PENN WHARTON
UNIVERSITY of PENNSYLVANIA
Budget Model

Did Wages Keep Up With Inflation in 2021?

Summary: We estimate that increases in wage earnings in 2021 offset the higher cost of living due to inflation for most households with incomes between $20,000 and $100,000. Higher-income households saw their earnings rise by more than their cost of living, while the lowest-income households (below $20,000) saw their earnings rise by only one third of their increase in cost of living.

Introduction

In a previous analysis, PWBM estimated that the increase in consumer prices in 2021 meant the average U.S. household had to spend around $3,500 more to buy the same goods and services they consumed in previous years. Low-income and working households were most affected because they spend more on necessity goods such as energy, food, and transportation, which saw faster price increases in 2021. In this follow-up analysis, we examine whether recent wage gains are enough to offset the increases in prices.

Figure 1. Dispersion in Household Consumption Price Inflation in 2021

Percent change from 12 months earlier

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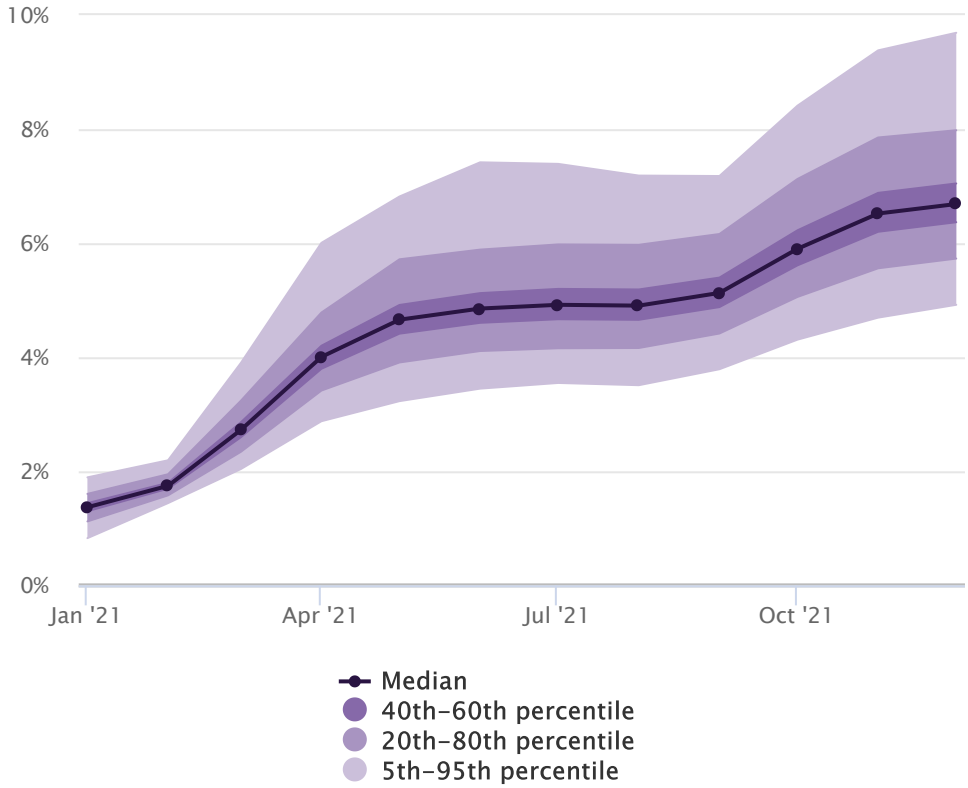

Source: Penn Wharton Budget Model calculations from Consumer Expenditure Survey, Bureau of Labor Statistics, Bureau of Economic Analysis.

Divergence in Household Inflation and Wages in 2021

The rise in prices in 2021 produced a wide range of increases in the cost of living across different households.[1] Figure 1 shows that, for the median household, prices rose 6.7 percent from the end of 2020 to the end of 2021. But for 20 percent of households, the increase exceeded 8 percent. For the 5 percent of households facing the most extreme price increases, inflation was 10 percent or higher.

