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Markups for Consumers

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Abstract

A central motivating factor for studying price markups is their effect on consumer welfare. Reported estimates of (firm-level) price markups in the literature, however, are often focused on industry or cross-country comparisons. These treat different industries equally rather than based on how relevant they are for consumers. We propose markup measures in which firm-level price markups are weighted according to consumption expenditures in the respective industries. Using a concordance table between consumption categories (otherwise used for the calculation of consumer price indices) and a firm's industry classification, we report results for Germany for the years 2002 through 2016. We find that consumption-weighted price markups are higher than the conventionally reported revenue-weighted markups. We further show that consumption-weighted markups have increased faster, in particular for medium-income households, which highlights a potential role of price markup as a contributing factor to changes of inequality in society.

Keywords: COICOP; consumption weights; Germany; inequality; price markups.

JEL Codes: D63; E31; K21; L11; L40

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1 Introduction

Price markups and the ability of a firm to set its prices above marginal cost (by "marking up") are often considered the manifestation of firms' market power. Increases in market power with the associated increases in markups – and eventually – prices result in lower consumer welfare. The newfound interest in both academia and policy for empirical evidence (e.g., De Loecker and Eeckhout, 2018; De Loecker et al., 2020; Autor et al., 2020), triggered by a convenient estimation procedure for firm-level price markups proposed by De Loecker and Warzynski (2012), is partially explained by this negative association of price markups and consumer welfare. It is all the more surprising that when price markups are reported, the consumer focus is often pushed aside. The standard or conventional way of reporting economy-wide averages of markups is the one of equiproportional (revenue-weighted) markups. Larger firms are assigned a higher weight because of their increased industry footprint. For consumers, however, not all industries are equally relevant, and consumers may be exposed to firms from some industries more than from others. Taking consumption patterns into account will better reflect consumers' exposure to price markups. In this paper, we construct such *consumption-weighted price markups* to ask how price markups have developed for consumers (rather than for industries) in Germany.

For the calculation of consumption-weighted price markups, we first construct a consumption-to-industry concordance table that allows us to assign to each firm in an industry the weight of that industry in the consumers' consumption expenditures. More specifically, we take 109 consumption classes of goods and services and for each identify the industries that supply the respective goods and services to consumers.[1] For each consumption class, we calculate the average (revenue-weighted) price markups of all firms assigned to that class. Finally, utilizing consumption weighting patterns with consumption expenditure weights for each of the consumption classes, we calculate economy-wide

[1]For the consumption classes, we use the *Classification of Individual Consumption by Purpose* (COICOP) developed by the UN Statistics Division. In Germany (and many other countries) this classification serves as the basis for the calculation of the consumer price index. For industry classification, we use the NACE Rev. 2 classification. A similar exercise (at a higher, more aggregate level) has been undertaken by Addessi et al. (2017).

consumption-weighted price markups for average households as well as different household types for Germany for the years 2002–2016.[2]

We present and discuss three main results. First, consumption-weighted price markups are higher than "standard" (equiproportional) price markups. The differences are at 15 to 25 percentage points, reaching more than 30 points in the later years of our sample period. Second, consumption-weighted price markups have increased faster, in particular in the last few years of our sample period. The difference in the annual averages increased from 17 percentage points in 2013 to 32 percentage points in 2016. Third, price markups for medium-income households grew faster than those for high-income households. While the price markup levels for all multi-member household types converged to those of average households, the markups for medium-income households converged faster. It was the medium-income households that have been disproportionately exposed to recent increases in price markups.

Our results contribute to the academic and policy literature in a variety of ways. First, our approach complements the literature on firm-level price markups by proposing a novel aggregation method that yields estimates of price markups to which consumers are exposed according to their consumption behavior. Second, we provide new estimates of price markups for Germany, thus contributing to an ongoing debate about the causes and consequences of increased market concentration (e.g., Wambach and Weche, 2020). Recent estimates (Weche and Wambach, 2018; Cavalleri et al., 2019; Ganglmair et al., 2020) suggest that price markups in Germany are noticeably lower than in the U.S. (De Loecker et al., 2020; Autor et al., 2020) and have experienced much weaker increases. When an assessment of effects on consumer welfare is the ultimate objective of an empirical study of price markups, then these reported results are underestimating the true extent of price markups (as they relate to consumers). In Germany, consumption-weighted price markups have been noticeably higher and growing faster than previously reported.

[2]We obtain these weighting patterns from the German Federal Statistical Office for average households as well as high-income, medium-income, and low-income households. The income-level household types are multi-member households (4 members or 2 members) and not representative of all households. In the early 2000s, these household types made up about 6% of all households (Egner, 2003). Our main discussion will be based on the numbers for the average household.

Third, our results for household-type specific price markups (with faster growing markups for medium-income than high-income households) add to the discussion of the effects of markups on income distribution and inequality. Market power generates higher profits for shareholders while consumers face higher prices (Ennis et al., 2019). Because the distribution of firm ownership is more skewed than the distribution of consumption, higher price markups serve as a redistribution mechanism from poorer households to richer ones. In other words, while all households will face higher prices due to higher price markups, the wealthier households will receive higher profits since generally they own a higher share of the rights to corporate profits (Gans et al., 2019). Markups have also been found to affect the income distribution through their impact on labor markets, interest rates and the value of firms (Nolan et al., 2019). Similarly, Kaplan and Zoch (2020) analyze the relationship between markups and labor income inequality and how markups can increase the labor income of white-collar workers while decreasing the labor income of blue-collar workers. Finally, a growing literature provides evidence that poor households tend to pay higher prices than more affluent households (Mendoza, 2011).

The rest of the paper is structured as follows: In Section 2, we introduce the markup estimation methodology and our data sample. In Section 3, we provide a detailed description of how we construct our consumption-to-industry concordance table. In Section 4, we present results for conventional equiproportional price markups. These serve as benchmark for our discussion of consumption-weighted price markups in Section 5. In Section 6, we conclude.

2 Methodology and Data

2.1 Estimating Price Markups

Following a growing body of literature (e.g., De Loecker and Warzynski, 2012; De Loecker and Scott, 2016; Autor et al., 2020), we define price markups as the ratio of output price over marginal cost. We obtain firm-level markup estimates applying the approach proposed by De Loecker and Warzynski (2012), often referred to as the *production function* *approach*.[3] Based on a firm's cost minimization problem, one can show that a firm i's (firm-level) price markup μ in time t is equal to the ratio of the output elasticity θ of a variable production input v over the cost share α (over sales) of that input,

$$\tilde{\mu}_{it} = \frac{\theta_{it}^{v}}{\alpha_{it}^{v}}. \tag{1}$$

To obtain the output elasticity of an input v, we apply the two-step control-function estimation approach in Ackerberg et al. (2015). We use a Cobb-Douglas structural value added (SVA) function specification as proposed by De Loecker and Scott (2016), where output is a function of capital K, labor L, materials M, an unobserved productivity shock ω_{it}, and a shock to production ϵ_{it}. The production function takes the following form:

$$Y_{it} = \min\left[\gamma M_{it}; F(L_{it}, K_{it})\exp(\omega_{it})\right] \cdot \exp(\epsilon_{it}).$$

In the first step of the control-function approach, we separate the unobserved productivity term ω_{it} from the error term by conditioning on the inverted demand function for materials – a nonparametric function of labor, capital, and materials (De Loecker and Scott, 2016). In a second step, we estimate the Cobb-Douglas production function coefficients for capital and labor. At this stage, unobserved productivity ω_{it} is assumed to follow a first-order Markov process. We express ω_{it} as a function of its realization in the previous period and an innovation term ξ_{it}. To account for selection (and eventually obtain more accurate output elasticities), we follow Olley and Pakes (1996) and control for a firm's market survival probability.[4]

The use of the SVA production technology requires an adjustment of the markup formula in equation (1). Because materials are not a factor in the estimated (Cobb-Douglas) production function but still a component contributing to marginal cost, the

[3]The approach was originally introduced by Hall (1988). De Loecker and Warzynski (2012) proposed a simple implementation of the estimation procedure. Numerous papers in the literature on price markups provide descriptions of the approach (e.g. Ganglmair et al., 2020).

[4]Firms that, based on their observable characteristics, are more likely to exit but are instead still active in the market are likely to have experienced a larger positive productivity shock. We model the probability P_{it} of a firm i surviving to year t as a 3rd-degree polynomial in the first lags of the production factors and estimate it using a Probit model. This results in $\omega_{it} = g(\omega_{it-1}, P_{it}) + \xi_{it}$ as the expression for the unobserved productivity.

adjusted markup formula (De Loecker and Scott, 2016) reads:

$$\mu_{it} = \frac{1}{\tilde{\mu}_{it}^{-1} + \alpha_{it}^{M}} \tag{2}$$

where α_{it}^{M} is the cost share of materials (as additional input factor) over sales. We obtain firm-level price markups μ_{it} by combining the estimated output elasticity θ_i^L of labor with the cost shares α_{it}^{L} and α_{it}^{M} of labor and materials.[5] We estimate the output elasticity at the industry level so that θ_i^L is the same for all i in the respective industry. We further assume time-invariant output elasticities.

