Markups and Cost Complementarities in Business Groups

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Abstract

Using a unique firm-level dataset, where the mother firm and its subsidiaries can be identified, this paper documents that the average markup for firms in business groups is larger and increasing relative to the markup of firms that operate as single entities. Theory predicts that firms in business groups should have higher markups than firms that operate individually because firms in business groups can take advantage of cost complementarities and productivity gains within the group and thus face lower marginal costs. An instrumental variable regression with firm-level shift-share instruments for changes in imported inputs show that firms in groups increase their markup by 6 percent when the share of their imported inputs rise by one percent. According to the estimates and aggregate data trends, the cost complementarity channel has the potential to explain the aggregate markup growth and the difference in markup growth between the two types of firms observed in the data.

Keywords: markups, concentration, price setting, heterogeneous firms.
JEL Codes: D21, D22, D24, D43, E31, E32, L11.

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1 Introduction

There is an ongoing debate about rising markups and increasing concentration (De Loecker and Warzynski, 2012; De Loecker et al., 2020; Gutierrez and Philippon, 2017). Some authors argue that an increasing pattern in markups and concentration cannot be observed (Foster et al., 2022) or that a positive correlation between concentration and markups may not be problematic (Berry et al., 2019). While De Loecker and Scott (2016) show that markups estimated from the production and the demand approach yield comparable increasing trends, Benkard, Yurukoglu and Zhang (2021) argue that defining markets based on the product space instead of industries results in significantly higher *but* declining measure of market concentration. In addition to the definition of markets, using the relevant weights when calculating the aggregate markup has a large impact on the stylized facts, depicting a significant increase in markups and concentration (Edmond, Midrigan and Xu, 2015).

This paper brings new evidence in support of rising markups using the production function approach. It documents that sales and cost weighted average markups are rising in Sweden. The paper also documents a new stylized fact, namely that firms that operate 'in business groups' charge a higher markup than 'individual' firms. In addition, this study is the first to establish a causal link between higher markups and being part of a group of firms via the marginal cost channel, introducing the idea that cost complementarities as a form of economies of scope is important for the level and evolution of the markups of firms. Specifically, cost complementarities within groups of firms can potentially explain the divergence in markups between the two types of firms and a significant fraction of the rise in the average markup.

A modified version of the model of Atkeson and Burstein (2008) is taken as a benchmark framework to provide testable hypotheses about the cost-complementarity channel. The model is then used to estimate the implied marginal cost reduction that would be needed for firms in groups to charge a 20 percent higher markup than individual firms, which is the observed difference between the markups of the two types of firms in 2016.

Then, an instrumental variable approach tests whether negative cost shocks, or exogenous cost reductions, can lead to a relative increase in the markup of firms in groups. In particular, an instrumental variable regression with the China supply shock of imported inputs is used as instrument for changes in firm-specific imported input shares over a long horizon between 2000 and 2007. The instrumental variable regression tests whether firms in groups increased their markups more than individual firms in response to a negative input cost shock, captured by the allegedly exogenous increase in cheaper imported inputs from China during 2000-2007.

The theoretical predictions of the model show that firms in groups, which share a high group productivity, have higher markups than firms that operate individually because groups enjoy lower marginal costs. Firms in groups enjoy a degree of cost savings among themselves which is a form of cost complementarity. The theory also explains that firms in groups are able take advantage of aggregate productivity shocks and thereby reduce their marginal costs by more, resulting in a relative increase in their markups. According to the model simulations, the 20 percent difference between the markups of individual firms and firms in groups in 2016 can be rationalized by an 86 percent lower marginal cost for firms in groups.

The results from the instrumental variable regression confirm that firms in groups increase their markups when the share of their cheaper imported inputs rise. Specifically, a one percent increase in the imported input share yields a 6 percent relative increase in the markup of firms that are a part of a business group.