These differences arise because consumption patterns vary widely across households.[2] Households that spend more on goods and services with faster-rising prices naturally face higher inflation. In 2021, a household's inflation experience was closely linked to the share of its consumption spending accounted for by energy and transportation, items whose prices rose rapidly last year.

Figure 2. Median Hourly Earnings Growth in 2021 by Level of Earnings

Percent change from 12 months earlier, 6-month moving average

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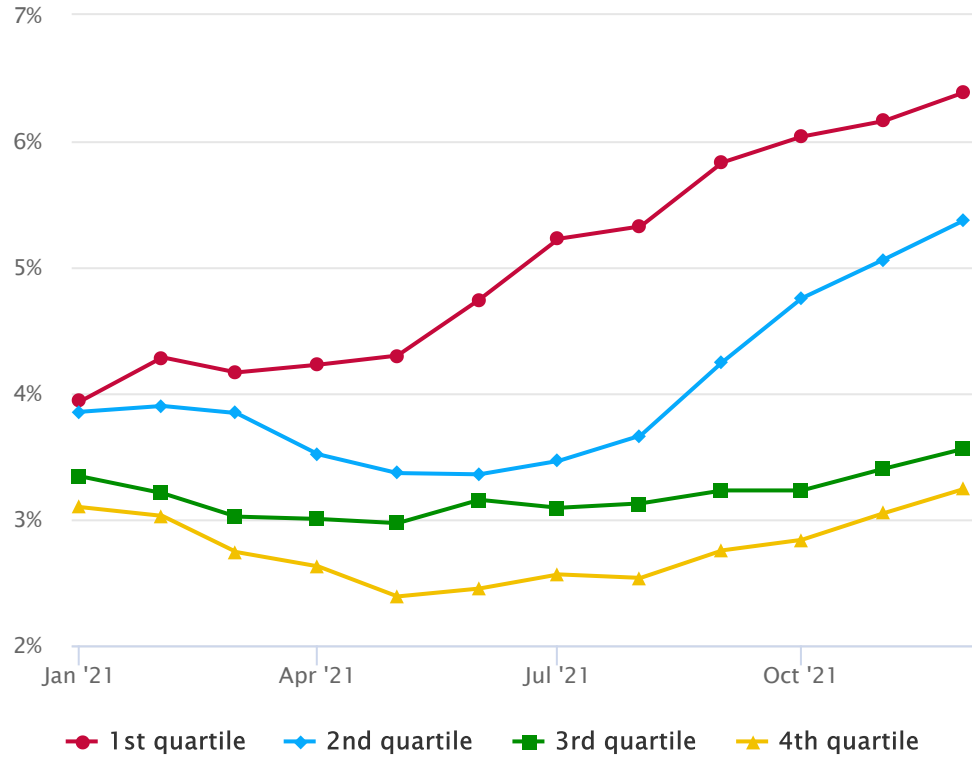

Source: Penn Wharton Budget Model calculations from Current Population Survey.

However, 2021 also produced rapid growth in hourly wages, as shown in Figure 2.[3] These gains too were distributed unevenly across households, with the rise in wage growth concentrated among the lowest-paid 50 percent of workers (the 1st and 2nd quartiles). For the 25 percent of workers with the lowest wages, growth in hourly earnings increased from 4 percent at the end of 2020 to nearly 6.5 percent at the end of 2021. By contrast, hourly earnings growth for the highest-paid workers stagnated in 2021.

Inflation Was Highest for Low-Income Working Households

Lower-income working households faced the highest inflation in 2021. Figure 3 shows how the median inflation rate varied by total household income and for working households compared with non-working households.[4] Working households with income below $40,000 saw their cost of living rise 6.9 percent. For low-income households that were not working, a group that includes many retirees and persons with work-limiting disabilities, inflation was 0.4 percentage points lower. These households typically spend less on items such as gasoline and vehicles, which saw particularly rapid price increases in 2021. Inflation declined with higher household income, falling to 6.1 percent for households with income above $150,000, largely because energy accounts for a smaller share of higher-income households' spending.[5]

