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Inflation Inequality in Taiwan

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This article examines the long-run evolution of cost-of-living disparities across income groups in Taiwan. Using detailed household expenditure data from the Survey of Family Income and Expenditure matched with official Consumer Price Index statistics, we construct income-specific cost-of-living indices for the bottom 20 percent, middle 60 percent, and top 20 percent of households over 1986–2017. We find that the cost of living has risen for all groups, but the increase has been largest for low-income households and smallest for high-income households. To investigate the underlying mechanisms, we estimate income-group-specific substitution elasticities within a constant elasticity of substitution (CES) utility framework that allows substitution behavior to vary across groups. The results show that higher-income households exhibit greater substitution flexibility in response to relative price changes, while lower-income households are more exposed to rising prices of essential goods and face limited adjustment opportunities, thereby amplifying the real burden of inflation and contributing to widening inequality over time.

Keywords: inflation inequality, sato-vartia index, consumption basket
JEL classification: C81, D12

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1 Introduction

Inflation directly affects household welfare through its impact on real purchasing power, but not all households experience it in the same way. A growing body of research has documented how inflation disproportionately burdens certain income groups - a phenomenon known as inflation inequality (e.g., Hobijn and Lagakos (2005); McGranahan and Paulson (2006); Jaravel (2019) and Chien, Lin, and Tsai (2026)). Much of this work focuses on countries like the United States and those in Europe, where inflation has been more volatile and responsive to domestic demand and policy shifts. In contrast, Taiwan has maintained low and stable headline inflation since the 1980s, with annual rates typically below 2%. Despite this stability, rising concerns about living costs, stagnant wages, and worsening housing affordability highlight the possibility that inflationary pressures differ substantially across income groups. Furthermore, since households consume different combinations of goods and services, heterogeneous price changes can produce markedly different cost-of-living experiences—even when overall inflation is low. Yet, a systematic investigation of inflation inequality in Taiwan is still lacking.

This paper fills an important gap by providing the first long-run analysis of inflation inequality in Taiwan from 1986 to 2017. Using detailed household expenditure data from Taiwan's Survey of Family Income and Expenditure (SFIE), matched with official Consumer Price Index (CPI) categories, we construct income-specific cost-of-living indices for high-, middle-, and low-income households. Expenditures are aggregated into CPI-consistent categories, and we apply a Sato-Vartia index to measure inflation in a manner that incorporates both price changes and consumer substitution.

Our findings show a persistent gradient in effective inflation rates across the income distribution: low-income households consistently experience higher inflation than high-income households, with middle-income households in between. This pattern is largely driven by differences in consumption baskets. Essential goods—particularly food—have exhibited faster price growth and constitute a substantially larger share of spending for low-income households. Middle-income households still devote a significant portion of their expenditures to necessities, though less so than low-income households. By contrast, high-income households allocate a greater share of their budgets to discretionary categories, such as education, recreation, and transportation, which have recorded comparatively slower price increases

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over time.

To investigate the underlying mechanism behind this divergence, we adopt a constant-elasticity-of-substitution (CES) utility framework that allows for heterogeneity in substitution elasticity across income groups. Our estimates show a systematic increase in substitution flexibility across income groups: higher-income households exhibit the greatest elasticity (1.86), followed by middle-income households (1.22), and lower-income households (0.79). This pattern reflects systematic differences in consumption composition. Higher-income households allocate a larger share of their budgets to flexible, discretionary goods, whereas lower-income households devote most of their spending to necessities that are difficult to substitute. Consequently, lower-income households are not only more exposed to inflationary pressures but also less able to adjust their spending in response to relative price changes, thereby amplifying real inequality over time.

These findings carry important policy implications. Because households differ in their ability to substitute across goods, an aggregate inflation rate can obscure important disparities in welfare losses across income groups. In particular, expansionary monetary policies aimed at stabilizing aggregate output or employment may have unequal welfare effects across households. Low-income households - whose budgets are heavily concentrated in necessity goods such as food, housing, and utilities—are more directly exposed to price increases in these categories and face limited substitution opportunities. As a result, increases in aggregate demand tend to translate more directly into higher living costs for these households. In contrast, higher-income households are partially insulated from such pressures through greater substitution flexibility across consumption categories and through exposure to asset-price channels, including housing and financial assets, which may offset consumption-based welfare losses. This asymmetry highlights inflation inequality as an important, yet often overlooked, dimension of monetary policy transmission, even in low-inflation environments.

On the fiscal side, our results point to a clear role for targeted policy interventions that explicitly account for heterogeneity in consumption baskets and substitution behavior. Instruments such as food and energy subsidies, temporary utility support, or transfers indexed to group-specific cost-of-living measures can help mitigate the regressive effects of inflation borne by lower-income households. More broadly, the availability of income-group-specific CPI series in Taiwan provides a practical basis for adjusting social transfers, minimum-income programs, or pensions using group-specific in-

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flation measures rather than a single aggregate CPI. Such an approach would better preserve real purchasing power for vulnerable households and improve the effectiveness of social safety nets.

Taken together, these considerations demonstrate that inflation inequality can remain economically meaningful even in a low-inflation economy such as Taiwan, and that recognizing household heterogeneity in both consumption composition and substitution capacity is essential for designing coordinated monetary and fiscal policies that stabilize the macroeconomy without generating unintended distributional consequences.

Our paper is most closely related to Argente and Lee (2021), who construct household-level inflation indices and estimate substitution elasticities to analyze inflation inequality in the United States. Like their study, we emphasize the dual importance of expenditure composition and substitution behavior in shaping heterogeneous inflation experiences across income groups. However, our study differs in several important respects. First, unlike Argente and Lee (2021), who rely on scanner data heavily dominated by food expenditures, we use comprehensive household survey data that cover both goods and services and more accurately reflect the full consumption basket underlying official inflation measures. Second, the limited time span of scanner datasets constrains the analysis in Argente and Lee (2021) to a relatively short period, whereas our data cover more than three decades, enabling us to assess long-term trends in inflation inequality. Third, we focus on Taiwan—a low-inflation, export-oriented economy with distinctive macroeconomic and institutional features. By extending the analysis beyond high-inflation advanced economies, we provide new evidence on how inflation inequality manifests in more stable price environments and under different consumption structures. Finally, whereas Argente and Lee (2021) find no statistically significant differences in substitution elasticities across income groups in the United States, our results for Taiwan reveal pronounced heterogeneity: higher-income households exhibit substantially greater substitution flexibility, followed by middle-income households, with lower-income households displaying the lowest elasticity. This contrast highlights that the degree of price responsiveness may depend not only on data coverage and time horizon, but also on structural differences in consumption composition and income distribution across economies. Together, these differences allow us to offer broader and more generalizable insights into the drivers and persistence of inflation inequality.

