_t^R$ is observable only after a policy is implemented, which poses challenges for policy-making. The following lemma establishes the relationship between sectoral price responses and sectoral price stickiness, which are perfectly observable and can be measured by the frequency of price adjustment $\{1-\alpha_i\}_{i=K,R}$.

Lemma 6. *Suppose the following condition holds:*

$$\lambda\kappa_R + (1-\lambda)\kappa_K + \chi_p(\kappa_R - \kappa_K)\frac{1-\lambda}{1-\lambda\chi_y} > 0, \tag{D.5}$$

where $\kappa_i = (1-\alpha_i)(1-\alpha_i\beta)/\alpha_i$ is the slope of the Phillips curve in sector i. Consider a sequence of unexpected interest rate changes $\{r_s\}_{s=t}^{\infty}$, such that $\phi_t = \mathbb{E}_t \sum_{s=t}^{\infty} r_s$ is bounded. The following result holds,

$$(\alpha_R - \alpha_K)(p_t^K - p_t^R)\phi_t < 0. \tag{D.6}$$

Proof. Combining the sectoral Phillips curves

$$\beta \mathbb{E}_t \pi^R_{t+1} = \pi^R_t - \kappa_R[\lambda p^r_t + (\gamma + \sigma^{-1})c_t],$$
$$\beta \mathbb{E}_t \pi^K_{t+1} = \pi^K_t - \kappa_K[-(1-\lambda) p^r_t + (\gamma + \sigma^{-1})c_t],$$

where $p^r_t = p^r_{t-1} + \pi^K_t - \pi^R_t$, and the expression for aggregate consumption (24) delivers

$$p^r_{t+1} - \left[\lambda\kappa_R + (1-\lambda)\kappa_K + \chi_p(\kappa_R - \kappa_K)\frac{1-\lambda}{1-\lambda\chi_y} + 2\right] p^r_t + p^r_{t-1} = z_t, \tag{D.7}$$

where

$$z_t = (\kappa_R - \kappa_K)(\gamma\sigma + 1)\frac{1-\lambda}{1-\lambda\chi_y}\mathbb{E}_t \sum_{s=0}^{\infty} r_{t+s}.$$

The corresponding characteristic function is

$$g(x) = x^2 - \left[\lambda\kappa_R + (1-\lambda)\kappa_K + (\kappa_R - \kappa_K)\chi_p\frac{1-\lambda}{1-\lambda\chi_y} + 2\right] x + 1 = 0$$

Denote the two roots of the characteristic function as x_1 and x_2. Denote $A = \lambda\kappa_R + (1-\lambda)\kappa_K + (\kappa_R - \kappa_K)\chi_p\frac{1-\lambda}{1-\lambda\chi_y} + 2$, and consider the following two cases:

Case 1 ($\boldsymbol{\kappa_R > \kappa_K}$): Let us first consider the case where $\kappa_R > \kappa_K$. Determinacy requires that $g(1) < 0$, which is always satisfied with assumption (D.5). Without loss of generality, let us assume $x_1 < 1$ and $x_2 > 1$. Equation (D.7) can be written as

$$(L^{-1} - x_1)(L^{-1} - x_2)p^r_{t-1} = z_t$$

It follows that

$$(L^{-1} - x_1)p^r_{t-1} = -\frac{1}{x_2(1 - x_2^{-1}L^{-1})}z_t$$

We then obtain

$$p^r_t = x_1 p^r_{t-1} - \frac{1}{x_2}\sum_{j=0} x_2^{-j} z_{t+j}$$

When $\kappa_R > \kappa_K$, it follows that $z_t p^r_t < 0$ for all t, So that $(\alpha_R - \alpha_K)p^r_t\phi_t < 0$ holds, where $\phi_t = \mathbb{E}_t \sum_{s=t}^{\infty} r_s$.

Case 2 ($\boldsymbol{\kappa_R < \kappa_K}$): Consider the second case where $\kappa_R < \kappa_K$. Determinacy requires that $g(1) < 0$, which is satisfied by assumption. Similar to the proof of the first case, it is straightforward to prove that $(\alpha_R - \alpha_K)p^r_t\phi_t < 0$ holds. □

The condition D.5 provides a sufficient condition for result (D.6) to hold. Specifically, it implies that as long as the slope of the Phillips curve for good K is small enough relative to that of good R, the price response on impact p^K_t is more responsive than p^R_t.

This result implies that the price of the more flexible-price sector responds more to shocks. Specifically, it increases more in response to an expansionary monetary shock and drops more in response to a tightening monetary shock.

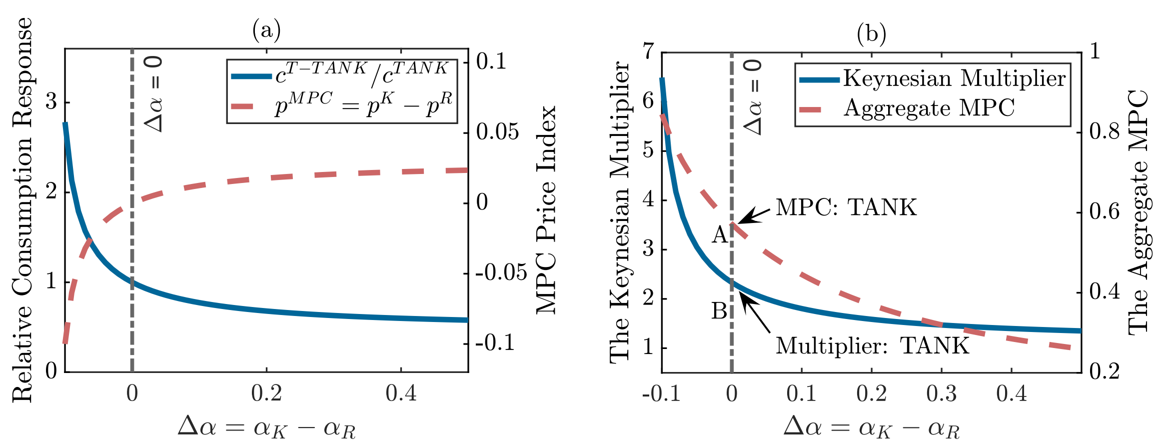
Proposition 8. *Suppose condition (D.5) holds, and consider a sequence of real interest rate cuts ($r_t <$ 0). If the price of goods in the Keynesian sector is more flexible ($\alpha_K < \alpha_R$), aggregate consumption response is dampened in T-TANK, i.e. $c_t^{T-TANK} < c_t^{TANK}$; if the price of goods in the Ricardian sector is more flexible ($\alpha_K > \alpha_R$), aggregate consumption response is amplified, i.e. $c_t^{T-TANK} > c_t^{TANK}$.*

D.3.2 A Numerical Example

We calibrate $1-\alpha^{TANK}$, the frequency of price changes in TANK, to be 0.208 to match the average frequency of price changes in the economy. The remaining model parameters follow conventional values in the literature.

We begin by solving the TANK model with $\alpha^{TANK} = 0.792$. Subsequently, we solve the T-TANK model, varying the degree of heterogeneity in price stickiness $\Delta\alpha = \alpha_K - \alpha_R$, while keeping the average price stickiness equal to α^{TANK}. Throughout these exercises, the path of the real interest rate changes remains unchanged.[34]

Figure D.1: Varying Heterogeneity in Price Stickiness in T-TANK



Note: The left panel presents the variation in the relative cumulative consumption responses between T-TANK and TANK (solid blue line, left y-axis) alongside $p^K - p^R$ (dashed red line, right y-axis) concerning the difference in price stickiness between K goods and R goods $\Delta\alpha$. The right panel plots the variations in the Keynesian multiplier (left y-axis) and the variations in aggregate MPC (right y-axis) with respect to $\Delta\alpha$.

In panel (a) of Figure D.1, the solid blue line plots $c^{\text{T-TANK}}/c^{\text{TANK}}$, representing the ratio between TANK and T-TANK in the cumulative consumption response to the same path of real interest rate

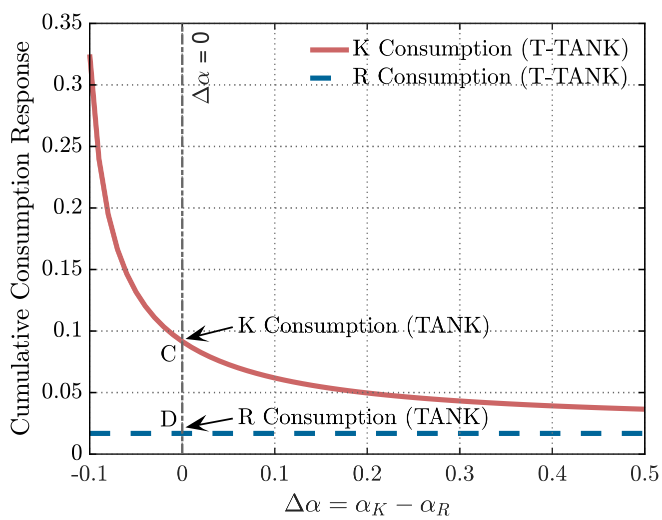
[34]The path of real interest rate changes is plotted in Figure F.2 in the Supplementary Appendix.

changes, across the degree of heterogeneity in price stickiness $\Delta\alpha = \alpha_K - \alpha_R$.[35] Consistent with our theory, if Keynesians experience more flexible prices ($\alpha^K > \alpha^R$), the aggregate consumption is dampened ($c^{T-TANK} > c^{TANK}$), and vice versa. Additionally, $c^{\text{T-TANK}}/c^{\text{TANK}}$ decreases with $\Delta\alpha$, indicating that a larger difference in sectoral price stickiness results in a higher degree of dampening or amplification. Correspondingly, the dashed red line in panel (a) plots the cumulative cyclical inequality in the cost of living $p^K - p^R$, increasing with $\Delta\alpha$.

Panel (b) in Figure D.1 displays the Keynesian multiplier and the aggregate MPC in T-TANK across varying values of $\Delta\alpha$. Point A and point B represent the multiplier and the aggregate MPC in TANK when $\Delta\alpha$ is equal to zero. Notably, both the Keynesian multiplier and the aggregate MPC decrease as heterogeneity in price stickiness $\Delta\alpha$ increases.

Figure D.2 illustrates how Keynesians' and Ricardians' consumption varies with $\Delta\alpha$. Fixing the path of real interest rates, the R's consumption remains constant as $\Delta\alpha$ varies, consistent with the Euler equation. This observation clarifies why the R's consumption in T-TANK is equal to that in TANK (point D). In contrast, K's consumption decreases with $\Delta\alpha$, driven by the general equilibrium effect discussed above. This leads to a decreasing Keynesian multiplier, as shown in Figure D.1 panel (b), and consequently, a decreasing aggregate consumption in Figure D.1 panel (a).

Figure D.2: Consumption Response of K and R in T-TANK and TANK



Note: The left panel plots the variation in cumulative consumption responses for Keynesians (solid red line) and the Ricardians (dashed blue line) with the difference in price stickiness between K goods and R goods $\Delta\alpha$. Points C and D represent the corresponding consumption by Keynesians and Ricardians in TANK, respectively.

[35] Figure F.2 and Figure F.3 in the Supplementary Appendix plot the impulse response functions (IRFs) of the aggregate consumption, the K's consumption, and the R's consumption, respectively, when $\Delta\alpha = 0.1$.

