Working Paper Research

October 2024 No 469

The anatomy of costs and firm performance evidence from Belgium

by Jan De Loecker, Catherine Fuss, Nathan Quiller-Doust and Leonard Treuren

NationalBank OF BELGIUM

Eurosystem

Publisher

Pierre Wunsch, Governor of the National Bank of Belgium

Statement of purpose

The purpose of these Working Papers is to promote the circulation of research results (Research Series) and analytical studies (Documents Series) made within the National Bank of Belgium or presented by external economists in seminars, conferences and conventions organised by the Bank. The aim is therefore to provide a platform for discussion. The opinions expressed are strictly those of the authors and do not necessarily reflect the views of the National Bank of Belgium.

The Working Papers are available on the website of the Bank: http://www.nbb.be

ISSN: 1375-680X (print)
ISSN: 1784-2476 (online)

Abstract

We separately observe variable input expenditure and expenditure on fixed inputs in novel firm-level data covering the Belgian manufacturing sector over the last decades. This permits a deeper investigation of two potential drivers of the globally observed widening gap between firms' revenue and variable input expenditure: *technology* and *market power*. Across the board, cost structures have become less reliant on variable input expenditure over time, while expenditure on fixed inputs or overhead costs has increased in prominence. We relate these changes in firms' cost structures to performance measures and document that markups and gross profit rates increase substantially as the role of variable costs in production diminishes. Profit rates net of fixed input expenditure also increase, but by substantially less than gross profit rates. Our results suggest that technological change can explain a considerable portion of the widening gap between revenue and variable input expenditure, but that markups increase by more than necessary to break even, and that this phenomenon operates remarkably similarly across different firms and industries.

Keywords: Intermediate goods and services; Fixed cost; Markups; Technology.

JEL Codes: D2; D4; L1; O14.

Authors:

Jan De Loecker, KU Leuven and CEPR.
E-mail: jan.deloecker@kuleuven.be

Catherine Fuss, National Bank of Belgium.
E-mail: catherine.fuss@nbb.be

Nathan Quiller-Doust, KU Leuven.
E-mail: nathan.quiller-doust@student.kuleuven.be

Leonard Treuren, KU Leuven.
E-mail: leonard.treuren@kuleuven.be

We are grateful to Gianluca Antonecchia, Giulio Gottardo, Jo Van Biesebroeck, and participants at the 2024 CRESSE (Crete) conference for helpful comments and suggestions. We thank Luis Moyano García for excellent research assistance. De Loecker gratefully acknowledges support from the ERC Consolidator grant 816638. The views expressed in this paper are those of the authors and do not necessarily reflect the views of the National Bank of Belgium, the Eurosystem, or any other institution with which the authors are affiliated. All errors are our own.

Non-technical summary

In recent years, a large number of studies have reported increasing markups and profit margins, as well as other firm performance indicators, across countries and industries. These indicators however have not necessarily increased for all firms across a distribution, and in particular these patterns can be primarily explained by the larger firms in an economy. A relative increase in fixed costs of production has also been observed. While most of these patterns have been documented in other regions of the world, most notably in the United States, this paper contributes by analyzing the above trends, and investigating the relationship between technological change and performance indicators from a European perspective, specifically for a set of Belgian companies.

This paper documents the main patterns regarding fixed versus variable input use in Belgium. We then attempt to uncover whether these inputs are used as substitutes or complements, and relate them to measures of firm performance such as markups, gross and net profit rates, and measures of productivity. To do this, we make use of firm-level annual accounts data across the population of private Belgian manufacturing firms over the 1985-2016 period, where we uniquely observe the breakdown of intermediate inputs into goods and services. In addition, we merge the annual accounts with survey data from the Enqûete Structurelle Des Enterprises (ESE), over the 2008-2016 period. This survey allows us to further break down intermediate services, typically thought of as fixed costs of production, to see which of these components influence the overall trends of services and firm performance indicators, and to explain any heterogeneity in our aggregate results.

We initially find an increase in the cost of goods sold share over time. Though when we break this down into its components, we find an increase in the services share, and a decrease in the goods and labor shares, typically thought of as variable costs of production. Firms tend to substitute services with goods inputs, whereas services and labor inputs appear to be complements in production. We also find that the rising service share has implications for firm performance; both net and gross profit rates, as well as markups, increase with a higher services share. These results hold when either looking within an industry or a firm over time. A closer inspection of the service inputs using the ESE data reveals that it mainly comprises external labor, energy, and capital rent costs. We find that these inputs behave surprisingly similarly to the whole bundle of services, despite being dissimilar in multiple ways. On the other hand, firms that rely heavily on intermediate services in their production process, especially external labor, behave differently from other firms in the study. For instance, these firms tend to rely less on full-time employment and therefore have higher labor productivity. Further work can be used to investigate this heterogeneity.

TABLE OF CONTENTS

1 Introduction

A growing number of studies report secular trends in measures of firm performance, including increased markups and profits, across a wide range of industries and countries.[1] One robust fact that emerges from this literature is a widening gap between a firm's revenue and variable input expenditures (typically measured as a bundle including the cost of labor and intermediate inputs, or intermediate inputs separately). This ratio has not increased equally for all firms in the economy; the aggregate patterns can often be traced back to firms at the top of the performance distribution, pulling away from the rest (either measured as the median or average). Through the lens of cost-minimizing firms, this ratio has been interpreted as a price-cost margin. However, this is only valid to the extent that the researcher's measure of variable input expenditure indeed captures variable factors of production.

How to interpret these facts remains the topic of research, as it is challenging to disentangle the two leading explanations behind an increase in the sales-to-variable input expenditure ratio: changes in *technology* versus changes in *market power*. It is difficult to attribute patterns to these two forces because they are not mutually exclusive and potentially interconnected.[2] While the separate identification of these sources requires specifying a model of firm heterogeneity and taking it to the data, an equally important challenge is measurement. More specifically, separately measuring variable and fixed factors of production – beyond the classic labor capital distinction – and overhead or fixed costs.[3] This measurement is critical to the estimation of markups and, therefore, the separation of market power from technological change, and ultimately matters for a host of policy questions.[4]

Measuring variable input expenditure is challenging as accounting measures often conflate variable and fixed or overhead costs. In the classic setup, a firm produces output using variable inputs (*labor* and *intermediates*). Financial statements routinely measure such variable expenditure by the Cost of Goods Sold (COGS). In addition, output depends on quasi-fixed inputs (*capital*), and firms potentially incur expenses not directly related to output – overhead or fixed costs.[5] Such fixed costs and overhead expenditure typically fall under Selling, General, and Administrative expenses (SG&A) in financial statements. In practice, the COGS/SG&A distinction does not perfectly separate variable and fixed or overhead

[1]See, for instance, De Loecker et al. (2020) and Autor et al. (2020) for the US, and De Loecker and Eeckhout (2018) for a global analysis using listed companies. Syverson (2019) and Miller (2024) provide overviews of the literature.

[2]In particular the work of Sutton (1991), and see De Loecker et al. (2021) for a structural analysis permitting to identify the specific role of technology and market power in the US economy.

[3]See De Loecker and Syverson (2022) for a discussion on measuring inputs in production. Foster et al. (2022) focus on the measurement of production technology.

[4]For instance, the appropriate response of antitrust policy to aggregate markup and concentration trends. See Shapiro and Yurukoglu (2024) for a discussion.

[5]The distinction between quasi-fixed inputs and factors of fixed cost depends on the time horizon, of course, and it greatly varies across production processes.

costs (Syverson, 2019; Shapiro and Yurukoglu, 2024). In particular, COGS often contains fixed or overhead expenditure.[6] A similar phenomenon exists outside of financial statements based on the Generally Accepted Accounting Principles (GAAP), with intermediate inputs typically capturing both variable and non-variable costs. This bundling of variable and fixed costs hampers markup estimation and the study of underlying causes of aggregate trends in firm performance (De Loecker and Syverson, 2022).

This article is concerned with separately measuring variable factors of production and fixed or overhead factors. We do this in the context of rich firm-level data covering the Belgian manufacturing sector between 1985 and 2016. In particular, we utilize a unique feature in the Belgian data, where we observe a breakdown of manufacturers' intermediate input expenditure into *goods* and *services*. Goods measures purchases of raw materials and consumables, while services consists of the purchase of services and all other goods.[7] This unique split of the total intermediate input bundle allows us to delve into the potential technology and market power channels by distinguishing between the role variable and non-variable production costs. We describe the use of services and the increase in their relative importance in the production process over time, and relate these changes to a host of measures of firm performance, including price-cost margins and profitability.

We estimate markups and generate several cost measures and profit rates. Markups of price over marginal cost are obtained using the production approach (De Loecker and Warzynski, 2012), where a considerable advantage of our data is the existence of a variable input: goods. We estimate output elasticities using a cost share approach where technology is assumed constant at the 3-digit-industry-by-year level to accommodate technological differences in the cross section and over time. COGS – the sum of expenditure on labor and intermediate inputs – is split into a variable component containing labor and goods that we call VCOGS, and services. VCOGS and services, therefore, split COGS into variable and non-variable input expenditure. We construct a gross profit rate that takes into account only VCOGS, while a net profit rate is based in addition on services and capital expenditures.

Our starting point is that markups have increased over the past decades, like in the US and many other countries. In addition, the ratio of revenue to total cost has increased, but by less than markups, suggesting that fixed production inputs have become more important over time. Nevertheless, the COGS cost share, typically interpreted as the importance of variable costs in total costs, is stable over time, suggesting that fixed inputs have not become more important in production over time. However, the latter interpretation ignores that certain elements of COGS do not correspond to variable input expenditure. Our unique data allows us to separate common measure of variable input expenditure into variable and

[6]For instance, Grieco et al. (2024) report that large automobile manufacturers sometimes report all operating expenses as COGS, even though they report fixed costs as being important in their operations.

[7]Services are distinct from fixed costs independent of production such as advertising and R&D activities (excluding process innovation for direct implementation in production).

non-variable components and to explain the apparent contradiction between the increasing markup-profitability gap and the stable COGS share.

We show that the stable COGS share obscures a substantial change in firms' cost structures over time, as the VCOGS share smoothly trended down while the services share smoothly trended up over the past decades. While more pronounced in the top percentiles of the cost share distributions, these patterns are present in their entire distributions, making them remarkably general. These secular trends cannot be explained by between-industry differences or entry and exit, as firms substitute services for variable inputs over time. An important implication is that researchers who only observe a bundle of intermediate inputs, or COGS, rather than a breakdown into variable and non-variable input expenditure potentially miss the required information to study markups and technology, or at least are confronted with this complication.

The changing cost structure of firms is linked to changes in firm performance. In particular, both markups and gross profit rates substantially increase as firms' services cost shares rise and their variable cost shares decrease. Simultaneously, we observe increased non-variable costs and decreased variable costs. Net profit rates, which take into account services expenditure, also grow, suggesting that firms increase markups by more than would occur in a perfectly competitive manufacturing sector. However, net profit rates increase substantially less than gross profit rates. Therefore, an important driver of markup growth appears to be the changing cost structure of firms. Note that our results are related to, but distinct from results linking increased SG&A spending to increased markups (e.g., De Loecker et al. (2020)), as services consist mainly of expenditure on fixed inputs in the production process, rather than overhead expenditure.[8]

Unique survey data allows us to further decompose the reported intermediate services bundle into specific cost items fro the years 2008 to 2016. The *Enquête Structurelle des Entreprises* (ESE) separately reports firm-level expenditure on (i) external labor, (ii) gifts, (iii) insurances, (iv) rent, and (v) software. As a share of overall services expenditure, external labor and rent are by far the most pronounced of the five types of expenditure. Nonetheless, the shift from variable to fixed expenditure that occurs as overall services expenditure becomes more important in firms' cost structures is not observed for external labor or rent, and the resulting increase in markups is only minor. Moreover, the sum of expenditure on all five ESE elements corresponds to, on average, 18 percent of total services expenditure. While labor outsourcing and information technology have received much attention in recent academic work, they do not appear to be able to explain the secular changes in cost structures and firm performance that we observe.[9]

[8]In the baseline analysis we treat services as a fixed input, consistent with their description. We also show results assuming that services are overhead expenditure and thus do not enter the production function. The main difference is that markup levels and increases are markedly larger for the overhead specification.

[9]For an in-depth analysis of the components of external labor costs see **?**. Grossman and Helpman (2005)

We make three main contributions thanks to our observed split of intermediates into variable and non-variable costs. We are the first to demonstrate a secular shift towards services and away from variable inputs, and this across a wide range of sectors over several decades.[10] Second, we show evidence consistent with technological change being an important mechanism behind aggregate changes in markups and profitability. Finally, we show that labor outsourcing and expenditure on information technology are unlikely candidates to entirely explain these secular trends. Our overall contribution is to provide evidence that certain aspects of technological change operate quite similarly throughout the manufacturing sector and that these secular changes are linked to markups and profitability. Moreover, our findings raise concerns for researchers who only observe bundled expenditure on variable and non-variable production inputs and who wish to study markups and technology. Our contributions are related to the issue of measurement and the consequences of (not) observing a detailed breakdown of variable and non-variable input expenditure. To pinpoint the relative importance of different mechanisms underlying the changing ratios of revenue to total or variable cost, a model of firm behavior is required, which is the topic of other work (e.g., De Loecker et al. (2021)).

Our work is related to research on technology, markups, and profitability beyond that cited above. In particular, we are interested in the age-old question of whether market outcomes are efficient or not – e.g., due to barriers to entry and lack of competition or economies of scale and firm heterogeneity.[11] In Sutton's (1991) theory of endogenous sunk costs, all these factors are determined jointly in equilibrium based on firms' investment decisions. As services contain arguably endogenous sunk costs, the rise of services in production and the decline of variable costs that we document align with Sutton's ideas.

Fixed costs and markups are studied in several recent articles. De Loecker et al. (2020) show that the rise in markups seems to go hand in hand with a rise in fixed production costs as captured by Selling, General, and Administrative (SG&A) expenses. De Ridder (2024) estimates fixed costs from the gap between markups and profitability and finds that cost structures have become more reliant on fixed costs over the last decades in the US and France, which can be explained by a model where firms invest in marginal-cost-reducing intangible inputs that come at a fixed cost.[12] Using Belgian data, Abraham et al. (2024)

---

and Bilal and Lhuillier (2021) focus on outsourcing, and Bloom et al. (2012) on software.

[10] This project draws from preliminary facts presented in De Loecker et al. (2018) using the observed split of intermediates into goods and services. They show distinct markup patterns depending on whether one relies on goods or the bundle of intermediates as variable input in the approach of De Loecker and Warzynski (2012). We depart from that study by focusing on the underlying cost structure and relating it to measures of firm performance, and hereby distinguish between the likely variable and fixed factors of production.

[11] Robinson (1933), for instance, argued that technological progress would create capital-intensive firms with market power in concentrated industries. See Stigler (1982) for a historical overview.

[12] Similarly, Ganapati (2024) studies US wholesalers and suggests that 'superstar' wholesalers make sunk investments in global sourcing capacity – for instance, by acquiring information technology capacity – which

utilize a Solow-residual-based approach to estimate input-specific shares of fixed costs in total expenditure and argue that markups primarily reflect the need to cover fixed costs rather than excess profit. We contribute by providing data-based, rather than model-based, measures of changing cost structures over time and by focusing on expenditure on fixed inputs rather than fixed or overhead costs.

The evolution of market power in particular industries is studied for airlines (Bet, 2021), automobile manufacturing (Grieco et al., 2024), beer (De Loecker and Scott, 2016), cement (Miller et al., 2023), consumer packaged goods (Döpper et al., 2022), steel (Collard-Wexler and De Loecker, 2015), and wholesaling (Ganapati, 2024). Miller (2024) surveys these and other industry studies and concludes that technological change is an important driver of long-run economic outcomes in most industries, although the particulars of such technological change appear industry-specific. We show that a shift in production away from variable inputs and towards services occurs over several decades in the entire manufacturing sector in Belgium, suggesting that some aspects of technological change operate broadly in the economy.[13]

Finally, we speak to a discussion of which input to use as variable input when estimating markups using the approach of De Loecker and Warzynski (2012). De Loecker et al. (2020) resort to COGS as it is the only measure that is available for several decades in the US. Where available, subsequent work has mainly employed intermediate inputs, interpreting differences in markup estimates based on labor and intermediates as evidence of either monopsony power in labor markets (e.g., Yeh et al. (2022)) or factor-biased technological change (e.g., Raval (2023)).[14] We show that intermediate inputs contain several components unlikely to be purely variable, and this in turn has implications for identification of production functions and the selection of variable inputs to measure markups. This highlights the advantage of the production approach to markup estimation, as the variable input can be selected among potentially many candidates and this provides not only econometric benefits, but also helps to detect underlying mechanisms and sources for changes in markups and performance broadly defined.