Our study makes two key contributions. First, it provides the first

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systematic measurement of inflation inequality in Taiwan using over three decades of household-level data, offering unique insights from a stable, low-inflation context. Second, we extend existing frameworks for cost-of-living indices and substitution elasticities to accommodate comprehensive survey data, which allows us to identify meaningful heterogeneity in substitution elasticities across income groups. These contributions provide new insights with practical implications for welfare analysis, inflation-inequality measurement, and policy design in Taiwan and beyond.

The remainder of the paper is organized as follows. Section 2 describes the data sources. Section 3 outlines the construction and computation of the cost-of-living indices. Section 4 introduces the CES utility framework, and Section 5 details the estimation procedure. Empirical estimates of the substitution elasticities are presented in Section 6. Section 7 concludes.

2 Data

This paper draws on two datasets to compute the cost of living for different income groups. The first is Taiwan's *Survey of Family Income and Expenditure (SFIE)*, which provides detailed information on household income, expenditures, and demographic characteristics. The second is the Consumer Price Index (CPI) for Taiwan, which reports the prices of goods and services purchased by domestic households. Below, we briefly describe each dataset.

2.1 The Survey of Family Income and Expenditure

The Survey of Family Income and Expenditure is a nationwide household survey conducted by the Directorate-General of Budget, Accounting and Statistics (DGBAS), Executive Yuan, Republic of China (Taiwan). Each year, approximately 15,000 to 20,000 households are sampled, representing about 0.2% of all families in Taiwan. The survey, launched in 1976, was initially conducted every two years and later became an annual exercise. It gathers comprehensive data on household spending across 12 broad categories, including clothing, housing, food, education, transportation, and health care.[1]

[1]The survey provides the data necessary for calculating the Consumer Price Index and is primarily used to determine the expenditure weights applied to price changes in the construction of the overall CPI.

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For this study, we reclassify the original 12 expenditure categories into 7 broader groups to align them with the CPI classification. This harmonization allows us to match household expenditure data with corresponding price data for estimating group-specific cost-of-living indices. Because the composition of goods within each major category has changed over time, we adjust the category definitions to ensure consistency across the entire sample period.

2.2 Consumer Price Index

We use Taiwan's Consumer Price Index (CPI) to measure price changes across household consumption categories. The CPI tracks 368 representative goods and services, with approximately 33,000 monthly price quotes collected through in-person interviews in 17 cities and counties. For our analysis, we focus on seven broad CPI categories—Food, Clothing, Housing (RUU), Transportation and Communication (TC), Health, Education and Entertainment (EE), and Others. To align the CPI data with household expenditure records, we reclassify items from the Survey of Family Income and Expenditure into these categories, following the official DGBAS framework with minor adjustments for consistency and analytical clarity.

The Food category includes cereals and cereal products; supplementary foods such as meats, eggs, fish, seafood, and vegetables; fruit; dairy products; alcoholic beverages; nonalcoholic beverages; and food consumed away from home. The Clothing category includes garments (apparel, apparel services, and accessories); and footwear. The Housing (RUU) category comprises rent; maintenance; household appliances; household operations; and utilities such as water, electricity, and gas.[2] The TC category includes

[2]While the Survey of Family Income and Expenditure (SFIE) reports housing expenditures that include both actual rent paid by tenants and imputed rent for owner-occupied housing, the corresponding price data at a disaggregated level are not available. This reflects a data limitation on the price side rather than on the expenditure side. Taiwan's official CPI measures the cost of housing services using a rental equivalence framework and publishes a single aggregate rent price index within the broader "Housing, Residential Services, and Utilities" category. In particular, the CPI does not separately report price series for actual rents and imputed rents, nor does it provide rent price indices disaggregated by tenure status or income group. As a result, our analysis follows the official CPI methodology and uses the aggregate rent component to capture common movements in the market price of housing services, rather than attempting to construct tenure-specific housing price measures that are

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equipment for transportation and communication; fuels; services; and parts. The Health category includes medical care; medicines; health food; medical supplies; and medical appliances. The EE category includes education and entertainment expenses. The Others category includes tobacco; cosmetics; personal effects; nursery care; personal care; and other miscellaneous items.

2.3 Demographic Characteristics

The Survey of Family Income and Expenditure provides comprehensive demographic information for each household. We classify households into income groups based on per-capita disposable income. Although both total income and disposable income are reported in the survey, we classify households by disposable income per capita, as it more accurately reflects the resources available for consumption decisions.[3] To account for differences in household size, both disposable income and expenditures are divided by the number of household members. Households are ranked by their per-capita disposable income, with the bottom 20% classified as "poor," the middle 60% as "middle-income," and the top 20% as "rich."

To illustrate demographic patterns across the income distribution, we summarize household characteristics for 2017.[4] Rich households (Top 20%) have an average per-capita disposable income of NTD 675,696 (SD = 334,288). They have smaller household sizes (mean 2.6 individuals) and more earners (mean 1.6). Household heads are on average 52.1 years old. Educational attainment is strongly skewed upward, with 65% of household heads holding a university degree or above. This pattern highlights the high human-capital composition of top-income households. Middle-income households have an average per-capita disposable income of NTD 307,671 (SD = 69,618) and an average household size of 3.2 individuals, with 1.6 earners. The average age of the household head is 51.2 years. In terms of education, 38% of household heads have a university degree or above, while 62% have less than a university education. These figures reflect the intermediate socioeconomic position of the middle-income group. Poor households (Bottom 20%) have an average per-capita disposable income of

not supported by the available price data.

[3]We discuss the robustness of our results to the use of these two income measures in Section 6.1.

[4]Although the levels of income and demographics evolve over time, the relative differences across income groups remain broadly stable.

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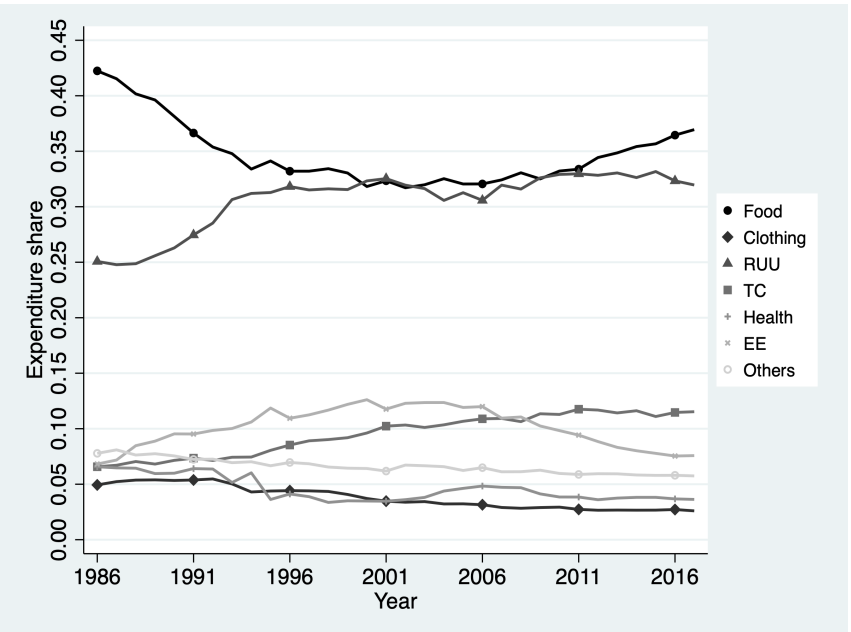


Figure 1: Expenditure shares of poor households

NTD 164,372 (SD = 35,224). Their household size is similar to the middle group (mean 3.2), but they have far fewer earners (mean 0.9). Household heads are older on average, at 56.7 years. Only 16% of household heads have a university degree or above, compared with 84% with less than a university education. This group also has the highest illiteracy rate (8%) and the lowest labor-market attachment. Taken together, these demographic differences across income groups—particularly in education, labor supply, and age—provide important context for understanding heterogeneity in inflation exposure and substitution behavior.

