

Structural Change and the Rise in Markups*

Ricardo Marto[†]

University of Pennsylvania

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Abstract

Is the recent rise in markups in the United States and Europe caused by increased monopoly power or is it a natural consequence of structural change in the economy? I show that the rise in aggregate markups has been driven by a reallocation of market share away from non-services to services-producing firms and a faster increase of services' markups. I develop a two-sector model of structural change to assess the sources of the rise in markups between 1980 and 2015. The two forces of structural change play opposing roles in the model. On one hand, an increase in the relative productivity of manufacturing leads to a decline of the relative price of manufactured goods. The pass-through to consumers is however smaller than one, pushing up the markups of goods-producing firms. On the other hand, increasing incomes trigger the rise of the services sector, leading to higher markups for firms in services. The higher markups result from preferences that imply the price elasticity of demand falls with income. The model matches key trends in the United States, specifically the rise of the service sector and the fall of the relative price of manufactured goods. I show that the rise in markups is in line with these observed shifts and may not necessarily reflect a decline of competition. I provide novel experimental evidence supporting the notion that the price elasticity of demand decreases with income.

Keywords: Endogenous markups, income elasticity of demand, manufacturing, non-homothetic preferences, online experiment, price elasticity of demand, services, skill premium, structural change, survey, technological progress

JEL Classifications: D11, D12, D22, D43, E21, E23, L11, L16, O41, O47

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[†]Department of Economics, University of Pennsylvania. Email address: rmarto@sas.upenn.edu.

1 Introduction

What has caused the recent rise in markups? Is this the result of an increase in monopoly power? Does it call for a strengthening of competition policy? Those questions sparked the interest of researchers and policymakers around the world.¹ Three hypotheses have been advanced to explain the evidence on the rise of markups. The first hypothesis relates to the rise of superstar firms. Highly innovative firms have reaped the benefits of technological advancement by creating new markets and acting like monopolists in those markets. The second hypothesis suggests that firms have charged higher markups in response to increased barriers to entry, which is also potentially related to the increased spending on advertising and managerial expenses. The third hypothesis relates to the mis-measurement of markups. Since markups are not directly observable, they have been inferred using different methods (estimating production functions or demand systems) that produced somewhat different results—yet they seem to point to an increase in markups.²

This paper takes a different view by asking: Does structural change explain the rise in markups? Backed by empirical evidence and a quantitative model matched to the trends observed in the U.S. economy over the last forty years, this paper shows that the rise in markups is intimately related with the process of structural transformation economies go through. Why structural change? I first show that structural change is accompanied by an increase in the relative price of services (44% between 1980 and 2015 in the U.S.). By definition, prices equal markups times marginal costs. Therefore, either markups in service industries grew faster than in non-service industries and/or marginal costs in non-service industries declined faster than in service industries. In turn, the 13 percentage points increase in the services share would further magnify the rise in markups.

I show that, indeed, the rise in markups has been driven by a reallocation of market share away from non-services-producing to services-producing firms along with a larger increase in the average markup of services. The contribution of the services sector to the aggregate markup increased from 46% in 1980 to 72% in 2015. Further decomposing the change in aggregate markups shows that about two-thirds of the increase in aggregate markups is driven by the rise of the average markup in the services sector and 7% due to the sectoral reallocation.³

By relying on Roy's (1947) identity to derive the Marshallian demand function, I show that three channels can affect firms' markups through the price elasticity of demand: (i) changes in prices, (ii) changes in incomes, and (iii) changes in the demand composition, as long as the firm is unable to perfectly price discriminate its consumers. Two key propositions are presented to establish their effects on the price elasticity of demand. The first provides conditions for the price elasticity of demand to be decreasing in the consumer's income. This relates to Harrod's (1936) *Law of Diminishing Elasticity of Demand*, who argued that

¹For instance, a high-level Competition Council was established in the United States in the summer of 2021 with the responsibility of overseeing policy measures related to competition. Several other countries, including emerging and developing economies, have recently strengthened their competition laws to curb anticompetitive practices. Syverson (2019) highlights the open questions in the macroeconomics of market power that need to be addressed.

²See, for instance, Autor, Dorn, Katz, Patterson, and Van Reenen (2020), Bond, Hashemi, Kaplan, and Zoch (2021), De Ridder, Grassi, and Morzenti (2022), Raval (2022), and Traina (2018).

³The remainder is due to the increase—albeit smaller—of the average markup of non-services firms.

"...as people's incomes become larger, the ratio between the trouble involved in finding the cheapest market, and the real gain in utility which will result in so doing, increases."

This is interpreted here as implying that a consumer's price elasticity of demand for goods and services is smaller the wealthier they are. The second proposition establishes the conditions for the price elasticity of demand to be increasing in the product's price. This relates to [Marshall's \(1890\) Second Law of Demand](#) and implies that the cost pass-through is smaller than one. A set of non-homothetic preferences is adopted that allows these propositions to hold.

The insights from these two propositions are then embedded into a model of structural change that rationalizes the observed trends in markups, relative price of services, and services share. The economy features two sectors with monopolistically competitive firms offering differentiated varieties of goods and services. Firms are retailers and, hence, sell directly to consumers. There are two types of consumers, high-skilled (or wealthy) and low-skilled (or poor), who have non-homothetic preferences over goods and services. Since households have different incomes, their price elasticities of demand for goods and services differ. The economic intuition behind the mechanisms that give rise to increasing markups in the model is simple and that is where the two forces of structural change are handy—namely, income effects and relative price changes caused by differential rates of technological progress across sectors.

As productivity grows faster in the non-services sector, marginal costs decline at a faster rate for these firms. This in turn allows them to reduce their prices. Yet, with imperfect competition the cost pass-through is less than one and some of the efficiency gains will be retained by the firm. As households' price elasticity of demand is increasing in prices, the decline in the price of goods decreases the consumers' price elasticities of demand. The efficiency gains from productivity growth therefore allow firms to increase their markups. This translates into an increase in the average markup of firms in the non-services sector. There is a caveat, however. As households buy more goods, the share of the non-services sector in the aggregate output could increase. This is not observed in the data, so a second driver of structural change is necessary.

Income effects play the countervailing role. As households' income grows, commodities that were luxuries become more accessible and consumption start flowing toward the sector providing them—i.e., the services sector. Hence, the services share increases. There is a second effect resulting from the introduction of non-homothetic preferences. As households' income increases, their price elasticity of demand decreases. Therefore, firms catering to wealthier consumers, who are now more willing to buy their services, are able to command higher markups. This driver of structural change explains both the rise of the services share and why the average markup in the services sector has increased.

The paper quantifies the role of four drivers on the rise of markups between 1980 and 2015: (i) neutral technological change, (ii) skill-biased technological change, (iii) changes in the fraction of high-skilled consumers, and (iv) changes in entry costs. Skill-biased technological progress is the main driver of the rise of markups. This results from two effects. The first is that it reduces marginal costs. Second, and more importantly, it creates wealthier consumers whose willingness to buy goods and services grows over time. The rise in wealthier consumers explains the increase in the average

markups of services firms. In contrast, neutral technological progress plays a smaller role, in particular in the non-services sector, and the rise in entry costs does not explain much of the increase in markups.

Four counterfactual exercises are performed. In the first experiment, changes in neutral technological change are shut down to keep the price of goods and services at their 1980 levels. Although prices of goods and services would be higher, the resulting aggregate markup is half as high as it was in 2015 relative to the baseline economy. Because goods and services are now more expensive, households are less willing to buy them, reducing the room for firms to increase their markups. This is particularly noticeable in the goods sector because the decline in prices in the baseline economy was larger. This in turn discourages potential entrants, leading to fewer firms operating in the market.

In the second experiment, the increase in skill-biased technological change is shut down to keep incomes of high- and low-skilled households at their 1980 levels. This experiment implies a much lower level of income inequality than in the data. The resulting aggregate markup would have stayed close to its level in 1980. The anemic response of aggregate markups is due to a decline in the average markup of services. As households are now poorer, their willingness to buy luxuries is now smaller. Firms have a smaller margin to increase their markups and as a result the number of firms willing to start a business is now smaller. Households are worse off in this economy despite the lower level of income inequality and markups.

In the third experiment, the increase in the share of wealthy consumers is shut down. The economy here features a larger share of poorer households than in the data. Firms are now more likely to sell their goods and services to poorer consumers than in the baseline economy. Because the demand share of low-skilled households increases, firms put more weight on their price elasticity of demand, which decreases the markup of firms in both sectors. Changes in the composition of firms' customer base has little effect on the aggregate markups. The aggregate markup would be 2% lower in 2015 in this economy relative to the baseline.

In the fourth experiment, entry costs are shut down. Although these are estimated to have increased 3 percentage points of sectoral output between 1980 and 2015, reducing them has little bearing on markups. Reducing entry barriers has, however, a direct impact on the number of active firms, which increased significantly.

The last part of the paper assesses the extent to which price elasticities of demand vary across the income distribution. This issue is addressed by conducting a new online survey eliciting consumers' price elasticities of demand for broad categories of goods and services. The survey questions are designed as experiments to capture individuals' perceptions of the impact of changes in prices on their purchase of different goods and services. In the main empirical exercise, individuals' perceived price elasticities of demand for a product are regressed on their incomes and a set of demographic controls. The key finding is that wealthier households are less willing to adjust their demand when prices increase, while less well-off consumers are more likely to reduce their demand. This holds for different categories of goods and services.⁴ For instance, in response to a 20% price increase of child

⁴Such as food at home, food away, apparel, public transportation, vehicle insurance, medical and dental services, health

care, 87% of households earning between \$50,000 and \$60,000 would reduce their demand for such services as opposed to less than 38% for households earning between \$150,000 and \$200,000.

Outline. The remainder of the paper is organized as follows. Section 2 presents evidence on structural change and the rise of services as the main driver of the rise in markups. Section 3 introduces novel theoretical results on the price elasticity of demand that allow structural change to interact with markups. Section 4 introduces the two-sector general equilibrium model to assess the sources of the rise markups between 1980 and 2015. Section 5 presents the calibration procedure for the United States and evaluates the performance of the model. Section 6 discusses the counterfactual experiments showing the role of different driving forces on the evolution of markups. Section 7 presents the results of the online survey eliciting consumers’ price elasticity of demand supporting the mechanism at play in the quantitative exercise. Section 8 concludes.

1.1 Related literature

This paper builds on three different strands of literature. The first relates to the recent wave of studies on the macroeconomics of market power seeking to understand the causes and consequences of the rise in markups. The second relates to the literature on structural change seeking to understand the drivers of the rebalancing of economic activity toward the services sector. The third relates to the use of tailored surveys to elicit consumer behavior and preferences. Each of these are discussed in greater detail below.

First, this paper builds on the empirical studies on market power. [De Loecker and Warzynski \(2012\)](#) popularized the estimation of production functions to derive firm-level markups and [De Loecker, Eeckhout, and Unger \(2020\)](#) documented a generalized increase in market power in the United States.⁵ Following a similar methodology, [Díez, Fan, and Villegas-Sánchez \(2021\)](#) uses data on both listed and private firms across many advanced economies to confirm the rise of market power, yet the magnitude of the increase in markups is much smaller.⁶ The contribution of this paper to this literature is to show that the services sector has been the main driver of the rise in markups. Other papers have studied the rise in markups from preferences. [Döpfer, MacKay, Miller, and Stiebale \(2022\)](#) find that consumers have become less price sensitive over time. [Sangani \(2022\)](#) provides empirical evidence that the price elasticity of demand for retail goods declines with income. Both papers provide support for the theory proposed in this paper that increases in income have led to a fall in price elasticities of demand.

insurance, child care, school and college tuition, personal insurance, audio and visual equipment and services, and vehicle purchases and maintenance.

⁵[Grullon, Larkin, and Michaely \(2019\)](#) and [Covarrubias, Gutiérrez, and Philippon \(2019\)](#) show that industries have also become more concentrated and [Hall \(2018\)](#) shows that markups across industries have increased.

⁶Other papers have discussed the potential pitfalls of the production function estimation strategy. [Raval \(2022\)](#) shows that using other variables inputs to recover firms’ markup can deliver a different distribution of markups. [Traina \(2018\)](#) also argues that including administrative expenses would display a smaller increase in markups in the United States. [Bond et al. \(2021\)](#) show that relying on firms’ revenue to estimate output elasticities might distort the level of markups. In contrast, [De Ridder, Grassi, and Morzenti \(2022\)](#) assess the biases in markup estimates from using revenue and show that these estimates are highly correlated with true markups.

This paper also complements the quantitative work on markups. [Edmond, Midrigan, and Xu \(2021\)](#) study the welfare costs of markup distortions. In line with this paper, they cast doubts on the possibility of increasing barriers to entry to explain the rise in markups. [De Loecker, Eeckhout, and Mongey \(2021\)](#) study the relationship between business dynamism and the rise of market power in a framework with rich heterogeneity. They show that technological change is an important driver of the increase in markups, which is also the case in this paper. [Akcigit and Ates \(2021\)](#) use a Schumpeterian model with endogenous markups to show that declining knowledge spillovers is an important driver of the decline in business dynamism. [De Ridder \(2021\)](#) proposes the increasing use of intangible inputs as an important driver of the rise in market power and [Aghion, Bergeaud, Boppart, Klenow, and Li \(2022\)](#) relate a decline in overhead costs of large firms to the rise in concentration. [Afrouzi, Drenik, and Kim \(2021\)](#) show that market power is associated with the size of firms' customer base and propose a framework in which firms grow through customer acquisition. The contribution of this paper is to take into account the effect of long-run shifts in the economy on markups by offering a framework in which both demand and supply forces interact to endogenously determine markups in equilibrium.

Second, this paper is also related to the literature on structural change. The interest in the services sector follows the work of [Buera and Kaboski \(2012\)](#), who study the rise of high-skilled labor in driving the growth of the services sector and [Hsieh and Rossi-Hansberg \(2021\)](#), who show that the services sector underwent its own industrial revolution. The differential rates of neutral technological progress across services and non-services was discussed by [Ngai and Pissarides \(2007\)](#).⁷ The process of skill-biased structural change draws on [Buera, Kaboski, Rogerson, and Vizcaino \(2021\)](#), who use it to explain the rise of the skill premium. [Bridgman and Herrendorf \(2022\)](#) proposes a model of structural change with input-output linkages to study the decline of the labor share. In related work, [Moreira \(2022\)](#) shows that the increase in market power accounts for most of the decline of the labor share. This paper complements this work by considering a framework where the standard drivers of structural change explain the rise in markups.

Non-homothetic preferences play an important role in the structural transformation literature and it is also the case in this paper. I build on the work of [Kongsamut, Rebelo, and Xie \(2001\)](#), who use Stone-Geary preferences to generate the reallocation of economic activity away from agriculture toward manufacturing and services, [Boppart \(2014\)](#), who proposes preferences suited to analyze the joint role of changes in relative prices and income as drivers of structural change, [Comin, Lashkari, and Mestieri \(2021\)](#) and [Matsuyama \(2019\)](#), who use generalized CES preferences to study structural transformation, [Bertoletti and Etro \(2017\)](#) and [Bertoletti, Etro, and Simonovska \(2018\)](#), who use indirectly additive preferences with monopolistically competitive firms to study the gains from trade liberalization. I contribute to this strand of the literature by proposing preferences that allow the study of structural transformation with variable markups.

Third, this paper builds on the recent literature using surveys and experiments to elicit behavior and preferences. [Stantcheva \(2020, 2021, 2022\)](#) uses large-scale surveys to study individuals' understanding of tax policy, health insurance, and trade. Individuals' social preferences and knowl-

⁷[Fan, Peters, and Zilibotti \(2022\)](#) show that productivity growth in consumer services is an important driver of structural change.

edge about policy vary along key demographic characteristics that are related with income. More related to this paper are [Coibion, Georganakos, Gorodnichenko, and van Rooij \(2021\)](#), who survey Dutch consumers to understand how inflation expectations affect their consumption decisions, and [Coibion, Georganakos, Gorodnichenko, Kenny, and Weber \(2022\)](#), who study how macroeconomic uncertainty perceived by households affects their consumption decisions. Both show that changes in households' expectations about their real incomes has an effect on their consumption behavior.⁸ This paper is the first to use experiments to elicit consumers' perceived price elasticities of demand for broad categories of goods and services.⁹

2 Empirical Evidence

The goal of this section is to document three facts. First, the process of structural transformation is accompanied by an increase in the relative price of services. Second, the rise of services is the main driving force of the rise of market power, connecting structural change to the rise of markups. Third, the competing explanations for the rise of market power, namely the rise of fixed costs and the emergence of superstar firms, are not able to jointly explain the rise of markups together with the differential role of services.

2.1 Data description

Several datasets at the industry and firm levels for the United States and other advanced economies are used. These datasets are briefly described below and the key variables used in the analysis are highlighted.

Industry-level data. Industry-level data is taken from the EUKLEMS dataset ("Basic File"), which covers the U.S. and several European countries for the period 1970-2015 (see [van Ark and Jäger \(2017\)](#)). This dataset allows me to compute sectoral value added shares and cost shares as well as relative prices. The goods or non-services sector is comprised of: Agriculture, Forestry, and Fishing; Mining and Quarrying; Manufacturing; Electricity, Gas, and Water Supply; and Construction. The services sector corresponds to the remaining industries.¹⁰

Goods- and services-producing industries. In line with the BLS, service-producing industries are defined using two-digit NAICS sector codes and comprise all industries with code 42 and higher. The goods sector encompasses all the other remaining primary and secondary sectors. At the European level, I use concordance tables between NAICS and NACE codes to define the goods and services sectors.¹¹

⁸This paper also complements the work of [Deaton \(1987, 1988, 1990\)](#) using expenditure and quantity data to estimate price elasticities of demand.

⁹As it will become clear from the theorems presented in Section 3, demand systems relying on homothetic preferences have the property that price elasticities of demand should be independent of households' income. Using experiments overcomes these concerns.

¹⁰Activities of households as employers and extraterritorial organizations are excluded from the analysis.

¹¹I further break each sector into broad economic categories (BEC) following the United Nations BEC's classification. Following their System of National Accounts end-use dimension, I define three types of goods: (i) consumption goods, (ii)

U.S. firm-level data. Firm-level data for the United States relies on Compustat, which is widely used in the estimation of production functions and the computation of markups.¹² The dataset provides financial information on listed firms starting in the 1950s and includes measures of sales, input expenditures, and capital. It also includes the firms' main industry classification, which allows me to group firms into non-services and services sectors. Despite being widely used, the dataset also poses some limitations. First, it only includes publicly traded firms. Second, only sales are recorded and therefore prices cannot be distinguished from quantities. [Bond, Hashemi, Kaplan, and Zoch \(2021\)](#) discuss the issue with the latter in greater detail. Whenever appropriate, the analysis is complemented with the Census Bureau's Business Dynamics Statistics (BDS). This dataset offers detailed statistics on the firm-size distribution and the sectoral composition of firms.

European firm-level data. The analysis at the European-level is based on Orbis Historical provided by Bureau van Dijk. Orbis provides harmonized cross-country financial information for both private and public firms since the mid-90s for many European countries. This dataset allows me to compute firm-level statistics, including markups, for millions of firms across Europe. [Díez, Fan, and Villegas-Sánchez \(2021\)](#) also use it to document the rise of market power across many countries. The cleaning steps closely follow [Kalemli-Ozcan, Sorensen, Villegas-Sanchez, Volosovych, and Yesiltas \(2019\)](#) and [Gopinath, Kalemli-Ozcan, Karabarbounis, and Villegas-Sanchez \(2017\)](#). This dataset has greater industry coverage but has a shorter time span.

2.2 Structural change and relative prices

The reallocation of economic activity and employment from agriculture and manufacturing toward the services sector—structural change—is accompanied in the United States and several other advanced countries by an increase in the relative price of services. Figure 2.1a shows that the relative (value added) price of service industries (over non-service industries) increased about 44% since 1980. Figure 2.1b presents the rise of the services sector, measured both as valued added and as a final consumption share of households' incomes. Both measures show that the shares of the services sector increased by more than 13 percentage points between 1980 and 2015, hovering around 79% of the economy (using value added shares). Figure 2.1c displays the cumulated inflation rate for selected goods (in blue) and services (in red) relative to December 2001. There has been a rapid increase in the average prices of hospital services, college tuition, dental services, food and alcoholic beverages consumed away from home over the last forty years, while the prices of traditional goods have risen at a much slower pace.

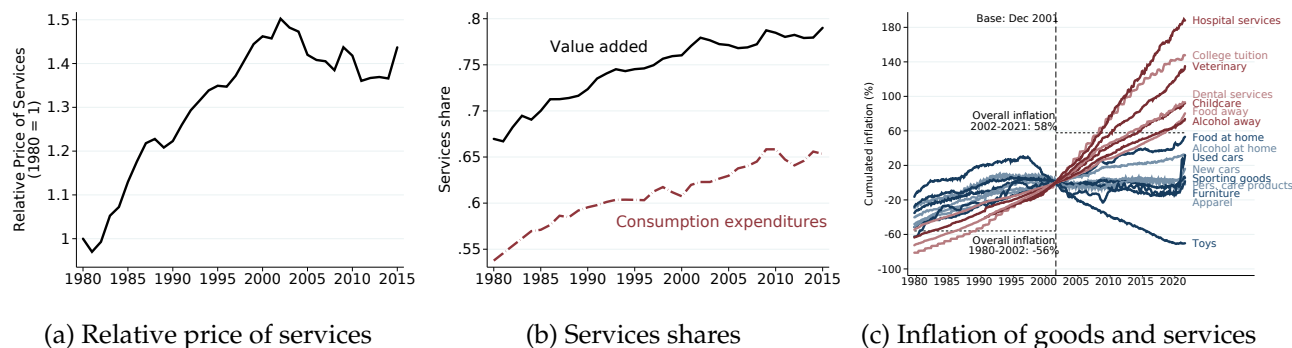
Why are these trends important? The increase of the relative price of services is intimately related

intermediate goods, and (iii) capital goods; as well as two type of services: (i) consumer services and (ii) producer services. The mapping between NAICS and BEC is done at the 6-digit level. Since there is no direct concordance table, a few steps are required to make that mapping feasible. The first step is to use the conversion table between the Standard International Trade Classification (SITC) and BEC, the second is to use the concordance table between the International Standard of Industrial Classification (ISIC) codes and the SITC, and then finally map ISIC codes to NAICS codes. Expert judgment is then needed to ensure there are no weird outliers.

¹²See [De Loecker and Warzynski \(2012\)](#) for the empirical methodology used to estimate firm-level output elasticities and markups.

with the evolution of both markups and marginal costs across sectors. On the one hand, this hints that the services sector had potentially larger markups than the non-services sector and/or that the latter has experienced faster productivity growth than the former. On the other hand, the rise of the services share help explains the reallocation of economic activity towards higher markup firms. The next subsection documents that, indeed, markups in the services sector have experienced faster growth relative to non-services firms.

Figure 2.1: Structural change in the U.S.



Note: Panel (a) shows the relative price of service industries, measured as the chain-weighted Fisher price index of the value added price indices of individual industries, using data from EUKLEMS. Panel (b) shows the value added share of the services sector (black) and the share of income spent on the final consumption of services (red), using data from EUKLEMS and the BLS’s Consumption Expenditure Survey. Panel (c) shows the cumulated inflation of selected goods (blue) and services (red) relative to December 2001 and contrasts these trends with the overall inflation in December 2021 (58%) and January 1980 (-56%), using data from the BLS’s Consumer Price Index.

2.3 Markups and services

The rising importance of services. A markup is defined as the ratio of a firm’s output price to its marginal cost. From a firm’s cost minimization problem, this can be shown to equal the ratio of the firm’s output elasticity to a variable input and its sales share. The numerator is usually obtained by estimating firms’ production functions. The denominator can be read off directly from balance sheet data. For the United States, the estimated output elasticities are taken from [De Loecker, Eeckhout, and Unger \(2020\)](#) to ensure the results are not driven by differences in estimation routines and the sales shares of variable inputs are taken from Compustat (here *cost of goods sold* or *Cogs*).¹³ The aggregate markup is then the weighted sum of firm-level markups, where the weights are each firm’s variable costs share in total variable costs.¹⁴

The aggregate markup can also be written as the sum of sectoral markups, $M_t = M_{G_t} + M_{S_t}$, where each sector’s markup is simply the product of its sectoral cost share in the aggregate economy, ω_{j_t} , and the average markup within that sector, \bar{m}_{j_t} ; i.e.,

$$M_t = (1 - \omega_{S_t}) \bar{m}_{G_t} + \omega_{S_t} \bar{m}_{S_t}.$$

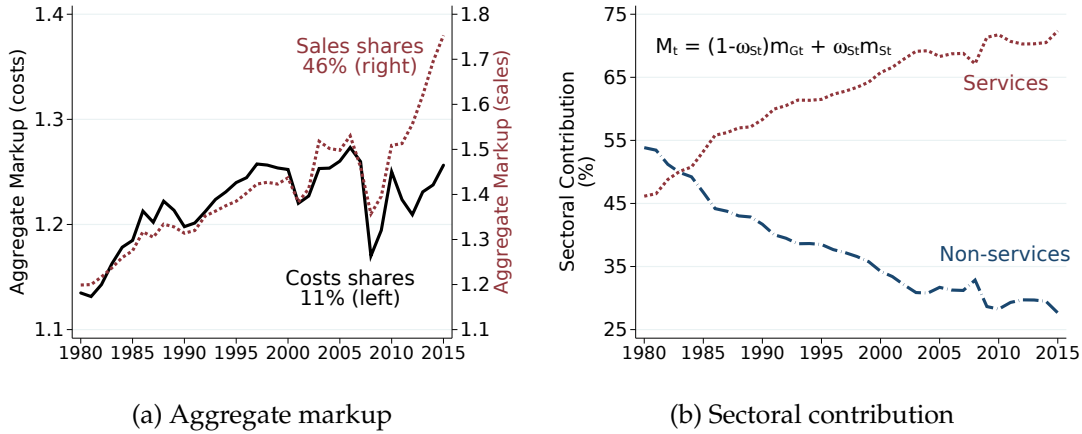
¹³The challenges related with the estimation of production functions is discussed in [Bond, Hashemi, Kaplan, and Zoch \(2021\)](#), [Basu \(2019\)](#), and [Syverson \(2019\)](#).

¹⁴An alternative specification is to compute the aggregate markup as the harmonic mean of firm-level markups weighted by each firm’s sales share in total sales.

Here the services (cost) share is measured using industry-level data from EUKLEMS, which accounts for the entire industrial production of the economy, and refers to the *compensation of employees and intermediate inputs*.¹⁵ The average markup within each sector is based on firm-level data from Compustat, with the underlying assumption that the estimated markup of listed firms is a good proxy for the markups of nonlisted firms.¹⁶

Figure 2.2a shows the aggregate markup, M_t , over time using both sectoral cost and gross output shares (from EUKLEMS). The aggregate markup (using cost shares) increased 11% between 1980 and 2015. The increase in markups is stronger if output shares are used to measure average markups and sectoral shares, displaying an increase of 46% between 1980 and 2015. Figure 2.2b displays the contribution of each sector to the aggregate markup, (M_{j_t}/M_t) . The increase in the aggregate markup is entirely driven by the rise of the services' markups. Between 1980 and 2015, the contribution of services grew by more than 26 percentage points, from 46% to 72% of the aggregate markup. Table 2.1 shows the average markups and sectoral shares of the services and non-services sector in 1980 and 2015, where weights are costs and sales shares.

Figure 2.2: Aggregate markups in the U.S.



Note: Panel (a) shows the aggregate markup measured as the cost-weighted average of firms' markups (black, left axis) and as the sales-weighted average of firms' markups (red, right axis), using data from Compustat and EUKLEMS. Panel (b) shows the sectoral contribution to the aggregate markup (non-services in blue, services in red), using data from Compustat and EUKLEMS.

Decomposing the rise of markups. The rise of the aggregate markup can be decomposed into three sources: (i) the rise of the average markup of non-service industries; (ii) the rise of the average

¹⁵Compustat firms' cost of goods sold is also used to measure the services (cost) share. That share increased from 35% of total costs in 1980 to 52% in 2015, while industry-level data display an increase from 46% to 71% over the same period. Although the services cost share from Compustat is smaller than what is implied at the aggregate level from industry data, the aggregate markup computed with Compustat's sectoral shares shows the same pattern as the aggregate markup from the industry-level data.

¹⁶To be precise, the average markup within sector $j = \{G, S\}$ is given by $\bar{m}_{j_t} = \sum_{i=1}^{N_{j_t}} \tilde{\omega}_{i_t}^j m_{i_t}^j$ where $\tilde{\omega}_{i_t}^j = \frac{\text{Cogs}_{i_t}^j}{\sum_{k=1}^{N_{j_t}} \text{Cogs}_{k_t}^j}$ is firm i 's cost share in sector $j = \{G, S\}$ variable costs.

Table 2.1: Average markups and sectoral shares

	Non-services			Services		
	1980	2015	Δ	1980	2015	Δ
Average markups (Cogs)	1.13	1.21	7.3%	1.14	1.27	11.9%
Average markups (Cogs + Sga)	1.18	1.44	22.3%	1.19	1.65	37.8%
Average markups (sales)	1.17	1.47	25.5%	1.22	1.86	52.2%
Sectoral shares (costs)	54.0	28.6	-47.0%	46.0	71.4	55.1%
Sectoral shares (sales)	47.4	27.6	-41.8%	52.6	72.4	37.7%

Note: The average markups are computed using Compustat data and sectoral shares using KLEMS data.

markup of service industries; and (iii) the increase of the services share. Specifically,¹⁷

$$\begin{aligned}
 M_{2015} - M_{1980} &= \left(\frac{\omega_{G1980} + \omega_{G2015}}{2} \right) (\bar{m}_{G2015} - \bar{m}_{G1980}) && \text{Non-services avg. markup (28\% / 20\%)} \\
 &+ \left(\frac{\omega_{S1980} + \omega_{S2015}}{2} \right) (\bar{m}_{S2015} - \bar{m}_{S1980}) && \text{Services avg. markup (65\% / 72\%)} \\
 &+ \left(\frac{\bar{m}_{S2015} - \bar{m}_{G2015} + \bar{m}_{S1980} - \bar{m}_{G1980}}{2} \right) (\omega_{S2015} - \omega_{S1980}) && \text{Services share (7\% / 8\%).}
 \end{aligned}$$

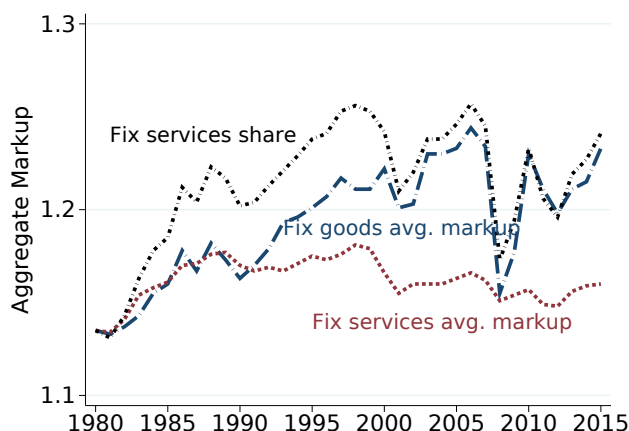
The increase in average markups within the goods sector contributed 28% to rise of the aggregate markup (and 20% if markups are aggregated using sales shares), while the increase in average markups within the services sector contributed 65% (and 72% if markups are aggregated using sales share). The rise of the services share contributed 7% (and 8% if markups are aggregated using sales share).

