Getting Real About Wages: A Nonhomothetic Wage Deflator*

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Abstract

Conventional real wages—nominal wages divided by a consumption deflator—are biased from a welfare perspective when households value leisure and exhibit nonhomothetic consumption behavior. We derive a welfare-consistent wage deflator, shown to be a multiplicative adjustment to the consumption deflator, that can be estimated nonparametrically using cross-sectional data. Applying our framework to US data from 1984 to 2019, we find that standard measures understate real wage growth by 8–34 percent and welfare growth by 5–17 percent across the income distribution. Our deflator does not alter the compression of the wage distribution during the recent high-inflation period, however.

Keywords: Inflation, real wages, inequality, welfare, nonhomothetic preferences.

JEL Codes: C43, E24, E31, I31, J31.

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1 Introduction

Ashenfelter (2012) states that the "connection between wage rates, well-being, and productivity is at the heart of the modern economic analysis of labor markets." Taking these words seriously, a natural question arises: how should we measure real wages from a welfare perspective? The conventional approach simply divides nominal wages by a consumption deflator, such as the Consumer Price Index (CPI). These indices are designed to provide money-metric measures of welfare, but only when households value nothing but consumption. In reality, people also care about leisure—an aspect absent from these deflators. Once we recognize this additional dimension of well-being, it is no longer clear that deflating both consumption and labor income with the same index is consistent with a money-metric welfare measure. Yet, little guidance exists on when standard practice remains valid, and how it should be corrected if it does not.

In this paper, we bridge this gap with two contributions. First, we develop welfare-consistent wage deflators through a broadly applicable framework where households value both consumption and leisure, rather than consumption alone. The resulting deflators are simple multiplicative adjustments of conventional consumption deflators, and the adjustment factor is directly identifiable from cross-sectional variation in nominal and real consumption expenditures, building on recent advances in price index methods. Moreover, our setup imposes no parametric restrictions on preferences besides weak separability between consumption and leisure—a standard assumption in labor supply models—and fully incorporates nonhomothetic behavior. Bringing the framework to combined Consumer Expenditure Survey (CEX) and Current Population Survey (CPS) data, we then construct new series of real wages and welfare trends by income deciles in the United States since the 1980s and show that they exhibit substantially higher growth than conventional estimates, especially at the bottom of the income distribution.

Our measure of real wages is welfare consistent because it aligns with money-metric utility once leisure is taken into account. Without leisure, the money metric is simply real consumption: the expenditure at constant prices of some base period that makes a household indifferent to its current consumption. The equivalent in labor supply models is the full income metric: the consumption and leisure expenditure that leaves the household indifferent at base prices. We evaluate this metric by asking: "holding current hours worked fixed, what consumption and wage rate maintain current utility at base prices?" Under separable preferences, this formulation preserves the conventional definition of real consumption, which can therefore be constructed independently using standard price index methods. The wage that rationalizes current utility at base prices—the real wage—then follows from households' optimality conditions for consumption and leisure.

Our key theoretical result then shows that the adjustment factor between the wage and consumption deflators is given by the elasticity of nominal with respect to real consumption expenditures. This elasticity equals unity if and only if preferences are homothetic in consumption. Beyond the homothetic knife edge, the elasticity drives a wedge between the deflators, in which case the conventional practice of deflating nominal wages by a consumption deflator is no longer valid. This reflects that, with nonhomothetic preferences, the value of time depends on income. Intuitively, more leisure implies lower labor income, which shifts consumption from luxuries to necessities. The welfare cost of this adjustment depends on the composition of the consumption basket, which itself varies with income. Taken together, our framework therefore reconciles conventional real wages as a homothetic benchmark and, more importantly, provides a correction for the empirically relevant case where preferences are nonhomothetic.

The real wage definition here differs from the small and seemingly dormant price index literature on wage deflators. Earlier work by Pencavel (1977, 1979a, 1979b), Lloyd (1979), Cleeton (1982), Coles and Harte-Chen (1985), Kokoski (1987), and Riddell (1990) inverts indirect utility functions to obtain constant-utility real wages as functions of consumer prices and unearned income. Our novelty is to effectively define real wages in terms of prices and consumption expenditure via households' optimality conditions. As explained by Preston and Walker (1999), both approaches generate valid welfare metrics when leisure enters the utility function.[1] But unlike the earlier literature, which rarely yields index formulae of practical use, the advantage of our formulation is that it delivers tractable wage deflators that can directly exploit state-of-the-art price index methods for consumption in applications.

To be specific, since the wage deflator is a product of the consumption deflator and a simple nominal-to-real expenditure elasticity, empirical implementations become a straightforward task: compute real consumption across heterogeneous households using household-specific consumption deflators, estimate nonparametrically the cross-sectional relationship between nominal and real consumption, and evaluate the elasticity at expenditure levels corresponding to the wages of interest. This mirrors the methodology proposed by Jaravel and Lashkari (2024), who develop algorithms based on the same elasticity to estimate real consumption growth under arbitrary preferences. We leverage this close connection by adopting their approach off the shelf in our empirical implementation, thereby allowing us to estimate both consumption and wage deflators in one go. The only additional requirement for our analysis is wage data, which we obtain by matching CEX and CPS data across the income distribution.

Empirically, the wage deflator implies substantially higher long-run real wage growth than a benchmark based on the Jaravel-Lashkari consumption deflator. Between 1984 and 2019, annual real wage growth measured in 2019 prices rises from 0.78 to 1.05 percent at the bottom income decile and from 2.07 to 2.26 percent at the top. Overall, real wage growth increases by 0.19 to 0.27 percentage points per year across the income distribution. This wage bias naturally carries over to a similar bias in welfare: considering the money metric defined as the sum of real consumption and leisure expenditure, welfare growth increases by 0.10 to 0.18 percentage points relative to the benchmark. Altogether, these findings suggest that the consumption deflator understates real wage growth by 8 to 34 percent and welfare growth by 5 to 17 percent relative to the corrected wage deflator.

The wage deflator also sheds new light on the compression of the wage distribution that followed the Covid-19 pandemic and the recent high-inflation episode, as documented by Autor, Dube and McGrew (2023) and Jaravel (2024). We extend their findings—which are obtained using homothetic and income-specific CPIs, respectively—by showing that the real wage convergence between 2019 and 2023 persists under our wage deflator and remains close to that implied by the standard CPI. While the biases resemble those in the 1984–2019 setting above, the 2019–2023 window is too short for cumulative growth differences to translate into sizable level effects. Instead, the large heterogeneity in nominal wage growth during this period dominates the comparatively modest differences across deflators. Thus, while the choice of deflator matters in general, it played only a limited role in shaping the recent US wage dynamics.

Overall, our results contribute to a large body of research on inflation inequality and consumer welfare measurement. Earlier work in this literature typically constructs separate homothetic price indices for

[1] Preston and Walker (1999) define six equally valid welfare metrics for consumption-leisure models. Our real consumption and real wage correspond exactly to their metrics (c) and (d)—the consumption and wage metrics defined for a reference level of hours worked, with current hours as reference—while the earlier literature corresponds to their metric (e).

different consumer groups; see Jaravel (2021) for a survey.[2] More recent contributions such as Baqaee and Burstein (2023), Atkin *et al.* (2024), Baqaee, Burstein and Koike-Mori (2024), Hochmuth, Pettersson and Weissert (2024, 2025), and Jaravel and Lashkari (2024) highlight that such price index methods are biased in the presence of nonhomothetic behavior. A common feature of this literature, however, is its exclusive focus on consumption. By showing theoretically and empirically that a similar bias arises for real wages constructed with consumption deflators, we take a first step toward extending this literature into the wage dimension, and demonstrate that accounting for leisure is essential in the measurement of economic well-being.

2 Framework for Deflating Wages

How should nominal wages be deflated when leisure matters for welfare? Existing approaches either impose strong restrictions on preferences or apply consumption deflators without justification. In this section, we provide a simple answer: define real wages so that households' observed hours are rationalized at base prices, and derive the corresponding wage deflator. The approach delivers a transparent correction to the conventional consumption deflator that is easy to estimate empirically.