E Appendix for Section 6

E.1 Proof of Lemma 2

The social planner maximizes the social welfare subject to the resource constraints:

$$\max_{\{N_t^K, N_t^R, C_{i,t}^K, C_{i,t}^R, N_{i,t}\}} \lambda \left[U(C_t^K) - V(N_t^K)\right] + (1-\lambda)\left[U(C_t^R) - V(N_t^R)\right]$$

subject to

$$\begin{aligned}
[\psi]: \;\; \lambda N_t^K + (1-\lambda) N_t^R &= \sum_i N_{i,t} \\
[\mu_i]: \;\; \lambda C_{i,t}^K + (1-\lambda) C_{i,t}^R &= A_{i,t} N_{i,t} \\
C_t^h &= \Pi_{i=1}^I (C_{i,t}^h / \omega_i^h)^{\omega_i^h}
\end{aligned}$$

The first order conditions give the following equations:

$$\begin{aligned}
\lambda U'(C_t^K) \frac{dC_t^K}{dC_{i,t}^K} - \lambda \mu_i &= 0 \\
(1-\lambda) U'(C_t^R) \frac{dC_t^R}{dC_{i,t}^R} - (1-\lambda)\mu_i &= 0 \\
\lambda V'(N_t^K) + \psi \lambda &= 0 \\
(1-\lambda) V'(N_t^R) + \psi(1-\lambda) &= 0 \\
\psi + \mu_i A_{i,t} &= 0
\end{aligned}$$

Combining and rearranging equations yields equation (27) and (28). To obtain equation (29), substituting the expression of C_t^R and C_t^K into (27) gives

$$C_{i,t}^h = A_{i,t} (C_t^h)^{1-\sigma^{-1}} \omega_i^h (N_t^h)^{-\gamma} \tag{E.1}$$

Combining this expression with the definition of C_t^h we have

$$\Pi_{i=1}^I (C_{i,t}^h / \omega_i^h)^{\omega_i^h} = C_t^h = (C_t^h)^{(1-\sigma^{-1})} (N_t^h)^{-\gamma} \Pi_{i=1}^I A_{i,t}^{\omega_i^h}. \tag{E.2}$$

Simplifying,

$$(C_t^h)^{-\sigma^{-1}} = (N_t^h)^{\gamma} (\Pi_{i=1}^I A_{i,t}^{\omega_i^h})^{-1}, \tag{E.3}$$

so that we obtain equation (29)

$$\left(\frac{C_{K,t}}{C_{R,t}}\right)^{-\frac{1}{\sigma}} = \left(\frac{A_t^K}{A_t^R}\right)^{-1}.$$

Since $N_t^K = N_t^R$ in the efficient allocation, we denote $N_t = N_t^K = N_t^R$. In fact, we can solve for the labor supply N_t using the goods market clearing condition.

$$N_{i,t}A_{i,t} = (\lambda C_{i,t}^K + (1-\lambda)C_{i,t}^R)$$

Aggregating across sectors yields

$$N_t = \sum_i \left(\lambda A_{i,t}^{-1} C_{i,t}^K + (1-\lambda) A_{i,t}^{-1} C_{i,t}^R\right)$$

Substituting equation (E.1) into this expression:

$$N_t = \sum_i \left(\lambda \omega_i^K (C_t^K)^{-\sigma^{-1}+1} N_t^{-\gamma} + (1-\lambda)\omega_i^R (C_t^R)^{-\sigma^{-1}+1} N_t^{-\gamma}\right)$$

Substituting C_t^h using equation (E.3) we can solve for N_t:

$$N_t = \left[\lambda (A_t^K)^{\sigma-1} + (1-\lambda)(A_t^R)^{\sigma-1}\right]^{\frac{1}{1+\sigma\gamma}},$$

E.2 Proof of Proposition 3

Denote ϕ_t^K and ϕ_t^R as the Lagrangian multiplier of the budget constraint of Keynesians and Ricardians at period t under the flexible-price equilibrium. The first-order conditions of household-type h are:

$$U'(C_t^h)\frac{dC_t^h}{dC_{i,t}} = \phi_t^h P_{i,t}$$
$$V'(N_t^h) = \phi_t^h W_t$$

Combined with the firms' price setting function $P_{i,t} = W_t / A_{i,t}$ we obtain equation (30). Combining the intratemporal condition of households $U'(C_t^h)/V'(N_t^h) = P_t^h / W_t$ and the budget constraint $P_t^h C_t^h = W_t N_t^h$ we can solve for N_t^h:

$$N_t^h = (A_t^h)^{\frac{\sigma-1}{1+\sigma\gamma}}$$

which yields equation (31). Using the intratemporal condition, we obtain C_t^h:

$$C_t^h = (A_t^h)^{\frac{\sigma(1+\gamma)}{1+\sigma\gamma}}.$$

It is obvious that when $\sigma \neq 1$, the flexible-price equilibrium is not efficient.

E.3 Proof of Proposition 4

Our proof proceeds in two steps. We first prove that if the prices of more than one sector are sticky, the sticky-price equilibrium can not be socially efficient. We then prove that when only one sector has sticky prices, a sufficient and necessary condition to achieve the first-best allocation is that consumption baskets are homogeneous across households.

Multi-sector stickiness. Define the sector i's price dispersion as $S_{i,t} = \int \left(\frac{P_{i,t}(j)}{P_{i,t}}\right)^{-\theta} dj$. The price dispersion $S_{i,t}$ evolves according to:

$$S_{i,t+1} = \alpha_i S_{i,t}(1+\pi_{i,t+1})^{\theta} + (1-\alpha_i)\left(\frac{P^*_{i,t+1}}{P_{t+1}}\right)^{-\theta} \tag{E.4}$$

Since there is no within-sector price dispersion under efficient allocation, we have $\pi_{i,t} = 0$ for all i and t. Denote the constant optimal price as P^*_i. Rewriting the expression (12) recursively and simplifying we have

$$P^*_i = W_t / A_{i,t}, \ \text{ for all } i, t \tag{E.5}$$

Suppose there are two sectors with sticky prices. We then have

$$P^*_i A_{i,t} = P^*_j A_{j,t}$$

which does not hold, almost surely. Hence, without loss of generality, we consider the case where only sector 1's prices are sticky.

Homogeneous consumption baskets. With prices in sector 1 being sticky and remaining constant, household h's price index is given by

$$P^h_t = (P^*_1)^{\omega^h_1} \Pi^I_{i=2}\left(\frac{W_t}{A_{i,t}}\right)^{\omega^h_i} = (\Pi^I_{i=1} A^{\omega^h_i}_{i,t})^{-1} = (A^h_t)^{-1},$$

where the second equality uses equation (E.5). Combining the intratemporal condition of households $U'(C^h_t)/V'(N^h_t) = P^h_t/W_t$ and the budget constraint $P^h_t C^h_t = W_t N^h_t$ we can solve for N^h_t and C^h_t:

$$N^h_t = (A^h_t)^{\frac{\sigma-1}{1+\sigma\gamma}},$$
$$C^h_t = (A^h_t)^{\frac{\sigma(1+\gamma)}{1+\sigma\gamma}},$$

which is efficient if and only if $A^K_t = A^R_t$, or equivalently $\omega^K_i = \omega^R_i$ for all i. This concludes the proof.

E.4 Triple Divine Coincidence: Robustness

E.4.1 Welfare weights

Characterizing first-best allocation. We set up the same social planner maximization problem as in Section E.1 with the social welfare function

$$\widetilde{\lambda}\left[U(C_t^K) - V(N_t^K)\right] + (1-\widetilde{\lambda})\left[U(C_t^R) - V(N_t^R)\right],$$

where $\widetilde{\lambda} \neq \lambda$ and obtain the first order conditions:

$$\begin{aligned}
\widetilde{\lambda} U'(C_t^K)\frac{dC_t^K}{dC_{i,t}^K} - \lambda\mu_i &= 0 \\
(1-\widetilde{\lambda})U'(C_t^R)\frac{dC_t^R}{dC_{i,t}^R} - (1-\lambda)\mu_i &= 0 \\
\widetilde{\lambda} V'(N_t^K) + \psi\lambda &= 0 \\
(1-\widetilde{\lambda})V'(N_t^R) + \psi(1-\lambda) &= 0 \\
\psi + \mu_i A_{i,t} &= 0
\end{aligned}$$

Combining and rearranging equations yields the following conditions corresponding to Lemma 2,

$$\begin{aligned}
\frac{V'(N_t^h)}{U'(C_t^h)dC_t^h/dC_{i,t}^h} &= A_{i,t} \\
\frac{V'(N_t^K)}{V'(N_t^R)} &= \frac{(1-\widetilde{\lambda})/\widetilde{\lambda}}{(1-\lambda)/\lambda}, \\
\frac{U'(C_t^K)}{U'(C_t^R)} &= \frac{V'(N_t^K)}{V'(N_t^R)}\left(\frac{A_t^K}{A_t^R}\right)^{-1},
\end{aligned}$$

Inefficiency of flexible equilibrium and triple divine coincidence. Since we only replace the welfare weights of the social welfare function, the flexible-price equilibrium is the same as our baseline model. Household h's labor supply and consumption are given by

$$\begin{aligned}
N_t^h &= (A_t^h)^{\frac{\sigma-1}{1+\sigma\gamma}}, \\
C_t^h &= (A_t^h)^{\frac{\sigma(1+\gamma)}{1+\sigma\gamma}}.
\end{aligned}$$

It is obvious that the flexible-price equilibrium continues to be inefficient. The triple divine coincidence result holds following similar proof of Proposition 4 in Section E.3.

E.4.2 Local labor market and specialized labor

Our baseline model assumes substitutable labor across households. We explore the robustness of our triple divine coincidence result with alternative specifications on labor markets and production functions. Production function in sector i is given by

$$Y_{i,t}(j) = A_{i,t}(N_{i,t}^K(j))^{\epsilon_i}(N_{i,t}^R(j))^{1-\epsilon_i},$$

and household h's utility function is

$$U(C_t^h) - V(N_t^h)$$

Efficient allocation with specialized labor. We first characterize the efficient allocations under the new assumptions. The social planner's maximization problem is given by

$$\max_{\{N_{i,t}^K, N_{i,t}^R, C_{i,t}^K, C_{i,t}^R\}} \lambda \left[U(C_t^K) - V(\sum_{i=1}^{I} N_{i,t}^K) \right] + (1-\lambda) \left[U(C_t^R) - V(\sum_{i=1}^{I} N_{i,t}^R) \right]$$

subject to

$$[\mu_i]: \;\; \lambda C_{i,t}^K + (1-\lambda) C_{i,t}^R = A_{i,t}(\lambda N_{i,t}^K)^{\epsilon_i}((1-\lambda)N_{i,t}^R)^{1-\epsilon_i}$$
$$C_t^h = \Pi_{i=1}^{I}(\frac{C_{i,t}^h}{\omega_i^h})^{\omega_i^h}$$

The first order conditions give the following equations:

$$U'(C_t^K)\omega_i^K \frac{C_t^K}{C_{i,t}^K} = \mu_i \tag{E.6}$$

$$U'(C_t^R)\omega_i^R \frac{C_t^R}{C_{i,t}^R} = \mu_i \tag{E.7}$$

$$V'(N_t^K) = \mu_i \epsilon_i A_{i,t}(\lambda N_{i,t}^K)^{\epsilon_i - 1}((1-\lambda)N_{i,t}^R)^{1-\epsilon_i} \tag{E.8}$$

$$V'(N_t^R) = \mu_i (1-\epsilon_i) A_{i,t}(\lambda N_{i,t}^K)^{\epsilon_i}((1-\lambda)N_{i,t}^R)^{-\epsilon_i} \tag{E.9}$$

Characterizing the Efficient Allocation. From (E.6) and (E.7), we get the condition for consumption efficiency:

$$U'(C_t^K)\omega_i^K \frac{C_t^K}{C_{i,t}^K} = U'(C_t^R)\omega_i^R \frac{C_t^R}{C_{i,t}^R} \tag{E.10}$$

From (E.6) and (E.8) we obtain the condition for consumption-labor efficiency:

$$V'(N_t^K) = U'(C_t^K)\omega_i^K \frac{C_t^K}{C_{i,t}^K}\epsilon_i A_{i,t}(\lambda N_{i,t}^K)^{\epsilon_i-1}((1-\lambda)N_{i,t}^R)^{1-\epsilon_i}, \tag{E.11}$$

$$V'(N_t^R) = U'(C_t^R)\omega_i^R \frac{C_t^R}{C_{i,t}^R}(1-\epsilon_i)A_{i,t}(\lambda N_{i,t}^K)^{\epsilon_i}((1-\lambda)N_{i,t}^R)^{-\epsilon_i}, \tag{E.12}$$

where the marginal rate of substitution is equal to the marginal product of labor in utility terms.

From (E.8) and (E.9), taking ratio for any two sectors i and j we obtain the optimal labor allocation ratio across sectors:

$$\frac{N_{i,t}^K}{N_{j,t}^K} = \frac{N_{i,t}^R}{N_{j,t}^R}, \ \ \forall i,j \tag{E.13}$$

That is, the relative allocation of each labor type across sectors should be the same.

From (E.8) and (E.9) for the same sector i:

$$\frac{V'(N_t^K)}{V'(N_t^R)} = \frac{\epsilon_i}{1-\epsilon_i}\frac{N_{i,t}^R}{N_{i,t}^K} \tag{E.14}$$

This determines the optimal mix of labor types within each sector.