By utilizing the detailed Swedish data, it can be shown that domestic production in increasingly substituted by cheaper imported products over the past decades. Specifically, China's and the low income countries' import shares have increased during a time when share of imports to total variable costs remained roughly constant. In terms of differences between the two types of firms, the increase in the Chinese import share is overwhelmingly driven by the input mix adjustments of firms that operate in groups. Firms 'in groups' increased their imports from China from one percent to almost 6 percent between 1998 and 2016, whereas individual firms have only slightly increased their imports from China. These aggregate and average trends and the estimated results suggests that the observed 5 percent relative increase in cheaper input use could generate as large as a 29 percent relative increase in markups, which is substantially more than the 20 percent observed difference in markups in 2016. Since the bulk of the increase in the aggregate markup is driven by the markup change of firms in groups, the findings suggest that the cost complementarity channel via imported input cost complementarities is a significant driver of the aggregate change in the average markup, in addition to explaining the difference between markup growth across different types of firms.

This paper relates to three main branches of literature. The first one constitutes of the theories developed by Gorman (1985) and Panzar and Willig (1981) who argue that economies of scope are a result of firms being able to take advantage of weak cost complementarities which reduce marginal cost when producing several outputs instead of one. I incorporate this idea to a model with heterogeneous firms by Atkeson and Burstein (2008) where the otherwise firms are able to use a group-wise common productivity component which helps them reduce their individual marginal costs. The marginal cost reduction by accessing a group productivity generate a marginal cost complementarity between the firms within the group, while the group supplies a variety of products.

This paper also relates to the debate on rising markups and provides a new explanation for the rise in markups as well as empirical evidence of this channel using Swedish data. [Insert further citations.]

Furthermore, the paper is related to the common ownership literature, which discusses how common ownership cause firms to compete less, charge higher prices and optimize on common profits instead of individual firm outcomes. The anti-competitive feature of common ownership has mostly been studied in the fields of corporate finance and industrial organization. For example, Azar, Schmalz and Tecu (2018) show that concentration may be 10 times larger in the airline industry when measurements take into account common ownership and Azar, Raina and Schmalz (2022) show that the measure of concentration, which is adjusted for common ownership across banks, is strongly correlated with prices. In addition, recent findings by Antón, Ederer, Giné and Schmalz (2023) posit that common ownership, managerial incentives and productivity across firms is correlated, and has a direct impact on prices, output, markups and market shares.

The findings of this paper complement the common ownership literature in that they show support for the stylized fact of a positive correlation between firm relations and markups. However, the common ownership literature mostly focuses on the mechanism that common shareholders stir decisions to similar directions within all of their companies (Reynolds and Snapp, 1986), which inevitably leads to a reduction in competition. In this study, 'group ownership' refers to production relations which may be horizontal, vertical, and across or within industries. In this broader sense of 'groups', relations may not be solely based on shareholder values and managerial decisions. Establishments operating in different industries can, in theory, display highly competitive behavior within their industry and the 'concentration reduction channel' need not be the only mechanism at play. Therefore, a particularly important difference to previous papers is that the present study examines the effect of groups via the 'cost complementarity channel', instead of the 'concentration reduction channel'. In addition, an important methodological difference relative to the ownership literature is that the present paper uses data from all industries in which firms with a 10-year lifespan are present in contrast to single-industry studies. Focusing on multiple industries and a broader definition of 'business group relations' provide a framework where cost complementarities can be detected, independently from the concentration channel, which can nevertheless be in place. In addition, using data from multiple industries make the results more generalizable to the manufacturing sector as a whole, in contrast to those papers that study within industry variation from one industry.

The paper is organized as follows. Chapter 2 introduces the model framework and presents the analytical predictions and the model simulations. Chapter 3 describes the data used for the empirical estimation in chapter 5. The empirical results are presented in chapter 6 and discussed in chapter 7. Chapter 8 concludes.

2 A benchmark model

To understand the mechanism that yields higher markups for firms that are part of business groups, I modify the model of Atkeson and Burstein (2008) to include two types of firms. One type of firm consist of 'individual firms' which are heterogeneous in their productivities, marginal costs and market shares. The other type of firms are 'in groups' who are not only heterogeneous in their individual productivities but also have access to a multiplicative productivity boost that is available at the group level. The group level productivity boost, or productivity improvement, represents the productivity gain that joining a group gives. The model is agnostic about the endogenous choice of why firms may join groups since firms' productivity draws in the model are random. Furthermore, the baseline model rules out the scenario in which firms operating in the same industry are also in a group with each other. This assumption ensures that upgrading from an individual productivity to a group productivity does not create a business stealing effect within the group. In other words, the model estimates the maximum positive effect of enrolling to a group, absent business stealing. The productivity upgrade and the resulting cost sharing that being part of a group yields, represents cost complementarities, a form of economies of scope formalized by Gorman (1985) and Panzar and Willig (1981).