2.1 Environment

We consider households that value consumption $\boldsymbol{q}$ of a set of goods and services and leisure time ℓ. Our only assumption on preferences is that they are identical across households and weakly separable between consumption and leisure, as is standard in labor supply models. In particular, we impose no homotheticity restrictions on neither consumption nor leisure. The utility function is

$$u = U\big(f(\boldsymbol{q}), \ell\big), \tag{1}$$

where $U(\cdot)$ is increasing and jointly quasiconcave in its arguments, and $f(\boldsymbol{q})$ is some well-behaved composite consumption function. We further assume that households face a common vector $\boldsymbol{p}$ of consumer prices and abstract from measurement issues such as quality adjustment, product turnover, or missing prices. While these are important issues, they are ultimately separate from ours and already well-studied in the price index literature.[3]

Separability is necessary and sufficient for two-stage budgeting (Gorman, 1996). Households therefore choose leisure and total expenditure $e = \boldsymbol{p} \cdot \boldsymbol{q}$ in a first stage, and then, conditional on the latter, allocate consumption between individual goods and services. This second stage can thus be summarized by the indirect subutility function $v(e, \boldsymbol{p}) = \max_q \{f(\boldsymbol{q}) \,|\, \boldsymbol{p} \cdot \boldsymbol{q} \leq e\}$ and its dual expenditure function $e(u_c, \boldsymbol{p}) = \min_q \{\boldsymbol{p} \cdot \boldsymbol{q} \,|\, f(\boldsymbol{q}) \geq u_c\}$, such that Equation (1) becomes

$$u = U\big(v(e, \boldsymbol{p}), \ell\big). \tag{2}$$

In the first stage, households maximize (2) subject to the budget constraint

$$e = wh + y, \tag{3}$$

[2] Examples include Hobijn and Lagakos (2005), McGranahan and Paulson (2005), Kaplan and Schulhofer-Wohl (2017), Jaravel (2019), Argente and Lee (2021), and Klick and Stockburger (2021).

[3] See for example Bils and Klenow (2001) and Bils (2009) on quality, Feenstra (1994) and Broda and Weinstein (2010) on entering and exiting products, and Atkin *et al.* (2024) on missing prices.

where w is the nominal wage rate, $h = T - \ell$ is hours worked of some time endowment T, and y is unearned income.

2.2 Measuring welfare-consistent real wages

How do we track welfare over time in this environment? The typical approach estimates money-metric utility using theoretically consistent deflators that convert nominal expenditures into real counterparts expressed in prices of some arbitrary base period. For instance, if subscripts t and b denote the current period and the base period, respectively, the following characterization for consumption alone is standard (see for example Deaton and Muellbauer, 1980, ch. 7.2):

Definition 1 (Real consumption)**.** Given base prices $\boldsymbol{p}_b$ and nominal expenditure e_t at current prices $\boldsymbol{p}_t$, which deliver subutility $u_{ct} = v(e_t, \boldsymbol{p}_t)$, real consumption is

$$c_{tb} := e(u_{ct}, \boldsymbol{p}_b) = \frac{e_t}{P^c_{tb}}, \tag{4}$$

where the consumption deflator

$$P^c_{tb} := \frac{e(u_{ct}, \boldsymbol{p}_t)}{e(u_{ct}, \boldsymbol{p}_b)} \tag{5}$$

is the Konüs (1939) cost-of-living index between b and t taking current utility as reference standard of living. ◁

Definition 1 states that real consumption is the expenditure at base prices that makes a household indifferent to its actual consumption at current prices.[4] This description is identical to Baqaee, Burstein and Koike-Mori (2024, Definition 1) and Jaravel and Lashkari (2024, Definition 1), and constitutes the standard money metric of welfare when leisure is ignored.

When households also choose leisure, a direct analogue of Definition 1 is the real full income metric following Becker (1965):

$$E(u_t, w^r_t, \boldsymbol{p}_b) = \min_{e,\ell} \left\{ e + w^r_t \ell \;\middle|\; U\big(v(e, \boldsymbol{p}_b), \ell\big) \geq u_t \right\}, \tag{6}$$

where $u_t = U\big(v(e_t, \boldsymbol{p}_t), \ell_t\big)$ is current utility and w^r_t is some reference real wage.[5] Intuitively, $E(\cdot)$ is the sum of consumption expenditure and leisure expenditure at base prices and w^r_t that leaves a household indifferent to its current situation. Because welfare now depends on both consumption and leisure, evaluating it generally requires fixing one more object besides prices to a reference value. In the case of the full income metric, that object is the real wage. This raises the question of what real wage to use in this measure.

[4] Note that real consumption is not expressed in terms of unearned income or wages. While it is true that the utility-maximizing expenditure level depends on these objects, Definition 1 is more general as it applies to any given expenditure level, whether utility-maximizing or not. What matters is that households allocate expenditure optimally across individual goods and services, which we impose through the expenditure function $e(\cdot)$. For a given expenditure level and separable preferences, these allocations are independent of the other items in the budget constraint.

[5] We could also consider the unearned income metric $E(u_t, w^r_t, \boldsymbol{p}_b) - w^r_t T$, but this metric is often negative, which complicates analyses of welfare growth.

One suggestion from traditional price index theory, beginning with Pencavel (1977), is to start from the indirect utility function associated with households' first-stage problem,

$$V(w, \boldsymbol{p}, y) \;=\; \max_{e,\ell} \left\{ U\left(v(e, \boldsymbol{p}), \ell\right) \,\middle|\, e \leq wh + y \right\},$$

and solve for the constant-utility wage w_t^r that satisfies $V\left(w_t^r, \boldsymbol{p}_b, y_t^r\right) = V\left(w_t, \boldsymbol{p}_t, y_t\right)$ for some reference unearned income y_t^r. However, while theoretically consistent, this approach rarely generates practically useful index formulae, and applications in this tradition by Pencavel (1977, 1979a, 1979b), Coles and Harte-Chen (1985), Kokoski (1987), and Riddell (1990) instead resort to bounding approximations or estimation of fully parametrized demand models. Another, more fundamental, limitation is that this method requires prior knowledge of the welfare-relevant unearned income y_t^r, a quantity that is rarely observed directly in practice and that, by design, is embodied in the very welfare metric we are trying to measure to begin with.

Most applications instead simply apply the consumption deflator (5) to both expenditures and wages. For the corresponding real full income to constitute a money metric, households must remain indifferent to their actual full income at current prices. With separable preferences, a necessary condition is then that leisure time stays unchanged at base prices, since Equation (5) keeps the subutility of consumption constant by construction. This notion is also reflected in the common practice of estimating real wages as total nominal earnings divided by current hours worked and a consumption deflator, since this conditions the wage measure precisely on current hours. But this is not saying that a household with real wage w_t / P_{tb}^c would actually choose consumption $c_{tb} = e_t / P_{tb}^c$ and leisure ℓ_t at base prices. If changes in relative prices lead to substitution between consumption and leisure, the level of consumption implied by the money metric (6) no longer coincides with Definition 1, which eliminates the rationale for applying Equation (5) in the first place.

To deal with this issue, we turn the question around: rather than fixing a real wage and asking what level of consumption and leisure sustains utility at base prices, we hold hours fixed at its current level and ask "what level of consumption and wage makes the household indifferent at base prices?" As explained by Preston and Walker (1999), both questions define valid welfare metrics. Yet, the advantage of fixing hours at their observed level is that it stays consistent with the assumptions underlying the conventional practice above, avoids arbitrary choices of reference unearned income or wages, and guarantees consistency with Definition 1 under our separability assumption. This last feature is particularly valuable, since it allows us to estimate real consumption independently using standard price index methods, which can then be inserted into households' first-order conditions to recover the wage that rationalizes current hours at base prices. We consequently define real wages accordingly.

Definition 2 (Real wage)**.** Given base prices $\boldsymbol{p}_b$, current leisure ℓ_t, and real consumption c_{tb} satisfying Definition 1, the real wage is the rate w_{tb}^* at which a household optimally chooses to work $h_t = T - \ell_t$ hours:

$$w_{tb}^* \;:=\; \frac{U_2\left(v(c_{tb}, \boldsymbol{p}_b), \ell_t\right)}{U_1\left(v(c_{tb}, \boldsymbol{p}_b), \ell_t\right)} \bigg/ \frac{\partial v(c_{tb}, \boldsymbol{p}_b)}{\partial c_{tb}}, \tag{7}$$

where $U_j(\cdot)$ denotes the derivative of $U(\cdot)$ with respect to its j-th argument. The corresponding wage deflator is implicitly defined by $P_{tb}^w := w_t / w_{tb}^*$. ◁

The right-hand side of Equation (7) is simply the marginal rate of substitution between leisure and consumption at $(c_{tb}, \ell_t, \boldsymbol{p}_b)$. An equivalent condition of course holds for the nominal wage in period t at $(e_t, \ell_t, \boldsymbol{p}_t)$. Taken together, these conditions yield our main theoretical result, which links the welfare-consistent wage deflator to the conventional consumption deflator:

Proposition 1 (Wage deflator)**.** *For an optimizing household with separable preferences (2) facing the budget constraint (3) and whose real consumption and real wage satisfy Definitions 1 and 2, its real wage can be written*

$$w^*_{tb} = \frac{w_t}{P^w_{tb}}, \tag{8}$$

where the wage deflator is

$$P^w_{tb} = P^c_{tb} \cdot \frac{\partial \ln e_t}{\partial \ln c_{tb}}. \tag{9}$$

Whenever $\boldsymbol{p}_t \neq \boldsymbol{p}_b$, this wage deflator equals the consumption deflator if and only if preferences are homothetic in consumption.