Triple Divine Coincidence. Similar to the proof of Proposition 3 in Section E.3, it is straightforward to show that the sticky-price equilibrium is inefficient when there is more than one sector with sticky prices. We consider the case where sector 1 has sticky prices, and all other sectors' prices are flexible. The efficient allocation mandates that $P_{1,t} = P_1^*$ is constant. The recursive formulation implies that

$$P_1^* = \frac{1}{A_{1,t}}\left(\frac{W_t^K}{\epsilon_1}\right)^{\epsilon_1}\left(\frac{W_t^R}{1-\epsilon_1}\right)^{1-\epsilon_1}.$$

Since prices in other sectors are flexible, prices are equal to marginal costs:

$$P_{i,t} = \frac{1}{A_{i,t}}\left(\frac{W_t^K}{\epsilon_i}\right)^{\epsilon_i}\left(\frac{W_t^R}{1-\epsilon_i}\right)^{1-\epsilon_i} \tag{E.15}$$

We first prove that the market's consumption-labor margin is efficient. Note that firms' optimal labor demand implies that:

$$\frac{N_{i,t}^K}{N_{i,t}^R} = \frac{\epsilon_i}{1-\epsilon_i}\frac{W_t^R}{W_t^K}. \tag{E.16}$$

Condition (E.15) and (E.16) imply that

$$\frac{W_t^K}{P_t^K} = \epsilon_i A_{i,t}(\lambda N_{i,t}^K)^{\epsilon_i-1}((1-\lambda)N_{i,t}^R)^{1-\epsilon_i}\frac{P_{i,t}}{P_t^K}$$

Substituting into the household's optimality condition, we have

$$\frac{V'(N_t^K)}{U'(C_t^K)} = \frac{W_t^K}{P_t^K} = \omega_i^K \frac{C_t^K}{C_{i,t}^K} \epsilon_i A_{i,t} (\lambda N_{i,t}^K)^{\epsilon_i - 1} ((1-\lambda) N_{i,t}^R)^{1-\epsilon_i} \tag{E.17}$$

where we replace $P_{i,t}/P_t^K$ using

$$C_{i,t}^h = \omega_i^h \left(\frac{P_{i,t}}{P_t^h} \right)^{-1} C_t^h.$$

Equation (E.17) is identical to the planner's condition (E.11). The same logic holds for Ricardian households.

We next prove that the efficiency of labor allocation requires that $\epsilon_i = \epsilon_j$ for all i, j. Since the relative wage $\frac{W_t^R}{W_t^K}$ is common across sectors, equation (E.16) implies that

$$\frac{N_{i,t}^K / N_{i,t}^R}{N_{j,t}^K / N_{j,t}^R} = \frac{\epsilon_i / (1-\epsilon_i)}{\epsilon_j / (1-\epsilon_j)}$$

This only satisfy the planner's condition (E.13) if $\epsilon_i/(1-\epsilon_i) = \epsilon_j/(1-\epsilon_j)$ for all i, j. That is, ϵ_i is the same across all sectors. If $\epsilon_i \neq \epsilon_j$ (sectors have different factor intensities), then $N_{i,s}^K / N_{i,s}^R \neq N_{j,s}^K / N_{j,s}^R$. The market allocates the two types of labor in different proportions across sectors, which is production inefficient.

Consequently, we only need to consider the case where $\epsilon_i = \epsilon_j$ for all i, j, and $N_{i,s}^K / N_{i,s}^R = N_{j,s}^K / N_{j,s}^R$. The demand for each type of labor is derived from firm cost minimization. For any sector i, the optimal labor ratio is:

$$\frac{N_{i,t}^K}{N_{i,t}^R} = \frac{\epsilon}{1-\epsilon} \frac{W_t^R}{W_t^K}$$

Considering that $\sum_i N_{i,t}^K = N_t^K$ and $\sum_i N_{i,t}^R = N_t^R$, we have

$$\frac{W_t^K N_t^K}{W_t^R N_t^R} = \frac{\epsilon}{1-\epsilon}$$

We now only need to provide a sufficient and necessary condition for the consumption efficiency (E.6). From the market budget constraints:

$$C_t^K = \frac{W_t^K}{P_t^K} N_t^K \quad \text{and} \quad C_t^R = \frac{W_t^R}{P_t^R} N_t^R$$

The efficiency condition (E.6) can be rewritten as:

$$\frac{(C_t^K)^{-1/\sigma}}{P_t^K} = \frac{(C_t^R)^{-1/\sigma}}{P_t^R}$$

Substituting the budget constraints for C_t^h into this equation and rearranging, we have

$$\frac{W_t^K N_t^K}{W_t^R N_t^R} = \left(\frac{P_t^K}{P_t^R}\right)^{1-\sigma},$$

which is

$$\left(\frac{A_t^R}{A_t^K}\right)^{1-\sigma} = \frac{\epsilon}{1-\epsilon}.$$

The sufficient and necessary conditions for the market equilibrium to be efficient can be summarized as $\epsilon = 1/2$ and $\omega_i^K = \omega_i^R$ for all i. (Note that we assume $\sigma \neq 1$.)

E.5 Proof of Proposition 5

E.5.1 Notation Definition

We first define some notation for subsequent analysis. All vectors are in bold letters. Define the price-stickiness matrix for sector i as follows,

$$\Phi = \text{diag}(\phi_1, \phi_1, ..., \phi_I), \tag{E.18}$$

where $\phi_i = \frac{(1-\alpha_i)(1-\beta\alpha_i)}{1-\beta\alpha_i(1-\alpha_i)}$, which is decreasing with α_i.

Define the following within and across operators:

$$\mathcal{H}^{\text{within}} = \text{diag}(\theta\boldsymbol{\omega})(1-\Phi)\Phi^{-1}, \tag{E.19}$$

$$\mathcal{H}^{\text{across}} = S(I_N, I_N), \tag{E.20}$$

where I_N is the identity matrix with size N, the weight vector $\boldsymbol{\omega} = (\omega_1, \omega_2, ..., \omega_I)^T$ represents the steady-state consumption share with $\omega_i = \lambda\omega_i^K + (1-\lambda)\omega_i^R$. The vector for weight share is defined as $\tilde{\boldsymbol{\omega}}^h = (\tilde{\omega}_1^h, \tilde{\omega}_2^h, ..., \tilde{\omega}_I^h)^T$ with $\tilde{\omega}_i^K = \frac{\lambda\omega_i^K}{\lambda\omega_i^K + (1-\lambda)\omega_i^R}$ and $\tilde{\omega}_i^K + \tilde{\omega}_i^R = 1$.

The substitution operator, $S(\cdot,\cdot) : \mathbb{R}_{N\times K} \times \mathbb{R}_{N\times H} \mapsto \mathbb{R}_{K\times H}$, is defined as[36]

$$[S(X,Y)]_{k,h} \equiv \frac{1}{2}\sum_i \sum_j \omega_i \omega_j \left(X_{i,k} - X_{j,k}\right)\left(Y_{i,h} - Y_{j,h}\right).$$

[36] See Baqaee and Farhi (2018) and Rubbo (2023) for more properties of the substitution operator.

We finally define some coefficients. The coefficients for consumption inequality are

$$\psi_{cy} = \frac{\chi_y - 1}{1-\lambda}, \tag{E.21}$$

$$\psi_{c\pi} = \frac{\gamma+1}{\gamma+\sigma^{-1}}. \tag{E.22}$$

The coefficient for the welfare function is

$$\psi_{wc} = \left(\sigma^{-2}/\gamma + \sigma^{-1} - 1\right)\lambda(1-\lambda). \tag{E.23}$$

The two coefficient vector and matrix for sectoral Phillips curves are

$$\mathcal{K} = \left(\sigma^{-1}+\gamma\right)\frac{\Phi\mathbf{1}}{1-\boldsymbol{\omega}^T\Phi\mathbf{1}}, \tag{E.24}$$

$$\mathcal{J} = \Phi - \frac{1}{\left(\sigma^{-1}+\gamma\right)}\mathcal{K}\boldsymbol{\omega}^T(I-\Phi), \tag{E.25}$$

where $\mathbf{1} \in \mathbb{R}^I$ is the unit vector. All notations are summarized in Table E.1.

Table E.1: Notation

Parameters	Notation and values
Price-stickiness matrix	$\Phi = \text{diag}(\phi_1, \phi_1, ..., \phi_I) \in \mathbb{R}_{I\times I}$
	$\phi_i = \frac{(1-\alpha_i)(1-\beta\alpha_i)}{1-\beta\alpha_i(1-\alpha_i)}$
Consumption share vector	$\boldsymbol{\omega} = (\omega_1, \omega_2, ..., \omega_I)^T \in \mathbb{R}^I$
	$\omega_i = \lambda\omega_i^K + (1-\lambda)\omega_i^R$
Weight share vector	$\tilde{\boldsymbol{\omega}}^h = (\tilde{\omega}_1^h, \tilde{\omega}_2^h, ..., \tilde{\omega}_I^h)^T \in \mathbb{R}^I$
	$\tilde{\omega}_i^K = \frac{\lambda\omega_i^K}{\lambda\omega_i^K + (1-\lambda)\omega_i^R}$, $\tilde{\omega}_i^K + \tilde{\omega}_i^R = 1$
Within operator	$\mathcal{H}^{\text{within}} = \text{diag}(\theta\boldsymbol{\omega})(1-\Phi)\Phi^{-1} \in \mathbb{R}_{I\times I}$
Across operator	$\mathcal{H}^{\text{across}} = S(I_N, I_N) \in \mathbb{R}_{N\times N}$
Substitution operator	$S(\cdot,\cdot) : \mathbb{R}_{N\times K} \times \mathbb{R}_{N\times H} \mapsto \mathbb{R}_{K\times H}$
	$[S(X,Y)]_{k,h} \equiv \frac{1}{2}\sum_i\sum_j \omega_i\omega_j(X_{i,k}-X_{j,k})(Y_{i,h}-Y_{j,h})$
Phillips curve coefficients	$\mathcal{K} = (\sigma^{-1}+\gamma)\frac{\Phi\mathbf{1}}{1-\boldsymbol{\omega}^T\Phi\mathbf{1}} \in \mathbb{R}_I$
	$\mathcal{J} = \Phi - \frac{1}{(\sigma^{-1}+\gamma)}\mathcal{K}\boldsymbol{\omega}^T(I-\Phi) \in \mathbb{R}_{I\times I}$
Consumption inequatlity coefficients	$\psi_{cy} = \frac{\chi_y-1}{1-\lambda}$, $\psi_{c\pi} = \frac{\gamma+1}{\gamma+\sigma^{-1}}$
Welfare coefficients	$\psi_{wc} = \left(\sigma^{-2}/\gamma + \sigma^{-1} - 1\right)\lambda(1-\lambda)$
Unit vector	$\mathbf{1} = (1, 1, ..., 1) \in \mathbb{R}^I$

E.5.2 Some Preliminary Results

To obtain the approximation of the social welfare loss function, we first derive some preliminary results.

Natural Rate of Output. Substituting $n_t = y_t - a_t$ into the labor supply equation, we obtain the expression for the nominal wage rate:

$$w_t = (\gamma + \sigma^{-1}) y_t + p_t - \gamma a_t.$$

With flexible prices, firms set their prices equal to the marginal costs $p_t^n = w_t^n - a_t$, which delivers the expression for the natural rate of output:

$$y_t^n = \frac{\gamma + 1}{\gamma + \sigma^{-1}} a_t. \tag{E.26}$$

Cyclical Inequality in Consumption and Labor Supply. With aggregate productivity shock a_t, the aggregate profit is

$$d_t = p_t + y_t - w_t - n_t = -(w_t - p_t) + a_t, \tag{E.27}$$

Substituting equation (E.26) and (E.27) into equation (18) we have

$$c_t^K = \chi_y y_t - \frac{\gamma + 1}{\gamma + \sigma^{-1}} (\chi_y - 1) a_t - (1 - \lambda) \frac{\gamma + 1}{\gamma + \sigma^{-1}} (p_t^K - p_t^R).$$

Ricardians' consumption is given by

$$c_t^R = \frac{1 - \lambda \chi_y}{1 - \lambda} y_t + \frac{\lambda}{1 - \lambda} \frac{\gamma + 1}{\gamma + \sigma^{-1}} (\chi_y - 1) a_t + \lambda \frac{\gamma + 1}{\gamma + \sigma^{-1}} (p_t^K - p_t^R)$$

The labor supply of the Keynesians and the Ricardians is given by

$$\begin{aligned}
n_t^K &= \left[1 - \frac{\sigma^{-1}}{\gamma} (\chi_y - 1)\right] y_t - \left[1 - \frac{\sigma^{-1}(\gamma + 1)}{\gamma(\gamma + \sigma^{-1})} (\chi_y - 1)\right] a_t + (1 - \lambda) \frac{\sigma^{-1}}{\gamma} \frac{\gamma + 1}{\gamma + \sigma^{-1}} (p_t^K - p_t^R), \\
n_t^R &= \left[1 + \frac{\sigma^{-1}}{\gamma} \frac{\lambda}{1 - \lambda} (\chi_y - 1)\right] y_t - \left[1 + \frac{\sigma^{-1}(\gamma + 1)}{\gamma(\gamma + \sigma^{-1})} \frac{\lambda}{1 - \lambda} (\chi_y - 1)\right] a_t - \lambda \frac{\sigma^{-1}}{\gamma} \frac{\gamma + 1}{\gamma + \sigma^{-1}} (p_t^K - p_t^R).
\end{aligned}$$

Hence, the consumption difference between the Keynesians and Ricardians is given by

$$c_t^K - c_t^R = \frac{\chi_y - 1}{1 - \lambda} \widetilde{y}_t - \frac{\gamma + 1}{\gamma + \sigma^{-1}} (p_t^K - p_t^R). \tag{E.28}$$

Similarly, the difference of labor supply is given by

$$n_t^K - n_t^R = -\frac{\sigma^{-1}(\chi_y - 1)}{\gamma(1-\lambda)}\tilde{y}_t + \frac{\sigma^{-1}}{\gamma}\frac{\gamma+1}{\gamma+\sigma^{-1}}(p_t^K - p_t^R). \tag{E.29}$$

Sectoral Markups and Inflation. Rearranging equation (C.2) yields the following expression:

$$\boldsymbol{\pi}_t = \Phi(\boldsymbol{mc}_t - \boldsymbol{p}_t + \boldsymbol{\pi}_t) + \beta(I-\Phi)\mathbb{E}_t\boldsymbol{\pi}_{t+1}$$

The sectoral markups $\boldsymbol{\mu}_t$ are therefore given by

$$\boldsymbol{\mu}_t = \boldsymbol{p}_t - \boldsymbol{mc}_t = -\Phi^{-1}(I-\Phi)(\boldsymbol{\pi}_t - \beta\mathbb{E}_t\boldsymbol{\pi}_{t+1}). \tag{E.30}$$

The Divine Coincidence Phillips Curve. Following Rubbo (2023), we derive an inflation index such that the central bank is able to stabilize the aggregate output gap by completely stabilizing this inflation index.