2.4 Expenditure Allocation

To examine inflation inequality, we analyze how rich, middle-income, and poor households allocate their expenditures across seven major product categories over time. Figure 1 shows the expenditure shares by category for poor households from 1986 to 2017. Throughout this period, Food consistently accounted for the largest share, exceeding 30% of total expenditures. The

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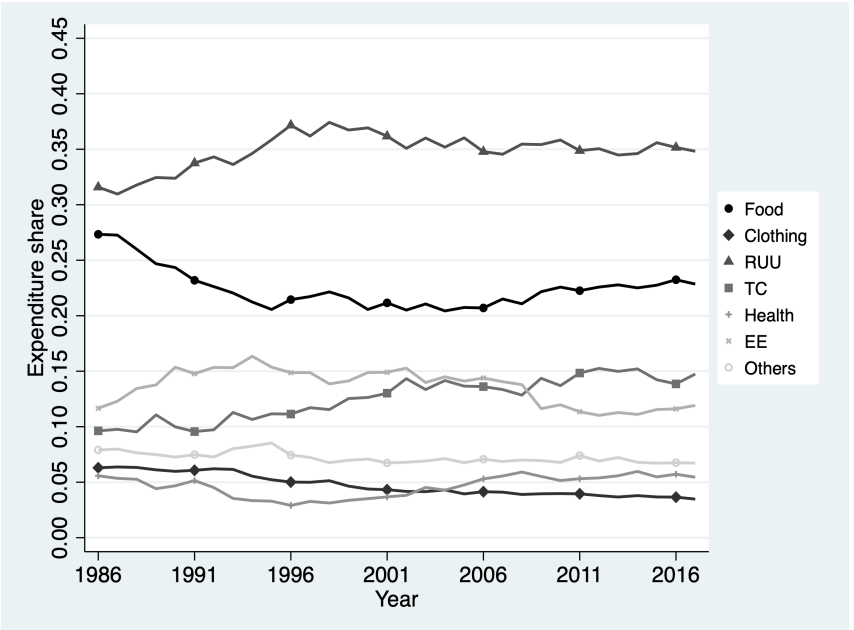


Figure 2: Expenditure shares of rich households

second-largest category was RUU (Housing and Utilities). Together, these two categories made up more than 65% of total spending for Poor households in every year. Most other categories—Clothing, TC (Transportation and Communication), Health, EE (Education and Entertainment), and Others—each accounted for less than 10% and remained relatively stable, though their rankings changed over time. The most notable changes occurred in Food and RUU. The share of Food declined from 43% in 1986 to 33% in 2003, then gradually rose to 37% by 2017. In contrast, RUU increased from 25% in 1986 to 34% in 2017.

Figure 2 presents the same breakdown for rich households. For this group, RUU represented the largest share of expenditures, followed by Food. Together, these two categories accounted for just over 55% of total expenditures between 1986 and 2017—roughly 10 percentage points less than for Poor households. The RUU share increased from 31% to 35%, while Food declined from 28% to 23% over the same period. EE and TC were the third- and fourth-largest categories for Rich households, each making up

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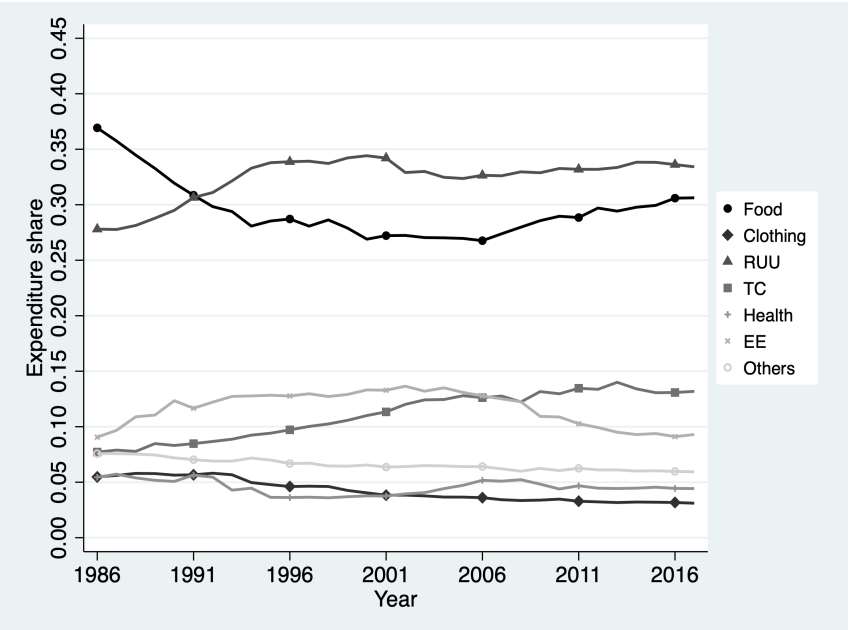


Figure 3: Expenditure shares of middle income households

more than 10% of total expenditures. The remaining categories—Clothing, Health, and Others—each accounted for under 10%.

Figure 3 displays the expenditure shares of middle-income households. Their consumption structure lies between that of the rich and the poor. Food and RUU together consistently account for roughly 60–65% of total spending, with Food declining gradually from about 36% in the late 1980s to around 30% by 2017, while RUU (rent, utilities, and housing-related expenses) rises from about 28% to nearly 34% over the same period. This shift mirrors the broader trend observed across income groups: a long-run reallocation away from food and toward housing and utilities. Beyond these essentials, Transportation and Communication (TC) and Education and Entertainment (EE) represent the next largest categories. TC rises steadily from about 7–8% in the late 1980s to roughly 12–13% in the mid-2000s before stabilizing slightly below that level, while EE peaks around 12–13% in the early 2000s and then declines to about 9–10% by 2017. In contrast, Health, Clothing, and Others each account for less than 6% of the budget. Among

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these smaller categories, Health shows a mild upward trend, whereas Clothing declines slowly over time. Overall, these patterns highlight that middle-income households allocate a substantial share of spending to essential goods (Food and Housing) while maintaining meaningful expenditures on discretionary categories such as Transportation and Education/Entertainment - consistent with their intermediate position in the income distribution.