Proof. Equation (8) is just the definition of the wage deflator. Equation (9) follows from the same definition together with Equations (4), (5) and (7), the nominal optimality condition $w_t = \frac{U_2(v(e_t,\boldsymbol{p}_t),\ell_t)}{U_1(v(e_t,\boldsymbol{p}_t),\ell_t)} \Big/ \frac{\partial v(e_t,\boldsymbol{p}_t)}{\partial e_t}$, and the fact that $\frac{\partial v(e,\boldsymbol{p})}{\partial e} = \frac{1}{\frac{\partial e(u_c,\boldsymbol{p})}{\partial u_c}}$:

$$P^w_{tb} := \frac{w_t}{w^*_{tb}} = \frac{\frac{U_2(v(e_t,\boldsymbol{p}_t),\ell_t)}{U_1(v(e_t,\boldsymbol{p}_t),\ell_t)}}{\frac{U_2(v(c_{tb},\boldsymbol{p}_b),\ell_t)}{U_1(v(c_{tb},\boldsymbol{p}_b),\ell_t)}} \cdot \frac{\frac{\partial v(c_{tb},\boldsymbol{p}_b)}{\partial c_{tb}}}{\frac{\partial v(e_t,\boldsymbol{p}_t)}{\partial e_t}} = \frac{e_t}{c_{tb}} \cdot \frac{\frac{u_{ct}}{e(u_{ct},\boldsymbol{p}_t)} \cdot \frac{\partial e(u_{ct},\boldsymbol{p}_t)}{\partial u_{ct}}}{\frac{u_{ct}}{e(u_{ct},\boldsymbol{p}_b)} \cdot \frac{\partial e(u_{ct},\boldsymbol{p}_b)}{\partial u_{ct}}} = P^c_{tb} \cdot \frac{\partial \ln e_t}{\partial \ln c_{tb}},$$

where the fraction of partial derivatives $U_j(\cdot)$ cancel since $v(c_{tb}, \boldsymbol{p}_b) = v(e_t, \boldsymbol{p}_t)$ by Definition 1. To prove the if-and-only-if statement, suppose first that preferences are homothetic in consumption. By definition, then, the consumption expenditure function can be written $e(u_c, \boldsymbol{p}) = F(u_c)G(\boldsymbol{p})$ for some functions F and G, which implies that

$$\frac{\partial \ln e_t}{\partial \ln c_{tb}} = \frac{\frac{\partial \ln e(u_{ct},\boldsymbol{p}_t)}{\partial \ln u_{ct}}}{\frac{\partial \ln e(u_{ct},\boldsymbol{p}_b)}{\partial \ln u_{ct}}} = \frac{u_{ct}F'(u_{ct})/F(u_{ct})}{u_{ct}F'(u_{ct})/F(u_{ct})} = 1.$$

Hence, $P^w_{tb} = P^c_{tb}$. Suppose conversely that $P^w_{tb} = P^c_{tb}$. Then $\frac{\partial \ln e_t}{\partial \ln c_{tb}} = 1$ by (9), which only holds for a given u_{ct} if the elasticity of expenditures with respect to utility is independent of prices. That is, for all price vectors $\boldsymbol{p}$,

$$\left.\frac{\partial \ln e(u,\boldsymbol{p})}{\partial \ln u}\right|_{u=u_{ct}} = C \qquad \text{for some constant } C.$$

Solving the differential equation yields $\ln e(u_{ct}, \boldsymbol{p}) = C \ln u_{ct} + B(\boldsymbol{p})$ for some function $B(\boldsymbol{p})$, which is equivalent to $e(u_{ct}, \boldsymbol{p}) = F(u_{ct})G(\boldsymbol{p})$ with $F(u_{ct}) = u_{ct}^C$ and $G(\boldsymbol{p}) = e^{B(\boldsymbol{p})}$. It follows that $e(u_{ct}, \boldsymbol{p})$ is a homothetic expenditure function. □

Proposition 1 adjusts the common consumption deflator by the elasticity $\frac{\partial \ln e_t}{\partial \ln c_{tb}}$, which we can interpret as an adjustment to the relative price of leisure arising from nonhomothetic preferences. To see this, divide both sides of the budget constraint (3) with the consumption deflator (5) and use Proposition 1 to form the real budget constraint (in terms of consumption)

$$c_{tb} = \frac{\partial \ln e_t}{\partial \ln c_{tb}} w^*_{tb} h_t + \frac{y_t}{P^c_{tb}}.$$

Intuitively, the value of leisure is the opportunity cost to get it, which is usually just the conventional real wage. With nonhomothetic preferences, there is an additional opportunity cost due to changes in the composition of the consumption basket: more leisure lowers your income, which shifts consumption away from luxuries and towards necessities. So, the relative value of leisure time depends on the composition of the consumption basket, which varies with expenditures. Under homothetic preferences, the composition of consumption is independent of expenditures, so this adjustment naturally disappears, and we obtain a standard deflator and real budget constraint.

We call the wage and the deflator in Proposition 1 "welfare consistent" because the corresponding full income satisfies $c_{tb} + w^*_{tb}\ell_t = E(u_t, w^*_{tb}, \boldsymbol{p}_b)$, and is therefore indeed a money metric. This also ensures consistency with traditional price index theory, since $V(w^*_{tb}, \boldsymbol{p}_b, y^*_{tb}) = V(w_t, \boldsymbol{p}_t, y_t)$ holds by design at the real unearned income $y^*_{tb} = c_{tb} - w^*_{tb} h_t$. Moreover, while we only consider working households—since only they have a wage to deflate and value leisure with—Proposition 1 extends to settings with nonworkers by adopting the analogue money metric defined in unearned rather than full income. In this case, nonworkers choose $h_t = 0$, which collapses the unearned income metric to the usual Definition 1. Note also that we effectively consider one worker per household, but that our results extend to N workers whenever consumption remains weakly separable and labor incomes enter the budget constraint additively. That is, if $u = U(f(\boldsymbol{q}), \boldsymbol{\ell})$ and $e = w_1 h_1 + \cdots + w_N h_N + y$, then Proposition 1 applies to each w_i, regardless of hours supplied.

Two key insights emerge from Proposition 1 and its preceding discussion. The first is that it only makes sense to deflate wages with a consumption deflator if people do not value leisure or if preferences are homothetic in consumption. These knife-edge cases rarely hold in practice, so separate wage deflators are generally required to avoid biases in estimated real wages. The second insight is that this is readily achieved by adjusting the consumption deflator with a single multiplicative factor. Being an elasticity between nominal and real expenditures, this multiplier and the corresponding wage deflator are easy to estimate nonparametrically in cross-sectional data: deflate nominal expenditures using some consumption deflator, then estimate by regression the cross-sectional relationship between nominal and real log expenditures, evaluate the derivative at the relevant expenditure points, and finally apply Equation (9).

This last point highlights a close connection between Equation (9) and the recent contribution by Jaravel and Lashkari (2024), who develop a nonparametric algorithm for estimating real consumption growth under arbitrary preferences. They correct the potential bias induced by deflating nominal growth e_{t+1}/e_t with homothetic inflation rates π_t by estimating "nonhomotheticity correction factors" $1 + \Lambda_t$ so that real growth satisfies $\ln \frac{c_{t+1b}}{c_{tb}} = (1 + \Lambda_t)^{-1}\left(\ln \frac{e_{t+1}}{e_t} - \pi_t\right)$. By Jaravel and Lashkari's Proposition 1, the factor $1 + \Lambda_t$ turns out to be exactly the expenditure elasticity $\frac{\partial \ln e_t}{\partial \ln c_{tb}}$. This suggests that their algorithm kills two birds with one stone: not only does it generate wage deflators under arbitrary preferences, but it also obtains both necessary components—the consumption deflator and the expenditure elasticity—in one go.

