Diverging Cost of Living*

Balázs Zélity†

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Abstract

Cost-of-living divergence is documented in the United States over the 2000-2019 time period between different age groups, income groups, and between renters and owners. Using household-level regression analysis as well as a decomposition of CPIs into different expenditure categories, the paper finds that the divergence is largely driven by housing and health expenditures. In particular, the way housing costs evolved created a gap between the inflation experienced by renters and owners, while rapid health cost inflation led to cost-of-living divergence along generational lines. Two consequences of cost-of-living divergence are documented. First, generational income inequality is dampened, while pure income inequality is exacerbated if one uses group-specific CPIs to convert nominal income into real income. Second, Social Security benefit increases did not keep up with the cost of living of the elderly because older cohorts experienced above-average ination. Finally, the paper shows that expansionary monetary policy is behind some of the renter/owner cost-of-living divergence, but not the health-related generational divergence.

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†Department of Economics, Wesleyan University, 238 Church St, Middletown, CT 06459, United States. Email: bzelity@wesleyan.edu.

1 Introduction

The 2010s saw one of the lowest rates of inflation in developed economies in modern history. Interestingly, this period coincided with historically low interest rates – for instance, the effective Fed funds rate was below 0.25% for at least half of the decade. Low interest rates may exacerbate inequality because despite not triggering high consumer price inflation, they seemingly triggered high inflation in financial assets or real estate. Herein lies the paradox of the 2010s, that while overall consumer price inflation has been low, the prices of some components of the Consumer Price Index (CPI) enjoyed robust growth. Most notably, these include housing and health expenditures. Groups spending more on these items could have experienced substantially more inflation than groups that spend little on them. This can have important consequences, such as making more exposed groups' real wages appear higher than they are in reality when calculated with overall average inflation rates.

Against this backdrop, this paper constructs Consumer Price Indices (CPIs) separately for a variety of demographic groups for the the 2000-2019 time period in the United States. This allows for examining whether some groups experienced substantially different rates of inflation than others, and whether these inflation differences are connected to the low interest rate environment. Three key points about the methodology are worth highlighting.

First, group-specific CPIs are constructed by combining household-level consumer expenditure data from the Consumer Expenditure Survey with price data. Expenditure weights on a host of different items are calculated separately for the various demographic groups, then price data on these same items is averaged using the group-specific expenditure weights.

Second, this paper also constructs an alternative measure of housing costs. The CPI figures released by the Bureau of Labour Statistics use owners' equivalent rent (OER) to measure the housing costs of homeowners (US Bureau of Labor Statistics, 2009). This paper argues that while this measure might make sense for creating a price index for consumer goods, it fails to capture the true cost of living of homeowners. To better capture cost of living, the alternative measure constructed in this paper relies on consumer expenditure data on homeownership expenditures. This measure essentially tracks the amount that homeowners spend on homeownership each year, and it may grow substantially faster (e.g. in 2005-2008) or slower (e.g. in the 2010s) than rents. This can create a discrepancy between the housing costs experienced by renters and owners. The same is not necessarily true for the OER measure, which is heavily correlated with rents. While the alternative housing cost measure is arguably a more accurate measure of cost of living than OER, the broad results of the paper are largely the same regardless of which measure is used.

Third, to examine the effect of monetary policy on inflation inequality, this paper estimates impulse response functions of inflation inequality to plausibly exogenous changes in the Fed funds

rate. Relying on exogenous monetary shocks from Kuttner (2001) and following the methodology of Romer and Romer (2016), it is estimated how the relative cost-of-living indices of various groups respond to monetary policy.

The paper's key findings are as follows. Substantial cost-of-living divergence is documented over the 2000-2019 time period, which is most pronounced between different age groups, income groups, and between renters and owners. Using household-level regression analysis as well as a decomposition of CPIs into different expenditure categories, the paper finds that the divergence is largely driven by housing and health expenditures. The ultimate demographic determinants of the divergence are age and renter/owner status with income and other factors mattering mostly through their correlation with age and renter/owner status. Two consequences of cost-of-living divergence are documented: (1) generational income inequality is dampened, while pure income inequality is exacerbated if one uses group-specific CPIs to convert nominal income into real income; (2) Social Security benefit increases did not keep up with the cost of living of the elderly because older cohorts experienced above-average inflation. Finally, the paper finds that monetary policy is one potential source for some cost-of-living divergence. Expansionary monetary policy exacerbates renter/owner inflation inequality, which is mostly mediated by the housing cost channel. Monetary policy, however, has no effect on age-related inflation inequality, which is mostly mediated by the health expenditure channel. Due to the correlation of income with renter/owner status, income inequality itself is somewhat exacerbated by lower interest rates.

The paper contributes to four strands of literature. First and most importantly, there is an extensive literature on inflation inequality – for a recent review, see Jaravel (2021). A number of papers have considered inflation differences between different groups in the US (Michael, 1979; Hagemann, 1982; Garner et al., 1996; Hobijn and Lagakos, 2005; Hobijn et al., 2009; Johannsen, 2014; Kaplan and Schulhofer-Wohl, 2017; Argente and Lee, 2021; Lauper and Mangiante, 2021) as well as in other countries (Crawford and Smith, 2002; Fritzer and Glatzer, 2009; Colavecchio et al., 2011; Cepparulo et al., 2012; Fessler and Fritzer, 2013; Hait and Janksy, 2014; Gürer and Weichenrieder, 2020). This manuscript contributes to our understanding of inflation inequality in three ways. First, the alternative housing cost measure mentioned above is introduced, which reveals the different experiences of renters and owners in a more nuanced way. Second, the key underlying demographic factors behind the divergence (age and renter/owner status) are identified. The existing literature either does not aggregate household-level data into demographic groups or primarily focuses on differences between income groups only (Jaravel, 2021). Third, the paper identifies expansionary monetary policy as one source of inflation inequality. This source of cost-of-living divergence is relatively new in the literature, having only been considered by Lauper and Mangiante (2021) who focus on the effect on income groups only. This paper is the first to identify

the ultimate channel for monetary policy's influence on inflation inequality: the disparity between renters and owners.

Second, there is a literature on the relationship between macroeconomic conditions and inequality. When it comes to inflation in particular, most papers find that higher inflation rates lead to more inequality (Albanesi, 2007; Desai et al., 2005; Al-Marhubi, 1997; Ayala et al., 2017), though Jäntti and Jenkins (2010) find no effect in the United Kingdom, and Bulíř (2001) and Monnin (2014) document a nonlinear effect. Filippin and Nunziata (2019) find that inequality can affect inflation perceptions. Fitoussi and Saraceno (2010) and Stiglitz (2012) argue that inequality can cause macroeconomic volatility by depressing aggregate demand and forcing policymakers to stimulate the economy thereby creating asset price bubbles. Galor and Zeira (1993) show theoretically that macroeconomic adjustment to shocks depends on wealth and income distribution. This paper contributes to our understanding of inequality and macroeconomic conditions in two ways: (1) it is documented how in the presence of heterogeneous inflation rates, even low rates of inflation can generate inequality; (2) the interaction between monetary policy and inflation inequality is investigated.

Third, there are a number of papers that consider measurement issues with inequality (Piketty et al., 2018; Bricker et al., 2018; Bricker and Henriques Volz, 2020; Smith et al., 2021; Auten and Splinter, 2022). Most closely related to this paper are Gürer and Weichenrieder (2020), Dabalen et al. (2020), Geloso and Lindert (2020), Klasen et al. (2016), and Krolage et al. (2022) who emphasise the role price indices play in the measurement of inequality. This paper contributes to the literature by documenting the potential of group-specific price indices to inflate or deflate measured inequality.

Fourth, the paper contributes to our understanding of the potential side effects of a low interest rate environment. Low interest rates are detrimental to bank profitability (Genay and Podjasek, 2014; Bikker and Vervliet, 2017) potentially leading to reversal rate effects (Borio and Gambacorta, 2017; Brunnermeier and Koby, 2018; van den End et al., 2020; Darracq Pariés et al., 2020). They can lead to increased risk-taking in a "hunt for yield" (Delis and Kouretas, 2011; Apel and Claussen, 2012; Maddaloni and Peydró, 2011; Ioannidou et al., 2015; Lian et al., 2019), which can endanger financial stability. A low interest rate environment can lead to the proliferation of zombie firms (Banerjee and Hofmann, 2018), which can be detrimental to business dynamism and productivity growth (Adalet McGowan et al., 2018; Andrews and Petroulakis, 2019). It can push down the cost of delaying investment making investment decline with rate cuts (Chetty, 2017). It can prompt consumers and businesses to bring forward durable goods purchases, which can make monetary policy less effective in the future (McKay and Wieland, 2019). Finally, it has also been argued in popular (Petrou, 2021; Dorfman, 2015; Hammer and Stein, 2019) and policy circles (Domanski et al., 2016) as well as in academia (Gornemann et al., 2016; Berisha et al., 2018; Bunn

et al., 2018; Casiraghi et al., 2018; Doepke et al., 2019; Battisti et al., 2020; He and La Cava, 2020; Dolado et al., 2021) that monetary policy can have distributional consequences. This paper contributes to this literature by documenting the effect of monetary policy on cost-of-living inequality.

The rest of the paper is organised as follows. Section 2 describes the data, the methodology used to construct group-specific CPIs and the alternative housing cost measure, and how regression analysis is employed to investigate the ultimate driving forces as well as the role of monetary policy behind cost-of-living divergence. Section 3 presents the results of the paper in four stages: (1) a descriptive analysis of inflation inequality, (2) an investigation of which demographic factors ultimately matter for this inequality, (3) documenting some of the consequences of inflation inequality, and (4) the role of monetary policy in driving some of this inequality. Section 4 concludes.

2 Data and methodology

This section first describes the data used in the paper. Then it discusses the methodology in three steps: how group-specific CPIs are constructed, how the key demographic factors behind cost-of-living divergence are identified, and how the role of monetary policy behind this divergence is evaluated.

2.1 Data

The paper relies on five main data sources. First, seasonally adjusted consumer price index data for a large number of items is obtained from the Consumer Price Index (CPI) database of the Bureau of Labor Statistics (US Bureau of Labor Statistics, 2022b). Second, consumer expenditure data is obtained from the Consumer Expenditure Surveys database of the Bureau of Labor Statistics (US Bureau of Labor Statistics, 2022a). The paper relies on public use microdata (PUMD) which provides household-level expenditure data. Third, the Occupational Employment Statistics (OES) by the BLS are used to obtain annual wage percentiles over time (US Bureau of Labor Statistics, 2020). Fourth, wage data by age group and ethnicity is obtained from the Current Population Survey (CPS) as reported by the Bureau of Labor Statistics (US Bureau of Labor Statistics, 2021b). This is median weekly earnings data. Fifth, data on monetary shocks is from Kuttner (2001). For more detailed information on the data sets, see Appendix C.

2.2 Methodology

The methodology of the paper is presented in three steps. First, the construction of group-specific CPIs is described along with the paper's treatment of housing costs. Second, the methodology behind determining the key demographic factors behind the divergence is explained. Finally, it is discussed how the effect of monetary policy on cost-of-living divergence is estimated.

2.2.1 Group-specific CPIs

The first step of this paper is to construct measures of inflation by demographic group. To achieve this, item-level CPI data is aggregated with group-specific expenditure weights. Two groups could have different expenditure weights, e.g. elderly cohorts are likely to spend a larger fraction of their income on health than younger cohorts. As a result of these group-specific expenditure patterns, a separate CPI can be constructed for different demographic groups. The goal of this paper is to calculate these group-specific CPIs, and document how much they diverge from each other.

Item-level CPI data comes from US Bureau of Labor Statistics (2022b). The full list of items considered is shown in Table 9. The price indices considered are seasonally adjusted and are available at a monthly frequency. Group-specific expenditure weights come from US Bureau of Labor Statistics (2022a). This is a survey of consumers' expenditure patterns. The data is available at the household level on a quarterly basis. The quarterly household-level data is aggregated into annual group-level data. The groups considered include age groups, income groups, ethnicity, region, education, family size, number of children, whether the household is rural or urban, whether it resides in a metropolitan area or not, and whether it owns or rents its primary residence. A combination of these groupings is also considered.

The expenditure weight data is aggregated to annual frequency to ensure the sample size of households is large enough to provide accurate estimates. The expenditure weight data thus has annual observations, while the price data has monthly observations. In order to calculate a weighted average of the prices, the expenditure weight data needs to be at the monthly level as well. This is done by converting the expenditure weight data into monthly frequency by spline interpolation.[1] The price indices are then matched with expenditure weights item by item, and prices are averaged weighted by the group-specific expenditure weights for each month in the data set.

At the core of it this describes the methodology behind the construction of group-specific CPIs. However, there are two additional considerations that must be taken into account. First, the expenditure weights could be variable or fixed. Second, housing costs can be treated in at least two

[1] One could alternatively avoid interpolation and just assume unchanged expenditure weights for the entire year. Results with unchanged annual weights are very similar to the ones presented in the paper and are available upon request.

different ways in the CPI calculations. These considerations are explained in more detail in what follows.