Two key patterns emerge. First, for all three income groups, Food and RUU constitute the two largest expenditure categories throughout the period. However, poor households allocate a substantially larger share to Food, while rich households devote a greater portion to RUU. Middle-income households fall in between, maintaining a more balanced allocation across these two categories. Second, although the absolute changes in expenditure shares over time appear larger for poor households, the percentage changes in some categories are actually more pronounced among rich households. These findings highlight that differences in consumption structure—and their evolution over time—reflect not only income constraints but also distinct preferences and spending flexibility across groups. Consequently, divergent price movements across categories can lead to heterogeneous increases in the cost of living and, ultimately, in household welfare.

2.5 Price Dynamics Across Major CPI Categories

Between 1986 and 2017, Taiwan experienced considerable variation in price growth across major consumption categories. Food prices rose most sharply, increasing by approximately 125% over the period, followed by Education and Entertainment (about 105%) and Health (91%). In contrast, categories such as Housing and Utilities (49%), Transportation and Communication (17%), and Clothing (9%) saw relatively modest price increases, with clothing prices remaining nearly flat. These heterogeneous price dynamics are particularly consequential for lower-income households, who typically devote a larger share of their consumption to essential goods such as food, health, and housing. As these categories experienced the steepest price increases, poorer households faced a more pronounced erosion of purchasing power, even in the context of Taiwan's overall low and stable inflation. This underscores the importance of analyzing inflation through a disaggregated lens, as headline figures can mask significant disparities in cost-of-living pressures across the income distribution.

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3 Constructing the Cost-of-Living Index

In this section, we outline the methodology used to construct income-specific cost-of-living indices based on the Sato–Vartia formula. Building on the framework, we combine household expenditure data from the Survey of Family Income and Expenditure with price data from the Consumer Price Index (CPI) to estimate inflation experiences across income groups, allowing us to trace the evolution of the cost-of-living for different income groups over time.

3.1 Sato–Vartia Index

The Sato–Vartia index, independently introduced by Sato (1976) and Vartia (1976), is widely used because it offers a more accurate measure of the true cost-of-living. It captures both the direct effects of price changes and consumer substitution behavior. Unlike fixed-weight indices such as the Laspeyres index—which tends to overstate inflation by ignoring consumers' ability to substitute away from goods that become more expensive—or the Paasche index—which tends to understate inflation by assuming full substitution to cheaper alternatives—the Sato–Vartia index strikes a balance by using expenditure shares averaged over two adjacent periods. This dynamic weighting mechanism reflects how consumers actually reallocate their spending when relative prices change, reducing substitution bias and yielding a more reliable inflation measure.

Formally, the Sato–Vartia index is a logarithmically weighted geometric average of relative price changes:

$$\ln P_t = \sum_i \phi_{i;t} \ln\left(\frac{p_{i;t}}{p_{i;t-1}}\right), \tag{1}$$

where $p_{i;t}$ denotes the price of category i at time t, and $\phi_{i;t}$ is a weight based on the logarithmic mean of expenditure shares across periods t and $t-1$. Specifically:

$$\phi_{i;t} = \frac{\frac{s_{i;t}-s_{i;t-1}}{\ln(s_{i;t})-\ln(s_{i;t-1})}}{\sum_{j=1}^{n} \frac{s_{j;t}-s_{j;t-1}}{\ln(s_{j;t})-\ln(s_{j;t-1})}}, \tag{2}$$

where $s_{i;t} = (e_{i;t}/\sum_k e_{k;t})$ denotes the expenditure share on category i at time t, and $e_{i;t}$ is total expenditure on that category. The flexibility of the

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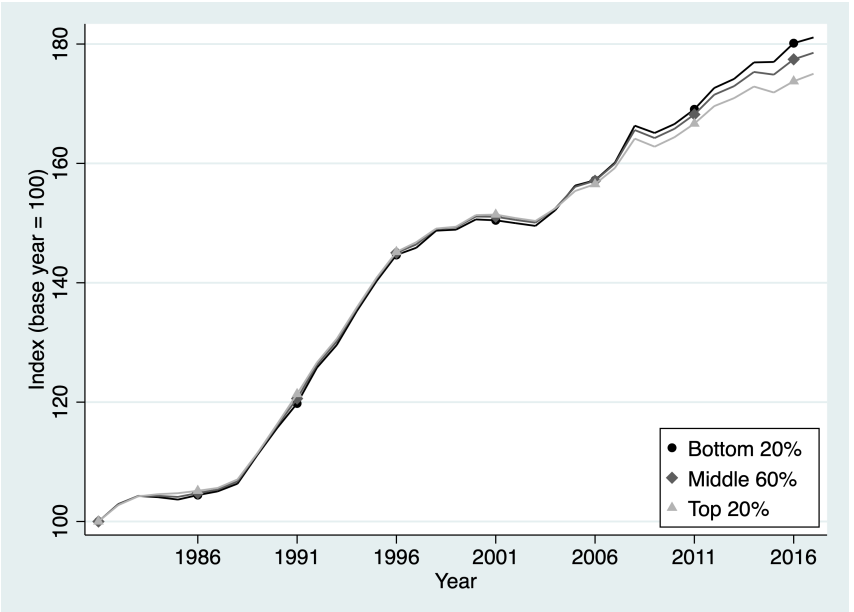


Figure 4: The indices

Sato–Vartia index in adjusting to evolving consumption patterns makes it particularly suitable for studying inflation inequality. It allows us to isolate how differences in expenditure composition contribute to heterogeneous inflation experiences across income groups.

3.2 Cost-of-Living Measurement for Taiwan

Building on the Sato–Vartia framework introduced above, we apply the index to estimate the evolution of the cost-of-living for different income groups over 1986–2017, normalizing each group's index to one in the base year (1986). For this period, we compute cost-of-living indices for the bottom-, middle-, and top-income groups under the assumption that all groups face a common set of prices. This assumption is required because, although income-specific expenditure shares are available, corresponding price data are not observed for most of the sample period.

Figure 4 plots the cumulative changes for all three groups. While the cost-of-living rose substantially for everyone, the increase is consistently

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largest for low-income households. Over this period, the bottom 20% experienced an increase of roughly 76%, compared with about 71% for the middle-income group and 67% for the top 20%. Although the numerical gaps are moderate, the pattern clearly indicates that lower-income households have borne a relatively heavier inflation burden.

This gap is largely attributable to differences in expenditure composition. Poor households allocate a greater share of their spending to food, which experienced the highest cumulative price increase (125.35%) among all categories. In contrast, rich households spend more on housing-related items (RUU), which saw a comparatively modest price increase of 49.13%. These contrasting spending patterns result in systematically different inflation experiences across income groups.