The model economy consists of perfectly competitive final good producers, a large number of industries and a finite number, $N(s)$, of intermediate good producers in each industry with index s. The intermediate good producers engage in oligopolistic competition so they take into account the decisions of their competitors when they make optimal production choices. The intermediate good producers are heterogeneous with respect to their productivity. Heterogeneity across intermediate producers means that all firms have different market shares and that they charge different markups. Firms with large market shares behave more like monopolists, whereas small firms behave more like firms that participate in monopolistic competition.

2.1 Final good firm

Final good producers produce a homogeneous final consumption good Y using inputs $y(s)$ from a continuum of industries

$$Y = \left(\int_0^1 y(s)^{\frac{\theta-1}{\theta}} ds \right)^{\frac{\theta}{\theta-1}}, \tag{1}$$

where $\theta > 1$ is the elasticity of substitution across industries indexed by $s \in [0,1]$. The inverse demand functions for the output of the industries are

$$p(s) = \left(\frac{y(s)}{Y} \right)^{-\frac{1}{\theta}} P. \tag{2}$$

Each industry s consists of a finite number of intermediate goods producers. Industry output is an aggregate of production from $N(s)$ intermediate input producing firms indexed by i

$$y(s) = \left(\sum_{i=1}^{N(s)} y_i^g(s)^{\frac{\gamma-1}{\gamma}} \right)^{\frac{\gamma}{\gamma-1}}. \tag{3}$$

The inverse demand function for the product of firm i within an industry s is given by

$$p_i^g(s) = \left(\frac{y_i^g(s)}{y(s)}\right)^{-\frac{1}{\gamma}} p(s). \tag{4}$$

2.2 The intermediate good producing firm

Intermediate good producer i in industry s produces output using labor

$$y_i^g(s) = a_i^g(s) l_i^g(s), \tag{5}$$

where superscript $g = 1$ if the firm is part of a group and $g = 0$ for individual firms. a_i^g is the exogenous productivity that varies across i firms and j groups. a_i^g has an idiosyncratic a_i and a group component a_j^g such that $a_i^g = a_i \times a_j^g$. a_i is drawn from a Pareto distribution so that only few firms are born with the highest productivities. It is also assumed that $a_j^{g=0} = 1$, so that individual firms get no boost on their productivity as they are not part of a group.

Demand for Intermediate Inputs Combining the industry and the product-level inverse demand functions gives the demand function facing the individual firm

$$y_i^g(s) = \left(\frac{p_i^g(s)}{p(s)}\right)^{-\gamma} \left(\frac{p(s)}{P}\right)^{-\theta} Y \tag{6}$$

where the aggregate and sectoral price indexes are

$$P = \left(\int_0^1 p(s)^{1-\theta} ds\right)^{\frac{1}{1-\theta}}, \tag{7}$$

$$p(s) = \left(\sum_{i=1}^{N(s)} p_i^g(s)^{1-\gamma}\right)^{\frac{1}{1-\gamma}}. \tag{8}$$

Production cost The cost complementarities in the model appear as a marginal cost reduction for firms that are in groups. The firm's marginal cost $\psi_i^g(s)$ is given by

$$\psi_i^g(s) = \frac{W}{a_i^g(s)}. \tag{9}$$

Because $a_i^g = a_i \times a_j^g$ and a_j^g enters multiplicatively, it can be interpreted as an productivity improvement from being part of a group, yielding a cost complementarity across firms in a group. Cost complementarities in this model exist because a decrease in the marginal cost of a firm via an increase in the group productivity a_j^g decreases the marginal cost of all firms in the business group. This formulation is in line with Gorman (1985) who defines cost complementarities as a form of economies of scope that allows firms to reduce the costs (in the group) while producing more varieties (within the group) so that the joint production cost less than the individual production of several outputs.