Variable and fixed weights

It is unclear whether the expenditure weights in the CPI calculations should be allowed to vary each month or whether they should be fixed throughout the time period considered. Variable weights are probably more accurate at tracking the true cost of living of consumers, because they inherently take into account substitution between different items as well as changing consumption patterns. Fixed weights, however, isolate the change in prices more clearly from the change in expenditure weights.

In this paper, both variable and fixed weights are considered. Variable weights are allowed to vary continuously (i.e. in each month). Fixed weights are held at the 2010-2019 average weight of each item. The preferred CPIs are the variable-weight ones.

Treatment of housing costs

Broadly speaking, a household's primary residence is either rented or owned. The BLS tracks the price index of rented housing as well as the expenditure weight of rented housing. These two series are used to calculate the contribution of housing costs for renter households. For non-rented housing units, the BLS constructs an item called "owners' equivalent rent of primary residence" (OER) which measures how much a homeowner could rent out their property for at market rates (US Bureau of Labor Statistics, 2009).

OER bears little relation to the actual housing expenditure of a homeowner, which consists of mortgage principal, interest, property tax, insurance and maintenance costs. The reason the BLS uses OER is that housing is a capital good, not a consumption good. Spending on housing is, therefore, seen as a combination of (1) investment in a capital good (principal payments) and (2) paying for the cost of capital (interest, taxes, maintenance). These expenditures are not defined by the BLS as "consumption", so they are not considered in the Consumer Price Index. Instead, it is the value of the services that the capital good can provide that is considered. A dwelling can provide "shelter services" whose value OER is meant to capture (US Bureau of Labor Statistics, 2009).

Thus if one wishes to construct a price index of consumption goods, then strictly speaking OER is the proper measure to consider. However, if one wants to measure cost of living (which is what, in practice, the CPI is often used for), then OER is not a good measure because it does not reflect the true costs of homeownership. Since this paper's goal is to measure cost of living, using OER to measure housing costs for homeowners may be inappropriate. Instead, an alternative homeownership price index is constructed by tracking the total housing expenditures (principal,

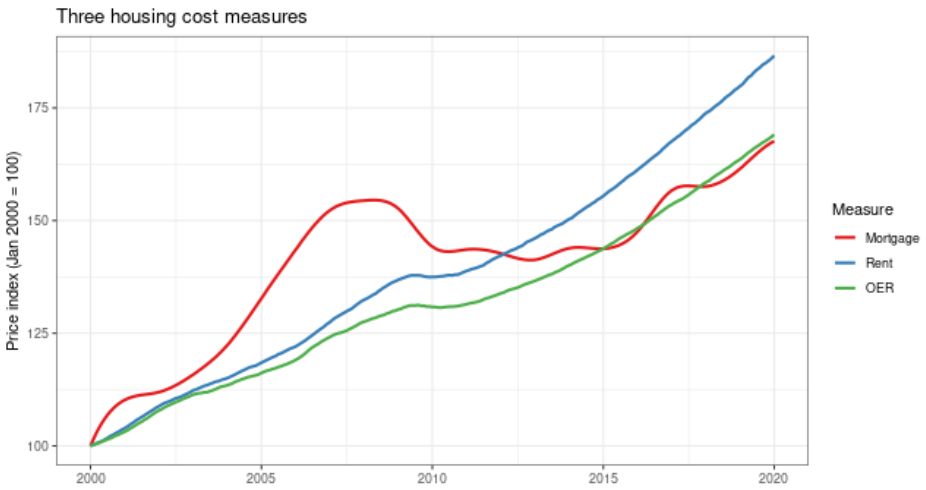

Figure 1: Measures of housing costs for owners and renters

Note: "Rent" and "OER" are the price indices for rented dwellings and owners' equivalent rent as reported by the BLS. "Mortgage" is the mortgage-based homeowners' cost index whose calculation is explained in-text.

interest, property taxes, maintenance) of homeowner households over time.[2] This is called the "mortgage price index".

Figure 1 shows how the mortgage price index compares to the OER and rent price indices. It is apparent that changes in OER and actual rents are highly correlated. However, the mortgage price index shows that homeowners' cost of living is not as correlated with renters' cost of living as OER suggests. Two examples of this can be seen in Figure 1. After 2005 in the subprime mortgage boom, mortgage-based housing costs increased greatly. In this period, homeowners' cost of living increased a lot relative to renters' cost of living and this would have been missed if OER had been used to measure homeowner housing costs. The opposite is true in the post-2008 era. Here, mortgage-based housing costs gradually declined relative to OER and rent. Thus homeowners' cost of living would be greatly overestimated relative to renters' in the post-2008 era if OER is used to measure homeowner housing costs.

The mortgage price index can diverge from OER and rents for a number of reasons. One possibility is that for homeowners, the expenditures for housing services reflect past housing prices as mortgage payments are often locked in for decades. Meanwhile, rents are more flexible and follow current housing prices more closely as terms in rental contracts are usually renegotiated once a year. Another possibility is that the price-to-rent ratio is altered by factors such as credit

[2]This data is available in the Consumer Expenditure Survey under the item called "owned home outlays" whose variable name is `EOWNDWLC`.

availability, e.g. during the 2000s subprime mortgage boom.

Overall, while as argued above, it is theoretically more accurate to rely on a mortgage-based measure of housing expenditures if one wants to capture cost of living, the results of this paper are not altered by how homeowners' costs are measured. In practice, therefore, it does not appear to matter much whether one uses the OER or mortgage-based index.

2.2.2 Which demographic factors matter the most?

Once group-specific CPIs are constructed, one can ascertain whether there is cost-of-living divergence between e.g. different age groups or different income groups. But which of these factors is actually behind the divergence? It could that e.g. both middle-aged and rich households experienced low inflation. Is the reason behind this age or income? This is the next question the paper sets out to answer: which, of the many demographic dimensions considered, are the most important factors behind cost-of-living divergence?

Two pieces of analysis are employed here. First, group-specific CPIs are constructed for more granular groups, e.g. for rich middle-aged vs. poor middle-aged households. This should help with identifying which factor are most important. Second, expenditure shares of major item categories (such as housing or health) are regressed on various household characteristics. This regression analysis reveals what demographic factors increase a household's expenditure weight on item categories that are deemed important for cost-of-living divergence.

The regressions estimated take the form

$$y_{it} = \alpha + \beta t + \sum_{j=1}^{J} (\gamma_j^0 x_j + \gamma_j^1 x_j t) + \varepsilon_{it}, \tag{1}$$

where y_{it} is the expenditure share on an item category for household i in year t, β is the coefficient on a linear time trend (t), x_j are J demographic factors which are interacted with the time trend, and ε_{it} are robust standard errors. The J demographic factors considered include age, ethnicity, region, urban/rural location, education, family size, renter/owner status, and income. All demographic factors are measured as categorical dummy variables to allow for non-linear effects as e.g. age or income increase.

Two things are of interest once Equation (1) is estimated. First, which demographic factors have statistically and quantitatively significant roles in explaining key expenditure weights, which is determined by the estimates of the γ_j^0. Second, which demographic factors have grown more important over the past 20 years, which is determined by the estimates of the γ_j^1.

2.2.3 The role of monetary policy

Finally, the role of monetary policy in potentially contributing to cost-of-living divergence is examined. Following the methodology employed in Romer and Romer (2016), impulse response functions of the following form are estimated

$$\Delta \frac{CPI_{t,i}}{CPI_{t,j}} = \alpha + \sum_{k=0}^{12} \beta_k MonShock_{t-k} + \varepsilon_t, \tag{2}$$

where the dependent variable is the change in the ratio of two groups' CPIs (e.g. renters relative to owners), and $MonShock_{t-k}$ refers to an exogenous monetary policy surprise that happened k months prior. Equation 2 thus estimates the effect of monetary policy shocks in the preceding months on CPI divergence between two groups.

As in Romer and Romer (2016), the results of this analysis are presented graphically by plotting the cumulative sums of coefficients. For instance, the immediate effect of a one basis point increase in the Federal funds rate is given by β_0, the cumulative effect in one month is given by $\beta_0 + \beta_1$, the cumulative effect in two months is given by $\beta_0 + \beta_1 + \beta_2$. These cumulative sums are plotted along with two-standard-error bands.

Finally, note that monetary policy shocks are measured following Kuttner (2001). The idea here is that regressing CPI ratios on the Federal funds rate itself may be problematic due to endogeneity. For instance, the Fed would likely cut rates when economic conditions deteriorate. Thus a correlation between interest rate cuts and cost-of-living divergence may actually be driven by adverse economic conditions, not monetary policy. To address this issue, the paper instead relies on unanticipated changes to the Fed funds rate, which are plausibly exogenous. These are changes in the Fed funds rate that go above or beyond what was anticipated by markets. Papers identifying the effect of monetary policy on various variables using similar methodology include e.g. Kuttner (2001); Romer and Romer (2004); Bernanke and Kuttner (2005); Gürkaynak et al. (2005, 2021).

3 Results

The paper's results are presented in four steps. First, the group-specific CPIs are presented and cost-of-living divergence between certain groups is documented. Second, regression analysis is used to determine which household characteristics matter the most for cost-of-living divergence. Third, some of the consequences of this divergence are discussed. Fourth, the role of monetary policy in behind the divergence is investigated.

As discussed in Section 2, there are four different ways in which the CPIs are constructed: variable vs. fixed weights and OER-based vs. mortgage-based. To conserve space, most analysis

below draws on the the preferred mortgage-based, variable weights variant.

3.1 Group-specific CPIs

Group-specific CPIs using the mortgage-based, variable weights variant are presented in Table 3. The corresponding annual average group-specific inflation rates are shown in Table 1 for the period 2000-2020 and in Table 2 for 2010-2020.[3] The sample size for each group in each year is shown in the Online Appendix.

There is clearly cost-of-living divergence between certain groups. For the entire 2000-2020 period, divergence by age and income is by far the largest (Figure 2). Older cohorts (65+) experienced substantially higher inflation than middle-aged cohorts (25-44). Similarly, lower income households (0-40th percentile) experienced substantially higher inflation than high-income households (81-100th). There is noticeable but smaller divergence by household size and number of children (larger households have lower inflation), education (less educated households have higher inflation), renter/owner status (renters have higher inflation), and region (the Midwest has lower inflation). There is no divergence by ethnicity and household location (whether the household is urban/rural, or in a metropolitan area or not). However, it is possible that different ethnicities pay different prices for the same goods and services, which the CPI data does not pick up. It is possible that these price differentials changed over time and the present analysis misses this phenomenon.

The situation changes in the more recent 2010-2020 period. Age and income still exhibit the highest divergence. However, now renter/owner status joins them as an equally important factor behind cost-of-living divergence with renters experiencing a larger increase in cost of living than owners since 2010 (Figure 3a). Divergence by region increased as the Midwest continued to experience low inflation through the 2010s, but while the South's cost of living was mostly in line with the Midwest's until around 2015, it started increasing more rapidly from that point on – bringing cost of living in the South in line with the Northeast and West by 2020 (Figure 3b). This fact is consistent with Diamond and Moretti (2021) whose findings imply that cost of living in (formerly relatively cheap) Southern cities is no longer below cities in the Northeast and West. Finally, some divergence by ethnicity (with Black households experiencing higher inflation) and household location (with urban/metropolitan households experiencing higher inflation) is visible in the 2010s.

The vast majority of these findings is consistent across the four measures of cost of living (OER vs. mortgage-based, fixed vs. variable weights). Most notably, the findings about age, income and renter/owner status hold regardless of which measure is used. CPI tables for these alternative

[3] Inflation tables span January 2000 to January 2020 to exclude the effect of coronavirus-related disruptions whose examination lies beyond the scope of this paper.

measures can be found in the Online Appendix.

The findings are relevant to a wide range of papers. High inflation for the elderly is of particular concern given the economic vulnerability of this demographic (Baduel et al., 2021). The disparity between income groups appears to exacerbate income inequality – a finding that is further explored in Section 3.3. Regional inequalities in developed countries have also been investigated in the literature and attributed to globalisation (Autor et al., 2013; Ezcurra and Rodríguez-Pose, 2013), and housing prices and the difficulty to migrate (Ganong and Shoag, 2017; Bayoumi and Barkema, 2019; Gbohoui et al., 2019). This paper's results underline an additional source of regional disparities: diverging cost of living.

Which expenditure categories drive this cost-of-living divergence between various groups? To answer this question, the total amount of inflation experienced by different groups is decomposed into eight expenditure categories: housing, education, health, household expenditures, transportation, clothing, food, and entertainment and other. The exact items contained in each category are listed in Table 9.

The decompositions of inflation into expenditure categories are shown in Figures 4-5. The broad conclusion is that housing and health costs are key drivers of divergence across many groupings. For age groups, it is apparent that housing drives inflation significantly less for middle-aged cohorts than for older and younger cohorts, and that the older a cohort is, the more health expenditures drive its inflation rates (Figure 4a). For income groups, Figure 4b shows that housing drives inflation much less for higher income groups. Similarly, housing drives inflation much less for homeowners than renters (Figure 5a). Housing also generates less inflation for rural as opposed to urban households explaining much of the rural/urban cost-of-living divergence since 2010 (Figure 5b).