The sectoral markups are given by

$$\begin{aligned}\boldsymbol{\mu}_t &= \boldsymbol{p}_t - \boldsymbol{mc}_t \\ &= \boldsymbol{p}_t - \mathbf{1}w_t + \boldsymbol{a}_t.\end{aligned} \tag{E.31}$$

Subtracting the above equation by the corresponding one under flexible prices relates the sectoral markups with the wage gap and price gaps,

$$\boldsymbol{\mu}_t = \tilde{\boldsymbol{p}}_t - \mathbf{1}\tilde{w}_t,$$

which leads to

$$\boldsymbol{\omega}^T\boldsymbol{\mu}_t = \boldsymbol{\omega}^T\tilde{\boldsymbol{p}}_t - \tilde{w}_t$$

Similarly, we obtain the following expression from the labor supply equation,

$$\tilde{w}_t - \boldsymbol{\omega}^T\tilde{\boldsymbol{p}}_t = (\sigma^{-1}+\gamma)\tilde{y}_t$$

Combining the last two equations, we relate the output gap with the weighted sum of sectoral markups,

$$(\sigma^{-1}+\gamma)\tilde{y}_t = -\boldsymbol{\omega}^T\boldsymbol{\mu}_t \tag{E.32}$$

Substituting equation (E.30) into equation (E.32) yields the divine coincidence Phillips curve:

$$\pi_t^{\mathrm{DC}} = \beta \mathbb{E}_t \pi_{t+1}^{\mathrm{DC}} + \frac{\sigma^{-1} + \gamma}{\sum_{i=1}^{I} \omega_i \frac{1-\phi_i}{\phi_i}} \widetilde{y}_t \tag{E.33}$$

where

$$\pi_t^{\mathrm{DC}} \equiv \sum_{i=1}^{I} \frac{\omega_i \frac{1-\phi_i}{\phi_i}}{\sum_{j=1}^{I} \omega_j \frac{1-\phi_j}{\phi_j}} \pi_{it}$$

E.5.3 Deriving the Welfare Loss Function

We are ready to derive the welfare loss function. Household type h's utility function is denoted by

$$U(Y_t^h) + V(N_t^h)$$

The second-order Taylor expansion of the first term of the utility around the steady state is

$$\begin{aligned} U(Y_t^h) &= U(\overline{Y}) + U'(\overline{Y})(Y_t^h - \overline{Y}) + \tfrac{1}{2} U''(\overline{Y})(Y_t^h - \overline{Y})^2 + o(2) \\ &= U(\overline{Y}) + \overline{Y} U'(\overline{Y}) y_t^h + \tfrac{1}{2}\left(U'(\overline{Y})\overline{Y} + U''(\overline{Y})\overline{Y}^2\right)(y_t^h)^2 + o(2) \end{aligned} \tag{E.34}$$

The second equality follows from the Taylor expansion

$$Y_t^h / \overline{Y} = 1 + y_t^h + \tfrac{1}{2}(y_t^h)^2 + o(2).$$

Summing across agents delivers

$$\begin{aligned} &\lambda U(Y_t^K) + (1-\lambda) U(Y_t^R) \\ &= U(\overline{Y}) + \overline{Y} U'(\overline{Y}) y_t + \tfrac{1}{2}\left(U'(\overline{Y})\overline{Y} + U''(\overline{Y})\overline{Y}^2\right)\left[\lambda (y_t^K)^2 + (1-\lambda)(y_t^R)^2\right] + o(2) \\ &= U(\overline{Y}) + U'(\overline{Y})\overline{Y}\left[y_t + \frac{1}{2}(1-\sigma^{-1}) y_t^2 + \frac{1}{2}(1-\sigma^{-1})\lambda(1-\lambda)(y_t^K - y_t^R)^2\right] \end{aligned} \tag{E.35}$$

where $\sigma^{-1} = -\overline{Y}\frac{U''(\overline{Y})}{U'(\overline{Y})}$, and the second equality uses the fact that

$$\lambda (y_t^K)^2 + (1-\lambda)(y_t^R)^2 = \lambda(1-\lambda)(y_t^K - y_t^R)^2 + y_t^2.$$

The second term of the utility can be approximated around the steady state to second order, expressed as

$$\begin{aligned}
&\lambda V(N_t^K) + (1-\lambda)V(N_t^R) \\
&= V(\overline{N}) + V'(\overline{N})\left[\lambda(N_t^K - \overline{N}) + (1-\lambda)(N_t^R - \overline{N})\right] + \frac{1}{2}V''(\overline{N})\left[(\lambda(N_t^K - \overline{N})^2 + (1-\lambda)(N_t^R - \overline{N})^2\right] \\
&= V(\overline{N}) + V'(\overline{N})\overline{N}\left[\left[\lambda n_t^K + (1-\lambda)n_t^R\right] + \frac{1}{2}\left[\lambda(n_t^K)^2 + (1-\lambda)(n_t^R)^2\right]\right] + \frac{1}{2}V''(\overline{N})\overline{N}^2\left[\lambda(n_t^K)^2 + (1-\lambda)(n_t^R)^2\right] \\
&= V(\overline{N}) + V'(\overline{N})\overline{N}\left[\lambda n_t^K + (1-\lambda)n_t^R + \frac{1}{2}\left[\lambda(n_t^K)^2 + (1-\lambda)(n_t^R)^2\right]\right] + \frac{1}{2}V'(\overline{N})\overline{N}\gamma\left[\lambda(1-\lambda)(n_t^K - n_t^R)^2 + n_t^2\right]
\end{aligned} \tag{E.36}$$

Denote $\widehat{Y}_t = \int Y_{i,t}(j)dj$ and approximate the labor market clearing condition

$$\lambda N_t^K + (1-\lambda)N_t^R = \sum_{i=1}^{I} \widehat{Y}_{i,t}/A_{i,t}$$

to second order

$$\begin{aligned}
&\overline{N}\left[\lambda n_t^K + (1-\lambda)n_t^R\right] + \frac{1}{2}\overline{N}\left[\lambda(n_t^K)^2 + (1-\lambda)(n_t^R)^2\right] \\
&= \overline{Y}\left(\sum_{i=1}^{I}\omega_i\widehat{y}_{i,t} + \frac{1}{2}\sum_{i=1}^{I}\omega_i\widehat{y}_{i,t}^2 - \sum_{i=1}^{I}\omega_i\widehat{y}_{i,t}a_{i,t}\right) + \text{t.i.p} \\
&= \overline{Y}\left(\sum_{i=1}^{I}\omega_i y_{i,t} + \sum_{i=1}^{I}\frac{\omega_i}{2\theta}\text{var}y_{i,t}(j) + \frac{1}{2}\sum_{i=1}^{I}\omega_i y_{i,t}^2 - \sum_{i=1}^{i}\omega_i y_{i,t}a_{i,t}\right) + \text{t.i.p} \\
&= \overline{Y}\left(y_t + \sum_{i=1}^{I}\frac{\omega_i}{2\theta}\text{var}y_{i,t}(j) + \frac{1}{2}y_t^2 + \frac{1}{4}\sum_{i,j}\omega_i\omega_j(y_{i,t}-y_{j,t})^2 - y_t a_t - \frac{1}{2}\sum_{i,j}\omega_i\omega_j(y_{i,t}-y_{j,t})(a_{i,t}-a_{j,t})\right) + \text{t.i.p} \\
&= \overline{Y}\left(y_t + \sum_{i=1}^{I}\frac{\omega_i}{2\theta}\text{var}y_{i,t}(j) + \frac{1}{2}y_t^2 - y_t a_t + \frac{1}{4}\sum_{i,j}\omega_i\omega_j[(y_{i,t}-y_{j,t}) - (a_{i,t}-a_{j,t})]^2\right) + \text{t.i.p}
\end{aligned} \tag{E.37}$$

The second equality follows from the expression below

$$\widehat{y}_{i,t} = y_{i,t} + \frac{1}{2\theta}\text{var}y_{i,t}(j) + o(2).$$

The third equality makes use of the following two equations:

$$\begin{aligned}
&\sum_{i=1}^{I}\omega_i y_{i,t} = y_t, \\
&\sum_{i=1}^{I}\omega_i y_{i,t}^2 = y_t^2 + \frac{1}{2}\sum_{i,j}\omega_i\omega_j(y_{i,t}-y_{j,t})^2
\end{aligned}$$

and the following factoring technique:

$$\sum \omega_i y_{i,t}a_{i,t} = y_t a_t + \frac{1}{2}\sum_{i,j}\omega_i\omega_j(y_{i,t}-y_{j,t})(a_{i,t}-a_{j,t})$$

Plugging equation (E.37) into (E.36) yields

$$\lambda V(N_t^K) + (1-\lambda)V(N_t^R) = V(\overline{N}) + V'(\overline{N})\overline{N}\Big[\frac{1}{2}(1+\gamma)y_t^2 + y_t + \sum_{i=1}^{I}\frac{\omega_i}{2\theta}\mathrm{var}\, y_{i,t}(j)$$
$$+\frac{1}{4}\sum_{i,j}\omega_i\omega_j[(y_{i,t}-y_{j,t})-(a_{i,t}-a_{j,t})]^2 - (1+\gamma)y_t a_t + \frac{1}{2}\gamma\lambda(1-\lambda)(n_t^K - n_t^R)^2\Big]. \tag{E.38}$$

Note that

$$\begin{aligned} Y_{i,t}(j) &= \left(\frac{P_{i,t}(j)}{P_{i,t}}\right)^{-\theta}(\lambda Y_{i,t}^K + (1-\lambda)Y_{i,t}^R) \\ &= \left(\frac{P_{i,t}(j)}{P_{i,t}}\right)^{-\theta} Y_t \end{aligned}$$

Hence, the following result holds,

$$\mathrm{var}\, y_{i,t}(j) = \theta^2 \mathrm{var}\, p_{i,t}(j)$$

Note also that the sum of discounted within-sector price dispersion can be expressed as:[37]

$$\sum_{t=0}^{\infty}\beta^t \mathrm{var}\, p_{i,t}(j) = \frac{\alpha_i}{(1-\alpha_i)(1-\alpha_i\beta)}\sum_{t=0}^{\infty}\beta^t\pi_{i,t}^2$$

We therefore have

$$\mathrm{var}\, y_{i,t}(j) = \frac{\alpha_i\theta^2}{(1-\alpha_i)(1-\alpha_i\beta)}\pi_{i,t}^2.$$

Substitute this expression into (E.38) we obtain

$$\lambda V(N_{K,t}) + (1-\lambda)V(N_{R,t}) = V(\overline{N}) + V'(\overline{N})\overline{N}\Big[\frac{1}{2}(1+\gamma)y_t^2 + y_t - (1+\gamma)y_t a_t + \sum_{i=1}^{I}\frac{\omega_i\theta\alpha_i}{2(1-\alpha_i)(1-\alpha_i\beta)}\pi_{i,t}^2$$
$$+\frac{1}{4}\sum_{i,j}\omega_i\omega_j[(y_{i,t}-y_{j,t})-(a_{i,t}-a_{j,t})]^2 + \frac{1}{2}\gamma\lambda(1-\lambda)(n_{K,t}-n_{R,t})^2\Big]. \tag{E.39}$$

Note that the aggregate demand for sectoral composite good i is given by

$$y_{i,t} = \widetilde{\omega}_i^K y_{i,t}^K + \widetilde{\omega}_i^R y_{i,t}^R,$$

where

$$\widetilde{\omega}_i^K = \frac{\lambda\omega_i^K}{\lambda\omega_i^K + (1-\lambda)\omega_i^R};\ \ \widetilde{\omega}_i^K + \widetilde{\omega}_i^R = 1.$$

Household h's demand for sectoral good i is

$$y_{i,t}^h = -(p_{it} - p_t^h) + y_t^h.$$

[37] see Woodford (2003) Chapter 6 for a proof.