2.2 Data Sources and Sample Construction

Our estimation sample comprises German firms for which we obtain financial statements information for the years 2000 through 2016 using the Bureau van Dijk's Orbis database.[6] This information includes firms' sales volume, number of employees, material costs, labor costs, tangible fixed assets (as a proxy for capital), and firms' industry activity classification (i.e., NACE Rev. 2 codes).

For the final estimation sample, we restrict our sample using the following rules: (1) We include only firms that have data from unconsolidated financial accounts. (2) We exclude firms with missing values for any of the variables needed for the construction of price markups (sales, number of employees, material costs, labor costs, and tangible fixed assets). (3) We exclude firms that report NACE sections O, T, or U as their main activity.[7] (4) We exclude firms with less than 20 employees, and firms that report sales below 500,000 Euros per year. (5) We eliminate observations with a computed annual

[5] We also perform a correction to eliminate any variation in cost shares that is not correlated with labor, capital, and other firm characteristics that are included in the estimation of the production function (De Loecker and Warzynski, 2012).

[6] For Germany, Bureau van Dijk draws its data from Creditreform and Creditreform Rating AG. The Orbis database records the entire firm universe of Germany and contains financial data for about 63% of these firms (Kalemli-Ozcan et al., 2015).

[7] We exclude firms in NACE sections "public administration and defense; compulsory social security" (O), "activities of households as employers; undifferentiated goods- and services-producing activities of households for own use" (T); and "activities of extraterritorial organizations and bodies" (U). For more information on NACE Rev. 2, see the Eurostat manual at `https://ec.europa.eu/eurostat/documents/3859598/5902521/KS-RA-07-015-EN.PDF`.

Table 1: Summary of the Estimation Sample

Variable	**NACE Section Group for Production Function Estimation**				
	Manufacturing	**Utilities**	**Construction**	**Trade**	**Services**
	Mean (Std.dev.)	Mean (Std.dev.)	Mean (Std.dev.)	Mean (Std.dev.)	Mean (Std.dev.)
Sales	69.449	132.106	18.352	71.761	54.200
	(172.026)	(329.468)	(31.226)	(116.029)	(176.086)
Capital stock (tangible assets)	12.165	78.176	1.820	4.710	28.000
	(53.069)	(219.842)	(4.710)	(11.479)	(213.659)
Labor costs	14.706	13.591	4.782	7.494	15.904
	(41.872)	(32.701)	(8.100)	(12.626)	(34.234)
Material costs	36.007	74.693	5.124	52.873	13.073
	(107.772)	(212.058)	(8.175)	(91.294)	(61.301)
Number of employees	269.977	213.114	102.617	183.060	358.961
	(645.552)	(416.877)	(154.944)	(386.553)	(713.266)
Number of firms	14,266	1,659	4,529	9,255	13,385
Number of observations	64,873	11,640	12,932	40,517	54,916

Notes: This table reports means (and standard deviations) of the data used for price markup estimation for the sample period of 2000 to 2016, broken down by estimation groups: manufacturing includes NACE Rev. 2 sections A, B, and C; utilities includes NACE sections D and E; construction includes NACE section F; trade includes both wholesale and retail trade in NACE section G; services includes NACE sections H, I, J, K, L, M, N, P, Q, R, and S. For more information on NACE Rev. 2, see the Eurostat manual at `https://ec.europa.eu/eurostat/documents/3859598/5902521/KS-RA-07-015-EN.PDF`. Monetary values (in million Euros) are deflated.

labor-costs-per-employee ratio below 5,000 Euros. (6) We further follow De Loecker et al. (2020) and eliminate observations with labor-costs-to-sales, material-costs-to-sales, and capital-to-sales ratios in the top and bottom 2% (with the percentiles computed separately for each NACE section-year combination). We also eliminate observations with turnover (sales) in the top 2%.

Our sample consists of 184,878 firm-year observations with a total of 43,094 firms and an average of 10,875 firms per year. The average attrition rate is 2.4% per year. Early years in our sample (i.e., 2000–2005) have a significantly smaller number of firms because of financial reporting regulations. In Table 1, we report means and standard deviations for the variables in our estimation sample for five different groups of NACE sections. Note that the first group labeled "manufacturing" also includes agriculture (section A) and mining (section B), in addition to manufacturing (section C).[8]

For all monetary values (sales, costs, and assets) we use deflators to render observations comparable over time.[9] That is, for sales, material costs, and capital in NACE

[8] As we describe below, we estimate production functions separately for each of these groups.

[9] Deflator data is calendar-year based, some observations in our data are fiscal-year based. For observations with end of fiscal year between July 1 of a year t and June 30 of a year $t + 1$, we deflate using

sections C, F, and G, we use producer price indices (PPI) provided by Eurostat.[10] For all other sectors, we use the respective CPI values of the matching COICOP codes. For labor costs we use a labor costs index provided by the German Federal Statistical Office.[11]

We supplement the data from Orbis with data on firm's exit rates from the Mannheim Enterprise Panel (MUP). The MUP is a panel database maintained by ZEW Mannheim in cooperation with Creditreform. The database is updated on a bi-annual basis and covers the total population of firms in Germany.[12] For our purposes, we classify a firm as exiting the market if the MUP indicates that the firm exited the market and the difference between the exit year (as recorded in the MUP) and the last available year in Orbis is not larger than three years.

2.3 Results for Production Function Estimation

We obtain output elasticities by estimating production functions for five different groups of NACE sections. Manufacturing includes all firms reporting sections agriculture, forestry and fishing (A), mining and quarrying (B), and manufacturing (C) as their main activity. Utilities includes all firms belonging to sections electricity, gas, steam and air conditioning supply (D) and water supply, sewerage, waste management and remediation activities (E). Construction includes all firms in construction (F). Trade includes all firms belonging to section wholesale and retail trade (G). Services includes all firms belonging to a variety of services sectors.[13] By grouping smaller NACE sections with fewer observations we obtain more reliable estimates. Our approach, of course, comes with the assumption that firms within each group use the same production technology. Moreover, we estimate one set

deflator for year t.

[10] For manufacturing (C), we use the two-digit NACE divisions PPIs when available for all years; otherwise, we use the PPI associated with the main NACE section. For construction (F), we use a single (section-level) PPI. For trade (G), we construct a PPI using data on revenue and deflated revenue on a two-digit NACE code level from Eurostat.

[11] The relevant time series are available from the German Federal Statistical Office at `https://www-genesis.destatis.de/genesis/online`.

[12] For more information and details on the Mannheim Enterprise Panel, see `https://www.zew.de/en/research-at-zew/the-mannheim-enterprise-panel`.

[13] The NACE sections for group Services are: transportation and storage (H); accommodation and food service activities (I); information and communication (J); financial and insurance activities (K); real estate activities (L); professional, scientific and technical activities (M); administrative and support service activities (N); education (P); human health and social work activities (Q); arts, entertainment and recreation (R); and other service activities (S).

Table 2: Estimated Production Function Coefficients

	NACE Section Group for Production Function Estimation				
Cobb-Douglas Coefficient	**Manufacturing**	**Utilities**	**Construction**	**Trade**	**Services**
Labor	0.90	0.89	1.06	0.67	0.73
	(0.010)	(0.424)	(0.017)	(0.015)	(0.010)
Capital	0.19	0.23	0.13	0.13	0.13
	(0.015)	(0.074)	(0.016)	(0.014)	(0.013)

Notes: This table presents estimated coefficients (standard errors in parentheses) for Cobb-Douglas production functions for each of the five estimation groups: manufacturing (NACE sections A, B, and C), utilities (D and E), construction (F), trade (G), and services (H, I, J, K, L, M, N, P, Q, R, and S). The estimation sample covers the years 2000 to 2016. Bootstrapped standard errors (1000 iterations) are reported in parentheses.

of time-invariant production-function coefficients for each group, thus assuming that the production technology does not change over time.

In Table 2, we report the estimated production function coefficients following the approach described above. Our estimates for the Cobb-Douglas production function compare well with those obtained elsewhere. For instance, Autor et al. (2020) (for different U.S. manufacturing sectors) estimate labor coefficients ranging from 0.627 to 0.863 and capital coefficients ranging from 0.183 to 0.341. De Loecker and Scott (2016) (for the U.S. brewing industry) estimate a labor coefficient of 0.749 and a capital coefficient of 0.3.