Housing and health expenditures, therefore, are at the core of cost-of-living divergence. This suggests that the truly important demographic factors for divergence are likely to be renter/owner status (which strongly correlates with housing expenditures) and age (which strongly correlates with health expenditures). Section 3.2 examines this claim more closely.

The importance of housing prices in driving cost-of-living inequality contributes to the literature on the welfare effects of housing market developments (Glaeser and Gyourko, 2002, 2018; Hsieh and Moretti, 2019; Ahrens and Lyons, 2020; Glaeser, 2020). The importance of health expenditures in driving inflation inequality complements the narrative of Case and Deaton (2020) who argue that the US healthcare system drives inequalities.

3.2 Which demographic factors matter the most?

It has been established that cost of living has diverged by various demographic factors, particularly age, income and renter/owner status. Not surprisingly, these factors are correlated with each other as shown in Table 4, so it is difficult to disentangle which one of them is the key factor behind behind cost-of-living divergence.

To begin, consider dividing households into more granular groups along the three dimensions that have been found to be the most important: age, income, and renter/owner status. Each of these groupings is split into two categories: above/below median age, above/below median income, and renter/owner. This procedure creates eight groups such as young poor renters or old rich renters. Comparing the cost of living trends of these eight groups can help disentangle whether it is age, income or renter/owner status that is important for divergence. It is reassuring that the sample size for seven out of these eight detailed groups is comfortably above 1,000 for all years considered. The only exception is the old rich renters group whose sample sizes is mostly between 500 and 1,000. For more details, see the Online Appendix.

The CPIs for these detailed groups are plotted in Figure 6. What stands out is that the four renter groups experience the highest CPIs, especially in the 2010-2020 period. It is clear that renter status is the primary factor behind cost-of-living divergence. Secondly, keeping renter status constant, older groups almost always experience higher inflation than younger groups. Age appears to be the secondary factor behind divergence. Finally, keeping everything but income constant, it appears that poor groups almost always experience higher inflation than rich groups. Income appears to be a less important factor behind divergence than the other two.

Decomposing the eight groups' inflation into expenditure categories reveals the reasons behind the divergence (Figure 7). The difference between renter and owner groups is overwhelmingly driven by housing costs. The disparity due to housing costs is worse in the more recent 2010-2020 era. The difference between the old and young groups is more moderate and it is primarily driven by health expenditures. There is no obvious systematic difference by income if renter status and age are held constant.

The evidence presented so far suggests that cost-of-living divergence is primarily between renters and owners, and between different age groups with the former driven by housing costs, the latter by health costs. To further examine these claims, household-level regressions are estimated following Equation (1). The dependent variables are the expenditure shares of categories such as housing and health. The independent variables are the various demographic factors such as age and income. Simultaneously including all demographic factors in such a regression can help shed further light on which factors are key determinants of spending patterns, especially on

housing and health which are the most important forces behind cost-of-living divergence.

Table 5 shows the key results from the regression for housing expenditures. The column called "Coefficient in 2000" shows γ_j^0, while the column called "Coefficient in 2021" shows $\gamma_j^0 + \gamma_j^1 \cdot 21$. The way to interpret this table is as follows. For age groups, the baseline (omitted) group is 0-24-year-olds. In 2000, the 25-34-year-old cohort spent on average 6.6 percentage points more of their total expenditure on housing than the 0-24-year-old cohort after controlling for the other demographic characteristics. By 2021, they spent only 3.9 percentage points more. This indicates housing price growth exerted more pressure on the cost of living of the 0-24-year-old cohort.

The largest coefficients are for renter/owner status, age groups, and urban/rural location. These three factors, therefore, are the most important determinants of how much a household spends on housing once the other demographic factors are controlled for. A higher housing expenditure share makes a group more susceptible to housing price inflation. Renters already had a 6.7 percentage point higher housing expenditure share than owners in 2000. This increased to an 11.2-percentage-point advantage by 2021. This is by far the sharpest increase of all demographic characteristics suggesting that the renter/owner divide is the most important factor behind housing-driven cost-of-living divergence. The impact of other demographic characteristics on divergence is comparatively small. But Table 5 also suggests that middle-aged (25-64), higher-income (41-100th percentile), and rural households all saw their housing expenditure shares evolve more favourably than the youngest (0-24) and oldest (65+), lower-income (0-40th percentile), and urban households, respectively.

Table 6 shows the same results for health expenditure share. Age is by far the most important determinant of health expenditure shares with a sharp jump for those over 65. There has not been much divergence in health expenditure shares over time, but the coexistence of high exposure to health costs and the high inflation rate of health-related goods and services clearly fuelled the relatively high cost-of-living growth of older cohorts.

Finally, note that the R^2 for the housing regression is 0.133, and for the health regression it is 0.231. In contrast, for other expenditure categories the R^2 fluctuates in the 0.022-0.073 range. This provides further evidence that it is primarily housing and health that are able to drive the cost-of-living divergence along demographic lines as other categories' expenditure shares have a weaker relationship with demographic characteristics. The full regression tables with the estimates of all coefficients for all expenditure categories are available in the Online Appendix.

3.3 Consequences of cost-of-living divergence

One important application of group-specific CPIs is that they can allow for the correction of nominal measures of inequality. As seen in Table 3, an inequality in terms of cost of living has opened

up between different age groups since 2000. This cost-of-living divergence also contributes to real income inequality. Take for instance the 25-34-year-old and the 55-64-year-old cohorts: their costs of living have diverged over time. If their real wages are calculated over time using age-specific CPIs, then one finds that income inequality between these two cohorts has increased less in real terms than in nominal terms. This is illustrated in Table 7 which shows the ratio of the 55-64-year-old cohort's wages to the 25-34-year-old cohort's. From 2000 to 2019, this ratio increased 6.5% in nominal terms, but only 3.6% in real terms. So while the older cohort enjoyed faster wage growth, due to them experiencing inflation, their real wage gains were not as attractive as the nominal data suggests.

A similar comparison is shown for different income groups in Table 7. The table compares the ratio of the 90th percentile wage to the 10th, 25th, 50th, and 75th percentiles. The 90th percentile group experienced faster nominal wage growth than all the other four groups. But their real wage growth, calculated with group-specific CPIs, was even more impressive. While the nominal wage ratios rose only between 5.0% and 9.2% in the 2001-2019 period, the real wage ratios rose between 9.4% and 18.3%. Thus income inequality increased significantly more in real terms than what the commonly used nominal data alone would suggest.

Naturally, these findings have implications for how inequality is measured, and so they relate to the literature on the measurement of inequality (Piketty et al., 2018; Bricker et al., 2018; Bricker and Henriques Volz, 2020; Smith et al., 2021; Auten and Splinter, 2022), and, in particular, to papers that emphasise the role of price indices in such measurements (Gürer and Weichenrieder, 2020; Dabalen et al., 2020; Geloso and Lindert, 2020; Klasen et al., 2016; Krolage et al., 2022). Further, these findings may also provide a partial explanation for the fact that saving has increased among rich households in the US (Mian et al., 2021): lower inflation rates for high-income groups can allow for higher saving rates in this group, which can lead to a growing saving gap over time. Another consideration is for models of inequality (Iacoviello, 2008; Bucciol et al., 2017; Tyrowicz et al., 2018; Kindermann and Krueger, 2022) to include the possibility of different consumption patterns by household that lead to different evolutions of cost of living.

A second application of group-specific CPIs concerns the generosity of Social Security benefits. Given the relatively high cost-of-living increases experienced by older age groups, it is interesting to compare the CPI of those over age 65 to the Social Security's Cost-of-Living Adjustment (COLA) index. This is a point that has also been emphasised by Amble and Stewart (1994) and Hobijn and Lagakos (2003). Social Security benefits are a crucial source of income for the elderly: for slightly more than half of those over age 65, Social Security benefits make up at least 50% of their family income, and for about 20-25% of them, benefits make up at least 90% of their family income (Dushi et al., 2017). To make sure these benefits keep up with the cost of living, the

Social Security Administration adjusts them for inflation using the CPI-W index (Social Security Administration, 2017).[4] This is called Cost-of-Living Adjustment (COLA). Figure 8 compares the COLA index with all four CPIs (variable vs. fixed weights, OER- vs. mortgage-based) for those aged over 65 in the 2000-2019 period.

It is apparent that the COLA index has not kept up with the true cost-of-living increases experienced by the elderly. This is because, as documented before, older age groups experienced above-average rates of inflation. The gap between the COLA and the average of the four age-specific CPIs has risen to 10.8% by December 2019. The average annual inflation rate of the four age-specific CPIs is 2.72% compared to only 2.19% for the COLA index. As Figure 8 also shows, OER-based measures would greatly underestimate the cost of living of the elderly.

3.4 The role of monetary policy

Does monetary policy play a role in cost-of-living divergence between demographic groups? As explained in Section 2.2.3, this question is examined by estimating impulse response functions as in Romer and Romer (2016) using monetary surprises from Kuttner (2001) as a measure of plausibly exogenous changes to the Fed funds rate. The results are presented graphically as the cumulative sum of coefficients from the estimation of Equation (2) with two-standard-error bands indicating statistical significance.

The two most important demographic factors behind cost-of-living divergence have been identified as renter/owner status and age. The divergence between renters and owners is primarily driven by housing costs – an item whose price could be directly influenced by monetary policy decisions. The divergence between age groups is primarily driven by health expenditures – an item whose price index might not be that closely influenced by monetary policy. Indeed, as Figure 9 shows, changes to the Fed funds rate do significantly affect renter/owner cost-of-living inequality, but not age-related inequality.

For renter/owner inequality, Figure 9a shows that about seven months after a one-basis-point increase in the Fed funds rate, the renter-to-owner CPI ratio declines. This decline becomes larger and persists for at least twelve months. After twelve months, a one basis point increase in the Fed funds rate leads to 0.018 percentage point decline in the renter-to-owner CPI ratio. To put this in perspective, during 2007-2009 the Fed gradually cut interest rates by 500 basis points. The estimate suggests that this would have eventually increased the renter-to-owner CPI ratio by 9 percentage points. For age-related cost-of-living inequality, monetary policy does not have a significant effect (Figure 9b). This is intuitive given that age-related inequality is primarily driven by health costs

[4]The CPI-W index is the Consumer Price Index for Urban Wage Earners and Clerical Workers. The source is the US Bureau of Labor Statistics (2021a).

which may be less sensitive to interest rates.

Finally, consider the third factor along which substantial cost-of-living divergence has been documented: income. As it has been established, income is not a direct factor behind divergence. But it is correlated with other factors such as renter/owner status, education, household size, household location or ethnicity (Table 4). Out of these, renter/owner status is one of the direct factors behind cost-of-living divergence and it is sensitive to monetary policy. This would suggest that, by association, cost-of-living inequality along income lines might also respond to monetary policy. Figure 10a provides evidence that the CPI ratio of 21-40th percentile earners to 81-100th percentile owners declines in response to higher interest rates. The decline starts around five months after the rate change, and grows and persists thereafter. Quantitatively, a one basis point increase in the Fed funds rate corresponds to a 0.009 percentage point decrease in the CPI ratio – about half that of the renter/owner effect. For the CPI ratio of 0-20th percentile to 81-100th percentile earners, the effect goes in the same direction, but does not persist (Figure 10b). This may be due to the higher likelihood of 0-20th percentile earners to live in rent-regulated or affordable housing units whose rents are less exposed to interest rate changes.

Monetary policy does not have a robust meaningful effect on cost-of-living divergence by education, ethnicity, household size, number of children, and household location. The findings presented here pertain to the mortgage-based, variable weights CPI indices. Reassuringly, however, they also largely hold with the other three CPI indices (see the Online Appendix).

The broad conclusion, therefore, is that low interest rates can increase inflation inequality, particularly between renters and owners, and to a lesser extent between different income groups. However, these findings do not imply that real income inequality between these groups must also increase in response to expansionary monetary policy. The reason is that low interest rates will not only have a differential impact on group-specific price indices, but likely also on group-specific incomes. There are three effects of low interest rates on households' income. First, there is a mechanical downward pressure on interest income. Second, households respond to this mechanical effect by increased risk-taking (Lian et al., 2019). Third, low interest rates lead to higher asset prices (Rigobon and Sack, 2004; Bernanke and Kuttner, 2005; Gürkaynak et al., 2005) which can increase capital gains for asset-holding households. The net effect of lower interest rates on income inequality between asset-rich and asset-poor households is thus ambiguous. The empirical literature tends to find that asset price increases often exacerbate income and wealth inequality (Kim and Rhee, 2022; Adam and Tzamourani, 2016). But there is evidence to the contrary as Furceri et al. (2018) find that contractionary monetary policy shocks (which should be associated with lower asset prices) increase income inequality. Overall, while this paper finds that expansionary monetary policy widens inflation inequality, it is unclear whether lower interest rates also translate

into higher real income inequality.