Combining these two equations, we have

$$\begin{aligned}(y_{i,t}-y_{j,t})-(a_{i,t}-a_{j,t}) &= -\left[(p_{i,t}-p_{jt})+(a_{i,t}-a_{j,t})\right]+(\widetilde{\omega}_i^K-\widetilde{\omega}_j^K)\left[(p_t^K-p_t^R)+(y_t^K-y_t^R)\right]\\ &= -\left[(p_{i,t}-p_{jt})+(a_{i,t}-a_{j,t})\right]+(\widetilde{\omega}_i^K-\widetilde{\omega}_j^K)[\frac{\sigma^{-1}-1}{\gamma+\sigma^{-1}}(p_t^K-p_t^R)+\frac{\chi_y-1}{1-\lambda}\widetilde{y}_t]\\ &= -\left[(p_{i,t}-p_{jt})+(a_{i,t}-a_{j,t})\right]+(\widetilde{\omega}_i^K-\widetilde{\omega}_j^K)[\frac{\sigma^{-1}-1}{\gamma+\sigma^{-1}}(\pi_t^K-\pi_t^R+p_{t-1}^K-p_{t-1}^R)+\frac{\chi_y-1}{1-\lambda}\widetilde{y}_t].\end{aligned} \tag{E.40}$$

Recall from equation (E.31)that $\mu_{i,t}=p_{i,t}-w_t+a_{i,t}$ and from equation (E.30) that $\mu_{i,t}=-\frac{1-\phi_i}{\phi_i}(\pi_{i,t}-\beta\mathbb{E}_t\pi_{i,t+1})$. We obtain the following expression,

$$(p_{i,t}-p_{jt})+(a_{i,t}-a_{j,t})=-\frac{1-\phi_i}{\phi_i}(\pi_{i,t}-\beta\mathbb{E}_t\pi_{i,t+1})+\frac{1-\phi_j}{\phi_j}(\pi_{j,t}-\beta\mathbb{E}_t\pi_{j,t+1}) \tag{E.41}$$

Subtracting expression (E.39) from (E.35) and collecting like terms we obtain the welfare loss function

$$\begin{aligned}W_t=\frac{1}{2}\Big[&(\gamma+\sigma^{-1})(y_t-y_t^n)^2+\sum_{i=1}^{I}\frac{\omega_i\theta\alpha_i}{(1-\alpha_i)(1-\alpha_i\beta)}\pi_{i,t}^2+\frac{1}{2}\sum_{i,j}\omega_i\omega_j[(y_{i,t}-y_{j,t})-(a_{i,t}-a_{j,t})]^2\\ &+(\sigma^{-1}-1)\lambda(1-\lambda)(c_t^K-c_t^R)^2+\gamma\lambda(1-\lambda)(n_t^K-n_t^R)^2\Big],\end{aligned} \tag{E.42}$$

where $(y_{i,t}-y_{j,t})-(a_{i,t}-a_{j,t})$ is given by (E.40), $(p_{i,t}-p_{jt})+(a_{i,t}-a_{j,t})$ is given by (E.41) $c_t^K-c_t^R$ is given by (E.28), and $n_t^K-n_t^R$ is given by (E.29).

Rewriting the welfare loss function (E.42) in vector form, we obtain the expressions in Proposition (5).

E.6 Proof of Proposition 6

We employ the Lagrangian method to solve the Ramsey problem. The Lagrangian is given by

$$\begin{aligned}\mathcal{L}=\mathbb{E}_0\sum_{t=0}^{\infty}\beta^t\Big\{&\frac{1}{2}\left[(\gamma+\sigma^{-1})\widetilde{y}_t^2+\boldsymbol{\pi}_t\mathcal{H}^{\text{within}}\boldsymbol{\pi}_t+\boldsymbol{\delta}_t^T\mathcal{H}^{\text{across}}\boldsymbol{\delta}_t+\psi_{wc}(c_t^K-c_t^R)^2\right]+\boldsymbol{\vartheta}_t^T(\boldsymbol{p}_t-\boldsymbol{\pi}_t-\boldsymbol{p}_{t-1})\\ &+\boldsymbol{\xi}_t^T\left(\boldsymbol{\pi}_t-\mathcal{K}\widetilde{y}_t+\mathcal{J}(\boldsymbol{p}_{t-1}+\boldsymbol{a}_t)-\beta(I-\mathcal{J})\mathbb{E}_t\boldsymbol{\pi}_{t+1}\right)\Big\},\end{aligned} \tag{E.43}$$

where $\boldsymbol{\vartheta}_t$ and $\boldsymbol{\xi}_t$ are the Lagrangian multipliers for the law of motion of sectoral prices and the sectoral Phillips curves, respectively.

$$\begin{aligned}\boldsymbol{\delta}_t &= \Phi^{-1}(1-\Phi)(\pi_t-\beta\mathbb{E}_t\boldsymbol{\pi}_{t+1})+\widetilde{\boldsymbol{\omega}}_K\left[(1-\psi_{c\pi})(\boldsymbol{\omega}_K^T-\boldsymbol{\omega}_R^T)(\boldsymbol{\pi}_t+\boldsymbol{p}_{t-1})+\psi_{cy}\widetilde{y}_t\mathbf{1}\right]\\ c_{K,t}-c_{R,t} &= \psi_{cy}\widetilde{y}_t-\psi_{c\pi}(\boldsymbol{\omega}_K^T-\boldsymbol{\omega}_R^T)(\boldsymbol{\pi}_t+\boldsymbol{p}_{t-1}),\end{aligned}$$

where recall that

$$\psi_{cy} = \frac{\chi_y - 1}{1-\lambda}$$
$$\psi_{c\pi} = \frac{\gamma+1}{\gamma+\sigma^{-1}}$$
$$\psi_{wc} = \left(\frac{\sigma^{-2}}{\gamma} + \sigma^{-1} - 1\right)\lambda(1-\lambda)$$

First-order condition for $\widetilde{y}_t$:

$$\mathcal{K}^T \boldsymbol{\xi}_t = (\gamma+\sigma^{-1})\widetilde{y}_t + \psi_{cy}\widetilde{\boldsymbol{\omega}}_k^T \mathcal{H}^{\text{cross}} \boldsymbol{\delta}_t + \psi_{wc}\psi_{cy}(c_t^K - c_t^R), \tag{E.44}$$

First-order condition for $\boldsymbol{\pi}_t$:

$$\begin{aligned}\mathcal{H}_t^{\text{within}}\boldsymbol{\pi}_t + \left[(I-\Phi)\Phi^{-1} + (1-\psi_{c\pi})(\boldsymbol{\omega}_K - \boldsymbol{\omega}_R)\widetilde{\boldsymbol{\omega}}_K^T\right]\mathcal{H}^{\text{across}}\boldsymbol{\delta}_t - \psi_{wc}\psi_{c\pi}(c_t^K - c_t^R)(\boldsymbol{\omega}_K - \boldsymbol{\omega}_R) \\ + \boldsymbol{\xi}_t - (I-\mathcal{J})^T \boldsymbol{\xi}_{t-1} - \boldsymbol{\vartheta}_t - (I-\Phi)\Phi^{-1}\mathcal{H}^{\text{across}}\boldsymbol{\delta}_{t-1} = 0 \end{aligned} \tag{E.45}$$

First-order condition for $\boldsymbol{p}_t$:

$$\beta\mathbb{E}_t\boldsymbol{\vartheta}_{t+1} - \boldsymbol{\vartheta}_t - \beta\mathcal{J}^T\mathbb{E}_t\boldsymbol{\xi}_{t+1} = \beta(1-\psi_{c\pi})(\boldsymbol{\omega}_K - \boldsymbol{\omega}_R)\widetilde{\omega}_K^T\mathcal{H}^{\text{across}}\mathbb{E}_t\boldsymbol{\delta}_{t+1} - \beta\psi_{wc}\psi_{c\pi}\left(c_t^K - c_t^R\right)(\boldsymbol{\omega}_K - \boldsymbol{\omega}_R) \tag{E.46}$$

Multiplying $\mathcal{K}^T$ to both sides of equation (E.45) and adding to equation (E.44) yields express (41),

$$\left(\gamma+\sigma^{-1}\right)\widetilde{y}_t + B_\pi\boldsymbol{\pi}_t + B_\delta\boldsymbol{\delta}_t + B_C(c_t^K - c_t^R) = \mathcal{K}^T(I-\mathcal{J})^T\boldsymbol{\xi}_{t-1} + \mathcal{K}^T\boldsymbol{\vartheta}_t + B_{-1,\delta}\boldsymbol{\delta}_{t-1}, \tag{E.47}$$

where

$$\begin{aligned} B_\pi &= \mathcal{K}^T\mathcal{H}^{\text{within}}, \\ B_\delta &= \left(\psi_{cy}\widetilde{\boldsymbol{\omega}}_K^T + \mathcal{K}^T F\right)\mathcal{H}^{\text{across}}, \\ B_c &= \psi_{wc}\left[\psi_{cy} - \psi_{c\pi}\mathcal{K}^T(\boldsymbol{\omega}_K - \boldsymbol{\omega}_R)\right], \\ B_{-1,\delta} &= \mathcal{K}^T(I-\Phi)\Phi^{-1}\mathcal{H}^{\text{across}}, \end{aligned} \tag{E.48}$$

and the coefficient matrix F is defined as

$$F = (I-\Phi)\Phi^{-1} + (1-\psi_{c\pi})(\boldsymbol{\omega}_K - \boldsymbol{\omega}_R)\widetilde{\boldsymbol{\omega}}_K^T.$$

E.7 Optimal Inflation-Targeting Policy

In this section, we characterize the optimal inflation indexes. The following proposition first gives the optimal weight of inflation indexes in vector form.

Proposition 9. *Assuming that the discount factor $\beta = 0$ and $\boldsymbol{p}_{t-1} = 0$, the optimal monetary policy in period* *t can be implemented by an inflation-stabilization policy of the form*

$$\boldsymbol{\varphi}^T \boldsymbol{\pi}_t = 0, \quad \textit{with} \quad \boldsymbol{\varphi} = \boldsymbol{\varphi}^{RANK} + \boldsymbol{\varphi}^{TANK} + \boldsymbol{\varphi}^{TANK\text{-}HT},$$

where

$$\boldsymbol{\varphi}^{RANK} = \underbrace{\boldsymbol{\omega}^T(I-\Phi)\Phi^{-1}}_{\textit{output gap}} + \underbrace{\mathcal{K}^T\mathcal{H}^{within}}_{\textit{within-sector dispersion}} + \underbrace{\mathcal{K}^T(I-\Phi)\Phi^{-1}\mathcal{H}^{across}\Phi^{-1}(I-\Phi)}_{\textit{cross-sector dispersion}}, \tag{E.49}$$

$$\boldsymbol{\varphi}^{TANK} = \underbrace{[\psi_{wc}\psi_{cy}^2/(\gamma+\sigma^{-1})]\boldsymbol{\omega}^T(I-\Phi)\Phi^{-1}}_{\textit{inequality}}, \tag{E.50}$$

$$\begin{aligned}
\boldsymbol{\varphi}^{TANK\text{-}HT} = & \underbrace{\psi_{cy}\widetilde{\boldsymbol{\omega}}_K^T\mathcal{H}^{across}\left[I + \frac{\psi_{cy}}{\gamma+\sigma^{-1}}\widetilde{\boldsymbol{\omega}}_K\boldsymbol{\omega}^T\right](I-\Phi)\Phi^{-1} + \frac{\psi_{cy}}{\gamma+\sigma^{-1}}\mathcal{K}^T(I-\Phi)\Phi^{-1}\mathcal{H}^{across}\widetilde{\boldsymbol{\omega}}_K\boldsymbol{\omega}^T(1-\Phi)\Phi^{-1}}_{\textit{cross-sector dispersion}} \\
& + \underbrace{(1-\psi_{c\pi})\mathcal{K}^T(\boldsymbol{\omega}_K-\boldsymbol{\omega}_R)\widetilde{\boldsymbol{\omega}}_K^T\mathcal{H}^{across}\left[\Phi^{-1}(I-\Phi)+\widetilde{\boldsymbol{\omega}}_K[\psi_{cy}\widetilde{y}+(1-\psi_{c\pi})(\boldsymbol{\omega}_K^T-\boldsymbol{\omega}_R^T)]\right]}_{\textit{cross-sector dispersion}} \\
& + \underbrace{\left\{\psi_{cy}\widetilde{\boldsymbol{\omega}}_K^T + \mathcal{K}^T\left[(I-\Phi)\Phi^{-1}+(1-\psi_{c\pi})(\boldsymbol{\omega}_K-\boldsymbol{\omega}_R)\widetilde{\boldsymbol{\omega}}_K^T\right]\right\}\mathcal{H}^{across}(1-\psi_{c\pi})\widetilde{\boldsymbol{\omega}}_K(\boldsymbol{\omega}_K^T-\boldsymbol{\omega}_R^T)}_{\textit{cross-sector dispersion}} \\
& + \underbrace{-\psi_{wc}\psi_{c\pi}\psi_{cy}\mathcal{K}^T(\boldsymbol{\omega}_K-\boldsymbol{\omega}_R)\widetilde{y}_t - \psi_{wc}\psi_{c\pi}\left[\psi_{cy}-\psi_{c\pi}\mathcal{K}^T(\boldsymbol{\omega}_K-\boldsymbol{\omega}_R)\right](\boldsymbol{\omega}_K^T-\boldsymbol{\omega}_R^T)}_{\textit{inequality}}
\end{aligned} \tag{E.51}$$