In the next section, we discuss the data and present the empirical framework. Section 3 presents the anatomy of costs for Belgian firms active in the manufacturing sector, and we relate this to measures of firm performance in Section 4. In Section 5, we further disaggregate the bundle of service intermediates using our unique survey data and highlight a few key facts that connect to the reported changes in performance and cost structures, drawing final conclusions in Section 6.

---

leads to lower average operating costs and increased markups.

[13]In line with this, for a subset of firms in Compustat for 1980-2018, Conlon et al. (2023) show that markup changes are only very weakly correlated to changes in industry-wide price indices, suggesting that markup changes are primarily due to marginal costs.

[14]Rubens et al. (2024) propose a framework that can separately identify wage markdowns in labor markets and factor-augmenting productivity. In contrast, previous work assumed away the one to identify the other.

2 Data and empirical framework

2.1 Data sources

We construct a firm-level dataset on manufacturing firms obliged to submit their annual accounts (AA) to the Belgian authorities, covering 1985 to 2016. We limit our sample to firms that report a breakdown of intermediate inputs into goods and services – as we focus on the role of services in production – and have at least 20 employees. While AA are collected for the vast majority of firms in Belgium, only large firms are required to provide a breakdown of intermediates. Our final sample is, however, representative of the Belgian manufacturing sector as it contains more than 82 percent of all reported revenue in manufacturing between 1985 and 2016. Further details on the data sources and sample selection are in Appendix A.

The AA contain yearly firm-level data on balance sheets and income statements. We observe revenue, full-time equivalent (FTE) employment, capital (tangible fixed assets), labor expenditure, intermediate input expenditure broken down by goods and services, and the firm's 3-digit NACE industry. Our final sample contains 73,023 observations covering 5,887 firms. This sample is quite balanced over time, with the number of firms in a given year between 1,919 in 2016 and 2,537 in 1992 (2,281 firms per year on average).

A key contribution of this paper is the decomposition of the cost of goods sold (COGS) into expenditure on fixed and variable inputs. COGS, typically defined as the sum of expenditure on labor and intermediate inputs, is a common accounting measure of variable production costs. In datasets on financial statements, however, both labor and intermediates are bundles of heterogeneous inputs. This is particularly true for intermediate inputs, which typically contain elements better described as expenditure on fixed inputs or overhead costs, such as capital rents and outsourced overhead labor. Nevertheless, for lack of better alternatives, researchers have been forced to rely on intermediates expenditure as a measure of variable input expenditure when using accounting data to study costs, productivity, and markups.[15] To the extent that different accounting practices vary in terms of which of these cost items are included in the bundle of intermediate inputs, results on markups, for example, can vary.

A unique feature of the AA data is the available breakdown of intermediate inputs into goods and services. Goods represent items that are best thought of as variable factors of production and consists of expenditure on raw materials and consumables. Services, on the other hand, consist of purchases of intermediate services and all other intermediate goods, which are mostly fixed production factors. Of course, some elements of services may have a variable component, for instance, external labor. We do not claim to separate variable and fixed factors of production perfectly but rather to have a measure closely corresponding to

[15] See De Loecker and Syverson (2022) for a discussion on standard measurement practices of firm-level input data.

variable intermediate input expenditure (goods) and a bundle containing mainly fixed factors (services). Our framework can treat all these types of intermediates as either variable or fixed factors of production, and this can be tested using the logic behind the production approach to markups of De Loecker and Warzynski (2012), which is precisely the value of considering multiple candidate variable inputs.

We decompose COGS into services and VCOGS, which contain expenditure on labor and goods:

$$\begin{aligned} \text{COGS} &= \text{VCOGS} + \text{Services Expenditure}, \\ &= (\text{Goods expenditure} + \text{Labor expenditure}) + \text{Services expenditure}. \end{aligned} \tag{1}$$

This splits COGS into categories roughly representing expenditure on variable – VCOGS – and fixed – services – intermediate inputs. We will show that VCOGS and services behave fundamentally differently, suggesting that standard accounting data on intermediate inputs obscure substantial heterogeneity which is informative about firms' production technology and performance in the output market.

We observe more detailed information on services expenditure for a subset of firms and years. This data is taken from the *Enquête Structurelle des Entreprises* (ESE), an annual firm-level survey conducted by Statistics Belgium since 2008. As our AA sample is only available before 2017, we use survey data for the 2008-2016 period. We observe expenditure on five categories of services: (i) external labor, (ii) gifts, (iii) insurance, (iv) rent, and (v) software. Inclusion in the ESE is determined by firm size. Firms with more than 50 employees and revenue in excess of 8 million euros are obligated to participate in the survey, which is supplemented by yearly samples of smaller firms. ESE data is available for 13,876 of the 18,975 AA observations between 2008 and 2016 (73.13 percent) and these observations cover 90.07 percent of all post-2007 AA revenue, ensuring that the ESE sample is representative of Belgian manufacturing in general. In Section 5, we discuss the ESE sample in more detail.

In line with the distinction between expenditure on fixed and variable inputs in our data, we define two profit margins. These gross and net profit margins for firm i at time t are given by

$$\pi_{it}^G = \frac{R_{it} - VCOGS_{it}}{R_{it}}, \text{ and} \tag{2}$$

$$\pi_{it}^N = \frac{R_{it} - TC_{it}}{R_{it}}, \tag{3}$$

where R_{it} is revenue. π_{it}^G only takes into account expenditure on variable factors of production – i.e., using the sum of labor and intermediate goods expenditures ($VCOGS_{it}$). π_{it}^N takes into account expenditure on both variable and fixed factors and relies on a measure of total costs (TC_{it}) defined as the sum of expenditure on labor (L_{it}), capital (K_{it}), goods (G_{it}), and

Table 1: Summary statistics

variable	p(25)	p(50)	p(75)	mean	s.d.
Revenue	7,323	14,325	36,507	58,890	277,116
Capital	764	1,808	4,864	7,699	32,848
Labor (FTE)	41.30	71.75	148.60	187.61	534.96
VCOGS	5,186	10,229	26,457	44,509	229,987
Labor Expenditure	1,300	2,315	5,307	7,860	27,048
Goods Expenditure	3,360	7,453	20,342	36,649	214,277
Services Expenditure	1,087	2,333	5,807	9,569	45,930
Gross profit rate	0.17	0.26	0.36	0.27	0.15
Net profit rate	0.02	0.07	0.14	0.07	0.11

Notes: Summary statistics for key variables. Based on the full sample of 73,023 observations covering 1985 to 2016. p(25), p(50), and p(75) refer to the 25th, 50th, and 75th percentile of the distribution, respectively. Mean and s.d. are the unweighted mean and standard deviation. Monetary values are in thousands and deflated. Labor and profit rates rounded to two decimal points.

services (S_{it}).[16]

Table 1 displays descriptive statistics for our firm-level annual accounts data. The distributions of labor expenditure and services expenditure are fairly similar, with median expenditure on both inputs close to 2.3 million euros. Goods expenditure tends to be substantially higher, over 7 million at the median. Most distributions are considerably skewed, with the mean significantly exceeding the 75th percentile. For instance, median employment is 71.75 while mean employment is 187.61. The exceptions are gross and net profit distributions, which are reasonably symmetrical and centered around 26 and 7 percent, respectively.

2.2 Empirical framework

Using one internally consistent measurement framework, we relate the different (variable and fixed) inputs to a host of firm outcome measures, including markups and profit rates. While profits are obtained directly from the financial statements, conditional on an estimate of the rental rate of capital, markups need to be estimated using data on revenue and expenditures.

The measurement of markups is based on the framework put forward by De Loecker and Warzynski (2012) and Hall (1988). This production approach obtains firm-level markups

[16] We approximate yearly capital expenditure as $0.1 \times K_{it}$. Results are robust to alternative definitions, for example, $\frac{r}{100}K_{it}$ with $r \in \{5, 8, 12, 15\}$.

based on input and output or revenue data. Assumptions on demand or the nature of competition are not required. Instead, the firm's production function is specified, and cost-minimizing behavior with respect to a variable input is required.

Consider the production function of a firm i at time t

$$Q_{it} = Q_t(\mathbf{V}_{it}, \mathbf{F}_{it}, \Omega_{it}), \tag{4}$$

where $\mathbf{V}_{it} = (V_{it}^1, \ldots, V_{it}^J)$ is a vector of J variable inputs, $\mathbf{F}_{it} = (F_{it}^1, \ldots, F_{it}^K)$ is a vector of K fixed inputs, and Ω_{it} is firm-time-specific physical productivity. For expositional simplicity, we assume that a single variable and a single fixed input are used to produce a single good, but the results straightforwardly extend to multiple variable inputs, fixed inputs, and outputs (e.g., De Loecker et al. (2016)).

We assume that firm i minimizes its contemporaneous cost of production with respect to its frictionlessly adjustable input V_{it}, given the price of the variable input P_{it}^V, expenditure on the fixed input $P_{it}^F F_{it}$, Ω_{it}, and the production technology captured by production function (4). The associated Lagrangian objective function is

$$\mathcal{L}(V_{it}, F_{it}, \Omega_{it}) = P_{it}^V V_{it} + P_{it}^F F_{it} - \lambda_{it}(Q(\cdot) - Q_{it}) + O_{it}, \tag{5}$$

where λ_{it} is the Lagrange multiplier, which represents the marginal cost of production – the change of the objective function as the output constraint is relaxed. Overhead costs are captured by O_{it}, and these are defined as cost items that do not enter the production process per se but impact the total cost of operating a business (e.g., advertising, promotion, human resources, and other administrative tasks).

We define the markup as $\mu_{it} = \frac{P_{it}}{\lambda_{it}}$, where P_{it} is the price of firm i's output. Following De Loecker and Warzynski (2012), the first-order condition of the Lagrangian with respect to the variable input V_{it} can be rewritten to obtain a simple expression for the markup

$$\mu_{it} = \theta_{it}^V \frac{R_{it}}{P_{it}^V V_{it}}, \tag{6}$$

where $\theta_{it}^V = \frac{\partial Q(\cdot)}{\partial V_{it}} \frac{V_{it}}{Q_{it}}$ is the output elasticity of V_{it}. Equation (6) shows that the two components required to measure markups are the revenue share of a variable input and that input's output elasticity. We observe revenue shares in our data and need to estimate output elasticities.

The existence of a variable input for which firms are price takers is a key requirement to identify markups based on equation (6). If an input for which these requirements are not satisfied is used in the place of V_{it}, the estimated markup is a joint measure of imperfections in the output and input markets.[17] Given the prevalence of imperfections such as collective

[17] Indeed, an emerging literature uses this insight to document evidence of monopsony power and adjustment frictions in labor markets (e.g., Yeh et al. (2022); Mertens (2022))

bargaining in Belgian labor markets, labor is not an ideal candidate for V_{it}. The current standard in the literature is to rely on intermediate inputs as a variable input instead. However, intermediates typically comprise fixed inputs, such as overhead costs, and variable inputs, such as intermediate goods.[18]

We use goods as the variable input on which markups are based. Our ability to separate fixed inputs from the bundle of intermediates is critical to obtaining accurate estimates of markups. Lacking a breakdown of intermediate inputs similar to ours, other researchers are typically forced to assume that all inputs in intermediates are variables and substitutable. Of course, some service elements might also be variable inputs, and conditional on observing a further breakdown of services, we might have more than one suitable candidate with whom to estimate markups.

We estimate output elasticities using a cost share approach (e.g., Foster et al. (2008); Autor et al. (2020)). This approach identifies the output elasticity of goods under the assumption of constant returns to scale and no factor market imperfections using

$$\theta_{st}^{G} = Median\left(\frac{P_{it}^{G}G_{it}}{TC_{it}}\right). \tag{7}$$

To allow production technology to differ in the cross-section and over time, we take the median within each 3-digit-industry-by-year cell (s) – i.e., we assume the technology is year-by-3-digit-industry specific. Output elasticities of other inputs can be determined similarly. The cost share approach avoids having to deal with the challenge of identifying output elasticities using standard production and cost data, with unobserved productivity shocks under imperfect competition (Ackerberg and De Loecker, 2021). In addition, it allows technology to be estimated at a more granular level than would be possible using proxy variable or dynamic panel methods, as the data requirements are more modest. There are, of course, restrictions placed on the cost function. Chief among them is the notion of constant returns to scale in production. However, our implementation of the cost share approach, as De Loecker and Fleitas (2023) discuss, does not rule out the presence of economies of scale, and allows for increasing short-run marginal cost schedules.[19]

Qualitatively, our results are robust to taking the median cost share at a more aggregated level and to estimating firm-time-specific output elasticities using a proxy variable approach to production function estimation (Olley and Pakes (1996); Levinsohn and Petrin (2003);

[18] There exists some evidence of buyer power for intermediate inputs in European manufacturing (e.g., Morlacco (2020); Treuren (2022)). If this is the case for goods in our sample, our markup measure captures both seller power in output markets as well as buyer power in intermediate input markets, which does not materially affect our main conclusions.

[19] When cost shares are disaggregated to the firm level we obtain the well-known result that – in the absence of non-production overhead cost – markups equal profit rates (e.g., Foster et al. (2022)). We strike a balance between allowing for meaningful heterogeneity in output elasticities without equating markups to profits.

Ackerberg et al. (2015)). Table A3 in Appendix A provides descriptive statistics on output elasticities and markups by 2-digit NACE industry.

To estimate total factor revenue productivity, we follow Foster et al. (2008) and rely on revenue data and a Cobb-Douglas production function with Hicks neutral productivity, in combination with cost share output elasticities

$$\ln(TFPR_{it}) = \ln(R_{it}) - \theta^L \ln(L_{it}) - \theta^K \ln(K_{it}) - \theta^G \ln(G_{it}) - \theta^S \ln(S_{it}), \quad (8)$$

where θ^x with $x \in \{L, K, S, G\}$ refers to the output elasticity of input x. TFPR is thus a residual of the log difference between revenue and the production function so that it captures both physical productivity and demand-side factors that cause revenue to differ between firms with identical output, inputs, and production technology.[20]

As far as inputs other than goods are concerned, note that – conditional on obtaining an estimate of the output elasticity of goods – our approach does not require taking a stand on whether they are fixed (F), variable (V), or correspond to overhead costs that do not enter the production function (O). However, to estimate output elasticities, and hence markups and TFPR, we have assumed that services enter the production function – it is a fixed input. Alternatively, we might consider services as overhead that does not enter the production function. This alternative approach would replace the denominator in equation (7) by $TC_i - S_i$ and remove the term $-\theta^S \ln(S_{it})$ from equation (8). We discuss results based on this alternative approach at the end of Section 4. It remains an open question whether overhead costs should be treated as inputs in production or not.[21]

3 The cost structure of Belgian manufacturing firms

3.1 Starting point

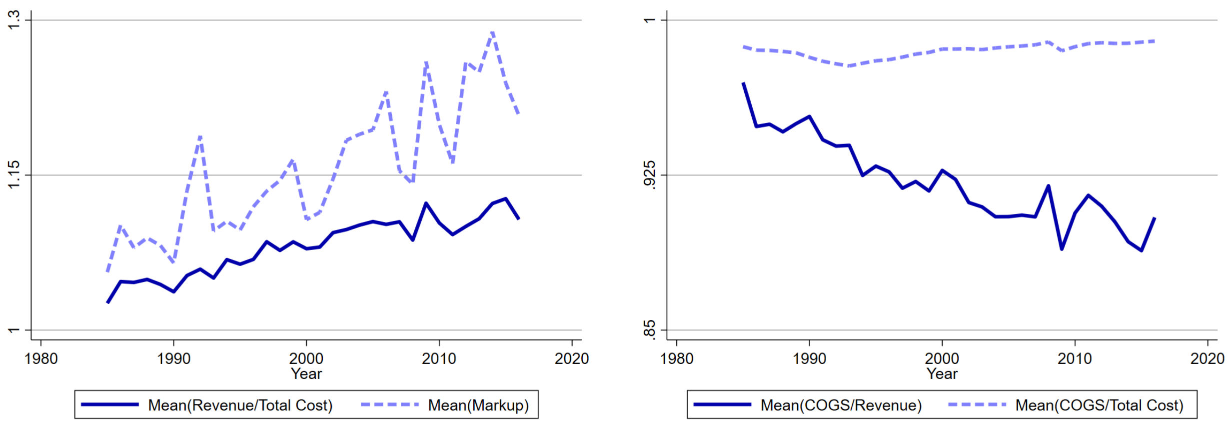
Our starting point is an increase in markups over time. Panel a of Figure 1 shows that the revenue-weighted average markup has increased from 1.06 in 1985 to 1.21 in 2016 (a 14.15 percent increase). This trend is even more pronounced at the top percentiles of the markup distribution, with the 95th percentile increasing by 27.96 percent – from 2.11 to 2.70. Similar broad trends have been reported in the United States and around the world (De Loecker and Eeckhout (2018); De Loecker et al. (2020)), and are also documented in a host of markets for which detailed product-level price and quantity data is available (Döpper et al., 2022).