3 A Consumption-to-Industry Concordance

3.1 Consumption-Proportional Size Weights

The standard or conventional way of reporting economy-wide averages of firm-level markups is the one of *equiproportional size-weighted* markups. Larger firms (with higher revenue or more employees) are assigned a higher weight because of their increased prominence. Firms across different industries, however, are treated equally. That means, two firms of equal size in two different industries are assigned the same weights. Equiproportional size-weighted markups are calculated with the following formula:

$$\bar{\mu} = \sum_i \frac{s_i}{\sum_j s_j} \mu_i \tag{3}$$

where s_i is firm i's size and $s_i/\sum_j s_j$ its size weight.

For consumers, however, not all industries are equally relevant, and consumers may be exposed to firms from some industries more than from others. An aggregation rule that takes this into account is one that uses information on *consumption*. One such source is consumption expenditure data. For instance, consumers that spend twice as much on a consumption category x (sold or provided by firms in industry X) relative to a category y (by firms in industry Y) are twice as exposed to price markups in industry X.

We will refer to average price markups that take consumption patterns into account as *consumption-proportional size-weighted* markups or, in short, *consumption-weighted* markups. For their construction, let $\mathcal{N}_c$ denote the set of all industries that provide goods and services in a given consumption category c. Moreover, let $\mathcal{I}_c$ denote the set of all firms i (belonging to an industry n_i) that are active in one of the industries in $\mathcal{N}_c$. *Within* each consumption category c, we treat all industries (and firms) according to their size. The size weight of an individual firm that is active in an industry relevant for consumption category c is given by

$$\frac{s_i}{\sum_{j\in\mathcal{I}_c} s_j}.$$

The average (size-weighted) markup to which a consumer of c is exposed is then

$$\hat{\mu}_c = \sum_{i\in\mathcal{I}_c} \frac{s_i}{\sum_{j\in\mathcal{I}_c} s_j}\mu_i. \tag{4}$$

If consumers spend more of their income on consumption category c' than on category c'', then the price markups of firms $\mathcal{I}_{c'}$ are more relevant for consumers and should be assigned a higher weight, so that $w' > w''$. For our consumption-weighted price markups, we are averaging over all consumption categories with w_c, the weight of c in the consumer's overall basket of goods and services. Consumption-weighted price markups can then be written as

$$\hat{\mu} = \sum_c w_c\hat{\mu}_c. \tag{5}$$

We obtain weights w_c from consumption-category weighting patterns used for the calculation of the consumer price index. We describe our data source next.

3.2 COICOP-NACE Concordance Table

For the construction of consumption-weighted price markups, we need information on consumption categories and industries that are relevant for these categories, that is, $\mathcal{N}_c$. For consumption categories, we use the 109 four-digit COICOP classes. The *Classification of Individual Consumption by Purpose (COICOP)* is a classification system developed by the United Nations Statistics Division to analyze consumption expenditures. In many countries, the COICOP system forms the basis for the basket of goods and services used for calculating the consumer price index.[14]

For each four-digit COICOP class, we identify all four-digit NACE classes that firms providing the consumption category (c) in the respective COICOP class report as their primary activity.[15] In a next step, we identify all NACE classes ($\mathcal{N}_c$) with firms ($\mathcal{I}_c$) that are in immediate or proximate contact with consumers.[16] In the last step, we merge this information with COICOP/CPI weighting patterns published by the German Federal Statistical Office. The final result is a COICOP-NACE concordance table that assigns to each NACE class in $\mathcal{N}_c$ the expenditure weight w_c of the respective consumption category c (i.e., COICOP class). Weighting patterns are revised every five years, and we use patterns for the years 2000, 2005, 2010, and 2015. We further include weighting patterns that are used for three household-type specific CPIs: high-income four-member households, medium-income four-member households, and two-member low-income (retired) households. The respective weighting patterns are from the year 1995. The household-type specific CPI series were discontinued in 2003.[17]

[14] The German Federal Statistical Office uses the Classification of Receipts and Expenditure of Households adapted to the requirements of Consumer Price Index (SEA-CPI). For our purposes, these two classification systems are equivalent.

[15] For the construction of our concordance table, we use the information from the weighting pattern for the year 2015 (https://www.destatis.de/DE/Themen/Wirtschaft/Preise/Verbraucherpreisindex/Methoden/Downloads/waegungsschema-2015.pdf), including information on five-digit and six-digit COICOP items. In several cases, we included all four-digit NACE classes of the next higher three-digit NACE group or two-digit NACE division when we considered these groups or divisions relevant.

[16] We are not considering the accumulation of price markups along the supply chain.

[17] High-income households consist of two adults and two children (at least one younger than 15 years).

For the calculation of the consumption-weighted price markups $\hat{\mu}$ as a weighted average of $\hat{\mu}_c$ (over all c), we must account for problems of limited data availability. While our concordance table is independent of our data sample, the actual calculation of weighted price markups relies on all consumption categories being populated by firms for which price markups can be estimated. Put differently, the set $\mathcal{I}_c$ must not be empty (or, there must be sufficient data to estimate price markups for these firms). If this is not the case, then average size-weighted markups for the respective COICOP class c are $\hat{\mu}_c = 0$.

In order to avoid a downward bias for the calculation of the consumption-weighted price markups, we account for empty $\mathcal{I}_c$ and rescale the weights w_c according to the following approach: Let $\mathcal{C}$ denote the set of consumption categories c for which we can calculate price markups for at least one firm (so that $\mathcal{I}_c$ is not empty). The rescaled weights are then

$$\tilde{w}_c = \frac{w_c}{\sum\limits_{k \in \mathcal{C}} w_k}. \tag{6}$$

By construction, $\sum_{c \in \mathcal{C}} \tilde{w}_c = 1$. The consumption-weighted price markups (accounting for limited data availability) can be written as

$$\hat{\mu}' = \sum_{c \in \mathcal{C}} \tilde{w}_c \hat{\mu}_c. \tag{7}$$

Note that, because of changing data availability, the sum of the raw weights $\sum_c w_c$ changes over time. The sum of the rescaled weights, however, is constant and equal to 1.

One adult is either a clerical worker or civil servant and the main provider of the family. Monthly gross income in 1995 Euros (converted) is between 3,323 and 4,499. Medium-income households consists of two adults and two children (at least one younger than 15 years). One adult is either blue-collar or white-collar worker and the sole provider of the family. Gross monthly in 1995 Euros (converted) is between 1,917 and 2,914. Low-income (retired) households consist of elderly couples with main income derived from the government (social security or pensions). Gross monthly income in 1995 Euros (converted) is between 895 and 1,278. These three household types made up about 6% of all German households in the early 2000s (Egner, 2003). For a relative comparison of household-type specific price markups, we also use a 1995 weighting pattern for average households.

3.3 Aggregated Concordance Tables

Alongside the results for $\hat{\mu}'$ using the class-level concordance table, we also construct an aggregated version of the concordance at the section level. This table will assign each (1-digit) NACE section the respective weight with which it enters the consumption-weighted price markups. We construct such an aggregated table in two steps.

In a first step, we ask how much firms of a given NACE section contribute to the markup for a given consumption category. In Table 3, we report such weights for 12 two-digit COICOP divisions (indexed by d). We denote this section contribution of a given NACE section N to a COICOP d by W_d^{N}. For the construction of these numbers, let $\mathcal{D}$ denote all COICOP classes (c) that make up a given COICOP division (d). Moreover, let $\mathcal{I}_c^{\mathrm{N}} \subseteq \mathcal{I}_c$, with $\bigcup_{\mathrm{N}} \mathcal{I}_c^{\mathrm{N}} = \mathcal{I}_c$, denote the set of firms that are assigned to COICOP class c and active in NACE section N. The weights are given by

$$W_d^{\mathrm{N}} = \sum_{c \in \mathcal{D}} \left(\frac{w_c}{\sum\limits_{k \in \mathcal{D}} w_k} \right) \left(\frac{\sum\limits_{i \in \mathcal{I}_c^{\mathrm{N}}} s_i}{\sum\limits_{i \in \mathcal{I}_c} s_i} \right). \tag{8}$$

We take a weighted sum of the size weights of all firms in N over all firms assigned to a given c (the second term in summation) where the weights are the relative consumption weights of a given c over all COICOP classes in the respective COICOP division (the first term in the summation). These section contributions W_d^{N} in Table 3 sum up (row wise) to 100.