Figure 3. Median Consumption Price Inflation in 2021 by Household Income

Percent change in October, November, and December from one year earlier

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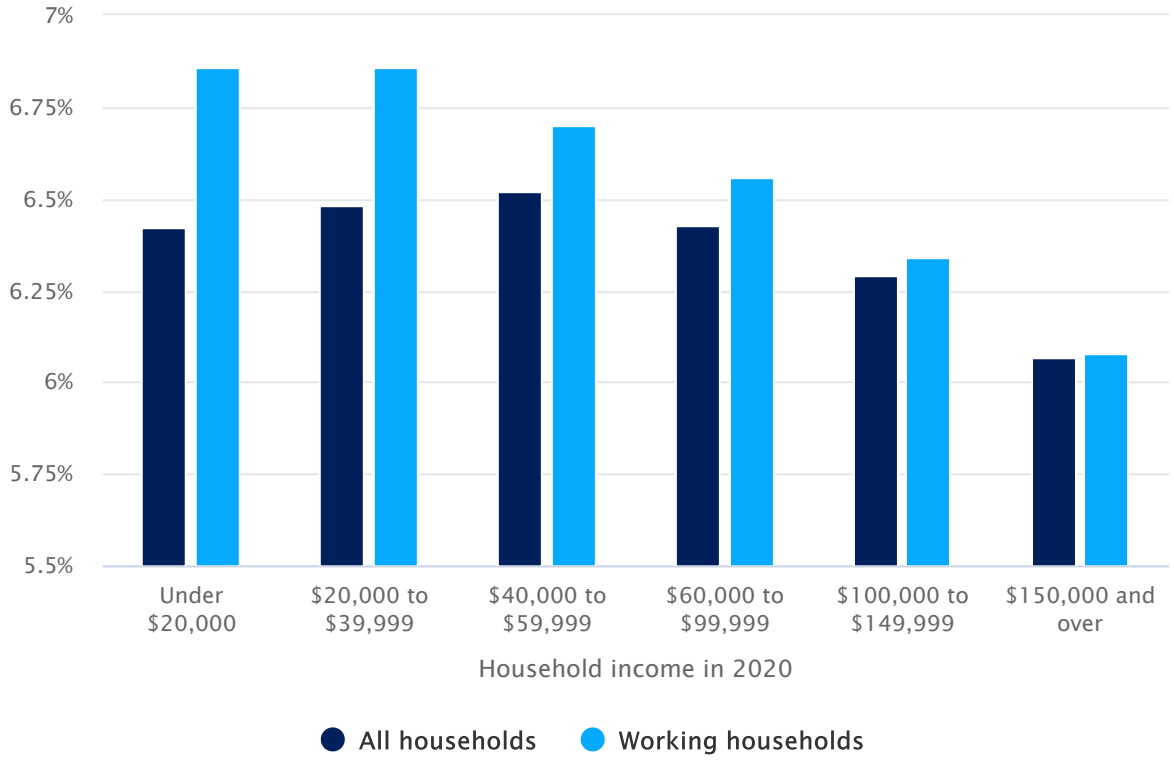

Note: Working households are households with wage or salary earnings.
Source: Penn Wharton Budget Model calculations from Consumer Expenditure Survey, Bureau of Labor Statistics, Bureau of Economic Analysis.

The Cost of Higher Prices

The high inflation of 2021 meant households had to spend thousands of dollars more to purchase the same goods and services as in 2020. Table 1 translates the increase in prices into the amount of additional expenditure required to maintain the same level of consumption.[6] For the median working household, the cost of their 2020 consumption rose $3,750. The increase ranged from around $2,000 for the lowest-income working households to $5,800 for the highest-income.[7]

Table 1. Median Expenditure Cost of Higher Prices in 2021

Dollars, change in October, November, and December from one year earlier

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Family income in 2020	Change in cost of 2020 bundle	Change in cost of 2021 bundle
All working households	3,747	3,570
Under $20,000	1,959	1,837
$20,000 to $39,999	2,331	2,218
$40,000 to $59,999	2,877	2,712
$60,000 to $99,999	3,598	3,365
$100,000 to $149,999	4,182	3,940
$150,000 and over	5,756	5,483

Note: Estimates include working households only. Working households are households with wage or salary earnings.
Source: Penn Wharton Budget Model calculations from Current Population Survey, Consumer Expenditure Survey, Bureau of Labor Statistics, Bureau of Economic Analysis.