The insights from Jaravel and Lashkari (2024) also allow us to relax the assumption of identical preferences to incorporate heterogeneity in tastes. Although welfare comparisons across households with different preferences are not meaningful per se, we can still compare heterogeneous households' real expenditures and wages at base prices. Suppose therefore that utility is given by $u = U\big(v(e, \boldsymbol{p}, \boldsymbol{x}^c), f_\ell(\ell, \boldsymbol{x}^\ell)\big)$, where $\boldsymbol{x}^c$ and $\boldsymbol{x}^\ell$ are household-specific taste shifters for consumption and leisure. Definitions 1 and 2 then generalize to equivalent statements that condition on current tastes, as in Jaravel and Lashkari's Definition 3. Real consumption and its deflator are now

$$c_{tb} := e\big(u_{ct}, \boldsymbol{p}_b, \boldsymbol{x}_t^c\big) \qquad \text{and} \qquad P_{tb}^c := \frac{e\big(u_{ct}, \boldsymbol{p}_t, \boldsymbol{x}_t^c\big)}{e\big(u_{ct}, \boldsymbol{p}_b, \boldsymbol{x}_t^c\big)},$$

and real wages follow analogously from households' first-order conditions. The wage deflator then becomes

$$P_{tb}^w = P^c\big(u_{ct}, \boldsymbol{p}_b, \boldsymbol{p}_t, \boldsymbol{x}_t^c\big) \cdot \frac{\partial \ln e\big(u_{ct}, \boldsymbol{p}_t, \boldsymbol{x}_t^c\big)}{\partial \ln e\big(u_{ct}, \boldsymbol{p}_b, \boldsymbol{x}_t^c\big)},$$

where we write the arguments to highlight the impact of tastes. Leisure tastes drop out altogether, since they are fully embodied in observed hours, but consumption tastes now show up in the deflator. In practice, however, these can be controlled for using Proposition 3 in Jaravel and Lashkari. Our framework therefore extends to heterogeneous tastes without losing its empirical tractability.

2.3 An Illustrative Example

To build intuition of the bias identified by Proposition 1, it is useful to analyze a parametric form of the utility function. To that end, consider the intertemporally aggregable preferences of Alder, Boppart and Müller (2022), which are prevalently used in the structural transformation literature to model long-run changes in the sectoral composition of output. The indirect utility function for consumption is then

$$v(e, \boldsymbol{p}) = \frac{1}{\varepsilon}\left[\left(\frac{e - A(\boldsymbol{p})}{B(\boldsymbol{p})}\right)^{\varepsilon} - 1\right] - \frac{\nu}{\varepsilon}\left[\left(\frac{D(\boldsymbol{p})}{B(\boldsymbol{p})}\right)^{\varepsilon} - 1\right], \tag{10}$$

where $\varepsilon \in (0, 1)$, $\nu \geq 0$, and $A(\boldsymbol{p})$, $B(\boldsymbol{p})$, $D(\boldsymbol{p})$ are linearly homogenous price functions. These preferences are nonhomothetic and flexible in the sense that they permit nonmonotonic (hump-shaped) budget shares. Equation (10) also nests commonly used preferences as special cases: we obtain quasi-homothetic preferences if $D(\boldsymbol{p}) = B(\boldsymbol{p})$, Muellbauer's (1975, 1976) price-independent generalized linearity (PIGL) preferences if $A(\boldsymbol{p}) = 0$, and homothetic preferences when both conditions hold.

While $A(\boldsymbol{p})$, $B(\boldsymbol{p})$, and $D(\boldsymbol{p})$ are generally functions of all individual goods and services, it helps to interpret these as representing distinct, homothetic sub-baskets with associated price indices $P_{Ct} := C(\boldsymbol{p}_t)/C(\boldsymbol{p}_b)$, $C \in \{A, B, D\}$. Roy's identity then implies expenditure shares of the forms

$$s_A = \frac{A(\boldsymbol{p})}{e}, \tag{11a}$$

$$s_B = \left(1 - \frac{A(\boldsymbol{p})}{e}\right)\left[1 - \nu\left(\frac{D(\boldsymbol{p})}{e - A(\boldsymbol{p})}\right)^{\varepsilon}\right], \tag{11b}$$

$$s_D = \left(1 - \frac{A(\boldsymbol{p})}{e}\right)\nu\left(\frac{D(\boldsymbol{p})}{e - A(\boldsymbol{p})}\right)^{\varepsilon}. \tag{11c}$$

Here, s_A decreases and s_B increases with expenditures, while s_D is hump-shaped if $A(\boldsymbol{p}) \neq 0$ and decreasing otherwise. $A(\boldsymbol{p})$ therefore represents necessities and $B(\boldsymbol{p})$ luxuries. $D(\boldsymbol{p})$ is an intermediate case in general and a necessity bundle under PIGL preferences.

Following Hochmuth, Pettersson and Weissert (2024, 2025), the consumption deflator and the expenditure elasticity under these preferences satisfy

$$P^c_{tb} = \left[(1 - s_{At}) \widetilde{P}_t^{-1} + s_{At} P_{At}^{-1} \right]^{-1} \qquad \text{and} \qquad \frac{\partial \ln e_t}{\partial \ln c_{tb}} = \left(\frac{P_{Bt}}{P^c_{tb}} \right)^{\varepsilon} \left(\frac{\widetilde{P}_t}{P^c_{tb}} \right)^{1-\varepsilon}, \tag{12a}$$

where

$$\widetilde{P}_t := \left[\frac{s_{Bt}}{1 - s_{At}} P_{Bt}^{-\varepsilon} + \frac{s_{Dt}}{1 - s_{At}} P_{Dt}^{-\varepsilon} \right]^{-\frac{1}{\varepsilon}}. \tag{12b}$$

The PIGL case arises when $s_{At} = 0$, implying $P^c_{tb} = \widetilde{P}_t$ and $\frac{\partial \ln e_t}{\partial \ln c_{tb}} = \left(\frac{P_{Bt}}{P^c_{tb}} \right)^{\varepsilon}$, while the quasi-homothetic case occurs when $P_{Dt} = P_{Bt}$, such that $P^c_{tb} = \left[(1 - s_{At}) P_{Bt}^{-1} + s_{At} P_{At}^{-1} \right]^{-1}$ and $\frac{\partial \ln e_t}{\partial \ln c_{tb}} = \frac{P_{Bt}}{P^c_{tb}}$. Under homothetic preferences, Equation (12) collapses to $P^c_{tb} = P_{Bt}$ and $\frac{\partial \ln e_t}{\partial \ln c_{tb}} = 1$, consistent with Proposition 1.

To further illustrate the expenditure elasticity in action, consider a simple structural transformation example with separable categories, where $A(\boldsymbol{p})$ consists of agricultural products, $D(\boldsymbol{p})$ of manufacturing products, and $B(\boldsymbol{p})$ of services. We take expenditures and price indices from the US National Income and Product Accounts (NIPA) and, as currently in the NIPA, use 2017 as base year. Food and beverages purchased for off-premises consumption is used as proxy for agriculture, and manufacturing is defined as total goods net of agriculture; the two are merged in the PIGL and quasi-homothetic cases. Setting $\varepsilon = 0.37$ based on Alder, Boppart and Müller's (2022) estimate for the United States, we then predict budget shares at hypothetical expenditure levels using the NIPA data and Equation (11), from which we calculate the elasticities in Equation (12).

Figure 1 shows the results in 1929 and 2023. Notably, in the cross section where prices are fixed, the real wage bias always disappears asymptotically: since $s_B \to 1$ as $e \to \infty$, it follows that $P^c_{tb} \to P_{Bt}$ and $\frac{\partial \ln e_t}{\partial \ln c_{tb}} \to 1$. In the PIGL and quasi-homothetic cases, this convergence is monotonic, thereby making the bias larger in magnitude at lower expenditure levels. The direction of the bias ultimately depends on the relative price of luxuries, however. For instance, if the change in the price of luxuries is smaller than that of necessities, we have $P_{Bt}/P^c_{tb} < 1$. It then follows that the consumption deflator exceeds the wage deflator and subsequently underestimates the real wage. This condition holds between 1929 and 2017 but not between 2017 and 2023, resulting in correction factors below one in 1929 and above one in 2023.

The economics behind these predictions amounts to nothing more than a Hicksian substitution effect. If luxuries become cheaper and the wage rate equals $\frac{w_t}{P^c_{tb}}$, households can maintain the utility of consumption with fewer working hours and consequently wish to substitute to more leisure. This is the same as saying that they demand higher wages than $\frac{w_t}{P^c_{tb}}$ to keep leisure constant, explaining the higher real wage and the lower deflator than we obtain with the usual consumption deflator.