[20] Integrating product-level price data allows estimation of quantity-based production functions and physical productivity and is the topic of future work. As only labor is measured in physical units, any firm-level input price deviations from the sector-level deflators will also enter out measure of TFPR, scaled by output elasticities. We follow the literature by still referring to the residual as TFPR.

[21] See the analysis of De Loecker et al. (2020), where SG&A are included as a factor of production and, therefore, in the production function.

Figure 1: Revenue-weighted averages of markups, profitability, and COGS shares, over time

Panel a: Mean(Markup) and Mean$\left(\frac{\text{Revenue}}{\text{Total Cost}}\right)$ Panel b: Mean$\left(\frac{\text{COGS}}{\text{Revenue}}\right)$ and Mean$\left(\frac{\text{COGS}}{\text{Total Cost}}\right)$



Notes: The revenue-weighted averages of the markup and revenue over total cost (panel a), and the revenue-weighted averages of the shares of COGS in revenue and total cost (panel b), over time. COGS refers to the sum of labor expenditure and intermediate input expenditure. Based on the full samples of 73,023 observations covering the years 1985 to 2016.

Although increasing markups are a robust fact in many markets and countries, the causes of such trends are difficult to pin down. Two leading explanations are increased market power of firms and changing production technology. While the market power hypothesis would imply that markup increases go hand-in-hand with profit increases, this is not necessarily the case if technological change is the leading cause. Indeed, if firms have no price-setting power, increases in fixed costs would still force firms to charge higher markups without affecting overall profitability. Therefore, it is informative to compare markup trends to firm profitability trends.

Panel a of Figure 1 reveals that the revenue-weighted average revenue-to-total-cost ratio has also increased over time, but by less than markups. Between 1985 and 2016, this ratio increased from 1.03 to 1.11 – a 7.77 percent increase. Again, the 95th percentile displays a much more significant increase, from 1.18 to 1.46. If all factors of production are variable, no input market imperfections exist, and constant returns to scale characterize production, the ratio of revenue to cost equals the markup. That markups increase by more than the revenue-to-total cost ratio suggests that production technology relying less on variable inputs might explain part of the increase in markups.

If firms have switched away from variable-input-intensive production processes over time, it stands to reason that the cost share of variable inputs has declined.[22] From Panel b of Figure 1, however, it is apparent that the cost share of COGS is remarkably stable over time.

[22]Throughout this paper, the revenue share of an input refers to the ratio of expenditure on that input to revenue, and the cost share of an input refers to the ratio of expenditure on that input to total cost.

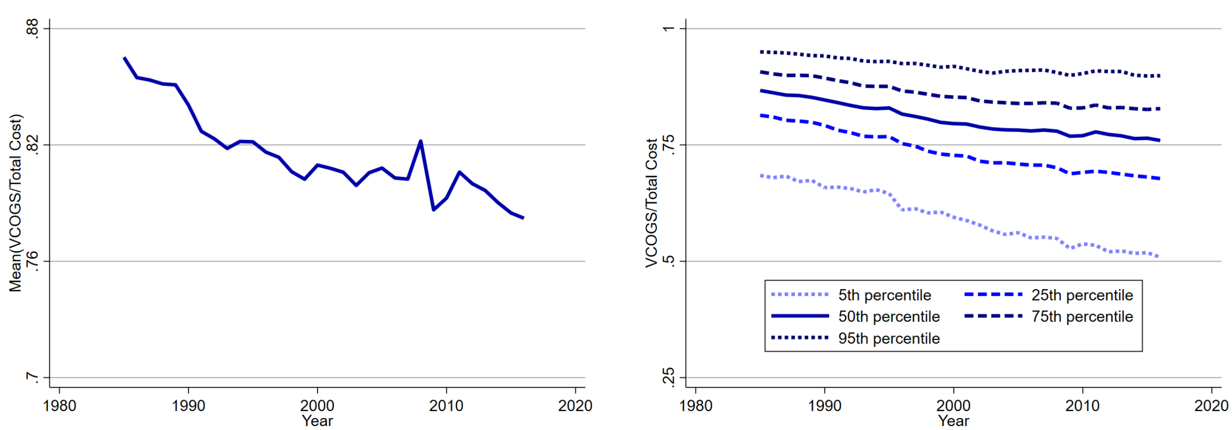
While the revenue share of COGS indeed declined from 0.97 in 1985 to 0.90 in 2016, this discrepancy in trends can be explained by revenue increasing relative to total cost. Another fact that stands out from Figure 1 is that capital cost shares appear very low. While averages in Figure 1 are revenue-weighted, cost-weighted averages produce near-identical graphs (Figure B1 in Appendix B).

One interpretation of the stable COGS share is that the technological change hypothesis has little merit, as we would expect the COGS cost share to trend down and the capital cost share to trend up in that case. However, as discussed in Section 2, COGS contains several elements best characterized as expenditure on fixed inputs or overhead. Indeed, some items contained in intermediate input expenditure, such as capital rents, appear to be capital expenditure. Therefore, properly investigating the technological change hypothesis requires the ability to separate variable from non-variable production factors in COGS. As standard financial statement datasets only contain a single bundle of COGS or expenditure on labor and intermediate inputs, researchers have struggled to separate such expenses.

In this paper, we use the split of intermediates input expenditure into goods and services available in our data to investigate the underlying causes of Figure 1. We show that the stable COGS cost share obscures significant heterogeneity. Cost shares of variable factors of production – captured in VCOGS – have substantially declined over time while expenditure on services markedly increased. We show that markups and gross profit margins increase substantially as production processes become more services-intensive. Profit margins net of services expenditure, however, increase much less strongly, suggesting that markups increase in large part to cover expenditure on other things than variable inputs.

Figure 2: VCOGS cost share, over time

Panel a: Mean$\left(\frac{\text{VCOGS}}{\text{Total Cost}}\right)$ Panel b: Distribution of $\frac{\text{VCOGS}}{\text{Total Cost}}$



Notes: The total-cost-weighted average (panel a), and selected percentiles from the distribution (panel b), of the share of VCOGS in total cost. VCOGS refers to the sum of labor expenditure and goods expenditure. Based on the full samples of 73,023 observations covering the years 1985 to 2016.

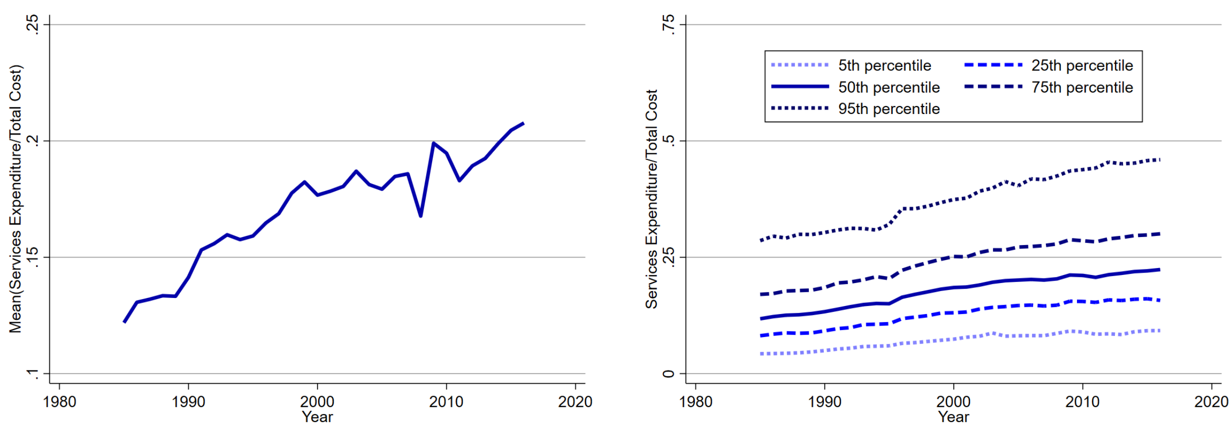
3.2 The anatomy of production

We examine the evolution of VCOGS and services to uncover the underlying heterogeneity of the stable COGS cost share displayed in Figure 1. Over time, the role of VCOGS in production has diminished. Panel a of Figure 2 shows that the VCOGS cost share decreased by roughly 8.5 percentage points between the mid-1980s and 2016. This average contains information on both the trend of firm-level VCOGS cost shares and the reallocation of total cost across firms. Panel b of Figure 2, therefore, graphs selected percentiles of the unweighted distribution of VCOGS over total cost. Throughout the entire distribution, the VCOGS cost share decreases smoothly over time. These trends starkly contrast the stable COGS shares in Figure 1.

On the other hand, the role of services in production has increased significantly since the 1980s. The total-cost-weighted average of the services cost share increases by roughly 8.5 percentage points percent between 1985 and 2016, as Panel a of Figure 3 shows, offsetting the decrease in the VCOGS cost share. The entire distribution of the services total cost share smoothly moves up during the entire sample period (Panel b of Figure 3). The increase in the cost share of services is particularly pronounced in absolute terms at the top of the distribution. The 95th percentile increased from 0.29 to 0.46 between 1985 and 2016, compared to a change from 0.12 to 0.22 at the median.

Figure 3: Services cost share, over time

Panel a: Mean$\left(\frac{\text{Services Expenditure}}{\text{Total Cost}}\right)$ Panel b: Distribution of $\frac{\text{Services Expenditure}}{\text{Total Cost}}$



Notes: The total-cost-weighted average (panel a), and selected percentiles from the distribution (panel b), of the share of services expenditure in total cost. Based on the full samples of 73,023 observations covering the years 1985 to 2016.

Figures 2 and 3 are based on cost shares, as these are more closely related to the production process than revenue shares because revenue can differ between firms with identical input use, productivity, and production technology. However, results for cost and revenue shares are qualitatively similar. Figures B2 and B3 in Appendix B show that the VCOGS revenue share decreased by more, and the services revenue share increased by less, than their cost share counterparts. This can be explained by the growth of revenue with respect to total cost over time displayed in Figure 1. As with cost shares, the entire cost share distribution of VCOGS moves down over time while the opposite occurs for services.

Overall, our results suggest that the role of services in production has substantially increased between 1985 and 2016. As the entire distribution of the services cost share moves up and the entire distribution of the VCOGS cost share moves down, the substitution of services for VCOGS appears to occur both within industry and within firm. To test this prediction, we run regressions of the form

$$\ln\left(\frac{\text{Services Expenditure}_{it}}{\text{Total Cost}_{it}}\right) = \beta_0 + \beta_1 \ln\left(\frac{\text{VCOGS}_{it}}{\text{Total Cost}_{it}}\right)_{it} + \text{controls} + \epsilon_{it}, \qquad (9)$$

where *controls* contains either 3-digit-industry-by-year fixed effects or both firm and year fixed effects. Standard errors are clustered at the 2-digit-industry level to account for any dependency caused by firms in the same broad industry interacting. Table 2 displays the results of this exercise.

Table 2: Input use: Substitutes and complements

	Dependent variable: ln(Services Expenditure/Total Cost)					
	(1)	(2)	(3)	(4)	(5)	(6)
ln(VCOGS/Total Cost)	-3.00	-2.69				
	(0.103)***	(0.103)***				
ln(Labor Expenditure/Total Cost)			0.30	0.16		
			(0.051)***	(0.026)***		
ln(Goods Expenditure/Total Cost)					-0.67	-0.57
					(0.056)***	(0.036)***
NACE×Year FE	×		×		×	
Firm FE & Year FE		×		×		×
R^2	0.79	0.97	0.31	0.80	0.48	0.85

Notes: Table 2 reports output from regressions relating the total cost shares of different inputs; VCOGS refers to the sum of labor expenditure and goods expenditure; All regressions include an unreported constant term; NACE×Year FE refers to 3-digit-industry-by-year fixed effects; Based on the full sample of 73,023 observations covering the years 1985 to 2016; Standard errors clustered at the 2-digit-industry level; ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Within industry-year, firms with higher services cost shares have lower VCOGS cost shares (Column 1 of Table 2), confirming that between-industry differences do not fully explain our results. Moreover, firms substitute services for VCOGS over time (Column 2), and the magnitude of this within-firm association is very similar to that of the within-industry-year association. Between 1985 and 2016, the median VCOGS cost share dropped from 86.70 percent to 75.96 percent, a 12.39 percent decrease. Our within-firm estimates imply that a firm following this trend increased its services cost share by 33.32 percent, while at the industry-year level a 37.16 percent increase is implied. Overall, then, the production process of firms appears to change over time, rather than the exit of VCOGS-intensive firms and entry of services-intensive firms driving the rise of services shares.

Decomposing VCOGS into expenditure on labor and goods uncovers heterogeneity underlying the substitution of services for VCOGS. Within industry-year, firms with relatively high services shares have relatively low goods shares but high labor shares (Columns 3 and 5 of Table 2). Over time, a similar pattern emerges within firm. A one percent increase in the services cost share goes hand-in-hand with a 0.16 percent increase in the labor cost share and a 0.67 percent decrease in the goods cost share (Columns 4 and 6).[23] Goods and services, typically reported as a single bundle, appear to be substitutes.[24]

Table C1 in Appendix C reports results from regressions similar to equation (9) but using revenue shares instead of cost shares. Again, the results suggest that labor and services are complements while goods and services are substitutes (Columns 3-6). Moreover, VCOGS as a whole and services are negatively related, both within firm and within industry-year. Our results, therefore, are not determined by our choice of shares. Of course, cost shares are more directly linked to a firm's cost structure than revenue shares.

As the top percentiles of the services cost share distribution experience a more significant percentage point increase over time, we zoom in on those percentiles. Table C2 in Appendix C replicates Table 2 on the sample of all firms in the top 5 percentiles of the services cost share distribution for each 2-digit-industry-year combination with at least 20 observations. The results are qualitatively unchanged, with one important exception. For firms with services-intensive cost structures, labor and services expenditure are negatively related, rather than positively, suggesting that, for these firms, labor and services are substitutes. We explore this result in more detail in Section 5, where we show that labor outsourcing constitutes an integral part of services expenditure for these firms.

Summing up The stable COGS share in Figure 1 obscures substantial heterogeneity. Expenditure tied closely to fixed inputs and overhead has become significantly more important in firms' total costs since the mid-1980s. On the other hand, expenditure on variable inputs,

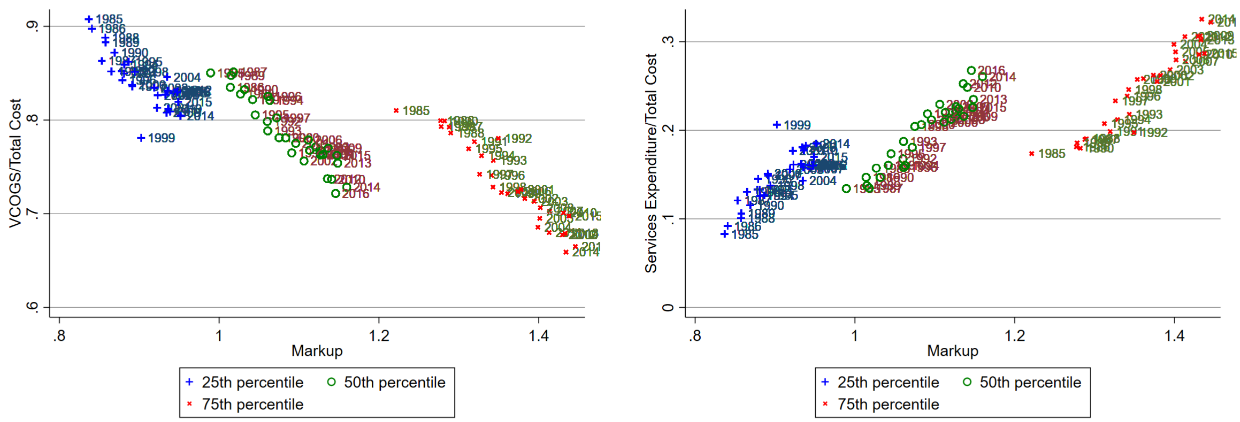
[23]As the VCOGS share is the sum of the labor share and the goods share, the point estimates reported in Columns 3 to 6 of Table 2 do not aggregate to the point estimates in Columns 1 and 2.

[24]Labor and goods are negatively related. Regressing the log of the cost share of labor on the log of the cost share of goods results in a within-industry-year point estimate (standard error) of -0.90 (0.052). The concomitant within-firm point estimate is -0.69 (0.037).

such as labor and goods expenditure, has decreased in importance. These secular trends occur throughout the distribution. The increased reliance on services in production is also a within-firm phenomenon. As goods and services are typically reported as a single bundle – intermediate inputs – our analysis highlights that this bundling obscures changing cost structures over time.

Figure 4: Correlation between markups and input expenditure cost shares

Panel a: Markups and $\frac{\text{VCOGS}}{\text{Total Cost}}$ Panel b: Markups and $\frac{\text{Services Expenditure}}{\text{Total Cost}}$



Notes: The sample for the p^{th} percentile in year t consists of all observations between the $(p-5)^{th}$ and $(p+5)^{th}$ percentile of the markup distribution in year t. Using this sample, the weighted average markup and either the weighted average VCOGS share of total cost (panel a), or the weighted average services expenditure share of total cost (panel b) are calculated. Weights are given by total cost shares.