4 Discussion

This paper looks at whether cost of living evolved similarly for different demographic groups in the 2000-2019 period in the United States. To accomplish this, group-specific Consumer Price Indices were constructed broken down by various characteristics such as age, income or renter/owner status. Overall, the findings are that some groups have experienced substantially higher average annual inflation rates than others. The most important sources of these differences are twofold: housing costs diverged along renter/owner lines with renters experiencing more inflation, and the contribution of health costs to cost of living varies by age with older generations being more impacted by inflation. The findings have implications for how inequality is measured and for how Social Security benefits are adjusted for cost of living.

Monetary policy, in particular a low interest rate environment, has been identified as one cause for housing cost-driven cost-of-living divergence. Since divergence is primarily driven by housing and health costs, it is also likely that structural policy issues are a driving force behind divergence. These may include the lack of housing supply due to restrictive regulations (Glaeser and Gyourko, 2002; Quigley and Rosenthal, 2005; Saks, 2008; Zabel and Dalton, 2011; Glaeser and Gyourko, 2018; Hsieh and Moretti, 2019; Glaeser, 2020; Kendall and Tulip, 2018) as well as investment demand (Chen et al., 2012; Gallent et al., 2017), and a large number of issues with the health care system in the US (Reichert and Cebula, 1999; Kumar et al., 2011; Dafny et al., 2012; Cicala et al., 2019; Case and Deaton, 2020). This paper underlines the importance of addressing the causes of excessive inflation in the prices of these goods and services.

Future research on this topic can take at least two avenues. First, further empirical work could investigate whether a similar divergence pattern is observed, particularly for housing costs, in other developed economies with low interest rates. Second, models of monetary policy transmission that look at life-cycle patterns (Berg et al., 2021; Mangiante, 2022) could be extended to consider the heterogeneous inflation experiences of different demographic groups. Then it could be examined whether the optimal monetary policy in such a model is affected by this heterogeneity in when goods are consumed and how sensitive their prices are to interest rates.

Conflict of Interest

The author declares that he has no conflict of interest.

Data Availability Statement

The datasets used in this manuscript are available at the sources described in Appendix C.

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A Tables

Table 1: Average inflation rate by group (2000-2020)

Group	OER, var.	OER, fix	mortgage, var.	mortgage, fix
All	2.47%	2.48%	2.47%	2.48%
Age: 0-24	2.48%	2.51%	2.46%	2.50%
Age: 25-34	2.40%	2.41%	2.32%	2.34%
Age: 35-44	2.38%	2.40%	2.39%	2.41%
Age: 45-54	2.45%	2.47%	2.49%	2.51%
Age: 55-64	2.46%	2.48%	2.57%	2.58%
Age: 65-74	2.54%	2.52%	2.80%	2.76%
Age: 75+	2.65%	2.64%	2.92%	2.89%
Broad age: 0-29	2.41%	2.44%	2.37%	2.40%
Broad age: 30-64	2.43%	2.45%	2.42%	2.44%
Broad age: 65+	2.58%	2.58%	2.87%	2.83%
Edu.: below h.s.	2.53%	2.54%	2.57%	2.58%
Edu.: high school	2.47%	2.48%	2.42%	2.43%
Edu.: college	2.45%	2.41%	2.28%	2.26%
Ethnicity: Black	2.44%	2.46%	2.52%	2.53%
Ethnicity: White	2.47%	2.48%	2.47%	2.47%
HH size: 1	2.55%	2.56%	2.61%	2.62%
HH size: 2	2.46%	2.47%	2.50%	2.51%
HH size: 3-4	2.43%	2.42%	2.42%	2.42%
HH size: 5+	2.36%	2.39%	2.30%	2.33%
Income: 0-20th	2.53%	2.54%	2.55%	2.56%
Income: 21-40th	2.58%	2.58%	2.57%	2.57%
Income: 41-60th	2.51%	2.50%	2.36%	2.36%
Income: 61-80th	2.44%	2.43%	2.17%	2.15%
Income: 81-100th	2.37%	2.35%	2.09%	2.08%
Kids: 0	2.51%	2.52%	2.57%	2.58%
Kids: 1-2	2.40%	2.40%	2.37%	2.37%
Kids: 3+	2.33%	2.35%	2.24%	2.27%
Metro: no	2.47%	2.49%	2.42%	2.43%
Metro: yes	2.47%	2.47%	2.43%	2.44%
Region: Midwest	2.44%	2.47%	2.40%	2.44%
Region: Northeast	2.48%	2.49%	2.53%	2.53%
Region: South	2.48%	2.48%	2.52%	2.51%
Region: West	2.48%	2.48%	2.48%	2.48%
Rent/own: own	2.42%	2.43%	2.41%	2.42%
Rent/own: rent	2.57%	2.57%	2.58%	2.58%
Urban: no	2.49%	2.51%	2.39%	2.40%
Urban: yes	2.47%	2.47%	2.44%	2.45%
Old/poor/owner	2.55%	2.55%	2.63%	2.63%
Old/poor/renter	2.70%	2.69%	2.71%	2.70%
Old/rich/owner	2.43%	2.42%	2.28%	2.28%
Old/rich/renter	2.59%	2.59%	2.58%	2.58%
Young/poor/owner	2.36%	2.39%	2.27%	2.30%
Young/poor/renter	2.54%	2.56%	2.54%	2.56%
Young/rich/owner	2.29%	2.31%	2.13%	2.15%
Young/rich/renter	2.49%	2.48%	2.51%	2.49%

Table 2: Average inflation rate by group (2010-2020)

Group	OER, var.	OER, fix	mortgage, var.	mortgage, fix
All	1.88%	1.90%	1.73%	1.76%
Age: 0-24	1.88%	1.93%	1.78%	1.82%
Age: 25-34	1.86%	1.86%	1.68%	1.70%
Age: 35-44	1.78%	1.82%	1.59%	1.65%
Age: 45-54	1.81%	1.87%	1.71%	1.78%
Age: 55-64	1.85%	1.88%	1.79%	1.83%
Age: 65-74	1.97%	1.95%	2.13%	2.07%
Age: 75+	2.07%	2.10%	2.26%	2.23%
Broad age: 0-29	1.85%	1.88%	1.63%	1.69%
Broad age: 30-64	1.82%	1.86%	1.67%	1.72%
Broad age: 65+	2.01%	2.02%	2.22%	2.17%
Edu.: below h.s.	1.89%	1.92%	1.79%	1.83%
Edu.: high school	1.88%	1.89%	1.68%	1.71%
Edu.: college	2.00%	1.90%	1.61%	1.55%
Ethnicity: Black	1.89%	1.89%	1.94%	1.94%
Ethnicity: White	1.88%	1.90%	1.71%	1.74%
HH size: 1	1.98%	2.02%	1.87%	1.91%
HH size: 2	1.88%	1.89%	1.70%	1.72%
HH size: 3-4	1.84%	1.82%	1.75%	1.74%
HH size: 5+	1.71%	1.76%	1.50%	1.57%
Income: 0-20th	1.91%	1.94%	1.75%	1.79%
Income: 21-40th	1.99%	1.99%	1.93%	1.93%
Income: 41-60th	1.93%	1.91%	1.76%	1.72%
Income: 61-80th	1.92%	1.85%	1.69%	1.55%
Income: 81-100th	1.87%	1.82%	1.44%	1.38%
Kids: 0	1.92%	1.95%	1.81%	1.85%
Kids: 1-2	1.82%	1.81%	1.66%	1.66%
Kids: 3+	1.71%	1.74%	1.47%	1.52%
Metro: no	1.74%	1.78%	1.57%	1.60%
Metro: yes	1.91%	1.92%	1.73%	1.75%
Region: Midwest	1.77%	1.86%	1.57%	1.68%
Region: Northeast	1.90%	1.91%	1.80%	1.82%
Region: South	1.91%	1.89%	1.83%	1.81%
Region: West	1.95%	1.96%	1.77%	1.79%
Rent/own: own	1.79%	1.81%	1.57%	1.60%
Rent/own: rent	2.06%	2.07%	2.07%	2.07%
Urban: no	1.71%	1.78%	1.55%	1.59%
Urban: yes	1.90%	1.91%	1.73%	1.76%
Old/poor/owner	1.89%	1.91%	1.80%	1.81%
Old/poor/renter	2.21%	2.21%	2.21%	2.20%
Old/rich/owner	1.86%	1.84%	1.61%	1.60%
Old/rich/renter	2.12%	2.10%	2.11%	2.11%
Young/poor/owner	1.64%	1.69%	1.37%	1.45%
Young/poor/renter	1.99%	2.02%	1.98%	2.02%
Young/rich/owner	1.70%	1.71%	1.33%	1.36%
Young/rich/renter	2.04%	1.99%	2.04%	1.99%

Table 3: CPI by group (variable weights, mortgage)