Figure 2.3 shows the aggregate markup when (i) the average markup in the goods sector is fixed at its 1980 level, (ii) the average markup in the services sector is fixed at its 1980 level, and (iii) the services share is fixed at its 1980 level. The rise of the average markup within the services sector was the strongest driver of the rise in markups. Shutting down that increase leads to the aggregate markup barely changing over the last forty years. Instead, when the average markup in the non-services sector or the share of services are shut down, the rise in the average markup of services is still strong enough to drive the aggregate markup up.

Concentration and services. A popular measure of market power is the Herfindahl–Hirschman Index (HHI), calculated as the sum of the square of the market share of firms competing in any given market. The aggregate HHI can be divided into the services and non-services HHI as was done above. Each sectoral HHI is then the product of the sectoral shares in the economy and the average concentration index within the sector across the κ different industries. The rise in concentration starting in the 2000s is driven by the rise of the services sector. On average, industries within the services sector are more concentrated than in the non-services sector (764 points higher). Starting in the late 2000s the reallocation of economic activity toward the services, as evidenced by fixing industry shares at their 1980 levels, contributed to the rise of concentration. Without that transition, the aggregate HHI would have declined. Appendix A.1 provides further details and figures about the HHI across services and non-services industries.

¹⁷The following expression is rescaled by M_{1980} so that the three components sum up to the change in the aggregate markup.

Figure 2.3: Aggregate markups across scenarios



Note: The figure shows the aggregate markup when the average markup within each sector is fixed at its 1980 level (non-services in blue, services in red) and when the sectoral cost shares are fixed at their 1980 level (black), using data from Compustat and EUKLEMS.

2.4 Not the superstars, nor the fixed costs

The rise in markups has been linked to a rise in monopoly power, potentially related with the emergence of superstar firms and the rapid increase in fixed costs and barriers to entry. To address these arguments, I now focus on superstar firms—here defined as firms in the right tail of the markup distribution—and fixed costs. Table 2.2 shows the correlation coefficients between the growth rate of a firm’s markup between 1980 and 2015 and the growth rates of its sales share in total sales and its fixed costs share in total fixed costs.¹⁸ We should expect that firms that experienced significant increases in markups would also have gained market share through an increase in sales. As the table shows, the rise in a firm’s markup is not positively correlated with an increase of its market share (first column). We should also expect firms with higher increases in fixed costs to have increased their markups. As the table shows, that is not the case. An increase in a firm’s markup is only positively correlated with greater spending on fixed expenses for non-services firms (second column).

Table 2.2: Correlation coefficients for the 1980-2015 change in markups, sales, and cost shares

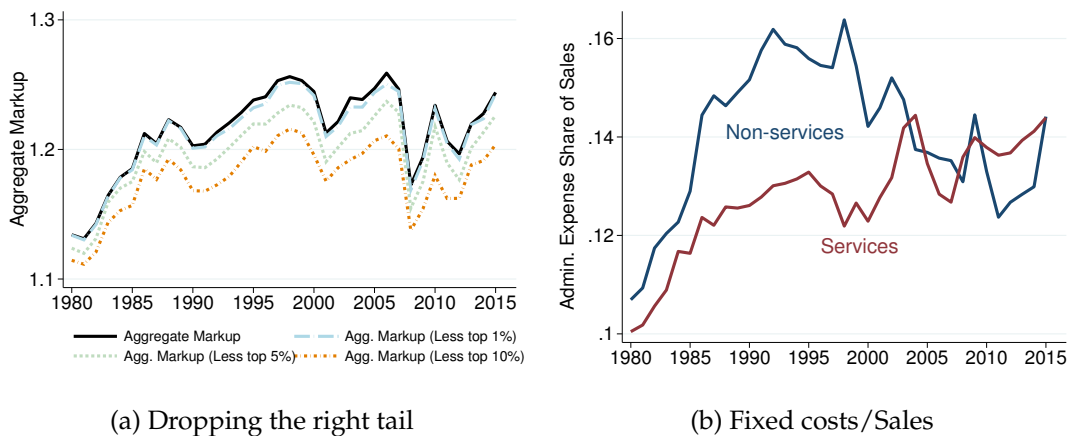
	Δ Markups, Δ Sales share	Δ Markups, Δ Fixed costs share
Aggregate	-0.0850	-0.0270
Non-services	-0.0467	0.0343
Services	-0.1028	-0.0464

Note: Each variable corresponds to the three-year average centered around 1980 and 2015. The denominator in the sales and fixed costs (SGA) shares are the corresponding aggregate across all firms (irrespective of sector). The correlation coefficients are weighted by firms’ cost shares. Data is taken from Compustat.

¹⁸Each variable is the three-year average centered around 1980 and 2015. The correlation coefficients are weighted by the firm’s cost shares.

When dropping firms that are in the top 1%, 5%, and 10% of the markup distribution within each sector and year, the increase in aggregate markups over the last four decades is still noticeable—albeit to a smaller extent as displayed in Figure 2.4a. In particular, the rapid increase between 1980 and the 2000’s does not seem to be driven by the superstars, nor the uptick experienced after the Great Financial Crisis.¹⁹ Figure 2.4b shows total general and administrative expenses over total sales for each sector. Starting in 1980, fixed costs increased from about 10% of revenue to less than 15% in 2015. Yet, the non-services sector saw a stronger increase in fixed costs relative to the services sector in the 1980s and 1990s, despite having lower average markups. The rise of superstar firms and fixed costs are certainly part of the explanation of why markups have increased but they are not sufficient to capture the extent of the rise in markups—in particular, its link to the services sector.

Figure 2.4: Ruling out competing drivers



Note: Panel (a) shows the aggregate markup when firms in the top 1%, 5%, and 10% of the markup distribution within each sector and year are removed, using Compustat data. Panel (b) shows the sum of Selling, General, and Administrative Expenses divided by the sum of Sales for the non-services (blue) and the services (red) sectors, using Compustat data.

Next, I explore differences across sectors to understand the sources of the increase in markups. Do changes in capital intensity or capital shares of sales help explain the sectoral differences in markups? Capital intensity, measured as the ratio of capital to costs of goods sold, has been fairly stable over the past forty years for the services sector at a factor of 1, while the ratio is about 1.5 for the non-services sector. The capital share of sales is also smaller in the services sector than in the non-services sector. Additionally, the share of sales spent on variable inputs has been steadily declining across both sectors.²⁰ These trends are confirmed by the regression results presented in Table 2.3, which shows the correlation between firms’ markups and their capital share (tangible and intangible), variable costs share, and fixed costs share of sales. An increase in the capital share, both tangible and intangible, of non-services firms tends to have a larger impact on their markups than for services-producing firms (e.g. a one percentage point increase in a non-services firm’s capital share is associated with a 0.028% increase in its markups, while for services firms that effect is 0.017%). A one percentage point decline

¹⁹Figure A.2.3 in Appendix A.2 replicates the decomposition of the aggregate markups into goods and services. As before, the services sector drives most of the increase in aggregate market power in the absence of the superstars.

²⁰See Figures A.2.4a, A.2.4b, and A.2.4c in Appendix A.2.

in a services firm's variable costs tends to have a stronger impact on its markup (a 1.228% increase as opposed to 1.072% for non-services firms).

Table 2.3: Firms' markups and their characteristics

	Firm-level markups (in logs)	
	Non-services (1)	Services (2)
Capital share	0.028*** (0.007)	0.017*** (0.005)
Intangible capital share	0.146*** (0.023)	0.009 (0.010)
Cogs share	-1.072*** (0.093)	-1.228*** (0.055)
Fixed cost share	0.126* (0.074)	0.156*** (0.028)
Time FE	Yes	Yes
Observations	97,351	74,197
Adjusted R ²	0.732	0.847

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Firms are weighted by their cost shares. Data is taken from Compustat for the 1980-2015 period.

I decompose the services and the non-services sector into subsectors according to their purpose. Firms producing consumption goods and in the consumer service industries have had on average higher markups than their peers and also tend to be more concentrated. Table 2.4 summarizes the changes in average markups and sectoral shares for different categories of goods and services-producing firms. The upshot of the table is that the firms in consumer services industries have been a key contributor to the rise of markups.

Table 2.4: Sectoral shares, markups, and HHI for services and non-services industries

	Sectoral share (%)	Avg. markup	Avg. HHI
	1980, 2015	1980, 2015	1980, 2015
<i>Non-services</i>			
Capital goods	12.3, 9.7	1.12, 1.24	2,741.9, 1,506.5
Consumption goods	6.4, 2.4	1.19, 1.67	2,642.9, 2,879.5
Intermediate goods	35.3, 16.5	1.12, 1.13	1,268.9, 1,200.6
<i>Services</i>			
Consumer services	25.3, 48.0	1.19, 1.29	2,454.2, 2,409.8
Producer services	19.5, 20.5	1.06, 1.20	4,408.9, 2,690.4

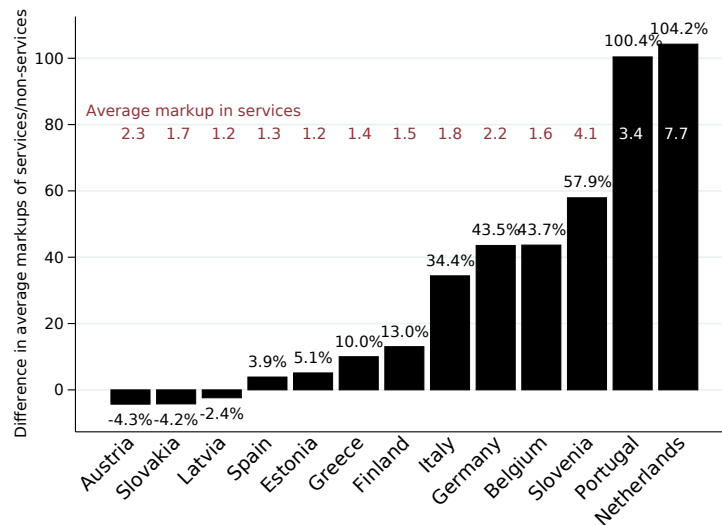
Note: The sectoral (cost) shares are computed using data from Compustat aggregated at the 6-digit NAICS code and rescaled using EUKLEMS sectoral cost shares. The average markup and HHI within each category are computed using data from Compustat (both are cost-based). Other services (not shown) account for less than 3% of aggregate costs.

2.5 Markups and services across Europe

This phenomenon is not unique to U.S. firms. A similar pattern emerges when looking at several European countries. Using Orbis data to estimate production functions at the three-digit NACE code

for both private and listed firms in each country separately, markups are computed as the ratio of the output elasticity of labor and materials over their sales shares. In each country, markups are then aggregated using variable cost shares. Figure 2.5 shows the difference in average markups in the services sector versus the non-services sector for several European countries, in which the average markup is the mean over each country's sample period. With the exception of Austria, Latvia, and Slovakia, services firms have higher markups than their peers (ranging from 4% for Spain to twice as large for the Netherlands and Portugal).

Figure 2.5: Difference in average markups of services vs. non-services



Note: The figure shows the difference in average markups of the services sector relative to the non-services sector, using data from Orbis, aggregated using cost shares and averaged over the sample period (from 1993 (Belgium and Netherlands), 1994 (Spain), 1995 (Greece), 1996 (Italy), 1997 (Finland and Slovenia), 1998 (Estonia), 1999 (Portugal), 2000 (Latvia), 2002 (Germany), 2004 (Austria and Slovakia) to 2015 (all countries)). The plot also shows the average markup in services in red over the sample period.

3 From Structural Change to Rising Markups: Theoretical Underpinnings

This section proposes the key ingredients needed for structural change to impact markups. It starts by offering a novel theorem linking the price elasticity of demand to the income elasticity of demand for a general class of preferences. In particular, it shows that non-homothetic preferences, which imply that for individuals of different income levels some commodities are luxuries and some are necessities, also mean that individuals of different income levels will have a different price elasticity of demand for the same commodity. This in turn has an effect on the markups firms can charge.

The theorem is used as a stepping stone for two key results. The first states the conditions for the price elasticity of demand to be increasing in a commodity's own price, which is to say that an individual's price sensitivity is lower for cheaper products. This is often referred to as [Marshall's \(1890\) Second Law of Demand](#). The second states the conditions for the price elasticity of demand to be decreasing in a consumer's income, i.e. individuals' price sensitivity is lower the wealthier they are.

This second result connects with [Harrod's \(1936\) Law of Diminishing Elasticity of Demand](#).

These results then allow me to develop a theory of why certain firms are able to charge higher markups. In particular, three channels are highlighted. First, technological progress that reduces marginal costs translate into less expensive products. As consumers are now more willing to buy those products, the firm captures part of the gains from the lower marginal costs by increasing its markup (i.e. its cost pass-through is smaller than one because the price elasticity of demand has risen).²¹ Second, the rise in customers' income decreases their price elasticity for a firm's products. In turn, the firm responds by increasing its markup. Third, changes in the composition of the firm's customer base also have an effect on the firm's markup—even if their incomes did not change. If a firm is now more likely to face wealthier consumers and cannot price discriminate them, then it will update its markup to reflect the average consumer's price elasticity of demand.

3.1 Why demand matters more than you think

Pricing with market power. A firm's markup depends on the slope of the demand curve as profit maximizing firms set their prices by equating marginal revenues to marginal costs. A firm's marginal revenue depends on the price and quantity of the product it is selling, which in turn depend on its consumers' own price elasticities of demand. If aggregate demand is composed of different consumers, all facing the same price, the price elasticity of the total demand faced by the firm can be written as the average of each individual's own price elasticity of demand weighted by their consumption share. Proposition 3.1 shows that in models in which firms have market power markups can be written as a weighted average of the firm's consumers' price elasticities of demand. Let $\xi_i(q^*)$ denote individual i 's own price elasticity of demand and $\omega_i(q^*)$ her consumption share, where $q^* = \sum_j y_j = \sum_i c_i$ is the aggregate quantity traded in equilibrium. Define $\epsilon_j(q^*) \equiv \left(\frac{\partial y_j(q^*)}{\partial q^*}\right)^{-1} \frac{y_j(q^*)}{q^*}$ as firm j 's output elasticity of aggregate demand.

Proposition 3.1. (MARKUP) *In models of imperfect competition, in which the market structure is composed of a monopolist, monopolistic competitors or oligopolists à la Cournot, firm j 's markup, $m_j(q^*)$, is given by*

$$m_j(q^*) = \frac{\sum_i \omega_i(q^*) \xi_i(q^*)}{\sum_i \omega_i(q^*) \xi_i(q^*) - \epsilon_j(q^*)}.$$

If firm j is a monopolist or a monopolistic competitor, then $\epsilon_j(q^) = 1$.*

Proof. See Appendix B.1. □

The roots of market power are thus intertwined with how preferences are defined as they determine in equilibrium consumers' price elasticities of demand, $\xi_i(q^*)$, and their consumption shares, $\omega_i(q^*)$. To proceed I resort to the indirect utility and [Roy's \(1947\) identity](#). Let e_i denote individual i 's expenditures (or income), $p(\omega)$ the price of variety $\omega \in [0, N]$, and \mathbf{p} a vector of all prices. The

²¹[Fabra and Reguant \(2014\)](#) document that the pass-through of emissions costs to electricity prices in Spain is about 80 percent and [Nakamura and Zerom \(2010\)](#) show that the pass-through of exchange rates to prices in the coffee industry is also not complete.

identity establishes that demand for a variety, $c(e_i, p(\omega), \mathbf{p})$, can be derived using an individual's indirect utility, $v(e_i, \mathbf{p})$, and its derivatives with respect to the variety's price as

$$c(e_i, p(\omega), \mathbf{p}) = -\frac{\partial v(e_i, \mathbf{p})/\partial p(\omega)}{\partial v(e_i, \mathbf{p})/\partial e_i}, \quad (3.1)$$

where the indirect utility satisfies the usual properties postulated in Assumption 3.1 below. The results that follow require the additional Assumption 3.2, which ensures all objects are well defined. In particular, Assumption 3.2 (i) is needed to ensure both the price and income elasticities of demand are well defined, while (ii) ensures the pass-through between the price and income elasticities of demand is not degenerate (i.e. $\chi(e_i, p(\omega), \mathbf{p}) \neq 0$) and (iii) ensures the price elasticity of demand is positive (i.e. $\xi(e_i, p(\omega), \mathbf{p}) > 0$). These objects are defined formally below. Proceeding in this fashion will make clear the link between the price elasticity of demand and the income elasticity of demand.

Assumption 3.1. (INDIRECT UTILITY) *The indirect utility $v(e_i, \mathbf{p})$ is: (i) continuous on $\mathbb{R}^N \times \mathbb{R}$; (ii) decreasing in prices, $\frac{\partial v(e_i, \mathbf{p})}{\partial p(\omega)} \leq 0$ for all $p(\omega)$; (iii) strictly increasing in income, $\frac{\partial v(e_i, \mathbf{p})}{\partial e_i} > 0$; (iv) homogeneous of degree 0 in (e_i, \mathbf{p}) ; (v) quasiconvex in (e_i, \mathbf{p}) .*

Assumption 3.2. (DIFFERENTIABILITY) *The indirect utility function $v(e_i, \mathbf{p})$ is at least twice continuously differentiable and satisfies (i) $\frac{\partial v(e_i, \mathbf{p})}{\partial p(\omega)} < 0$ for all $p(\omega)$; (ii) $\frac{\partial^2 v(e_i, \mathbf{p})}{\partial e_i \partial p(\omega)} \neq 0$ for all $p(\omega)$; and (iii) $\frac{\partial^2 v(e_i, \mathbf{p})}{\partial p(\omega)^2} > 0$.*

Price elasticity of demand. Start with an individual's price elasticity of demand, $\xi(e_i, p(\omega), \mathbf{p}) \equiv -\frac{\partial c(e_i, p(\omega), \mathbf{p})}{\partial p(\omega)} \frac{p(\omega)}{c(e_i, p(\omega), \mathbf{p})}$. Using the indirect utility, the price elasticity of demand can be expressed as

$$\xi(e_i, p(\omega), \mathbf{p}) = -p(\omega) \left[\frac{\partial^2 v(e_i, \mathbf{p})/\partial p(\omega)^2}{\partial v(e_i, \mathbf{p})/\partial p(\omega)} - \frac{\partial^2 v(e_i, \mathbf{p})/\partial e_i \partial p(\omega)}{\partial v(e_i, \mathbf{p})/\partial e_i} \right]. \quad (3.2)$$

This expression highlights the different channels through which changes in the price elasticity of demand materialize. Notably, changes in the variety's price, and possibly all other prices, and in the household's income can alter a consumer's price elasticity of demand. In models without strategic interactions, the dependence on competitors' prices does not affect the price elasticity of demand directly. Likewise, in models with homothetic preferences the price elasticity of demand does not depend on the consumer's income. Finally, demand for a variety is said to be inelastic when the price elasticity is less than one (i.e. $\xi(e_i, p(\omega), \mathbf{p}) < 1$): that is, changes in price have a relatively small effect on the quantity demanded (perfectly inelastic if the elasticity is zero). Demand for a variety is said to be elastic when the elasticity is greater than one (i.e. $\xi(e_i, p(\omega), \mathbf{p}) > 1$; perfectly elastic if the elasticity is infinity). Varieties conform to the law of demand as long as $\xi(e_i, p(\omega), \mathbf{p}) \geq 0$.

Income elasticity of demand. The income elasticity of demand, $\eta(e_i, p(\omega), \mathbf{p}) \equiv \frac{\partial c(e_i, p(\omega), \mathbf{p})}{\partial e_i} \frac{e_i}{c(e_i, p(\omega), \mathbf{p})}$, measures how demand changes in response to changes in income. Using the consumer's indirect utility, the elasticity is given by

$$\eta(e_i, p(\omega), \mathbf{p}) = e_i \left[\frac{\partial^2 v(e_i, \mathbf{p})/\partial e_i \partial p(\omega)}{\partial v(e_i, \mathbf{p})/\partial p(\omega)} - \frac{\partial^2 v(e_i, \mathbf{p})/\partial e_i^2}{\partial v(e_i, \mathbf{p})/\partial e_i} \right]. \quad (3.3)$$

A variety is said to be a luxury for the consumer if the income elasticity is greater than one (i.e. $\eta(e_i, p(\omega), \mathbf{p}) > 1$), a necessity if the elasticity is positive but less than one (i.e. $0 < \eta(e_i, p(\omega), \mathbf{p}) < 1$), and an inferior good if the elasticity is negative (i.e. $\eta(e_i, p(\omega), \mathbf{p}) < 0$).

Income elasticity and super-elasticity of utility. The income elasticity of utility, $\Phi(e_i, \mathbf{p}) \equiv \frac{\partial v(e_i, \mathbf{p})}{\partial e_i} \frac{e_i}{v(e_i, \mathbf{p})}$, measures how the consumer's utility changes when income changes. Note that this elasticity is common to all varieties and takes into account all the possible interactions across varieties when income changes. As households tend to enjoy more utility if their income grows, $\Phi(e_i, \mathbf{p})$ is usually positive. In turn, the income super-elasticity of utility, $\varphi(e_i, \mathbf{p}) \equiv \frac{\partial \Phi(e_i, \mathbf{p})}{\partial e_i} \frac{e_i}{\Phi(e_i, \mathbf{p})}$, measures how responsive the utility's income elasticity is to changes in the household's income. This super-elasticity can also be written as $\varphi(e_i, \mathbf{p}) = (1 - \Phi(e_i, \mathbf{p})) + e_i \frac{\partial v^2(e_i, \mathbf{p}) / \partial e_i^2}{\partial v(e_i, \mathbf{p}) / \partial e_i}$.

Pass-through. The variety's pass-through, $\chi(e_i, p(\omega), \mathbf{p})$, measures the relative strength of the income elasticity of demand and the price elasticity of demand and it is given by

$$\chi(e_i, p(\omega), \mathbf{p}) = -\frac{p(\omega)}{e_i} \frac{\partial^2 v(e_i, \mathbf{p}) / \partial p(\omega)^2}{\partial^2 v(e_i, \mathbf{p}) / \partial e_i \partial p(\omega)}. \quad (3.4)$$

Proposition 3.2 below establishes the relationship between the price elasticity of demand and the income elasticity of demand, and is the fundamental mechanism behind the demand channel underlying markups. Often overlooked and obscured by simplifying assumptions, this relationship has important implications for the rise in markups observed in the data.

Proposition 3.2. (PRICE AND INCOME ELASTICITIES OF DEMAND) *Given Assumptions 3.1 and 3.2, the price elasticity of demand of individual i for variety ω is related to their income elasticity of demand through the following expression*

$$\underbrace{\xi(e_i, p(\omega), \mathbf{p})}_{\text{price elast of demand}} = \underbrace{\alpha(e_i, p(\omega), \mathbf{p})}_{\text{fixed effect}} + \underbrace{\chi(e_i, p(\omega), \mathbf{p})}_{\text{pass-through}} \left[\underbrace{\eta(e_i, p(\omega), \mathbf{p})}_{\text{income elast of demand}} + \underbrace{(\Phi(e_i, \mathbf{p}) + \varphi(e_i, \mathbf{p}))}_{\text{income elast of utility and super-elast}} - 1 \right],$$

where $\alpha(e_i, p(\omega), \mathbf{p}) = p(\omega) \frac{\partial^2 v(e_i, \mathbf{p}) / \partial e_i \partial p(\omega)}{\partial v(e_i, \mathbf{p}) / \partial e_i}$ is a variety-specific fixed effect (that is approximately 0).

Proof. See Appendix B.2. □

Remark 3.1. *It is common to drop the variety-specific fixed effect term, $\alpha(e_i, p(\omega), \mathbf{p})$, and define the price elasticity of demand as $\xi(e_i, p(\omega), \mathbf{p}) = -p(\omega) \frac{\partial^2 v(e_i, \mathbf{p}) / \partial p(\omega)^2}{\partial v(e_i, \mathbf{p}) / \partial p(\omega)}$. In that case, the relationship still holds with only a minor change, i.e. the fixed effect is dropped and*

$$\xi(e_i, p(\omega), \mathbf{p}) = \chi(e_i, p(\omega), \mathbf{p}) [\eta(e_i, p(\omega), \mathbf{p}) + (\Phi(e_i, \mathbf{p}) + \varphi(e_i, \mathbf{p})) - 1]. \quad (3.5)$$

Without loss of generality, that is the the definition of the price elasticity of demand used hereafter.

3.2 Price elasticity of demand: Two key results

For the two forces of structural change, namely differential rates of technological progress across sectors and income effects, to alter the price elasticity of demand and therefore markups, two additional results are needed. Assumptions 3.3 and 3.4 provides additional conditions for the results to go through.

Assumption 3.3. (INDIRECT UTILITY AND INCOME) *The indirect utility $v(e_i, \mathbf{p})$ is at least thrice continuously differentiable with $\frac{\partial^3 v(e_i, \mathbf{p}) / \partial p(\omega)^2 \partial e_i}{\partial^2 v(e_i, \mathbf{p}) / \partial p(\omega)^2} < \frac{\xi(e_i, p(\omega), \mathbf{p})}{\chi(e_i, p(\omega), \mathbf{p}) e_i}$.*

Assumption 3.4. (INDIRECT UTILITY AND PRICE) *The indirect utility $v(e_i, \mathbf{p})$ is at least thrice continuously differentiable with $\frac{\partial^3 v(e_i, \mathbf{p}) \partial p(\omega)^3}{\partial^2 v(e_i, \mathbf{p}) / \partial p(\omega)^2} > -\frac{(1 + \xi(e_i, p(\omega), \mathbf{p}))}{p(\omega)}$.*

Two results follow. First, the price elasticity of demand must be decreasing in the consumer's income, which sustains Harrod's (1936) *Law of Diminishing Elasticity of Demand*. This property has the following effect: as households' income increases over time and people start shifting their consumption basket toward luxuries, i.e. services, their price elasticity of demand decreases. This in turn allows firms to charge a higher markup. Proposition 3.3 formalizes that intuition.

Proposition 3.3. (PRICE ELASTICITY OF DEMAND ACROSS INCOME) *Under Assumptions 3.1, 3.2, and 3.3, the price elasticity of demand for a variety ω is decreasing in the consumer's income.*

Proof. See Appendix B.3. □

Second, the price elasticity of demand must be increasing in the variety's price in line with Marshall's (1890) *Second Law of Demand*. Stronger technological progress in the manufacturing sector will decrease the marginal costs of goods faster than that of services. This allows firms in the manufacturing sector to decrease their prices. However, if firms have some market power, the cost pass-through is not one-to-one and the firm is able to capture some of the efficiency gains. As consumers' price elasticities of demand have now increased, firms will be able to retain some of those gains and therefore charge higher markups. Proposition 3.4 formalizes that intuition.

Proposition 3.4. (PRICE ELASTICITY OF DEMAND ACROSS PRICE) *Under Assumptions 3.1, 3.2, and 3.4, the price elasticity of demand for a variety ω is increasing in the variety's price.*

Proof. See Appendix B.4. □

Given Propositions 3.3 and 3.4, firms' markups will be higher the lower the price of the variety they sell and/or the wealthier their consumers are. This has implications both for the cross-sectional distribution of markups and for the distribution of markups over time. If Proposition 3.3 holds and households are heterogeneous in terms of income or wealth, then changes in the composition of demand has an effect on markups—even if each household's price elasticity of demand does not change. For instance, if the demand share from wealthier consumers increases, firms best respond by charging higher markups. In addition, if consumers become wealthier over time, firms respond by charging higher markups. Similarly, firms that are more productive will be able to sell their varieties at lower prices, which in turn will allow them to charge higher markups. These considerations will be featured in the quantitative model in the following section.

4 A Model of Structural Change and Rising Markups

Motivated by the empirical evidence and the theoretical underpinnings described above, this section presents a general equilibrium model of structural change with two additional ingredients to study the rise of markups: (i) monopolistic competition, and (ii) non-homothetic preferences. The first ingredient introduces firm-level markups, while the second makes them endogenous and responsive to changes in productivity, consumers' incomes, and consumers' composition. The framework is in its essence a two-sector model with firms acting as retailers and extended to have two types of labor inputs and hence two types of consumers.

The previous section showed that the drivers of structural change—namely, differential rates of technological progress across sectors and rising incomes—can be forces behind the rise of markups. These forces will however play opposing roles across the two sectors. On the one hand, faster (neutral) technological progress in the non-services sector that brings the average price of goods down relative to services will also lead to an increase in the average markups of goods. Recall that price elasticities of demand increase with a rise in prices. On the other hand, as households become richer and start shifting their consumption toward services, firms will adjust their prices upward leading to an increase in the average markup of services as price elasticities of demand are decreasing in income. Next, the economy is described in greater detail and analytic expressions capturing the rise of aggregate markups and its link to structural change are derived.

Environment. Time is discrete and indexed by t . The economy is populated by a unit mass of heterogeneous households that differ in their skill level, which can either be high or low, $i \in \{H, L\}$. A fraction μ_H are high-skilled, while $\mu_L \equiv (1 - \mu_H)$ are low-skilled. Households are endowed with one unit of productive time that is supplied inelastically in the labor market in exchange for the wage w_i . High-skilled workers receive a skill premium in the labor market, i.e. $w_H/w_L > 1$. Households also receive nonlabor earnings Λ_i from owning firms. Labor is freely mobile across sectors and firms take factor prices as given. There are two sectors in this economy, one that produces goods and another that produces services, $j \in \{G, S\}$. Within each sector, there is a continuum of firms producing a differentiated variety of commodity j and behaving as monopolistic competitors. A variety of commodity j differs in terms of its price and quality, both chosen by the firm. A variety can be purchased by both types of households for the same price and quality.

4.1 Households

Preferences. Preferences play an important role in determining the sources of market power as discussed in the previous section. In what follows, preferences will be non-homothetic (in prices) and admit an analytic representation for both the direct and indirect utilities. Households have preferences over consumption of different varieties of goods and services, denoted c_{G_t} and c_{S_t} , and their respective quality, denoted \mathbf{q}_{G_t} and \mathbf{q}_{S_t} , where the bold variables correspond to vectors of the different varieties of goods and services. Each variety ω is indexed by its price $p_{j_t}(\omega)$ and quality $q_{j_t}(\omega)$ taken as given by the household.