However, households offset some of the increase in costs by changing which goods and services they purchased. Consumers typically respond to faster increases in some prices by substituting their consumption away from those items and towards those with slower-rising prices. Accounting for this substitution, the median household's consumption costs rose $3,570. The increase ranged from $1,800 to $5,500 across income groups.[8]

Did Earnings Keep Up?

Increases in wage income offset the higher cost of living for most working households with incomes between $20,000 and $100,000, as shown in Figure 4. However, these households saw essentially no annual wage gains in real (inflation-adjusted) terms. Working households with incomes below $20,000 – who faced the highest inflation rate of any group (Figure 3) – saw their wage income rise by only about one third of the increase in their cost of living. Unless these households supplemented their earnings from employment with increases in other forms of income (such as transfers), they experienced a decline in purchasing power in 2021. Only households with incomes of $100,000 or more saw their annual wage income rise by significantly more than their consumption costs.[9]

Figure 4. Median Change in Annual Earnings and the Cost of Higher Prices in 2021 by Household Income

Dollars, change in October, November, and December from one year earlier

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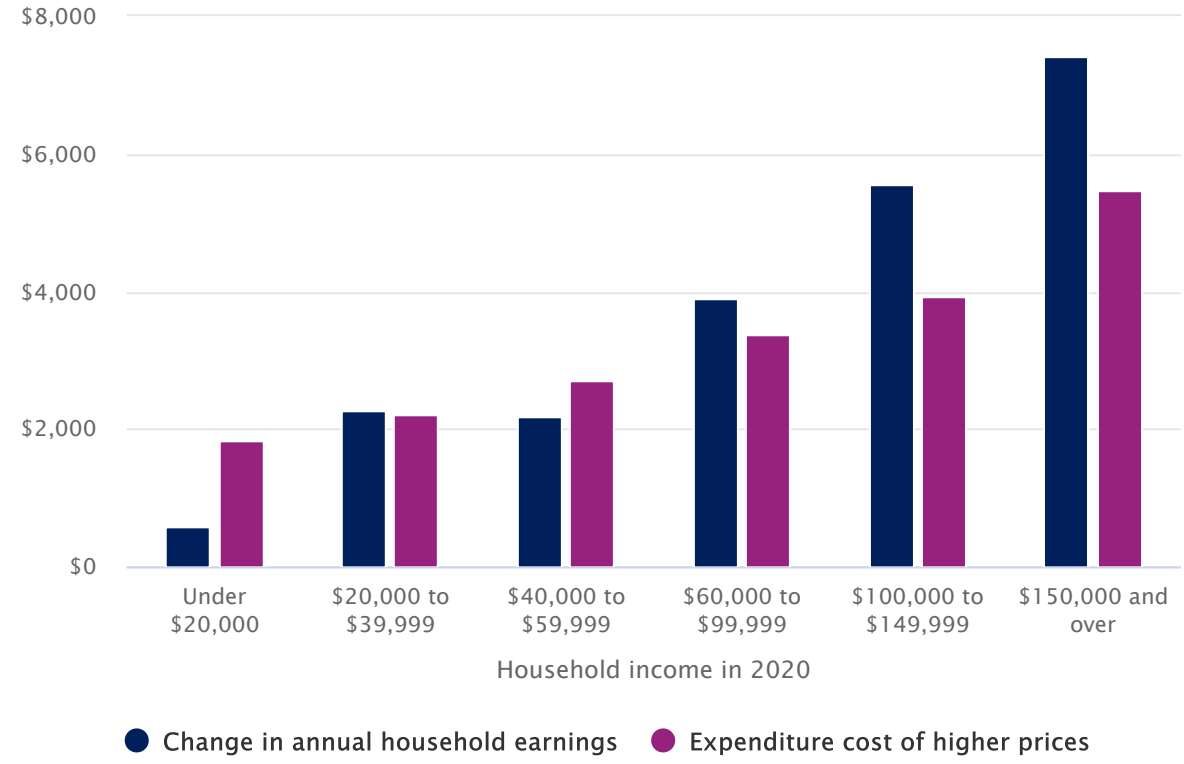

Note: Estimates include working households only. Working households are households with wage or salary earnings.
Source: Penn Wharton Budget Model calculations from Current Population Survey, Consumer Expenditure Survey, Bureau of Labor Statistics, Bureau of Economic Analysis.