4 Technology and firm performance

So far, we have shown that firms' cost structures have shifted away from expenditure on variable inputs and towards services expenditure throughout the manufacturing sector. What remains to be done is to determine if these changes are linked to increased markups and whether they might explain the wedge between markups and profitability implied by Figure 1. In this section, therefore, we relate services cost shares to a host of firm-level outcomes such as markups and profit rates. We show that markups and gross profit rates indeed increase as firms' cost structures rely more on services. Net profit rates also increase, but substantially less, suggesting that markup increases are partially driven by the need to cover higher expenditure on non-variable production factors and overhead costs.

Panel a of Figure 4 shows that the cost share of VCOGS is negatively correlated with the markup of price over marginal cost throughout the sample period. In contrast, services cost shares and markups are positively correlated (Panel b).[25] Moreover, markups and service shares increase over time, and the association between the two becomes stronger. For instance, at the beginning of the sample, going from the 25th to the 75th percentile of the markup distribution implies an increase of the services share of about 0.1. In contrast, at the end of the sample, this would imply an increase roughly equal to 0.15 – a 50 percent increase. As the separate components of services are mostly fixed factors of production, high markups need not imply high profit rates.

Figure 5 displays the correlations between the cost share of either VCOGS or services and the net profit rate. Firms with higher VCOGS cost shares have lower net profit rates. The reverse is true for services, and the absolute magnitude of both changes is very similar. As with markups, the correlations are very alike when using revenue shares instead of cost shares (Figure B5 in Appendix B). However, the correlation between services shares and net profit rates appears lower than the markup correlations displayed in Figure 4. Indeed, the difference between the mid-1980s and the 2010s within a percentile of the markup distribution is often larger than the difference between the median and either the 25th or the 75th percentile of that distribution.

Figures 4 and 5 suggest that part of the high markups charged by firms with services-intensive production processes are required to cover expenditure on fixed inputs and overhead costs. However, when considering these expenses, profit rates are still higher for firms with higher services shares, as net profit rates do increase. Markups appear to increase by more than would be the case under zero profit conditions. Of course, some intermediate steps are missing here, particularly the relation of services cost shares to the gross profit rate and the variable and fixed input expenditure levels. Therefore, we regress the total cost share of services on markups, TFPR, expenditure measures, and profit rates. We vary whether within-industry or within-firm variation is used, as in equation (9). Results are in Table 3.

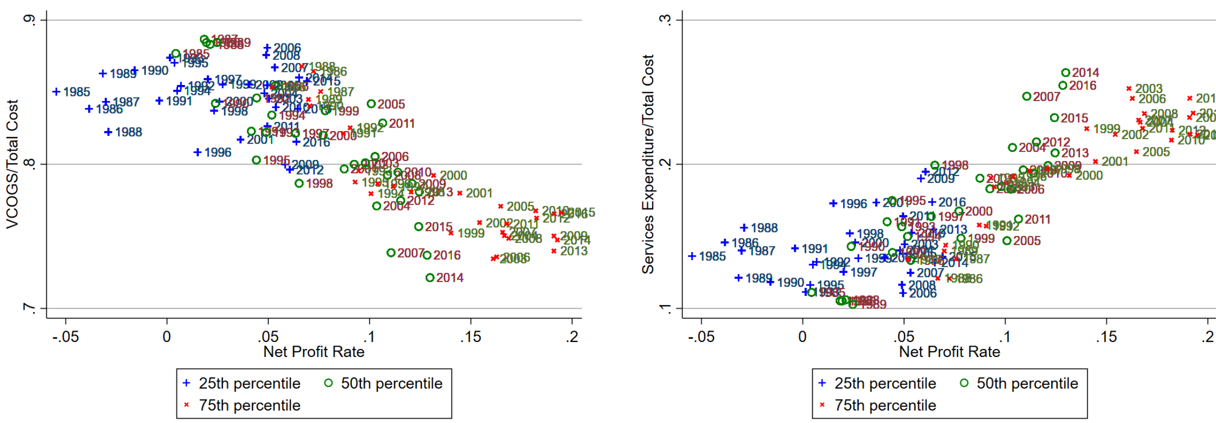
High services cost shares go hand in hand with high markups (Column 1 of Table 3). Moreover, in years where firms rely more on services, they set substantially higher markups (Column 2) – a 10 percent increase in the service share is associated with a 4.3 percent increase in a firm's markup. Our results imply that a firm following the trend of the median services cost share over time – an increase from 0.12 in 1985 to 0.22 in 2016 – increases its markup by about 35 percent. Cost structures becoming more reliant on services coincides with – and potentially requires – prices to be marked up more strongly over marginal costs.

TFPR also increases with services cost shares, but more moderately than markups (Columns 3 and 4 of Table 3). Recall from equation (8) that TFPR is defined based on a production function where services are an input. Formally, $R_{it} = F(L_{it}, K_{it}, G_{it}, S_{it})TFPR_{it}$. TFPR is a measure of a firm's revenue-generating capacities, holding fixed production technology, output, and inputs. While revenue productivity does increase, a firm following the

[25] The magnitude of these correlations is very similar when considering revenue shares instead of cost shares (Figure B4 in Appendix B).

Figure 5: Correlation between net profit rates and input expenditure cost shares

Panel a: Net profit rate and $\frac{\text{VCOGS}}{\text{Total Cost}}$ Panel b: Net profit rate and $\frac{\text{Services Expenditure}}{\text{Total Cost}}$



Notes: The sample for the p^{th} percentile in year t consists of all observations between the $(p-5)^{th}$ and $(p+5)^{th}$ percentile of the profit rate distribution in year t. Using this sample, the weighted average profit rate and either the weighted average VCOGS share of total cost (panel a), or the weighted average services expenditure share of total cost (panel b) are calculated. Weights are given by total cost shares.

median services cost share over the past decade would see TFPR increase by about 6 percent, substantially less than the 30 percent markup increase, consistent with markup changes not entirely originating in physical productivity or market power.

A high services cost share coupled with a low VCOGS cost share does not necessarily imply that a firm has low expenditure on variable inputs and high expenditure on services. For instance, if firms with high services cost shares are small in terms of input expenditure, high services shares could coincide with low levels of services expenditure. However, Columns 5 to 8 of Table 3 show that firms with high services cost shares spend less on variable inputs and more on fixed inputs and overhead than firms with low services cost shares. Our estimates imply that a firm whose services share increases over time from 0.12 to 0.22 experiences an increase in services and capital expenditure of roughly 50 percent, while expenditure on VCOGS decreases by about 47 percent. Cost structures relying less on variable input expenditure over time is, thus, tied to substantial increases in fixed input and overhead expenditure and substantial decreases in variable input expenditure.

The gross profit rates of firms with high services cost shares are substantially higher than those of firms with low services cost shares, as a consequence of the last paragraphs (Column 7 of Table 2). In addition, in years where firms have higher services cost shares, they have higher gross profit rates (Column 8). While net profit rates are also positively related to services cost shares both within industry-year and within firm, the magnitude of this positive relation is considerably weaker than for gross profit (Columns 11 and 12). A firm that follows the median services cost share trend over the entire sample sees its gross

Table 3: Services expenditure cost shares and firm performance

Dependent variable:	log(Markup)		log(TFPR)		log(VCOGS)	
	(1)	(2)	(3)	(4)	(5)	(6)
log(Services Expenditure/Total Cost)	0.53	0.43	0.08	0.07	-0.58	-0.56
	(0.023)***	(0.030)***	(0.011)***	(0.039)*	(0.058)***	(0.044)***
NACE×Year FE	×		×		×	
Firm FE & Year FE		×		×		×
R^2	0.36	0.79	0.96	0.80	0.24	0.92
Observations	73,023	73,023	73,023	73,023	73,023	73,023
Dependent variable:	log(Services + Capital)		log(Gross Profit Rate)		log(Net Profit Rate)	
	(7)	(8)	(9)	(10)	(11)	(12)
log(Services Expenditure/Total Cost)	0.62	0.61	0.78	0.75	0.40	0.28
	(0.055)***	(0.039)***	(0.032)***	(0.021)***	(0.082)***	(0.041)***
NACE×Year FE	×		×		×	
Firm FE & Year FE		×		×		×
R^2	0.30	0.93	0.60	0.73	0.24	0.50
Observations	73,023	73,023	71,491	71,491	59,245	59,245

Notes: Table 3 reports output from regressions relating the total cost share of services expenditure to measures of firm performance; TFPR refers to total factor revenue productivity; VCOGS refers to the sum of labor expenditure and goods expenditure; Services + Capital refers to the sum of services expenditure and capital costs; All regressions include an unreported constant term; NACE×Year FE refers to 3-digit NACE industry by year fixed effects; Standard errors clustered at the 2-digit NACE industry level; ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

profit rate increase by about 62 percent. A similar exercise for the net profit rate results in an increase of roughly half the size – 32 percent. Therefore, about half the increase in gross profits associated with changing cost structures does not result in an increase in net profits.

Table C3 in Appendix C reproduces Table 3 using revenue shares instead of cost shares. Results using cost and revenue shares are similar, with the exception of the TFPR and profit rate regressions. Higher profit rates and TFPR are associated with higher revenue, which pushes down revenue shares relative to cost shares. Points estimates for the TFPR and profit regressions are, therefore, lower, occasionally not significantly different from zero, and in one instance – the within-firm net profit regression – the sign even flips. Cost shares are informative on firms' cost structures, so that the results in Table 3 investigate the relation between production technology and firm outcomes. Revenue shares, on the other hand, contain information on both production and demand, making them a less direct measure of production technology and cost structures.

So far, our regression analysis has yet to consider the degree to which firms rely on services explicitly. Table C4 in Appendix C replicate the analyses of Table 3 on the sample of all firms in the top 5 percent of the services cost share distribution within each 2-digit-industry-year combination with at least 20 observations. While the sign of all point estimates is unchanged compared to the full-sample results, their magnitude tends to be substantially larger. For instance, a within-firm 10 percent increase in the services cost share is associated with a 10 percent increase in its markup and a 3.7 percent increase in TFPR. Again, the point estimates of the gross profit rate regressions – 0.92 and 0.87 in Columns 9 and 10 – substantially exceed those of the net profit rate regressions – 0.27 and 0.24 in Columns 11 and 12.

The forces documented in Table 3 appear to be present to an even larger degree for firms that heavily rely on services. Note that between-industry differences cannot fully explain this as the sample is constructed by industry-year services share distribution, and all regressions contain either industry-by-year or firm fixed effects. One potential explanation for our results is that the type of services that firms rely on differs along the distribution of the services cost share. Therefore, in the next section, we unpack services expenditure further, relying on our survey data.

Before moving on, recall that we assume that services enter the production function, which influences our output elasticity estimates and, hence, markups and TFPR. Figure B6 in Appendix B and Table C5 in Appendix C replicate our main findings on markups and TFPR and show that they are robust to instead assuming that services are overhead expenditure and do not enter the production function. From Figure B6, it is clear that markups are substantially higher and increase by more in this alternative specification, while the positive correlation with services cost shares is maintained. Table C5 shows that the size of the correlations between markups and services cost shares are virtually identical whether we assume services are overhead expenditure or not, while services shares are much more strongly positively associated with TFPR in this alternative specification. This is because TFPR is a residual measure that attributes any impact of omitted services on revenue in the overhead specification as increased TFPR.

Summing up Our results suggest that substituting services expenditure for VCOGS expenditure is associated with various measures of firm performance. As the services share increases, markups increase notably, and TFPR increases as well. These changes are accompanied by a decline in total expenditure on variable inputs while expenditure on fixed inputs and overhead costs increase. Consequently, gross profit rates markedly increase, while net profit rates increase, but by less. As firms' cost structures become more services-intensive and markups increase, the resulting increase in net profit rates is only half of the increase in gross profit rates. Therefore, a likely explanation for a substantial part of the observed markup increase is technology shifting from variable-input-intensive to fixed-input-and-overhead-intensive production processes.

5 Decomposing intermediates services

The ESE data allows us to study five separate components of services expenditure from 2008 onward: i) external labor, ii) gifts, iii) insurance, iv) rent, and v) software. We refer to the sum of expenditure on all five elements as ESE services expenditure and to the sample of all firms that report such information as the ESE sample. The median ESE services cost share increases over time – by roughly 25 percent between 2008 and 2016 – albeit more strongly than the services cost share – roughly 8 percent over the same period. ESE services expenditure does not correspond to the services expenditure that we observe for all firms and years in our sample because two elements in the ESE survey contain both services and goods – 'energy and energy carriers' and 'raw materials and other goods and services'. As there is no information on the distribution of these items across goods and services, and most of the expenditure captured in those bundles should accrue to goods rather than services, we do not include them in our bundle of ESE services.[26]

Table 4: Summary statistics of ESE services shares

variable	p(25)	p(50)	p(75)	mean	s.d.
External Labor Expenditure/Services Expenditure	0.02	0.05	0.11	0.08	0.10
Gifts Expenditure/Services Expenditure	0	0	0	0	0.02
Insurance Expenditure/Services Expenditure	0.01	0.01	0.03	0.02	0.03
Rent Expenditure/Services Expenditure	0.01	0.04	0.09	0.08	0.15
Software Expenditure/Services Expenditure	0	0	0	0.01	0.07
ESE Services Expenditure/Services Expenditure	0.08	0.14	0.24	0.18	0.19

Notes: Summary statistics for ESE services. ESE Services Expenditure bundles expenditure on all five separate components. Based on the full ESE sample of 13,876 observations covering the years 2008 to 2016. p(25), p(50), and p(75) refer to the 25th, 50th, and 75th percentile of the distribution, respectively. Mean and s.d. are the unweighted mean and standard deviation. Shares are rounded to two decimal points.

To investigate the relative importance of the five ESE categories in overall services expenditure, we express expenditure on each ESE component as a fraction of overall services

[26] If we add these two items to our ESE services expenditure measure, the resulting sum is, on average, 3.41 times as large as the reported total services expenditure, in line with these two ESE items consisting mostly of goods.

expenditure. Table 4 displays descriptive statistics on these services shares, and Figures B7 to B9 in Appendix B plots percentiles of the services share distributions over time. Expenditure on gifts, insurance, and software make up a tiny fraction of total services expenditure for the vast majority of firms. On average, these items comprise less than one percent of total services expenditure, with a median close to zero. Over time, the services shares of gifts and insurance are stable. While the median software services share is zero throughout the sample period, the 95th percentile increases from 2.3 percent in 2008 to 3.86 percent in 2016, suggesting that software has become more important in total service expenditure over time. However, as total services expenditure barely contains expenditure on gifts, insurance, or software, we conclude that these inputs play only a minor role in the secular shift towards services expenditure documented in Section 3 and ignore them in the remainder of this section.

External labor and rent each account for about 8 percent of total services expenditure, on average, which means that they comprise nearly all of ESE services expenditure (itself roughly 18 percent of total services expenditure, on average). External labor consists of employees not employed directly by the firm in question. Rent contains rental payments for land, buildings, machinery, plants, equipment, furniture, and vehicles and is best thought of as rental expenditure on capital. While these two inputs might contain variable components, by and large, they are fixed within a year. For instance, outsourced cleaning staff do not scale up immediately with production. Over time, the services shares of both items have increased slightly, as can be seen from Figures B7 and B9 in Appendix B. Due to their importance in overall services expenditure, we next investigate whether the results from Sections 3 and 4 extend to these two types of services.

Section 3 established that firms substitute service for variable inputs over time.[27] The ESE data allows us to explore the sensitivity of these results to the type of services expenditure that firms make. In particular, we regress input expenditure cost shares of external labor and rent on the cost shares of VCOGS and services. Table 5 reports the results.

Firms substitute both external labor and rent for VCOGS over time, and the magnitude of this relation is larger for external labor than for rent (Columns 2 and 6 of Table 5). Our results imply that a firm that follows the median VCOGS cost share between 2008 and 2016 increases its external labor cost share by about 5.94 percent and its rent cost share by 3.65 percent. Over time, an adjustment in the services cost share is accompanied by an (in percentage terms) near-identical change in the external labor cost share (Column 4). The cost shares of rent and services are also positively related but by substantially less (Column 8). Table C7 in Appendix C verifies that the remaining results on inputs also carry over to external labor and rent. In particular, external labor does not come at the cost of in-house employment, which is consistent with firms outsourcing certain jobs while simultaneously

[27]Table C6 in Appendix C verifies that this result also holds in the ESE sample, although the magnitude of the point estimate is slightly smaller there.