Start with the indirect utility function in a period, which is the household's maximal attainable

utility given her income, e_t , the vector of prices of goods and services, denoted \mathbf{p}_{G_t} and \mathbf{p}_{S_t} , and their respective quality, \mathbf{q}_{G_t} and \mathbf{q}_{S_t} . Let the indirect utility be a composite of two sectoral indirect utilities, one for goods and one for services, aggregated in a Cobb-Douglas fashion according to

$$v(e_t, \mathbf{p}_{G_t}, \mathbf{p}_{S_t}, \mathbf{q}_{G_t}, \mathbf{q}_{S_t}) = v_G(e_t, \mathbf{p}_{G_t}, \mathbf{q}_{G_t})^{\lambda_G} v_S(e_t, \mathbf{p}_{S_t}, \mathbf{q}_{S_t})^{\lambda_S}, \quad (4.1)$$

where $\lambda_j \in (0, 1)$ is the weight on the utility from commodity $j = \{G, S\}$. Each sectoral indirect utility is additively separable across the differentiated varieties of commodity j implying

$$v_j(e_t, \mathbf{p}_{j_t}, \mathbf{q}_{j_t}) = \int_{\Omega_{j_t}} \hat{v}_j(e_t, p_{j_t}(\omega), q_{j_t}(\omega)) d\omega, \quad (4.2)$$

where the sector-specific indirect subutility satisfies the standard properties of indirect utility functions as defined in Assumption C.1 in Appendix C. The sectoral indirect subutility for each variety ω of commodity j is taken to be

$$\hat{v}_j(e_t, p_{j_t}(\omega), q_{j_t}(\omega)) = \frac{1}{1 + \gamma_j} \left[\frac{(\phi_j e_t - p_{j_t}(\omega)) q_{j_t}(\omega)^{\delta_j}}{e_t} \right]^{1 + \gamma_j} \quad \text{for } p_{j_t}(\omega) \leq \phi_j e_t \quad (4.3)$$

and zero otherwise. Here, $\phi_j e_t > 0$ is the sectoral choke price of any variety of commodity j , i.e., the maximum price the household is willing to pay in order to consume a positive amount of that variety. A price above the consumer's choke price is not purchased and therefore yields a utility of zero. The higher the value of $\phi_j > 0$, the higher is the consumer's choke price. Similarly, the higher the household's income e_t , the higher is the choke price. Each variety is weighted by its quality $q_{j_t}(\omega)$. Varieties of higher quality are valued more than low-quality varieties. The parameter $\delta_j > 0$ is a quality-specific weight and $\gamma_j > 0$ ensures demand satisfies the law of demand. Setting $\phi_j = 0$ and multiplying the subutility by -1 corresponds to the CES indirect subutility.

Let \hat{C}_t denote a measure of aggregate consumption, given by

$$\hat{C}_t = \phi_G \int_{\Omega_{G_t}} c_{G_t}(\omega) d\omega + \phi_S \int_{\Omega_{S_t}} c_{S_t}(\omega) d\omega,$$

\tilde{C}_{j_t} denote a quality-adjusted composite of the different varieties of commodity $j = \{G, S\}$, given by

$$\tilde{C}_{j_t} = \left(\int_{\Omega_{j_t}} \left[\frac{c_{j_t}(\omega)}{q_{j_t}(\omega)^{\delta_j}} \right]^{\frac{1 + \gamma_j}{\gamma_j}} d\omega \right)^{\frac{\gamma_j}{1 + \gamma_j}},$$

and $\psi > 0$ be a parameter defined as a function of the remaining structural parameters, given by $\psi = (1 + \gamma_G)^{-\lambda_G} (1 + \gamma_S)^{-\lambda_S} \left[\frac{\lambda_G(1 + \gamma_G)}{\lambda_G(1 + \gamma_G) + \lambda_S(1 + \gamma_S)} \right]^{\lambda_G(1 + \gamma_G)} \left[\frac{\lambda_S(1 + \gamma_S)}{\lambda_G(1 + \gamma_G) + \lambda_S(1 + \gamma_S)} \right]^{\lambda_S(1 + \gamma_S)}$. Proposition 4.1 shows that there is an analytic representation of the direct utility when the indirect utility has the above form (equation (4.1)). Proposition 4.2 further demonstrates that the indirect utility collapses to the two-sector CES direct utility with quality.

Proposition 4.1. (DIRECT UTILITY) *The indirect utility (equation (4.1)) admits an analytic representation of the direct utility given by*

$$u(\mathbf{c}_{G_t}, \mathbf{c}_{S_t}, \mathbf{q}_{G_t}, \mathbf{q}_{S_t}) = \psi \left(\frac{\widehat{C}_t - 1}{\widetilde{C}_{G_t}} \right)^{\lambda_G(1+\gamma_G)} \left(\frac{\widehat{C}_t - 1}{\widetilde{C}_{S_t}} \right)^{\lambda_S(1+\gamma_S)}.$$

Proof. See Appendix C.2. □

Proposition 4.2. (TWO-SECTOR CES) *Assume $\phi_j = 0$, $\gamma_j < -1$, and $\delta_j < 0$ for $j = \{G, S\}$. Then, these preferences collapse to the two-sector CES preferences with quality and $(-\gamma_j)$ as the sector-specific elasticity of substitution.*

Proof. See Appendix C.3. □

Budget constraint. The budget constraint the household faces requires that total spending on goods and services, e_t , be paid for with labor income w_t and nonlabor earnings Λ_t . A household of skill i faces the following budget constraint in nominal terms

$$e_t \equiv \sum_{j=G,S} \int_{\Omega_{j_t}} p_{j_t}(\omega) c_{j_t}(\omega) d\omega = w_t + \Lambda_t. \quad (4.4)$$

Demand for varieties. The household's demand for each variety of goods and services can be recovered using Roy's identity.²² Demand for variety ω of commodity $j \in \{G, S\}$ can then be expressed as

$$c_{j_t}(\omega) = \left[\underbrace{\phi_j e_t}_{\text{choke price}} - p_{j_t}(\omega) \right]^{\gamma_j} \underbrace{q_{j_t}(\omega)^{\delta_j(1+\gamma_j)}}_{\text{variety quality}} \underbrace{A_{j_t}}_{\text{sectoral composite}},$$

where $A_{j_t} = \left[\frac{\widetilde{C}_{j_t}^{(1+\gamma_j)/\gamma_j}}{\psi_j e_t (\widehat{C}_t - 1)} \right]^{\gamma_j}$ is a household-specific sectoral composite. The demand function depends on the distance of the variety's price to the maximum amount the household is willing to pay to consume it, i.e. the commodity's choke price. Hence, lower-priced varieties are associated with more consumption. Similarly, the higher the quality of the variety, the larger is the household's demand

²²Household i 's demand for variety ω of commodity j can be expressed using Roy's identity as (abstracting from functions' arguments)

$$c_{j_t}(\omega) = - \frac{(\partial \widehat{v}_{j_t}(\omega) / \partial p_{j_t}(\omega)) e_t}{(v_{j_t} / \lambda_j) \Phi_t},$$

where $(\partial \widehat{v}_{j_t}(\omega) / \partial p_{j_t}(\omega))$ is the derivative of the sectoral indirect subutility with respect to the price of the variety, v_{j_t} is sectoral indirect utility defined in equation (4.2), and $\Phi_t = (\partial v_t / \partial e_t) (e_t / v_t) > 0$ is the total utility's income/expenditure elasticity. This elasticity can in turn be expressed as a convex combination of the sectoral utilities' income/expenditure elasticities as $\Phi_t = \lambda_G \Phi_{G_t} + \lambda_S \Phi_{S_t}$, where $\Phi_{j_t} \equiv (\partial v_{j_t} / \partial e_t) (e_t / v_{j_t}) > 0$. Note that within each commodity j differences in the consumption of varieties ω stem solely from the derivative of the sectoral indirect subutility $(\partial \widehat{v}_{j_t}(\omega) / \partial p_{j_t}(\omega))$, while differences in the consumption of varieties of goods versus services also depend on the level of the commodity's utility (v_j / λ_j) .

for that variety. The consumption demand for different varieties of the same commodity $j = \{G, S\}$ only varies because of differences in prices and quality. Note that firms will never set a price above households' choke prices, nor choose a quality level of zero, as that would make the demand for their variety equal to zero.

Consumption spending shares. The household's spending share on a variety ω of commodity $j = \{G, S\}$, denoted $\omega_{j_t}(\omega)$, can be written using the utility's income elasticities as

$$\omega_{j_t}(\omega) \equiv \frac{p_{j_t}(\omega)c_{j_t}(\omega)}{e_t} = \frac{\lambda_j \Gamma_{j_t}(\omega)}{\Phi_t},$$

where $\Gamma_{j_t}(\omega) = \frac{\partial \widehat{v}_j(e_t, p_{j_t}(\omega), q_{j_t}(\omega))}{\partial e_t} \frac{e_t}{v_j(e_t, p_{j_t}(\omega), q_{j_t}(\omega))} > 0$ measures the marginal effect of increasing the household's income on her subutility. By aggregating over the different varieties of j yields the income elasticity of the sectoral utility as $\int_{\Omega_{j_t}} \Gamma_{j_t}(\omega) d\omega = \Phi_{j_t}$.²³ The household's spending share on services is then simply given by

$$\omega_{S_t} \equiv \frac{\int_{\Omega_{S_t}} p_{S_t}(\omega)c_{S_t}(\omega) d\omega}{e_t} = \frac{\lambda_S \Phi_{S_t}}{\lambda_G \Phi_{G_t} + \lambda_S \Phi_{S_t}}, \quad (4.5)$$

while the household's spending share on goods is $\omega_{G_t} = 1 - \omega_{S_t}$.

Price elasticity of demand. The household's consumption demand yields a direct price elasticity of demand that depends on her income and the price of the particular variety demanded. Let $\xi_{j_t}(\omega)$ denote the (negative of the) percentage change in quantity demanded of variety ω of commodity j in response to a percentage change in its own price, or $\xi_{j_t}(\omega) = -\frac{\partial c_{j_t}(\omega)}{\partial p_{j_t}(\omega)} \frac{p_{j_t}(\omega)}{c_{j_t}(\omega)}$. The household's price elasticity of demand is then

$$\xi_{j_t}(\omega) = \frac{\gamma_j p_{j_t}(\omega)}{\phi_j e_t - p_{j_t}(\omega)}. \quad (4.6)$$

This expression satisfies the two key attributes discussed in the previous section (Propositions 3.3 and 3.4). First, demand becomes *less* elastic when the household's income goes up, i.e. the price elasticity of demand is decreasing in household's income. Given that households face the same price and $e_{H_t} \geq e_{L_t}$, the price elasticity of demand of the high skilled consumer is lower than the elasticity of the low-skilled consumer, $\xi_{H,j_t}(\omega) \leq \xi_{L,j_t}(\omega)$. As a result, firms selling to wealthier customers will be able to charge high markups. Second, demand becomes *more* elastic when the price of the variety goes up, i.e. the price elasticity of demand is increasing in the variety's price. As a result, firms selling cheaper varieties will be able to charge higher markups as $\xi_{j_t}(\widehat{\omega}) < \xi_{j_t}(\widetilde{\omega})$ for $p_{j_t}(\widehat{\omega}) < p_{j_t}(\widetilde{\omega})$. As $\gamma_j > 0$, the household's demand satisfies the law of demand and therefore her quantity demanded varies inversely with the variety's price. Also, the price elasticity of demand is greater than one, which guaranties that a firm's markup is well defined, as long as the variety's price is such that $p_{j_t}(\omega) > \frac{\phi_j e_{H_t}}{1+\gamma_j} \geq \frac{\phi_j e_{L_t}}{1+\gamma_j}$.²⁴

²³Note that the income elasticity of sectoral utility can be written as $\Phi_{j_t} = \frac{1+\gamma_j}{\gamma_j} \frac{1}{v_{j_t}} \int \xi_{j_t}(\omega) \widehat{v}_{j_t}(\omega) d\omega$, with $\Phi_t = \lambda_G \Phi_{G_t} + \lambda_S \Phi_{S_t}$.

²⁴The price super-elasticity of demand with respect to price and income is given by $\frac{\partial \xi_{j_t}(\omega)}{\partial p_{j_t}(\omega)} = \frac{\xi_{j_t}(\omega)}{p_{j_t}(\omega)} \left[1 + \frac{\xi_{j_t}(\omega)}{\gamma_j} \right]$ and $\frac{\partial \xi_{j_t}(\omega)}{\partial e_t} = -\phi_j \xi_{j_t}(\omega)$, respectively.

The elasticity of substitution across varieties, i.e. how demand for variety $\tilde{\omega}$ of commodity j changes in response to a change in the consumption of variety $\hat{\omega}$ of commodity κ , is equal to the consumer's price elasticity of demand of the variety in the numerator.²⁵

Quality elasticity of demand. Let $\sigma_{j_t}(\omega)$ denote the percentage change in quantity demanded of variety ω of commodity j in response to a percentage change in its own quality, or $\sigma_{j_t}(\omega) = \frac{\partial c_{j_t}(\omega)}{\partial q_{j_t}(\omega)} \frac{q_{j_t}(\omega)}{c_{j_t}(\omega)}$. As preferences are non-homothetic in prices and not quality, the quality elasticity of demand does not depend on the household's income, nor on the price or quality of the variety. Hence, both types of households have the same quality elasticity of demand, which is given by

$$\sigma_{j_t}(\omega) = \delta_j (1 + \gamma_j). \quad (4.7)$$

As $\delta_j, \gamma_j > 0$, an increase in a variety's quality makes households increase their demand for that variety.

4.2 Incumbent firms

Technology. Varieties of goods and services are produced by firms that differ in terms of their total factor productivity (TFP), denoted by z_{j_t} , and their skill-biased productivity, denoted by x_{j_t} . Increases in z_{j_t} and x_{j_t} over time reflect neutral and skill-biased technological progress in sector $j = \{G, S\}$.

The output of a firm selling variety ω of commodity j is produced via a constant returns to scale nested CES production function that combines high-skilled labor h_j and low-skilled labor l_j according to

$$y_{j_t} = z_{j_t} [\alpha x_{j_t} h_{j_t}^\iota + (1 - \alpha) l_{j_t}^\iota]^{1/\iota}. \quad (4.8)$$

The substitution parameter between high-skilled and low-skilled labor is such that $0 < \iota \leq 1$, which implies that high and low-skilled labor are somewhat substitutes in production with the elasticity of substitution given by $\frac{1}{1-\iota}$. This elasticity together with the weight parameters $0 < \alpha < 1$ are common to both sectors.

Costs. Firms in the goods or services sector have a total cost function that comprises the wage bill on high and low-skilled workers, expenses associated with quality, and other fixed costs, given by

$$tc_{j_t} = w_{H_t} h_{j_t} + w_{L_t} l_{j_t} + \kappa_j q_{j_t}^{\vartheta_j} + f_{j_t},$$

where $\kappa_j > 0$ and $\vartheta_j > 1$ are sector-specific parameters. I will refer to the term f_{j_t} as entry costs, which can vary over time.

²⁵Let the elasticity of substitution be $E(\tilde{\omega}_{j_t}, \hat{\omega}_{\kappa_t}) = -\frac{\partial \left(\frac{c_{j_t}(\tilde{\omega})}{c_{\kappa_t}(\tilde{\omega})} \right) \frac{p_{j_t}(\tilde{\omega})}{p_{\kappa_t}(\tilde{\omega})}}{\partial \left(\frac{p_{j_t}(\tilde{\omega})}{p_{\kappa_t}(\tilde{\omega})} \right) \frac{c_{j_t}(\tilde{\omega})}{c_{\kappa_t}(\tilde{\omega})}}$. Then, $E(\tilde{\omega}_{j_t}, \hat{\omega}_{\kappa_t}) = \xi_{j_t}(\tilde{\omega})$. Note that as

the price elasticity of demand is greater than one, the elasticity of substitution is also greater than one, which implies that varieties are gross substitutes. Hence, the reduction in the relative quantity demanded of a variety exceeds the increase in its relative price. This leads to a decline of the relative expenditure on that variety. For CES preferences, the elasticity of substitution is given by $E(\tilde{\omega}_{j_t}, \hat{\omega}_{\kappa_t}) = -\gamma_j$.

The firm solves its cost minimization problem by optimally choosing the quantity of high and low-skilled labor it needs to produce the variety of the commodity it sells subject to the technological constraint (4.8). The first-order conditions from this problem yield the factor demands for high and low-skilled labor, with the relative demand for high-skilled labor given by

$$\frac{h_{jt}}{\ell_{jt}} = \left[\frac{\alpha x_{jt}}{(1-\alpha)} \frac{w_{Lt}}{w_{Ht}} \right]^{\frac{1}{1-\iota}}, \quad (4.9)$$

which depends on the skill premium and sector-specific skill-biased productivity. By replacing these factor demands in the firm's variable cost function, an expression for its marginal cost is obtained as

$$mc_{jt} = \frac{w_{Lt}}{z_{jt}} \left[(\alpha x_{jt})^{\frac{1}{1-\iota}} \left(\frac{w_{Ht}}{w_{Lt}} \right)^{\frac{1}{1-\iota}} + (1-\alpha)^{\frac{1}{1-\iota}} \right]^{\frac{1-\iota}{\iota}}. \quad (4.10)$$

Note that the firm's marginal cost is decreasing in neutral and skill-biased technological change given that high and low-skilled labor are somewhat substitutes (or $\iota > 0$). On the other hand, marginal costs are increasing in the skill premium, w_{Ht}/w_{Lt} .

Profit maximization. A firm sets a price, p_{jt} , and a level of quality, q_{jt} , to maximize its profits taking the aggregate demand for its variety as given. Since the firm's production technology is constant returns to scale, its marginal cost is equal to its average variable cost. A firm producing variety ω in sector j maximizes profits by solving the following problem

$$\pi_{jt} = \max_{p_{jt}, q_{jt}} (p_{jt} - mc_{jt}) y_{jt} - \kappa_j q_{jt}^{\vartheta_j} - f_{jt} \quad (4.11)$$

$$\text{s.t. } y_{jt} = \mu_{Ht} c_{H,jt} + \mu_{Lt} c_{L,jt}.$$

Here, consumer demand of high and low-skilled households depend on the price and quality chosen by the firm. Note that the demand faced by a firm vanishes if it is above the consumers' choke prices. For instance, if $p_{jt} \geq \phi_j e_{Ht}$, then consumer demand for the variety is zero. If instead $\phi_j e_{Lt} \leq p_{jt} < \phi_j e_{Ht}$, then only the high-skilled households consume the variety. If $p_{jt} < \phi_j e_{Lt}$, both types of households demand the variety.

Price and markup. The solution to the firm's profit maximization problem yields its variety's price as a markup m_j over marginal cost according to

$$p_{jt} = m_{jt} mc_{jt}. \quad (4.12)$$

In turn, the firm's markup is a function of the (endogenous) *average* price elasticity of demand of all consumers of its variety. Let $\bar{\xi}_{jt} \equiv -\frac{\partial y_{jt}/y_{jt}}{\partial p_{jt}/p_{jt}}$ denote the variety's average price elasticity of demand. The markup is then given by the usual expression

$$m_{jt} = \frac{\bar{\xi}_{jt}}{\bar{\xi}_{jt} - 1}. \quad (4.13)$$

However, the average price elasticity of demand is now a weighted average of each consumer's own price elasticity of demand, $\xi_{i,jt}$, and her demand share in the firm's customer base, $\omega_{i,jt}$, i.e.

$$\bar{\xi}_{jt} = \omega_{H,jt} \xi_{H,jt} + \omega_{L,jt} \xi_{L,jt}, \quad (4.14)$$

where the consumption share of wealthy households is $\omega_{H,j_t} = \frac{\mu_{H,t} c_{H,j_t}}{y_{j_t}}$ and that of poor households is $\omega_{L,j_t} = \frac{\mu_{L,t} c_{L,j_t}}{y_{j_t}}$. Each type's price elasticity of demand is given by equation (4.6). Note that the price is a fixed point as elasticities and consumption shares depend on it.

Introducing the average price elasticity of demand highlights the three channels behind an increase in markups: (i) the price channel, (ii) the income channel, and (iii) the composition channel. First, technological progress that reduces marginal costs allow firms to reduce their prices. As prices decrease, households are more willing to buy them. This translates into a reduction in each consumer's own price elasticity of demand, which in turn allows firms to charge higher markups. The cost pass-through is therefore less than one as firms are able to capture some of the benefits of technological progress. Second, a generalized increase in incomes reduces consumers' price elasticities of demand. Firms then respond by increasing their markups. Finally, an increase of the share of wealthier consumers in the economy (even without incomes rising) increases the probability the firm meets a wealthier shopper. As these consumers have a lower price elasticity of demand, the firm will adjust its prices by increasing its markup.

Quality. The firm's optimal choice of quality is tightly linked to its markup. A firm faces a tradeoff when choosing its price: higher markups need to be accompanied by better quality, as it weights its consumers' quality elasticity of demand and its markup. In particular, the firm equates the share of quality-related fixed costs in terms of sales to

$$\frac{\kappa_j q_{j_t}^{\vartheta_j}}{p_{j_t} y_{j_t}} = \frac{\bar{\sigma}_{j_t} (m_{j_t} - 1)}{\vartheta_j m_{j_t}}, \quad (4.15)$$

where $\bar{\sigma}_{j_t} \equiv \frac{\partial y_{j_t}/y_{j_t}}{\partial q_{j_t}/q_{j_t}}$ denotes the average quality elasticity of demand. Since the quality elasticity of demand does not differ across households, the average quality elasticity of demand is simply equivalent to each household's own quality elasticity of demand as defined in equation (4.7), i.e.

$$\bar{\sigma}_{j_t} = \sigma_{j_t}.$$

4.3 Entrants

Potential entrants consider entering the market for goods or services as long as they can make profits. If a firm chooses to enter and produce a variety ω in sector $j = \{G, S\}$, it receives the profit π_{j_t} . If instead the firm chooses to not enter the market, it gets a payoff of zero. Firms will thus keep entering the market driving down profits to zero. This implies that in equilibrium the markup of a zero-profit firm is greater than one and equivalent to

$$\frac{\bar{\xi}_{j_t}}{\bar{\xi}_{j_t} - 1} = 1 + \frac{\vartheta_j}{(\vartheta_j - \bar{\sigma}_{j_t})} \frac{f_{j_t}}{vc_{j_t}}. \quad (4.16)$$

The free-entry condition determines the aggregate number of operating firms in each sector, which is denoted by N_{j_t} . The aggregate number of operating firms in the economy is $N_t = N_{G_t} + N_{S_t}$.

4.4 Equilibrium

The equilibrium requires that all markets clear, profits and fixed costs are rebated lump sum to households, and that there is no money left on the table for potential entrants in each sector. In particular, labor supplied by households must equate labor demanded by firms, i.e.

$$\mu_{H_t} = \int_0^{N_{G_t}} h_{G_t}(\omega) d\omega + \int_0^{N_{S_t}} h_{S_t}(\omega) d\omega \quad (4.17)$$

$$\mu_{L_t} = \int_0^{N_{G_t}} \ell_{G_t}(\omega) d\omega + \int_0^{N_{S_t}} \ell_{S_t}(\omega) d\omega. \quad (4.18)$$

Aggregate nonlabor earnings, $\Lambda_t \equiv \mu_{H_t}\Lambda_{H_t} + \mu_{L_t}\Lambda_{L_t}$, is the sum of operating firms' expenses associated with quality and entry costs in both sectors, such that

$$\Lambda_t = \kappa_G \int_0^{N_{G_t}} q_{G_t}(\omega)^{\vartheta_G} d\omega + \kappa_S \int_0^{N_{S_t}} q_{S_t}(\omega)^{\vartheta_S} d\omega + N_{G_t}f_{G_t} + N_{S_t}f_{S_t}. \quad (4.19)$$

4.5 Tacking stock of the aggregate implications

Markups. Next, the key implications of the model regarding the rise of the services' markup are derived. The premise of structural change is a shift of economic activity out of the goods sector toward the services sector. To identify how the rise of services emerges, define the services share measured in terms of aggregate costs, $\omega_{S_t}^{\text{costs}} \equiv \frac{\int v_{CS_t}(\omega) d\omega}{w_{H_t}\mu_{H_t} + w_{L_t}\mu_{L_t}}$, using households' consumption and income shares as

$$\omega_{S_t}^{\text{costs}} = \left[\underbrace{\varpi_{H,S_t}\epsilon_{H_t}}_{\text{High-skilled cons. share}} + \underbrace{\varpi_{L,S_t}\epsilon_{L_t}}_{\text{Low-skilled cons. share}} - \text{Fixed Costs Shares}_{S_t} \right] \frac{1}{\text{Agg Labor Share}_t},$$

where ϖ_{i,S_t} is the consumption share of services of household i defined in equation (4.5), $\epsilon_{i_t} = \frac{\mu_{i_t}e_{i_t}}{e_t}$ is the income share of households i in aggregate income (with $\epsilon_{L,t} = 1 - \epsilon_{H,t}$), $\text{Fixed Costs Shares}_{S_t} = \frac{FC_{S_t}}{e_t}$ is the share of fixed costs in services in terms of aggregate output (with $FC_{S_t} = \kappa_S \int_0^{N_{S_t}} q_{S_t}(\omega)^{\vartheta_S} d\omega + N_{S_t}f_{S_t}$), and $\text{Agg Labor Share}_t = \frac{e_t - \Lambda_t}{e_t}$ is the aggregate labor share. Note that the aggregate labor share scales both the goods and services shares equally.

The services (cost) share can increase over time if (i) both types of households increase their spending on services, i.e. ϖ_{i,S_t} increases; (ii) the share of wealthier households, who consume more services out of their income, rises, i.e. ϵ_{H_t} increases and ϵ_{L_t} decreases; and (iii) services fixed costs as a share of aggregate income decreases. The latter is clearly not supported by the data, but both the increase in the services spending share and the rise of wealthier households have been observed over the last decades.

In turn, the average (cost-weighted) markup within the services sector, or $\bar{m}_{S_t} = \int \frac{v_{CS_t}(\omega)}{VC_{S_t}} m_{S_t}(\omega) d\omega$ (where $VC_{S_t} = \int_0^{N_{S_t}} v_{CS_t}(\omega) d\omega$), can be expressed as a function of the consumption spending

shares, income shares, the sectoral share of the services sector, and the aggregate labor share as

$$\bar{m}_{S_t} = \frac{\omega_{H,S_t} \epsilon_{H_t} + \omega_{L,S_t} \epsilon_{L_t}}{\omega_{S_t}^{\text{costs}} \text{Agg Labor Share}_t}.$$

For the average markup within the sector to increase, it must be that the consumption share of services increased at a smaller pace than the rise of the sectoral fixed costs share in aggregate output. Otherwise, an increase in the services cost share could drive the average markup down.

Contrast the average markup within the services sector with the average markup within the goods sector. For the average markup to be larger in services than in the goods sector it must be that the relative (sales-)share of the services sector is larger than the relative (cost-)share of the services sector. Thus, $\bar{m}_{S_t} > \bar{m}_{G_t}$ as long as

$$\frac{\omega_{S_t}^{\text{sales}}}{\omega_{G_t}^{\text{sales}}} > \frac{\omega_{S_t}^{\text{costs}}}{\omega_{G_t}^{\text{costs}}}.$$

Finally, the services' contribution to the aggregate markup (where $M_{S_t} = \omega_{S_t}^{\text{costs}} \bar{m}_{S_t}$) corresponds to households' consumption shares of services, or

$$\frac{M_{S_t}}{M_t} = \omega_{H,S_t} \epsilon_{H_t} + \omega_{L,S_t} \epsilon_{L_t}.$$

Relative prices. Differential rates of technological progress across sectors help explain the upward trend in the relative price of services. To see this, use equation (4.10) to rewrite the (cost-weighted) average sectoral price $\bar{p}_{j_t} = \int \frac{v_{C_{j_t}}(\omega)}{V_{C_{j_t}}} p_{j_t}(\omega) d\omega$. Then, the relative price of services in a symmetric equilibrium can be written as

$$\frac{\bar{p}_{S_t}}{\bar{p}_{G_t}} = \frac{z_{G_t}}{z_{S_t}} \left[\frac{(\alpha x_{S_t})^{\frac{1}{1-\tau}} \left(\frac{w_{H_t}}{w_{L_t}} \right)^{\frac{\tau}{1-\tau}} + (1-\alpha)^{\frac{1}{1-\tau}}}{(\alpha x_{G_t})^{\frac{1}{1-\tau}} \left(\frac{w_{H_t}}{w_{L_t}} \right)^{\frac{\tau}{1-\tau}} + (1-\alpha)^{\frac{1}{1-\tau}}} \right]^{\frac{1-\tau}{\tau}} \frac{\bar{m}_{S_t}}{\bar{m}_{G_t}}.$$

A decline in the relative productivity of the services sector, i.e. a drop in $\frac{z_{S_t}}{z_{G_t}}$, leads to an increase in the relative price of services. Similarly, skill-biased technological progress in the services sector, i.e. an increase in x_{S_t} , pushes the relative price of services down, while skill-biased technological progress in the goods sector has the reverse effect. An increase in the skill premium has mixed effects on the relative price of services. If the relative skill-biased productivity of services is such

that $\frac{x_{S_t}}{x_{G_t}} > \left[\frac{(\alpha x_{S_t})^{\frac{1}{1-\tau}} \left(\frac{w_{H_t}}{w_{L_t}} \right)^{\frac{\tau}{1-\tau}} + (1-\alpha)^{\frac{1}{1-\tau}}}{(\alpha x_{G_t})^{\frac{1}{1-\tau}} \left(\frac{w_{H_t}}{w_{L_t}} \right)^{\frac{\tau}{1-\tau}} + (1-\alpha)^{\frac{1}{1-\tau}}} \right]^{1-\tau}$, then the rise of the skill premium translates into an increase in the relative price of services. Finally, an increase of the markups of services-producing firms, or a decline of the markups of goods-producing firms, leads to an increase of the relative price of services.

Costs. Aggregate fixed costs in sector j , FC_{j_t} , includes the aggregate entry costs in the sector and costs associated with quality according to

$$FC_{j_t} = \kappa_j Q_{j_t} + N_{j_t} f_{j_t},$$

where the quality composite in sector j is $Q_{j_t} \equiv \int q_{j_t}(\omega)^{\vartheta_j} d\omega$. Note that higher quality and more competing firms can drive the aggregate fixed costs up. The quality composite increases with the average wage in the economy as wealthier consumers enjoy varieties of higher quality. It also increases with the average markup in the sector as firms are pressed to offer varieties of better quality while keeping costs low. Using households' quality elasticity of demand and the firm's optimality condition, equations (4.7) and (4.15) respectively, we can derive an expression for the quality composite in sector j as

$$Q_{j_t} = \frac{\delta_j (1 + \gamma_j)}{\kappa_j \vartheta_j} w_t \omega_{j_t}^{\text{costs}} (\bar{m}_{j_t} - 1),$$

where $w_t = \mu_{H_t} w_{H_t} + \mu_{L_t} w_{L_t}$ is the average wage in the economy. The free-entry condition implies that the aggregate fixed costs in sector j can be written as function of aggregate wages, sectoral cost shares, and average markups, i.e.

$$FC_{j_t} = w_t \omega_{j_t}^{\text{costs}} (\bar{m}_{j_t} - 1).$$

Employment. Differential rates of skill-biased technological progress affect the allocation of high and low-skilled workers across sectors. Let $\theta_{H,j_t} \equiv \frac{\int h_{j_t}(\omega) d\omega}{\mu_{H_t}}$ and $\theta_{L,j_t} \equiv \frac{\int \ell_{j_t}(\omega) d\omega}{\mu_{L_t}}$ denote the share of high and low-skilled labor employed in sector $j = \{G, S\}$, respectively. The relative employment of high-skilled workers in the services sector is related with the relative skill-biased productivity in the sector according to

$$\frac{\theta_{H,S_t}}{\theta_{H,G_t}} = \left(\frac{x_{S_t}}{x_{G_t}} \right)^{\frac{1}{1-\tau}} \frac{\theta_{L,S_t}}{\theta_{L,G_t}},$$

where $\theta_{H,G_t} = 1 - \theta_{H,S_t}$ and $\theta_{L,G_t} = 1 - \theta_{L,S_t}$.