Proposition 9 shows that introducing heterogeneous agents and heterogeneous consumption baskets affects central banks' incentives to stabilize the cross-sector price dispersion as well as to stabilize inequality. The next corollary presents the optimal inflation index for individual sectors. The sector-i specific terms are highlighted in bold font.

Corollary 4. *The weight for the optimal inflation index in sector i is given by*

$$\varphi_i = \varphi_i^{RANK} + \varphi_i^{TANK} + \varphi_i^{TANK\text{-}HT},$$

where

$$\varphi_i^{RANK} = \underbrace{\boldsymbol{\omega_i (1/\phi_i - 1)}}_{\textit{output gap}} + \underbrace{\frac{\theta(\sigma^{-1}+\gamma)\boldsymbol{\omega_i(1-\phi_i)}}{1-\sum_{j=1}^{I}\omega_j\phi_j}}_{\textit{within-sector dispersion}} + \underbrace{\frac{1}{2}\frac{\boldsymbol{\omega_i(1/\phi_i - 1)}\left[\left(\sum_{h=1}^{I}\omega_h\phi_h\right)-\boldsymbol{\phi_i}\right](\sigma^{-1}+\gamma)}{1-\sum_{j=1}^{I}\omega_j\phi_j}}_{\textit{cross-sector dispersion}} \tag{E.52}$$

$$\varphi_i^{TANK} = e_1 \cdot \underbrace{\boldsymbol{\omega_i (1/\phi_i - 1)}}_{\textit{inequality}} \tag{E.53}$$

$$\begin{aligned}\varphi_i^{TANK\text{-}HT} = & \underbrace{\left(d_1 + d_2 + \frac{\psi_{cy}(\boldsymbol{\widetilde{\omega}_{K,i}} - \sum_h \widetilde{\omega}_{K,h}\omega_h)}{2}\right)\cdot \boldsymbol{\omega_i(1/\phi_i - 1)}}_{\textit{cross-sector dispersion}} \\ & + \underbrace{(f_1+f_2)\cdot(\boldsymbol{\omega_{K,i} - \omega_{R,i}}) + f_3\cdot\boldsymbol{\omega_i(1/\phi_i - 1)} + f_4\cdot(\boldsymbol{\widetilde{\omega}_{K,i}} - \sum_h \widetilde{\omega}_{K,h}\omega_h)\boldsymbol{\omega_i(1/\phi_i - 1)}}_{\textit{cross-sector dispersion}} \\ & + \underbrace{g_1 \cdot \boldsymbol{\omega_i}\left(\boldsymbol{1/\phi_i - 1}\right) + g_2\cdot(\boldsymbol{\omega_{K,i} - \omega_{R,i}}) + g_3\cdot(\boldsymbol{\omega_{K,i} - \omega_{R,i}})}_{\textit{inequality}}\end{aligned} \tag{E.54}$$

where d_1*,* d_2*,* e_1*,* f_1*,* f_2*,* f_3*,* f_4*,* g_1*,* g_2*, and* g_3 *are sector-invariant constants, whose expressions are given by*

$$\begin{aligned}
d_1 &= \left[\frac{1}{2(\gamma+\sigma^{-1})}\sum_{j,h}\omega_j\omega_h(\widetilde{\omega}_{K,j}-\widetilde{\omega}_{K,h})^2\right]\psi_{cy}^2; \\
d_2 &= \frac{\psi_{cy}}{2(1-\sum_h\omega_h\phi_h)}\left[\sum_j\sum_h\omega_j\omega_h(\phi_j-\phi_h)(\widetilde{\omega}_{K,h}-\widetilde{\omega}_{K,j})\right] \\
e_1 &= \frac{\psi_{wc}\psi_{cy}^2}{\gamma+\sigma^{-1}} \\
f_1 &= \frac{\psi_{cy}(1-\psi_{c\pi})}{(1-\sum_h\omega_h\phi_h)}\left[\sum_{j=1}^{I}\phi_j(\omega_{K,j}-\omega_{R,j})\right]\left[\sum_j\sum_h\omega_j\omega_h(\omega_j-\omega_h)^2\right] + \frac{\psi_{cy}(1-\psi_{c\pi})}{2}\sum\left[\omega_j\omega_h(\widetilde{\omega}_{K,j}-\widetilde{\omega}_{K,h})^2\right] \\
f_2 &= \frac{\psi_{cy}(1-\psi_{c\pi})}{2(1-\sum_h\omega_h\phi_h)}\left[\sum_j\sum_h\omega_j\omega_h(\phi_j-\phi_h)(\widetilde{\omega}_{K,h}-\widetilde{\omega}_{K,j})\right] \\
f_3 &= \frac{(\sigma^{-1}+\gamma)(1-\psi_{c\pi})^2}{1-\sum_h\omega_h\phi_h}\left[\sum_{j=1}^{I}\phi_j(\omega_{K,j}-\omega_{R,j})\right]\left[\sum_j\sum_h\omega_j\omega_h(\omega_j-\omega_h)^2\right] \\
f_4 &= \frac{(\sigma^{-1}+\gamma)(1-\psi_{c\pi})}{2(1-\sum_h\omega_h\phi_h)}\left[\sum_{j=1}^{I}\phi_j(\omega_{K,j}-\omega_{R,j})\right]
\end{aligned} \tag{E.55}$$

$$g_1 = -\frac{\psi_{wc}\psi_{c\pi}\psi_{cy}}{1-\sum_h \omega_h\phi_h}\left[\sum_{j=1}^{I}\phi_j(\omega_{K,j}-\omega_{R,j})\right]$$

$$g_2 = -\psi_{wc}\psi_{c\pi}\psi_{cy}$$

$$g_3 = \frac{\psi_{wc}\psi_{c\pi}^2(\sigma^{-1}+\gamma)}{1-\sum_h \omega_h\phi_h}\left[\sum_{j=1}^{I}\phi_j(\omega_{K,j}-\omega_{R,j})\right]$$

The next corollary further characterizes the optimal inflation index.

Corollary 5. *Suppose that the Kynesian households face on average greater price flexibility, i.e.,* $\sum_j \phi_j\omega_{K,j} > \sum_j \phi_j\omega_{R,j}$. *The following results hold:* $d_1 > 0$, $e_1 > 0$, $f_1 > 0$, $f_3 > 0$, $g_1 < 0$, $g_2 < 0$, $g_3 > 0$

Corollary 5 establishes that introducing heterogeneous consumption baskets presents the central bank with a trade-off between stabilizing cross-sectoral dispersion and stabilizing inequality. The existing TANK literature demonstrates that the motive to reduce inequality unambiguously strengthens output gap stabilization (reflected by $e_1 > 0$). When heterogeneous consumption baskets are introduced, the motive to stabilize inequality itself can alter policy incentives, possibly leading the optimal inflation index to assign greater weight to flexible-price sectors (reflected by $g_1 < 0$ and $g_3 > 0$).

E.7.1 Proof of Corollary 2

The expression for ϕ_i^{RANK} in (E.52) can be arranged as

$$\begin{aligned}\frac{\varphi_i^{\text{RANK}}}{\omega_i} &= \mathbf{(1/\phi_i - 1)} \;+\; \frac{\theta(\sigma^{-1}+\gamma)\mathbf{(1-\phi_i)}}{1-\sum_{j=1}^{I}\omega_j\phi_j} \;+\; \frac{\mathbf{(1/\phi_i - 1)}\left[\left(\sum_{h=1}^{I}\omega_h\phi_h\right)-\phi_i\right](\sigma^{-1}+\gamma)}{1-\sum_{j=1}^{I}\omega_j\phi_j}\\ &= \mathbf{(1/\phi_i - 1)} \;+\; \frac{\mathbf{(1/\phi_i - 1)}\left(\sum_{h=1}^{I}\omega_h\phi_h\right)(\sigma^{-1}+\gamma)}{1-\sum_{j=1}^{I}\omega_j\phi_j} \;+\; \frac{\mathbf{(1-\phi_i)}(\theta-1)(\sigma^{-1}+\gamma)}{1-\sum_{j=1}^{I}\omega_j\phi_j}\end{aligned}$$

Since $\phi_i \in (0,1)$ and $\theta > 1$, all three terms in the expression above are positive and decreasing with ϕ_i.

E.8 Optimal Monetary Policy: Discussion and Robustness

E.8.1 Welfare Weights

The welfare function is given by

$$\widetilde{\lambda}\left[U(C_t^K)-V(N_t^K)\right]+(1-\widetilde{\lambda})\left[U(C_t^R)-V(N_t^R)\right],$$

where $\widetilde{\lambda} \neq \lambda$. Note that we can rewrite the welfare function as follows,

$$\begin{aligned}&\widetilde{\lambda}\left[U(C_t^K)-V(N_t^K)\right]+(1-\widetilde{\lambda})\left[U(C_t^R)-V(N_t^R)\right]\\ &=\underbrace{\lambda\left[U(C_t^K)-V(N_t^K)\right]+(1-\lambda)\left[U(C_t^R)-V(N_t^R)\right]}_{\text{conventional term}}+\underbrace{(\widetilde{\lambda}-\lambda)\left[U(C_t^K)-U(C_t^R)\right]}_{\text{new consumption inequality}}-\underbrace{(\widetilde{\lambda}-\lambda)\left[V(N_t^K)-V(N_t^R)\right]}_{\text{new labor inequality}}\end{aligned} \tag{E.56}$$

The first term of equation (E.56) is the conventional term when the welfare weights coincide with the population weight $(\lambda, 1-\lambda)$. The second and third terms emerge because the central bank prefers allocating more consumption and less labor to the households with relatively more weight. That is, the first-best allocation entails consumption and labor supply inequality.