Table 5: ESE input use: Substitutes and complements

Dependent variable:	ln(External Labor/Total Cost)			
	(1)	(2)	(3)	(4)
ln(VCOGS/Total Cost)	-2.10	-2.23		
	(0.330)***	(0.152)***		
ln(Services/Total Cost)			0.95	0.99
			(0.119)***	(0.056)***
NACE×Year FE	×		×	
Firm FE & Year FE		×		×
R^2	0.19	0.73	0.22	0.74
Observations	12,877	12,877	12,877	12,877
Dependent variable:	ln(Rent/Total Cost)			
	(5)	(6)	(7)	(8)
ln(VCOGS/Total Cost)	-2.04	-1.43		
	(0.206)***	(0.164)***		
ln(Services/Total Cost)			0.88	0.68
			(0.081)***	(0.079)***
NACE×Year FE	×		×	
Firm FE & Year FE		×		×
R^2	0.21	0.80	0.23	0.81
Observations	12,504	12,504	12,504	12,504

Notes: Table 5 reports output from regressions relating the total cost shares of different inputs; VCOGS refers to the sum of labor expenditure and goods expenditure; All regressions include an unreported constant term; NACE×Year FE refers to 3-digit-industry-by-year fixed effects; Based on the full ESE sample of 13,876 observations covering the years 2008 to 2016; Standard errors clustered at the 2-digit-industry level; ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

expanding the in-house employment of other jobs.

Overall, our results on complementarity and substitutability in Section 3 extend to the two primary components of services expenditure observed in the ESE. Note that this does not imply anything about the substitutability of external labor and rent. Indeed, regressing the cost share of external workers on that of rent while including firm and year fixed effects results in a point estimate of -0.01 with a standard error of 0.011. In terms of cost structure, therefore, external labor and rent are two unrelated inputs that are both substituted for VCOGS over time.

In Section 4, we demonstrated that high services cost shares go hand-in-hand with high markups, high expenditure on fixed inputs and overhead, and low expenditure on variable inputs. As a result, gross profit rates strongly increase with services cost shares, while net profit rates only moderately rise. Table 6 repeats this analysis with cost shares of either external labor or rent taking the place of services cost shares.

Table 6 shows that markups and TFPR increase by about 2 to 3 percent as firms increase either their external labor or rent cost share by 1 percent over time. Using services shares, these correlations are substantially larger (43 percent increase for markups and 7 percent increase for TFPR – see Table 3), although qualitatively the results are similar. As a result, the within-firm association between cost shares and gross profit rates is very moderate for both rent and external labor. Net profit rates do not increase at all in response to a within-firm cost share increase of rent and even mildly decrease with external labor cost shares. Moreover, the shift from expenditure on variable inputs to expenditure on fixed inputs and overhead that accompanies increases in services cost shares is absent for both external labor and rent – compare results in Tables 3 and 6. Differences in the sample period cannot explain these differences. Table C8 in Appendix C replicates Table 3 on the ESE sample and finds that the results are qualitatively and quantitatively similar. Moreover, while we have focused on the two main components of observed services, external labor and rent, similar results can be obtained using the entire bundle of ESE services expenditure instead.[28]

Summing up While cost shares of external labor and rent co-move with services cost shares, they correlate quite differently to firm outcomes. Therefore, the observed shift from expenditure on variable inputs to expenditure on fixed inputs and overhead and the resulting change in markups and profit rates are unlikely to be explained by firms investing more in external labor, rent, software, or other services reported in the ESE. In light of recent academic work on outsourcing and investment in information technology, it is noteworthy that these items do not appear to explain our results.

[28]Focusing on the other three observed ESE services components – gifts, insurance, and software – also gives similar results although power is often low due to the very small fraction of firms that utilize these services. These results, and results based on the total ESE services bundle, are omitted so as not to clutter the paper with tables further.

Table 6: External labor and rent expenditure cost shares and firm performance

Dependent variable:	log(Markup)		log(TFPR)		log(VCOGS)	
	(1)	(2)	(3)	(4)	(5)	(6)
log(External Labor Expenditure/Total Cost)	0.09	0.02	0.01	0.02	-0.30	-0.01
	(0.011)***	(0.008)***	(0.003)***	(0.009)**	(0.042)***	(0.014)
NACE×Year FE	×		×		×	
Firm FE & Year FE		×		×		×
R^2	0.11	0.86	0.91	0.78	0.34	0.97
Observations	12,877	12,877	12,877	12,877	12,877	12,877
Dependent variable:	log(Services + Capital)		log(Gross Profit Rate)		log(Net Profit Rate)	
	(7)	(8)	(9)	(10)	(11)	(12)
log(External Labor Expenditure/Total Cost)	-0.16	0.04	0.11	0.02	0.12	-0.03
	(0.030)***	(0.009)***	(0.021)***	(0.006)***	(0.026)***	(0.013)*
NACE×Year FE	×		×		×	
Firm FE & Year FE		×		×		×
R^2	0.31	0.97	0.21	0.81	0.18	0.68
Observations	12,877	12,877	12,808	12,808	11,638	11,638
Dependent variable:	log(Markup)		log(TFPR)		log(VCOGS)	
	(13)	(14)	(15)	(16)	(17)	(18)
log(Rent Expenditure/Total Cost)	0.08	0.03	0.01	0.03	-0.20	-0.07
	(0.014)***	(0.007)***	(0.004)*	(0.010)**	(0.031)***	(0.013)***
NACE×Year FE	×		×		×	
Firm FE & Year FE		×		×		×
R^2	0.10	0.87	0.91	0.78	0.29	0.97
Observations	12,504	12,504	12,504	12,504	12,504	12,504
Dependent variable:	log(Services + Capital)		log(Gross Profit Rate)		log(Net Profit Rate)	
	(19)	(20)	(21)	(22)	(23)	(24)
log(Rent Expenditure/Total Cost)	-0.07	-0.02	0.07	0.02	0.04	-0.01
	(0.021)***	(0.011)*	(0.016)***	(0.006)**	(0.017)**	(0.011)
NACE×Year FE	×		×		×	
Firm FE & Year FE		×		×		×
R^2	0.29	0.97	0.16	0.80	0.15	0.69
Observations	12,504	12,504	12,432	12,432	11,285	11,285

Notes: Table 6 reports output from regressions relating the total cost share of external labor or rent expenditure to measures of firm performance; TFPR refers to total factor revenue productivity; VCOGS refers to the sum of labor expenditure and goods expenditure; Services + Capital refers to the sum of services expenditure and capital costs; All regressions include an unreported constant term; NACE×Year FE refers to 3-digit NACE industry by year fixed effects; Standard errors clustered at the 2-digit NACE industry level; ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

6 Concluding remarks

Recent work documents a widening gap between a firm's revenue and variable input expenditure. This paper analyzes this trend and takes a first step at looking into the likely underlying causes using data from the Belgian manufacturing sector between 1985 and 2016. Our data uniquely allows us to separate intermediate input expenditure into services and goods. This breakdown roughly corresponds to fixed (services) and variable (goods) factors of production contained in intermediates. In addition, for an economically meaningful subset of our data, we observe a further breakdown of services into several separate components, including external labor and rent.

While the COGS share of total cost is stable over time, we document an increasing services cost share, while cost shares of variable expenditure (labor and intermediates goods) decrease over time. This distinction is important if these input shares are used to measure markups across firms and time. Firms substitute services for variable inputs over time, suggesting that production technology is changing, particularly for firms that rely heavily on services. The changing cost structure of Belgian manufacturing firms is associated with changing firm performance. In particular, markups increase with services cost shares, as do gross profit rates. Net profit rates, that take into account services expenditure, also increase, but by substantially less than gross profit rates. The increase in markups, therefore, appears to exceed that of a competitive firm increasing services expenditure. Nonetheless, a considerable part of markup increases is likely due to technological change. As none of the services components we observe – external labor, gifts, insurance, rent, software – can fully explain these trends, an important avenue for future work is identifying the types of services expenditure that drive our results.

Our results suggest that changing cost structures, which are informative on production technology, can explain part of the aggregate trends of markups and profitability. Moreover, this trend appears strikingly similar across firms and industries. Of course, part of the change in markups and profitability might occur for other reasons and be orthogonal to firms' cost structure. Ultimately, two essential components are required to determine the relative importance of different channels in explaining aggregate trends: measurement of key variables and a model of firm behavior. We hope to have contributed to the former with this article and leave the latter for future work.

References

Abraham, F., Bormans, Y., Konings, J., and Roeger, W. (2024). Price-cost margins, fixed costs and excess profits. *Economic Journal*, page ueae037.

Ackerberg, D. A., Caves, K., and Frazer, G. (2015). Identification properties of recent production function estimators. *Econometrica*, 83(6):2411–2451.

Ackerberg, D. A. and De Loecker, J. (2021). Identification of production functions under imperfect competition. *mimeo*.

Autor, D., Dorn, D., Katz, L. F., Patterson, C., and Van Reenen, J. (2020). The fall of the labor share and the rise of superstar firms. *Quarterly Journal of Economics*, 135(2):645–709.

Bet, G. (2021). Market power in the U.S. airline industry 1990-2019. *mimeo*.

Bilal, A. and Lhuillier, H. (2021). Outsourcing, inequality and aggregate output. (no. w29348) National Bureau of Economic Research.

Bloom, N., Sadun, R., and Reenen, J. V. (2012). Americans do IT better: US multinationals and the productivity miracle. *American Economic Review*, 102(1):167–201.

Collard-Wexler, A. and De Loecker, J. (2015). Reallocation and technology: Evidence from the US steel industry. *American Economic Review*, 105(1):131–171.

Conlon, C., Miller, N. H., Otgon, T., and Yao, Y. (2023). Rising markups, rising prices? In *AEA Papers and Proceedings*, volume 113, pages 279–283.

De Loecker, J. and Eeckhout, J. (2018). Global market power. (no. w24768) National Bureau of Economic Research.

De Loecker, J., Eeckhout, J., and Mongey, S. (2021). Quantifying market power and business dynamism in the macroeconomy. (no. w28761) National Bureau of Economic Research.

De Loecker, J., Eeckhout, J., and Unger, G. (2020). The rise of market power and the macroeconomic implications. *Quarterly Journal of Economics*, 135(2):561–644.

De Loecker, J. and Fleitas, S. (2023). Markups and mergers in the us hospital industry. *mimeo*.

De Loecker, J., Fuss, C., and Van Biesebroeck, J. (2018). Markups and price dynamics: Linking micro to macro. (no. 357) National Bank of Belgium.

De Loecker, J., Goldberg, P. K., Khandelwal, A. K., and Pavcnik, N. (2016). Prices, markups, and trade reform. *Econometrica*, 84(2):445–510.

De Loecker, J. and Scott, P. T. (2016). Estimating market power. evidence from the us brewing industry. *NBER Working Paper*, (22957).

De Loecker, J. and Syverson, C. (2022). An industrial organization perspective on productivity. In Ho, K., Hortacsu, A., and Lizzeri, A., editors, *Handbook of Industrial Organization, Volume 4*. Elsevier.

De Loecker, J. and Warzynski, F. (2012). Markups and firm-level export status. *American Economic Review*, 102(6):2437–2471.

De Ridder, M. (2024). Market power and innovation in the intangible economy. *American Economic Review*, 114(1):199–251.

Döpper, H., MacKay, A., Miller, N., and Stiebale, J. (2022). Rising markups and the role of consumer preferences. Harvard Business School Strategy Unit Working Paper 22-025.

Eurostat (2008). NACE Rev. 2. Statistical classification of economic activities in the European community.

Foster, L., Haltiwanger, J., and Syverson, C. (2008). Reallocation, firm turnover, and efficiency: Selection on productivity or profitability? *American Economic Review*, 98(1):394–425.

Foster, L., Haltiwanger, J., and Tuttle, C. (2022). Rising markups or changing technology? (no. w30491) National Bureau of Economic Research.

Ganapati, S. (2024). The modern wholesaler: Global sourcing, domestic distribution, and scale economies. *American Economic Journal: Microeconomics, Forthcoming*.

Grieco, P. L., Murry, C., and Yurukoglu, A. (2024). The evolution of market power in the US automobile industry. *Quarterly Journal of Economics*, 139(2):1201–1253.

Grossman, G. M. and Helpman, E. (2005). Outsourcing in a global economy. *Review of Economic Studies*, 72(1):135–159.

Hall, R. E. (1988). The relation between price and marginal cost in US industry. *Journal of Political Economy*, 96(5):921–947.

Levinsohn, J. and Petrin, A. (2003). Estimating production functions using inputs to control for unobservables. *Review of Economic Studies*, 70(2):317–341.

Mertens, M. (2022). Micro-mechanisms behind declining labor shares: Rising market power and changing modes of production. *International Journal of Industrial Organization*, 81:102808.

Miller, N., Osborne, M., Sheu, G., and Sileo, G. (2023). Technology and market power: The United States cement industry 1974-2019. Georgetown Mcdonough School of Business Research Paper No. 4041168.

Miller, N. H. (2024). Industrial organization and the rise of market power. (no. w32627) National Bureau of Economic Research.

Morlacco, M. (2020). Market power in input markets: Theory and evidence from French manufacturing. *mimeo.*

Olley, G. S. and Pakes, A. (1996). The dynamics of productivity in the telecommunications equipment industry. *Econometrica*, 64(6):1263–1297.

Raval, D. (2023). Testing the production approach to markup estimation. *Review of Economic Studies*, 90(5):2592–2611.

Robinson, J. (1933). *The Economics of Imperfect Competition.* Macmillan and Co. Ltd.

Rubens, M., Wu, Y., and Xu, M. J. (2024). Exploiting or augmenting labor? *mimeo.*

Shapiro, C. and Yurukoglu, A. (2024). Trends in competition in the United States: What does the evidence show? *mimeo.*

Stigler, G. (1982). The economists and the problem of monopoly. *American Economic Review*, 72(2):1–11.

Sutton, J. (1991). *Sunk Costs and Market Structure: Price Competition, Advertising, and the Evolution of Concentration.* MIT Press.

Syverson, C. (2019). Macroeconomics and market power: Context, implications, and open questions. *Journal of Economic Perspectives*, 33(3):23–43.

Treuren, L. (2022). Wage markups and buyer power in intermediate input markets. *KU Leuven Discussion Paper DPS22.06.*

Yeh, C., Macaluso, C., and Hershbein, B. (2022). Monopsony in the US labor market. *American Economic Review*, 112(7):2099–2138.

Appendices

A Data

A.1 Data sources and cleaning

This paper uses annual firm-level data from the National Bank of Belgium (NBB), covering all private manufacturing firms that have to submit their annual accounts to the Belgian authorities from 1985 to 2016. Although annual accounts (AA) are collected for (nearly) all companies located in Belgium, larger firms are required to report more information. In particular, for large firms, we observe revenue and a breakdown of intermediate input expenditure into goods and services expenditure. We limit the sample to firms reporting this breakdown, as it is the central focus of this paper.

The reporting thresholds that define whether a firm is considered large vary over our sample period. From 1985 to 1996, large firms are those that satisfy at least two of the following criteria: i) yearly mean employment of at least 50, ii) yearly revenue of at least 3.59 million euros (145 million Belgian francs (BEF)) excluding value-added taxes, iii) total assets worth at least 1.74 million euros (70 million BEF). In addition, any firm with at least 100 employees is classified as large. For the period 1996 to 2016, the revenue and total assets thresholds are 9 million euros and 4.5 million euros, respectively.

The AA contain firm-level data on revenue, FTE employment, tangible fixed assets, and expenditure on labor, goods, and services. Where physical quantities are unavailable, we use deflated expenditure. Deflators on value added, investment and intermediate consumption at the 2-digit NACE are based on published data in the National Accounts and sector classification information reported in the annual accounts database. More specifically, revenue is deflated by the value added deflator, capital stock is deflated by the gross fixed capital consumption deflator, and intermediate goods and services are both deflated by the intermediate consumption deflator. Monetary values are in 1991 units, including labor expenditure for which deflating is done at the sample level.

Each firm is allocated to a single 2-digit NACE Rev. 2 industry, which are defined in a time-consistent manner over the entire sample period using industry concordances. Table A1 in Appendix A lists all 2-digit industries that are included in the final sample. Eurostat (2008) provides a description of all NACE classifications and the conversion to other international industry classification codes.

The NBB makes a small set of corrections concerning dates in the annual accounts and annualizes the resulting data while extrapolating missing values. In addition, we drop observations for which the breakdown of intermediate inputs into services and goods is not reported and for which either inputs, input expenditure, or revenue are missing. This reduces the sample from 165,404 to 92,209 observations. Next, we focus on firms with at least

20 full-time equivalent employees and trim the top and bottom 0.5 percent of the distributions of the cost shares of services, goods, labor, and capital. Finally, we remove outliers by dropping markups above 50 or below 0.5 and net profit rates below -0.5. These steps, in particular the selection on employment levels, further reduces the sample to 73,023 observations. However, firms that are dropped play only a small role in the Belgian economy as our final sample contains 82.40 percent of all reported revenue in the raw data.

The final sample contains 73,023 observations covering 5,887 firms. The observation count is relatively stable across different years and does not display a clear trend over time. On average, 2,281 firms are present in a given year, ranging from 1,919 in 2016 to 2,537 in 1992. Table A2 describes how observations, revenue, and employment are distributed over the different 2-digit industries in our final sample.