The distribution of high and low-skilled workers within a sector is in turn determined by the evolution of the skill premium, the share of high-skilled households in the economy, and the skill-biased productivity within the sector. To see this, note that for each sector $j = \{G, S\}$, we have $\log \left(\frac{\theta_{H,j_t}}{\theta_{L,j_t}} \right) = \frac{1}{1-\tau} \left[\log \left(\frac{\alpha}{1-\alpha} \right) + \log (x_{j_t}) - \log \left(\frac{w_{H_t}}{w_{L_t}} \right) \right] - \log \left(\frac{\mu_{H_t}}{\mu_{L_t}} \right)$.

5 Matching the Model to the U.S.

In this section the model is matched to U.S. data to be consistent with the key macroeconomic trends documented in Section 2. In particular, the estimated model will deliver the increase in aggregate markups and average markups within both sectors together with the rise of the services share and the relative price of services. The model also accounts very well for other key trends observed over the last forty years.

The calibration proceeds in two steps. In the first step, the parameters governing preferences, technology, and costs are estimated to match the main outcomes at two different points in time (namely in 1980 and 2015). In the second step, the transition between these points in time is computed by allowing sectoral productivities and entry costs to vary in order to match the trends in the

aggregate markup, the relative price of services, the skill premium, the income share of high-skilled households, the fraction of low-skilled labor employed in the services sector, and entry rates across sectors, given the parameters estimated in the first step.

5.1 Data targets

Markups. The aggregate markup is measured using the average markups within each sector that are computed as in Section 2 using the data from listed firms in Compustat. Average markups are then weighted using cost shares with KLEMS data. The sectoral cost shares exclude intermediate inputs, but the aggregate markup stays almost unchanged relative to the figure presented in Section 2. The targeted aggregate markups are then $M_t = \{1.136, 1.263\}$. The average (cost-weighted) markup within each sector follows the procedure presented in Section 2 and the targeted values are $\bar{m}_{G_t} = \{1.132, 1.214\}$ and $\bar{m}_{S_t} = \{1.138, 1.273\}$.

Relative price of services. The relative price of services is computed using KLEMS data. In particular, sectoral prices are chain-weighted Fisher price indices of the value added price indices of individual industries for the years 1980 and 2015.²⁶ The relative price of services is normalized to one in 1980. The targeted relative prices of services are then $\frac{\bar{p}_{S_t}}{\bar{p}_{G_t}} = \{1.0, 1.437\}$.

Skill premium. The skill premium corresponds to the ratio of the median income of males with four-year college degrees vs. high school graduates in 1980 and 2015 taken from the Census' Current Population Survey. The resulting skill premiums are $\frac{w_{H_t}}{w_{L_t}} = \{1.347, 1.928\}$. These targets are similar to Buera, Kaboski, Rogerson, and Vizcaino (2021), who adjust the skill premium for differences in hourly wage rates among skill groups.

Income share. The income share of high-skilled households corresponds to the income share of individuals with a college degree (or some college) as reported by Kuhn and Ríos-Rull (2013) and their 2019 update using data from the Survey of Consumer Finances. The earliest period available is 1989. To compute a value of $\epsilon_{H_t} = \frac{\mu_{H_t} e_{H_t} / \mu_{L_t} e_{L_t}}{1 + \mu_{H_t} e_{H_t} / \mu_{L_t} e_{L_t}}$ for 1980, the average growth rate of $\frac{e_{H_t}}{e_{L_t}}$ (2.4% per year) and the evolution of the share of high and low-skilled households in the economy (μ_{H_t} and μ_{L_t}) are used. The value of $\frac{e_{H_t}}{e_{L_t}}$ for 2015 is obtained by linearly interpolating the available data points (2013 and 2016). The resulting targets for the income share of high-skilled households are $\epsilon_{H_t} = \{0.365, 0.603\}$.

Employment share. Unskilled labor comprises the following occupations: clerks; service workers and shop and market sales; skilled agricultural and fishery workers; crafts and related trades workers; plant and machine operators; and elementary occupations (ILO's categories 4 to 9). The data is taken from the Census' 1980 Current Population Survey and the 2015 American Community Survey, and corresponds to workers ages 18 to 64. The resulting targets are $\theta_{L,S_t} = \{0.631, 0.739\}$, which corresponds to about 42.6% of the total population employed in low-skilled occupations in the services sector in both 1980 and 2015 (in spite of the decline in the share of low-skilled households over the period).

²⁶Following Section 2, the goods sector corresponds to industries A to F and the services sector to industries G to S in KLEMS's classification.

Services share. The services share is taken as the value added share of service industries as in Section 2 using KLEMS data. The targeted services shares are $\omega_{S_t}^{\text{sales}} = \{0.670, 0.790\}$.

Quality costs. The sectoral costs associated with quality as a share of sales correspond to the ratio of selling, general, and administrative expenses to sales in each sector as reported in Compustat in line with the data presented in Section 2. The targeted costs related with quality are $\frac{\kappa_G Q_{G_t}}{P Y_{G_t}} = 0.144$ in the goods sector and $\frac{\kappa_S Q_{S_t}}{P Y_{S_t}} = 0.144$ in the services sector for 2015.

Entry. The number of active firms operating in the non-services sector went from 751,565 to 844,487 firms between 1980 and 2015, while the number of active firms in the services sector grew from 3,050,428 to 4,374,412 firms over the same period. The data is taken from the Census' Business Dynamism Statistics. To compute the entry rates in each sector, the number of firms are rescaled by total population. This implies entry rates of -20.4% in the non-services sector and 1.6% in the services sector between 1980 and 2015. The number of firms operating in the non-services sector is normalized to one in 1980 and to 0.796 in 2015. The number of firms in services is then 4.059 in 1980 and 4.123 in 2015. The targeted relative numbers of firms operating in the services sector are $\frac{N_{S_t}}{N_{G_t}} = \{4.059, 5.180\}$, which matches the entry rates in each sector between 1980 and 2015.

5.2 Estimated parameters

There are eight preference parameters to be calibrated, $\{\delta_G, \delta_S, \gamma_G, \gamma_S, \lambda_G, \lambda_S, \phi_G, \phi_S\}$, ten technology parameters, $\{\alpha, \iota, \chi_{G_t}, \chi_{S_t}, z_{G_t}, z_{S_t}\}$ (for t in 1980 and 2015), eight cost parameters, $\{\kappa_G, \kappa_S, \vartheta_G, \vartheta_S, f_{G_t}, f_{S_t}\}$, and the fraction of high-skilled households in the economy, μ_{H_t} , in 1980 and 2015. Some of these parameters are exogenously imposed, while others are matched to the targets discussed above. The low-skilled wage is the numeraire and is thus normalized to one in both periods, i.e. $w_{L_t} = \{1.0, 1.0\}$.

Externally chosen. Six parameters are exogenously imposed. The substitution parameter in the firms' technology, ι , guides the elasticity of substitution between high and low-skilled labor. [Acemoglu and Autor \(2011\)](#), [Buera et al. \(2021\)](#), [Katz and Murphy \(1992\)](#) estimate the elasticity of substitution for different periods and find values ranging from -2.9 to -1.4, which corresponds to a value of $\iota \in [0.291, 0.661]$. This range is consistent with skill-biased technological change decreasing marginal costs as high and low-skilled labor are substitutes. A value of $\iota = 0.4$ is chosen. Since α and χ_{j_t} cannot be separately identified, the skill-biased productivity parameter in the goods sector is normalized to 1 in 1980, i.e. $\chi_{G_{1980}} = 1$. The fixed cost exponent related to firms' costs associated with quality is set to two across both sectors, i.e. $\vartheta_G = \vartheta_S = 2$, so that there are convex costs for quality upgrading.

The shares of high-skilled households at the initial and terminal dates ($\mu_{H_{1980}}$ and $\mu_{H_{2015}}$) are measured directly from the data as the fraction of people employed in skilled jobs. The Census' 1980 Current Population Survey and the 2015 American Community Survey are used to pin down those values. Following ILO's ISCO categories, high-skilled labor corresponds to workers in the following occupations: legislators, senior officials, and managers; professionals; and technicians and associate professionals (ILO's categories 1 to 3). Unskilled labor comprises the following occupations: clerks; service workers and shop and market sales; skilled agricultural and fishery workers; crafts and related trades workers; plant and machine operators; and elementary occupations (ILO's categories 4

to 9). The resulting shares of high-skilled households in 1980 and 2015 are $\mu_{H_t} = \{0.3253, 0.4237\}$.

Preference parameters. The sectoral indirect utility weights, λ_G and λ_S , help match the services share in terms of value added in 1980 and 2015 (ω_t^{sales}). The preference parameters related with the choke prices, ϕ_G and ϕ_S , and the elasticities of substitution, γ_G and γ_S , are estimated to match the average markups within each sector in both periods (\bar{m}_{G_t} and \bar{m}_{S_t}). In turn, δ_G and δ_S are chosen to normalize the average quality in each sector to one in 1980 (i.e. $\bar{q}_{G_{1980}} = \bar{q}_{S_{1980}} = 1$).

Technology parameters. The share of high-skilled labor used in production, α , and the sectoral skill-biased productivity terms, $x_{G_{2015}}$ and x_{S_t} , help match the skill premium ($\frac{w_{H_t}}{w_{L_t}}$) as well as the share of low-skilled labor employed in the services sector (θ_{L,S_t}) in both periods. The sectoral neutral productivity parameters, z_{G_t} and z_{S_t} , help match the relative price of services ($\frac{\bar{p}_{S_t}}{\bar{p}_{G_t}}$) and the income share of high-skilled households (ϵ_{H_t}) in both periods.

Costs parameters. The fixed cost parameters, κ_G and κ_S , match the share of costs associated with quality in terms of sales across both sectors in 2015 (i.e. $\frac{\kappa_G Q_{G_{2015}}}{PY_{G_{2015}}}$ and $\frac{\kappa_S Q_{S_{2015}}}{PY_{S_{2015}}}$). The entry cost, f_{G_t} and f_{S_t} , help match the aggregate markup (M_t) as well as the relative number of firms operating in the services sector ($\frac{N_{S_t}}{N_{G_t}}$) in both periods.

Table 5.1: Parameters

Parameter	Description	Value	Identification
<i>Preferences</i>			
λ_G, λ_S	Indirect utility's weight on goods, services	0.389, 1.483	Services share
γ_G, γ_S	Exponent in indirect subutility of goods, services	63.246, 93.867	Average goods markups
ϕ_G, ϕ_S	Choke price of goods, services	3.149, 7.311	Average services markups
δ_G, δ_S	Quality-specific exponent on goods, services	0.024, 0.014	Quality of goods and services (normalization)
<i>Technology</i>			
α	High-skilled weight	0.418	Skill premium
ι	Elasticity of substitution between high and low-skilled	0.400	Exogenous
x_{G_t}	High-skilled prod. in goods sector in 1980, 2015	1.000, 1.989	Normalization, Skill premium
x_{S_t}	High-skilled prod. in services sector in 1980, 2015	1.322, 2.313	Low-skilled share in services
z_{G_t}	TFP in goods sector in 1980, 2015	3.556, 3.533	High-skilled income share
z_{S_t}	TFP in services sector in 1980, 2015	2.925, 2.047	Relative price of services
<i>Costs</i>			
κ_G, κ_S	Quality cost parameters in goods, services	0.024, 0.020	Quality costs/sales in goods and services
ϑ_G, ϑ_S	Quality exponent on goods, services	2.000, 2.000	Exogenous
f_{G_t}	Entry costs in goods sector in 1980, 2015	0.007, 0.022	Aggregate markup
f_{S_t}	Entry costs in services sector in 1980, 2015	0.010, 0.023	Rel. number of service firms
<i>Measure</i>			
μ_{H_t}	Share of high-skilled households in 1980, 2015	0.325, 0.424	Exogenous

Results. Table 5.1 above presents the estimated parameters set to minimize the sum of squared deviations between the data targets and their model counterparts. Specifically, denote the i 'th data target by \mathcal{D}_i and the model's solution for this target by $\mathcal{M}_i(\Theta)$. Weighting each observation uniformly, the parameters solve the following minimization problem

$$\min_{\Theta} \sum_i \left[\frac{\mathcal{D}_i - \mathcal{M}_i(\Theta)}{\mathcal{D}_i} \right]^2.$$

Of note, the services choke price parameter is more than twice as large as the one for goods, which reflects the higher willingness to pay for the former. Households' indirect utility has higher weight on services than on goods, which indicates a stronger elasticity of the indirect utility with respect to the services utility. Similarly, the exponent related with the price elasticity of demand is large and larger for services than for goods.

Although total factor productivity was stronger in the goods sector than in services in 1980, high-skilled workers were more productive in the services sector than in non-services firms. Skill-biased technological change has risen significantly in both sectors. This helps the services sector upskill its workforce and sustains the rise of the skill premium. In contrast, the model predicts a stagnation of neutral productivity in the goods sector and a decline of TFP in the services sector in line with the arguments in favor of secular stagnation. This differential growth rate helps explain the strong decline of the price of goods over time.

Table 5.2 displays the match between the data and model. The resulting fit is very good. The model matches perfectly the aggregate markup, the relative price of services, the skill premium, the income share of high-skilled households, the employment share of low-skilled households in the services sector for both 1980 and 2015, as well as the fixed cost shares and net entry rates across sectors in 2015.

Table 5.2: Targeted moments

Moment	Description	Model		Data		Source
		1980	2015	1980	2015	
<i>Markups</i>						
M_t	Aggregate markups	1.136	1.263	1.136	1.263	Compustat, KLEMS
\bar{m}_{G_t}	Average goods markups	1.086	1.232	1.132	1.214	Compustat
\bar{m}_{S_t}	Average services markups	1.160	1.272	1.138	1.273	Compustat
<i>Relative prices and income</i>						
$\bar{p}_{S_t}/\bar{p}_{G_t}$	Relative price of services	1.000	1.437	1.000	1.437	KLEMS
w_{H_t}/w_{L_t}	Skill premium	1.347	1.928	1.347	1.928	CPS
ϵ_{H_t}	High-skilled income share	0.365	0.603	0.365	0.603	Kuhn-Ríos-Rull (2013), CPS
<i>Sectoral shares</i>						
$\omega_{S_t}^{\text{sales}}$	Services share	0.685	0.772	0.670	0.790	KLEMS
θ_{L,S_t}	Low-skilled employment share in services	0.631	0.739	0.631	0.739	CPS
<i>Costs</i>						
$\kappa_G Q_{G_t}/PY_{G_t}$	Sales share of costs with quality in goods	0.060	0.144	0.107	0.144	Compustat
$\kappa_S Q_{S_t}/PY_{S_t}$	Sales share of costs with quality in services	0.093	0.144	0.100	0.144	Compustat
<i>Entry</i>						
N_{S_t}/N_{G_t}	Relative number of services firms	4.059	5.180	4.059	5.180	BDS, CPS

5.3 Matching trends

Once all the parameters are estimated, the model is solved yearly from 1980 to 2015 by finding the set of productivity parameters, z_{G_t} , z_{S_t} , x_{G_t} , and x_{S_t} , and entry costs f_{G_t} and f_{S_t} that match the time series of aggregate markups (M_t), the relative price of services ($\frac{\bar{p}_{S_t}}{\bar{p}_{G_t}}$), the skill premium ($\frac{w_{H_t}}{w_{L_t}}$), the relative income share of high-skilled households (ϵ_{H_t}), the low-skilled employment share in services

(θ_{L,S_t}) , and the relative number of firms in the services sector $\left(\frac{N_{S_t}}{N_{G_t}}\right)$. The fraction of high-skilled households in the economy μ_{H_t} is taken directly from the data.²⁷ All other parameters are constant over time.

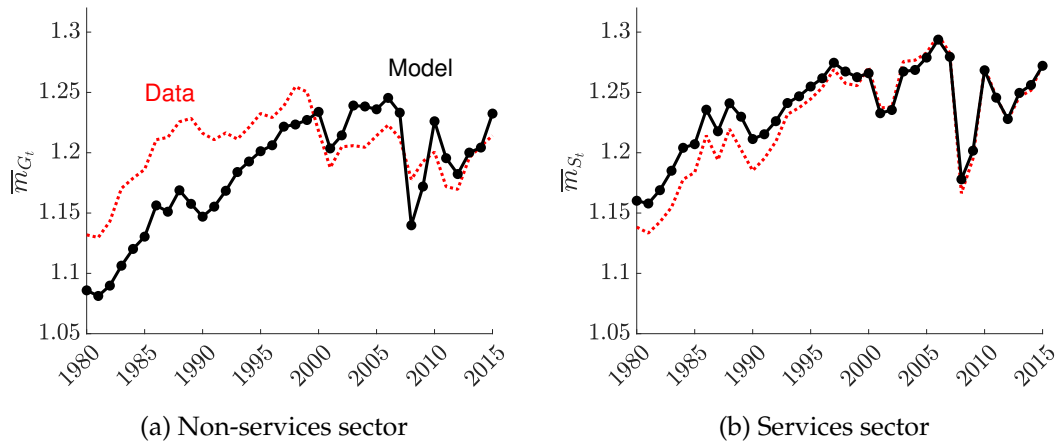
The model matches these six aggregate trends perfectly. The underlying productivity and entry costs that match them are presented in Figure C.4.1 in Appendix C.4. Neutral productivity in the goods sector rises rapidly until the 2000s and then starts declining until it reaches its 1980 level. Instead, TFP in the services sector declines steadily over the last forty years. Skill-biased technological progress in the goods sector catches up rapidly with the services sector. Although initially smaller, entry costs in the goods sector have reached similar values since the financial crisis.

5.4 Model validation

To validate the model, time series statistics from the model not directly targeted in the calibration procedure are compared with their counterparts in the data.

Average markups. Although the aggregate markup is by construction matched perfectly, the average markups within each sector between 1980 and 2015 are not. Figure 5.1 displays the average markups in the services and non-services sector in the model with their data counterparts. The model fits the average markup within the services sector particularly well. What is remarkable is that the rise in average markups is achieved together with an increase in the number of firms in services and a decline in both the price of goods and services (despite the increase in the relative price of services).

Figure 5.1: Average markups across sectors



Note: Panel (a) shows the average markup within the goods sector (\bar{m}_{G_t}) in the model (black) and data (red). Panel (b) shows the average markup within the services sector (\bar{m}_{S_t}) in the model (black) and data (red).

The increase in average markups is directly linked to decline in the average price elasticity of demand. In turn, the average price elasticity responds to changes in each type's price elasticity of demand and their demand share. The demand share of high-skilled households for both goods and

²⁷These time series are computed as described above.

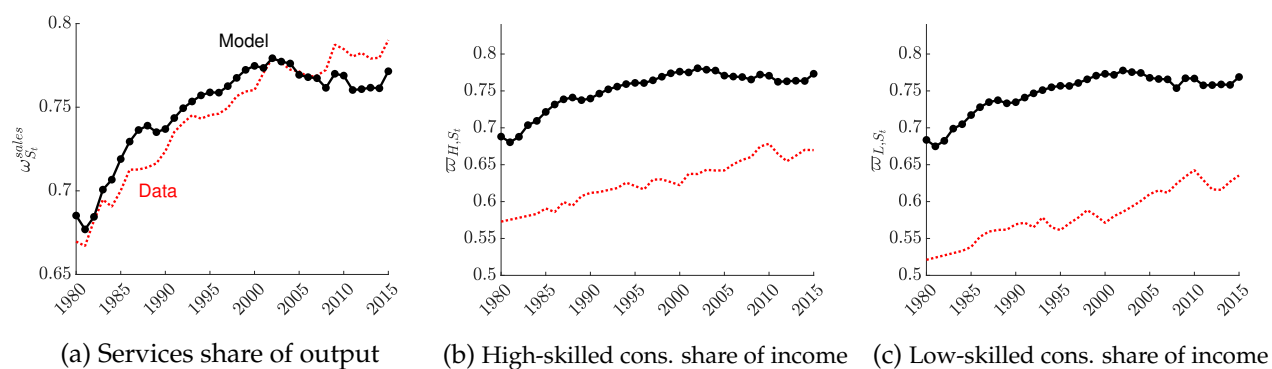
services increased by 65% between 1980 and 2015 (from 36.7% to 60.5% of sales in the services sector and from 36.2% to 59.9% of sales in the goods sector). Hence, firms were more likely to sell their goods and services to wealthier consumers in 2015 than they were in 1980. There are more wealthier consumers and their income grew faster than that of poorer households due to the rise in inequality.

In addition, price sensitiveness declined for both high and low-skilled households and for both goods and services. In particular, the price elasticity of demand for services declined 50% for higher-income consumers and 11% for poorer households between 1980 and 2015 as shows Figure C.4.2 in Appendix C.4. The price elasticity of demand for goods declined even further (67% for high-skilled households and 42% for low-skilled households), but as households shifted their consumption toward services the impact on the average markup in the goods sector was more muted.

As Proposition 3.2 showed, the price elasticity of demand is intimately related with the income elasticity of demand when preferences are non-homothetic. As is usually the case in models of structural change, services are luxuries. Aguiar and Bills (2015) estimate income elasticities for different categories of goods and services. Several services (such as food away from home, entertainment, education, childcare) have income elasticities well above one. In the model, services are luxuries for both rich and poor households (the income elasticity of demand was 1.03 and 1.04 in 1980, respectively, and 1.01 in 2015 for both household types) as shows Figure C.4.3 in Appendix C.4. The income elasticity of demand for goods was below one (0.91 and 0.93 in 1980, and 0.96 and 0.98 in 2015 for high and low-skilled consumers, respectively).

Services share. The model matches well the value added share of the services sector between 1980 and 2015 as Figure 5.2 shows. The services share increases steadily from 69% of aggregate output in 1980 to 77% in 2015. The fit after the 2008 financial crisis worsened nonetheless. The services cost share, used in the calculation of the aggregate markup, also increased steadily over the period in line with the data (the level is however higher than the KLEMS data).

Figure 5.2: Services share



Note: Panel (a) shows the services share of output ($\omega_{S_t}^{sales}$) in the model (black) and data (red). Panel (b) shows the high-skilled services consumption share of income (ω_{H,S_t}) in the model (black) and data (red). Panel (c) shows the low-skilled services consumption share of income (ω_{L,S_t}) in the model (black) and data (red).

The model also predicts well the shift of consumption spending from goods toward services for both types of households. Figure 5.2 also shows services consumption spending shares for high and

low-skilled households, implied by the model and compared with CEX data.²⁸ The magnitude of the increase in the model between 1980 and 2015 was about 9 percentage points, which is close to the increase observed in the CEX data. However, the level is higher in the model than the one implied from CEX data, which highlights the challenge of mapping consumption categories to industrial output as shown above in Figure 2.1.

Labor shares. In this framework, the aggregate labor share is the inverse of the aggregate markup. Its level is higher than in the data (88% 1980 and 79% in 2015). However, its decline of 9 percentage points between 1980 and 2015 is in line with the evidence provided by Karabarbounis and Neiman (2014). This decline is entirely driven by the fall of the low-skilled labor share, which went down by 21 percentage points between 1980 and 2015. As Figure 5.3 displays below, the low-skilled labor share for workers in the non-services sector declined from 20% of aggregate output in 1980 to 9% in 2015, while the low-skilled labor share for workers in the services sector dropped from 34% of aggregate output to 24% over the same period.

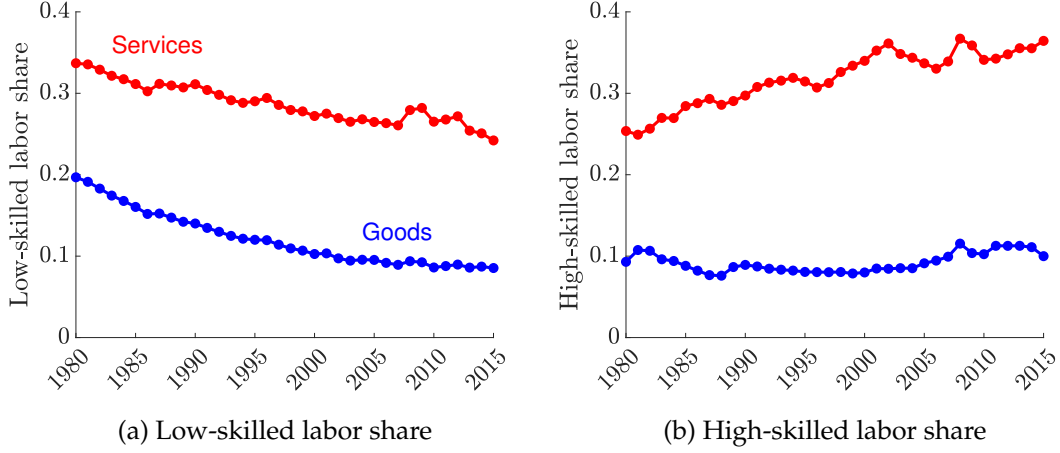
In contrast, the high-skilled labor share in aggregate output increased 12 percentage points between 1980 and 2015. The high-skilled labor share for workers in the non-services sector stayed fairly constant over the period at about 10% of aggregate output. The high-skilled labor share for workers in the services sector increased markedly from 25% to 36% of aggregate output between 1980 and 2015. The model matches the reallocation of low-skilled workers to the services sector by construction. The reallocation of high-skilled workers to the services sector is not targeted however. Figure C.4.4 in Appendix C.4 contrasts the model-implied share of high-skilled workers in the services sector with its data counterpart. The model understates the reallocation of high-skilled labor toward the services sector in particular prior to the 2000s.

Fixed and entry costs. Fixed costs have risen in response to greater spending on quality. They went from 6% and 9% of sales in the non-services and services sectors in 1980, respectively, to more than 14% in 2015 in both sectors. Although only the value of the fixed costs share in 2015 is targeted in the calibration, the model reproduces very well the rise of fixed costs in the services sector observed in the data, as Figure C.4.5 in Appendix C.4 shows. The model undershoots however the share of fixed costs in terms of sales in the non-services sector prior to the 2000s. Entry costs in terms sales increased 3 and 2 percentage points between 1980 and 2015 in the non-services and services sector, respectively, as the left panel of Figure C.4.6 shows. It is higher in the services sector than in the goods sector (4.5% vs. 1.9% in 1980 and 7.0% vs. 4.4% in 2015) despite the higher number of operating firms in the sector.

The quality of goods and services increased markedly between 1980 and 2015 as the right panel of Figure C.4.6 shows. The quality of services increased less than the quality of goods however (30% vs. 46%). This happens because households' quality elasticity of demand is higher for goods than for services, which implies that consumers value more improvements in the quality of goods than improvements in the quality of services. So firms producing goods have to offer better quality than firms producing services for the same intended increase in markups.

²⁸High-skilled households in CEX corresponds to Managers and professionals, and Technical, sales and clerical workers. Low-skilled households in CEX corresponds to Service workers, Construction workers and mechanics, Operators, fabricators and laborers.

Figure 5.3: Labor shares



Note: Panel (a) shows the low-skilled labor share of income in the goods sector ($\frac{VC_{L,G_t}}{PY_t}$, in red) and in the services sector ($\frac{VC_{L,S_t}}{PY_t}$, in blue). Panel (b) shows the high-skilled labor share of income in the goods sector ($\frac{VC_{H,G_t}}{PY_t}$, in red) and in the services sector ($\frac{VC_{H,S_t}}{PY_t}$, in blue).

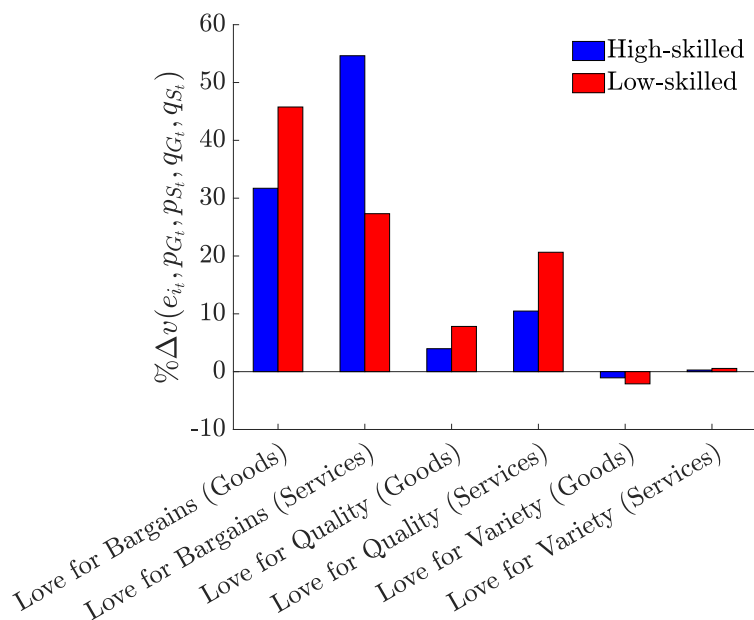
Welfare. In contrast to [Edmond, Midrigan, and Xu \(2021\)](#) and [De Loecker, Eeckhout, and Mongey \(2021\)](#), who document the welfare costs of the rise of market power, this framework predicts that welfare increases along with the rise of markups. Using equation 4.1, we can now decompose the changes in the log of the indirect utility of a type i household between 1980 and 2015 as stemming from (i) changes in the difference between the varieties' prices and the consumer's choke price net of changes in her income (called *love for bargains*); (ii) changes in the varieties' quality (capturing the *love for quality*); and (iii) changes in the number of varieties (capturing the *love for variety*). The change in welfare between 1980 and 2015 is given by

$$\begin{aligned}
 \Delta v(e_{i_t}, \mathbf{p}_{G_t}, \mathbf{p}_{S_t}, \mathbf{q}_{G_t}, \mathbf{q}_{S_t}) &= \underbrace{\lambda_G (1 + \gamma_G) [\Delta(\phi_G e_{i_t} - p_{G_t}) - \Delta e_{i_t}] + \lambda_S (1 + \gamma_S) [\Delta(\phi_S e_{i_t} - p_{S_t}) - \Delta e_{i_t}]}_{\text{love for bargains (net of income changes)}} \\
 &\quad + \underbrace{\lambda_G (1 + \gamma_G) \delta_G \Delta q_{G_t} + \lambda_S (1 + \gamma_S) \delta_S \Delta q_{S_t}}_{\text{love for quality}} \\
 &\quad + \underbrace{\lambda_G \Delta N_{G_t} + \lambda_S \Delta N_{S_t}}_{\text{love for variety}}. \tag{5.1}
 \end{aligned}$$

Figure 5.4 shows this decomposition as a fraction of the total change in utility between 1980 and 2015. The biggest contributor to the increase in welfare for both types of households is the *love for bargains* term. As the price of goods declines over time, both poor and richer households consume more of them in 2015 relative to 1980, which increases their utility from consuming goods. The price of services also declines over time but to a smaller extent. As low-skilled households see their incomes increase at a much slower pace than high-skilled households, the increase in utility from consuming services is lower for the former.

Although both high and low-skilled households value the *love for quality* and the *love for variety* in the same fashion (as they do not depend on income), the contribution of these terms to the increase in welfare across the two types of households is different. The increase in quality had a bigger impact on low-skilled households than on high-skilled households. As the number of varieties of goods declined over the 1980-2015 period and low-skilled households devote a larger fraction of their income on goods relative to high-skilled households, the contribution of the *love for variety* of goods is negative and more significant for low-skilled consumers. Given the modest increase in the number of varieties of services, its contribution to the welfare increase is barely noticeable.