These insights largely extend to the broader intertemporally aggregable case. However, monotonicity now requires an alignment between basket price indices and income elasticities ($P_{At} \leq P_{Dt} \leq P_{Bt}$, or vice versa); otherwise, the correction can become nonmonotonic and even change sign across the expenditure

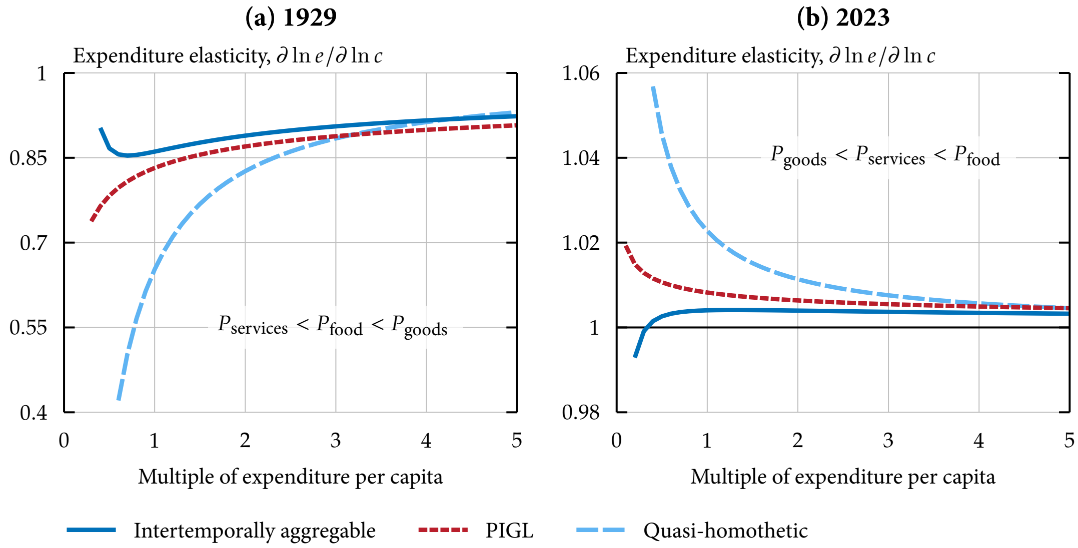

Figure 1. Illustrative example of wage deflator corrections.

Notes. The figures compute the expenditure elasticity in Equation (12) at hypothetical expenditure levels for different cases of the intertemporally aggregable preferences using US NIPA spending data on agriculture, manufacturing, and services in 1929 and 2023.

distribution. This is precisely what happens in Figure 1, where both years exhibit hump-shaped patterns, and 2023 also showing a reversed direction at low expenditure levels.

Finally, Figure 1 reveals smaller corrections in 2023 than in 1929. Echoing Jaravel and Lashkari's (2024) discussion about the choice of price base, this reflects their proximity to the NIPA base year. By construction, nominal and real variables are similar close to the base year—and identical in the base year itself—so biases are similarly small. As we move further away from the base period, the differences accumulate, thereby increasing any bias in the deflators.

In sum, we therefore reiterate Jaravel and Lashkari (2024, p. 493): the real wage bias is "likely to be sizable when preferences are nonhomothetic, price inflation is large and correlated with income elasticities across goods, and real consumption is expressed in terms of a base period that is distant from the current period." Adding to their discussion, we further expect the real wage bias to diminish at higher expenditures in the cross section and that the consumption deflators overestimate the welfare-consistent wage deflators whenever price changes of necessities exceed those of luxuries (and vice versa).

3 Real Wages and Welfare: Long-Run Estimates for the United States

While the theory above identifies a clear wedge between wage and consumption deflators under non-homothetic preferences, its magnitude ultimately remains an empirical issue. To assess the significance of Proposition 1, we now put our approach to work by constructing estimates of real wages and welfare for the United States using both the consumption deflator and our corrected wage deflator. These estimates are based on consumption and wage data going back 40 years, and comparing them allows us to quantify the potential bias introduced by relying solely on conventional consumption deflators.

To fully demonstrate the advantage of our framework, we follow the suggestion in Section 2.2 and proceed with Jaravel and Lashkari's (2024) algorithm for real consumption growth, which directly produces the income-specific consumption deflators and expenditure elasticities required to apply Proposition 1. To make things even simpler, we take these components off the shelf from their replication package, which is based on CEX and CPI data spanning 596 expenditure categories and 159 distinct price series from 1984 to 2019, with 2019 as the base year.[6] We construct hourly wages from the March CPS supplement (Flood *et al.*, 2024) by dividing wage and salary income by total hours worked last year (usual hours worked per week times weeks worked), restricting the sample to workers aged 18–64 with reported family income and winsorizing wages at the 1st and 99th percentiles.[7] Each observation is then assigned a deflator based on its corresponding family income. Further details are given in Online Appendix A.

The results, summarized in Figure 2, confirm the empirical relevance of our theory: the wage deflator yields substantially higher real wage growth than the pure consumption deflator. For instance, in the fifth income decile—shown in Figure 2a—real wages increase by 1.18 percent per year under the wage deflator, compared to just 0.94 percent under the consumption deflator. At a qualitative level, this finding is unsurprising. As shown by Jaravel and Lashkari (2024), the consumption deflators we use exhibit systematically higher inflation rates for lower-income households, which implies that the relative price of luxuries falls over time. Consistent with the predictions in Section 2.3, we therefore observe slower growth in the wage deflator—and faster growth in real wages—relative to the consumption deflator.

While the qualitative pattern is expected, the magnitudes we find are striking. The 0.24 percentage point gap in the fifth income decile implies that the consumption deflator generates a bias in measured wage growth equal to 20.4 percent of the corrected growth rate. In comparison, Jaravel and Lashkari (2024) estimate a "nonhomotheticity bias" in real consumption growth between 1984 and 2019 that never exceeds 7.5 percent of their uncorrected growth rates. Likewise, the substitution bias in the US CPI—roughly measured as the inflation rate difference between the BLS's chained and non-chained CPIs for all urban consumers—amounts to about 12 percent per year relative to the average chained-CPI inflation rate between December 1999 and December 2024. These reference points underline the quantitative importance of our wage deflator.

This bias is also not limited to the fifth decile but arises systematically throughout the income distribution. As shown in Figure 2c, the annual growth rate gap between the two deflators ranges from 0.19 to 0.27 percentage points across all income deciles. The gap declines monotonically with income, which again aligns with Section 2.3: since the numerator—the nominal wage—remains fixed across deflators in a given year and income group, the growth differences within each group directly reflect the wedge in Proposition 1, making the narrowing gap consistent with the prediction of asymptotic homotheticity. These differences imply a bias from the consumption deflator that ranges from 8.4 to 34.3 percent of the corrected wage growth rates, thereby highlighting that the fifth decile is representative rather than exceptional.

How does the real wage bias translate into broader measures of household well-being? While our real wage definition is explicitly designed to permit welfare statements about households that value both consumption and leisure, comparisons of wage rates alone may be seriously misleading if unearned income—implicitly captured by consumption expenditures—varies substantially across individuals. A more comprehensive and natural way to express current total utility in base-period prices in this setting is through the full income money metric given by Equation (6). We implement this measure in our CEX-CPS data for

[6] Figure B.1 in Online Appendix B shows the same analysis as here using 1984 as base year. The results are similar.

[7] Starting in 1989, the CPS directly reports wages for hourly workers. We consider this variable in Section 4 but omit it here, since it neither spans the full sample period nor covers the entire population.