Having documented cost-of-living patterns over the full 1986–2017 period, we next focus on the post–2008 period, when income-specific CPIs become available. To validate our cost-of-living measures, we compare the Sato-Vartia (SV) indices with the official income-specific CPIs. Figure 5 shows this comparison between our SV index - constructed using a common price series - and the government's income-specific CPIs. As shown in Figure 5, the two indices move closely together for all three groups, with similar turning points and nearly identical cumulative growth. This strong correspondence indicates that our constructed indices successfully capture the cost-of-living dynamics reflected in the official statistics. Some systematic differences nevertheless arise. Our constructed SV indices tend to lie slightly below the official income specific CPI series due to their incorporation of substitution behavior, which allows consumers to shift expenditure toward relatively cheaper goods. In contrast, the official CPI relies on a fixed basket updated only every five years, making it less responsive to short-run expenditure adjustments and more prone to upward bias. A small exception appears for middle-income households, where our computed cost of living occasionally exceeds the official CPI, likely reflecting infrequent weight revisions in the official basket. Overall, the comparison supports the Sato–Vartia index as a theoretically grounded and empirically reliable measure of cost-of-living changes.

Beginning in 2008, the DGBAS also releases separate price indices for the bottom 20%, middle 60%, and top 20%, allowing us to relax the uniform-price assumption imposed in the earlier analysis. In practice, households at different income levels may face different effective prices due to variation in store choices, regional availability, product quality, or quan-

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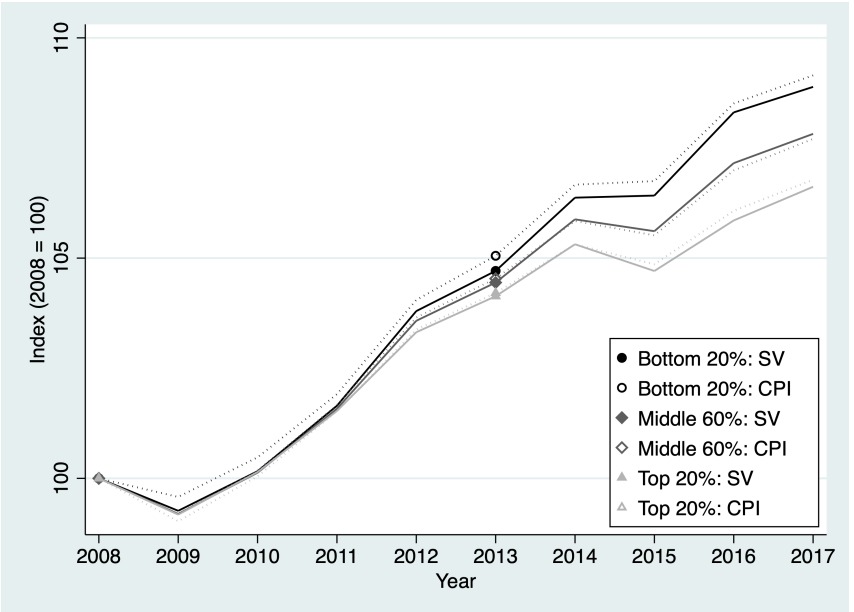


Figure 5: Comparison of sato-vartia indices and income–specific cPIs

tity discounts. To account for this possibility, we construct cost-of-living indices for 2008–2017 using the income-specific price series published by the DGBAS for each group. As shown in Figure 6, the Sato–Vartia indices computed using income-specific price series and those based on a common price series yield nearly identical cost-of-living levels across all three income groups. This arises because, although the income-specific price levels differ, their growth rates are nearly identical. For the bottom 20%, the SV values are 109.38 using common prices and 109.15 using income-specific prices. The differences are similarly small for the middle 60% (108.02 versus 107.71) and for the top 20% (106.36 versus 106.78). These deviations are economically negligible, indicating that allowing income groups to face different price series has little effect on the estimated cost-of-living changes.

Overall, these exercises show that lower-income households experience systematically higher inflation is not driven by the choice of uniform price series, the time window, or the index construction method. This robustness motivates the need to formally model differences in substitution behavior across income groups. In the next section, we develop a utility-based

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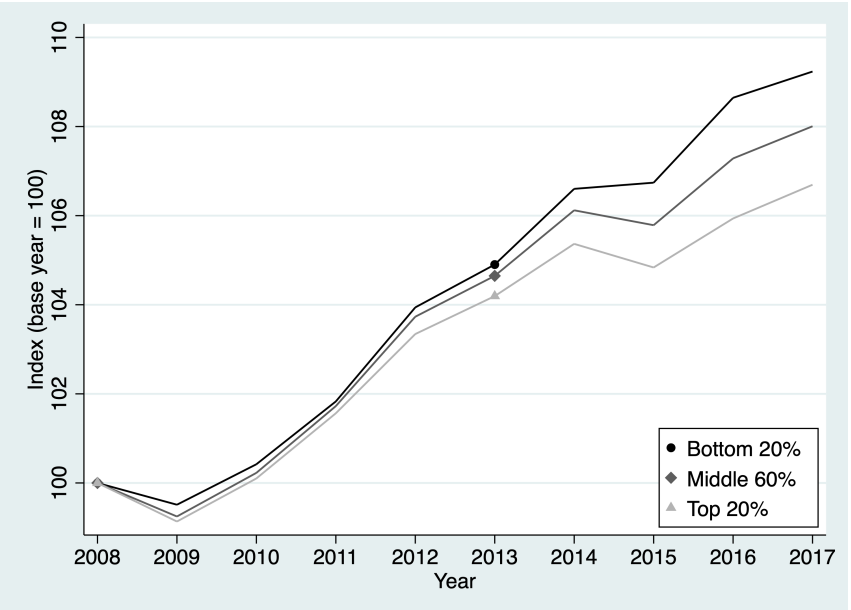


Figure 6: Sato–vartia indices computed using income-specific price series

framework featuring heterogeneous substitution elasticities to quantify how variation in spending flexibility contributes to inflation inequality.

4 Consumer Choice Model

To investigate the underlying causes of the differences in cost-of-living increases across rich, middle-income, and poor households, we consider a static model with heterogeneous households that differ in both income and spending behavior. Consumers' preferences are represented by a constant elasticity of substitution (CES) utility function, with elasticity allowed to vary across income groups. This framework allows us to examine how both price changes and substitution flexibility jointly shape inflation inequality.

4.1 CES Utility and Expenditure Allocation

In our simplified specification, each income group $g \in \{r, m, p\}$ maximizes utility by allocating a fixed expenditure budget e_t^g across i categories of con-

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sumption goods. Preferences for consumer g are represented by a constant elasticity of substitution (CES) utility function:

$$U_t^g = \left(\sum_i \left(d_i^g q_{i;t}^g \right)^{-\gamma_g} \right)^{-\frac{1}{\gamma_g}}, \tag{3}$$

where $q_{i;t}^g$ denotes the quantity of good i consumed by group g at time t, and d_i^g is a preference weight capturing the relative utility income group g derives from good i. The curvature parameter $\gamma_g = (1 - \sigma_g/\sigma_g)$ is a function of the elasticity of substitution σ_g, which governs how readily group g substitutes between goods in response to changes in their relative prices.