Figure 5.4: Decomposing welfare gains



Note: The figure shows the contribution of each term in equation (5.1) to the change in indirect utilities for high-skilled (blue) and low-skilled (red) consumers.

How much would consumers in 1980 need to receive in order to have the utility level they enjoyed in 2015? The equivalent variation measures the adjustment in income in 1980 that would make consumer i 's utility equal to the level achieved in 2015, which corresponds to the value of ε_i^{ev} that solves the following equation

$$v(e_{i_{1980}}(1 + \varepsilon_i^{ev}), \mathbf{p}_{G_{1980}}, \mathbf{p}_{S_{1980}}, \mathbf{q}_{G_{1980}}, \mathbf{q}_{S_{1980}}) = v(e_{i_{2015}}, \mathbf{p}_{G_{2015}}, \mathbf{p}_{S_{2015}}, \mathbf{q}_{G_{2015}}, \mathbf{q}_{S_{2015}}). \quad (5.2)$$

Table 5.3 shows the equivalent variation for high and low-skilled consumers. The increase in income of high-skilled households in 1980 that would give the consumer the same utility as in 2015, when markups are higher but prices are lower, is 159%. In contrast, the income of low-skilled households in 1980 would have had to be 34% higher in order to enjoy the same level of utility as in 2015.

Similarly, we can ask how much would consumers have to forego in 2015 in order to have the level of utility enjoyed in 1980 given the prices and quality prevalent in 2015. The compensating

variation measures the adjustment in income in 2015 that would make consumer i 's utility equal to the level achieved in 1980, which corresponds to the value of $\varepsilon_i^{c\nu}$ that solves the following equation

$$v(e_{i_{2015}}(1 - \varepsilon_i^{c\nu}), \mathbf{p}_{G_{2015}}, \mathbf{p}_{S_{2015}}, \mathbf{q}_{G_{2015}}, \mathbf{q}_{S_{2015}}) = v(e_{i_{1980}}, \mathbf{p}_{G_{1980}}, \mathbf{p}_{S_{1980}}, \mathbf{q}_{G_{1980}}, \mathbf{q}_{S_{1980}}). \quad (5.3)$$

Table 5.3 shows the compensating variation for high and low-skilled consumers. The 2015 income of high-skilled households would have to be reduced by 56% to accept the level of utility in 1980, while the compensating variation for low-skilled households corresponds to 24% of their income.

Table 5.3: Equivalent and compensating variations

	High-skilled	Low-skilled
Equivalent variation ($\varepsilon_i^{e\nu}$, %)	158.844	33.728
Compensating variation ($\varepsilon_i^{c\nu}$, %)	56.001	23.586

Note: The table shows the equivalent and compensating variations for high and low-skilled consumers from moving from 1980 to 2015.

6 Decomposing the Drivers of Markups

The model is now used to decompose the forces driving the rise of markups over time. In particular, I proceed by shutting down the exogenous forces in the model, namely neutral and skill-biased technological progress, the rise of fixed costs, and the increase of the share of high-skilled workers in the economy. Additionally, the model is used to compute the impact of the rise of incomes, income inequality, and of the relative price of services on markups.

6.1 Neutral technological progress

The first experiment is to set neutral productivity in each sector to its 1980 value. First, the change in neutral productivity of goods-producing firms is shut down, i.e. $z_{G_t} = z_{G_{1980}}$, while keeping the other exogenous forces at their baseline values. As neutral productivity is slightly higher in 1980 relative to 2015, firms in the non-services sector are more productive in 2015 than in the baseline. The results of this experiment are presented in Table 6.1 (column 2). As the productivity gains are marginal, there are very few noticeable changes relative to the baseline.

More interesting is what happens when only the change in neutral productivity of services-producing firms is shut down, i.e. $z_{S_t} = z_{S_{1980}}$. Since neutral productivity declined since 1980, this makes services firms more productive in 2015 than in the baseline. Column 3 of Table 6.1 presents the values for the endogenous variables. As firms become more productive, they are able to pass on part of the decline in marginal costs to consumers by reducing their prices. Yet, their cost pass-through is smaller than one. This is the result of having consumers' price elasticities of demand increase with prices. In turn, this allows services firms to increase their markups by 13% relative to the baseline, which brings the aggregate markup up from 1.263 to 1.378. Note that the increase in markups is achieved with a decline in the relative price of services, which went down by 23%.

Stronger productivity in the services sector leads to a slower reallocation of labor toward this sector, bringing down the labor share of both high and low-skilled households working in services. This is accompanied by an income effect resulting from higher aggregate output in the counterfactual economy. Stronger productivity encourages more firms to enter not only the services sector, but also the goods sector. The number of operating firms increases by more than 43% relative to the baseline. Yet, households are worse off in this economy. Consumers are willing to forego between 48% and 65% of their 2015 income (measured in the baseline economy) to avoid the lower neutral productivity level in the services sector.

6.2 Skill-biased technological progress

In the second experiment, skill-biased technological progress is shut down in each sector so that $\chi_{j,t}$ is set at its 1980 value. First, only skill-biased productivity in the goods sector is shut down, i.e. $\chi_{G,t} = \chi_{G,1980}$ and all other exogenous forces are kept at their baseline values. This makes goods-producing firms half as productive in 2015 as they are in the baseline. As column 4 in Table 6.1 shows, aggregate markups would increase less than 5% relative to 1980, with the bulk of the decline stemming from a reduction of the average markup of goods.

As goods-producing firms are less productive, their prices increase and even become more expensive than services. This leads to an increase in the non-services share of output as both high and low-skilled households devote a larger portion of their income on goods. The decline in the productivity differential between high and low-skilled workers also leads to a significantly higher low-skilled employment share in the goods sector. This has a direct effect on the low-skilled labor share in the goods sector, which tripled relative to the baseline. With slower productivity, the number of firms in both sectors declines significantly. Households are worse off in this economy despite the lower markups. Consumers are willing to forego between 13% and 33% of their 2015 income (measured in the baseline economy) to avoid the economy with lower skill-biased productivity in the goods sector.

Next, only skill-biased productivity in the services sector is shut down, i.e. $\chi_{S,t} = \chi_{S,1980}$ and all other exogenous forces are kept at their baseline values. Column 5 of Table 6.1 displays the results for 2015. In this scenario, services-producing firms are 75% less productive in their use of high-skilled labor than in the baseline. Hence, firms now benefit less from employing high-skilled workers. Without skill-biased technological change, the skill premium almost vanishes and income inequality reduces significantly. As households are poorer, firms have to reduce their markups to sell their services. This is because consumers' price elasticities of demand are now higher and firms' marginal costs increased. The average markup in services is in fact lower than in 1980, suggesting that firms are behaving close to perfectly competitive. As a result, the aggregate markup would be significantly lower.

The Baumol effect is visible in that there is a noticeable shift in employment from the goods sector to services. There is a direct increase in the low-skilled labor share in services, which almost doubled relative to the baseline. The lower skill-biased productivity in the services cuts the number of active firms in the sector by 64%. This also depresses the number of entrants in the goods sector, which

declined in a similar fashion. This reduces the amount of varieties available for consumption. The level of inequality is now smaller and both rich and poor households are better off in this economy. Households are willing to pay between 17% to 22% of their 2015 income (measured in the baseline economy) to enjoy the same level of utility obtained in the economy with lower skill-biased productivity in the services sector.

6.3 Rising fixed costs

The third experiment shuts down the exogenous change in each sector's entry cost parameter f_{j_t} . First, only the entry cost term in the goods sector is set to its 1980 value, i.e. $f_{G_t} = f_{G_{1980}}$. Overall, the lower entry costs have very little impact on markups as displays Table 6.2 (column 2). Changes in aggregate and average markups are barely noticeable. Most of the other aggregates are also very close to their baseline values. There are a few exceptions. For instance, the number of active firms in the sector increases significantly in response to lower barriers to entry. Yet, that is not enough to make consumers better off. Households are willing to forego between 20% to 57% of their 2015 income (measured in the baseline economy) to avoid living in this economy with lower fixed costs in the goods sector.

Shutting down the increase in entry costs in the services sector has similar effects. Column 3 of Table 6.2 shows the outcome of setting $f_{S_t} = f_{S_{1980}}$. Now reducing entry barriers significantly increases the number of active firms in the services sector. Although nonlabor earnings decreases, high-skilled households get a larger fraction of those earnings. These changes don't make consumers better off relative to the baseline as they would still accept a decline in their 2015 incomes ranging from 9% to 61% to avoid the economy with lower fixed costs in the services sector.

6.4 Rising high-income households

In the fourth experiment, the share of high-skilled households, μ_{H_t} , is kept fixed at its 1980 value. The economy thus features more poorer households than in the baseline. Column 4 of Table 6.2 shows the results. As there are fewer wealthier consumers, firms are more likely to sell their goods and services to poorer households. This puts more weight on the price elasticity of demand of low-skilled households, which decreases the markup of firms in both sectors. If preferences were constant across the income distribution, then this effect would simply disappear. Changes in the composition of firms' customer base would therefore have no bearing on the aggregate markup. Instead, the aggregate markup is 2% lower in 2015 in this economy relative to the baseline.

As there are fewer high-skilled households in the economy and firms' skilled-biased productivity are at their baseline values, the skill premium increases sharply to respond to the reduced supply of high-skilled labor. Households are worse off nonetheless. They would accept a reduction of their 2015 income (measured in the baseline economy) ranging from 13% to 60% to avoid the economy with more poorer households.

To sum up the relative contribution of each these factors, Figure 6.1 shows the marginal effect of shutting down each exogenous term at a time on markups. In particular, each bar measures the

Table 6.1: Decomposition experiments: Technological progress

Variable	Description	(1)	(2)	(3)	(4)	(5)
		Baseline 1980, 2015	z_{G_t} fixed 2015	z_{S_t} fixed 2015	x_{G_t} fixed 2015	x_{S_t} fixed 2015
<i>Markups</i>						
M_t	Aggregate markups	1.136, 1.263	1.263	1.378	1.192	1.123
\bar{m}_{G_t}	Average goods markups	1.086, 1.232	1.234	1.256	1.093	1.213
\bar{m}_{S_t}	Average services markups	1.160, 1.272	1.272	1.432	1.264	1.110
<i>Relative prices and income</i>						
$\bar{p}_{S_t}/\bar{p}_{G_t}$	Relative price of services	1.000, 1.437	1.444	1.109	0.728	2.722
w_{H_t}/w_{L_t}	Skill premium	1.347, 1.928	1.929	1.908	1.404	1.200
ϵ_{H_t}	High-skilled income share	0.365, 0.603	0.603	0.570	0.531	0.491
ΔPY_t	Percent change in aggregate output		0.056	8.449	-20.684	-30.793
<i>Services shares</i>						
$\omega_{S_t}^{\text{sales}}$	Services share	0.685, 0.772	0.772	0.721	0.610	0.870
ω_{H,S_t}	High-skilled services cons. spend. share	0.688, 0.773	0.774	0.723	0.617	0.870
ω_{L,S_t}	Low-skilled services cons. spend. share	0.684, 0.769	0.770	0.718	0.603	0.870
θ_{H,S_t}	High-skilled employment share in services	0.732, 0.785	0.786	0.716	0.737	0.842
θ_{L,S_t}	Low-skilled employment share in services	0.631, 0.739	0.741	0.663	0.409	0.913
<i>Labor shares</i>						
$V_{C_{H,G_t}}/PY_t$	High-skilled labor share in goods	0.093, 0.100	0.099	0.120	0.112	0.066
$V_{C_{H,S_t}}/PY_t$	High-skilled labor share in services	0.254, 0.364	0.365	0.303	0.314	0.351
$V_{C_{L,G_t}}/PY_t$	Low-skilled labor share in goods	0.197, 0.085	0.085	0.102	0.244	0.041
$V_{C_{L,S_t}}/PY_t$	Low-skilled labor share in services	0.337, 0.242	0.242	0.200	0.169	0.432
<i>Fixed costs</i>						
$\kappa_G Q_{G_t}/PY_{G_t}$	Share of fixed costs with quality in goods	0.060, 0.144	0.145	0.156	0.065	0.134
$\kappa_S Q_{S_t}/PY_{S_t}$	Share of fixed costs with quality in services	0.093, 0.144	0.144	0.203	0.141	0.067
$N_{G_t}^f f_{G_t}/PY_{G_t}$	Entry costs share in goods	0.019, 0.044	0.045	0.048	0.020	0.041
$N_{S_t}^f f_{S_t}/PY_{S_t}$	Entry costs share in services	0.045, 0.070	0.070	0.098	0.068	0.033
<i>Entry</i>						
N_{G_t}	Number of active firms in goods	1.000, 0.796	0.798	1.140	0.486	0.292
N_{S_t}	Number of active firms in services	4.059, 4.123	4.133	5.895	2.530	1.496
<i>Welfare</i>						
Δv_{H_t}	Welfare change for high-skilled households		0.007	5.161	-0.974	-1.000
Δv_{L_t}	Welfare change for low-skilled households		0.048	90.752	-0.852	-1.000
ϵ_H^{ev}	Equivalent var. for high-skilled households (%)		-56.028	-65.327	-32.852	16.509
ϵ_L^{ev}	Equivalent var. for low-skilled households (%)		-23.846	-47.521	-13.329	21.671
ϵ_H^{cv}	Compensating var. for high-skilled households (%)		-159.191	-304.909	-51.645	3.826
ϵ_L^{cv}	Compensating var. for low-skilled households (%)		-34.238	-113.465	-15.826	16.635

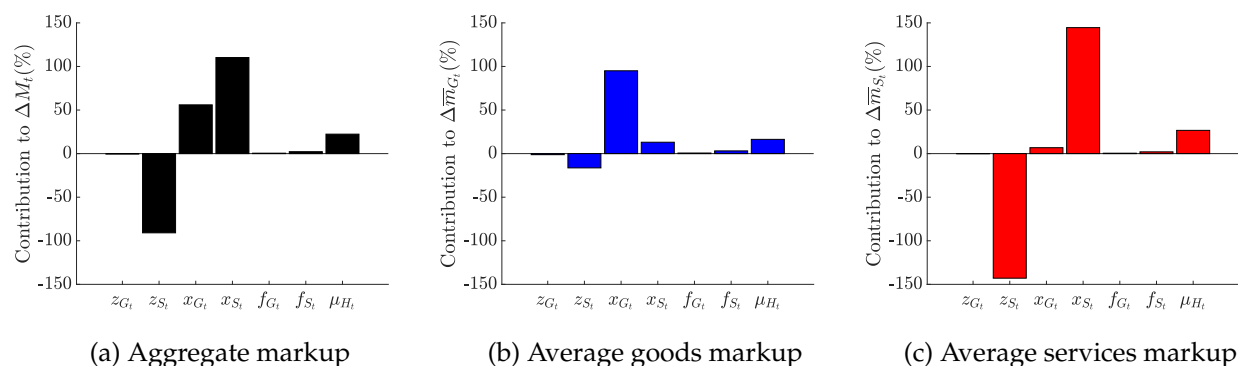
Note: The equivalent variation, ϵ_i^{ev} , solves the following equation $v(e_{i2015}^B (1 + \epsilon_i^{ev}), p_{G2015}^B, p_{S2015}^B, q_{G2015}^B, q_{S2015}^B) = v(e_{i2015}^C, p_{G2015}^C, p_{S2015}^C, q_{G2015}^C, q_{S2015}^C)$ and the compensating variation, ϵ_i^{cv} , solves the following equation $v(e_{i2015}^C (1 - \epsilon_i^{cv}), p_{G2015}^C, p_{S2015}^C, q_{G2015}^C, q_{S2015}^C) = v(e_{i2015}^B, p_{G2015}^B, p_{S2015}^B, q_{G2015}^B, q_{S2015}^B)$, where the superscript B stands for the baseline economy and superscript C for the counterfactual economy.

difference between the growth rate of markups in the baseline and the growth rate of markups in the counterfactual economy over the 1980 and 2015 (rescaled by the former), or

$$\text{Contribution} = 100 \times \left(\frac{M_{2015}^{\text{baseline}} - M_{2015}^{\text{experiment}}}{M_{2015}^{\text{baseline}} - M_{1980}^{\text{baseline}}} \right).$$

Skill-biased technological progress in the goods and services sector contributes the most to the increase in markups, both at the aggregate level and when looking at averages within each sector. Shutting these two forces would have led to higher markups. This happened for two reasons. First, faster skill-biased productivity growth decreases marginal costs, which helps firms pass these gains on to consumers through reduced prices and to keep some in the form of higher markups, given the assumed form of preferences that imply the price elasticity of demand decreases as prices fall. Second, faster skill-biased productivity growth increases income inequality by rewarding high-skilled workers in the labor market. This in turn decreases their price elasticity of demand for goods and services, which allows firms to increase their markups. In contrast, the decline in neutral productivity across services firms helps contain the rise in aggregate markups. The rise of the share of high-income consumers in the economy also plays an important role in driving markups up. The increase in entry costs plays a minor role in the rise of market power overall.

Figure 6.1: Decomposing the rise of markups



Note: Panel (a) shows the relative importance of each exogenous force behind the rise of the aggregate markup. Panel (b) shows the relative importance of each exogenous force behind the rise of the average markup in the goods sector. Panel (c) shows the relative importance of each exogenous force behind the rise of the average markup in the services sector.

Table 6.2: Decomposition experiments: Fixed costs and high-skilled share

Variable	Description	(1) Baseline 1980, 2015	(2) f_{G_t} fixed 2015	(3) f_{S_t} fixed 2015	(4) μ_{H_t} fixed 2015
<i>Markups</i>					
M_t	Aggregate markups	1.136, 1.263	1.262	1.260	1.234
\bar{m}_{G_t}	Average goods markups	1.086, 1.232	1.232	1.228	1.208
\bar{m}_{S_t}	Average services markups	1.160, 1.272	1.272	1.270	1.242
<i>Relative prices and income</i>					
$\bar{p}_{S_t}/\bar{p}_{G_t}$	Relative price of services	1.000, 1.437	1.437	1.439	1.454
w_{H_t}/w_{L_t}	Skill premium	1.347, 1.928	1.928	1.928	2.486
ϵ_{H_t}	High-skilled income share	0.365, 0.603	0.617	0.672	0.553
ΔPY_t	Percent change in aggregate output		-0.050	-0.231	4.060
<i>Services shares</i>					
$\omega_{S_t}^{\text{sales}}$	Services share	0.685, 0.772	0.772	0.772	0.773
ω_{H,S_t}	High-skilled services cons. spend. share	0.688, 0.773	0.773	0.774	0.776
ω_{L,S_t}	Low-skilled services cons. spend. share	0.684, 0.769	0.769	0.767	0.770
θ_{H,S_t}	High-skilled employment share in services	0.732, 0.785	0.785	0.785	0.789
θ_{L,S_t}	Low-skilled employment share in services	0.631, 0.739	0.739	0.739	0.744
<i>Labor shares</i>					
$VC_{H,G_t}/PY_t$	High-skilled labor share in goods	0.093, 0.100	0.100	0.100	0.093
$VC_{H,S_t}/PY_t$	High-skilled labor share in services	0.254, 0.364	0.365	0.365	0.348
$VC_{L,G_t}/PY_t$	Low-skilled labor share in goods	0.197, 0.085	0.085	0.086	0.094
$VC_{L,S_t}/PY_t$	Low-skilled labor share in services	0.337, 0.242	0.242	0.243	0.274
<i>Fixed costs</i>					
$\kappa_G Q_{G_t}/PY_{G_t}$	Share of fixed costs with quality in goods	0.060, 0.144	0.144	0.142	0.132
$\kappa_S Q_{S_t}/PY_{S_t}$	Share of fixed costs with quality in services	0.093, 0.144	0.144	0.143	0.131
$N_{G_t} f_{G_t}/PY_{G_t}$	Entry costs share in goods	0.019, 0.044	0.044	0.044	0.041
$N_{S_t} f_{S_t}/PY_{S_t}$	Entry costs share in services	0.045, 0.070	0.070	0.064	0.064
<i>Entry</i>					
N_{G_t}	Number of active firms in goods	1.000, 0.796	2.388	0.782	0.752
N_{S_t}	Number of active firms in services	4.059, 4.123	4.115	6.856	3.920
<i>Welfare</i>					
Δv_{H_t}	Welfare change for high-skilled households		0.324	1.378	0.616
Δv_{L_t}	Welfare change for low-skilled households		-0.427	-0.925	-0.841
ϵ_H^{eV}	Equivalent var. for high-skilled households (%)		-57.394	-61.338	-59.681
ϵ_L^{eV}	Equivalent var. for low-skilled households (%)		-20.310	-8.844	-13.307
ϵ_H^{cV}	Compensating var. for high-skilled households (%)		-174.011	-212.328	-185.951
ϵ_L^{cV}	Compensating var. for low-skilled households (%)		-27.946	-10.595	-16.457

Note: The equivalent variation, ϵ_i^{eV} , solves the following equation $v(e_{2015}^B (1 + \epsilon_i^{eV}), p_{G_{2015}}^B, p_{S_{2015}}^B, q_{G_{2015}}^B, q_{S_{2015}}^B) = v(e_{2015}^C, p_{G_{2015}}^C, p_{S_{2015}}^C, q_{G_{2015}}^C, q_{S_{2015}}^C)$ and the compensating variation, ϵ_i^{cV} , solves the following equation $v(e_{2015}^C (1 - \epsilon_i^{cV}), p_{G_{2015}}^C, p_{S_{2015}}^C, q_{G_{2015}}^C, q_{S_{2015}}^C) = v(e_{2015}^B, p_{G_{2015}}^B, p_{S_{2015}}^B, q_{G_{2015}}^B, q_{S_{2015}}^B)$, where the superscript B stands for the baseline economy and superscript C for the counterfactual economy.

6.5 Taming the rise of inequality

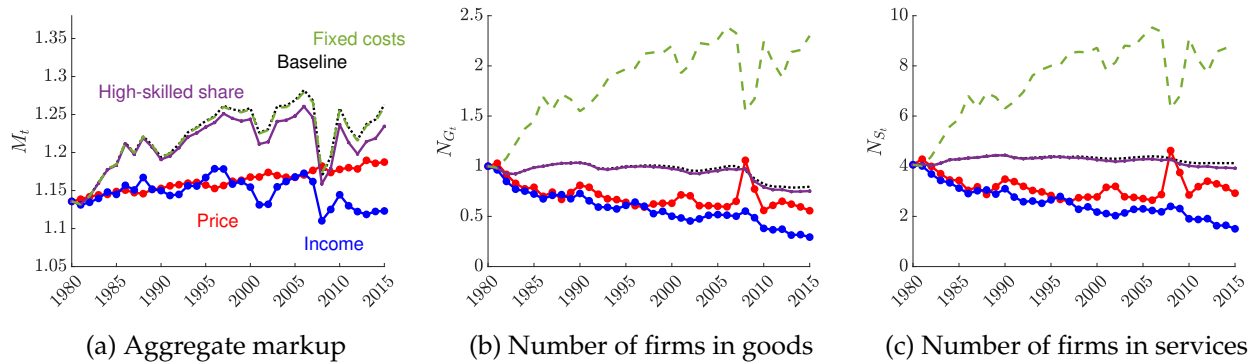
Circling back to the discussion of Section 3, this subsection studies the effect of keeping households' income as in 1980, thereby reducing the amount of inequality in the economy. To achieve this, I change the nature of the experiments by finding the values of the skill-biased productivity terms in both sectors, χ_{G_t} and χ_{S_t} , that minimize the distance between the model-implied total household income of both types, e_{H_t} and e_{L_t} , and their 1980 values. Figures C.4.7 and C.4.8 in Appendix C.4 show the path of these variables. All the other exogenous forces are kept at their baseline values. Note that as the fraction of high-skilled households in the economy, μ_{H_t} , increases, the economy still features a higher share of wealthier households over time.

Figure 6.2 contrasts the path of aggregate markups in the economy with no changes in inequality with the baseline calibration. Without the increase in inequality, the aggregate markup would have barely changed between 1980 and 2015. The average goods markup would have been smaller than in the baseline until the 2008 financial crisis. After that, the sharp increase in the skill-biased productivity of goods producing firms needed for labor markets to clear translates into lower marginal costs that are passed on to consumers in the form of lower prices and higher markups. In sharp contrast with the baseline, the average services markup declines over time.

The figure also shows what would have happened to the number of firms in the economy with no increase in inequality. The decline in business dynamism is remarkable, with the number of operating firms declining significantly over time in both sectors. For instance, entry rates between 1980 and 2015 would be -56% in the non-services sector and -46% in the services sector (as opposed to -20% and 2% in the baseline in the non-services and services sector, respectively).

Table C.5.1 in Appendix C.4 contrasts the experiment with the baseline for 2015 for the remaining variables. Income inequality is now lower. The skill premium declined from 44% to 22% and the share of total income held by high-skilled households amounts to 49%. Due to the sharp increase in skill-biased productivity in the goods sector after 2008, both low and high-skilled labor reallocate to the services sector, thereby increasing the labor share in the sector—in particular of low-skilled labor. This in turn leads to an increase in households' consumption share of services as well as the sector's share in aggregate output. Both types of households are worse off in this economy despite the lower level of inequality. They would accept a reduction of their 2015 income (measured in the baseline economy) ranging from 4% to 17% to avoid the economy with 1980 incomes.

Figure 6.2: Markups and number of firms across experiments



Note: Panel (a) shows the aggregate markup in the baseline (black), in the experiment with low inequality (blue), and in the experiment with constant prices (red). Panel (b) shows the number of active firms in the goods sector in the baseline (black), in the experiment with low inequality (blue), and in the experiment with constant prices (red). Panel (c) shows the number of active firms in the services sector in the baseline (black), in the experiment with low inequality (blue), and in the experiment with constant prices (red).

6.6 Keeping relative prices constant

In this subsection, the values of the neutral productivity terms in both sectors, z_{G_t} and z_{S_t} , are chosen to minimize the distance between the model-implied price of goods and services, p_{G_t} and p_{S_t} , and their 1980 values. This makes the relative price of services equal to one over the 1980-2015 period. Figures C.4.9 and C.4.10 in Appendix C.4 show the path of these variables. All the other exogenous forces are kept at their baseline values.

Figure 6.2 above displays the path of aggregate markups. Keeping prices constant, which would make both the average price of goods and services more expensive, would have still led to an increase in the aggregate markup (5% between 1980 and 2015). This increase is driven by the rise in the average markup of services, with its level in 2015 close to the baseline. In contrast, the average markup of goods stays fairly constant over the period. The figure also shows the number of firms in each sector when prices are constant. The decline in business dynamism is smaller than under the experiment with low inequality. The number of operating firms in the goods sector declines, while the number of services firms in 2015 is similar to the value in 1980.

Table C.5.1 in Appendix C.4 also contrasts this experiment with the baseline for 2015. The upshot is that keeping the relative price of services constant would slow down the rise of the services sector, with less spending on services and fewer workers transitioning from the goods sector to the services sector. As both goods and services are now more expensive, low-skilled households are now worse off. In contrast, high-skilled households are willing to pay 73% of their 2015 income (measured in the baseline economy) to enjoy the utility level obtained in the economy with 1980 prices.

7 Eliciting Demand Elasticities

Do price elasticities of demand vary across the income distribution? Section 3 provided the theoretical underpinnings for this to hold and Sections 5 and 6 showed that the mechanism is quantitatively important for explaining the rise of markups. The section below proposes a novel strategy to address this question by conducting a new online survey covering 607 consumers in the United States.²⁹ The survey questions are designed to capture individuals' perception of the impact of changes in prices on their purchase of different goods and services. The categories of goods and services follow the structure of the Bureau of Labor Statistics' Consumer Expenditure Survey (CEX).

7.1 Survey design

Recruitment of survey participants. Survey participants were selected through ResearchMatch, a platform developed by the National Institutes of Health (NIH) to help connect potential survey participants with researchers. A first message was sent in March 2022 through ResearchMatch to a pool of registered volunteers, age 18 and above who reside in the United States and can read English. Of the 37,497 individuals contacted, 1,765 volunteers showed interest in the study and agreed to receive more information about the survey. Of those who showed interest, 607 individuals completed the survey between March and May 2022. Although 812 individuals responded to the survey, 205 responses were discarded either because they were duplicates, were filled out too quickly, or only responded to the demographic questions. The survey could be completed online using a smartphone or a computer. The average time to complete the survey was 54 minutes and the median time was 14 minutes. Participants did not receive any compensation from participating in the study and were free to withdraw at any point without any consequences.

Survey questions. The questionnaire consists of six sections and is available in Appendix D.1. The first section collects detailed data on the socio-economic background of the individual and includes questions about gender, age, race, educational attainment, relationship status, household composition, zipcode of residence, yearly household income, home and vehicle ownership, employment status, occupation, and industry of employment.

The second section covers average spending per month on: (1) food at home, (2) food away from home, (3) alcoholic beverages, (4) mortgage payments and rent, (5) home insurance, (6) utilities, (7) housekeeping expenses, (8) apparel, (9) gasoline, (10) public transportation, (11) vehicle insurance, (12) medical and dental services, drugs and medical supplies, (13) health insurance, (14) child care, preschool tuition, and related expenses or care of elderly, (15) school and college tuition and related expenses, (16) personal insurance and pensions, (17) tobacco and other smoking products. It also asks about the average spending per year on: (18) house maintenance and repairs, (19) other lodging expenses out of town, (20) furniture, (21) household appliances, (22) audio and visual equipment and services, (23) entertainment fees and admissions, hobbies, pets, and toys, (24) vehicle purchases, maintenance and repairs, leases and rental charges, (25) other expenses. These spending categories follow the structure of the CEX.

²⁹The survey was approved by the University of Pennsylvania's Institutional Review Board (IRB) in February 2022.

The goal of the third section is to gauge each person’s perceived own price elasticity of demand. The question posits the following scenario for the different categories of goods and services defined above “Suppose you spent \$ x on the following items in any given y . If the same items you purchased in the past now cost $\$1.2x$, how much would you now be willing to spend (US\$)?”.³⁰ The respondent has five options, ranging from $\$0.9x$ to $\$1.3x$. These values correspond to a price elasticity of demand greater than 1, equal to 1, between 0 and 1, equal to 0, and negative, respectively. The fourth section aims to gather information about the average quality of goods and services purchased by the consumer with the question “How would you rate the average quality of the products you usually purchase or consume?” and available responses ranging from *low-end quality* to *high-end quality*.³¹

Sample. Table 7.1 shows key statistics regarding the characteristics of the final sample of 607 individuals who filled out the questionnaire relative to the U.S. population. Population statistics are taken from the 2019 Current Population Survey. Each response is weighted through an iterative proportional raking procedure that minimizes the difference between the sample and the known population statistics along different demographic dimensions. The resampling procedure aims to make the survey representative of the U.S. population in terms of gender, age distribution, race, educational attainment, marital status, employment status, home ownership status, and household income. As the table shows, the sample is representative of the U.S. population.