We illustrate the implications of weights in equation (8) in a simple example in Table 4. For a given division d, we have two classes, $c = 1001$ and $c = 1002$. Their weights in the overall weighting pattern are 100 and 200 (out of 1000) so that the combined weight of division d is $w = 300$ (out of 1000). Two NACE sections, A and B, contribute to the broader division, each with 4 firms (2 in each class). Firms are of different size, s_i. Following equation (8), we calculate the weight of section A for division d as

$$W_d^A = \frac{100}{300} \cdot \frac{600 + 300}{600 + 300 + 200 + 100} + \frac{200}{300} \cdot \frac{100 + 200}{100 + 200 + 900 + 600} = \frac{13}{36} \approx 0.36$$

Table 3: Aggregated COICOP-NACE Concordance Table (for 2015)

			NACE Section														
COICOP Division		**Weight**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**P**	**Q**	**R**	**S**
01	Food and non-alcoholic beverages	96.85	.	.	.	100.00	.	.	.	.	.	.	.	.	.	.	.
02	Alcoholic beverages and tobacco	37.77	.	.	.	100.00	.	.	.	.	.	.	.	.	.	.	.
03	Clothing and footwear	45.34	.	.	.	98.12	.	.	.	.	.	.	.	.	.	.	1.88
04	Housing, water, electricity, gas and other fuels	324.70	15.99	5.79	3.98	6.67	.	.	.	.	63.83	.	3.74	.	.	.	.
05	Furniture, lighting equipment, appliances and other household equipment	50.04	.	.	.	92.20	.	.	.	.	.	.	7.02	.	.	.	0.78
06	Health	46.13	.	.	.	49.38	.	.	.	.	.	.	.	.	50.62	.	.
07	Transport	129.05	.	.	.	69.89	18.15	.	.	.	.	.	10.26	.	.	.	1.70
08	Communication	26.72	.	.	.	59.11	40.89	.	.	.	.	.	.	.	.	.	.
09	Recreation, entertainment and culture	113.36	.	.	.	39.28	.	.	4.62	.	.	4.68	23.48	.	.	26.22	1.71
10	Education	9.02	.	.	.	.	.	.	.	.	.	.	.	67.63	32.37	.	.
11	Restaurant and accommodation services	46.77	.	.	.	.	.	100.00	.	.	.	.	.	.	.	.	.
12	Miscellaneous goods and services	74.25	.	.	.	37.40	.	.	.	0.18	.	4.00	.	.	28.59	.	29.84
Sum		1,000.00	51.92	18.80	12.91	447.97	34.35	46.77	5.24	0.13	207.26	8.28	55.52	6.10	47.50	29.72	27.53

Notes: This table summarizes the COICOP-NACE concordance table in aggregated form for the year 2015. The concordance table for our main analysis is at the 4-digit NACE class level and the 4-digit COICOP class level. This table provides information for the contribution W_d^{N} of (1-digit code) NACE sections for each of the 12 COICOP divisions d. Column Weights reports the overall weights for each of the COICOP divisions. The values in the column sum up to 1000. The values in each row (for columns D through S) correspond to the section weights within each COICOP division. Values in each row sum up to 100 (subject to rounding errors).

Table 4: Aggregating COICOP-NACE Weights – An Example

		NACE Section A		NACE Section B	
	w	Firm	Size s_i	Firm	Size s_i
Class: 1001	100	A_1	600	B_1	200
Class: 1001	100	A_2	300	B_2	100
Class: 1002	200	A_3	100	B_3	900
Class: 1002	200	A_4	200	B_4	600
Division	300		1,200		1,800

The contribution of section B is then 0.64. If, instead, we calculate the respective contributions without the additional relative weights for the consumption class in Table 4, we obtain weights for 0.4 and 0.6 for A and B, respectively. Because section A has larger firms contributing to the consumption class with the lower weight, we overestimate the contribution of that sector when following this latter approach.

Table 3 highlights the importance of the trade sector for consumption-weighted markups. Section G is the only relevant section in two of the COICOP divisions, it has a weight of 92% and more in two other divisions, and it has a positive weight in ten out of the twelve COICOP divisions listed in the table. Broad relevance of a section, however, is not a guarantee for a high total weight. For instance, sections N (administrative and support service activities) and S (other service activities) contribute to 4 and 5 different COICOP divisions, respectively, but only make up 5.5% and 2.8% of the total weights, respectively. The overall weight (for 2015) of trade is close to 45%. The NACE section with the second highest total weight is real estate activities (L) with 21%. It contributes to COICOP 04 (housing, water, electricity, gas and other fuels) with 64%. This COICOP division covers six different NACE sections. We observe the same diversity in industries for COICOP division 09 (recreation, entertainment and culture). Of all 15 NACE sections, only 5 are the main section in at least one COICOP division: G, I (accommodation and food service activities), L, P (education), and Q (human health and social work activities).

In the second step for the construction of the aggregated concordance tables, we take a weighted average for each NACE section. This weighted average is the last row of Table 3. It is the weighted sum of the section contributions W_d^{N}, where the weights are the respective consumption weights w_d of each division d taken from the weighting pattern:

$$\tilde{W}^{\mathrm{N}} = \sum_{d} W_d^{\mathrm{N}} w_d. \tag{9}$$

We use these total weights to construct an approximate version of the consumption-weighted price markups,

$$\hat{\mu}'' = \sum_{N} \tilde{W}^{\mathrm{N}} \bar{\mu}^{\mathrm{N}}, \tag{10}$$

where $\bar{\mu}^{\mathrm{N}}$ is the section-N version of the simple size-weighted markups in equation (3). We summarize these total weights for each NACE section in Table 5 (for the years 2002, 2005, 2010, and 2015) and in Table 6 (for three different household categories, for data from 2010). In Table 5, we also report the simple, equiproportional revenue weights for each NACE section – for all NACE section (Full) and those for which COICOP-NACE weights are non-zero (Covered).

For the COICOP-NACE weights, we observe some variation over time, but do not see any major changes in the relative positions of NACE sections. The trade sector is the most relevant for consumption-weighted price markups, with the weights ranging between 45% and 48%. The second-most relevant sector is real estate activities (L) with constant weights around 20–21%. Five more NACE sections (D, H, I, N, and Q) have weights between 3.5% and 5.5%. When comparing the equiproportinal weights (column Covered), we can observe stark differences. First, note that manufacturing as the largest sector by revenue weight does not enter the consumption weights. The largest sections by revenue weight also included in the consumption weights are trade (G), electricity, gas, steam and air conditioning supply (D), and human health and social work activities (Q). The weight of real estate activities, the second-largest section by consumption weight, is negligible when looking at the revenue weights. These differences in how we weigh NACE sections when calculating average price markups are responsible for the patterns we observe when reporting our main results in Section 5.

Table 6 reports the aggregated weights for three different household types: high-

Table 5: Aggregated COICOP-NACE Weights

	NACE Section	COICOP-NACE Weights 2002	2005	2010	2015	Economy Full	Covered
A	Agriculture, forestry and fishing	.	.	.	.	1.69	.
B	Mining and quarrying	.	.	.	.	10.23	.
C	Manufacturing	.	.	.	.	383.89	.
D	Electricity, gas, steam and air conditioning supply	38.38	49.38	54.85	51.92	96.38	159.52
E	Water supply; sewerage, waste management and remediation activities	26.28	27.28	24.58	18.80	6.61	10.94
F	Construction	5.68	7.17	5.93	12.91	21.25	35.17
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	481.16	470.22	455.98	447.97	240.94	398.79
H	Transportation and storage	41.19	36.61	39.90	34.35	43.99	72.81
I	Accommodation and food service activities	46.57	43.99	44.67	46.77	5.92	9.80
J	Information and communication	3.47	7.76	7.59	5.24	29.58	48.96
K	Financial and insurance activities	.	5.95	.	0.13	2.89	4.78
L	Real estate activities	212.17	203.32	209.95	207.26	3.63	6.01
M	Professional, scientific and technical activities	6.40	17.23	11.62	8.28	39.71	65.73
N	Administrative and support service activities	52.96	45.17	49.26	55.52	17.67	29.25
P	Education	6.66	4.32	6.81	6.10	2.29	3.79
Q	Human health and social work activities	33.45	40.71	41.04	47.50	81.38	124.69
R	Arts, entertainment and recreation	28.79	18.32	27.66	29.72	3.61	5.98
S	Other service activities	16.84	22.56	20.15	27.53	8.33	13.79

Notes: This table summarizes the COICOP-NACE concordance table in aggregated form for the years 2002, 2005, 2010, and 2015. It provides the weights $\tilde{W}^N$ with which each NACE section enters the calculation of the consumption-weighted markups. Columns sum up to 1000 (subject to rounding errors). The table further reports the weight of each sector over the entire economy (when applying equiproportional weights). In column Full, we report weights for all NACE section, in column Covered, we report rescaled weights for those sections covered by the COICOP-NACE weights. Both columns sum up to 1000 (subject to rounding errors).

income households (with four household members), the 4-member medium-income households, and low-income households (with two retired members). For most NACE sections, the weights are of a similar order of magnitude. Note, however, that the weight on trade is significantly lower for low-income (retired) households than for the other household types. Conversely, retired households spend a noticeably larger share of their income in real estate (i.e., rent). We also see stark differences (in %) in education (section P) and human health and social work activities (section Q).