We consider an endowment economy in which each income group g receives an exogenous expenditure e_t^g in period t. Consumers do not save and derive utility only from contemporaneous consumption. Taking prices as given, they decide how to allocate their expenditures across consumption categories. The budget constraint for group g is:

$$\sum_i p_{i;t} q_{i;t}^g = e_t^g, \tag{4}$$

where $p_{i;t}$ denotes the price of good i at time t, which is common across all income groups, and $q_{i;t}^g$ is the quantity consumed by group g.

Solving the consumer g's problem yields:

$$q_{i;t}^g = \left(\frac{p_{i;t}}{d_i^g p_t^g} \right)^{\frac{\gamma_g}{1+\gamma_g}} \frac{e_t^g}{p_{i;t}}, \tag{5}$$

where the group-specific aggregate price index p_t^g is given by:

$$p_t^g = \left(\sum_i \left(\frac{p_{i;t}}{d_i^g} \right)^{\frac{\gamma_g}{1+\gamma_g}} \right)^{\frac{1+\gamma_g}{\gamma_g}}. \tag{6}$$

Note that although all groups face the same prices $p_{i;t}$, the group-specific aggregate price index p_t^g can differ due to variation in how they allocate spending across goods. These differences in consumption baskets arise from group-specific preferences d_i^g and substitution elasticity σ_g, which

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together determine how spending is allocated across categories and how sensitively it responds to price changes. Specifically, the implied expenditure share of group g on good i is given by:

$$s_{i;t}^{g} = \frac{p_{i;t} q_{i;t}^{g}}{e_{t}^{g}} = \left(\frac{p_{i;t}}{d_{i}^{g} p_{t}^{g}} \right)^{\frac{\gamma_g}{1+\gamma_g}}.$$

While the preference parameters d_i^g are assumed to remain stable over time, expenditure shares evolve in response to relative price movements, with the elasticity of substitution σ_g determining the degree of adjustment. This framework enables us to estimate γ_g using observed variation in prices and expenditure shares. In this setting, inflation inequality emerges from two key sources: differences in the rate of price changes across categories and heterogeneity in how income groups adjust their spending in response to those changes.

4.2 The Sato–Vartia Index and CES Preferences

We now link the CES model to the Sato–Vartia index. Using the expenditure share of category i, we can express the price of good i as

$$p_{i;t} = d_{i}^{g} p_{t}^{g} \left(s_{i;t}^{g} \right)^{\frac{1+\gamma_g}{\gamma_g}}.$$

Substituting this expression into the Sato–Vartia index yields:

$$\begin{aligned} \ln P_{t}^{g} &= \sum_{i} \phi_{i;t}^{g} \ln \left(\frac{d_{i}^{g} p_{t}^{g} \left(s_{i;t}^{g} \right)^{\frac{1+\gamma_g}{\gamma_g}}}{d_{i}^{g} p_{t-1}^{g} \left(s_{i;t-1}^{g} \right)^{\frac{1+\gamma_g}{\gamma_g}}} \right) \\ &= \ln \left(\frac{p_{t}^{g}}{p_{t-1}^{g}} \right) \sum_{i} \phi_{i;t}^{g} + \left(\frac{1+\gamma_g}{\gamma_g} \right) \sum_{i} \phi_{i;t}^{g} \left(\ln s_{i;t}^{g} - \ln s_{i;t-1}^{g} \right). \end{aligned}$$

By definition, the Sato–Vartia weight is given by

$$\phi_{i;t}^{g} = \frac{\frac{s_{i;t}^{g} - s_{i;t-1}^{g}}{\ln\left(s_{i;t}^{g}\right) - \ln\left(s_{i;t-1}^{g}\right)}}{\sum_{i} \frac{s_{i;t}^{g} - s_{i;t-1}^{g}}{\ln(s_{i;t}^{g}) - \ln\left(s_{i;t-1}^{g}\right)}},$$

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and it satisfies $\sum_i \phi^g_{i;t} = 1$. Substituting into the expression for the Sato–Vartia index, we have:

$$\ln P^g_t = \ln\left(\frac{p^g_t}{p^g_{t-1}}\right) + \left(\frac{1+\gamma_g}{\gamma_g}\right)\left(\frac{\sum_i s^g_{i;t} - \sum_i s^g_{i;t-1}}{\sum_i \frac{s^g_{i;t} - s^g_{i;t-1}}{\ln\left(s^g_{i;t}\right) - \ln\left(s^g_{i;t-1}\right)}}\right).$$

Since $\sum_i s^g_{i;t} = \sum_i s^g_{i;t-1} = 1$, the numerator in the second term becomes zero, and the Sato-Vartia index becomes

$$\ln P^g_t = \ln\left(\frac{p^g_t}{p^g_{t-1}}\right).$$

Therefore, the Sato-Vartia index measures the change in the cost-of-living for income group g from $t-1$ to t.

5 Estimation Procedure

In this section, we combine a reduced-form supply function with the equilibrium allocation of household expenditure shares to estimate the elasticity of substitution. Following the approach of Feenstra (1994), we estimate separate elasticities of substitution for rich, middle-income, and poor households. Superscripts $g \in \{r, m, p\}$ denote household type. Specifically, the expenditure share of category i at time t is written as $s^r_{i,t}$ for rich households, $s^m_{i,t}$ for middle-income households, and $s^p_{i,t}$ for poor households.

By taking logarithms of the CES expenditure share for each consumption category, we obtain the following demand system as functions of log relative prices and the elasticity of substitution:

$$\begin{aligned}\ln s^g_{i;t} &= \frac{\gamma_g}{1+\gamma_g}\left(\ln p_{i;t} - \ln\left(d^g_i\, p^g_t\right)\right) \\ &= \left(1-\sigma_g\right)\left(\ln p_{i;t} - \ln\left(d^g_i\, p^g_t\right)\right), \end{aligned} \tag{7}$$

where the second equality follows as $(1-\sigma_g) = (\gamma_g/1+\gamma_g)$. We take time differences to obtain demand side of the equilibrium equation.

$$\Delta_t\left(\ln s^g_{i;t}\right) = \left(1-\sigma_g\right)\left(\Delta_t\left(\ln p_{i;t}\right) - \Delta_t\left(\ln p^g_t\right)\right) + \epsilon_{i;t}, \tag{8}$$

where Δ denotes the difference operator and $\Delta_t(x_t) = x_t - x_{t-1}$. Note that a random term is added in the expenditure share of consumption to reflect

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an idiosyncratic shock to expenditure shares $\epsilon_{i;t}$, which is independent and identically distributed across goods and over time. In addition, to eliminate the group-specific, time-dependent terms, p_t^g, in the demand system, we take the mean difference.

$$\Delta_m \Delta_t \left(\ln s_{i;t}^g\right) = \left(1 - \sigma_g\right) \cdot \Delta_m \Delta_t \left(\ln \left(p_{i;t}\right)\right) + \tilde{\epsilon}_{i;t},$$

where $\Delta_m(y_i) = y_i - E(y_i) = y_i - (\sum_i (y_i)/n)$, and n is the number of categories.