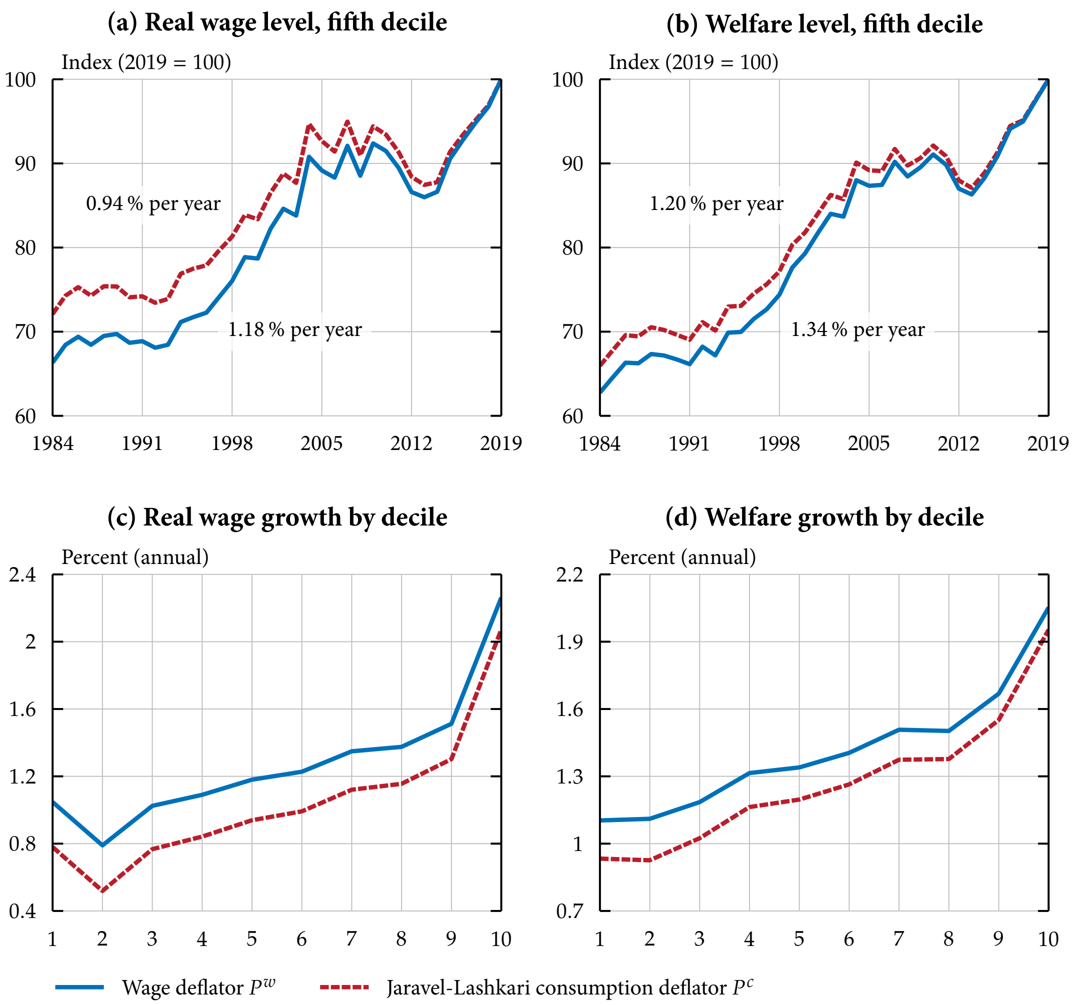

Figure 2. Real wages and welfare by deflator and income decile, 1984–2019.

Notes. Wages refer to hourly earnings as observed in the Annual Social and Economic Supplement of the CPS. Welfare is measured as the sum of real consumption and real leisure expenditure, assuming a total time endowment of 16 hours per day. All variables are measured in 2019 prices. The percentages in Figures 2a and 2b denote average annual growth rates. Blue solid lines show wages and welfare levels deflated using the wage deflator P^w, while red dashed lines show the same variables deflated using the consumption deflator P^c.

both measures of real wages, with leisure defined as a 16-hour daily time endowment net of daily hours worked.

Figures 2b and 2d summarize the resulting welfare estimates, which show that the consumption deflator's understatement of real wage growth translates into similar underestimates of welfare growth. The welfare growth bias is necessarily smaller than the real wage growth bias, since wages form a subset of welfare, but it nevertheless remains sizable. Switching to the wage deflator, we find upward adjustments in annual welfare growth ranging from 0.18 percentage points at the second income decile to 0.14 and 0.10 percentage points for the median and top income deciles, respectively. Relative to the corrected welfare growth rates, these adjustments suggest a bias of 17 percent at the bottom, 11 percent at the middle, and 5 percent at the top—figures that remain large compared to the reference points above.

Taking stock, these findings suggest that the consumption deflator introduces a sizable measurement bias—larger than several other biases identified in the price index literature—that leads to understated long-run growth in both real wages and welfare. Because we express real variables in 2019 prices—the final year of our sample—a direct implication of the faster growth under the wage deflator is that the corresponding *levels* of wages and welfare are, in fact, lower than what conventional measures imply across the sample period. Figures 2a and 2b, for instance, show that real wages and overall well-being for the fifth income decile are 8.0 and 4.8 percent lower in 1984 when measured with the wage deflator. The flip side of adopting the wage deflator, in other words, is that US households appear worse off before 2019 than the consumption deflator alone would suggest.

4 On the Recent Compression of the US Wage Distribution

Having established that the consumption deflator introduces a sizable bias in real wages, an immediate question arises in light of recent economic developments: how has this bias shaped the wage dynamics during the post-pandemic inflation surge? Amid concerns about the distributional impacts of this episode, Autor, Dube and McGrew (2023) document a compression of the real wage distribution to the benefit of low-wage workers. However, their real wage estimates rely on the standard CPI deflator, which is the same for all households, irrespective of income. To what extent are their findings driven by this choice?

To answer this question, we estimate the evolution of real wages from 2016 to 2023 using two distinct nominal wage measures: (i) hourly earnings for all US workers, constructed as before by dividing annual wage and salary income by annual hours worked; and (ii) reported wages for hourly workers, which are directly available in the CPS for an 8.7 percent subsample of all workers. These measures are again obtained from the March CPS supplement under the same sample restrictions and winsorization as in Section 3.[8] Similar to Autor, Dube and McGrew (2023), we additionally control for compositional changes during the Covid-19 pandemic by reweighting each year's workforce to keep the composition of the 2019 workforce constant.[9]

For each nominal measure, we construct real wages using three different price indices: our wage deflator and the Jaravel-Lashkari consumption deflator, as in Section 3, and the standard CPI for all urban consumers from the BLS, as in Autor, Dube and McGrew (2023). For the former two, we can no longer directly use Jaravel and Lashkari's (2024) estimates, as they are only available until 2019. We therefore implement their algorithm ourselves, using Jaravel's (2024) distributional CPI series by income—which are methodologically consistent with the official CPI—together with the underlying CEX data on total consumption expenditures. As before, we match the resulting income-specific deflators to CPS observations based on family income, which allows us to compute real wages for each worker. To track the evolution of the wage distribution, we then assign workers to nominal wage deciles within each year and report average real wages by decile and deflator.[10]

Figure 3 plots the resulting wage series for the first, fifth, and tenth wage deciles—Figure 3a for inferred hourly earnings of all workers and Figure 3b for reported wages of hourly workers. Between 2019 and 2023, our wage deflator suggests that real hourly earnings among all workers rose by a cumulative 8.0 percent in the bottom decile but remained roughly flat at 1.8 and 2.4 percent in the fifth and tenth deciles.

[8] Wages of hourly workers are available in all months, but we use March data since we only observe total family income in the March supplement, which is needed for deflator assignment.

[9] This inverse probability reweighting is estimated with a logit model with controls for age, education, race, Hispanic origin, gender, nativity, and region of residence.

[10] Grouping workers by nominal wages isolates the impact of deflators on real wages themselves, but fails to account for subsequent changes in the real wage distribution. Figure B.2 in Online Appendix B corroborates our comparisons here with estimates based on real wage quantiles.

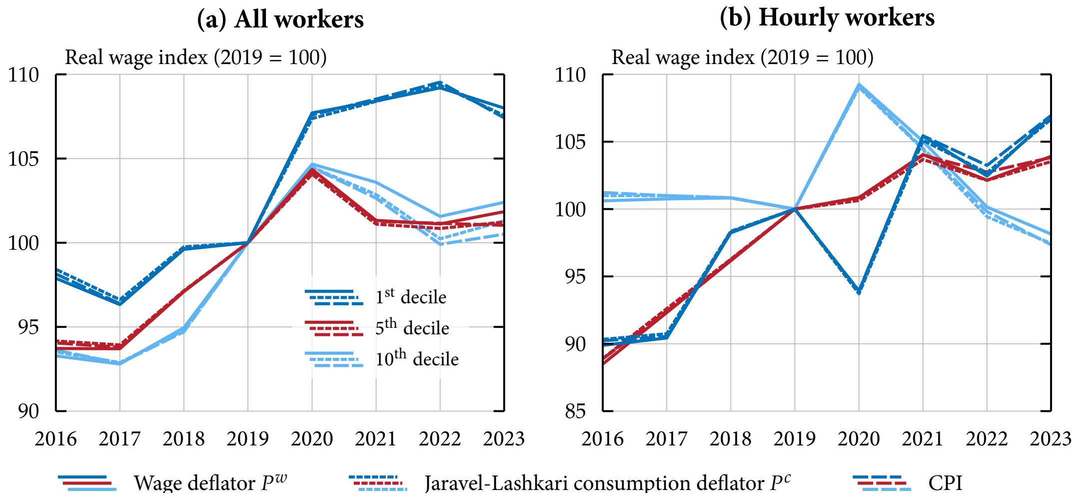

Figure 3. Recent evolution of real wages by deflator and nominal wage decile.