The second-order approximation of the conventional term is the same as in expression (34) with the derivation in Appendix E.5.3. We therefore only need to derive the second and

$$
\begin{aligned}
&(\tilde{\lambda}-\lambda)[U(Y_t^K)-U(Y_t^R)] \\
&= (\tilde{\lambda}-\lambda)U'(\overline{Y})\overline{Y}\left[y_t^K - y_t^R + \frac{1}{2}(1-\sigma^{-1})\left[(y_t^K)^2-(y_t^R)^2\right]\right] \\
&= U'(\overline{Y})\overline{Y}(\tilde{\lambda}-\lambda)(y_t^K - y_t^R)
\end{aligned}
$$

and the third term

$$
\begin{aligned}
&(\tilde{\lambda}-\lambda)[V(N_t^K)-V(N_t^R)] \\
&= (\tilde{\lambda}-\lambda)V'(\overline{Y})\overline{Y}\left[n_t^K - n_t^R + \frac{1}{2}(1-\sigma^{-1})\left[(n_t^K)^2-(n_t^R)^2\right]\right] \\
&= V'(\overline{Y})\overline{Y}(\tilde{\lambda}-\lambda)(n_t^K - n_t^R)
\end{aligned}
$$

The second equality holds because we assume that the welfare difference $\tilde{\lambda}-\lambda$ is small, so that we drop terms higher than the second order. Combining the three terms yields the welfare function

$$
\begin{aligned}
\widetilde{W}_t &= -\frac{1}{2}\Big[\left(\gamma+\sigma^{-1}\right)\tilde{y}_t^2 \; + \boldsymbol{\pi}_t^T\mathcal{H}^{\text{within}}\boldsymbol{\pi}_t \; + \boldsymbol{\delta}_t^T\mathcal{H}^{\text{across}}\boldsymbol{\delta}_t \; + \; \psi_{wc}\left(c_t^K-c_t^R\right)^2 - \underbrace{2(1+\sigma^{-1})(\tilde{\lambda}-\lambda)(c_t^K-c_t^R)}_{\text{new term}}\Big] \\
&= -\frac{1}{2}\Big[\left(\gamma+\sigma^{-1}\right)\tilde{y}_t^2 \; + \boldsymbol{\pi}_t^T\mathcal{H}^{\text{within}}\boldsymbol{\pi}_t \; + \boldsymbol{\delta}_t^T\mathcal{H}^{\text{across}}\boldsymbol{\delta}_t \; + \; \psi_{wc}\left[\left(c_t^K-c_t^R\right) - \underbrace{\left((1+\sigma^{-1})(\tilde{\lambda}-\lambda)/\psi_{wc}\right)^{1/2}}_{\text{new target}}\right]^2\Big]
\end{aligned}
\tag{E.57}
$$

Expression (E.57) implies that the central bank now targets non-zero inequalities, equal to $\left((1+\sigma^{-1})(\tilde{\lambda}-\lambda)/\psi_{wc}\right)^{1/2}$. This motive leads to inflation biases, and the optimal monetary policy with time-0 commitment could be different from our baseline model. However, the optimal commitment policy under the timeless perspective is the same as in our baseline model.

E.9 Optimal Monetary Policy: Examples

Our TANK-HT framework departs from Benigno (2004) in two assumptions: 1) the presence of two distinct household types (K and R) instead of a representative household, and 2) the introduction of heterogeneity in the consumption baskets of K and R households. We investigate how these two assumptions reshape the optimal inflation-targeting policy in Benigno (2004). We reveal that the second assumption qualitatively changes the optimal monetary policy, while the first assumption does not. To delve into the details, we initiate our analysis by temporarily disregarding the second assumption to isolate the effect of the first assumption.

The Role of Heterogeneous Agents. All households have identical consumption baskets, implying $\omega_1^K = \omega_1^R$ and $\omega_2^K = \omega_2^R$. Essentially, we are comparing a two-sector TANK model with a two-sector RANK model, assuming heterogeneous price stickiness between sectors.

Introducing heterogeneous agents, as opposed to its RANK counterpart, introduces an inequality term to the welfare loss function. This term turns out to be proportional to the output gap, as shown by the following corollary:

Corollary 6. *The approximated welfare loss function when households have homogeneous consumption baskets is given by*

$$W_t = -\frac{V'(\overline{Y})\overline{Y}}{2}\Bigg[\underbrace{(\gamma+\sigma^{-1})(y_t-y_t^n)^2+\frac{\omega_i\theta\alpha_i}{(1-\alpha_i)^2}\pi_{i,t}^2+\sum_{i,j}\omega_i\omega_j\left[(y_{i,t}-y_{j,t})-(a_{i,t}-a_{j,t})\right]^2}_{\text{Conventional term}}$$
$$\underbrace{+(\sigma^{-1}+\gamma-\gamma/\sigma^{-1})\lambda(1-\lambda)\frac{\sigma^{-1}}{\gamma}\left(\frac{\chi_y-1}{1-\lambda}\right)^2(y_t-y_t^n)^2}_{\text{Inequality term}}\Bigg], \quad \text{(E.58)}$$

The expression (E.58) implies that, compared to the RANK model in Benigno (2004), the central bank finds it optimal to put a greater weight on stabilizing the aggregate output gap. However, given that output gap stabilization is already deemed nearly optimal in Benigno (2004),[38] introducing heterogeneous agents does not qualitatively change the optimal monetary policy.

In the context of inflation-targeting policies, the redistributive motive suggests that the central bank benefits from adopting a more aggressive stance in stabilizing the inflation of the sector with stickier prices. This is due to the fact that an equivalent amount of variation in the sectoral inflation results in a smaller sectoral output gap when a sector has relatively stickier prices.

A Numerical Example. We use a numerical example to illustrate the role of heterogeneous agents in Section 6.3.6. The model is calibrated as follows. We follow Woodford (2003) Chapter 4.3 to generate a similar degree of strategic complementarity and the slope of sectoral Phillips curves, so that we set the elasticity of substitution σ to be 5 and the inverse of Frisch elasticity γ to be 0.2. We set the elasticity of substitution across differentiated goods θ to be 4, so that the average markup is 66%.

For illustrative purposes, we set consumption weights $\omega_1^K = \omega_1^R = \omega_2^K = \omega_2^R = 0.5$. We set $\alpha_1 = 0.5 - \Delta\alpha$ and $\alpha_2 = 0.5 + \Delta\alpha$, and vary $\Delta\alpha$ from 0 to 0.5.[39] We consider and compare two models: RANK when $\lambda = 0$ and TANK when $\lambda = 0.5$.

Panel (a) and panel (b) of Figure E.1 show the welfare loss of (1) CPI stabilization policy (2) stabilizing the optimal inflation index (OII) and (3) the output-gap stabilization policy in RANK and TANK, respectively.[40]

[38] Recent papers studying optimal monetary policy in RANK have similar findings (e.g., Rubbo (2023); La'O and Tahbaz-Salehi (2022))

[39] Note that the frequency of price changes in sector i is $1-\alpha_i$. So prices in sector 2 are more sticky.

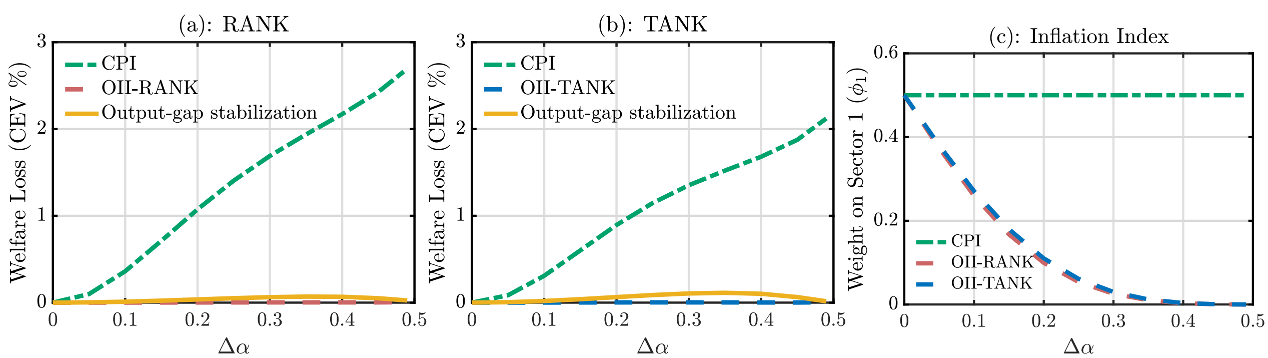
[40] All welfare losses are relative to the welfare loss under the optimal monetary policy.

In both cases, the welfare difference between stabilizing the OII and the optimal policy is negligible. Output-gap stabilization is also nearly optimal, leading to slightly greater welfare loss than OII. Stabilizing CPI is not desirable when the difference in price stickiness between the two sectors is large.

Panel (c) of Figure E.1 plots ϕ_1: the weight on sector 1 (the flexible-price sector) of the optimal inflation index. Compared to RANK, the optimal inflation index (OII) in TANK assigns more weight to sector 2, the sector with more sticky prices. However, the difference between OII-RANK and OII-TANK is small, consistent with the prediction of our theory.

The results demonstrate that stabilizing the aggregate output gap is nearly optimal in both RANK and TANK. However, compared to RANK, the optimal inflation index in TANK assigns more weight to the sector with stickier prices.

Figure E.1: Monetary Policies: RANK vs TANK



Note: Panel (a) and panel (b) plot how the the welfare loss (relative to optimal policy) vary with difference in price stickiness $\Delta\alpha = (\alpha_2 - \alpha_1)/2$ under different monetary policies: stabilizing the output gap, stabilizing the CPI, stabilizing the optimal inflation index in RANK (OII-RANK) and in TANK (OII-TANK) respectively. Panel (c) plots how the weight on the flexible-price sector 1 varies with $\Delta\alpha$.

F Figures and Tables

Figure F.1: Housing Tenure Status: Household Demographics

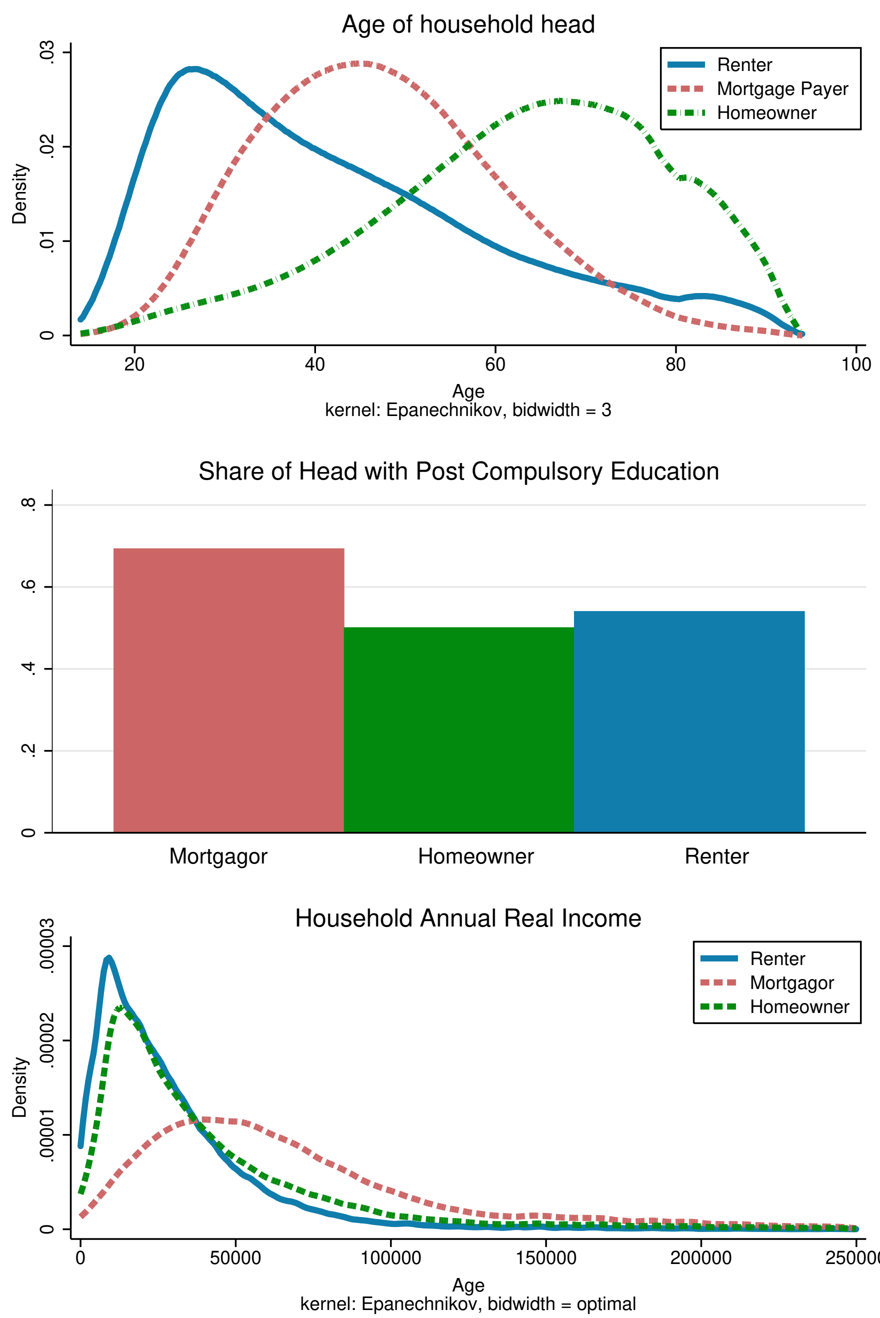


Table F.1: Top Contributors and Mitigators to the Difference in Household Price Flexibility