Group	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
All	100.0	105.2	105.5	109.1	112.7	117.9	125.9	128.6	137.3	133.4	137.2	141.6	146.5	148.5	150.7	146.4	147.6	153.3	156.9	159.0	162.9	164.2
Age: 0-24	100.0	104.0	104.4	107.8	111.9	115.6	123.0	125.5	135.9	132.1	136.4	142.0	147.9	148.2	151.3	147.3	149.5	154.0	157.3	158.9	162.7	169.3
Age: 25-34	100.0	103.9	104.5	108.0	111.3	115.6	123.8	125.4	133.7	129.3	133.9	138.5	144.2	145.6	146.8	142.8	144.4	149.3	152.7	154.7	158.1	160.8
Age: 35-44	100.0	105.4	105.8	108.9	111.9	117.6	126.9	129.6	138.1	134.4	136.9	140.1	145.0	147.7	150.1	144.9	146.8	151.8	155.5	156.6	160.3	160.0
Age: 45-54	100.0	105.4	105.7	109.9	112.7	119.3	125.8	129.8	137.8	133.0	138.1	142.7	146.6	148.3	151.9	147.7	148.1	154.7	157.5	159.2	163.6	164.8
Age: 55-64	100.0	106.4	106.5	109.6	114.2	119.3	127.7	129.7	139.1	135.0	139.1	144.5	150.2	152.2	153.3	148.5	149.3	156.8	162.6	163.4	166.0	165.8
Age: 65-74	100.0	106.0	104.7	109.6	113.6	118.7	126.7	129.7	138.0	136.9	140.7	147.0	152.8	155.5	156.3	152.6	153.4	161.1	161.2	169.6	173.7	173.8
Age: 75+	100.0	104.6	106.2	109.7	116.0	119.6	127.2	130.0	141.0	140.2	142.3	146.1	150.9	154.7	160.4	157.1	156.7	161.2	169.3	171.3	177.9	181.9
Broad age: 0-29	100.0	103.9	104.7	107.8	110.7	115.7	123.5	125.9	135.7	131.6	135.8	140.7	145.2	146.4	147.9	144.0	146.0	150.3	154.9	156.6	159.7	163.6
Broad age: 30-64	100.0	105.4	105.6	109.1	112.5	118.1	126.2	128.9	137.3	132.9	136.9	141.2	146.1	148.0	150.3	145.7	146.7	152.8	156.6	157.8	161.4	162.1
Broad age: 65+	100.0	105.4	105.3	109.6	114.5	118.9	127.0	129.8	139.2	138.4	141.4	146.9	152.3	155.7	158.1	154.7	155.4	161.9	164.8	170.7	176.1	177.4
Edu.: below h.s.	100.0	104.2	104.9	109.5	112.5	118.2	126.1	131.1	138.6	136.7	139.2	143.7	149.8	151.4	155.3	150.3	150.2	156.0	159.7	162.5	166.2	167.0
Edu.: high school	100.0	105.3	105.2	108.9	112.3	117.6	125.4	128.1	136.6	133.1	136.5	141.1	145.6	147.7	149.8	145.3	146.5	151.9	155.5	157.6	161.4	162.8
Edu.: college	100.0	104.9	106.3	108.1	112.0	116.5	124.6	125.9	134.8	128.4	133.9	136.7	142.2	143.5	145.7	142.8	143.6	150.3	153.5	154.5	157.0	158.1
Ethnicity: Black	100.0	105.1	106.3	108.7	111.7	115.9	124.5	128.5	135.9	131.6	135.8	140.5	147.1	148.1	150.7	146.6	147.8	154.1	158.0	160.6	164.6	165.9
Ethnicity: White	100.0	105.3	105.5	109.2	112.9	118.2	126.1	128.6	137.5	133.6	137.4	141.8	146.5	148.6	150.8	146.4	147.6	153.2	156.8	158.9	162.8	164.0
HH size: 1	100.0	105.5	106.0	109.5	114.7	118.2	127.8	130.5	138.7	135.2	139.1	142.7	148.4	150.1	153.0	149.7	150.7	155.9	160.1	162.8	167.4	171.5
HH size: 2	100.0	105.1	105.8	109.0	112.7	118.4	126.9	128.5	137.7	134.2	138.6	143.1	147.1	149.6	151.8	146.5	147.8	154.0	157.0	160.3	164.0	163.4
HH size: 3-4	100.0	105.2	104.6	109.1	112.0	117.1	124.6	127.9	136.2	131.9	135.6	140.4	145.6	147.6	150.0	145.0	146.5	152.2	155.9	156.1	161.2	162.1
HH size: 5+	100.0	105.9	106.9	108.4	111.2	119.2	125.8	128.8	138.2	132.7	135.7	140.7	146.3	147.4	148.9	144.5	144.1	150.1	153.8	157.5	157.5	159.9
Income: 0-20th	100.0	105.3	106.6	108.5	111.1	113.0	125.4	129.4	139.8	136.2	139.2	142.6	148.3	149.4	152.1	148.3	147.5	154.4	156.6	162.0	165.6	164.1
Income: 21-40th	100.0	105.1	104.8	108.6	111.2	115.2	123.5	126.1	135.3	132.9	137.1	142.3	146.8	149.9	152.0	148.6	149.7	154.8	159.4	162.4	166.0	167.6
Income: 41-60th	100.0	103.6	103.5	106.9	109.2	113.8	121.3	123.9	132.9	128.9	134.0	139.0	143.9	145.4	148.0	142.8	143.6	150.6	154.0	155.4	159.5	162.5
Income: 61-80th	100.0	103.6	102.9	106.2	108.8	113.5	120.7	122.7	130.2	125.3	130.0	134.7	140.7	142.7	144.6	139.7	140.8	145.3	149.4	150.1	153.8	155.4
Income: 81-100th	100.0	105.5	104.9	107.5	110.2	114.8	122.7	124.9	132.2	127.6	131.1	134.6	138.5	140.5	143.1	138.3	139.6	144.7	147.5	149.0	151.3	152.3
Kids: 0	100.0	105.2	105.8	109.5	113.6	118.3	126.9	129.4	138.1	134.8	138.9	143.3	148.1	150.1	152.6	148.0	149.4	155.6	159.0	161.5	166.2	167.5
Kids: 1-2	100.0	105.2	104.9	108.6	111.7	117.3	124.8	127.6	136.0	131.6	135.5	139.7	144.9	147.0	149.2	144.6	145.7	150.4	155.0	155.7	159.7	159.8
Kids: 3+	100.0	105.6	106.2	108.6	110.7	117.8	125.1	128.3	138.4	132.6	134.5	139.7	145.6	147.2	148.3	144.9	144.3	151.0	153.4	157.5	155.6	158.8
Metro: no	100.0	104.6	105.5	110.1	112.4	117.5	125.2	127.9	138.7	132.4	138.0	144.0	150.5	151.1	154.1	146.7	145.5	151.8	154.7	156.1	161.2	162.6
Metro: yes	100.0	105.4	105.5	108.8	112.8	117.3	125.1	127.7	136.1	132.6	136.2	140.4	145.1	147.2	149.4	145.4	146.7	152.3	155.9	158.1	161.6	162.7
Region: Midwest	100.0	105.8	105.2	108.9	113.5	118.9	126.1	128.7	137.8	133.1	137.5	141.5	146.3	148.6	150.6	147.3	148.2	152.2	155.8	157.8	160.7	162.5
Region: Northeast	100.0	105.3	105.7	109.3	113.6	117.6	126.5	128.5	138.8	135.7	137.8	143.5	147.6	149.7	152.1	147.9	149.1	155.2	160.2	161.5	164.7	167.2
Region: South	100.0	104.9	105.6	109.3	112.5	117.6	125.2	128.6	137.3	133.0	137.2	141.8	147.8	150.0	152.3	147.3	148.8	154.7	158.4	160.8	164.4	166.1
Region: West	100.0	105.2	105.7	109.1	111.9	118.5	126.6	128.8	135.6	132.8	137.0	140.4	144.5	146.1	148.0	145.2	146.6	153.2	155.5	158.0	163.2	162.3
Rent/own: own	100.0	104.0	105.4	108.7	111.7	115.4	121.7	124.1	132.5	130.6	135.5	139.9	145.2	148.1	150.3	147.9	149.7	155.0	160.3	162.8	166.3	168.3
Rent/own: rent	100.0	105.9	105.6	109.2	113.0	118.9	127.8	130.4	139.2	134.4	137.7	142.3	147.0	148.6	150.8	145.6	146.3	152.3	154.9	156.9	160.9	161.9
Urban: no	100.0	104.0	104.5	109.9	111.7	117.7	123.3	125.3	136.7	129.9	137.5	143.6	149.1	150.7	153.6	147.3	145.8	153.2	155.6	155.8	160.2	163.8
Urban: yes	100.0	105.4	105.6	108.9	112.9	117.5	125.4	128.0	136.5	132.9	136.4	140.7	145.6	147.6	149.8	145.6	146.8	152.4	156.1	158.3	162.0	163.1
Old/poor/owner	100.0	105.7	104.5	108.4	110.0	113.6	125.0	129.3	141.6	136.9	140.7	145.4	150.1	151.9	155.9	151.0	149.0	155.9	159.3	164.0	168.2	167.1
Old/poor/renter	100.0	104.3	106.7	109.6	112.8	116.6	122.7	125.4	132.7	133.1	137.2	140.8	145.9	149.0	151.0	150.6	153.3	158.5	164.2	166.8	170.7	172.9
Old/rich/owner	100.0	104.8	103.7	107.0	110.6	115.9	123.4	125.7	133.6	129.8	133.8	139.0	143.7	146.0	148.7	142.2	143.6	149.6	152.5	153.4	157.0	158.5
Old/rich/renter	100.0	103.6	105.1	108.7	111.5	115.3	121.2	123.6	132.5	129.8	135.1	139.5	145.1	148.3	150.2	147.8	149.3	155.8	160.6	163.4	166.5	170.2
Young/poor/owner	100.0	105.2	105.1	106.8	106.6	108.9	124.1	128.1	137.6	133.6	136.6	140.4	148.3	146.9	148.2	141.2	142.4	148.7	148.5	153.2	156.6	160.8
Young/poor/renter	100.0	104.1	105.2	108.6	111.7	115.3	121.8	124.2	132.9	130.6	135.7	140.2	145.6	148.7	150.8	147.6	149.3	154.6	159.7	162.2	165.2	166.4
Young/rich/owner	100.0	104.9	104.5	108.4	110.5	116.4	125.6	127.9	136.4	130.4	133.5	137.8	141.6	143.7	145.4	140.7	141.7	146.4	148.2	148.8	152.4	152.7
Young/rich/renter	100.0	103.8	104.9	108.1	110.9	114.6	120.7	123.1	131.4	128.5	134.1	138.3	144.1	146.5	148.8	145.9	147.2	152.6	157.5	160.2	164.1	166.0

Table 4: Correlation matrix of demographic factors

	Income	Education	Age	Fam. size	No. children	Urban?	Metro?	Renter?	Black?
Income	1.000	0.318	-0.056	0.200	0.100	0.075	0.102	-0.204	-0.103
Education	0.318	1.000	-0.096	-0.042	-0.032	0.096	0.109	-0.128	-0.076
Age	-0.056	-0.096	1.000	-0.258	-0.337	-0.055	-0.027	-0.281	-0.051
Fam. size	0.200	-0.042	-0.258	1.000	0.827	0.012	0.030	-0.088	0.015
No. children	0.100	-0.032	-0.337	0.827	1.000	0.010	0.015	0.017	0.052
Urban?	0.075	0.096	-0.055	0.012	0.010	1.000	0.683	0.081	0.072
Metro?	0.102	0.109	-0.027	0.030	0.015	0.683	1.000	0.071	0.064
Renter?	-0.204	-0.128	-0.281	-0.088	0.017	0.081	0.071	1.000	0.155
Black?	-0.103	-0.076	-0.051	0.015	0.052	0.072	0.064	0.155	1.000

Table 5: Summary of coefficients for housing expenditure share

Group	Coefficient in 2000	Coefficient in 2021	Change (p.p.)
Age: 0-24	Baseline	Baseline	–
Age: 25-34	6.636	3.949	-2.686
	(0.204)	(0.275)	(0.423)
Age: 35-44	8.654	5.320	-3.334
	(0.204)	(0.277)	(0.424)
Age: 45-54	6.980	5.046	-1.934
	(0.206)	(0.278)	(0.427)
Age: 55-64	5.090	3.947	-1.144
	(0.215)	(0.281)	(0.437)
Age: 65-74	2.135	2.874	0.739
	(0.225)	(0.290)	(0.452)
Age: 75+	2.200	2.616	0.417
	(0.239)	(0.315)	(0.486)
Edu.: below h.s.	Baseline	Baseline	–
Edu.: high school	0.385	0.306	-0.080
	(0.129)	(0.167)	(0.259)
Edu.: college	2.985	2.931	-0.054
	(0.187)	(0.213)	(0.347)
Ethnicity: Black	Baseline	Baseline	–
Ethnicity: White	-0.534	0.360	0.894
	(0.138)	(0.160)	(0.261)
Household size	-0.897	-1.218	-0.321
	(0.031)	(0.036)	(0.059)
Income: 0-20th	Baseline	Baseline	–
Income: 21-40th	-2.213	-2.711	-0.498
	(0.138)	(0.178)	(0.275)
Income: 41-60th	-1.605	-3.684	-2.079
	(0.133)	(0.163)	(0.257)
Income: 61-80th	0.057	-2.879	-2.936
	(0.136)	(0.161)	(0.258)
Income: 81-100th	2.688	0.146	-2.542
	(0.151)	(0.164)	(0.273)
Region: Midwest	Baseline	Baseline	–
Region: Northeast	2.518	3.374	0.856
	(0.130)	(0.153)	(0.246)
Region: South	-1.429	-1.686	-0.257
	(0.108)	(0.125)	(0.204)
Region: West	3.334	3.328	-0.006
	(0.123)	(0.141)	(0.229)
Rent/own: own	Baseline	Baseline	–
Rent/own: rent	6.687	11.201	4.515
	(0.105)	(0.121)	(0.196)
Urban: no:	Baseline	Baseline	–
Urban: yes	5.436	7.270	1.834
	(0.144)	(0.187)	(0.284)

Table 6: Summary of coefficients for health expenditure share

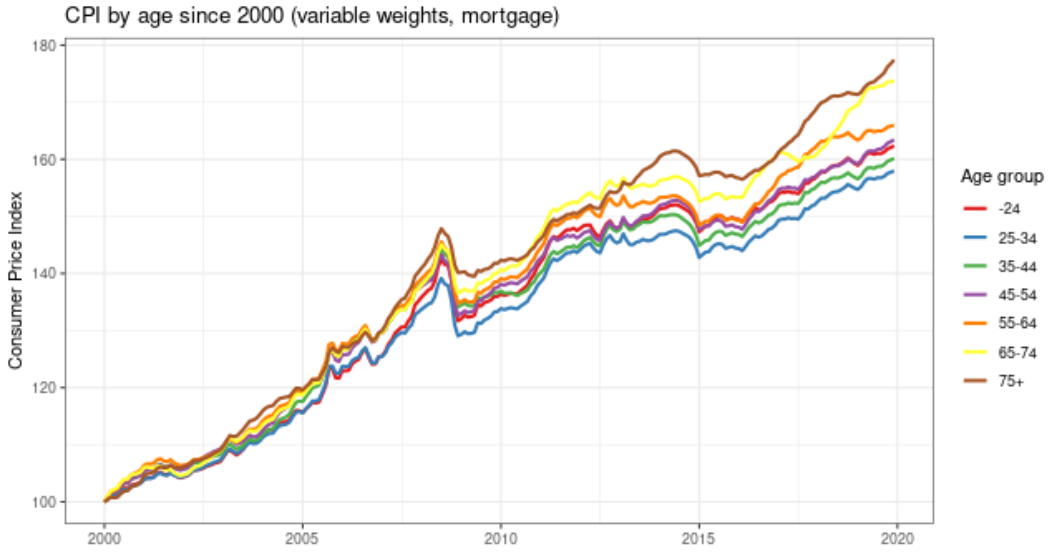
Group	Coefficient in 2000	Coefficient in 2021	Change (p.p.)
Age: 0-24	Baseline	Baseline	–
Age: 25-34	1.187	1.996	0.809
	(0.078)	(0.200)	(0.180)
Age: 35-44	1.946	2.737	0.791
	(0.081)	(0.204)	(0.186)
Age: 45-54	3.085	3.609	0.525
	(0.084)	(0.205)	(0.191)
Age: 55-64	5.222	5.884	0.662
	(0.097)	(0.206)	(0.206)
Age: 65-74	10.231	10.455	0.223
	(0.113)	(0.214)	(0.225)
Age: 75+	14.531	14.539	0.008
	(0.131)	(0.244)	(0.262)
Edu.: below h.s.	Baseline	Baseline	–
Edu.: high school	0.181	1.643	1.462
	(0.078)	(0.132)	(0.155)
Edu.: college	-0.204	1.541	1.745
	(0.105)	(0.146)	(0.201)
Ethnicity: Black	Baseline	Baseline	–
Ethnicity: White	1.779	1.298	-0.481
	(0.064)	(0.103)	(0.129)
Household size	-0.041	0.017	0.058
	(0.015)	(0.024)	(0.031)
Income: 0-20th	Baseline	Baseline	–
Income: 21-40th	1.377	0.302	-1.075
	(0.079)	(0.137)	(0.159)
Income: 41-60th	1.290	1.700	0.410
	(0.074)	(0.119)	(0.148)
Income: 61-80th	0.311	2.575	2.264
	(0.072)	(0.112)	(0.146)
Income: 81-100th	-0.930	1.840	2.771
	(0.077)	(0.100)	(0.149)
Region: Midwest	Baseline	Baseline	–
Region: Northeast	-1.390	-1.919	-0.529
	(0.071)	(0.107)	(0.142)
Region: South	-0.115	-0.864	-0.749
	(0.066)	(0.091)	(0.128)
Region: West	-0.974	-1.973	-0.999
	(0.069)	(0.097)	(0.133)
Rent/own: own	Baseline	Baseline	–
Rent/own: rent	-1.526	-2.111	-0.585
	(0.054)	(0.081)	(0.105)
Urban: no:	Baseline	Baseline	–
Urban: yes	-1.600	-1.424	0.177
	(0.099)	(0.155)	(0.204)