The *Enquête Structurelle des Entreprises* (ESE) is an annual survey conducted by Statistics Belgium that provides a detailed breakdown of intermediate inputs. We use this data for the 2008 to 2016 period, as it is unavailable prior to 2008. Statistics Belgium separates firms into 5 different classes based on their number of employees, revenue, and social security status. Firms in class 5, that is, firms with above 50 employees and a revenue of above 8 million euros, are obligated to fill out the survey annually. Firms in other classes are subject to a rotating sample. If firms in class 5 do not cover at least 50% of annual activity, then the survey is supplemented with data from firms from lower classes, until the 50% threshold is reached.[29] From the ESE, we construct a bundle of services expenditure consisting of expenditure on the separately observed components (i) external labor, (ii) gifts, (iii) insurance, (iv) rent, and (v) software. The ESE sample contains 13,876 observations covering 2,685 firms. On average 1,542 firms are present per year, ranging from 1,298 in 2014 to 1,928 in 2012. Firm that are in the ESE data report on average 5.17 years out of a possible nine.

A.2 Definition of variables

The following list gives the definition of key variables taken from the AA

- Revenue (R_{it}): Total revenue net of value-added taxes (VAT)
- Capital (K_{it}): Total book value of tangible fixed assets
- Labor (L_{it}): Full-time equivalent employment
- Cost of goods sold ($COGS_{it}$): Sum of expenditure on labor and intermediate inputs
- Variable cost of goods sold ($VCOGS_{it}$): Sum of expenditure on labor and goods
- Intermediate input expenditure ($P_{it}^M M_{it}$): Sum of expenditure on goods and services

[29]See https://www.ejustice.just.fgov.be/cgi/article_body.pl?language=nl&caller=summary&pub_date=08-09-22&numac=2008011338 for a more detailed description (in Dutch).

- Labor expenditure ($W_{it}L_{it}$): Total labor expenditure consisting of gross wages and all other labor expenses, such as employers' mandatory social security and pension contributions
- Goods expenditure ($P_{it}^{G}G_{it}$): Sum of expenditure on raw materials and consumables
- Services expenditure ($P_{it}^{S}S_{it}$): Sum of expenditure on services and all other goods
- Total cost (TC_{it}): Sum of $0.1K_{it}$ and expenditure on labor, goods, and services
- Gross profit rate: The ratio of revenue minus VCOGS to revenue
- Net profit rate: The ratio of revenue minus total cost to revenue

The following list gives the definition of key variables taken from the ESE, the total of which constitutes our complete bundle of ESE services

- External Labor Expenditure ($P_{it}^{EW}EW_{it}$): Sum of costs related to agency workers and persons placed at the disposal of the enterprise
- Gifts Expenditure ($P_{it}^{GI}GI_{it}$): Sum of costs related to gifts and donations
- Insurance Expenditure ($P_{it}^{IN}IN_{it}$): Sum of premiums for non-life insurance
- Rent Expenditure ($P_{it}^{RN}RN_{it}$): Sum of rental payments for land, buildings, machinery, plant, equipment, furniture and vehicles
- Software Expenditure ($P_{it}^{SW}SW_{it}$): Sum of expenditure on computer software

Table A1: NACE divisions covered in the final sample

Division	Description
10	Manufacture of food products
11	Manufacture of beverages
12	Manufacture of tobacco products
13	Manufacture of textiles
14	Manufacture of wearing apparel
15	Manufacture of leather and related products
16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
17	Manufacture of paper and paper products
18	Printing and reproduction of recorded media
19	Manufacture of coke and refined petroleum products
20	Manufacture of chemicals and chemical products
21	Manufacture of of basic pharmaceutical products and pharmaceutical preparations
22	Manufacture of rubber and plastic products
23	Manufacture of other non-metallic mineral products
24	Manufacture of basic metals
25	Manufacture of fabricated metal products, except machinery and equipment
26	Manufacture of computer, electronic and optical products
27	Manufacture of electrical equipment
28	Manufacture of machinery and equipment n.e.c.
29	Manufacture of motor vehicles, trailers and semi-trailers
30	Manufacture of other transport equipment
31	Manufacture of furniture
32	Other manufacturing
33	Repair and installation of machinery and equipment

Notes: This table lists all NACE divisions (2-digit NACE industries) covered by the final sample. Manufacturing covers NACE divisions 10 to 33.

Table A2: Percentage share of total revenue, employment, and observations, by NACE division

NACE division	Revenue share	Employment share	Observations share	Observations
10	15.97	12.13	15.68	11453
11	0.97	0.63	0.49	358
12	1.23	0.54	0.47	341
13	3.65	6.23	8.22	5999
14	1.01	1.24	1.95	1425
15	0.24	0.39	0.39	286
16	1.20	1.30	2.98	2173
17	3.14	2.69	2.88	2101
18	1.39	2.80	5.09	3715
19	3.50	0.59	0.22	158
20	15.52	11.47	7.74	5654
21	3.36	3.03	1.51	1105
22	3.84	4.19	6.27	4580
23	3.39	5.69	7.44	5430
24	12.46	9.26	3.01	2199
25	4.06	7.06	12.19	8899
26	3.77	4.63	2.51	1832
27	2.64	4.49	3.13	2282
28	5.56	8.81	8.65	6317
29	10.64	8.66	2.78	2027
30	0.85	0.98	0.82	599
31	0.88	2.06	3.90	2851
32	0.36	0.57	1.11	811
33	0.38	0.55	0.59	428

Notes: Industry (2-digit NACE) shares of total revenue, employment, and observations. Shares calculated as percentage of sample total. Percentage shares rounded to two decimal points. Based on the full sample of 73,023 observations covering 1985 to 2016.

Table A3: Output elasticities and markups: median *mean* (standard deviation), by NACE division

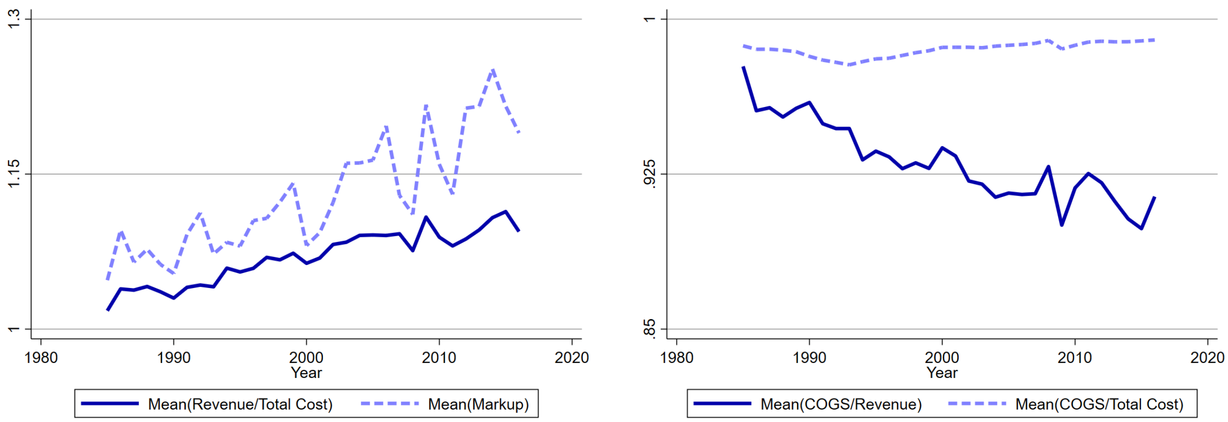
NACE division	goods elastivity	services elasticty	labor elasticity	markup	observations
10	0.68 *0.69* (0.04)	0.17 *0.16* (0.05)	0.12 *0.12* (0.03)	1.08 *1.43* (2.59)	11,453
11	0.48 *0.47* (0.02)	0.36 *0.35* (0.02)	0.11 *0.11* (0.01)	1.43 *1.82* (1.64)	358
12	0.73 *0.73* (0.04)	0.11 *0.12* (0.04)	0.11 *0.12* (0.04)	1.14 *1.48* (1.41)	341
13	0.59 *0.59* (0.05)	0.17 *0.18* (0.05)	0.18 *0.20* (0.08)	1.08 *1.47* (2.41)	5,999
14	0.56 *0.56* (0.08)	0.14 *0.16* (0.06)	0.24 *0.24* (0.13)	1.01 *1.19* (1.02)	1,425
15	0.56 *0.55* (0.08)	0.13 *0.15* (0.07)	0.30 *0.28* (0.12)	1.06 *1.10* (0.30)	286
16	0.64 *0.64* (0.04)	0.17 *0.16* (0.04)	0.17 *0.16* (0.05)	1.08 *1.39* (2.35)	2,173
17	0.62 *0.62* (0.03)	0.19 *0.18* (0.05)	0.17 *0.16* (0.06)	1.12 *1.27* (1.23)	2,101
18	0.47 *0.48* (0.04)	0.16 *0.17* (0.04)	0.32 *0.30* (0.07)	1.08 *1.40* (1.52)	3,715
19	0.68 *0.64* (0.19)	0.13 *0.15* (0.09)	0.15 *0.16* (0.09)	0.98 *1.88* (3.95)	158
20	0.62 *0.61* (0.04)	0.20 *0.20* (0.03)	0.16 *0.16* (0.04)	1.06 *1.63* (3.07)	5,654
21	0.48 *0.49* (0.05)	0.24 *0.25* (0.05)	0.23 *0.23* (0.06)	1.12 *1.56* (2.39)	1,105
22	0.59 *0.59* (0.04)	0.21 *0.20* (0.04)	0.17 *0.18* (0.06)	1.12 *1.29* (1.29)	4,580
23	0.51 *0.51* (0.05)	0.21 *0.21* (0.03)	0.23 *0.24* (0.06)	1.09 *1.34* (1.40)	5,430
24	0.61 *0.60* (0.10)	0.17 *0.17* (0.05)	0.18 *0.18* (0.09)	1.09 *1.33* (1.07)	2,199
25	0.54 *0.54* (0.06)	0.17 *0.17* (0.03)	0.24 *0.25* (0.07)	1.10 *1.53* (1.97)	8,899
26	0.55 *0.54* (0.08)	0.19 *0.19* (0.05)	0.24 *0.25* (0.08)	1.15 *1.57* (2.81)	1,832
27	0.55 *0.54* (0.06)	0.17 *0.17* (0.05)	0.25 *0.26* (0.07)	1.08 *1.29* (1.37)	2,282
28	0.53 *0.53* (0.05)	0.16 *0.16* (0.02)	0.27 *0.27* (0.06)	1.08 *1.36* (1.57)	6,317
29	0.63 *0.64* (0.05)	0.15 *0.15* (0.04)	0.16 *0.19* (0.07)	1.09 *1.43* (1.66)	2,027
30	0.54 *0.53* (0.11)	0.17 *0.18* (0.06)	0.25 *0.26* (0.12)	1.09 *1.29* (0.68)	599
31	0.52 *0.53* (0.04)	0.18 *0.17* (0.03)	0.28 *0.27* (0.06)	1.08 *1.17* (1.09)	2,851
32	0.57 *0.56* (0.07)	0.18 *0.18* (0.04)	0.24 *0.24* (0.06)	1.04 *1.69* (3.41)	811
33	0.52 *0.53* (0.06)	0.20 *0.20* (0.02)	0.26 *0.25* (0.05)	1.11 *2.23* (4.75)	428
Full sample	0.58 *0.58* (0.08)	0.18 *0.18* (0.05)	0.20 *0.21* (0.09)	1.09 *1.42* (2.09)	73,023

Notes: Table A3 shows summary statistics for the output elasticities of goods, services, and labor, and markups. For each NACE division, the median, mean (in italics), and standard deviation (in brackets) are displayed. Medians, means, and standard deviations are rounded to 2 decimal points. Output elasticities are the median 3-digit-industry-by-year total cost shares and markups are estimates assuming that goods are variable. Based on the full sample of 73,023 observations.

B Additional figures

Figure B1: Cost-weighted averages of markups, profitability, and COGS shares, over time

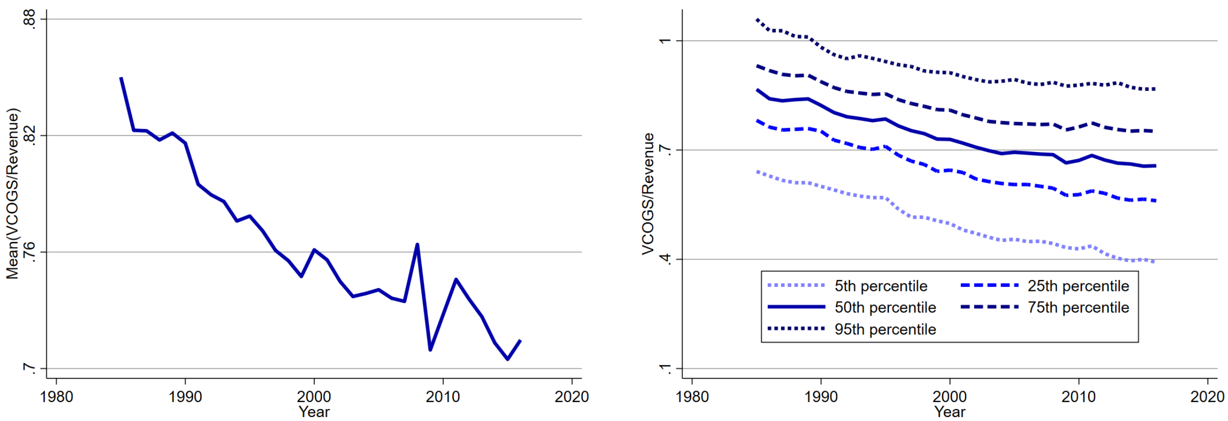
Panel a: Mean(Markup) and Mean$\left(\frac{\text{Revenue}}{\text{Total Cost}}\right)$ Panel b: Mean$\left(\frac{\text{COGS}}{\text{Revenue}}\right)$ and Mean$\left(\frac{\text{COGS}}{\text{Total Cost}}\right)$



Notes: The total-cost-weighted averages of the markup and revenue over total cost (panel a), and the revenue-weighted averages of the shares of COGS in revenue and total cost (panel b), over time. COGS refers to the sum of labor expenditure and intermediate input expenditure. Based on the full samples of 73,023 observations covering the years 1985 to 2016.

Figure B2: VCOGS revenue share, over time

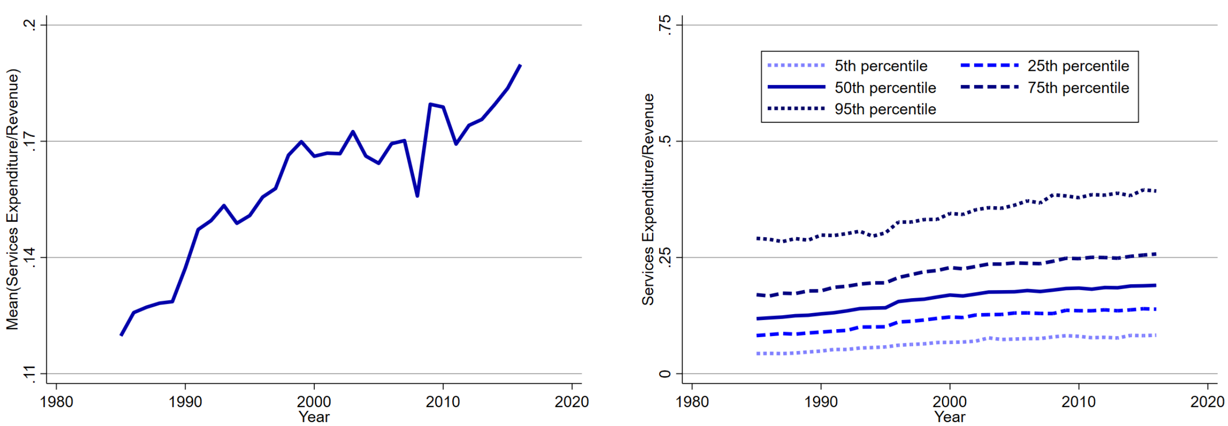
Panel a: Mean$\left(\frac{\text{VCOGS}}{\text{Revenue}}\right)$ Panel b: Distribution of $\frac{\text{VCOGS}}{\text{Revenue}}$



Notes: The revenue-weighted average (panel a), and selected percentiles from the distribution (panel b), of the share of VCOGS in revenue, over time. VCOGS refers to the sum of labor expenditure and goods expenditure. Based on the full samples of 73,023 observations covering the years 1985 to 2016.