In Section 5, we present our results for consumption-weighted price markups using both the detailed COICOP-NACE concordance table as well as the aggregated weights in Tables 5 and 6. Presenting our results from aggregated tables allows other researchers to apply our consumption weights to their own section-level markup estimates. Our COICOP-NACE concordance table is independent of the data sample, the calculated weights reported in the tables, however, are a function of the respective sample. As long

Table 6: Household-Type Specific COICOP-NACE Weights

		Household-Type Specific		
	NACE Section	Medium Income	High Income	Retired
D	Electricity, gas, steam, and air conditioning supply	44.95	33.79	61.96
E	Water supply; sewerage, waste management, remediation activities	23.07	18.38	34.24
F	Construction	3.73	2.88	5.35
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	551.01	540.23	479.95
H	Transportation and storage	19.75	21.51	31.24
I	Accommodation and food service activities	50.28	60.31	46.24
J	Information and communication	8.33	9.16	4.62
K	Financial and insurance activities	.	.	.
L	Real estate activities	203.69	185.00	250.30
M	Professional, scientific and technical activities	10.18	10.44	8.77
N	Administrative and support service activities	31.86	33.17	35.54
P	Education	8.14	10.38	0.54
Q	Human health and social work activities	13.80	39.85	6.38
R	Arts, entertainment and recreation	17.00	18.77	10.22
S	Other service activities	14.21	16.13	24.66

Notes: This table summarizes the COICOP-NACE concordance table in aggregated form for the household-type specific consumer price indices (1995 weighting pattern) for the year 2010. It provides information for the NACE section weights for the 4-member high-income households, the 4-member medium-income households, and the 2-member low-income (retired) households. The concordance table for our main analysis is at the (4-digit) NACE class level and the 4-digit COICOP class level. For NACE section K (financial and insurance services), we do not have observe any firms in the respective 4-digit NACE classes in 2010. The respective weights are zero. Columns sum 1000 (subject to rounding errors).

as sample selection issues are not too severe, we feel confident that issues arising from the tables' sample dependence are negligible.

4 Baseline Price Markup Estimates

We first present baseline results for the price markups obtained from the procedure described in Section 2. While we estimate production functions for the years 2000 through 2016, data availability for the years 2000 and 2001 is too limited for a reliable calculation of consumption-weighted price markups.[18] For this reason, we report price markups in this and the next section for the time period of 2002 through 2016.[19]

Figure 1 depicts these sector-level averages in equation (3) for the following five sectors as well as the full economy (equiproportional weighting): manufacturing, utilities, construction, trade (wholesale and retail), and services. We present annual averages as

[18] For the first couple of years in our sample, we miss a significant number of 4-digit COICOP classes because we do not observe firms active in the respective NACE classes.

[19] All reported markup estimates are without outliers (i.e., the estimates are trimmed at the top and bottom 3%.)

dots and capture longer-term developments by fitting a cubic polynomial. In Table 7, we further report average price markups for each individual NACE section in our sample for four different time periods. Each of these time periods corresponds to one of the versions of the COICOP weighting patterns (2000, 2005, 2010, and 2015).

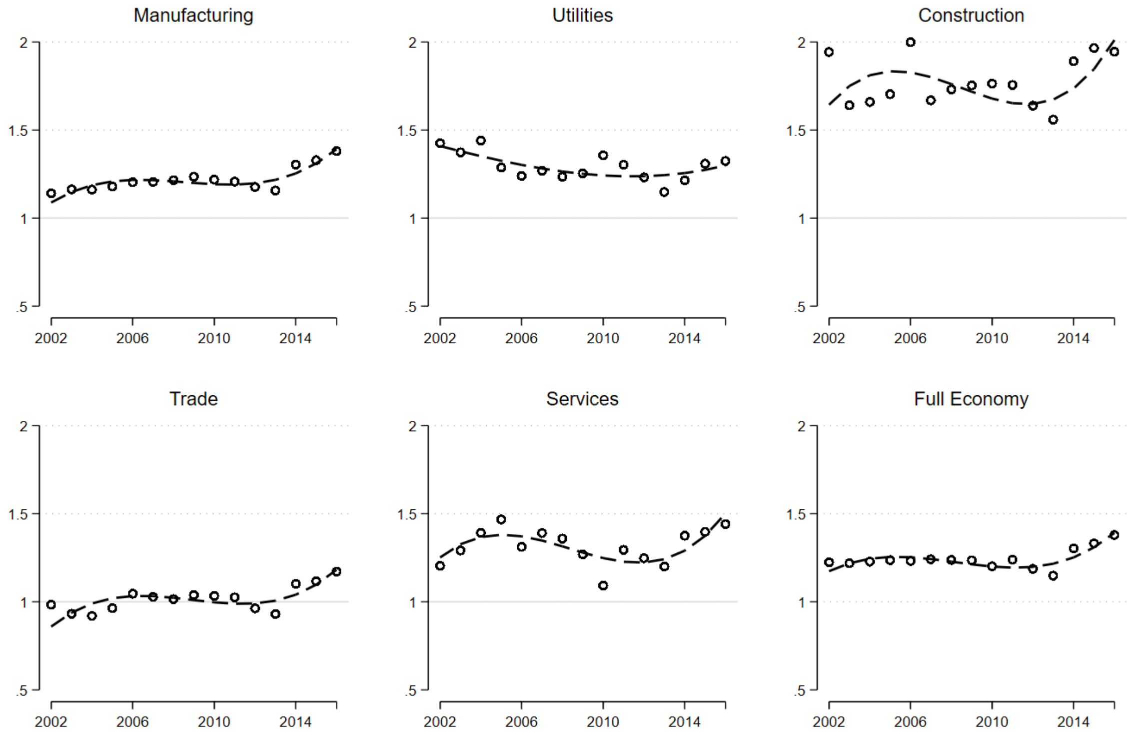
We make a number of observations. First, we observe a significant variation of price markups over time and across industries. For instance, markups in trade (0.95 to 1.14) are lower than in manufacturing (1.16 to 1.35), and those in manufacturing are lower than in services. These broad patterns compare well with results reported in Ganglmair et al. (2020) for German data from 2007 through 2016.[20] Note that, within our broader sectors utilities and services, we see significant variation. For utilities, firms in NACE section D (electricity and gas) exhibit lower price markups than firms in section E (water and sewerage). For services (which encompasses 11 NACE sections) we also see significant variation. The sections with the lowest markups are K (financial and insurance activities) and M (professional, scientific and technical activities). Sections with the highest markups are H (transportation and storage), I (accommodation and food service activities), P (education), and R (arts, entertainment, and recreation).

Second, levels of estimated price markups fall within the range of estimates reported elsewhere. De Loecker and Eeckhout (2018) find average price markups of 35 percent for Germany in 2016. Cavalleri et al. (2019) estimate average markups in Germany of about 15 percent. As we can observe in the Full Economy panel of Figure 1 and from the bottom row of Table 7, our estimated price markups for the full economy are of the same order of magnitude. Moreover, our estimates are noticeably lower than those reported for the U.S. For instance, De Loecker et al. (2020) estimate price markups of 61 percent (for 2016), and Autor et al. (2020) find markups of 80 percent (for 2012).

Third, Figure 2 depicts the cumulative changes of sector-level price markups. Across all sectors, we observe a strong increase in price markups starting around 2013. In manufacturing (and to a lesser extent in trade and construction) we see fairly constant

[20] Deutsche Bundesbank (2017), Hall (2018), and Cavalleri et al. (2019) report sector-level results that, in part, compare with ours.

Figure 1: Sector-Level Price Markups



Notes: This figure presents levels of average (within-sector revenue-weighted) price markups (as in equation (3)) for different sectors using all available observations in each sector. Manufacturing is NACE section C; utilities includes sections D and E; construction is section F; trade (including wholesale and retail) is section G; services includes sections H, I, J, K, L, M, N, P, Q, R, and S. We do not plot price markups for sections A (agriculture, forestry, and fishing) and B (mining and quarrying). Annual revenue-weighted averages are depicted by dots, the dashed line represents a cubic polynomial.

markups in the years prior to that increase.[21] Firms in services exhibit an initial increase in markups with a longer decline starting in 2005. Last, markups for firms in utilities have been steadily decreasing throughout the early years in our sample. We can observe average markups at the end of the sample period that are lower than in the early 2000s.