Table 7: Nominal and real wage inequality for different groups (mortgage, variable weights)

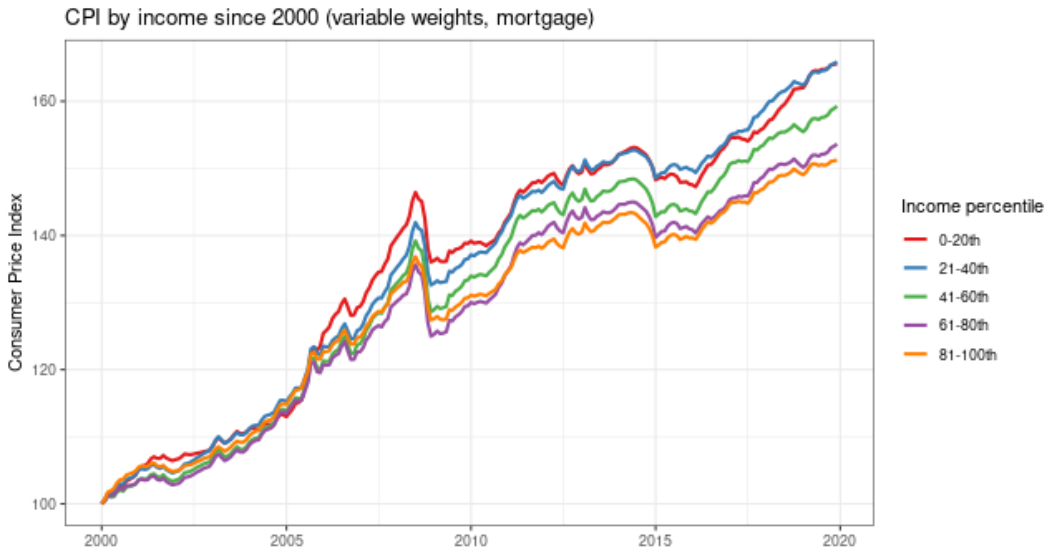
Group 1	Group 2	Type	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Age: 55-64	Age: 25-34	Nominal	1.129	1.108	1.140	1.192	1.200	1.216	1.232	1.249	1.239	1.240	1.261	1.271	1.269	1.277	1.255	1.261	1.268	1.260	1.230	1.202
Age: 55-64	Age: 25-34	Real	1.129	1.111	1.149	1.189	1.190	1.204	1.220	1.228	1.212	1.221	1.236	1.247	1.241	1.251	1.234	1.247	1.237	1.209	1.190	1.170
Income: 90th	Income: 10th	Nominal	–	4.469	4.491	4.542	4.604	4.645	4.707	4.727	4.737	4.735	4.700	4.738	4.799	4.856	4.908	4.881	4.901	4.815	4.756	4.692
Income: 90th	Income: 10th	Real	–	4.469	4.463	4.522	4.471	4.646	4.803	4.917	4.983	4.952	4.900	4.998	5.031	5.078	5.187	5.084	5.151	5.033	5.082	5.061
Income: 90th	Income: 25th	Nominal	–	3.466	3.493	3.522	3.550	3.566	3.599	3.629	3.660	3.699	3.753	3.811	3.862	3.896	3.924	3.931	3.916	3.882	3.823	3.730
Income: 90th	Income: 25th	Real	–	3.466	3.532	3.566	3.575	3.593	3.638	3.718	3.818	3.872	3.972	4.050	4.128	4.145	4.221	4.229	4.200	4.201	4.173	4.101
Income: 90th	Income: 50th	Nominal	–	2.324	2.344	2.363	2.381	2.385	2.400	2.417	2.440	2.445	2.457	2.475	2.498	2.518	2.534	2.544	2.552	2.551	2.547	2.538
Income: 90th	Income: 50th	Real	–	2.324	2.360	2.374	2.398	2.389	2.414	2.464	2.498	2.531	2.569	2.608	2.622	2.638	2.660	2.656	2.690	2.702	2.695	2.711
Income: 90th	Income: 75th	Nominal	–	1.489	1.497	1.510	1.520	1.520	1.526	1.529	1.533	1.534	1.533	1.537	1.545	1.553	1.560	1.564	1.572	1.573	1.574	1.573
Income: 90th	Income: 75th	Real	–	1.489	1.506	1.519	1.534	1.523	1.529	1.536	1.533	1.549	1.561	1.591	1.600	1.599	1.610	1.610	1.608	1.624	1.618	1.629

B Figures

B.1 Age groups

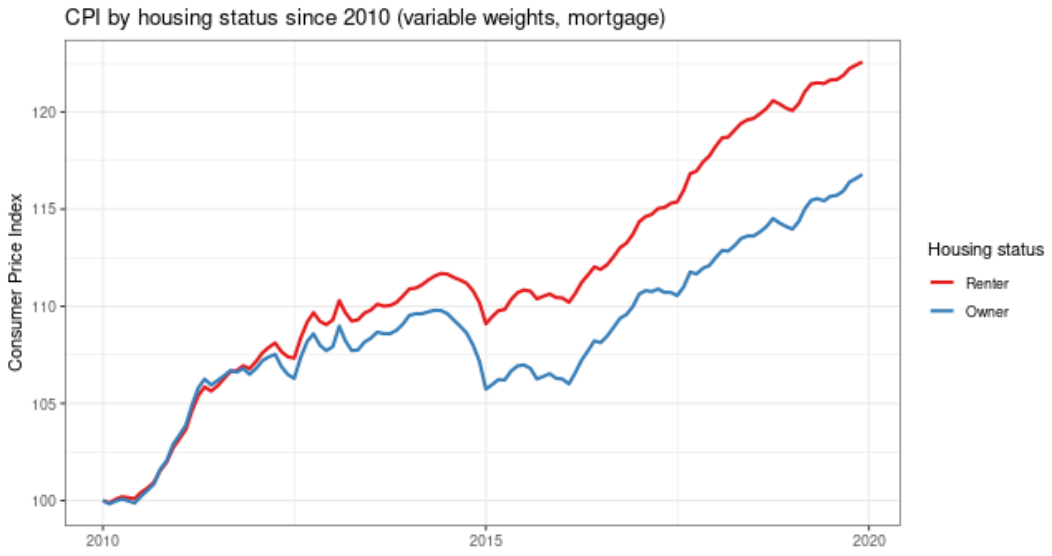


(a) By age group

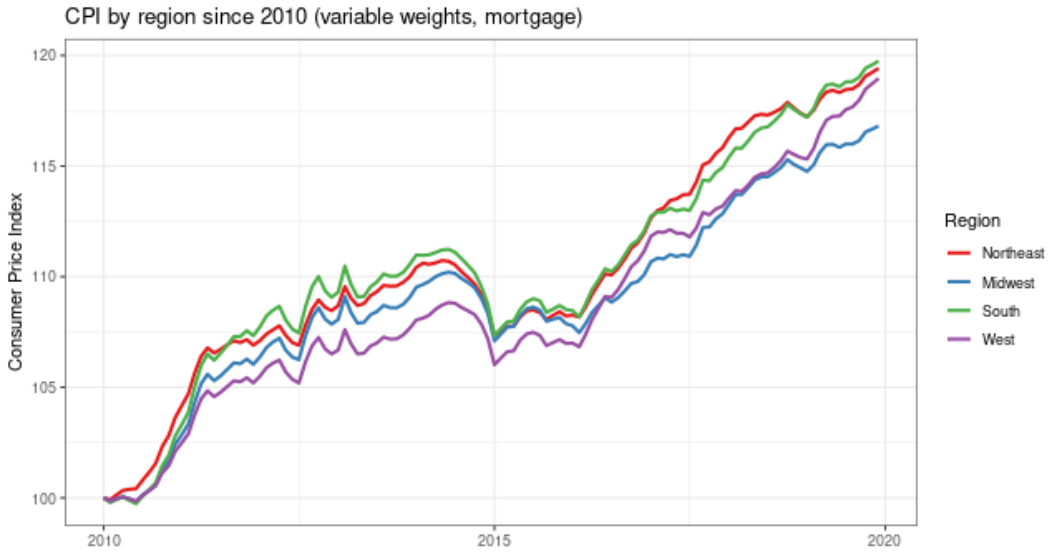


(b) By income group

Figure 2: Consumer price indices by age and income group from 2000 to 2020

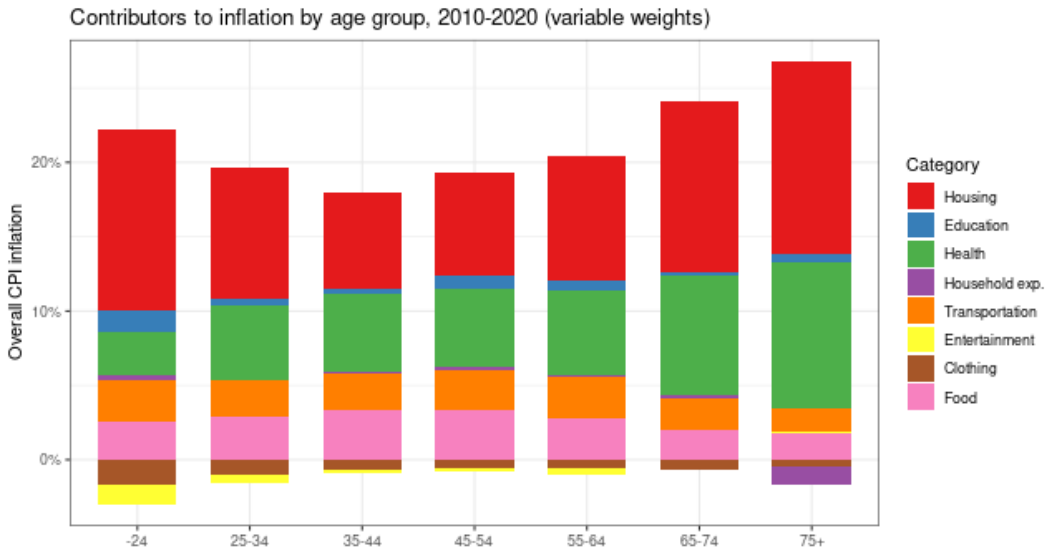


(a) By age renter/owner status



(b) By region

Figure 3: Consumer price indices by renter/owner status and region from 2010 to 2020