The spread of $a_j^{g=1} > 1$ across j groups is calibrated to match the difference between markups of the two types of firms that occur in the data overtime. Since the individual and the group productivity enters multiplicatively, the simulated results depend only a little on the spread of the original draws, and significantly more on the correlation between the individual and the group productivity draws. To be able to use the model to estimate a lower bound on the productivity difference between the two types of firms that can explain the observed markup difference in the data, I assume that there is perfect correlation between the two draws, such that the most productive firms belong to the most productive groups.

Profit maximization Each intermediate good producer engages in Cournot competition within their industries. That is, each firm chooses a quantity $y_i(s)$ taking as given the quantity decisions of its competitors in industry s and the aggregate wage W. The problem of the firm can be written as

$$\pi_i^g(s) \equiv \max_{y_i^g(s)} \Big[\big(p_i^g(s) - \psi_i^g(s) \big) y_i^g(s) \Big], \tag{10}$$

subject to demand.

The solution to the firm's problem is characterized by a price that is set as a markup over marginal cost

$$p_i^g(s) = \frac{\epsilon_i^g(s)}{\epsilon_i^g(s) - 1} \psi_i^g(s), \tag{11}$$

where $\epsilon_i^g(s) > 1$ is the demand elasticity that faces the firm.

Demand Elasticity With the nested CES demand system and Cournot competition, it can be shown that this demand elasticity is a weighted harmonic average of the underlying elasticities of substitution θ and γ

$$\epsilon_{it}^{g} = \left(\omega_i^g(s)\frac{1}{\theta} + (1-\omega_i^g(s))\frac{1}{\gamma}\right)^{-1}, \tag{12}$$

where $\theta < \gamma$ and $\omega_i^g(s) \in [0,1]$ is the firm's market share measured as the firm's share of its industry's revenue:

$$\omega_i^g(s) \equiv \frac{p_i^g(s)y_i^g(s)}{\sum_{i=1}^{N(s)} p_i^g(s)y_i(s)} = \left(\frac{p_i^g(s)}{p(s)}\right)^{1-\gamma}. \tag{13}$$

In this model, each firm faces a different, endogenously determined demand elasticity. The formula for the firm's demand elasticity in (12) reveals that firms with large market shares behave more like monopolists. They face relatively low demand elasticities, closer to the across-industry elasticity θ, whereas small firms face a relatively high demand elasticity, closer to the within-sector elasticity γ. With $\theta = 1$ and $\gamma = 10$, the elasticity of demand for a smaller firm with a 10 percent market share is $1/(0.1 + 0.9 \times 0.1) = 5.26$ while it is 1.56 for a firm with a 60 percent market share. This difference in demand elasticities means that a smaller firm can increase its quantity sold about three times more than a larger firm can when it cuts its price by the same amount.

Market Shares and Markups The formula for the firm's demand elasticity in (12) implies a linear relationship between a firm's inverse markup and its market share

$$\mu_i^g(s) = \left(\frac{\gamma - 1}{\gamma} - \left(\frac{1}{\theta} - \frac{1}{\gamma}\right)\omega_i^g(s)\right)^{-1}. \tag{14}$$

where $\mu_i^g(s) \equiv \frac{\epsilon_i^g(s)}{\epsilon_i^g(s)-1}$ is the firm's markup. Since $\theta < \gamma$, firms with relatively high market shares face a low demand elasticity and set high markups. An infinitesimal firm charges a markup of $\gamma/(\gamma-1)$ and a pure monopolist charges $\theta/(\theta-1)$. This relationship is depicted in Figure 1 with $\gamma = 10.5$ and $\theta = 1.24$. The end point of the convex curve to the left-hand side is where the firm has a near zero market share and the markup is minimal $\gamma/(\gamma-1)$; and the end point to the right-hand side is where the firm has a market share of one and the markup is maximal $\theta/(\theta-1)$.