Figure 4 shows that, despite faster growth in earnings per hour for lower-wage workers, annual earnings in 2021 did not keep up with the costs of inflation for low-income households and barely kept up for middle-income households. There are two main reasons for the apparent disconnect between hourly wage growth and the increase in annual wage income. First, lower-wage workers saw faster wage growth but from a much smaller base, meaning that their wages did not increase as much in dollar terms as higher-wage workers'.[10] Second, lower-wage workers were less likely to be consistently employed throughout the year and more likely to work part time in 2021, so the increase in hourly wages applied to fewer hours of work. Workers in high-income households were more likely to remain employed and to work full time.

The outcomes in Figure 4 also reflect the fact that many low-income households spend more on consumption each year than they earn in wage income. That means that even if their annual earnings grow at the same rate as inflation, their cost of living in dollar terms rises by more than their income. Table 2 shows annual consumption spending and earnings in 2020 across the income distribution. More than 90 percent of households with incomes below $20,000 spent more than they earned from working, and the median household in this group consumed 3.5 times their wage income. These households financed most of their consumption either with nonwage income (such as transfers) or by borrowing or running down savings. At the

top end, fewer than 10 percent of households with incomes above $150,000 spent more than they earned, and the median high-income household consumed less than half of their wage income while saving the rest.

Table 2. Median Annual Consumption Expenditures and Earnings in 2020 by Household Income

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Household income in 2020	Consumption Expenditures (dollars)	Wage and Salary Earnings (dollars)	Ratio of Expenditures to Earnings	Percent of Households with Expenditures Greater Than Earnings
All working households	50,616	68,000	0.73	33
Under $20,000	26,060	7,668	3.53	91
$20,000 to $39,999	31,822	25,899	1.25	63
$40,000 to $59,999	38,296	43,590	0.91	40
$60,000 to $99,999	48,908	70,000	0.71	26
$100,000 to $149,999	60,690	110,000	0.56	15
$150,000 and over	84,100	198,000	0.43	9

Notes: Working households are households with wage or salary earnings. Expenditures are annualized quarterly totals.
Source: Penn Wharton Budget Model calculations from Consumer Expenditure Survey.

Appendix: Methodology

Estimates of household consumption price inflation

A household's rate of consumption price inflation depends on the bundle of goods and services it consumes and on changes in the prices of those goods and services. Since different households purchase different bundles and may pay different prices, they face different inflation rates.

We measure variation in household consumption bundles using the 2020 Consumer Expenditure Survey (CE), a nationwide household survey conducted by the Bureau of Labor Statistics (BLS) that provides information on expenditures, income, assets, and demographic characteristics of U.S. consumers. We aggregate the survey's expenditure items into five major categories: food, energy, shelter, commodities less food and energy commodities, and services less shelter and energy services.

The survey reports each household's total expenditure on each category over a three-month period and covers spending through December 2020. We estimate expenditures in 2021 and impute expenditures by

month in 2020 using data on monthly personal consumption expenditures (PCE) from the Bureau of Economic Analysis. The PCE data report total spending by all households on different goods or services through December 2021. We apply monthly patterns in PCE by category of spending to all households in the 2020 CE sample. We first distribute 2020 spending within three-month periods and then project 2021 spending based on the twelve-month change in PCE for each spending category.

We estimate a separate price index for each household based on how much it spends on different goods or services and on the prices of those goods or services. We measure prices using Consumer Price Index (CPI) data from BLS and assume that all households face the same set of prices. The price index for a particular household's consumption is the average of CPIs for the five categories of spending, weighted by how much that household spends on each category.[11]

To capture the experience of the typical household, in this analysis we focus on the median household-level inflation rate. Overall inflation rates are typically reported using a different form of aggregation: the average inflation rate (instead of the median) weighted by total expenditures (instead of weighting all households equally). For example, the Consumer Price Index for All Urban Consumers (CPI-U) published by BLS is an expenditure-weighted average.