5 Price Markups for Consumers

5.1 Consumption-Weighted Price Markups

Figure 3 presents consumption-weighted price markups. As a benchmark, we also plot the equiproportional revenue-weighted markups (equation (3)) for the full economy (dotted

[21]This observation (for the earlier years in our sample) is consistent with the findings in Weche and Wambach (2018) or Cavalleri et al. (2019) who find fairly stable markups. Ganglmair et al. (2020) also find a stronger increase in manufacturing over the last few years.

Table 7: NACE-Level Price Markups

	NACE Section	**Time Periods** 2002–4	2005–9	2010–14	2015–16
A	Agriculture, forestry and fishing	2.25	2.21	1.79	1.53
B	Mining and quarrying	1.46	1.82	2.15	1.85
C	Manufacturing	1.16	1.21	1.21	1.35
D	Electricity, gas, steam and air conditioning supply	1.36	1.16	1.17	1.25
E	Water supply; sewerage, waste management and remediation activities	2.50	2.59	2.47	2.40
F	Construction	1.75	1.77	1.72	1.96
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	0.95	1.02	1.01	1.14
H	Transportation and storage	1.82	1.87	1.56	1.76
I	Accommodation and food service activities	1.87	1.80	1.90	2.05
J	Information and communication	1.02	1.01	0.97	1.13
K	Financial and insurance activities	0.83	0.75	0.76	0.91
L	Real estate activities	1.55	1.56	1.58	1.67
M	Professional, scientific and technical activities	0.76	0.93	0.90	1.06
N	Administrative and support service activities	1.29	1.37	1.39	1.58
P	Education	2.23	1.97	1.90	2.20
Q	Human health and social work activities	1.76	1.57	1.41	1.63
R	Arts, entertainment and recreation	1.70	1.99	2.02	1.96
S	Other service activities	1.36	1.26	1.38	1.67
	Revenue-Weighted Average	1.22	1.24	1.22	1.36

Notes: This table provides average price markups for each NACE section for the time periods 2002–2004, 2005–2009, 2010–2014, and 2015–2016. We calculate within-industry revenue-weighted averages and take simple arithmetic means over the respective years. The time periods correspond to the respecstive time periods to which the COICOP weighting patterns (published by the German Federal Statistical Office) apply.

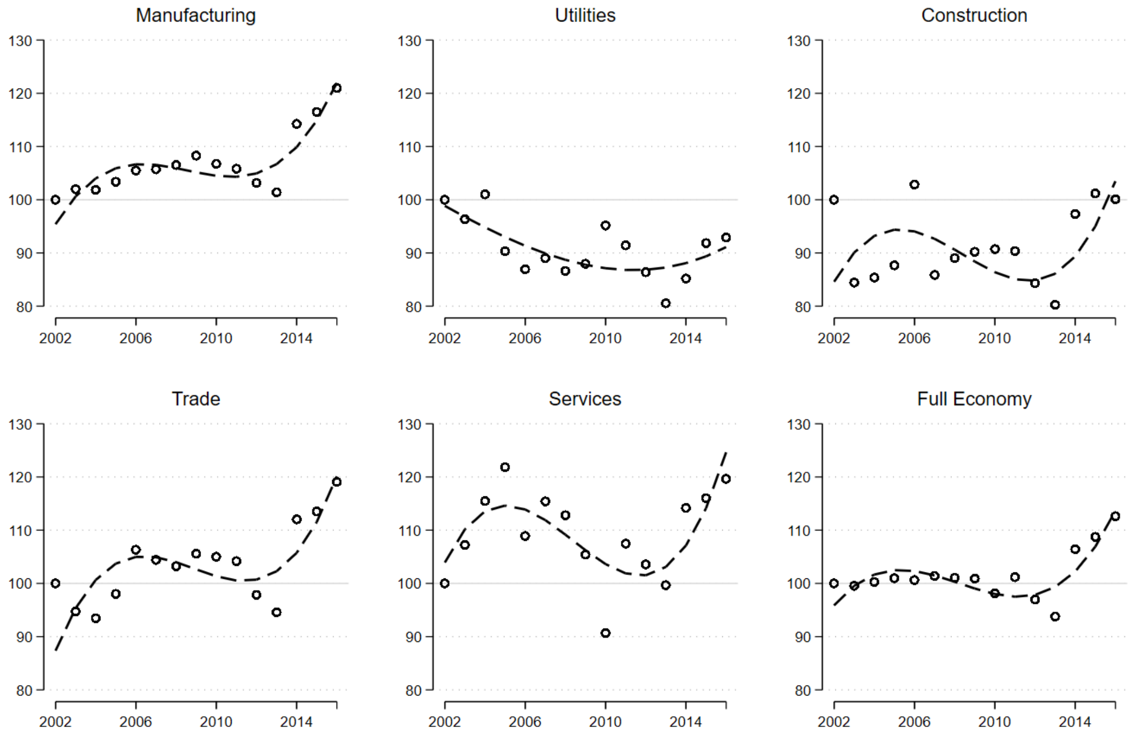
line).[22] The solid line depicts consumption-weighted price markups $\hat{\mu}'$ in equation (7) using the full concordance table (based on COICOP classes). The dashed line depicts the consumption-weighted price markups $\hat{\mu}''$ in equation (10) using the aggregated weights from Table 5.[23]

We make two main observations: First, we find that consumption-weighted price markups are significantly higher than "standard" (equiproportional) price markups. This holds for both our approaches, using either the detailed or the aggregated concordance table. The differences are at 15 to 25 percentage points, reaching more than 30 in the later years of our sample period. The reason for this lies in the different weights for low and high-markup sections. The numbers in Table 5 illustrate this. For instance, section L (real estate activities) enters the equiproportional price markups with a relatively low

[22]For the full economy, we use all available observations. The data depicted by the dotted line are the same as those in the scatter plot in the Full Economy panel of Figure 1.

[23]The weights in Table 5 are applied to their respective range of years. That means, the weight for 2002 applies to 2002–2004; the weight for 2005 applies to 2005–2009; the weight for 2010 applies to 2010–2014; and the weight for 2015 applies to 2015–2016.

Figure 2: Cumulative Changes of Sector-Level Price Markups



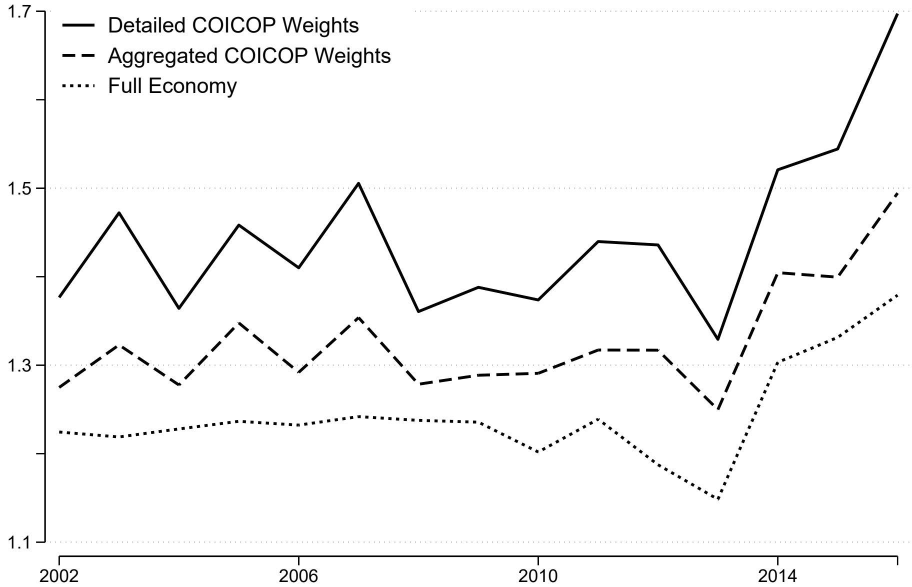
Notes: This figure presents cumulative changes of average price markups (depicted in Figure 1) for different sectors using all available observations in each sector. Base year (=100) is 2020. Manufacturing is NACE section C; utilities includes sections D and E; construction is section F; trade (including wholesale and retail) is section G; services includes sections H, I, J, K, L, M, N, P, Q, R, and S. We do not plot price markups for sections A (agriculture, forestry, and fishing) and B (mining and quarrying). Annual averages are depicted by dots, the dashed line represents a cubic polynomial.

weight. The section includes rent and therefore enters the consumption-weighted price markups with a significantly higher weight. Also, while section C (manufacturing) is very prominent in the calculation of the equiproportional price markups, the section does not enter the consumption-weighted price markups.

The two different aggregation approaches follow similar patterns, both exhibiting a strong increase in the years 2013 through 2016. Consumption-weighted price markups, however, are more volatile. This is likely driven by more volatile price markup estimates for services that enter with a disproportionately high weight.