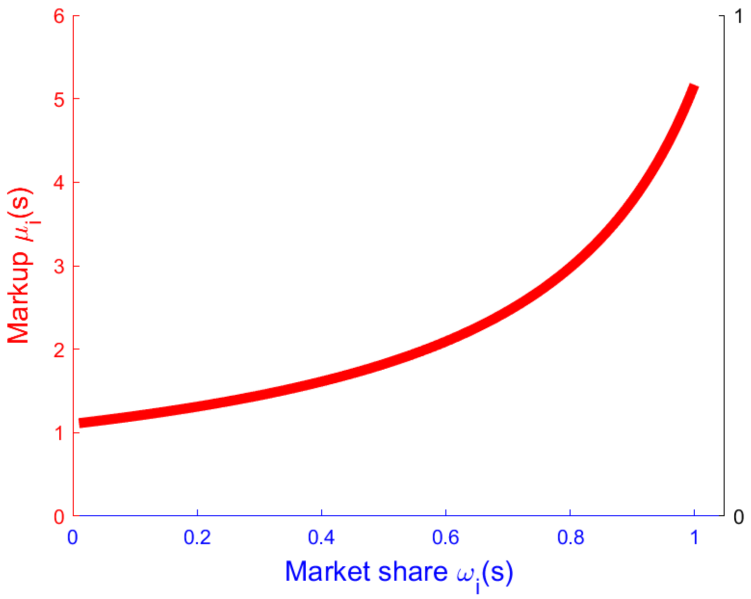


Figure 1: The value of the firm's markup as the firm's market share increases from 0 to 1

The firm's markup is an increasing convex function of its market share.[1] The elasticity of the markup with respect to the firm's market share is positive and increasing in the market share of the firm

(15) $$\varepsilon_{\mu,\omega} = \frac{\partial \mu_i^g}{\partial \omega_i^g}\frac{\omega_i^g}{\mu_{i^g}} = \left(\frac{1}{\theta} - \frac{1}{\gamma}\right)\omega_i^g \mu_i^g.$$

Equation (15) implies that larger firms increase their markups by a larger percentage than smaller firms when their market shares double. This relative change in markups leads to higher relative prices and lower relative market shares for larger firms than before.[2]

Price setting The formula for the firm's markup implies that the price is increasing in the firm's market share and its marginal cost

(16) $$p_i^g(s) = \left(\frac{\gamma - 1}{\gamma} - \left(\frac{1}{\theta} - \frac{1}{\gamma}\right)\omega_i^g(s)\right)^{-1} \psi_i^g(s).$$

[1]Because of the convexity in markups with respect to market shares, a mean-preserving spread in market shares will increase the average markup. When $\theta = \gamma$, the demand elasticity is constant and independent of the dispersion in market shares, and the model collapses into a standard monopolistic competition model with constant markups as in Atkeson and Burstein (2008).

[2]Under Bertrand competition too, the elasticity of the markup with respect to the firm's market share is positive and increasing in the market share of the firm. Thus, the model predictions are qualitatively similar and carry over under Bertrand competition.

If each industry comprises of $N(s) \geq 1$ identical producers who each have an identical market share $\omega_i^g(s) = 1/N(s)$ then the markup of all producers is identical and equal to

$$\mu_i^g(s) = \left(\frac{\gamma - 1}{\gamma} - \left(\frac{1}{\theta} - \frac{1}{\gamma} \right) \frac{1}{N(s)} \right)^{-1}, \tag{17}$$

and therefore the prices are

$$p_i^g(s) = \left(\frac{\gamma - 1}{\gamma} - \left(\frac{1}{\theta} - \frac{1}{\gamma} \right) \frac{1}{N(s)} \right)^{-1} \psi_i^g(s). \tag{18}$$

In this special case, the markup declines from $\frac{\theta}{\theta-1}$, at $N(s) = 1$ the monopoly case, to $\frac{\gamma}{\gamma-1}$, the case of almost monopolistic competition as $N(s) \to \infty$.

2.3 Prediction for the individual firm

2.3.1 Joining a group

The markup change from a firm becoming a part of a business group can be measured by taking the difference in the markup of a standalone firm vis-a-vis the markup of firm that is part of a group. Assuming that the group has access to a higher level of productivity, moving the firm from $a_{i=1}^{g=0}$ to a higher $a_{i=1}^{g=1}$ the change in the firm's markup can be written as

$$\begin{aligned} \Delta\mu_i(s) &= \mu_i^1(s) - \mu_i^0(s) \\ &= \left(\frac{\gamma - 1}{\gamma} - \left(\frac{1}{\theta} - \frac{1}{\gamma} \right) \omega_i^1(s) \right)^{-1} - \left(\frac{\gamma - 1}{\gamma} - \left(\frac{1}{\theta} - \frac{1}{\gamma} \right) \omega_i^0(s) \right)^{-1}. \end{aligned} \tag{19}$$

which is strictly positive since the firm's relative market share grows after an increase in the firm's productivity as other firms' productivity remains constant.