Appendix Figure A.1 plots inflation from the published CPI-U against our estimate of median household inflation in 2021. This figure also shows an estimate of expenditure-weighted average inflation calculated from our data. PWBM's expenditure-weighted series differs from the published CPI because it is based on consumption patterns from 2020 while the published series is based on consumption patterns from 2017 and 2018, and because of small differences in seasonal adjustment.

Figure A.1. Household Consumption Price Inflation Vs. Published CPI in 2021

Percent change from 12 months earlier

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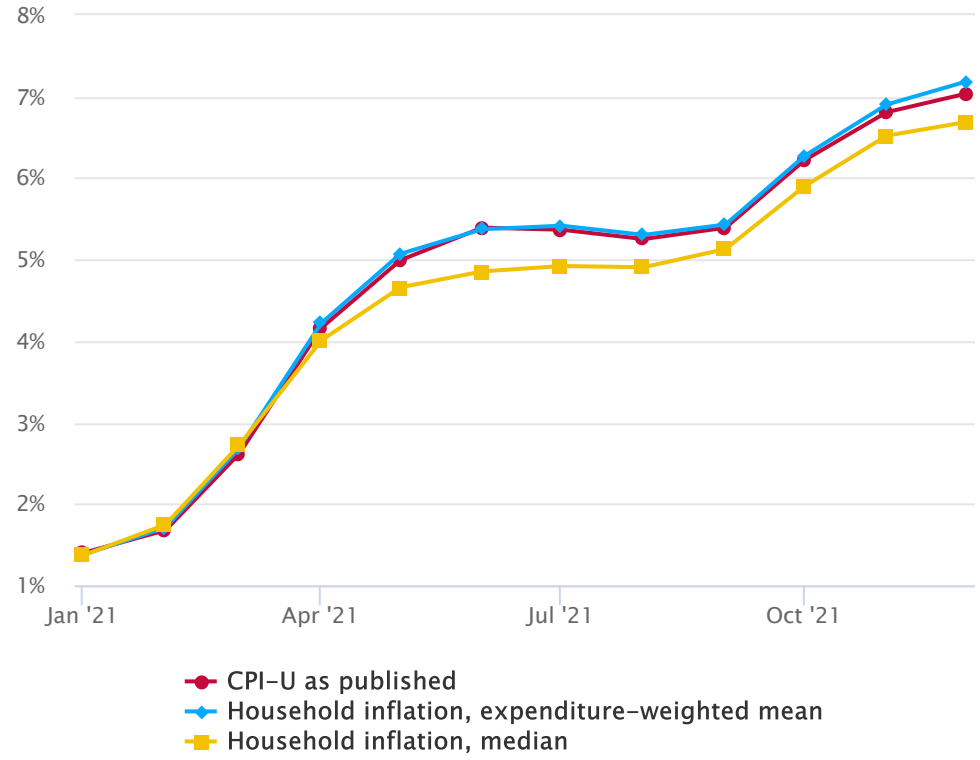

Sources: Bureau of Labor Statistics; Penn Wharton Budget Model calculations from Consumer Expenditure Survey, Bureau of Labor Statistics, Bureau of Economic Analysis.

Estimates of earnings

We measure growth in hourly and weekly earnings using data from the BLS' Current Population Survey's (CPS) outgoing rotation groups—a subset of the CPS sample who report their earnings at two points in time twelve months apart. Our data and methodology are the same as underlie the Atlanta Fed Wage Growth Tracker.

Earnings reported in the CPS include wage and salary income from the respondent's main job. Workers who are paid hourly report their hourly wage; other workers report their weekly earnings. We calculate hourly and weekly wages for all workers based on the reported number of hours worked per week. We exclude workers whose earnings are top coded or have been edited by BLS. We also exclude agricultural workers and those with extreme values of hourly earnings (below the federal tipped minimum wage of $2.13 or above $100 per hour).

We calculate growth in hourly or weekly wages as the percent change in earnings for the same individual or household over a 12-month period. Data on annual wage income are not yet available for 2021, so we estimate households' total earnings over the year based on their weekly earnings and other worker characteristics.