Table 7.1: Sample characteristics

	Sample (%)	Population (%)
Female	51.93	51.64
18-25 y.o.	10.90	10.96
25-35 y.o.	17.92	17.91
35-45 y.o.	16.60	16.61
45-55 y.o.	16.29	16.26
55-65 y.o.	17.02	17.01
White	74.37	74.22
Black	12.24	12.28
Asian	5.91	5.99
No college degree	67.98	68.21
Bachelor’s degree	20.06	19.95
Married	51.20	51.07
Single	29.56	29.62
Employed	63.46	63.47
Unemployed	2.84	2.85
Owner with mortgage	43.96	43.95
Owner without mortgage	25.93	25.92
Household income < 40k	22.90	22.88
Household income \in [40k, 80k)	27.68	27.66
Household income \in [80k, 120k)	20.10	20.09

Note: The table displays summary statistics for the sample and the U.S. population. Source: Statistics for the U.S. population are taken from the 2019 Current Population Survey.

³⁰Here $\{x, y\} = \{100, \text{week}\}$ for regular purchases, $\{x, y\} = \{1,000, \text{month}\}$ for bigger purchases, and $\{x, y\} = \{10,000, \text{year}\}$ for irregular big-ticket items.

³¹The fifth section focuses on the income elasticity of demand and the last section allows respondents to provide comments.

7.2 Price elasticities of demand

Table 7.2 shows the distribution of price elasticities of demand for the 24 categories of goods and services, together with the sample average spending per year.³² For instance, for more than half of the sample, the price elasticity of demand for mortgage payments and rent is zero. This implies that most consumers would not switch homes if their rent or mortgage payments increase. Similarly, very few individuals would change their demand for health or personal insurance if their premiums increase, nor change their consumption of food at home if the price of groceries increases. In contrast, the demand for furniture, appliances, audio and visual equipment and services, alcohol is elastic for most households.

Table 7.2: Distribution of price elasticities of demand, ξ , by categories

Category	Avg. spend. (yearly, US\$)	% with $\xi = 0$	% with $\xi \in (0, 1)$	% with $\xi = 1$	% with $\xi > 1$
Mortgage payments and rent	13,747	50.54	4.79	20.53	13.46
Health insurance	5,065	42.30	15.11	20.09	11.61
Personal insurance (e.g. life insurance, accident and disability)	5,032	34.24	13.47	24.69	21.57
Food at home (e.g. cereals, meats, dairy products, fruits, vegetables)	4,704	46.00	13.15	17.64	10.22
Utilities (electricity, natural gas, water and trash collection, telephone/mobile services)	4,694	41.22	16.63	21.64	7.72
Vehicle insurance	3,918	41.21	16.77	16.31	17.63
Medical and dental services, drugs and medical supplies	3,629	34.53	16.42	23.16	16.93
Gasoline	3,490	37.72	16.76	20.77	13.31
Home insurance	2,717	43.46	13.13	17.48	11.95
Food away (e.g. fast food, take-out, delivery, full-service restaurants, excl. alcoholic bev.)	2,036	16.04	7.33	34.02	34.92
Housekeeping expenses (e.g. cleaning, post., stationary, garden., pest control, storage)	1,893	19.40	15.70	30.68	27.22
Tuition and related expenses (e.g. elementary, high-school, college, books, supplies)	1,832	24.93	11.96	38.44	15.92
Apparel (e.g. men, women, boys, girls, footwear, watches, jewelry)	1,616	11.49	7.88	31.21	43.92
Vehicle purchases, maintenance and repairs, leases and rental charges	1,585	20.62	17.76	28.04	26.81
Other lodging expenses out of town (e.g. hotels, vacation homes)	1,493	14.74	7.74	26.34	44.31
House maintenance and repairs	1,295	22.97	7.98	35.89	26.29
Child care, preschool tuition, or care of the elderly	1,110	29.03	7.65	18.50	27.86
Entertainment fees and admissions, hobbies, pets, and toys	879	11.43	13.33	28.92	42.01
Audio and visual equipment and services (e.g. tvs, smartphones, cable, musical instr.)	613	8.33	12.58	23.83	49.96
Alcohol (at home or away from home)	602	12.72	9.68	22.52	47.54
Tobacco and other smoking products	484	4.74	19.32	21.35	32.21
Furniture (indoor, outdoor, floor coverings)	436	9.25	8.38	28.43	50.54
Appliances (e.g. refrigerators, dishwashers, ovens, vacuum cleaners, air-conditioners)	382	12.24	8.43	24.57	50.43
Public transportation (e.g. mass transit, buses, trains, airlines, taxis, school buses)	313	23.06	18.84	10.70	36.09

Note: The price elasticities of demand, ξ , are for individuals who reported positive expenditures on that category.

Estimation results. The main empirical exercise is based on the following linear probability model

$$\xi_{ij} = \alpha + \beta e_i + \gamma z_i + \epsilon_{ij}, \quad (7.1)$$

where ξ_{ij} is a dummy capturing respondent i 's perception of their price elasticity of demand for product j , e_i is the household's income, and z_i is a set of demographic characteristics. Two cases are considered for the dummy of the price elasticity of demand. The first case is where ξ_{ij} equals 1 if the individual's demand is elastic, i.e., the respondent answered she would reduce her consumption if

³²Here, the price elasticity of demand is defined as the negative change in consumption given a change in price, in line with the definition used in the previous sections.

prices increased, and 0 otherwise. The second case is where ξ_{ij} equals 1 if the individual's demand is inelastic, i.e., the respondent answered they would consume the same amount despite the price increase, and 0 otherwise. The set of demographic characteristics includes the age of the respondent, their employment status, gender, household size, industry of employment, occupation, race, and relationship status. Observations are scaled by their survey weight. For robustness, a probit model is also estimated.

Table 7.3 presents the estimated coefficient capturing the income effect on the price elasticity of demand (β in equation (7.1) above) for each category of goods and services (each column) for both the linear probability and probit models (only statistically significant estimates are shown). The upshot is that demand is more likely to be elastic for lower-income households and thus those households are more likely to reduce their consumption when prices increase, in particular for food at home (column 1), food away (2), apparel (3), public transportation (4), vehicle insurance (5), medical and dental services, drugs and medical supplies (6), health insurance (7), child care, preschool tuition, or care of elderly (8), school and college tuition and related expenses (9), personal insurance (10), audio and visual equipment and services (14), and vehicle purchases, maintenance and repairs, leases and rental charges (15).

Figure 7.1 displays the predicted probability of adjusting demand for (a) child care, preschool tuition, or care of elderly, (b) food away, and (c) vehicle purchases, maintenance and repairs, leases and rental charges, along the household income distribution based on the probit estimation for households with expenses in that category and the set of controls used in equation (7.1). In response to a price increase for child care, 87% of households whose income is between \$50,000 and \$60,000 would reduce their demand as opposed to less than 38% for households earning between \$150,000 and \$200,000. In response to a price increase of fast food, take-out, delivery, or full-service restaurants, 85% of households whose income is between \$50,000 and \$60,000 would reduce their demand as opposed to less than 59% for households earning between \$150,000 and \$200,000. In response to a price increase of vehicles, maintenance and repairs, or leases and rental charges, 81% of households whose income is between \$50,000 and \$60,000 would reduce their demand as opposed to less than 52% for households earning between \$150,000 and \$200,000.

Similarly, households who are more likely not to adjust their consumption level when prices rise are wealthier, as Table 7.3 shows. For them, the demand for food at home (column 1), food away (2), apparel (3), personal insurance (10), appliances (13), and vehicle purchases, maintenance and repairs, leases and rental charges (15) is perfectly inelastic. The only exception is the demand for tobacco and other smoking products (11). In that case, less well-off households are more likely not to adjust their consumption level if prices were to increase.

Figure 7.2 presents the predicted probability of *not* adjusting demand for (a) tobacco and other smoking products, (b) food away, and (c) vehicle purchases, maintenance and repairs, leases and rental charges, along the household income distribution based on the probit estimation for households with expenses in that category and the set of controls used in equation (7.1). For instance, in response to a price increase of tobacco, only 1% of households earning between \$150,000 and \$200,000 would not change their demand for tobacco, while 31% of households whose income is between \$50,000 and \$60,000 would consume the same amount of tobacco in spite of the price hike. The

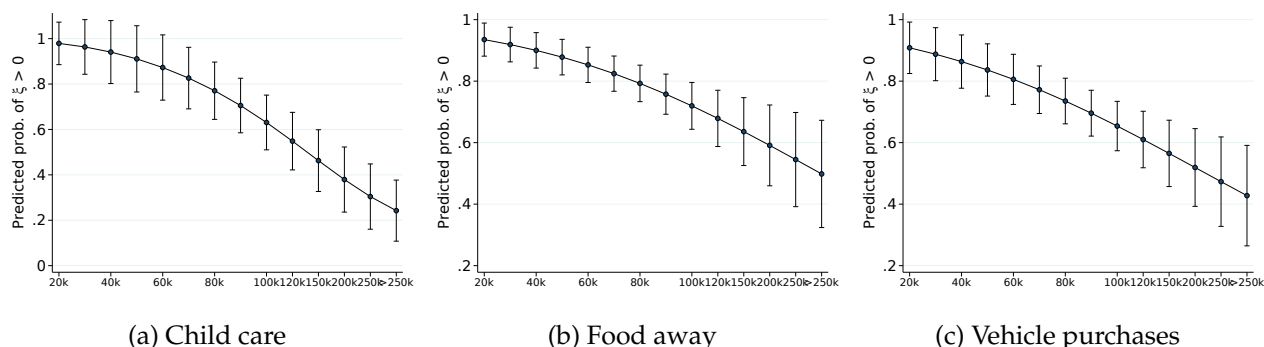
Table 7.3: Effect of income on price elasticity of demand, $\hat{\beta}$

Specification	Price elasticity of demand							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Elastic (LPM)</i>	-0.020*	-0.034***	-0.014*	-0.037**	-0.024**	-0.027**	-0.027*	-0.079**
	(0.011)	(0.010)	(0.008)	(0.014)	(0.012)	(0.012)	(0.014)	(0.034)
Observations	581	555	476	86	513	444	428	52
Adjusted R ²	0.059	0.126	0.190	0.478	0.144	0.115	0.120	0.465
<i>Elastic (Probit)</i>	-0.053*	-0.125***	-0.083**	-0.177***	-0.073**	-0.079**	-0.077**	-0.386***
	(0.029)	(0.033)	(0.036)	(0.050)	(0.032)	(0.031)	(0.038)	(0.121)
Observations	581	555	476	86	513	444	428	52
Adjusted R ²	0.044	0.125	0.207	0.446	0.121	0.094	0.093	0.458
<i>Inelastic (LPM)</i>	0.019*	0.021***	0.014**	0.014	0.015	0.017	0.015	0.029
	(0.010)	(0.008)	(0.007)	(0.010)	(0.011)	(0.012)	(0.013)	(0.027)
Observations	581	555	476	86	513	444	428	52
Adjusted R ²	0.040	0.111	0.108	0.521	0.129	0.074	0.082	0.218
<i>Inelastic (Probit)</i>	0.051*	0.105***	0.111**	0.098*	0.049	0.056*	0.043	-0.042
	(0.028)	(0.033)	(0.044)	(0.053)	(0.031)	(0.033)	(0.036)	(0.105)
Observations	581	555	476	86	513	444	428	46
Adjusted R ²	0.030	0.154	0.198	0.521	0.114	0.067	0.066	0.188
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	
<i>Elastic (LPM)</i>	-0.032**	-0.054***	-0.012	-0.019	-0.016	-0.028***	-0.037***	
	(0.015)	(0.013)	(0.016)	(0.012)	(0.011)	(0.009)	(0.011)	
Observations	105	270	76	370	279	383	464	
Adjusted R ²	0.300	0.162	0.607	0.168	0.153	0.135	0.143	
<i>Elastic (Probit)</i>	-0.120**	-0.160***	-0.045	-0.067*	-0.069*	-0.128***	-0.125***	
	(0.059)	(0.042)	(0.066)	(0.040)	(0.042)	(0.038)	(0.035)	
Observations	105	270	76	370	279	383	464	
Adjusted R ²	0.260	0.130	0.620	0.159	0.171	0.161	0.134	
<i>Inelastic (LPM)</i>	0.009	0.034***	-0.016**	0.004	0.012*	0.004	0.024**	
	(0.013)	(0.012)	(0.008)	(0.007)	(0.007)	(0.005)	(0.009)	
Observations	105	270	76	370	279	383	464	
Adjusted R ²	0.342	0.144	0.163	0.118	0.151	0.085	0.068	
<i>Inelastic (Probit)</i>	0.051	0.117***	-0.294***	0.019	0.104**	0.034	0.094***	
	(0.060)	(0.044)	(0.088)	(0.039)	(0.050)	(0.044)	(0.032)	
Observations	105	270	54	370	279	383	464	
Adjusted R ²	0.321	0.132	0.385	0.206	0.325	0.171	0.075	

Note: The estimated coefficients are for the effect of household income on the price elasticity of demand for each specification, $\hat{\beta}$. *Elastic* stands for the case in which the price elasticity of demand is positive, while *Inelastic* stands for the case in which the price elasticity of demand is equal to 0. The regressions are estimated for each category of goods and services separately and include the following set of controls: age, employment status, gender, household size, industry, occupation, race, relationship status. Each column is for a category: (1) food at home; (2) food away; (3) apparel; (4) public transportation; (5) vehicle insurance; (6) medical and dental services, drugs and medical supplies; (7) health insurance; (8) child care, preschool tuition, or care of elderly; (9) school and college tuition and related expenses; (10) personal insurance; (11) tobacco and other smoking products; (12) other lodging expenses out of town; (13) appliances; (14) audio and visual equipment and services; (15) vehicle purchases, maintenance and repairs, leases and rental charges. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

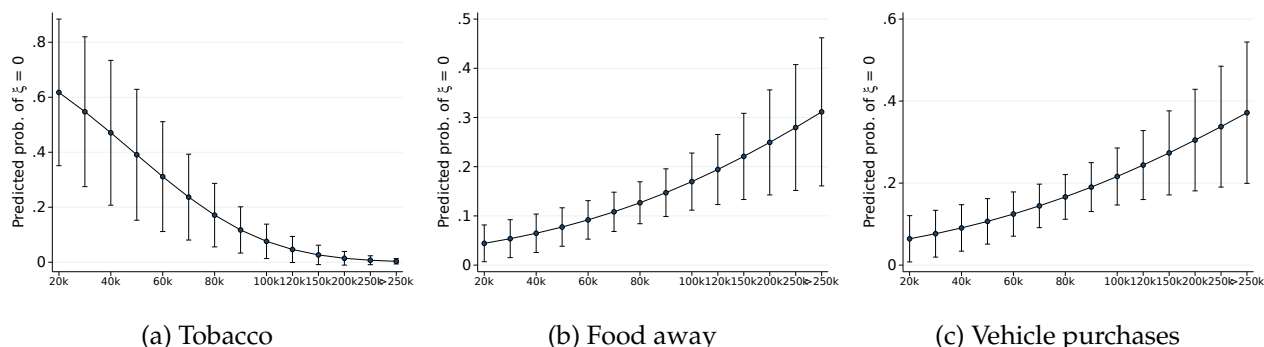
discussion of the results on quality is in Appendix D.2.

Figure 7.1: Who is more likely to adjust demand in response to a price increase?



Note: Panel (a) shows the probability of adjusting child care demand in response to a price increase along different household income levels, based on the probit estimation for households with expenses in that category and the set of controls. Panel (b) shows the same response for food away. Panel (c) shows the same response for vehicle purchases, maintenance and repairs, leases and rental charges.

Figure 7.2: Who is more likely *not* to adjust demand in response to a price increase?



Note: Panel (a) shows the probability of *not* adjusting tobacco and other smoking products demand in response to a price increase along different household income levels, based on the probit estimation for households with expenses in that category and the set of controls. Panel (b) shows the same response for food away. Panel (c) shows the same response for vehicle purchases, maintenance and repairs, leases and rental charges.

8 Conclusion

This paper documents that the rise of services is the key driver of the rise in markups. This rise is observed despite similar trends in the share of fixed costs in terms of sales for firms in the services and non-services sectors and is robust to dropping superstar firms. In particular, this rise is consistent with the pattern of structural change shifting economic activity and consumption from manufacturing toward services and characterized by an increase in the relative price of services.

Therefore, this suggests that the two standard drivers of structural change—namely, differential rates of technological progress and income effects through non-homotheticities—can potentially explain the rise of markups. This paper quantitatively demonstrates that the drivers of structural

change lead to the rise of markups. The condition necessary for this to happen is to design preferences that make the price elasticity of demand for goods and services increasing in consumers' income—what Harrod (1936) called the *Law of Diminishing Elasticity of Demand*—as well as the pass-through of efficiency gains to consumers to be smaller than one—often referred to as Marshall's (1890) *Second Law of Demand*. This paper provides the theoretical foundation for this mechanism. Results from novel experimental data based on a representative online survey eliciting demand elasticities supports the assumed form of preferences.

A two-sector model of structural change is built and calibrated to U.S. data over the 1980-2015 period. I use the model to assess the quantitative importance of structural change for understanding the rise in markups. I find that skill-biased technological change, which reduces marginal costs but increases income inequality, was the main driver of the rise in markups. In particular, keeping income inequality at its 1980 level would have lead to a decline in the aggregate markup. In contrast, changes in fixed costs seem to have played a minor role in the increase in markups. Keeping the price of goods and services constant over time mitigates the increase in markups. However, consumers would be worse off in both counterfactual economies.

The findings in this paper have important implications for the interpretation of the rise of markups in particular and for models of imperfect competition in general. Jointly modeling changes in demand and supply provides a new avenue for analyzing markups and market power. In addition, the increasing importance of services poses new challenges that have yet to be quantified. They allowed firms to offer more targeted and specialized products to consumers, increasing their abilities to price discriminate between them. The advent of digital advertising and big data may have facilitated this better targeting of consumers. Those considerations are left for future research.

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Appendix

A Empirics

A.1 Concentration and services

A market here is defined at the four-digit NAICS code. Thus, the four-digit industry-level HHI in any given year is $HHI_{\kappa t} = \sum_{i=1}^{N_{\kappa t}} s_{it}^{\kappa 2}$, where s_{it}^{κ} is the market share of firm i in the κ four-digit NAICS market. Each industry κ 's HHI is then aggregated using the cost share of that industry in total variable costs, $\omega_{\kappa t}$ (using Compustat's Cogs),³³ according to

$$HHI_t = \sum_{\kappa=1}^{K_t} \omega_{\kappa t} HHI_{\kappa t}.$$

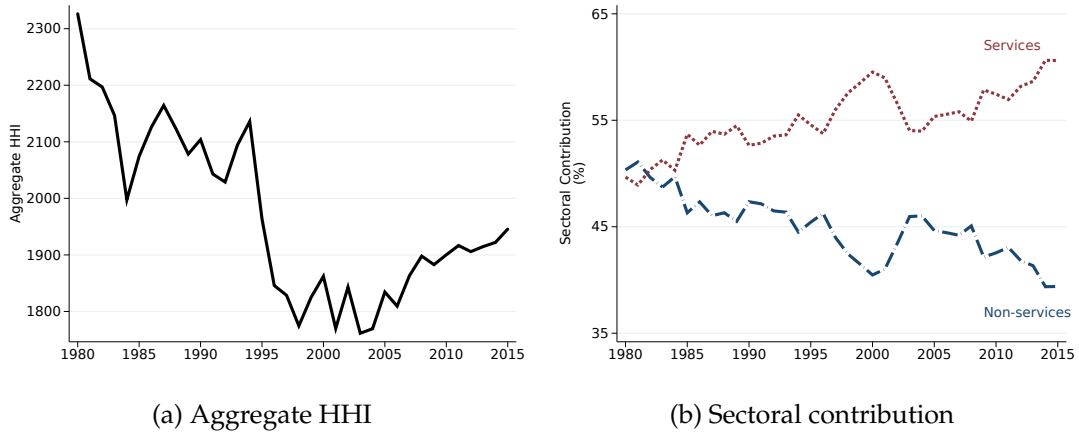
The aggregate HHI can be divided into the services and non-services HHI as was done above. Each sectoral HHI is then the product of the sectoral shares in the economy and the average concentration index within the sector across the κ different industries.

Figure A.2.1a in Appendix A.2 shows the aggregate HHI. The index stays fairly high in the 1980s and starts declining in the mid-1990s. Starting in the early 2000s, the HHI rises steadily in line with Grullon, Larkin, and Michaely (2019) and substantially over the last few years. Between 2000 and 2018, the HHI increased 14%. Figure A.2.1b shows the sectoral contribution to the aggregate HHI. The rise in concentration starting in the 2000s is driven by the rise of the services sector. On average, industries within the services sector are more concentrated than in the goods sector (764 points higher). Figure A.2.2 shows the aggregate HHI when (i) the HHI in non-services industries are fixed at their 1980 levels, (ii) the HHI in services industries are fixed at their 1980 levels, and (iii) the four-digit industry cost shares are fixed at their 1980 levels. Starting in the late 2000s the reallocation of economic activity toward the services, as evidenced by fixing industry shares at their 1980 levels, contributed to the rise of concentration. Without that transition, the aggregate HHI would have declined.

A.2 Additional figures

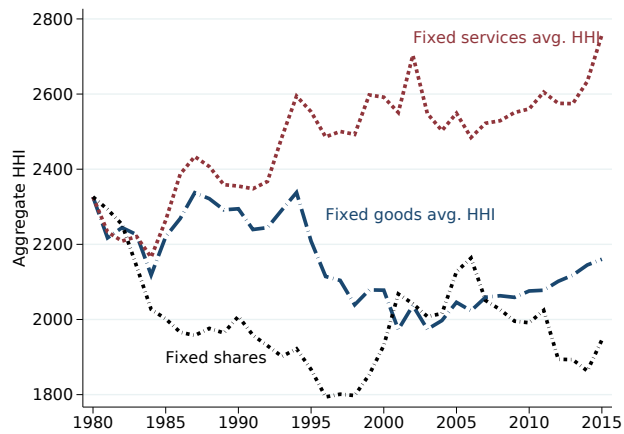
³³Note that KLEMS data is not available at the four-digit NAICS code starting in 1980 and hence Compustat is used to measure industry cost shares.

Figure A.2.1: U.S. HHI by sector



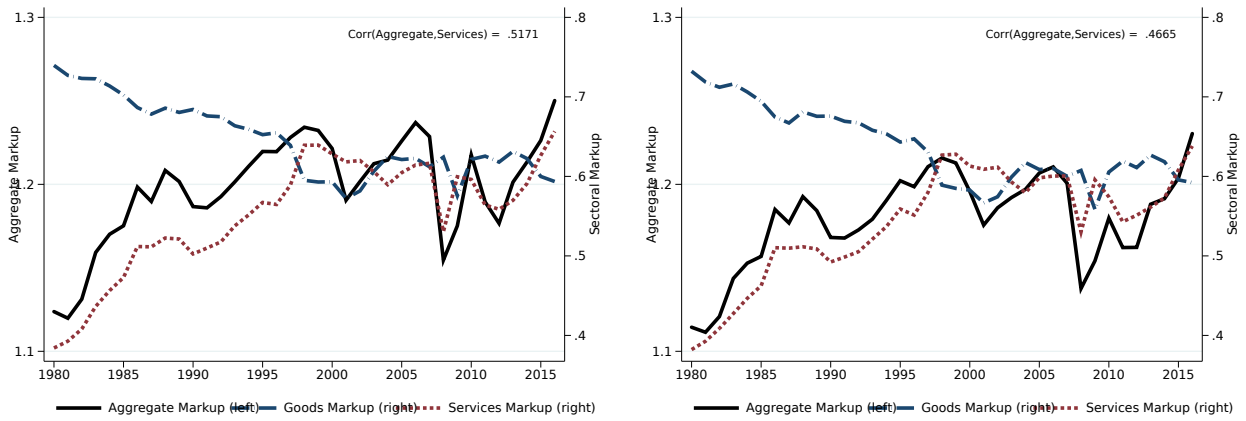
Note: Panel (a) shows the aggregate HHI measured as the cost-weighted average of four-digit NAICS industries' HHI, using data from Compustat. Panel (b) shows the sectoral contribution to the aggregate HHI (non-services in blue, services in red), using data from Compustat.

Figure A.2.2: Aggregate HHI across scenarios



Note: The plot shows the aggregate HHI when the average HHI within each four-digit NAICS industry is fixed at its 1980 level (non-services in blue, services in red) and when the sectoral cost share are fixed at their 1980 level (black), using data from Compustat.

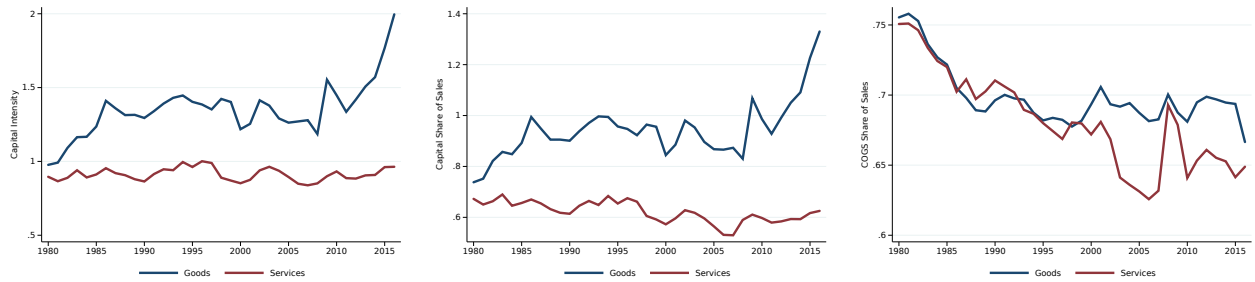
Figure A.2.3: Markups and superstars



(a) Markups and superstars (top 5th percentile)

(b) Markups and superstars (top 10th percentile)

Figure A.2.4: Firm characteristics



(a) Capital intensity

(b) Capital share of Sales

(c) COGS share of Sales

A.3 Additional tables

Table A.3.1: Firm's markups across sectors

	Firm-level markups			
	(1)	(2)	(3)	(4)
Services	0.352*** (0.005)	0.337*** (0.005)		
Consumer Services			0.391*** (0.007)	0.367*** (0.006)
Producer Services			0.315*** (0.007)	0.305*** (0.007)
Time FE	No	Yes	No	Yes
Observations	271,627	271,627	271,627	271,627
Adjusted R ²	0.017	0.047	0.018	0.047

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A.3.2: Industry-level HHI across sectors

	Industry-level HHI			
	(1)	(2)	(3)	(4)
Services	759.47*** (57.68)	764.10*** (57.52)		
Consumer Services			879.35*** (68.31)	882.54*** (68.10)
Producer Services			623.40*** (69.96)	629.33*** (69.69)
Time FE	No	Yes	No	Yes
Observations	12,521	12,521	12,521	12,521
Adjusted R ²	0.013	0.024	0.014	0.025

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

B Theory

B.1 Proof of Proposition 3.1 (Markup)

Proof. Assume firms have constant returns to scale technologies. If the firm is a monopolist or a monopolistic competitor, it solves the following profit maximization problem

$$\max_{c>0} p(c) c - mc c.$$

A solution to this problem must satisfy the first-order condition, which equates the marginal revenue to the marginal cost. Dividing both sides by $p(c)$, we have

$$\frac{\partial p(c)}{\partial c} \frac{c}{p(c)} + 1 = \frac{1}{m(c)},$$

where $m(c)$ is the firm's markup, and rearranging

$$m(c) = \frac{\xi(c)}{\xi(c) - 1},$$

where $\xi(c)$ is the price elasticity of aggregate demand or the weighted of each individual's own price elasticity of demand $\xi(c) = \sum_i \omega_i(c) \xi_i(c)$.