Without loss of generality, we assume a supply curve for each category, which takes the following form.

$$\ln s_{i;t} = \alpha \ln p_{i;t},$$

where $\alpha > 0$. The presumed positive sign of α implies that the quantity of goods increases in response to a rise in price. Therefore, we can interpret this equation as a reduced-form supply curve. By taking differences with respect to both the mean and the time, we obtain

$$\Delta_m \Delta_t \left(\ln s_{it}\right) = \alpha \Delta_m \Delta_t \left(\ln p_{i;t}\right) + \tilde{e}_{i;t},$$

where $\tilde{e}_{i;t}$ denotes the supply shocks, which accounts for factors such as technology changes over time.

Next, we assume that the demand and supply shocks are uncorrelated, yielding the moment condition

$$\mathbb{E}\left(\tilde{\epsilon}_{i;t}\tilde{e}_{i;t}\right) = 0.$$

Substituting the demand and supply equations into this condition and rearranging yields

$$\begin{aligned}\mathbb{E}\left[\left(\Delta_m \Delta_t \ln s_{i;t}^g\right)^2\right] = &-\alpha(1 - \sigma_g)\mathbb{E}\left[\left(\Delta_m \Delta_t \ln p_{i;t}\right)^2\right] \\ &+ \left(\alpha + 1 - \sigma_g\right)\mathbb{E}\left[\Delta_m \Delta_t \ln s_{i;t}^g \Delta_m \Delta_t \ln p_{i;t}\right].\end{aligned}$$

With above estimation, we can get σ_g^* and α^* via a linear regression as shown by Feenstra (1994).

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Table 1: Estimated elasticity of substitution

	Bottom 20%	Middle 60%	Top 20%
Elasticity (σ^g)	0.79	1.22	1.86
Standard error	0.16	0.15	0.26

Notes: Estimates are based on household expenditure data from the Survey of Family Income and Expenditure (SFIE), matched with CPI micro-categories for 1986–2017.

6 Estimation Results: Substitution Elasticity

Table 1 reports the estimated elasticity of substitution across major consumption categories for the top 20%, middle 60%, and bottom 20% of households in Taiwan, using data from 1986 to 2017.[5] The estimated elasticity for the top-income group is 1.86 (standard error = 0.26), for the middle-income group is 1.22 (standard error = 0.15), and for the bottom-income group is significantly lower at 0.79 (standard error = 0.16).

The sizable and statistically significant differences in estimated elasticities imply that richer households are substantially more responsive to relative price changes. When the price of a particular category rises, top-income households are better able to reallocate spending toward relatively cheaper alternatives, thereby mitigating the impact on their overall cost of living. Middle-income households exhibit a moderate degree of substitution flexibility, while low-income households—who allocate a disproportionate share of their budgets to necessities face the lowest elasticity. As a result, poorer households are far more exposed to inflationary shocks.

Our findings show substantial differences in substitution elasticities across income groups—patterns that stand in contrast to Argente and Lee (2021), who document little variation across U.S. households. In the Taiwanese context, however, the elasticity gradient is both economically large and precisely estimated. A key reason for this divergence lies in differences in data coverage and time horizon. Much of the existing literature relies on

[5] We also estimated the model using the 2008–2017 subsample, but we do not report those results due to the limited sample length and reduced statistical power. Our analysis therefore focuses on the full 1986–2017 period, which provides a more reliable basis for inference.

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scanner data that are heavily concentrated in grocery purchases and therefore capture only a narrow segment of household consumption. As emphasized by Kaplan and Schulhofer-Wohl (2017), food accounts for roughly 61% of expenditures in scanner datasets but only about 15% in the official CPI, substantially limiting the scope for identifying heterogeneity in substitution behavior across income groups. By contrast, our analysis is based on comprehensive household expenditure surveys that encompass the full consumption basket—including services, housing, transportation, education, and recreation—categories in which substitution opportunities, expenditure shares, and price dynamics differ systematically across the income distribution. These broader dimensions of consumption are precisely where differences in adjustment capacity between high- and low-income households are most pronounced. More importantly, the limited time span of scanner datasets constrains the analysis in Argente and Lee (2021) to a relatively short period, whereas our data span more than three decades (1986–2017). This long time horizon allows us to capture persistent and cumulative differences in consumption patterns, relative price movements, and substitution responses that may not be detectable in short panels. As a result, our estimates reflect long-run substitution behavior rather than transitory responses, providing a clearer picture of how inflation inequality evolves over time in a low-inflation economy. Together, these differences in data scope and temporal coverage help explain why we detect pronounced heterogeneity in substitution elasticities across income groups, while prior studies do not.

6.1 Robustness and Sensitivity Checks

To evaluate the robustness of our findings, we perform two sets of sensitivity analyses: (i) considering alternative income-group definitions, and (ii) shorter sample periods.

Alternative income group definitions

Having established the baseline results using disposable income per capita, we conduct a robustness check by reclassifying households according to gross income per capita. Using the same percentile cutoffs to form three income brackets—the bottom 20%, the middle 60%, and the top 20%—we re-estimate the elasticity of substitution for each group under this alternative

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Table 2: Estimated Elasticity of Substitution under Alternative Income Definition

	Bottom 20%	Middle 60%	Top 20%
Elasticity (σ^g)	0.77	1.19	1.93
Standard error	0.13	0.15	0.25

Notes: Estimates are based on the Survey of Family Income and Expenditure (SFIE), matched with CPI micro-categories, 1986–2017. Households are grouped using gross income per capita.

income definition.

The results, presented in Table 2, closely mirror those obtained under the baseline classification. The ordering of elasticities remains intact, with higher-income households exhibiting the greatest substitution flexibility, followed by middle-income and then low-income households. Moreover, the estimated magnitudes and standard errors are highly comparable to those from our main specification, indicating that the elasticity gradient is robust to how households are grouped by income.

Taken together, these findings confirm that our main conclusions regarding substitution behavior—and its implications for inflation inequality—are not driven by the choice between disposable and gross income as the income metric.

To understand why the estimated substitution elasticities remain nearly identical when households are classified by gross rather than disposable income, we first examine how closely the two income measures align. Table 3 reports the cross-tabulation between gross and disposable income quintiles. Each cell shows the percentage of households that fall into a given pair of categories—effectively the probability that a household in a particular gross income quintile is also ranked in the corresponding disposable income quintile. The diagonal entries, which range from roughly 15% to 18%, are by far the largest in each row, indicating that most households remain in the same quintile before and after accounting for taxes and transfers. Off-diagonal entries are small, and the table exhibits a strong diagonal structure, suggesting very limited movement across quintiles.