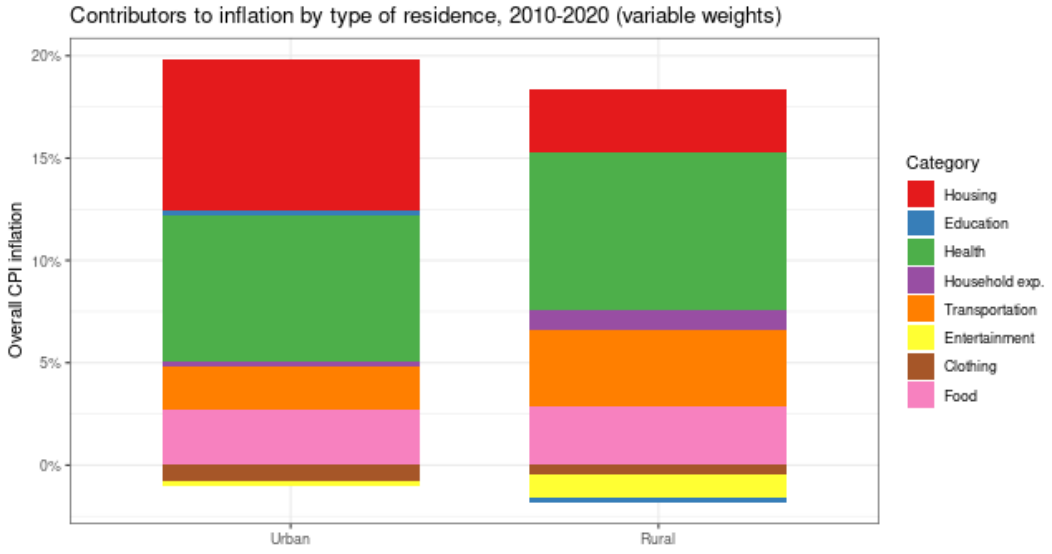


(a) By age group

(b) By income group

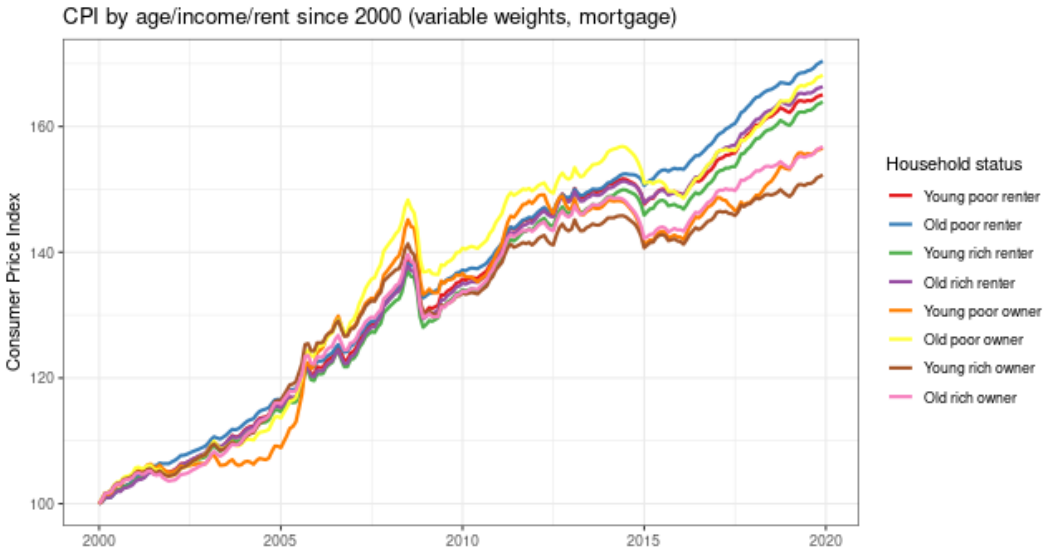
Figure 4: Contributions to inflation by age and income from 2010 to 2020

(a) By renter/owner status

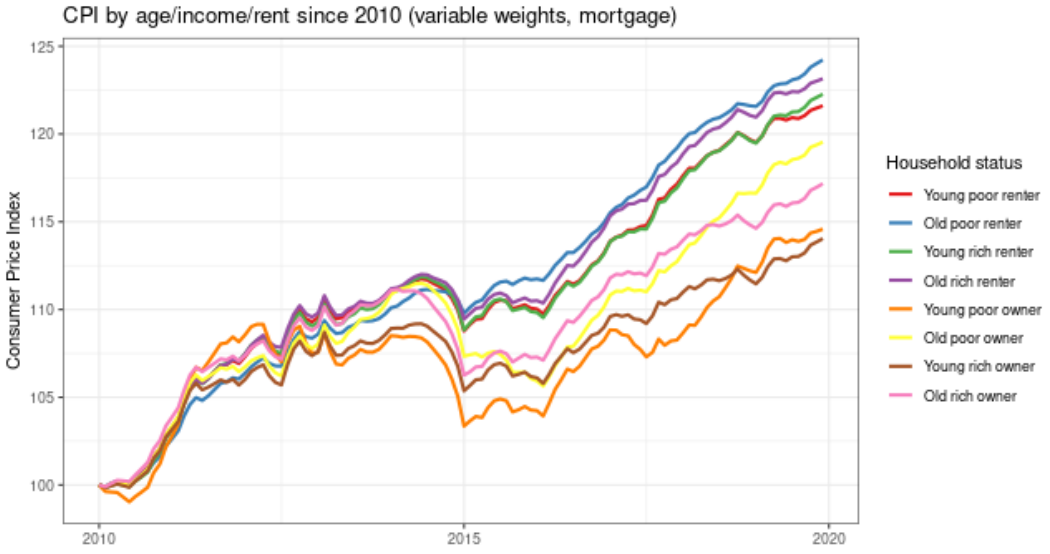


(b) By household location

Figure 5: Contributions to inflation by renter/owner status and household location from 2010 to 2020

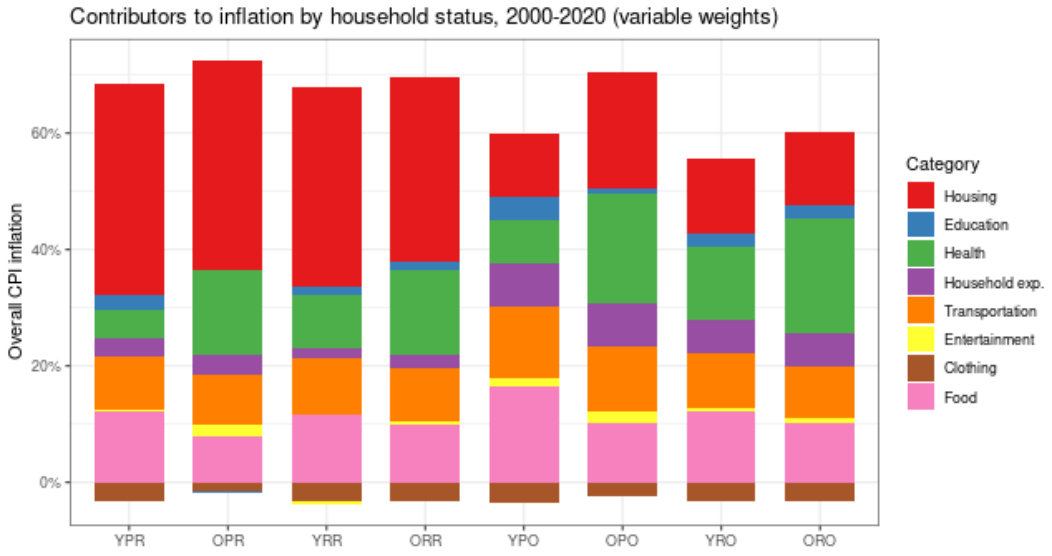


(a) For 2000-2020

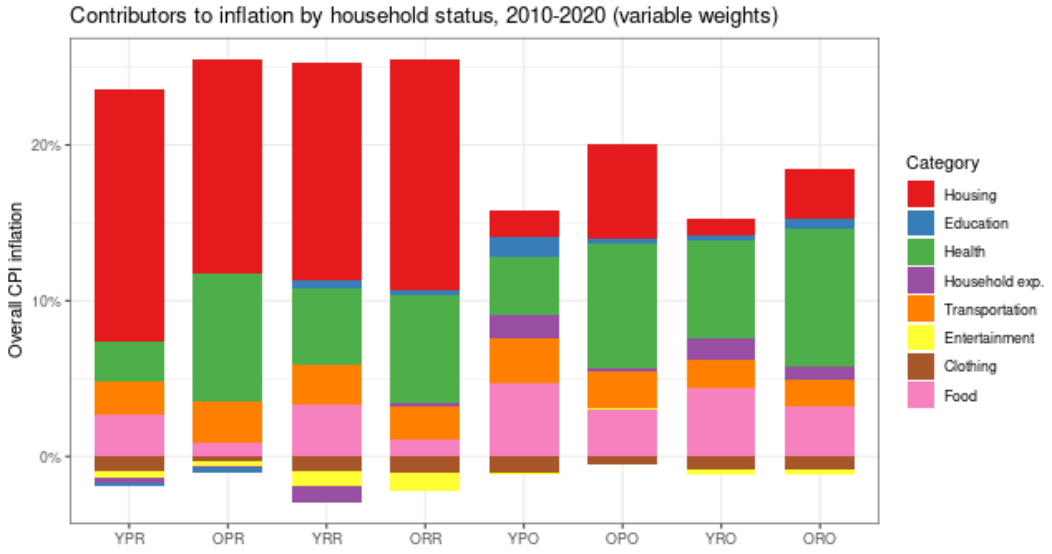


(b) For 2010-2020

Figure 6: Consumer price indices by age/income/renter status for two time periods



(a) For 2000-2020



(b) For 2010-2020

Figure 7: Contributions to inflation by age/income/renter status for two time periods

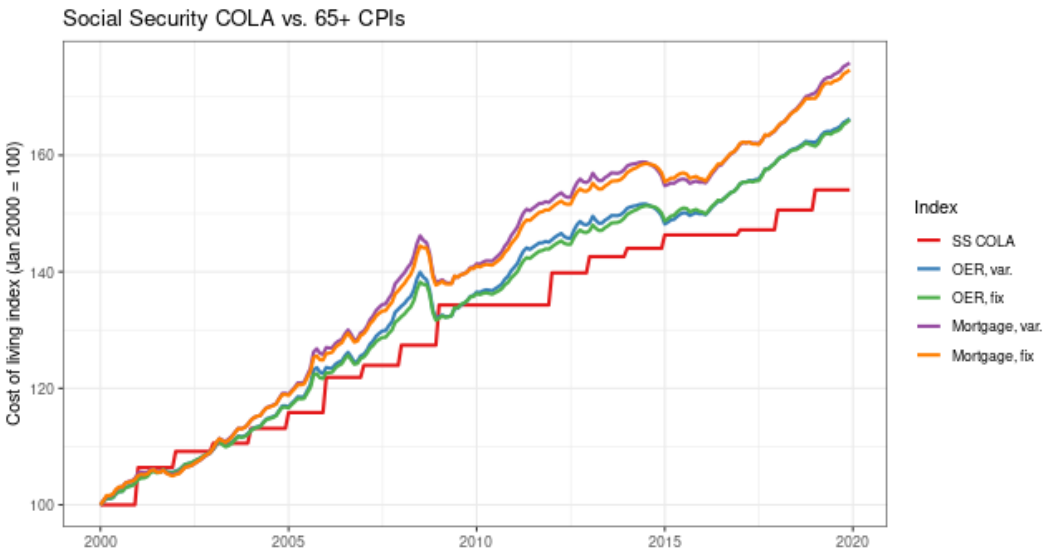
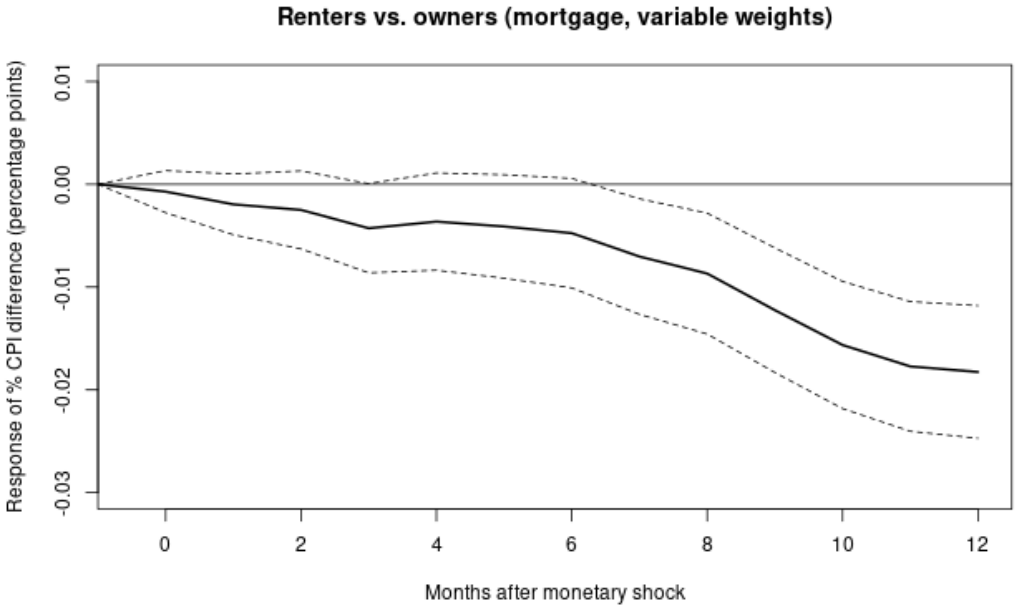
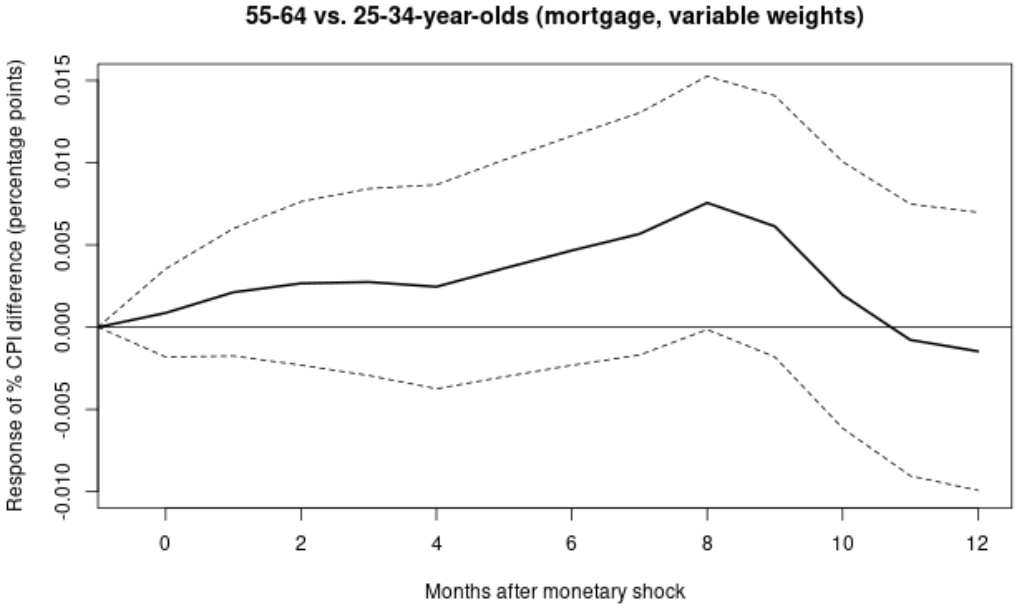