Figure B3: Services revenue share, over time

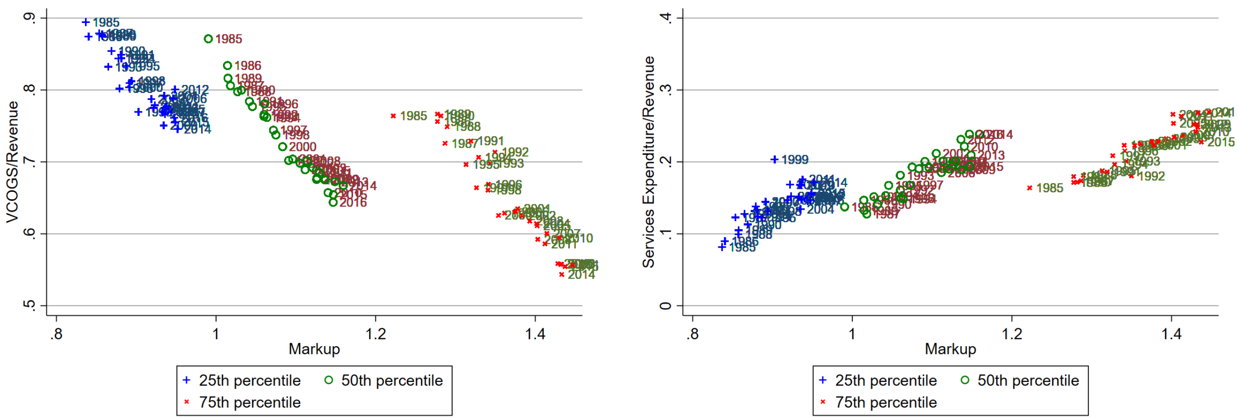
Panel a: Mean$\left(\frac{\text{Services Expenditure}}{\text{Revenue}}\right)$ Panel b: Distribution of $\frac{\text{Services Expenditure}}{\text{Revenue}}$



Notes: The revenue-weighted average (panel a), and selected percentiles from the distribution (panel b), of the share of services expenditure in revenue, over time. Based on the full samples of 73,023 observations covering the years 1985 to 2016.

Figure B4: Correlation between markups and input expenditure revenue shares

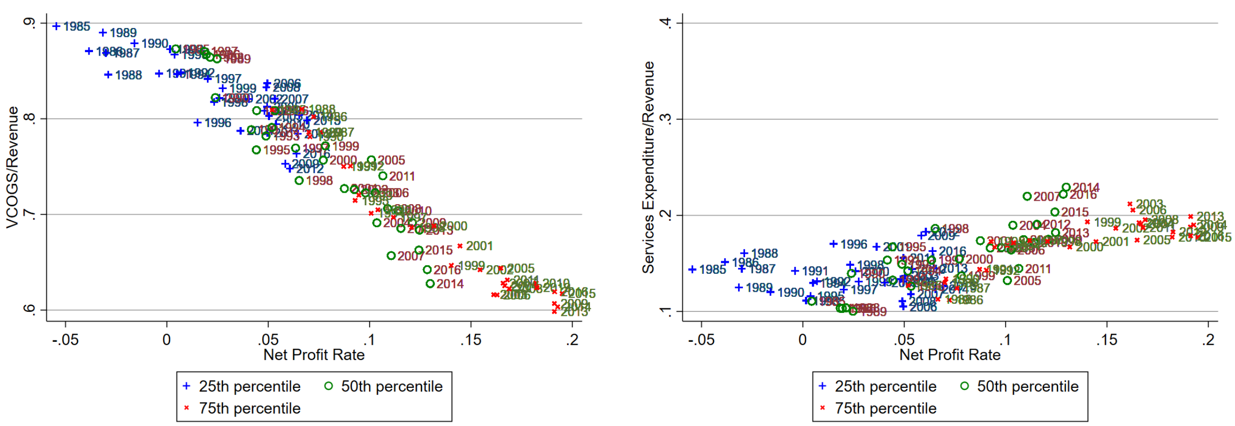
Panel a: Markups and $\frac{\text{VCOGS}}{\text{Revenue}}$ Panel b: Markups and $\frac{\text{Services Expenditure}}{\text{Revenue}}$



Notes: The sample for the p^{th} percentile in year t consists of all observations between the $(p-5)^{th}$ and $(p+5)^{th}$ percentile of the markup distribution in year t. Using this sample, the weighted average markup and either the weighted average VCOGS share of revenue (panel a), or the weighted average services expenditure share of revenue (panel b) are calculated. Weights are given by revenue shares.

Figure B5: Correlation between net profit rates and input expenditure revenue shares

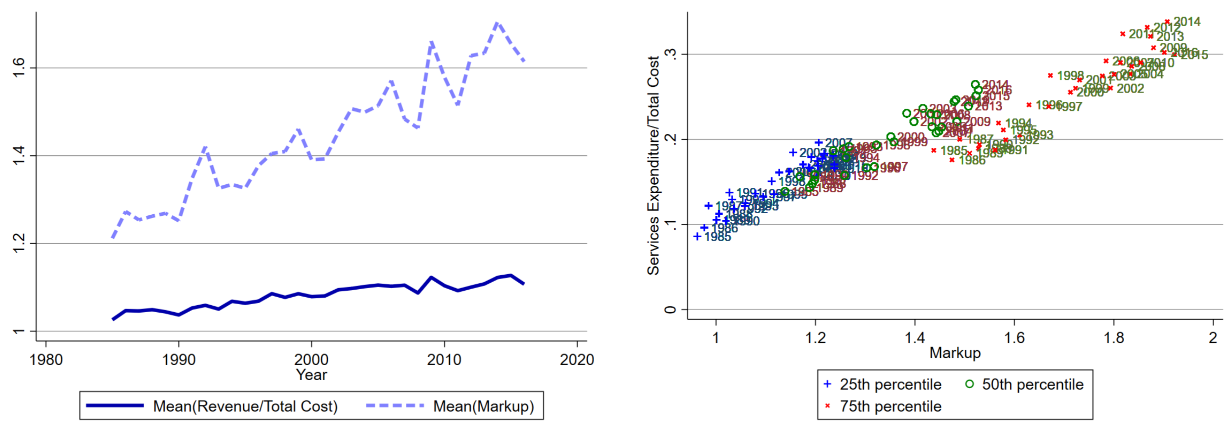
Panel a: Net profit rate and $\frac{\text{VCOGS}}{\text{Revenue}}$ Panel b: Net profit rate and $\frac{\text{Services Expenditure}}{\text{Revenue}}$



Notes: The sample for the p^{th} percentile in year t consists of all observations between the $(p-5)^{th}$ and $(p+5)^{th}$ percentile of the profit rate distribution in year t. Using this sample, the weighted average profit rate and either the weighted average VCOGS share of revenue (panel a), or the weighted average services expenditure share of revenue (panel b) are calculated. Weights are given by revenue shares.

Figure B6: Results assuming that services are overhead expenditure

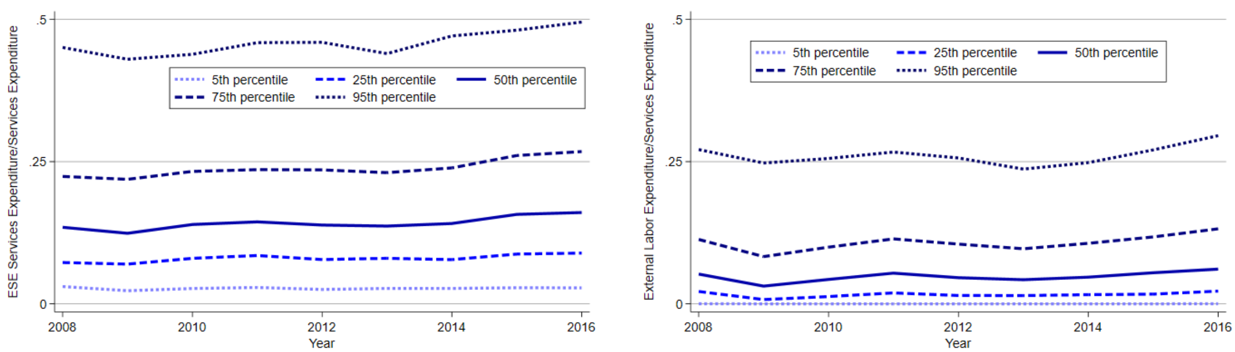
Panel a: Mean(Markup) and Mean$\left(\frac{\text{Revenue}}{\text{Total Cost}}\right)$ Panel b: Markups and $\frac{\text{Services Expenditure}}{\text{Total Cost}}$



Notes: Panel a replicates panel a of Figure 1, and panel b replicates panel b of Figure 4, under the assumption that services are overhead expenditure and do not enter into the production function.

Figure B7: Services shares of ESE services and external labor, over time

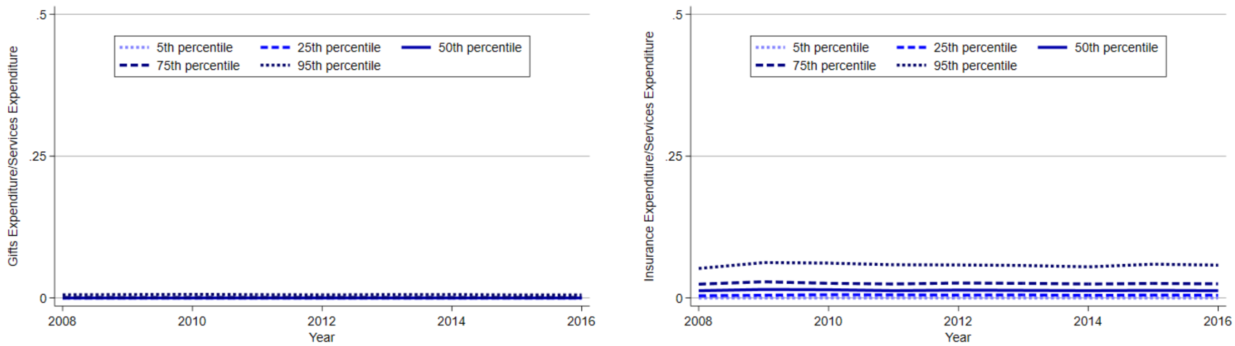
Panel a: Distribution of $\frac{\text{ESE Services Expenditure}}{\text{Services Expenditure}}$ Panel b: Distribution of $\frac{\text{External Labor Expenditure}}{\text{Services Expenditure}}$



Notes: Selected percentile from the distributions of the share of ESE services expenditure (panel a) and external labor expenditure (panel b) in total services expenditure, over time. Based on the ESE samples of 13,876 observations covering the years 2008 to 2016.

Figure B8: Services shares of gifts and insurance, over time

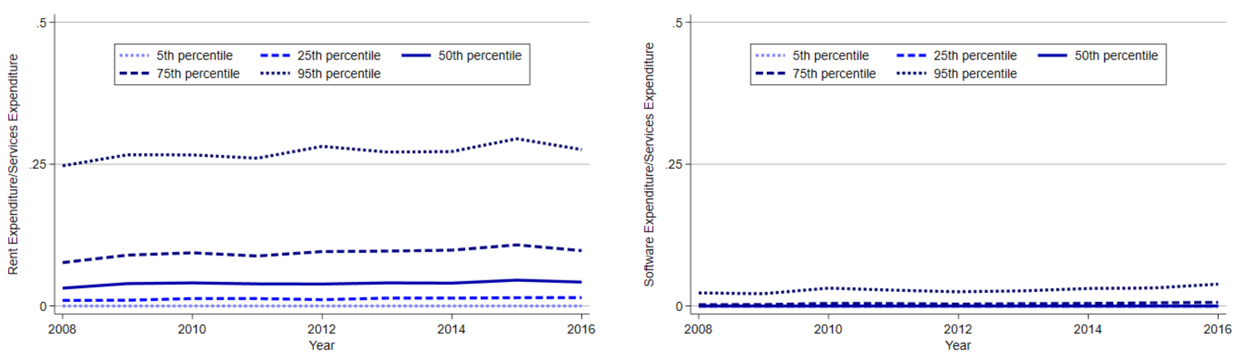
Panel a: Distribution of $\frac{\text{Gifts Expenditure}}{\text{Services Expenditure}}$ Panel b: Distribution of $\frac{\text{Insurance Expenditure}}{\text{Services Expenditure}}$



Notes: Selected percentile from the distributions of the share of gifts expenditure (panel a) and insurance expenditure (panel b) in total services expenditure, over time. Based on the ESE samples of 13,876 observations covering the years 2008 to 2016.

Figure B9: Services shares of rent and software, over time

Panel a: Distribution of $\frac{\text{Rent Expenditure}}{\text{Services Expenditure}}$ Panel b: Distribution of $\frac{\text{Software Expenditure}}{\text{Services Expenditure}}$



Notes: Selected percentile from the distributions of the share of rent expenditure (panel a) and software expenditure (panel b) in in total services expenditure, over time. Based on the ESE samples of 13,876 observations covering the years 2008 to 2016.

C Additional tables

Table C1: Input use: Substitutes and complements (revenue shares)

	Dependent variable: ln(Services Expenditure/Revenue)					
	(1)	(2)	(3)	(4)	(5)	(6)
ln(VCOGS/Revenue)	-1.40	-0.66				
	(0.101)***	(0.078)***				
ln(Labor Expenditure/Revenue)			0.29	0.21		
			(0.044)***	(0.018)***		
ln(Goods Expenditure/Revenue)					-0.53	-0.38
					(0.047)***	(0.021)***
NACE×Year FE	×		×		×	
Firm FE & Year FE		×		×		×
R^2	0.42	0.79	0.26	0.78	0.37	0.80

Notes: Table C1 reports output from regressions relating the revenue shares of different inputs; VCOGS refers to the sum of labor expenditure and goods expenditure; All regressions include an unreported constant term; NACE×Year FE refers to 3-digit-industry-by-year fixed effects; Based on the full sample of 73,023 observations covering the years 1985 to 2016; Standard errors clustered at the 2-digit-industry level; ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Table C2: Input use: Substitutes and complements (outliers)

	Dependent variable: log(Services Expenditure/Total Cost)					
	(1)	(2)	(3)	(4)	(5)	(6)
log(VCOGS/Total Cost)	-0.84	-0.97				
	(0.081)***	(0.054)***				
log(Labor Expenditure/Total Cost)			-0.01	-0.14		
			(0.021)	(0.019)***		
log(Goods Expenditure/Total Cost)					-0.08	-0.15
					(0.010)***	(0.012)***
NACE×Year FE	×		×		×	
Firm FE & Year FE		×		×		×
R^2	0.94	0.96	0.77	0.86	0.80	0.87

Notes: Table C2 reports output from regressions relating the total cost shares of different inputs; VCOGS refers to the sum of labor expenditure and goods expenditure; All regressions include an unreported constant term; NACE×Year FE refers to 3-digit-industry-by-year fixed effects; Based on the reduced sample of 3,878 observations, which contains only firms that are in the top 5% of the services cost share distribution for each 2-digit-industry-year combination with at least 20 observations, covering the years 1985 to 2016; Standard errors clustered at the 2-digit-industry level; ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Table C3: Services expenditure revenue shares and firm performance

Dependent variable:	log(Markup)		log(TFPR)		log(VCOGS)	
	(1)	(2)	(3)	(4)	(5)	(6)
log(Services Expenditure/Revenue)	0.45	0.29	0.02	0.01	-0.50	-0.50
	(0.019)***	(0.028)***	(0.015)	(0.038)	(0.062)***	(0.044)***
NACE×Year FE	×		×		×	
Firm FE & Year FE		×		×		×
R^2	0.27	0.76	0.18	0.79	0.23	0.92
Observations	73,023	73,023	73,023	73,023	73,023	73,023
Dependent variable:	log(Services + Capital)		log(Gross Profit Rate)		log(Net Profit Rate)	
	(7)	(8)	(9)	(10)	(11)	(12)
log(Services Expenditure/Revenue)	0.67	0.57	0.64	0.41	0.14	-0.30
	(0.052)***	(0.036)***	(0.055)***	(0.041)***	(0.111)	(0.067)***
NACE×Year FE	×		×		×	
Firm FE & Year FE		×		×		×
R^2	0.31	0.93	0.48	0.68	0.21	0.50
Observations	73,023	73,023	71,491	71,491	59,245	59,245

Notes: Table C3 reports output from regressions relating the revenue share of services expenditure to measures of firm performance; TFPR refers to total factor revenue productivity; VCOGS refers to the sum of labor expenditure and goods expenditure; Services + Capital refers to the sum of services expenditure and capital costs; All regressions include an unreported constant term; NACE×Year FE refers to 3-digit NACE industry by year fixed effects; Standard errors clustered at the 2-digit NACE industry level; ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Table C4: Services expenditure cost shares and firm performance (outliers)

Dependent variable:	log(Markup)		log(TFPR)		log(VCOGS)	
	(1)	(2)	(3)	(4)	(5)	(6)
log(Services Expenditure/Total Cost)	1.70	1.04	0.94	0.37	-0.88	-0.79
	(0.296)***	(0.093)***	(0.169)***	(0.144)**	(0.484)*	(0.138)***
NACE×Year FE	×		×		×	
Firm FE & Year FE		×		×		×
R^2	0.56	0.91	0.18	0.79	0.52	0.95
Observations	3,878	3,878	3,878	3,878	3,878	3,878
Dependent variable:	log(Services + Capital)		log(Gross Profit Rate)		log(Net Profit Rate)	
	(7)	(8)	(9)	(10)	(11)	(12)
log(Services Expenditure/Total Cost)	0.95	0.92	0.92	0.87	0.27	0.24
	(0.466)*	(0.140)***	(0.052)***	(0.061)***	(0.322)	(0.246)
NACE×Year FE	×		×		×	
Firm FE & Year FE		×		×		×
R^2	0.55	0.96	0.70	0.89	0.56	0.64
Observations	3,878	3,878	3,875	3,875	3,067	3,067