Second, consumption-weighted price markups have increased faster, in particular in the last few years of our sample period. The difference in the annual averages increased from 17 percentage points in 2013 to 32 percentage points in 2016 (for the detailed concordance table). We can also see this difference in changes in Figure 4, where we plot

Figure 3: Levels of Consumption-Weighted Price Markups



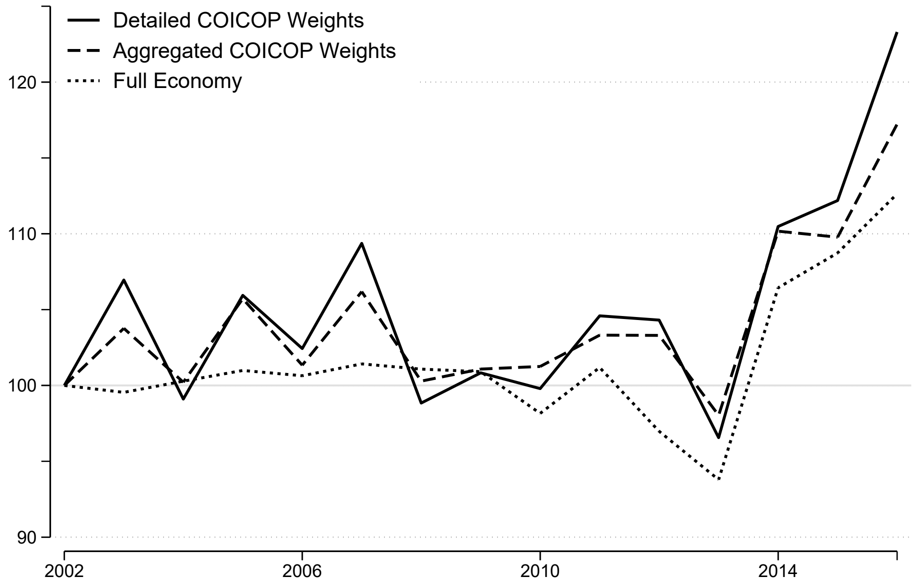
Notes: This figure presents the levels of consumption-weighted price markups. The solid line depicts our main results for consumption-weighted markups in equation (7) using the detailed COICOP-NACE concordance table as described in Section 3. The dashed line depicts the approximate consumption-weighted markups in in equation (10) using the aggregated concordance table reported in Table 5. The dotted line depicts the full economy (equiproportional revenue-weighted) price markups (equation (3)) using all available observations across all sectors.

the cumulative changes for each of the three average markup measures. The difference in the cumulative changes increases from 4 points in 2013 to 11 points in 2016.

5.2 Sources of Variation

The difference in the levels (and cumulative changes) is driven by substantial differences in the weights with which individual industries enter the calculation of average price markups. To better understand the sources of variation over time, we conduct a decomposition exercise following De Loecker et al. (2020). We decompose the changes in average price markups ($\Delta\hat{\mu}'_t = \hat{\mu}'_t - \hat{\mu}'_{t-1}$) into changes of markups induced by changes in the consumption weight, changes of markups, and a compositive effect (residual). For our consumer-weighted markups based on the detailed concordance table, this decomposition

Figure 4: Cumulative Changes of Consumption-Weighted Price Markups



Notes: This figure presents the cumulative changes of consumption-weighted markup estimates. Base year (=100) for each time series is 2002. The solid line depicts our main results for consumption-weighted markups in equation (7) using the detailed COICOP-NACE concordance table. The dashed line depicts the approximate consumption-weighted markups in in equation (10) using the aggregated concordance table reported in Table 5. The dotted line depicts the full economy revenue-weighted price markups using all available observations across all sectors.

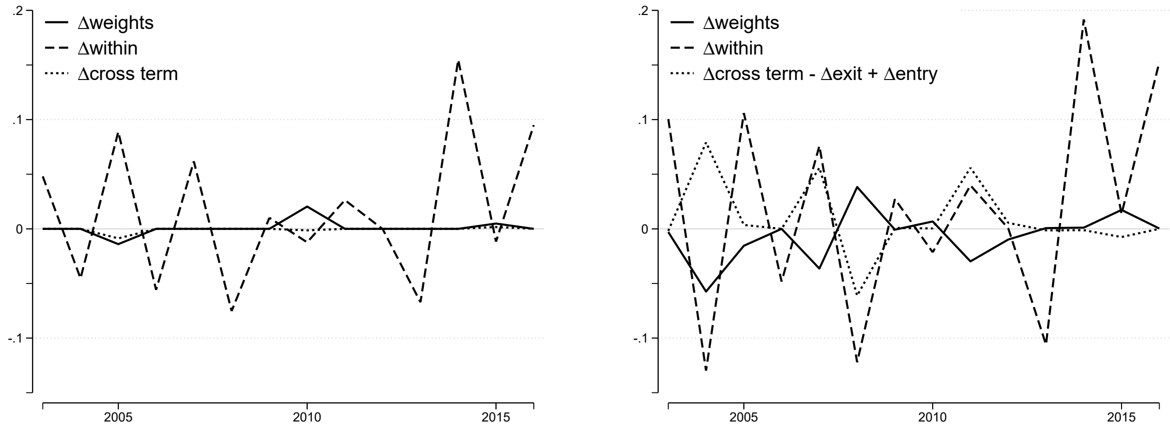
is captured by the following formula:

$$\Delta\hat{\mu}'_t = \underbrace{\sum_{c\in\mathcal{C}_{t-1}\cap\mathcal{C}_t} \Delta\tilde{w}_{c,t}\hat{\mu}_{c,t-1}}_{\Delta weights} + \underbrace{\sum_{c\in\mathcal{C}_{t-1}\cap\mathcal{C}_t} \tilde{w}_{c,t-1}\Delta\hat{\mu}_{c,t}}_{\Delta within} + \underbrace{\sum_{c\in\mathcal{C}_{t-1}\cap\mathcal{C}_t} \Delta\tilde{w}_{c,t}\Delta\hat{\mu}_{c,t}}_{\Delta cross\ term} - \underbrace{\sum_{c\in\mathcal{C}_{t-1}\backslash\mathcal{C}_t} \tilde{w}_{c,t-1}\hat{\mu}_{c,t-1}}_{\Delta exit} + \underbrace{\sum_{c\in\mathcal{C}_t\backslash\mathcal{C}_{t-1}} \tilde{w}_{c,t}\hat{\mu}_{c,t}}_{\Delta entry}, \tag{11}$$

where t is a time index, c is the four-digit COICOP class, and $\mathcal{C}_t$ the set of all COICOP classes for which data is available in t. The term $\Delta weights$ captures the change in consumption-weighted markups induced by a change in the weighting pattern, keeping markups (in c) constant.[24] The term $\Delta within$ captures the change in average markups caused by the variation of markups within the industries relevant for a consumption class c, keeping the weighting pattern constant. The term $\Delta cross\ term$ is the joint effect of the previous two. Over time, we may see some consumption classes dropping from or

[24]These changes can come from both, the numerator and denominator of $\tilde{w}_{c,t}$ in equation (6).

Figure 5: Decomposition of Changes of Consumption-Weighted Price Markups



(a) Aggregated COICOP Weights **(b)** Detailed COICOP Weights

Notes: This figure presents the results from decomposition exercise in equations (11) and (12). The solid lines depict the changes in average price markups induced by changes in the weighting pattern; the dashed lines depict changes in average price markups induced by within sector changes of markups; the dotted lines depict the sum of the cross term Δ*cross term*, the exit term Δ*exit*, and the entry term Δ*entry* (in equation (11)) or the cross term (in equation (12)).

entering our data (when we do not observe any firms in a category-relevant industry, or when new firms enter the sample). The last two expressions in equation (11) capture the effects of such exit (Δ*exit*) and entry (Δ*entry*). In our depiction of the decomposition in the RHS panel of Figure 5, we refer to the last three terms of equation (11) as the residual term.

For the consumption-weighted markups generated with the aggregated concordance table in Table 5, the decomposition formula is simpler:

$$\Delta\hat{\mu}'' = \underbrace{\sum_N \Delta\tilde{W}_t^{\mathrm{N}}\,\bar{\mu}_{t-1}^{\mathrm{N}}}_{\Delta weights} + \underbrace{\sum_N \tilde{W}_{t-1}^{\mathrm{N}}\,\Delta\bar{\mu}_t^{\mathrm{N}}}_{\Delta within} + \underbrace{\sum_N \Delta\tilde{W}_t^{\mathrm{N}}\,\Delta\bar{\mu}_t^{\mathrm{N}}}_{\Delta cross\ term}. \tag{12}$$

Again, the term Δ*weights* captures the variation in consumption-weighted markups induced by a change in weights, keeping the markups constant.[25] The term Δ*within* is the change in average price markups that can be attributed to a change in markups within NACE sections, keeping the weights constant. Last, the term Δ*cross term* is the joint effect. The LHS panel in Figure 5 depicts this decomposition.