If the firm is an oligopolist competing à la Cournot, it solves the following profit maximization problem

$$\max_{c_j>0} p(c) c_j - mc_j c_j \quad \text{s.t.} \quad c_j + \sum_{\kappa=1}^N c_\kappa = c,$$

where N is the number of oligopolistic competitors. As before, a solution to this problem must satisfy the first-order condition, which equates the marginal revenue to the marginal cost. This can be written as

$$\frac{\partial p(c)}{\partial c} \frac{c}{p(c)} \frac{\partial c}{\partial c_j} \frac{c_j}{c} + 1 = \frac{1}{m_j(c)},$$

and rearranging

$$m_j(c) = \frac{\xi(c)}{\xi(c) - \epsilon_j(c)},$$

where $\epsilon_j(c)$ firm j 's output elasticity of aggregate demand, which includes the strategic interactions over the oligopolists as $\frac{\partial c}{\partial c_j} = 1 + \sum_{\kappa=1}^N \frac{\partial c_\kappa(c_j)}{\partial c_j}$. Firms' markup is increasing in $\epsilon_j(c)$ as $\frac{\partial m_j(c)}{\partial \epsilon_j(c)} = \frac{m_j(c)^2}{\xi(c)} > 0$. \square

B.2 Proof of Proposition 3.2 (Price and income elasticities of demand)

Proof. Rearrange equation (3.2) to have

$$\frac{1}{\partial v(e_i, \mathbf{p})/\partial p(\omega)} = \frac{1}{\partial^2 v(e_i, \mathbf{p})/\partial p(\omega)^2} \left[\frac{\partial^2 v(e_i, \mathbf{p})/\partial e_i \partial p(\omega)}{\partial v(e_i, \mathbf{p})/\partial e_i} - \frac{\xi(e_i, p(\omega), \mathbf{p})}{p(\omega)} \right]$$

and rewrite the income super-elasticity of utility $\varphi(e_i, \mathbf{p})$ as

$$\varphi(e_i, \mathbf{p}) = - \left[1 + \Phi(e_i, \mathbf{p}) + e_i \frac{\partial^2 v(e_i, \mathbf{p})/\partial e_i^2}{\partial v(e_i, \mathbf{p})/\partial e_i} \right].$$

Next, plug these in equation (3.3) to have the income elasticity of demand as

$$\eta(e_i, p(\omega), \mathbf{p}) = 1 + \Phi(e_i, \mathbf{p}) + \varphi(e_i, \mathbf{p}) + \frac{[\xi(e_i, p(\omega), \mathbf{p}) - \alpha(e_i, p(\omega), \mathbf{p})]}{\chi(e_i, p(\omega), \mathbf{p})}.$$

Rearranging this equation gives the result in the proposition, i.e.

$$\xi(e_i, p(\omega), \mathbf{p}) = \alpha(e_i, p(\omega), \mathbf{p}) + \chi(e_i, p(\omega), \mathbf{p}) [\eta(e_i, p(\omega), \mathbf{p}) + (\Phi(e_i, \mathbf{p}) + \varphi(e_i, \mathbf{p})) - 1]$$

If the price elasticity of demand is instead defined as $\xi(e_i, p(\omega), \mathbf{p}) = -p(\omega) \frac{\partial^2 v(e_i, \mathbf{p})/\partial p(\omega)^2}{\partial v(e_i, \mathbf{p})/\partial p(\omega)}$, we have that

$$\alpha(e_i, p(\omega), \mathbf{p}) - p(\omega) \frac{\partial^2 v(e_i, \mathbf{p})/\partial e_i \partial p(\omega)}{\partial v(\partial p(\omega))/\partial e_i} = 0,$$

which defines the variety-specific fixed effect. In that case, the relationship between the price and income elasticities of demand is simply

$$\xi(e_i, p(\omega), \mathbf{p}) = \chi(e_i, p(\omega), \mathbf{p}) [\eta(e_i, p(\omega), \mathbf{p}) + (\Phi(e_i, \mathbf{p}) + \varphi(e_i, \mathbf{p})) - 1].$$

□

B.3 Proof of Proposition 3.3 (Price elasticity of demand across income)

Proof. The derivative of a consumer's price elasticity of demand for a variety ω with respect to her income is given by

$$\frac{\partial \xi(e_i, p(\omega), \mathbf{p})}{\partial e_i} = \xi(e_i, p(\omega), \mathbf{p}) \left[\frac{\partial^3 v(e_i, \mathbf{p})/\partial p(\omega)^2 \partial e_i}{\partial^2 v(e_i, \mathbf{p})/\partial p(\omega)^2} - \frac{\partial^2 v(e_i, \mathbf{p})/\partial p(\omega) \partial e_i}{\partial v(e_i, \mathbf{p})/\partial p(\omega)} \right].$$

The expression in the square brackets must be negative for the price elasticity of demand for a variety ω to be decreasing in the consumer's income, e_i . Recall that under Assumption 3.2, the following holds: (i) $\frac{\partial v(e_i, \mathbf{p})}{\partial p(\omega)} < 0$ for all $p(\omega)$; (ii) $\frac{\partial^2 v(e_i, \mathbf{p})}{\partial e_i \partial p(\omega)} \neq 0$ for all $p(\omega)$; and (iii) $\frac{\partial^2 v(e_i, \mathbf{p})}{\partial p(\omega)^2} > 0$. Using the definition of the pass-through (equation (3.4)) and rearranging the term in the square brackets implies the result in the proposition, i.e.,

$$\frac{\partial^3 v(e_i, \mathbf{p})/\partial p(\omega)^2 \partial e_i}{\partial^2 v(e_i, \mathbf{p})/\partial p(\omega)^2} < \frac{\xi(e_i, p(\omega), \mathbf{p})}{\chi(e_i, p(\omega), \mathbf{p}) e_i}.$$

□

B.4 Proof of Proposition 3.4 (Price elasticity of demand across price)

Proof. The derivative of a consumer's price elasticity of demand for a variety ω with respect to its price is given by

$$\frac{\partial \xi(e_i, p(\omega), \mathbf{p})}{\partial p(\omega)} = \frac{\xi(e_i, p(\omega), \mathbf{p})}{p(\omega)} \left[1 + p(\omega) \frac{\partial^3 v(e_i, \mathbf{p}) / \partial p(\omega)^3}{\partial^2 v(e_i, \mathbf{p}) / \partial p(\omega)^2} + \xi(e_i, p(\omega), \mathbf{p}) \right].$$

The expression in the square brackets must be positive for the price elasticity of demand for a variety ω to be increasing in its price, $p(\omega)$. Recall that under Assumption 3.2, $\frac{\partial^2 v(e_i, \mathbf{p})}{\partial p(\omega)^2} > 0$. Rearranging the term in the square brackets implies the result in the proposition, i.e.,

$$\frac{\partial^3 v(e_i, \mathbf{p}) / \partial p(\omega)^3}{\partial^2 v(e_i, \mathbf{p}) / \partial p(\omega)^2} < -\frac{(1 + \xi(e_i, p(\omega), \mathbf{p}))}{p(\omega)}.$$

□

C Quantitative Analysis

C.1 Assumptions on the indirect subutility

Assumption C.1. (SECTORAL INDIRECT SUBUTILITY) *The sector-specific indirect subutility $v_j(e, p_j, q_j)$ satisfies the standard properties of indirect utilities, namely: $v_j(e, p_j, q_j)$ is continuous on \mathbb{R}^3 ; decreasing in prices, $\frac{\partial v_j}{\partial p_j(\omega)} \leq 0$; strictly increasing in income, $v'_e > 0$; homogeneous of degree 0 in $(e, p_j(\omega))$; convex, and hence quasiconvex, in $(e, p_j(\omega))$ up to a choke price, which is the the maximum willingness to pay for each variety of commodity j (common to all households and possibly infinite). For any price above that choke price, the indirect subutility is such that $v_j = v'_{j_p} = v'_{j_e} = 0$ (and it is thus assumed that $v_j > 0$ for any price below). It is further assumed that v_j is at least thrice differentiable, with $v''_{j_{p,p}} > 0$, $v''_{j_{p,w}} < 0$, $v'''_{j_{p,p,p}} < -\frac{v''_{j_{p,p}}}{p_j(\omega)} < 0$, and $v'''_{j_{p,p,w}} < 0$, which ensures that the price elasticity of demand is positive and that commodities consumed conform to the law of demand.*

C.2 Proof of Proposition 4.1 (From the indirect to the direct utility)

Start from the household's consumption demand for some variety ω of commodity $j \in \{G, S\}$ using Roy's identity

$$c_{j_t}(\omega) = -\frac{(\partial \hat{v}_j(e_t, p_{j_t}(\omega), q_{j_t}(\omega))/\partial p_{j_t}(\omega)) e_{i_t}}{(v_j(e_t, p_{j_t}, q_{j_t})/\lambda_j) \Phi_t(e_t, p_{G_t}, p_{S_t}, q_{G_t}, q_{S_t})'}$$

where $\partial \hat{v}_j(e_t, p_{j_t}(\omega), q_{j_t}(\omega))/\partial p_{j_t}(\omega) = -\frac{1}{e_t} \left(\frac{\phi_j e_t - p_{j_t}(\omega)}{e_t} \right)^{\gamma_j} q_{j_t}(\omega)^{\delta_j(1+\gamma_j)}$. Rearrange this expression to write

$$\left(\frac{\phi_j e_t - p_{j_t}(\omega)}{e_t} \right)^{1+\gamma_j} = -\left[\frac{v_j(e_t, p_{j_t}, q_{j_t}) \Phi_t(e_t, p_{G_t}, p_{S_t}, q_{G_t}, q_{S_t}) c_{j_t}(\omega)}{\lambda_j} \right]^{\frac{1+\gamma_j}{\gamma_j}} q_{j_t}(\omega)^{-\frac{\delta_j(1+\gamma_j)^2}{\gamma_j}}.$$

Use this in the sectoral indirect utility (equation (4.3)) to write it as a function of consumption and quality. This results in the following sectoral *direct* utility u_j given by

$$u_j(c_{G_t}, c_{S_t}, q_{G_t}, q_{S_t})^{-\frac{1}{\gamma_j}} = -\frac{1}{1+\gamma_j} \left[\frac{\Phi_t(e_t, p_{G_t}, p_{S_t}, q_{G_t}, q_{S_t}) \tilde{C}_{j_t}}{\lambda_j} \right]^{\frac{1+\gamma_j}{\gamma_j}},$$

where $\tilde{C}_{j_t} = \left(\int_0^{N_{j_t}} \left[\frac{c_{j_t}(\omega)}{q_{j_t}(\omega)^{\delta_j}} \right]^{\frac{1+\gamma_j}{\gamma_j}} d\omega \right)^{\frac{\gamma_j}{1+\gamma_j}}$. To derive an expression of the income elasticity of the indirect utility, Φ , as a function of consumption, use the equations above to write the consumption spending share on commodity j as

$$\frac{\int_0^{N_{j_t}} p_{j_t}(\omega) c_{j_t}(\omega) d\omega}{e_t} = \phi_j \int_0^{N_{j_t}} c_{j_t}(\omega) d\omega + \left[\frac{u_j(c_{G_t}, c_{S_t}, q_{G_t}, q_{S_t}) \Phi_t(e_t, p_{G_t}, p_{S_t}, q_{G_t}, q_{S_t})}{\lambda_j} \right]^{\frac{1}{\gamma_j}} \tilde{C}_{j_t}^{\frac{1+\gamma_j}{\gamma_j}}.$$

Note that from the definition of the direct utility above, we have

$$\frac{\int_0^{N_{j_t}} p_{j_t}(\omega) c_{j_t}(\omega) d\omega}{e_t} = \phi_j \int_0^{N_{j_t}} c_{j_t}(\omega) d\omega - (1 + \gamma_j) \frac{\lambda_j}{\Phi_t(e_t, \mathbf{p}_{G_t}, \mathbf{p}_{S_t}, \mathbf{q}_{G_t}, \mathbf{q}_{S_t})}.$$

Next, use that expression in the budget constraint to get

$$\widehat{C}_t - \frac{1}{\Phi_t(e_t, \mathbf{p}_{G_t}, \mathbf{p}_{S_t}, \mathbf{q}_{G_t}, \mathbf{q}_{S_t})} [(1 + \gamma_G)\lambda_G + (1 + \gamma_S)\lambda_S] = 1,$$

where $\widehat{C}_t = \phi_G \int_{\Omega_{G_t}} c_{G_t}(\omega) d\omega + \phi_S \int_{\Omega_{S_t}} c_{S_t}(\omega) d\omega$. Now that an expression for Φ was obtained as a function of consumption and parameters, we can replace it in the definition of the sectoral direct utility according to

$$u_j(\mathbf{c}_{G_t}, \mathbf{c}_{S_t}, \mathbf{q}_{G_t}, \mathbf{q}_{S_t}) = -\frac{1}{1 + \gamma_j} \left[\frac{\lambda_j(1 + \gamma_j)}{\lambda_G(1 + \gamma_G) + \lambda_S(1 + \gamma_S)} \right]^{1 + \gamma_j} \left(\frac{\widehat{C}_t - 1}{\widetilde{C}_{j_t}} \right)^{1 + \gamma_j}.$$

To get the direct utility, aggregate the two sectoral direct utilities using the Cobb-Douglas weights λ_G and λ_S according to

$$u(\mathbf{c}_{G_t}, \mathbf{c}_{S_t}, \mathbf{q}_{G_t}, \mathbf{q}_{S_t}) = \psi \left(\frac{\widehat{C}_t - 1}{\widetilde{C}_{G_t}} \right)^{\lambda_G(1 + \gamma_G)} \left(\frac{\widehat{C}_t - 1}{\widetilde{C}_{S_t}} \right)^{\lambda_S(1 + \gamma_S)},$$

where $\psi = (1 + \gamma_G)^{-\lambda_G} (1 + \gamma_S)^{-\lambda_S} \left[\frac{\lambda_G(1 + \gamma_G)}{\lambda_G(1 + \gamma_G) + \lambda_S(1 + \gamma_S)} \right]^{\lambda_G(1 + \gamma_G)} \left[\frac{\lambda_S(1 + \gamma_S)}{\lambda_G(1 + \gamma_G) + \lambda_S(1 + \gamma_S)} \right]^{\lambda_S(1 + \gamma_S)}$.

C.3 Proof of Proposition 4.2 (Two-sector CES)

Assume $\phi_j = 0$, $\gamma_j < -1$, and $\delta_j < 0$ for $j = \{G, S\}$. Denote the elasticity of substitution across varieties by $\vartheta_j = -\gamma_j$ and let P_{j_t} denote the sectoral ideal price index given by

$$P_{j_t} = \left[\int_0^{N_{j_t}} p_{j_t}(\omega)^{1 - \vartheta_j} q_{j_t}(\omega)^{\delta_j(1 - \vartheta_j)} d\omega \right]^{\frac{1}{1 - \vartheta_j}}.$$

The direct utility is then given by

$$u(\mathbf{c}_{G_t}, \mathbf{c}_{S_t}, \mathbf{q}_{G_t}, \mathbf{q}_{S_t}) = \psi \widetilde{C}_{G_t}^{\lambda_G(\vartheta_G - 1)} \widetilde{C}_{S_t}^{\lambda_S(\vartheta_S - 1)}$$

and the indirect utility by

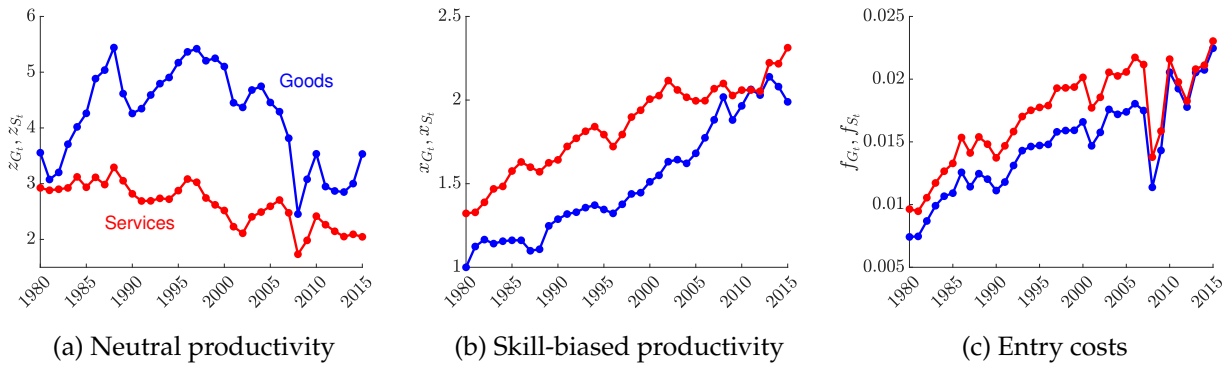
$$v(e_t, \mathbf{p}_{G_t}, \mathbf{p}_{S_t}, \mathbf{q}_{G_t}, \mathbf{q}_{S_t}) = \left[\int_0^{N_{G_t}} \frac{1}{\vartheta_G - 1} \left[\frac{e_t}{(\phi_G e_t - p_{G_t}(\omega)) q_{G_t}(\omega)^{\delta_G}} \right]^{\vartheta_G - 1} d\omega \right]^{\lambda_G} \left[\int_0^{N_{S_t}} \frac{1}{\vartheta_S - 1} \left[\frac{e_t}{(\phi_S e_t - p_{S_t}(\omega)) q_{S_t}(\omega)^{\delta_S}} \right]^{\vartheta_S - 1} d\omega \right]^{\lambda_S}.$$

The consumption demand for variety ω of commodity j is

$$c_{j_t}(\omega) = \left[\frac{p_{j_t}(\omega)}{P_{j_t}} \right]^{-\vartheta_j} q_{j_t}(\omega)^{\delta_j(1 - \vartheta_j)} \widetilde{C}_{j_t}.$$

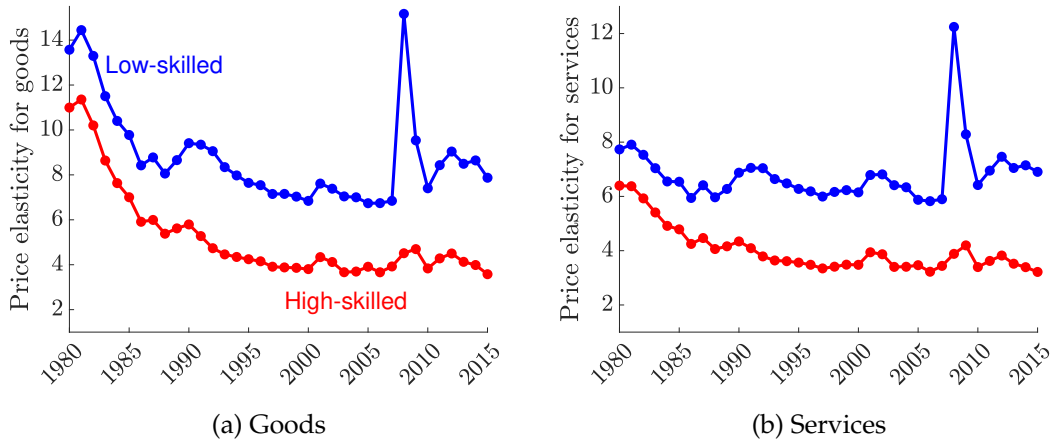
C.4 Additional figures

Figure C.4.1: Model-implied trends in productivity and entry costs



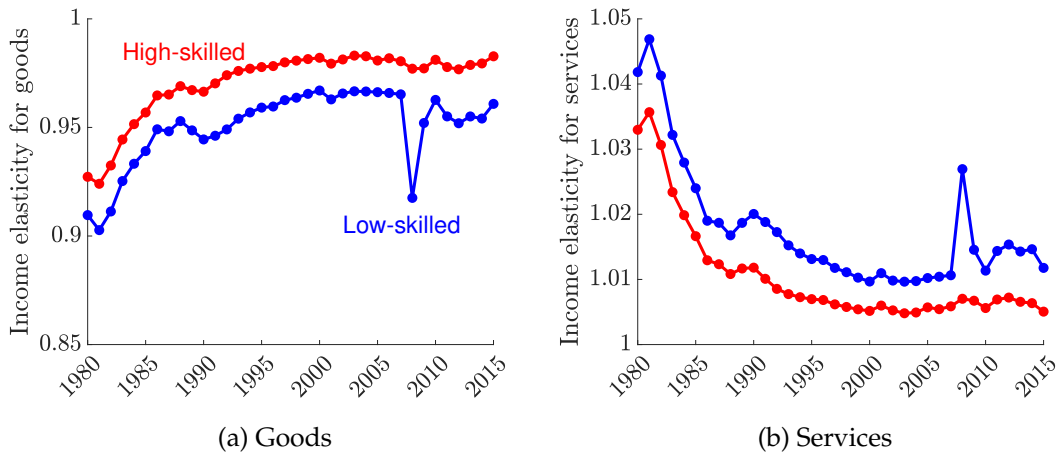
Note: Panel (a) shows the neutral productivity terms in the goods (blue; z_{G_t}) and services (red; z_{S_t}) sectors. Panel (b) shows the skill-biased productivity terms in the goods (blue; x_{G_t}) and services (red; x_{S_t}) sectors. Panel (c) shows the entry cost terms in the goods (blue; f_{G_t}) and services (red; f_{S_t}) sectors.

Figure C.4.2: Price elasticities of demand



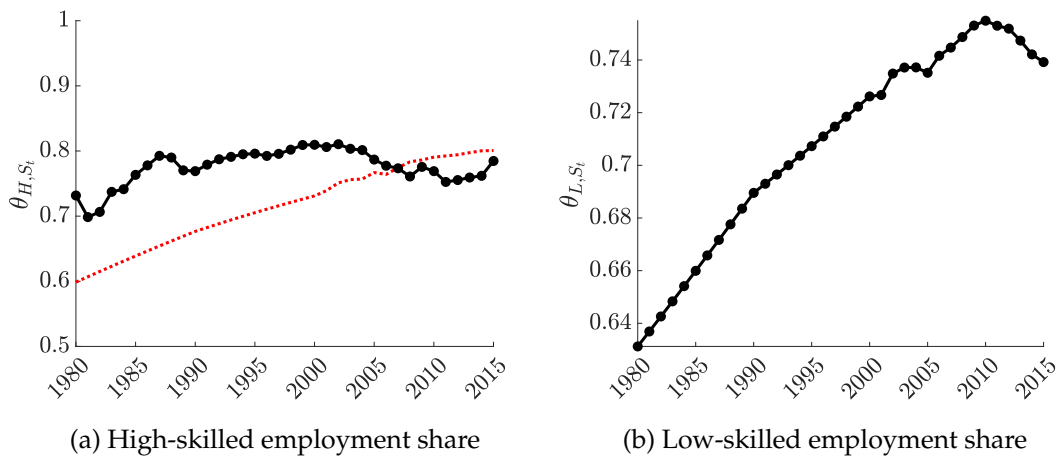
Note: Panel (a) shows the price elasticities of demand for goods for high (red) and low-skilled (blue) households in the model (ξ_{H,G_t} and ξ_{L,G_t}). Panel (b) shows the price elasticities of demand for services (ξ_{H,S_t} and ξ_{L,S_t}).

Figure C.4.3: Income elasticities of demand



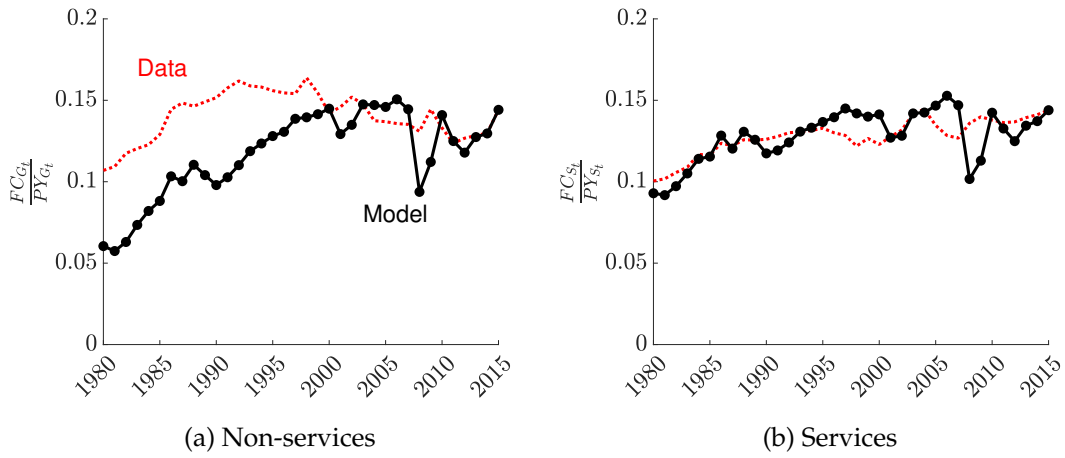
Note: Panel (a) shows the income elasticities of demand for goods for high (red) and low-skilled (blue) households in the model (η_{H,G_t} and η_{L,G_t}). Panel (b) shows the income elasticities of demand for services (η_{H,S_t} and η_{L,S_t}).

Figure C.4.4: Employment in services



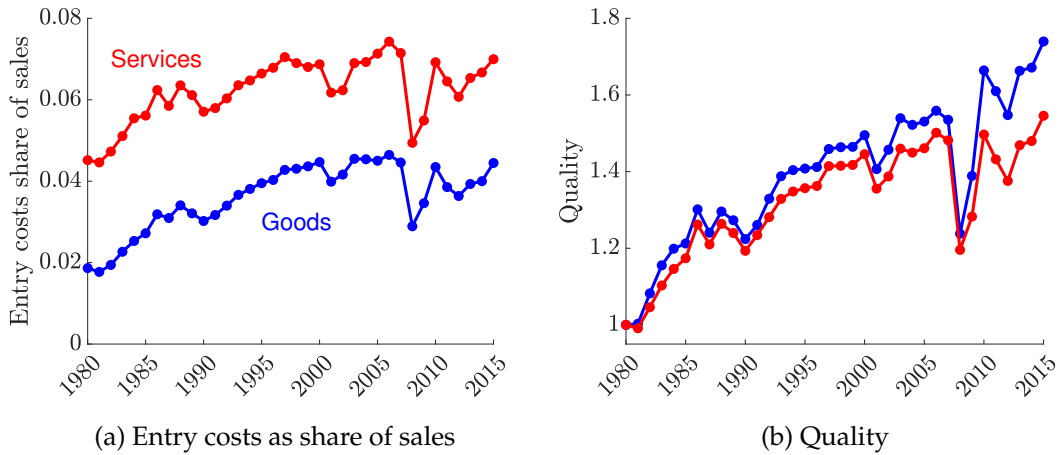
Note: Panel (a) shows the employment share of high-skilled workers (θ_{H,S_t}) in the services sector in the model (black) and data (red). Panel (b) shows the employment share of low-skilled workers (θ_{L,S_t}) in the services sector in the model (black) and data (red). Since the model matches the low-skilled employment share in the services perfectly by construction, the model and data curves are superimposed.

Figure C.4.5: Fixed costs as share of sales



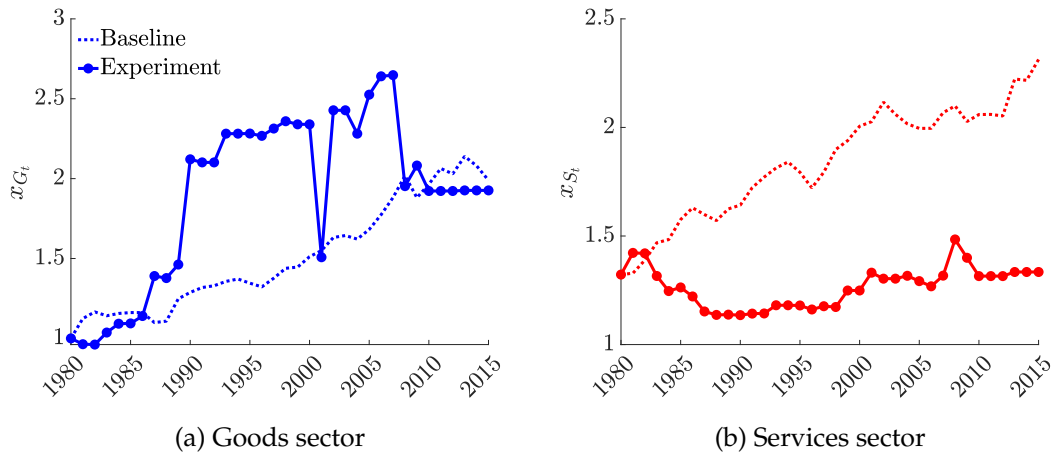
Note: Panel (a) shows the fixed costs related to quality as a share of sales ($\frac{FC_{G_t}}{PY_{G_t}}$) in the goods sector in the model (black) and data (red). Panel (b) shows the fixed costs related to quality as a share of sales ($\frac{FC_{S_t}}{PY_{S_t}}$) in the services sector in the model (black) and data (red).

Figure C.4.6: Quality and Entry costs as share of sales



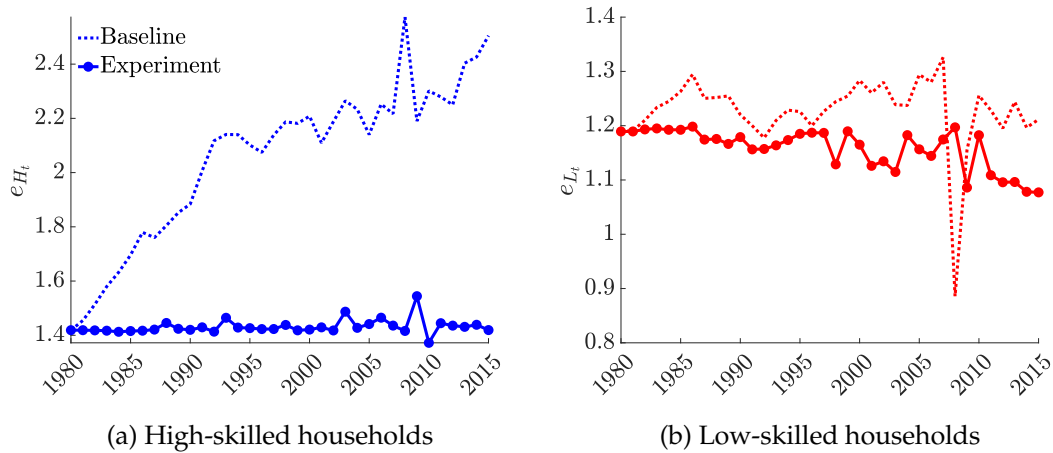
Note: Panel (a) shows the entry costs as a share of sales in the goods (blue; $\frac{EC_{G_t}}{PY_{G_t}}$) and services (red; $\frac{EC_{S_t}}{PY_{S_t}}$) sectors. Panel (b) shows quality in the goods (blue; q_{G_t}) and services (red; q_{S_t}) sectors.

Figure C.4.7: Skill-biased productivity: Low inequality experiment



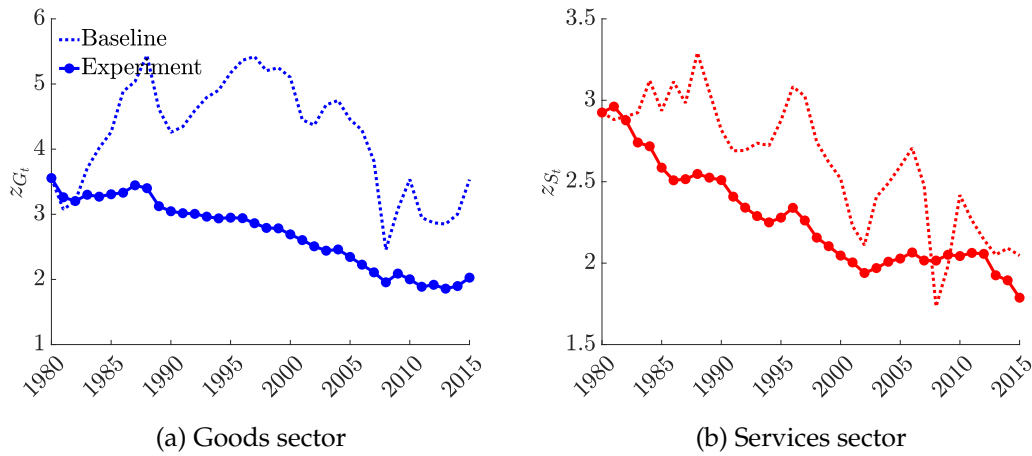
Note: Panel (a) shows the skill-biased productivity term in the goods sector in the baseline (dashed line) and the experiment with low inequality (full line). Panel (b) shows the skill-biased productivity term in the services sector in the baseline (dashed line) and the experiment with low inequality (full line).

Figure C.4.8: Total income: Low inequality experiment



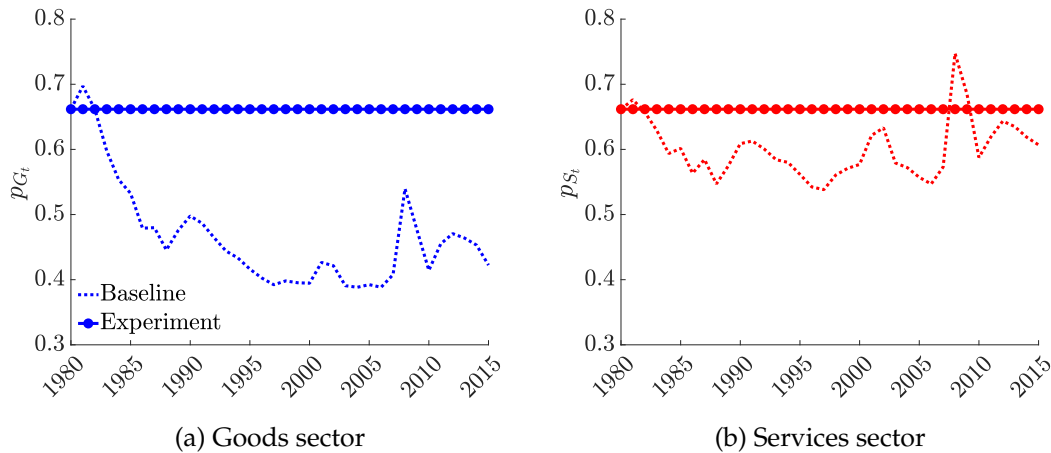
Note: Panel (a) shows the total income of high-skilled households in the baseline (dashed line) and the experiment with low inequality (full line). Panel (b) shows the total income of low-skilled households in the baseline (dashed line) and the experiment with low inequality (full line).

Figure C.4.9: Neutral productivity: Price experiment



Note: Panel (a) shows the neutral productivity term in the goods sector in the baseline (dashed line) and the experiment with constant relative price of services (full line). Panel (b) shows the neutral productivity term in the services sector in the baseline (dashed line) and the experiment with constant relative price of services (full line).

Figure C.4.10: Prices: Price experiment



Note: Panel (a) shows the average price of goods in the baseline (dashed line) and the experiment with constant relative price of services (full line). Panel (b) shows the average price of services in the baseline (dashed line) and the experiment with constant relative price of services (full line).