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Contributions	Expenditure Shares			Freq of Regular	HHs. Price Flexibility Breakdown	
	(%) $\frac{(\omega^h_{j,t}-\omega^h_{i,t})\alpha_j}{\alpha^h-\alpha^g}$	Mortgagors ω^h_j	Homeowners ω^g_j	Differences $\omega^h_j-\omega^g_j$	Price Changes α_j	Mortgagors $\frac{w^h_j\alpha_j}{\alpha^h}$	Homeowners $\frac{w^g_j\alpha_j}{\alpha^g}$
Top 10 largest contributors to the difference in mortgagors' and homeowners' price flexibility							
Gasoline	114.7	9.0	3.5	5.4	87.7	37.7	18.5
Used Cars	9.3	1.9	1.5	0.4	100.0	9.0	9.0
Vehicle Leasing	2.5	0.6	0.4	0.2	42.4	1.3	1.0
Day Care And Nursery School	1.4	1.0	0.2	0.8	6.9	0.3	0.1
Cellular Telephones	1.1	1.7	1.4	0.3	13.0	1.1	1.1
Limited Service Meals And Snacks	0.8	2.5	1.9	0.5	6.1	0.7	0.7
Diesel And Alternative Fuels	0.6	0.2	0.1	0.1	45.2	0.4	0.3
Subcompact Cars	0.4	4.3	4.2	0.1	31.3	6.4	7.9
Elementary And High School Tuition And Fixed Fees	0.4	0.5	0.3	0.3	6.2	0.2	0.1
Full College Tuition And Fixed Fees	0.3	1.6	1.4	0.2	5.8	0.4	0.5
Top 10 largest mitigators to the difference in mortgagors' and homeowners' price flexibility							
Electricity	-6.2	3.1	3.7	-0.7	38.1	5.6	8.6
Prescription Drugs	-4.3	4.4	5.6	-1.2	15.0	3.1	5.0
Utility Natural Gas Service	-2.8	1.1	1.3	-0.2	72.4	3.9	5.6
Fuel Oil	-2.4	0.2	0.3	-0.1	68.0	0.6	1.4
Hospital Services	-2.0	11.3	12.6	-1.3	6.3	3.4	4.7
Rental Of Lodging Away From Home	-1.1	0.9	1.0	-0.1	41.7	1.8	2.5
Motor Vehicle Insurance	-1.0	2.5	3.0	-0.5	8.2	1.0	1.5
Bottled Or Tank Gas	-0.9	0.1	0.2	-0.1	37.9	0.3	0.6
Airline Fare	-0.9	0.9	0.9	-0.1	59.8	2.5	3.3
General Medical Practice	-0.8	8.5	9.6	-1.0	3.4	1.4	1.9

Note: This table reports the top 10 product categories that contribute to or offset the difference in price flexibility between mortgagors and homeowners (column 1). Columns 2-4 show the average expenditure shares of mortgagors and homeowners on these products over the period 2004-2019, where $\omega^h_j = \frac{1}{T}\sum_1^T \omega^h_{j,t}$ and $\omega^g_j = \frac{1}{T}\sum_1^T \omega^g_{j,t}$ Columns 5 reports the frequency of regular price changes of these categories. Columns 7-8 show the contributions of these product categories to the overall price flexibility of mortgagors and homeowners, respectively.

Table F.2: Expenditure Share Differences and Frequency of Price Changes

Category	Expenditure Shares			Freq of Regular
	Morgagors	Homeowners	Differences	Price Changes (%)
Top 10 larger expenditure shares by mortgagors				
Gasoline(all types)	9.0	3.5	5.4	87.7
Day care and nursery school	1.0	0.2	0.8	6.9
Limited Service meals and snacks	2.5	1.9	0.5	6.1
Used cars	1.9	1.5	0.4	100.0
Cellular Telephones	1.7	1.4	5.4	13.0
Elementary/high school tuition and fixed fees	0.5	0.3	0.3	6.2
Vehicle leasing	0.6	0.4	0.2	42.4
Full college tuition and fixed fees	1.6	1.4	0.2	5.8
Fees for lessons or instructions	0.3	0.1	0.2	3.3
Food at employee sites and schools	0.3	0.2	0.1	2.9
Top 10 larger expenditure shares by homeowners				
Hospital services	11.3	12.6	-1.3	6.3
Prescription drugs	4.4	5.6	-1.2	15.0
General medical practice	8.5	9.6	-1.0	3.4
Electricity	3.1	3.7	-0.7	38.1
Motor vehicle insurance	2.5	3.0	-0.5	8.1
Prosthodontics and implants	2.3	2.7	-0.5	4.5
Funeral expenses	0.1	0.4	-0.3	8.9
Community antenna or cable TV	1.4	1.7	-0.3	12.4
Care of elderly in the home	0.0	0.3	-0.3	2.8
Internal and respiratory drugs	0.4	0.6	-0.2	7.9

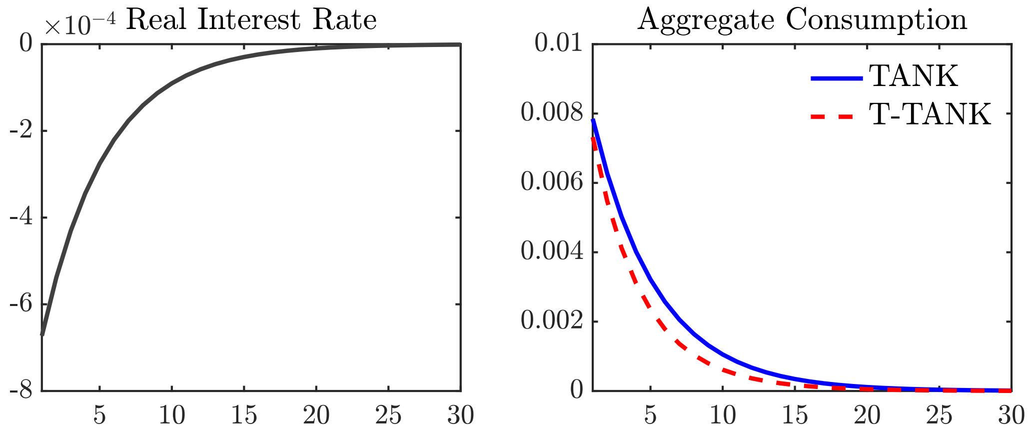
Note: This table presents the top 10 product categories with the largest differences in expenditure shares between mortgagors and homeowners and reports the frequency of regular price changes for these categories. The expenditure shares are calculated as averages over the period 2004-2019.

Table F.3: Top 10 Highest and Least Contributors to the Volatility of the IPI Inflation

	(1)	(2)	(3)	(4)	(5)	(6)
	Changes in Inflation Volatility			Volatility of Inflation		
	IPI $\Delta sd(P^h - P^g)$	High MPC $\Delta sd(P^h)$	Low MPC $\Delta sd(P^g)$	IPI $sd(P^h - P^g)$	High MPC $sd(P^h)$	Low MPC $sd(P^g)$
Top 10 Highest Contributors to the Inequality Price Index Inflation Volatility						
Gasoline (all types)	-41.924	-49.376	-36.853	0.078	0.327	0.362
Gardening and lawncare services	-0.588	0.356	0.591	0.158	0.759	0.643
Funeral expenses	-0.231	0.337	0.603	0.159	0.759	0.644
Other lodging away from home including hotels and motels	-0.114	1.161	1.776	0.159	0.763	0.647
Outdoor equipment and supplies	-0.032	0.513	0.728	0.159	0.760	0.644
Domestic services	0.108	0.393	0.472	0.159	0.759	0.642
Floor coverings	0.145	0.314	0.236	0.160	0.759	0.641
Sports vehicles including bicycles	0.175	0.333	0.202	0.160	0.759	0.641
Tenants' and household insurance	0.210	0.486	0.649	0.159	0.760	0.644
Care of invalids and elderly at home	0.226	0.189	0.220	0.160	0.757	0.641
Top 10 Lowest Contributors to the Inequality Price Index Inflation Volatility						
Fuel oil	9.287	-1.556	-4.327	0.175	0.742	0.607
Limited service meals and snacks	7.050	3.218	1.786	0.173	0.783	0.651
Hospital services	6.854	8.159	7.217	0.165	0.791	0.670
Physicians' services	6.309	8.083	8.277	0.164	0.791	0.675
Utility (piped) gas service	5.935	-3.451	-6.509	0.167	0.714	0.574
College tuition and fees	4.976	2.253	1.173	0.168	0.774	0.648
Child care and nursery school	4.479	1.239	0.221	0.167	0.767	0.641
Motor vehicle insurance	4.358	2.816	2.460	0.166	0.784	0.662
Full service meals and snacks	2.977	2.838	2.755	0.165	0.780	0.658
Wireless telephone services	2.747	0.694	0.061	0.165	0.765	0.643
All items				0.159	0.639	0.756

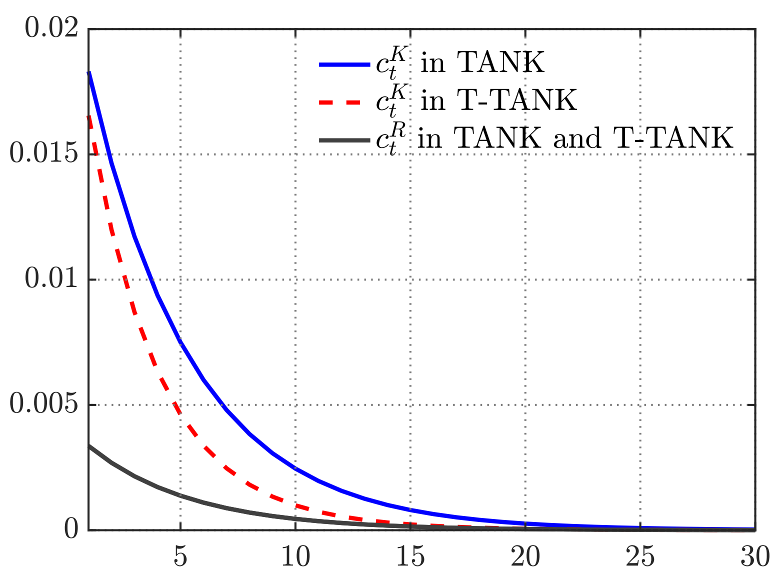
Note: This table presents the top 10 items with the highest and lowest contributions to the volatility of the Inequality Price Index (IPI) inflation. Columns 2-4 display the change in the volatility of IPI inflation, as well as inflation for high-MPC and low-MPC households, resulting from the exclusion of each item. Columns 5-6 report the standard deviation of IPI inflation and inflation for high-MPC and low-MPC households, after excluding each corresponding item. The final row shows the baseline volatilities for IPI, high-MPC, and low-MPC inflation using the full consumption basket (i.e., including all items).

Figure F.2: IRFs: Real Interest Rates and Aggregate Consumption



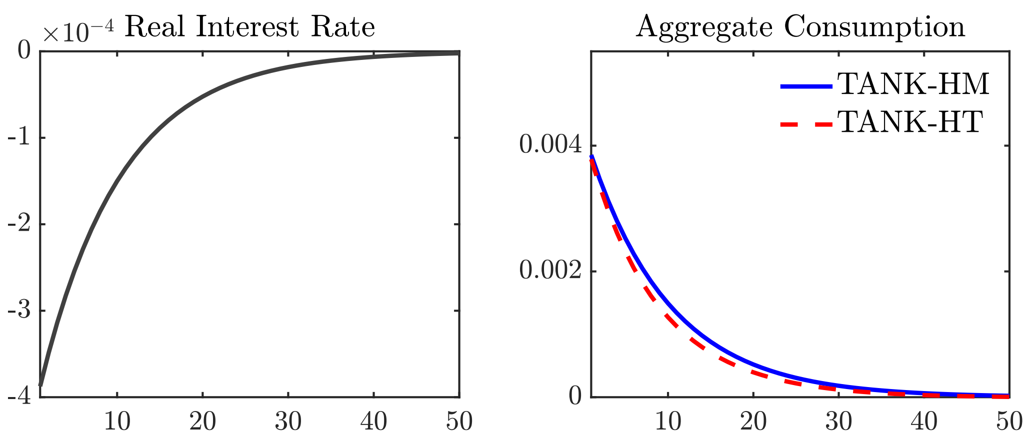
Note: This figure plots the path of real interest rate and the IRFs of aggregate consumption in the numerical example in Section D.3 when $\Delta_\alpha = 0.1$.

Figure F.3: IRFs: K's and R's Consumption



Note: This figure plots the IRFs of Keynesians' and Ricardians' consumption in TANK and TANK-HT in the numerical example in Section D.3 when $\Delta_\alpha = 0.1$.

Figure F.4: IRFs: Real Interest Rates and Aggregate Consumption



Note: This figure plots the path of the future real interest rate, and the IRFs of aggregate consumption to this real interest rate shock in TANK-HT and TANK-HM in our calibrated model in Section 5.2.

PUBLICATIONS

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