Notes: Table C4 reports output from regressions relating the total cost share of services expenditure to measures of firm performance; TFPR refers to total factor revenue productivity; VCOGS refers to the sum of labor expenditure and goods expenditure; Services + Capital refers to the sum of services expenditure and capital costs; All regressions include an unreported constant term; NACE×Year FE refers to 3-digit NACE industry by year fixed effects; Based on the reduced sample, which contains only the firms who are in the top 5% of the services cost share distribution for each 2-digit-industry-year combination with at least 20 observations, covering the years 1985 to 2016; Standard errors clustered at the 2-digit-industry level; ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Table C5: Services expenditure cost shares and firm performance assuming that services are overhead expenditure

Dependent variable:	log(Markup)		log(TFPR)	
	(1)	(2)	(3)	(4)
log(Services Expenditure/Total Cost)	0.53	0.45	0.31	0.32
	(0.023)***	(0.031)***	(0.014)***	(0.045)***
NACE×Year FE	×		×	
Firm FE & Year FE		×		×
R^2	0.38	0.81	0.96	0.83

Notes: Table C5 reports output from regressions relating the total cost share of services expenditure to markups and TFPR under the assumption that services are overhead expenditure and do not enter the production function; TFPR refers to total factor revenue productivity; All regressions include an unreported constant term; NACE×Year FE refers to 3-digit NACE industry by year fixed effects; Based on the full sample of 73,023 observations covering the years 1985 to 2016; Standard errors clustered at the 2-digit NACE industry level; ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Table C6: Input use: Substitutes and complements (ESE sample)

Dependent variable:	ln(Services Expenditure/Total Cost)					
	(1)	(2)	(3)	(4)	(5)	(6)
ln(VCOGS/Total Cost)	-2.47	-2.23				
	(0.090)***	(0.074)***				
ln(Labor Expenditure/Total Cost)			0.37	0.21		
			(0.041)***	(0.046)***		
ln(Goods Expenditure/Total Cost)					-0.68	-0.55
					(0.046)***	(0.048)***
NACE×Year FE	×		×		×	
Firm FE & Year FE		×		×		×
R^2	0.80	0.97	0.31	0.91	0.49	0.94
Observations	13,876	13,876	13,876	13,876	13,876	13,876

Notes: Table C6 reports output from regressions relating the total cost shares of different inputs; VCOGS refers to the sum of labor expenditure and goods expenditure; All regressions include an unreported constant term; NACE×Year FE refers to 3-digit-industry-by-year fixed effects; Based on the full ESE sample of 13,876 observations covering the years 2008 to 2016; Standard errors clustered at the 2-digit-industry level; ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Table C7: ESE input use: Substitutes and complements (additional results)

Dependent variable:	ln(External Labor/Total Cost)			
	(1)	(2)	(3)	(4)
ln(Labor Expenditure/Total Cost)	0.61	0.28		
	(0.090)***	(0.133)**		
ln(Goods Expenditure/Total Cost)			-0.68	-0.56
			(0.107)***	(0.066)***
NACE×Year FE	×		×	
Firm FE & Year FE		×		×
R^2	0.20	0.73	0.18	0.73
Observations	12,877	12,877	12,877	12,877
Dependent variable:	ln(Rent/Total Cost)			
	(5)	(6)	(7)	(8)
ln(Labor Expenditure/Total Cost)	0.61	0.60		
	(0.047)***	(0.076)***		
ln(Goods Expenditure/Total Cost)			-0.71	-0.58
			(0.069)***	(0.083)***
NACE×Year FE	×		×	
Firm FE & Year FE		×		×
R^2	0.22	0.81	0.20	0.80
Observations	12,504	12,504	12,504	12,504

Notes: Table C7 reports output from regressions relating the total cost shares of different inputs; All regressions include an unreported constant term; NACE×Year FE refers to 3-digit-industry-by-year fixed effects; Based on the full ESE sample of 13,818 observations covering the years 2008 to 2016; Standard errors clustered at the 2-digit-industry level; ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Table C8: Services expenditure cost shares and firm performance (ESE sample)

Dependent variable:	log(Markup)		log(TFPR)		log(VCOGS)	
	(1)	(2)	(3)	(4)	(5)	(6)
log(Services Expenditure/Total Cost)	0.69	0.65	0.12	0.08	-0.97	-0.75
	(0.037)***	(0.065)***	(0.024)***	(0.059)	(0.087)***	(0.076)***
NACE×Year FE	×		×		×	
Firm FE & Year FE		×		×		×
R^2	0.44	0.89	0.91	0.77	0.36	0.97
Observations	13,876	13,876	13,876	13,876	13,876	13,876
Dependent variable:	**log(Services + Capital)**		**log(Gross Profit Rate)**		**log(Net Profit Rate)**	
	(7)	(8)	(9)	(10)	(11)	(12)
log(Services Expenditure/Total Cost)	0.31	0.52	0.74	0.68	0.45	0.18
	(0.084)***	(0.065)***	(0.034)***	(0.029)***	(0.075)***	(0.082)**
NACE×Year FE	×		×		×	
Firm FE & Year FE		×		×		×
R^2	0.30	0.97	0.59	0.84	0.20	0.68
Observations	13,876	13,876	13,797	13,797	12,531	12,531

Notes: Table C8 reports output from regressions relating the total cost share of services expenditure to measures of firm performance; TFPR refers to total factor revenue productivity; VCOGS refers to the sum of labor expenditure and goods expenditure; Services + Capital refers to the sum of services expenditure and capital costs; All regressions include an unreported constant term; NACE×Year FE refers to 3-digit NACE industry by year fixed effects; Based on the full ESE sample of 13,876 observations covering the years 2008 to 2016; Standard errors clustered at the 2-digit NACE industry level; ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

NATIONAL BANK OF BELGIUM - WORKING PAPERS SERIES

The Working Papers are available on the website of the Bank: http://www.nbb.be.

405. “Robert Triffin, Japan and the quest for Asian Monetary Union”, I. Maes and I. Pasotti, *Research series*, February 2022.
406. “The impact of changes in dwelling characteristics and housing preferences on house price indices”, by P. Reusens, F. Vastmans and S. Damen, *Research series*, May 2022.
407. “Economic importance of the Belgian maritime and inland ports – Report 2020”, by I. Rubbrecht, *Research series*, May 2022.
408. “New facts on consumer price rigidity in the euro area”, by E. Gautier, C. Conflitti, R. P. Faber, B. Fabo, L. Fadejeva, V. Jouvanceau, J. O. Menz, T. Messner, P. Petroulas, P. Roldan-Blanco, F. Rumler, S. Santoro, E. Wieland and H. Zimmer, *Research series*, June 2022.
409. “Optimal deficit-spending in a liquidity trap with long-term government debt”, by Charles de Beauffort, *Research series*, July 2022.
410. “Losing prospective entitlement to unemployment benefits. Impact on educational attainment”, by B. Cockx, K. Declercq and M. Dejemeppe, *Research series*, July 2022.
411. “Integration policies and their effects on labour market outcomes and immigrant inflows”, by C. Piton and I. Ruyssen, *Research series*, September 2022.
412. “Foreign demand shocks to production networks: Firm responses and worker impacts”, by E. Dhyne, A. K. Kikkawa, T. Komatsu, M. Mogstad and F. Tintelnot, *Research series*, September 2022.
413. “Economic research at central banks: Are central banks interested in the history of economic thought?”, by I. Maes, *Research series*, September 2022.
414. “Softening the blow: Job retention schemes in the pandemic”, by J. Mohimont, M. de Sola Perea and M.-D. Zachary, *Research series*, September 2022.
415. “The consumption response to labour income changes, by K. Boudt, K. Schoors, M. van den Heuvel and J. Weytjens, *Research series*, October 2022.
416. “Heterogeneous household responses to energy price shocks, by G. Peersman and J. Wauters, *Research series*, October 2022.
417. “Income inequality in general equilibrium”, by B. Bernon, J. Konings and G. Magerman, *Research series*, October 2022.
418. “The long and short of financing government spending”, by J. Mankart, R. Priftis and R. Oikonomou, *Research series*, October 2022.
419. “Labour supply of households facing a risk of job loss”, by W. Gelade, M. Nautet and C. Piton, *Research series*, October 2022.
420. “Over-indebtedness and poverty: Patterns across household types and policy effects”, by S. Kuypers and G. Verbist, *Research series*, October 2022.
421. “Evaluating heterogeneous effects of housing-sector-specific macroprudential policy tools on Belgian house price growth”, by L. Coulier and S. De Schryder, *Research series*, October 2022.
422. “Bank competition and bargaining over refinancing”, by M. Emiris, F. Koulischer and Ch. Spaenjers, *Research series*, October 2022.
423. “Housing inequality and how fiscal policy shapes it: Evidence from Belgian real estate”, by G. Domènech-Arumì, P. E. Gobbi and G. Magerman, *Research series*, October 2022.
424. “Income inequality and the German export surplus”, by A. Rannenberg and Th. Theobald, *Research series*, October 2022.
425. “Does offshoring shape labor market imperfections? A comparative analysis of Belgian and Dutch firms”, by S. Dobbelaere, C. Fuss and M. Vancauteren, *Research series*, November 2022.
426. “Sourcing of services and total factor productivity”, E. Dhyne and C. Duprez, *Research series*, December 2022.
427. " Employment effect of citizenship acquisition: Evidence from the Belgian labour market", S. Bignandi and C. Piton, *Research series*, December 2022.
428. "Identifying Latent Heterogeneity in Productivity", R. Dewitte, C. Fuss and A. Theodorakopoulos, *Research series*, December 2022.
429. “Export Entry and Network Interactions - Evidence from the Belgian Production Network”, E. Dhyne, Ph. Ludwig and H. Vandenbussche, *Research series*, January 2023.
430. "Measuring the share of imports in final consumption", E. Dhyne, A.K. Kikkawa, M. Mogstad and F. Tintelnot, *Research series*, January 2023.
431. "From the 1931 sterling devaluation to the breakdown of Bretton Woods: Robert Triffin’s analysis of international monetary crises", I. Maes and I. Pasotti, *Research series*, January 2023.
432. “Poor and wealthy hand-to-mouth households in Belgium”, L. Cherchye, T. Demuynck, B. De Rock, M. Kovaleva, G. Minne, M. De Sola Perea and F. Vermeulen, *Research series*, February 2023.

433. “Empirical DSGE model evaluation with interest rate expectations measures and preferences over safe assets”, G. de Walque, Th. Lejeune and A. Rannenberg, *Research series*, February 2023.

434. “Endogenous Production Networks with Fixed Costs”, E. Dhyne, A. K. Kikkawa, X. Kong, M. Mogstad and F. Tintelnot, *Research series*, March 2023.

435. “BEMGIE: Belgian Economy in a Macro General and International Equilibrium model”, G. de Walque, Th. Lejeune, A. Rannenberg and R. Wouters, *Research series*, March 2023.

436. “Alexandre Lamfalussy and the origins of instability in capitalist economies”, I. Maes, *Research series*, March 2023.

437. “FDI and superstar spillovers: Evidence from firm-to-firm transactions”, M. Amiti, C. Duprez, J. Konings and J. Van Reenen, *Research series*, June 2023.

438. “Does pricing carbon mitigate climate change? Firm-level evidence from the European Union emissions trading scheme”, J. Colmer, R. Martin, M. Muûls and U.J. Wagner, *Research series*, June 2023.

439. “Managerial and financial barriers to the green transition”, R. De Haas, R. Martin, M. Muûls and H. Schweiger, *Research series*, June 2023.

440. “Review essay: The young Hayek”, I. Maes, *Document series*, September 2023.

441. “Review essay: Central banking in Italy”, I. Maes, *Document series*, September 2023.

442. “Debtor (non-)participation in sovereign debt relief: A real option approach”, D. Cassimon, D. Essers and A. Presbitero, *Research series*, September 2023.

443. “Input varieties and growth: a micro-to-macro analysis”, D.-R. Baqaee, A. Burstein, C. Duprez and E. Farhi, *Research series*, October 2023.

444. “The Belgian business-to-business transactions dataset 2002-2021”, E. Dhyne, C. Duprez and T. Komatsu, *Research series*, October 2023.

445. “Nowcasting GDP through the lens of economic states”, K. Boudt, A. De Block, G. Langenus and P. Reusens, *Research series*, December 2023.

446. “Macroeconomic drivers of inflation expectations and inflation risk premia”, J. Boeckx, L. Iania and J. Wauters, *Research series*, February 2024.

447. “What caused the post-pandemic era inflation in Belgium?”, G. de Walque and Th. Lejeune, *Research series*, March 2024.

448. “Financial portfolio performance of Belgian households: a nonparametric assessment”, L. Cherchye, B. De Rock and D. Saelens, *Research series*, April 2024.

449. “Owner-occupied housing costs, policy communication, and inflation expectations”, J. Wauters, Z. Zekaite and G. Garabedian, *Research series*, May 2024.

450. “Managing the inflation-output trade-off with public debt portfolios”, B. Chafwehé, Ch. de Beauffort and R. Oikonomou, *Research series*, July 2024.

451. “State-owned suppliers, political connections, and performance of privately-held firms evidence from Belgian firm data”, P. Muylle and E. Dhyne, *Research series*, July 2024.

452. “Inputs in distress: Geoeconomic fragmentation and firms’ sourcing”, L. Panon, L. Lebastard, M. Mancini, A. Borin, P. Caka, G. Cariola, D. Essers, E. Gentili, A. Linarello, T. Padellini, F. Requena and J. Timini, *Document series*, August 2024.

453. “Anatomy of the Phillips Curve: micro evidence and macro implications”, L. Gagliardone, M. Gertler, S. Lenzu and J. Tielens, *Research series*, August 2024.

454. “Hunting “brown zombies” to reduce industry’s carbon footprint”, G. Bijnens and C. Swartenbroekx, *Research series*, September 2024.

455. “Exchange rate overshooting: unraveling the puzzles”, M. Braig, S. K. Rüth and W. Van der Veken, *Research series*, September 2024.

456. “Multinational networks and trade participation”, P. Conconi, F. Leone, G. Magerman and C. Thomas, *Research series*, September 2024.

457. “Inflation (de-)anchoring in the euro area”, V. Burbau, B. De Backer and A. L. Vladu, *Research series*, September 2024.

458. “Bank specialization and corporate innovation”, H. Degryse, O. De Jonghe, L. Gambacorta and C. Huylebroek, *Research series*, October 2024.

459. “Will labour shortages and skills mismatches throw sand in the gears of the green transition in Belgium?”, M. Barslund, W. Gelade and G. Minne, *Research series*, October 2024.

460. “Aggregate and distributional effects of a carbon tax”, C. Proebsting, *Research series*, October 2024.

461. “Emission trading and overlapping environmental support: installation-level evidence from the EU ETS”, K. Mulier, M. Ovaere and L. Stimpfle, *Research series*, October 2024.

462. “Digitalization and international competitiveness: a cross-country exploration of the relation between firm level ICT use, productivity and export”, M. Vancauteren, K. Randy Chemo Dzukou, M. Polder, P. Mohnen and J. Miranda, *Research series,* October 2024.

463. “Digitalisation of firms and (type of) employment”, S. Bignandi, C. Duprez and C. Piton, *Research series,* October 2024.

464. "Deglobalization and the reorganization of supply chains: effects on regional inequalities in the EU", G. Magerman and A. Palazzolo, *Research series*, October 2024.
465. "Home country effects of multinational network restructuring in times of deglobalization: evidence from European MNEs", B. Merlevede and B. Michel, *Research series*, October 2024.
466. "A bridge over troubled water: flooding shocks and supply chains", G. Bijnens, M. Montoya and S. Vanormelingen, *Research series*, October 2024.
467. "The effects of carbon pricing along the production network", R. Martin, M. Muûls and Th. Stoerk, *Research series*, October 2024.
468. "The impact of climate transition policies on Belgian firms – what can we learn from a survey?", R. Basselier, N. Bouamara, G. Langenus, G. Peersman and P. Reusens, *Research series*, October 2024.
469. "The anatomy of costs and firm performance evidence from Belgium", J. De Loecker, C. Fuss, N. Quiller-Doust and L. Treuren, *Research series*, October 2024.

National Bank of Belgium
Limited liability company
Brussels RLE – Company's number: 0203.201.340
Registered office: 14 Boulevard de Berlaimont – BE-1000 Brussels
www.nbb.be

Editor

Pierre Wunsch
Governor of the National Bank of Belgium

Layout: Analysis and Research Group
Cover: NBB CM – Prepress & Image

Published in October 2024