For each worker in the CPS outgoing rotation group sample – who we observe in one month of 2021 and in the same month of 2020 – we estimate the probability they were employed in each month of the year and the

expected change in their weekly earnings between that month and the month in which they were observed. These estimates are based on workers' age, sex, occupation, and level of earnings (in deciles). Together with the assumption that workers who are employed in a given month worked all four weeks, they lead to an initial estimate of annual earnings. We then adjust these initial estimates to correct for the effects of top coded and imputed data in the CPS. Within household income groups, we rescale the level of annual earnings by percentile to match the distribution from the 2020 CE. This adjustment has minimal impact except for the lowest- and highest-income groups and does not affect estimates of earnings growth. Estimates for 2020 based on this method are very similar to the actual distribution of annual earnings in 2020 from the CPS Annual Social and Economic Supplement, in terms of both levels and changes from 2019 to 2020.

Household income

In both the CPS and CE, households are asked about their income from all sources over the previous 12 months. Household income includes wage and salary income; business, farm, or rental income; dividends and interest; pensions and Social Security payments; transfers; and any other monetary income received.

Table A.1 shows the share of households in each of the household income groups we report in this analysis, from the CE. Note that because working households necessarily have some market income, they typically have higher total household incomes.

Table A.1. Distribution of Household Income in 2020

Percent of households

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Household income in 2020	All households	Working households
Under $20,000	16	7
$20,000 to $39,999	19	15
$40,000 to $59,999	15	16
$60,000 to $99,999	21	25
$100,000 to $149,999	14	18
$150,000 and over	15	19

Source: Penn Wharton Budget Model calculations from Consumer Expenditure Survey
Note: Working households are households with wage or salary earnings.

This analysis was written by Alexander Arnon, Zheli He, and Xiaoyue Sun. Prepared for the website by Mariko Paulson.

1. See the appendix for a description of how PWBM estimates household-level inflation and its relationship to official statistics published by the Bureau of Labor Statistics. ↩
2. PWBM's previous post includes a discussion of differences across households in the composition of consumption expenditures. ↩
3. Workers are ranked by level of hourly earnings based on the average of their earnings in 2020 and in 2021. Earnings include all wage and salary income except tips. Growth rates are measured for the same worker over time. Since monthly growth rates are noisy, Figure 2 shows six-month moving averages for each quartile. See the appendix for more detail on how PWBM measures earnings. ↩
4. Household income includes wage and salary income, self-employment income, dividends and interest, government transfers, and other forms of cash income. A household is considered a working household if at least one resident earned wage or salary income. Note that the y-axis scale in Figure 3 does not begin at zero to better show the differences between groups. ↩
5. The gap of 0.8 percentage points between median inflation experienced by the lowest-income and the highest-income working households is small compared with the roughly 5 percentage point range shown in Figure 1. Hence, most of the variability in household-level inflation rates in 2021 reflects differences *across* households within income groups, not systematic differences *between* income groups. ↩
6. These estimates update those in our previous post to reflect additional data and to report estimates for the median household instead of the average across households. ↩
7. We restrict our attention to working households for consistency with the analysis of wage earnings below. ↩
8. This amount represents how much less households would spend on the goods and services they purchased in 2021, if prices were the same as in 2020. Substituting to cheaper goods may reduce the household's total welfare. ↩
9. Since comprehensive data on annual income in 2021 is not yet available, PWBM estimated changes in annual earnings based on available data. These estimates are subject to a higher degree of uncertainty than other results presented here. See the appendix for additional detail. ↩
10. For example, a worker with an initial wage of $10 per hour and hourly wage growth of 10 percent earns an additional $1 per hour. A worker with an initial wage of $40 per hour and hourly wage growth of 5 percent earns an additional $2 hour. Even though the first worker's wage grows twice as fast, the dollar increase in their wage is only half as much as the second worker's. ↩
11. Specifically, we compute a Tornqvist price index for every household. A Tornqvist index weights changes in each price by the average of the corresponding expenditure shares over time, a form of chained weighting. This takes into account households' tendency to substitute their consumption away from goods or services with fast-rising prices and towards those with slower-rising prices. ↩