This tight correspondence implies that classifying households by gross

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Table 3: Cross-Tabulation: Gross vs. Disposable Income Quintiles

	Q1	Q2	Q3	Q4	Q5
Gross Q1	18.47	1.45	0.00	0.00	0.00
Gross Q2	1.40	16.27	2.35	0.00	0.00
Gross Q3	0.10	2.12	15.48	2.32	0.00
Gross Q4	0.02	0.14	2.10	16.21	1.55
Gross Q5	0.01	0.02	0.07	1.46	18.45

Notes: Each cell reports the percentage of households jointly classified in the corresponding gross and disposable income quintiles.

Table 4: Robustness Check: Elasticity of Substitution by Time Period

Period	Income Group	σ	SE
1986–2000	Bottom 20%	0.818	(0.247)
	Middle 60%	1.253	(0.213)
	Top 20%	2.018	(0.460)
2001–2017	Bottom 20%	2.321	(0.386)
	Middle 60%	1.496	(0.239)
	Top 20%	1.634	(0.246)

income produces groups that are nearly identical to those obtained using disposable income. Because the underlying household composition—and thus the expenditure patterns that drive substitution behavior—changes very little across the two classifications, the resulting elasticity estimates thus remain extremely close.

Shorter sample periods

To examine the stability of substitution elasticities over time, we divide the sample into two subperiods and re-estimate the elasticity of substitution for each income group. As shown in Table 4, the estimates for 1986–2000

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broadly preserve the ordering observed in the full sample: higher-income households exhibit the greatest substitution flexibility, followed by middle-income and then low-income households. However, the confidence intervals are much wider than in the baseline estimates, and the differences across groups are no longer statistically significant at conventional levels.

In the later period, 2001–2017, the estimated elasticities display a different pattern: the bottom 20% exhibit the highest elasticity (2.321), exceeding both the middle-income group (1.496) and the top-income group (1.634). This reversal suggests substantial sampling variability when the estimation window is shortened. In both subperiods, the loss of precision arises from the reduced sample length, which significantly diminishes statistical power. As a result, while the point estimates suggest some persistent heterogeneity, the evidence is insufficient to draw strong conclusions about the temporal stability of the elasticity gradient.

7 Conclusion

In this paper, we study the long-run evolution of inflation inequality in Taiwan from 1986 to 2017 using detailed household expenditure data matched with official CPI statistics. By constructing income-group-specific cost-of-living indices, we document a persistent and economically meaningful gradient in inflation exposure across the income distribution. Despite Taiwan's low and stable headline inflation, lower-income households have experienced systematically higher effective inflation than middle- and high-income households, reflecting both differences in consumption baskets and heterogeneous price dynamics across expenditure categories.

To understand the mechanisms underlying these patterns, we estimate income-group-specific elasticities of substitution within a CES framework. Our estimates reveal substantial heterogeneity in substitution behavior: high-income households exhibit significantly greater flexibility in reallocating expenditures in response to relative price changes, while low-income households face markedly limited adjustment capacity. As a result, increases in the prices of essential goods - such as food and utilities - translate more directly into higher living costs for poorer households, amplifying the welfare consequences of inflation over time. These differences in substitution elasticity play a central role in explaining why inflation inequality persists even when aggregate inflation remains subdued.

Our analysis is subject to several data limitations that are important to

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acknowledge. First, for most of the sample period, price data are available at aggregate and subcategory levels but are not reported separately by income group, which requires us to assume a common set of prices across income groups. This limitation reflects the structure of Taiwan's historical CPI data rather than a modeling choice. Reassuringly, when income-specific CPI series become available after 2008 and allow us to relax this assumption, the resulting cost-of-living indices are nearly identical to those constructed using common prices, suggesting that differential price growth across income groups plays a limited role in our finding. Second, while the Survey of Family Income and Expenditure reports housing expenditures that include both actual rent paid by tenants and imputed rent for owner-occupied housing, the corresponding price data at a disaggregated level are not available. Taiwan's official CPI measures the cost of housing services using a rental equivalence framework and publishes a single aggregate rent price index within the broader "Housing, Residential Services, and Utilities" category, without separately reporting price series for actual and imputed rents or providing rent indices disaggregated by tenure status or income group. This data limitation on the price side prevents us from constructing tenure-specific housing price measures, leading us to follow the official CPI methodology and use the aggregate rent component to capture common movements in the market price of housing services. Taken together, these limitations imply that our results should be interpreted as capturing differences in overall cost-of-living experiences across income groups, rather than isolating the contribution of specific housing price subcomponents or tenure-specific adjustment mechanisms.

These findings have direct implications for policy. Our estimates imply that reliance on a single aggregate CPI can mask substantial heterogeneity in welfare losses from inflation, particularly for low-income households with limited substitution opportunities. From a monetary policy perspective, this suggests that stabilizing headline inflation may not be sufficient to equalize real purchasing power across households, even in a low-inflation environment. On the fiscal side, our results support the use of targeted interventions - such as food or energy subsidies, utility support, or transfers indexed to income-group-specific cost-of-living measures - to mitigate the regressive effects of inflation. More broadly, incorporating heterogeneity in consumption baskets and substitution elasticities into policy design can improve the effectiveness of both stabilization and redistribution policies, ensuring that macroeconomic interventions do not inadvertently exacerbate inequality.

Overall, our study shows that inflation inequality can remain economi-

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cally significant even in economies with stable prices, and that understanding household-level inflation experiences requires going beyond aggregate measures. By combining long-run household data with a structural interpretation of substitution behavior, this paper provides new evidence on the distributional consequences of inflation and offers a framework for incorporating these considerations into policy analysis in Taiwan and other low-inflation economies.

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台灣通膨不均之長期演變

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本文探討1986年至2017年間台灣不同所得群體之通膨不均現象, 分析生活成本差距的長期演變。研究利用《家庭收支調查》之詳細家庭支出資料, 配合消費者物價指數 (CPI), 建構所得最低20%、中間60%與最高20%家庭之生活成本指數。實證結果顯示, 雖然台灣整體通膨長期維持低且穩定, 各所得群體生活成本皆呈上升趨勢, 但低所得家庭所面臨之有效通膨率顯著高於高所得家庭, 中所得家庭則介於兩者之間。本文進一步利用固定替代彈性 (CES) 效用函數架構, 探討其背後機制及估計不同所得群體之替代彈性。研究發現, 高所得家庭之替代彈性最高, 中所得家庭次之, 低所得家庭最低。此結果顯示, 高所得家庭在面對相對價格變動時, 較能透過消費重分配降低生活成本衝擊; 相對地, 低所得家庭因支出集中於必需品, 替代能力有限, 故較難調整消費結構, 因而承受較重之實質通膨負擔。

關鍵詞: 通膨不均, Sato-Vartia 指數, 生活成本
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