Given the fixed weights for each NACE section (for as long as a given COICOP

[25] More specifically, it captures the effect of a switch from one column in Table 5 to another.

weighting pattern applies), changes in average markups from the aggregate appraoch (LHS panel) are induced by changes in weights only when the weighting patterns change (see Table 5). The main contributor of markup changes over time are within-NACE-section markup changes. The approach (and picture) is different when considering the consumption-weighted price markups from the detailed concordance table (RHS panel). With the detailed concordance table, the weights change over time because weighting patterns change and industry composition changes (so that different sets of firms are considered when calculating consumption weights). A noticeably larger fraction of the changes of price markups is induced by changes in weights. The main contributor, however, remains the variation of within-industry markups.

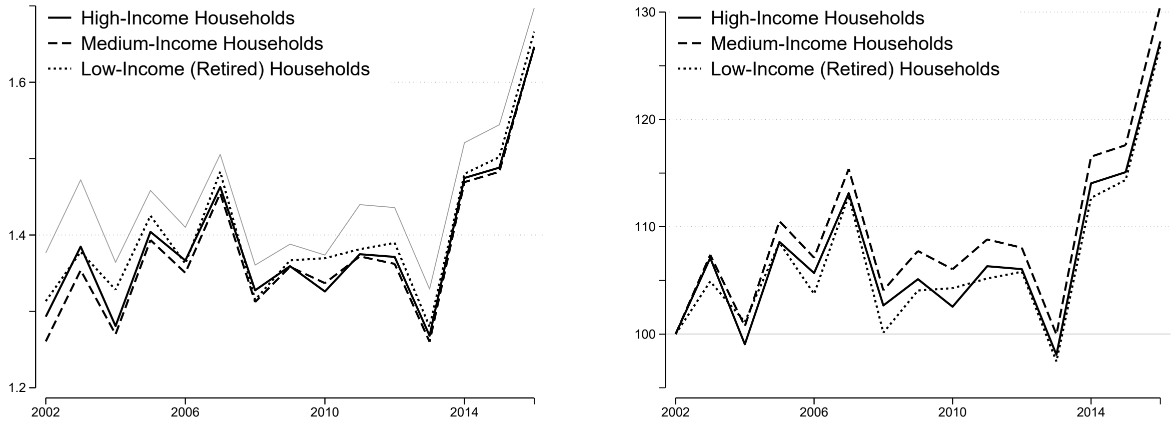
The decomposition exercise provides insights into the drivers behind the increase in consumption-weighted price markups in the later years of our sample period (2013–2016) as observed in Figure 3. Figure 5 reveals that the observed increase can be largely attributed to higher markups of firms that are already relevant for consumers (captured by $\Delta within$) rather than consumers spending more on goods and services provided by high-markup industries (captured by $\Delta weights$).

5.3 Household-Type Specific Price Markups

The results for consumption-weighted markups in the previous section apply to average or typical households (i.e., the unit for which the COICOP weighting patterns are meant to be representative). Weighting patterns for different types of households will yield consumption-weighted price markups relevant for these households. In Figure 6, we present results for such price markups for three different household types: high-income four-member households; medium-income four-member households; and low-income (retired) two-member households (Table 6). In the LHS panel of the figure, we can see that the levels for household-type specific markups are lower than the levels for our baseline estimates as we have depicted in Figure 3 (based on the detailed concordance table).[26]

[26]The household-type specific results in Figure 6 are for narrowly defined household types and do not include households without children, single-parent households, or households with one or more than two children. In the early 2000s, the three specific household types made up about 6% of all German households (Egner, 2003:424).

Figure 6: Household-Type Specific Price Markups



(a) Levels **(b)** Cumulative Changes

Notes: This figure presents the levels (panel (a)) and cumulative changes (panel (b)) of consumption-weighted price markups using household-type specific COICOP weighting patterns (as summarized in Table 6). The solid line depicts the consumption-weighted markups for 4-member high-income households; the dashed line depicts the consumption-weighted markups for 4-member medium-income households; the dotted line depicts the consumption-weighted markups for 2-member low-income (retired) households. In panel (a), the grey line depicts the consumption-weighted price markups (based on the detailed concordance table) from Figure 3.

All four, however, follow similar time patterns.

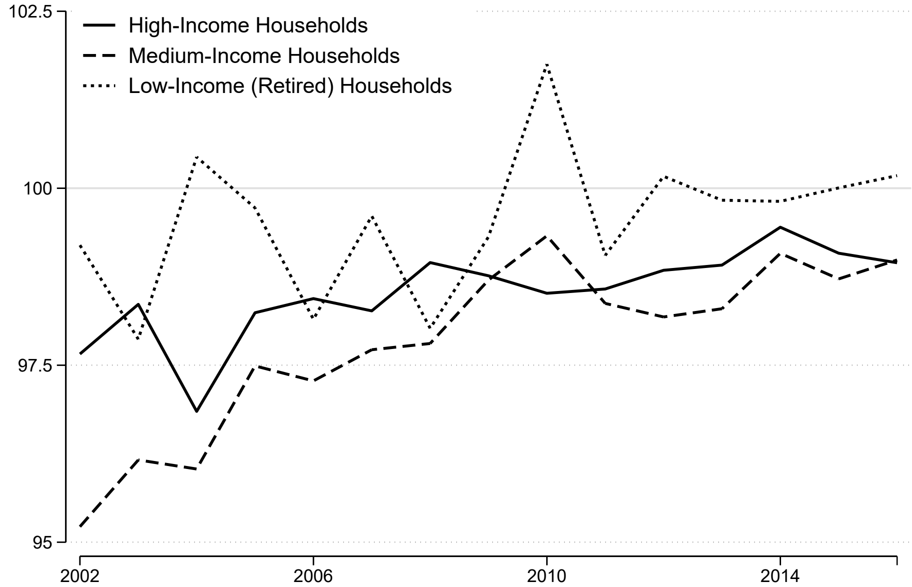
In the RHS panel of Figure 6, we plot the cumulative changes of household-type specific price markups. We can see that price markups for medium-income households grew faster than price markups for high-income households. In Figure 7, we look at these patterns from a different angle. We plot household-type specific price markups relative to average consumption-weighted price markups.[27] We see a convergence of markups for all multi-member households toward average-household markups. Moreover, markups for medium-income households converge faster than markups for high-income households. While we find slightly higher markup levels for high-income households, it was the medium-income households that have been disproportionately exposed to recent increases in price markups.

6 Concluding Remarks

In this paper, we present a novel approach of reporting average price markups. Instead of calculating average price markups by weighing all firms relative to their size but in-

[27]We use the 1995 weighting pattern for this relative benchmark.

Figure 7: Relative Values of Household-Type Specific Price Markup



Notes: This figure presents the relative differences of household-type specific price markup estimates relative to estimates for the average household (from a 1995 weighting pattern). The solid line depicts the consumption-weighted markups for 4-member high-income households; the dashed line depicts the consumption-weighted markups for 4-member medium-income households; the dotted line depicts the consumption-weighted markups for 2-member low-income (retired) households.

dependent of their industry, we consider consumers' consumption patterns when taking a weighted average. We construct a consumption-to-industry concordance table that allows us to assign to each firm in an industry a weight that reflects the relevance of its industry for consumers' consumption expenditures. Industries to which consumers are more exposed enter with higher weights. We find (for Germany for the years 2002–2016) that these consumption-weighted price markups are noticeably higher and grow faster than the conventional revenue-weighted price markups. We also show that markups are higher for medium-income households than high-income households.

Our descriptive results highlight the importance of using a consumption-based weighting scheme for the calculation of price markups when consumers are the focus of the analysis. Full-economy based weights might downward bias the relevant price markups for consumers. The approach we take, however, does come with a number of limitations. First, when constructing the consumption-to-industry concordance table, we consider only the industries closest to the consumer – industries that are in immediate contact with consumers. In a large number of cases this industry is the retail sector. By taking this approach, we ignore the accumulation of markups along the supply chain (leading to the consumer). This is also the reason, why the manufacturing sector does not enter our concordance table. Second, we use markup estimates for German firms only, excluding foreign firms that may be immediately relevant for consumers in Germany. Third, we do not provide any inference. Our results are purely descriptive.

Last, while we stress the importance of reporting price markups relevant for consumers, we do not link these consumption-weighted price markups to prices and inflation. Between 2002 and 2016, the German CPI increased by approximately 20%, closely tracking the increase in consumption-weighted price markups – between 17% (using aggregate weights) to 23% (using detailed weights). We hope future research will further explore the question of how much price markups contribute to inflation – or vice versa (e.g., Bénabou, 1992; Banerjee and Russell, 2001).

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