Notes. Figure 3a plots average real hourly earnings for all workers in a calendar year, deflated using annual deflators with 2019 as base year. Figure 3b plots real wages for hourly workers in March of each year, deflated with monthly deflators of that month, with March 2019 as base month. Solid lines show wages deflated using the wage deflator P^w, while short-dashed and long-dashed lines show the same variables deflated with the consumption deflator P^c and the CPI, respectively.

The smaller sample of hourly workers is more affected in March 2020, but conveys a similar pattern: a 6.9 percent gain at the bottom and a 1.9 percent decline at the top. In both cases, the estimates indicate a clear compression of the wage distribution throughout the Covid period.

How sensitive is this compression to the choice of deflator? Figure 3 reveals that the differences between the CPI and our wage deflator are modest. Among all workers, the wage ratio between the tenth and the first decile declined by 5.2 percent from 2019 to 2023. This reduction is smaller than the 6.4 percent implied by the CPI, which is known to understate inflation at the bottom of the distribution and overstate it at the top (see Jaravel, 2021), with inverse effects on real wage growth. Similar differences hold for these ratios in the population of hourly workers: 8.2 percent under our wage deflator, versus 9.0 percent under the CPI. These differences—which are similar prior to 2019—remain small relative to the overall magnitude of the observed wage compression.

Several reasons explain the seemingly limited role for the deflator in this context. A partial explanation is that while these results concern the wage distribution, the underlying deflators are still constructed along the income dimension. Since households within a given income group include workers from across the wage spectrum, both high and low hourly wages may be deflated using similar deflators. As a result, the average deflators across wage groups exhibit a flatter profile than those across income groups, thus pushing the former closer to the CPI. Figure 4a, which plots growth rates of our wage deflator across both the income and wage distributions in the short-run sample, exhibits precisely this pattern. Only under a one-to-one positive correlation between income and wages would the deflators align across the two distributions. This is also not unique to our wage deflator or the recent inflation surge: Figure 4b, for example, shows the same result in our long-run sample.

Another explanation relates to the short time horizon investigated. As discussed in Section 2.3, the growth differences across deflators do not accumulate into large biases in real wage *levels* when measured close to the base period. Meaningful differences only arise over longer periods. As an illustration, in Section 3 we found that P^c-deflated wages exceed P^w-deflated wages by a cumulative 8 percent in 1984 for the

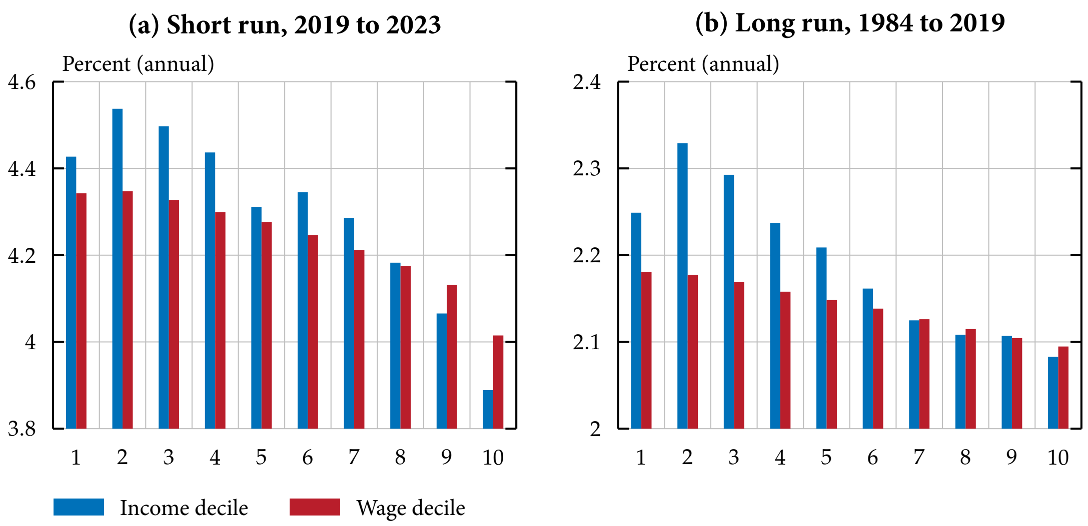

Figure 4. Growth in the wage deflator P^w across the income and wage distribution.

Notes. We use the hourly earnings of all workers (salaried earners and hourly workers alike) in both subplots.

fifth income decile. But in 2016, the first year of the short-run analysis, the gap is less than a tenth of that—around 0.7 percent. This is similar to the estimates in Figure 3: the fifth wage decile of all workers, for instance, exhibits P^c-deflated wages that are 0.5 percent larger than P^w-deflated wages in 2016, and 0.6 percent smaller in 2023, thus highlighting that the short-run biases do not radically differ from their long-run counterparts during comparable years.

Ultimately, however, the stark compression in nominal wages far outweighs the impact that the inflation heterogeneity in Figure 4a has relative to other deflators. The picture therefore remains consistent with Autor, Dube and McGrew's (2023) findings. Was this result inevitable? Not necessarily. To fully eliminate the 5.2 percent decline in the real wage ratio between the top and bottom deciles in Figure 3, the bottom decile's wage deflator would need to exceed the top's by 1.73 percentage points annually. While significantly larger than the 0.33 and 0.54 percentage point gaps we estimate for the wage and income distributions in Figure 4a—numbers broadly in line with the inflation inequality literature—such scenario is not unthinkable. Hochmuth, Pettersson and Weissert (2025), for instance, document a 1.3 percentage point gap in PCE inflation between the top and bottom consumption deciles throughout 2022, with a peak of 2.3 percentage points in June of that year. While not critical in our setting, their findings underline that the choice of deflator may still shape short-run wage inequality in other contexts.

5 Conclusion

Virtually all existing measures of real wages are constructed by deflating nominal wages with price indices originally designed for consumption, such as the CPI. At the core of this paper lies the idea that such practices can introduce systematic biases in real wage estimates when households value both consumption and leisure and exhibit nonhomothetic preferences. We provide a remedy grounded in standard index number theory and illustrate that these biases can be large in practice. While our findings suggest that wage and welfare estimates based on CPI-deflated real wages should be interpreted with caution, we also show that the CPI nevertheless provides an accurate description of the real wage compression that followed the post-pandemic inflation surge.

Moving forward, a key advantage of our approach is that it can be implemented using standard price index techniques—even under arbitrary preferences—as long as cross-sectional consumption data are available. This is a relatively weak data requirement that is met in many contexts, including various micro-level surveys and distributional national accounts. As such, our contribution offers a broadly applicable tool with clear appeal to researchers and policymakers concerned with wage and income dynamics, inequality, and welfare evaluation.

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Getting Real About Wages:
A Nonhomothetic Wage Deflator
Online Supplement

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29 October 2025

This supplement provides (a) additional information on the data used and the empirical implementation method and (b) additional figures.

Appendix A Data and Methods

A.1 Matching wages to Family Income

We use total family income to match deflators to wages. Income-specific deflators are based on CEX micro data, in which we compute the minimum family income for each unit of time and income decile. We then use these bounds to assign workers in the CPS to income deciles and the corresponding deflators.

Family income in the CEX Since we rely on the underlying CEX micro data provided by the D-CPI project (see Jaravel, 2024) for the computation of family income bounds also in the long run, we observe family income starting only in 1999. We therefore use family expenditures by income decile—available in the replication package of Jaravel and Lashkari (2024)—to impute family income for the years preceding 1999 as follows.

For a given decile, we estimate a log-linear relationship between the decile's minimum family income and minimum family expenditures, using the annual data between 1999 and 2019. These regressions have a relatively high fit: the corresponding R^2 depends on the decile and varies between 0.84 and 0.95. We then use these decile-specific estimated relationships to predict the minimum family income for the years before 1999. The resulting family income data yields smooth patterns without discernible patterns around 1999, when the imputation stops.[1]

Family income in the CPS The monthly CPS files provide `faminc`, where households are asked to estimate their family income bracket. The March supplements additionally ask all household members about their total income, and provide `ftotval`, a computation of total family income. We found that these two measures disagree significantly, and therefore only rely on `ftotval` and the March CPS to match deflators to wages.[2]

A.2 Consumption and Wage Deflator in the Short Run

The nonhomothetic consumption deflator is computed using Algorithm 1 in Jaravel and Lashkari (2024). For a detailed description of the algorithm, the interested reader is referred to that paper. Intuitively, the way the algorithm works is to compute a nonhomotheticity correction factor by regressing the inflation rates of an income-specific geometric price index from period t to $t+1$ on real income to fit a quadratic function.[3] The first derivative of this quadratic function evaluated at the income level of specific percentiles can then be used to calculate real consumption of that income percentile in period $t+1$. The algorithm starts in the base period, in which real income is equal nominal income. For annual deflators in our analysis between 2016 and 2013 we set this base period to 2019 for annual deflators and March 2019 for monthly deflators. Subsequently, the correction factor facilitates the computation of real income in the next period. This allows to fit the quadratic function of inflation on real income in $t+1$ and repeat the steps to continue the algorithm. We apply the algorithm once forward until 2023 and once backward until 2016 and concatenate the results. Eventually, we obtain the nonhomotheticity correction factors $1+\Lambda_t$ for all periods and can use them directly to compute the wage deflator as outlined in the main text.