Figure 8: Comparison of Social Security COLA index and age-specific CPIs

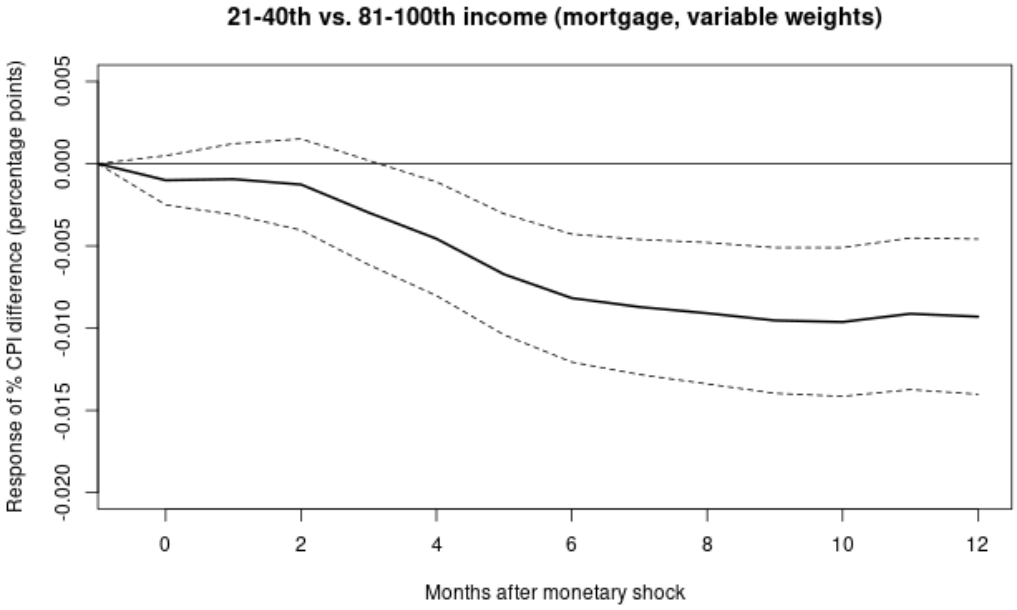


(a) Renter-to-owner CPI

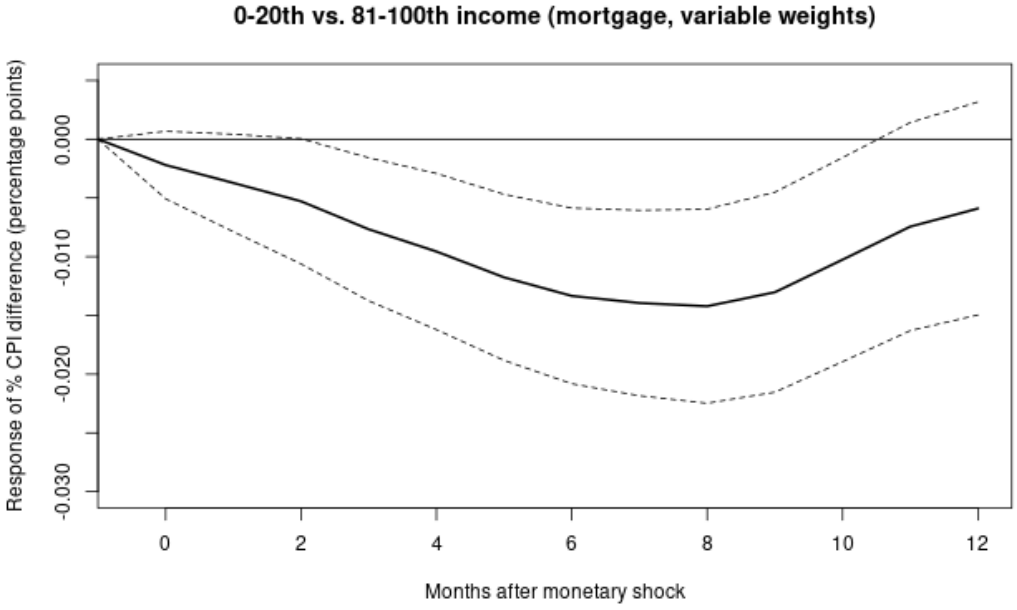


(b) 55-64-year-old to 25-34-year-old CPI

Figure 9: Impulse response of renter/owner and age-related CPI ratios to monetary policy



(a) 21-40th to 81-100th earner CPI



(b) 0-20th to 81-100th earner CPI

Figure 10: Impulse response of income-related CPI ratios to monetary policy

C Data appendix

C.1 Consumer Price Index data

The source of this data is the BLS (US Bureau of Labor Statistics, 2022b). It refers to the Consumer Price Index of all urban consumers (current series). The data comes at a monthly frequency and covers January 2000 to February 2022. For a list of the items whose CPI was considered, see Table 9. The results presented in the paper use seasonally adjusted CPIs with the exception of the items shown in Table 8.

Table 8: Items for which not seasonally adjusted CPI time series are used

No seasonally adjusted CPI series	Not seasonally adjusted CPI series is longer
Telephone services	Music instruments and accessories
Domestic services	Sewing machines, fabric and supplies
Other linens	Window coverings
Floor coverings	Major appliances
Motor vehicle fees	Photography

Further miscellaneous data adjustments and decisions are as follows.

- The CPI time series for "Domestic services" is missing data for five non-consecutive months: September 2015, May 2016, February 2017, June 2017, August 2017. These missing values are imputed by linear interpolation.
- The CPI items "Medical services" (professional and hospital visits) and "Health insurance" are combined, because the "Health insurance" CPI series only starts in December 2005, but the combined data goes back further in time.

C.2 Consumer Expenditure Surveys data

The source of this data is the BLS (US Bureau of Labor Statistics, 2022a). It refers to the expenditure on different items reported in the Consumer Expenditure Surveys (CEX). The data comes at the household level at a quarterly frequency and covers 1984 to 2021. For sample size considerations, the data is aggregated to the annual level. To reconcile the data with the monthly frequency of the CPI data set, monthly observations of the CEX data are constructed using spline interpolation on the annual data. All results in the paper use this "smoothed" CEX data. Results based on the unsmoothed data are available upon request. For a list of the items considered in the CEX data set, see Table 9.

In some cases the item detail is different in the CPI data set from the CEX data set. For instance, while the CEX data set has a category called "Household textiles", the CPI data set breaks this down into "Window coverings" and "Other linens" with no aggregated variable available. In these cases, a weighted average is taken of the CPI items to combine them into a single item corresponding to the CEX item. The relative

weights are taken from the February 2022 release of the CPI (US Bureau of Labor Statistics, 2022c), and they are shown in the "CPI weight" column of Table 9. The flip side is when the CEX data has a more detailed breakdown. For instance, while the CPI data only has "Medical care services", the CEX data breaks this down into "Health insurance" and "Medical services". In these cases, the CEX expenditure weights are added up. For example, if the expenditure weight of "Health insurance" is 0.01 and that of "Medical services" is 0.02, then the weight of "Medical care services" in the CPI calculations will be 0.03.

Further miscellaneous data adjustments and decisions are as follows.

- The following expenditure items are omitted from the analysis as they have no corresponding item in the CPI data set: "other vehicle purchases" (motorcycles, motor scooters, mopeds), "miscellaneous outlays", "personal insurance and pensions", and "cash contributions" (alimony, child support, etc.).
- Expenditure items related to medical expenditures can be negative as medical reimbursements are treated as negative expenditure. For households with negative expenditures on medical items, the negative values were replaced with zeros. Affected expenditure items include: "domestic services", "medical services", "medical supplies", and "prescription drugs".

C.3 Occupational Employment Statistics earnings data

The source of this data is the BLS (US Bureau of Labor Statistics, 2020). It refers to the annual wage percentiles of all US workers. The data is obtained at an annual frequency from 2001 to 2019 (using the May surveys).

C.4 Current Population Survey earnings data

The source of this data is the BLS (US Bureau of Labor Statistics, 2021b). It refers to the median weekly earnings by demographic group of full-time wage and salary workers. The data is obtained at an annual frequency from 1979 to 2020. It is broken down by age group and by ethnicity.

C.5 Social Security COLA data

The COLA index in Figure 8 is constructed following the procedure laid out by the Social Security Administration (2017). The underlying data source is the CPI-W index (US Bureau of Labor Statistics, 2021a).

C.6 Monetary shocks data

Monetary shocks are measured by the data provided by Kuttner (2001), a widely used measure of exogenous monetary surprises. The paper uses an updated version of this data set spanning 1989 to 2019 (Kuttner, 2019).

Table 9: Items considered in the CPI and CEX data sets

CEX code	CPI code	Item name	CPI weight	Category name
FDHOMECQ	SAF11	Food at home	1	Food
FDAWAYCQ	SEFV	Food away from home	1	Food
ALCBEVCQ	SAF116	Alcoholic beverages	1	Food
EOWNDWLC	–	Owned home outlays	1	Housing
RENDWECQ	SEHA	Rent of primary residence	1	Housing
RENTEQVX	SEHC01	Owners equivalent rent	1	Housing
EOTHLODC	SEHB	Lodging away from home	1	Housing
NTLGASCQ	SEHF02	Natural gas	1	Household expenses
ELCTRCCQ	SEHF01	Electricity	1	Household expenses
ALLFULCQ	SEHE	Fuel oil and other fuels	1	Household expenses
TELEPHCQ	SEED	Telephone services	1	Household expenses
WATRPSCQ	SEHG	Water and other public services	1	Household expenses
DOMSRVCQ	SEHP01	Domestic services	1	Household expenses
OTHHEXCQ	SEHL	Other household expenditures	1	Household expenses
TEXTILCQ	SEHH02	Window coverings	0.059	Household expenses
TEXTILCQ	SEHH03	Other linens	0.173	Household expenses
FURNTRCQ	SEHJ	Furniture	1	Household expenses
FLRCVRCQ	SEHH01	Floor coverings	1	Household expenses
MAJAPPCQ	SEHK01	Major appliances	1	Household expenses
SMLAPPCQ	SEHK02	Small appliances	1	Household expenses
MISCEQCQ	SEHL	Other household equipment	1	Household expenses
MENBOYCQ	SAA1	Mens and boys clothing	1	Clothing
WOMGRLCQ	SAA2	Womens and girls clothing	1	Clothing
CHLDRNCQ	SEAF	Childrens clothing	1	Clothing
FOOTWRCQ	SEAE	Footwear	1	Clothing
OTHAPLCQ	SEAG	Other apparel	1	Clothing
ECARTKNC	SETA01	New vehicles	1	Transportation
ECARTKUC	SETA02	Used vehicles	1	Transportation
GASMOCQ	SETB	Gasoline and motor oil	1	Transportation
MAINRPCQ	SETD	Vehicle maintenance and repairs	1	Transportation
VEHINSCQ	SETE	Vehicle insurance	1	Transportation
VRNTLOCQ	SETA04	Car and truck rental	0.135	Transportation
VRNTLOCQ	SETF	Motor vehicle fees	0.518	Transportation
PUBTRACQ	SETG	Public transportation	1	Transportation
HLTHINCQ	SAM2	Health insurance	1	Health
MEDSRVCQ	SAM2	Medical services	1	Health
MEDSUPCQ	SAM1	Medical supplies	1	Health
PREDRGCQ	SEMF01	Prescription drugs	1	Health
FEEADMCQ	SERF	Fees and admissions	1	Entertainment
TVRDIOCQ	SERA	Video and audio	1	Entertainment
PETTOYCQ	SERB	Pets	1.06	Entertainment
PETTOYCQ	SERE01	Toys	0.301	Entertainment
EOTHENTC	SERC	Sporting goods	0.573	Entertainment
EOTHENTC	SERD	Photography	0.021	Entertainment
EOTHENTC	SERE02	Sewing	0.026	Entertainment
EOTHENTC	SERE03	Music instruments and accessories	0.043	Entertainment
PERSCACQ	SAG1	Personal care	1	Entertainment
READCQ	SERG	Recreational reading materials	1	Entertainment
EDUCACQ	SEEA	Educational books and supplies	0.089	Education
EDUCACQ	SEEB	Tuition and childcare	2.568	Education
TOBACCCQ	SEGA	Tobacco and smoking products	1	Entertainment