C.5 Additional tables


Table C.5.1: Experiments: Inequality and prices

Variable	Description	(1)	(2)	(3)	(4)
		Baseline 1980, 2015	$\frac{e_{H_t}}{e_{L_t}}$ and $\frac{w_{H_t}}{w_{L_t}}$ fixed 2015	e_{H_t} and e_{L_t} fixed 2015	p_{G_t} and p_{S_t} fixed 2015
<i>Markups</i>					
M_t	Aggregate markups	1.136, 1.263	1.173	1.132	1.187
$\bar{\pi}_{G_t}$	Average goods markups	1.086, 1.232	1.087	1.340	1.117
$\bar{\pi}_{S_t}$	Average services markups	1.160, 1.272	1.234	1.113	1.222
<i>Relative prices and income</i>					
$\bar{p}_{S_t}/\bar{p}_{G_t}$	Relative price of services	1.000, 1.437	0.749	3.747	1.000
w_{H_t}/w_{L_t}	Skill premium	1.347, 1.928	1.335	1.218	1.901
ϵ_{H_t}	High-skilled income share	0.365, 0.603	0.466	0.493	0.596
ΔPY_t	Percent change in aggregate output		-23.860	-29.744	-6.756
<i>Services shares</i>					
$\omega_{S_t}^{sales}$	Services share	0.685, 0.772	0.616	0.904	0.691
ω_{H,S_t}	High-skilled services cons. spend. share	0.688, 0.773	0.619	0.904	0.696
ω_{L,S_t}	Low-skilled services cons. spend. share	0.684, 0.769	0.613	0.905	0.683
θ_{H,S_t}	High-skilled labor in the services sector	0.732, 0.785	0.747	0.878	0.694
θ_{L,S_t}	Low-skilled employment share in services	0.631, 0.739	0.426	0.956	0.639
<i>Labor shares</i>					
$VC_{H,G_t}/PY_t$	High-skilled labor share in goods	0.093, 0.100	0.107	0.051	0.150
$VC_{H,S_t}/PY_t$	High-skilled labor share in services	0.254, 0.364	0.315	0.367	0.341
$VC_{L,G_t}/PY_t$	Low-skilled labor share in goods	0.197, 0.085	0.247	0.021	0.127
$VC_{L,S_t}/PY_t$	Low-skilled labor share in services	0.337, 0.242	0.183	0.446	0.224
<i>Fixed costs</i>					
$\kappa_G Q_{G_t}/PY_{G_t}$	Share of fixed costs with quality in goods	0.060, 0.144	0.061	0.194	0.080
$\kappa_S Q_{S_t}/PY_{S_t}$	Share of fixed costs with quality in services	0.093, 0.144	0.128	0.068	0.122
$N_{G_t} f_{G_t}/PY_{G_t}$	Entry costs share in goods	0.019, 0.044	0.019	0.060	0.025
$N_{S_t} f_{S_t}/PY_{S_t}$	Entry costs share in services	0.045, 0.070	0.062	0.033	0.059
<i>Entry</i>					
N_{G_t}	Number of active firms in goods	1.000, 1.124	0.611	0.445	0.785
N_{S_t}	Number of active firms in services	4.059, 5.820	3.139	2.279	4.129
<i>Welfare</i>					
Δv_{H_t}	Welfare change for high-skilled households		-0.998	-1.000	-0.922
Δv_{L_t}	Welfare change for low-skilled households		-0.763	-0.999	-0.986
ϵ_H^{ev}	Equiv. var. for high-skilled households (%)		4.912	-3.667	72.792
ϵ_L^{ev}	Equiv. var. for low-skilled households (%)		-9.634	-16.605	-0.502
ϵ_H^{cv}	Comp. var. for high-skilled households (%)		3.123	-16.021	39.634
ϵ_L^{cv}	Comp. var. for low-skilled households (%)		-11.020	-21.601	-0.489

Note: The equivalent variation, ϵ_i^{ev} , solves the following equation $v(e_{i2015}^B (1 + \epsilon_i^{ev}), p_{G2015}^B, p_{S2015}^B, q_{G2015}^B, q_{S2015}^B) = v(e_{i2015}^C, p_{G2015}^C, p_{S2015}^C, q_{G2015}^C, q_{S2015}^C)$ and the compensating variation, ϵ_i^{cv} , solves the following equation $v(e_{i2015}^C (1 - \epsilon_i^{cv}), p_{G2015}^C, p_{S2015}^C, q_{G2015}^C, q_{S2015}^C) = v(e_{i2015}^B, p_{G2015}^B, p_{S2015}^B, q_{G2015}^B, q_{S2015}^B)$, where the superscript B stands for the baseline economy and superscript C for the counterfactual economy.

D Survey

D.1 Questionnaire



Informed Consent

INFORMED CONSENT FORM
UNIVERSITY OF PENNSYLVANIA

Protocol Title: The impact of prices and income on the purchase of goods and services

Principal Investigators:

- Prof. Aviv Nevo, George A. Weiss and Lydia Bravo Weiss University Professor, [Wharton School of Business](#) and [Department of Economics](#), University of Pennsylvania.
- Ricardo Marto, PhD candidate in Economics, [Department of Economics](#), University of Pennsylvania.

Address and Contacts:
The Ronald O. Perelman Center for Political Science and Economics
133 South 36th Street, Suite 150
Philadelphia, PA 19104
consumption-survey-2021@sas.upenn.edu

Research Study:
You are being invited to participate in a research study. Your participation is voluntary and any questions you may have before agreeing to participate in the study can be addressed to the research team at consumption-survey-2021@sas.upenn.edu. If you have any questions about your rights at any time before, during, or after participation, or believe the study has had a negative impact on you, please contact the University of Pennsylvania Institutional Review Board (IRB) at 215-898-2614 for assistance.

If you agree to join the study, you will be asked to complete one online survey. The study team will send you a link to the survey, which can be accessed online via phone or computer, and completed whenever convenient for you. The survey will take approximately 15 minutes to complete. You may also be invited to complete a follow-up survey later in 2022. Your participation will last no longer than 6 months in total.

The objective of the study is to assess how people's purchase of a wide variety of goods and services changes in response to shifts in prices and income. The study is open to any adult age 18 and above, who resides in the US. Your response to the survey will help researchers and policymakers design better antitrust policies. There will be no direct benefit from participating in this research study. The risks of participating in this study, namely data or confidentiality breach, are minimal. Therefore, to protect your data and confidentiality, your personal information will be removed from your survey and all data will be stored on a private computer network that only the study team has access to. You are free to refuse to participate in, or to withdraw from, the study at any point without any consequences. If you drop out of the study, we will store your survey responses unless you specifically ask us to remove them. Your survey responses can be used in future research.

Thank you for your time! We sincerely appreciate your willingness to share your opinion. Feel free to contact the study team at consumption-survey-2021@sas.upenn.edu if you need more information or have any questions.

By clicking "Next," you agree that you have read the information above, understood it, and agree to be part of this research study.

Demographics

What gender do you most identify with?

- Male
 Female
 Other, please specify:

What is your age?

What race/ethnic group do you most identify with?

- White or Caucasian
 Black or African American
 Asian
 Hispanic or Latino
 American Indian or Alaska Native or Native Hawaiian or Pacific Islander
 Other, please specify:

What is the highest level of education you completed?

- Less than high school degree
 High school graduate (high school diploma or equivalent including GED)
 Some college but no degree or Associate degree in college (2-year)
 Bachelor's degree in college (4-year)
 Postgraduate degree (Master, MBA, MD, JD, PhD)

What is your ZIP code?

What is your relationship status?

- Married
 Live-in relationship
 Partnered, not living together
 Widowed
 Divorced
 Single

How many people live in your household?

Adults (18 to 65)

Adults (65 and over)

Children (under 18)

Which statement best describes your current employment status?

- Working full-time
 Working part-time
 Student
 Retired
 Not working (looking for work)
 Not working (disabled)
 Not working (other)

What is the total yearly income (after taxes) of your household?

- Less than \$19,999
- \$20,000 to \$29,999
- \$30,000 to \$39,999
- \$40,000 to \$49,999
- \$50,000 to \$59,999
- \$60,000 to \$69,999
- \$70,000 to \$79,999
- \$80,000 to \$89,999
- \$90,000 to \$99,999
- \$100,000 to \$119,999
- \$120,000 to \$149,999
- \$150,000 to \$199,999
- \$200,000 to \$249,999
- \$250,000 or more

Which of the following occupations most closely matches the one in which you are or were lastly employed?

- Management or Business
- Professional Activities
- Sales and Office support
- Farming, Construction, Production, Transportation
- Government
- Other, please specify:

Which of the following industries most closely matches the one in which you are or were lastly employed?

- Agriculture, Forestry, Fishing, or Hunting
- Mining, Utilities, or Construction
- Manufacturing
- Wholesale or Retail Trade
- Transportation or Warehousing
- Information
- Finance or Insurance
- Real Estate or Rental and Leasing
- Professional, Scientific or Technical Services
- Management of Companies or Enterprises
- Admin, Support, or Waste management or Remediation services
- Educational Services
- Health Care or Social Assistance
- Arts, Entertainment or Recreation
- Accommodation or Food Services
- Public Administration

Which best describe your situation? Select all that apply.

- Homeowner with mortgage
- Homeowner without mortgage
- Renter
- One vehicle (owned or leased)
- Two or more vehicles (owned or leased)

Spending

How much do you spend on **average per month** (US\$) on the following?

1) **Food at home** (e.g. cereals, meats, dairy products, fruits, vegetables)



\$

2) **Food away from home** (e.g. fast food, take-out, delivery, full-service restaurants, excluding alcoholic beverages)



\$

3) **Alcoholic beverages** (at home or away from home)



\$

4) **Mortgage payments and rent**



\$

5) **Home insurance**



\$

6) **Utilities** (electricity, natural gas, water and trash collection, and telephone/mobile services)



\$

7) **Housekeeping expenses** (e.g. laundry and cleaning, postage, stationary, gardening and lawn care, pest control, moving and storage)



\$

8) **Apparel** (e.g. men, women, boys, girls, footwear, watches, jewelry)



\$

9) **Gasoline**



\$



10) **Public transportation** (e.g. mass transit, buses, trains, airlines, taxis, school buses)



\$ 0

11) **Vehicle insurance**



\$ 0

12) **Medical and dental services, drugs and medical supplies** (e.g. hospital room, physicians' services, eye and dental care, lab tests and X-rays, medical care in a retirement community)



\$ 0

13) **Health insurance**



\$ 0

14) **Child care, preschool tuition, and related expenses or care of the elderly**



\$ 0

15) **Tuition and related expenses** (e.g. elementary, high-school, college, textbooks, supplies, books, newspapers, and magazines)



\$ 0

16) **Personal insurance and pensions** (e.g. life insurance, accident and disability, Social Security contributions, private pension programs)



\$ 0

17) **Tobacco and other smoking products**



\$ 0

Total

\$ 0

How much do you spend on *average per year* (US\$) on the following?

1) **House maintenance and repairs**



\$

2) **Other lodging expenses out of town** (e.g. hotels, vacation homes)



\$

3) **Furniture** (indoor, outdoor, floor coverings)



\$

4) **Household appliances** (e.g. refrigerators and freezers, dishwashers and garbage disposals, stoves and ovens, vacuum cleaners, microwaves, air-conditioners, sewing machines, houseware)



\$

5) **Audio and visual equipment and services** (e.g. tv sets, smartphones, cable tv, musical instruments)



\$

6) **Entertainment fees and admissions, hobbies, pets, and toys** (e.g. sporting events, movies, concerts, and plays, tennis and country club memberships, indoor exercise equipment, bicycles, camping equipment, hunting and fishing equipment, sports equipment)



\$

7) **Vehicle purchases, maintenance and repairs, leases and rental charges** (e.g. new and used domestic and imported cars, trucks, or motorcycles)



\$

8) **Other expenses not mentioned above**

\$

Total

\$

Price Elasticity

Suppose you spent **\$100** on the following items in any given **week**.

If the same items you purchased in the past now cost **\$120**, **how much would you now be willing to spend (US\$)?**

	About \$90	About \$100	About \$110	About \$120	About \$130
1) Food at home (e.g. cereals, meats, dairy products, fruits, vegetables)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2) Food away from home (e.g. fast food, take-out, delivery, full-service restaurants, excluding alcoholic beverages)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3) Alcoholic beverages (at home or away from home)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4) Home insurance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5) Utilities (electricity, natural gas, water and trash collection, and telephone/mobile services)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6) Housekeeping expenses (e.g. laundry and cleaning, postage, stationary, gardening and lawn care, pest control, moving and storage)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7) Apparel (e.g. men, women, boys, girls, footwear, watches, jewelry)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8) Gasoline	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9) Public transportation (e.g. mass transit, buses, trains, airlines, taxis, school buses)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10) Vehicle insurance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11) Medical and dental services, drugs and medical supplies (e.g. hospital room, physicians' services, eye and dental care, lab tests and X-rays, medical care in a retirement community)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12) Health insurance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13) Personal insurance and pensions (e.g. life insurance, accident and disability, Social Security contributions, private pension programs)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14) Tobacco and other smoking products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Suppose you spent **\$1,000** on the following items in any given **month**.

If the same items you purchased in the past now cost **\$1,200**, **how much would you now be willing to spend (US\$)?**

	About \$900	About \$1,000	About \$1,100	About \$1,200	About \$1,300
1) Mortgage payments and rent	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2) Child care, preschool tuition, and related expenses or care of the elderly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3) Tuition and related expenses (e.g. elementary, high-school, college, textbooks, supplies, books, newspapers, and magazines)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Suppose you spent **\$10,000** on the following items in any given **year**.

If the same items you purchased in the past now cost **\$12,000**, **how much would you now be willing to spend (US\$)?**

	About \$9,000	About \$10,000	About \$11,000	About \$12,000	About \$13,000
1) House maintenance and repairs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2) Other lodging expenses out of town (e.g. hotels, vacation homes)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3) Furniture (indoor, outdoor, floor coverings)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4) Household appliances (e.g. refrigerators and freezers, dishwashers and garbage disposals, stoves and ovens, vacuum cleaners, microwaves, air-conditioners, sewing machines, houseware)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5) Audio and visual equipment and services (e.g. tv sets, smartphones, cable tv, musical instruments)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6) Entertainment fees and admissions, hobbies, pets, and toys (e.g. sporting events, movies, concerts, and plays, tennis and country club memberships, indoor exercise equipment, bicycles, camping equipment, hunting and fishing equipment, sports equipment)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7) Vehicle purchases, maintenance and repairs, leases and rental charges (e.g. new and used domestic and imported cars, trucks, or motorcycles)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Income Elasticity

Suppose your household income is **\$5,000** in any given *month* and you spent **\$100** on the following items in any given *week*.

If your monthly income increases to **\$6,000**, *how much would you now be willing to spend on the following items (US\$)?*

	About \$80	About \$100	About \$120	About \$140	About \$160
1) Food at home (e.g. cereals, meats, dairy products, fruits, vegetables)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2) Food away from home (e.g. fast food, take-out, delivery, full-service restaurants, excluding alcoholic beverages)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3) Alcoholic beverages (at home or away from home)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4) Home insurance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5) Utilities (electricity, natural gas, water and trash collection, and telephone/mobile services)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6) Housekeeping expenses (e.g. laundry and cleaning, postage, stationary, gardening and lawn care, pest control, moving and storage)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7) Apparel (e.g. men, women, boys, girls, footwear, watches, jewelry)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8) Gasoline	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9) Public transportation (e.g. mass transit, buses, trains, airlines, taxis, school buses)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10) Vehicle insurance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11) Medical and dental services, drugs and medical supplies (e.g. hospital room, physicians' services, eye and dental care, lab tests and X-rays, medical care in a retirement community)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12) Health insurance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13) Personal insurance and pensions (e.g. life insurance, accident and disability, Social Security contributions, private pension programs)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14) Tobacco and other smoking products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Suppose your household income is **\$5,000** in any given *month* and you spent **\$1,000** on the following items in any given *month*.

If your monthly income increases to **\$6,000**, *how much would you now be willing to spend on the following items (US\$)?*

	About \$800	About \$1,000	About \$1,200	About \$1,400	About \$1,600
1) Mortgage payments and rent	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2) Child care, preschool tuition, and related expenses or care of the elderly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3) Tuition and related expenses (e.g. elementary, high-school, college, textbooks, supplies, books, newspapers, and magazines)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Suppose your household income is **\$5,000** in any given *month* and you spent **\$10,000** on the following items in any given *year*.

If your monthly income increases to **\$6,000**, *how much would you now be willing to spend on the following items (US\$)?*

	About \$8,000	About \$10,000	About \$12,000	About \$14,000	About \$16,000
1) House maintenance and repairs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2) Other lodging expenses out of town (e.g. hotels, vacation homes)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3) Furniture (indoor, outdoor, floor coverings)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4) Household appliances (e.g. refrigerators and freezers, dishwashers and garbage disposals, stoves and ovens, vacuum cleaners, microwaves, air-conditioners, sewing machines, houseware)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5) Audio and visual equipment and services (e.g. tv sets, smartphones, cable tv, musical instruments)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6) Entertainment fees and admissions, hobbies, pets, and toys (e.g. sporting events, movies, concerts, and plays, tennis and country club memberships, indoor exercise equipment, bicycles, camping equipment, hunting and fishing equipment, sports equipment)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7) Vehicle purchases, maintenance and repairs, leases and rental charges (e.g. new and used domestic and imported cars, trucks, or motorcycles)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Quality

How would you rate the **average quality** of the products you usually purchase or consume?

	Low-end quality only	A mix of low and medium-end quality	A mix of medium and high-end quality	High-end quality only
1) Food at home (e.g. cereals, meats, dairy products, fruits, vegetables)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2) Food away from home (e.g. fast food, take-out, delivery, full-service restaurants, excluding alcoholic beverages)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3) Alcoholic beverages (at home or away from home)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4) Mortgage payments and rent	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5) Home insurance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6) Utilities (electricity, natural gas, water and trash collection, and telephone/mobile services)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7) Housekeeping expenses (e.g. laundry and cleaning, postage, stationary, gardening and lawn care, pest control, moving and storage)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8) Apparel (e.g. men, women, boys, girls, footwear, watches, jewelry)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9) Gasoline	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10) Public transportation (e.g. mass transit, buses, trains, airlines, taxis, school buses)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11) Vehicle insurance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12) Medical and dental services, drugs and medical supplies (e.g. hospital room, physicians' services, eye and dental care, lab tests and X-rays, medical care in a retirement community)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13) Health insurance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14) Child care, preschool tuition, and related expenses or care of the elderly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15) Tuition and related expenses (e.g. elementary, high-school, college, textbooks, supplies, books, newspapers, and magazines)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16) Tobacco and other smoking products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17) Personal insurance and pensions (e.g. life insurance, accident and disability, Social Security contributions, private pension programs)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18) House maintenance and repairs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19) Other lodging expenses out of town (e.g. hotels, vacation homes)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20) Furniture (indoor, outdoor, floor coverings)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
21) Household appliances (e.g. refrigerators and freezers, dishwashers and garbage disposals, stoves and ovens)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

stoves and ovens, vacuum cleaners, microwaves, air-conditioners, sewing machines, houseware)

22) **Audio and visual equipment and services** (e.g. tv sets, smartphones, cable tv, musical instruments)

23) **Entertainment fees and admissions, hobbies, pets, and toys** (e.g. sporting events, movies, concerts, and plays, tennis and country club memberships, indoor exercise equipment, bicycles, camping equipment, hunting and fishing equipment, sports equipment)

24) **Vehicle purchases, maintenance and repairs, leases and rental charges** (e.g. new and used domestic and imported cars, trucks, or motorcycles)

Comments

Would you like to be contacted again by the survey team?

Yes

No

Please enter any comments you would like to leave with the survey team:

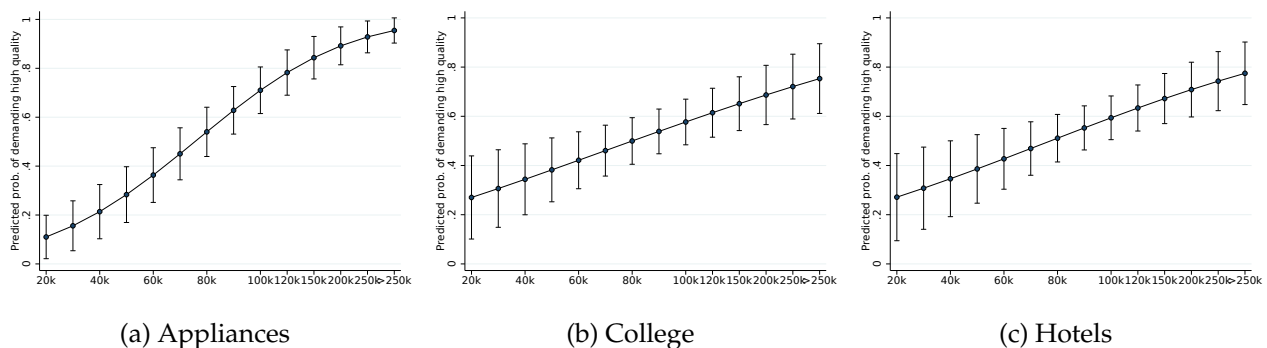
D.2 Additional results

D.2.1 Quality

Table D.2.1 shows the distribution of quality demanded for the 24 categories of goods and services, together with the sample average spending per year. When buying health or personal insurance, most individuals reported buying high and mid-high quality plans, while the opposite holds for vehicle insurance. Table D.2.2 displays the estimated coefficient from equation (7.1) above capturing the income effect on the quality demanded for each category of goods and services. For most goods and services, wealthier individuals tend to demand more high-quality products, while less well-off consumers are more likely to demand low-quality products.

Figure D.2.1 presents the predicted probability of demanding high-quality (a) appliances, (b) college, and (c) hotels, along the household income distribution based on the probit estimation for households with expenses in that category and the set of controls used in equation (7.1). Households earning between \$150,000 and \$200,000 are more likely to demand high-quality appliances (89%), colleges (69%), and hotels (71%). In contrast, fewer than 36%, 42%, and 43% of households earning between \$50,000 and \$60,000 would choose those high-quality items, respectively. Figure D.2.2 presents the predicted probability of demanding low-quality (a) apparel, (b) entertainment, and (c) home insurance, along the household income distribution based on the probit estimation for households with expenses in that category and the set of controls used in equation (7.1). Households earning between \$150,000 and \$200,000 are less likely to demand low-quality apparel (39%), entertainment (23%), and home insurance (23%). In contrast, more than 64%, 46%, and 51% of households earning between \$50,000 and \$60,000 would choose those low-quality items, respectively.

Figure D.2.1: Who is more likely to demand high-quality goods and services?



Note: Panel (a) shows the probability of demanding high-quality appliances along different household income levels, based on the probit estimation for households with expenses in that category and the set of controls. Panel (b) shows the same response for school and college tuition and related expenses. Panel (c) shows the same response for other lodging expenses out of town.

Table D.2.1: Quality of demand by category

Category	Avg. spend. (yearly, US\$)	% with low/ mid-low quality	% with high/ mid-high quality
Mortgage payments and rent	13,747	61.56	38.44
Health insurance	5,065	29.51	70.49
Personal insurance (e.g. life insurance, accident and disability)	5,032	24.94	75.06
Food at home (e.g. cereals, meats, dairy products, fruits, vegetables)	4,704	37.10	62.90
Utilities (electricity, natural gas, water and trash collection, telephone/mobile services)	4,694	41.98	58.02
Vehicle insurance	3,918	77.98	22.02
Medical and dental services, drugs and medical supplies	3,629	34.14	65.86
Gasoline	3,490	50.90	49.10
Home insurance	2,717	41.73	58.27
Food away (e.g. fast food, take-out, delivery, full-service restaurants, excl. alcoholic bev.)	2,036	55.44	44.56
Housekeeping expenses (e.g. cleaning, post., stationary, garden., pest control, storage)	1,893	45.53	54.47
Tuition and related expenses (e.g. elementary, high-school, college, books, supplies)	1,832	39.88	60.12
Apparel (e.g. men, women, boys, girls, footwear, watches, jewelry)	1,616	56.07	43.93
Vehicle purchases, maintenance and repairs, leases and rental charges	1,585	37.62	62.38
Other lodging expenses out of town (e.g. hotels, vacation homes)	1,493	38.17	61.83
House maintenance and repairs	1,295	41.80	58.20
Child care, preschool tuition, or care of the elderly	1,110	61.05	38.95
Entertainment fees and admissions, hobbies, pets, and toys	879	37.31	62.69
Audio and visual equipment and services (e.g. tvs, smartphones, cable, musical instr.)	613	35.80	64.20
Alcohol (at home or away from home)	602	54.51	45.49
Tobacco and other smoking products	484	56.21	43.79
Furniture (indoor, outdoor, floor coverings)	436	44.42	55.58
Appliances (e.g. refrigerators, dishwashers, ovens, vacuum cleaners, air-conditioners)	382	35.17	64.83
Public transportation (e.g. mass transit, buses, trains, airlines, taxis, school buses)	313	52.07	47.93

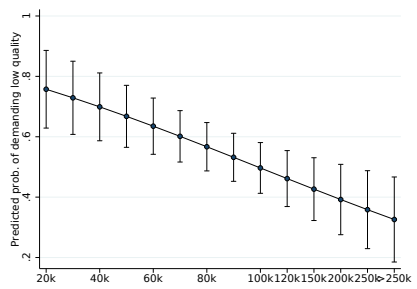
Note: The quality of demand are for individuals who reported positive expenditures on that category.

Table D.2.2: Effect of income on quality

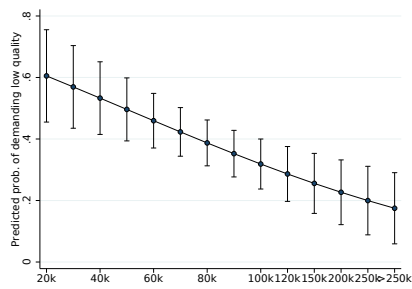
Specification	Quality								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<i>Low/Mid-low quality (LPM)</i>	-0.024***	-0.021**	-0.021*	-0.041***	-0.030***	-0.028**	-0.034***	-0.031***	-0.044**
	(0.009)	(0.010)	(0.013)	(0.011)	(0.010)	(0.012)	(0.010)	(0.011)	(0.019)
Observations	581	555	352	429	551	512	476	540	86
Adjusted R ²	0.190	0.104	0.121	0.215	0.114	0.109	0.145	0.126	0.369
<i>Low/Mid-low quality (Probit)</i>	-0.073**	-0.059**	-0.060*	-0.120***	-0.086***	-0.076**	-0.094***	-0.083***	-0.169***
	(0.029)	(0.028)	(0.035)	(0.036)	(0.029)	(0.032)	(0.029)	(0.029)	(0.056)
Observations	581	555	352	429	551	512	476	540	86
Adjusted R ²	0.157	0.082	0.092	0.175	0.091	0.086	0.112	0.073	0.340
<i>High/Mid-high quality (LPM)</i>	0.026***	0.023**	0.030**	0.037***	0.037***	0.031***	0.038***	0.031***	0.046**
	(0.009)	(0.010)	(0.013)	(0.012)	(0.010)	(0.012)	(0.010)	(0.010)	(0.018)
Observations	581	555	352	429	551	512	476	540	86
Adjusted R ²	0.196	0.122	0.197	0.174	0.197	0.116	0.181	0.126	0.464
<i>High/Mid-high quality (Probit)</i>	0.077***	0.067**	0.090**	0.105***	0.110***	0.084***	0.114***	0.090***	0.261***
	(0.029)	(0.028)	(0.040)	(0.035)	(0.030)	(0.031)	(0.029)	(0.028)	(0.067)
Observations	581	555	352	429	551	512	476	540	86
Adjusted R ²	0.158	0.101	0.164	0.138	0.163	0.091	0.151	0.100	0.535
	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
<i>Low/Mid-low quality (LPM)</i>	-0.031*	-0.046**	-0.027**	-0.035***	-0.046***	-0.055***	-0.039***	-0.034***	-0.023**
	(0.017)	(0.020)	(0.012)	(0.012)	(0.012)	(0.010)	(0.013)	(0.010)	(0.011)
Observations	105	76	412	370	309	279	383	495	464
Adjusted R ²	0.368	0.547	0.125	0.159	0.256	0.326	0.150	0.184	0.182
<i>Low/Mid-low quality (Probit)</i>	-0.106*	-0.186***	-0.078**	-0.103***	-0.130***	-0.209***	-0.110***	-0.101***	-0.059*
	(0.060)	(0.062)	(0.036)	(0.035)	(0.040)	(0.038)	(0.039)	(0.031)	(0.032)
Observations	105	76	412	370	309	279	383	495	464
Adjusted R ²	0.315	0.552	0.099	0.127	0.208	0.296	0.118	0.151	0.161
<i>High/Mid-high quality (LPM)</i>	0.038**	0.055***	0.028**	0.039***	0.052***	0.069***	0.039***	0.036***	0.026**
	(0.015)	(0.017)	(0.013)	(0.012)	(0.012)	(0.009)	(0.013)	(0.010)	(0.011)
Observations	105	76	412	370	309	279	383	495	464
Adjusted R ²	0.438	0.600	0.120	0.189	0.311	0.421	0.163	0.193	0.164
<i>High/Mid-high quality (Probit)</i>	0.175***	0.207***	0.081**	0.113***	0.151***	0.254***	0.112***	0.101***	0.067**
	(0.058)	(0.056)	(0.036)	(0.034)	(0.040)	(0.037)	(0.036)	(0.030)	(0.033)
Observations	105	76	412	370	309	279	383	495	464
Adjusted R ²	0.408	0.588	0.095	0.150	0.255	0.379	0.130	0.153	0.132

Note: The estimated coefficients are for the effect of household income on the quality demanded for each specification. The regressions are estimated for each category of goods and services separately and include the following set of controls: age, employment status, gender, household size, industry, occupation, race, relationship status. Each column is for a category: (1) food at home; (2) food away; (3) alcohol; (4) home insurance; (5) utilities; (6) housekeeping expenses; (7) apparel; (8) gasoline; (9) public transportation; (10) school and college tuition and related expenses; (11) tobacco and other smoking products; (12) house maintenance and repairs; (13) other lodging expenses out of town; (14) furniture; (15) appliances; (16) audio and visual equipment and services; (17) entertainment fees and admissions, hobbies, pets, and toys; (18) vehicle purchases, maintenance and repairs, leases and rental charges. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

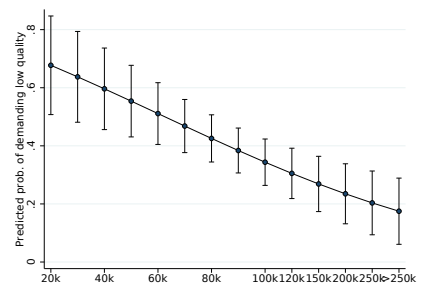
Figure D.2.2: Who is more likely to demand low-quality goods and services?



(a) Apparel



(b) Entertainment



(c) Home insurance

Note: Panel (a) shows the probability of demanding low-quality apparel along different household income levels, based on the probit estimation for households with expenses in that category and the set of controls. Panel (b) shows the same response for entertainment fees and admissions, hobbies, pets, and toys. Panel (c) shows the same response for home insurance.