A.3 Wage Data

Data sources and sample construction Our primary data source is the Annual Social and Economic Supplement to the CPS (ASEC), which asks individuals sampled in March about their income and hours worked in the previous year. We use total labor income, hours usually worked per week, and weeks worked last year, to compute hourly earnings for the previous year.

For the short-run analysis, we also create a separate sample where we restrict ourselves within the ASEC to workers that are paid by the hour, and use their reported hourly wages—excluding workers that have imputed reported hourly wages.

We restrict ourselves to workers with a reported family income in the ASEC (variable `ftotval`), and who are aged 18–64. Wages and hourly earnings are winsorized at the 1st and 99th percentiles.

[1] The annual growth in family income in the non-imputed data post 1999, averaged across years and income deciles, is 0.030, whereas the average annual growth in the first imputation year of 1999 is 0.033, reasonably close.

[2] Only 30 percent of househould heads were assigned to the same CEX income decile when using independently `faminc` and `ftotval`.

[3] When running their algorithm we directly use the distributional CPI inflation rates by income percentiles instead of computing them based on observed expenditure shares in the CEX micro data to retain consistency with the official CPI.

Appendix B Figures

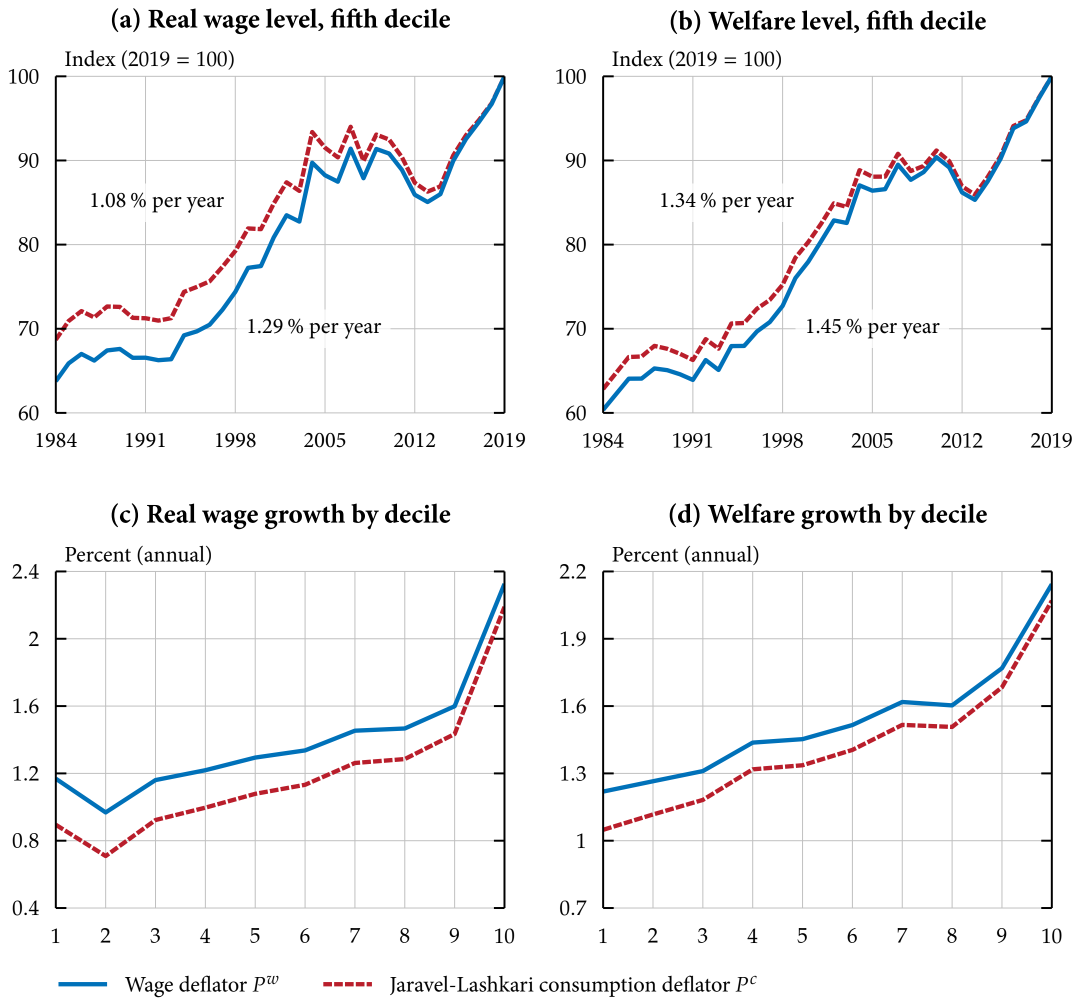

Figure B.1. Real wages and welfare by deflator and income decile, 1984–2019, using 1984 as base year.

Notes. Wages refer to hourly earnings as observed in the Annual Social and Economic Supplement of the CPS. Welfare is measured as the sum of real consumption and real leisure expenditure, assuming a total time endowment of 16 hours per day. All variables are measured in 1984 prices instead of 2019 prices as in Figure 2. The upper panels are still normalized to 100 in 2019 for comparability.

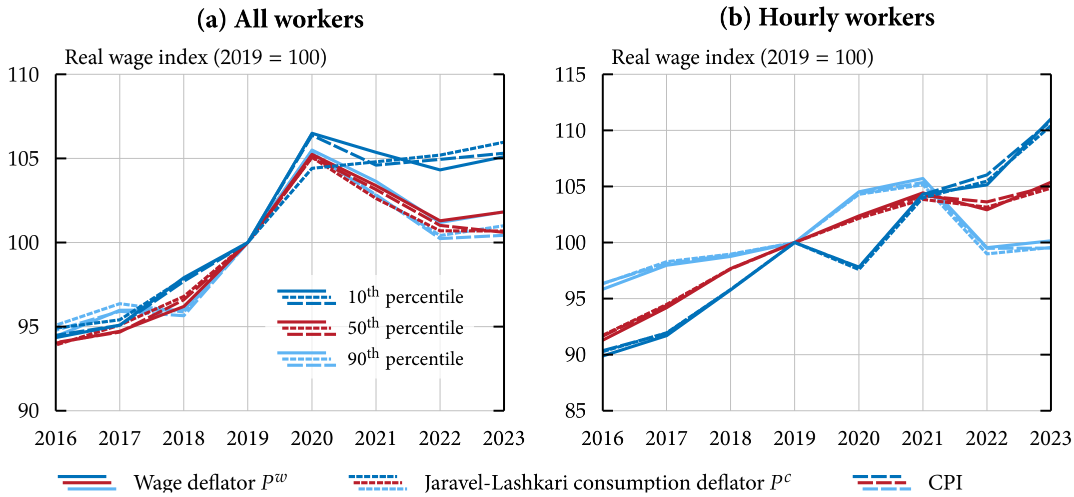

Figure B.2. Recent evolution of real wages by deflator and real wage percentile.

Notes. Figure B.2a plots real hourly earnings for all workers in a calendar year, deflated using annual deflators with 2019 as base year. Figure B.2b plots real wages for hourly workers in March of each year, deflated with monthly deflators of that month, with March 2019 as base month. In both panels, percentiles are computed along the distribution of real wages corresponding to each deflator instead of the distribution of nominal wages as in Figure 3.

Appendix References

Jaravel, X. (2024). *Distributional Consumer Price Indices* (CEPR Discussion Paper No. 19802). Centre for Economic Policy Research. Paris & London. (Cited on page 18.)

Jaravel, X., and Lashkari, D. (2024). 'Measuring growth in consumer welfare with income-dependent preferences: Nonparametric methods and estimates for the United States'. *Quarterly Journal of Economics*, vol. 139(1), pp. 477–532. (Cited on pages 18, 19.)