2.3.2 Productivity improvements to firms 'in groups'

Combining the expressions for the markup, market share, price, and marginal cost yields that the change in the markup of firm i of type g can be expressed as a function of the change in the group productivity from a_j^g to $a_j^{g'}$

$$\Delta\mu_i^{g'}(s) = \mu_i^{g'}(s) - \mu_i^g(s)$$
$$= \left(\frac{\gamma-1}{\gamma} - \left(\frac{1}{\theta}-\frac{1}{\gamma}\right)\left(\frac{\frac{\epsilon_i^{g'}(s)}{\epsilon_i^{g'}(s)-1}\frac{W}{a_i \times a_j^{g'}}}{p'(s)}\right)^{1-\gamma}\right)^{-1}$$
$$- \left(\frac{\gamma-1}{\gamma} - \left(\frac{1}{\theta}-\frac{1}{\gamma}\right)\left(\frac{\frac{\epsilon_i^{g}(s)}{\epsilon_i^{g}(s)-1}\frac{W}{a_i \times a_j^{g}}}{p(s)}\right)^{1-\gamma}\right)^{-1} \tag{20}$$

Following a positive productivity shock to a group, the difference in markup growth between a firm in a group and a firm in other groups, and to an individual firm will be positive and proportional to the difference in the improvement in the group productivity $a_j^{g'}(s)$ relative to the other firm's productivity.

$$\Delta\mathcal{M}^{1,1} = \Delta\mu^{1'}_{i,j=1}(s) - \Delta\mu^{1}_{i,j\neq 1}(s) \quad \propto \quad (a^{1'}_{i,j=1} - a^{1}_{i,j\neq 1}) \tag{21}$$
$$\Delta\mathcal{M}^{1,0} = \Delta\mu^{1'}_{i}(s) - \Delta\mu^{0}_{i}(s) \quad \propto \quad (a^{1'}_{i,j=1} - a^{0}_{i}).$$

The second line in (21) is tested using micro data.

2.4 Aggregation

I define industry productivity as industry production divided by industry labor input

$$a(s) \equiv \frac{y(s)}{l(s)}. \tag{22}$$

The industry markup can be defined as the total value of production divided by the total cost of production

$$\mu(s) \equiv \frac{p(s)y(s)}{Wl(s)}, \tag{23}$$

Markup Using the ratio of the firm-level equation (16) and the industry-level equation (23), the industry markup can be expressed as the sales-weighted harmonic average of individual markups

$$(24) \qquad \mu(s) = \left(\sum_{i=1}^{N} \frac{\omega_i^g(s)}{\mu_i^g(s)} \right)^{-1}.$$

To derive the aggregate markup, I define the quantity of final output as

$$(25) \qquad Y = AL,$$

where A is the endogenous level of aggregate productivity and L is the aggregate amount of labor employed. Taking the ratio of firm-level prices to the aggregate price index, the aggregate markup can be written as a revenue-weighted harmonic mean of firm-level markups

$$(26) \qquad \mathcal{M} = \left(\int_0^1 \left(\sum_{i=1}^{N(s)} \frac{1}{\mu_i^g(s)} \frac{p_i^g(s) y_i^g(s)}{PY} \right) ds \right)^{-1}.$$

2.5 Calibration and numerical exercise

The model is calibrated to three main features of the data. The number of industries in the sample (250) and the median number of firms in each industry (40) where half of the firms (20×250) in each industry are in groups. There is an initial Pareto distribution of firms in their individual productivities a_i. A feature of this model is that a mean preserving spread in productivities does not change the aggregate markup. Therefore, $a_j^g = 1$ is calibrated to create an asymmetric large spread between the productivities of firms in groups and individual firms, which means that the business groups on the top tail of the distribution are drawn much higher productivities than the firms that are in groups between the p50-p80. In addition, it is also assumed that the most productive firms are in the most productive groups so that the productivity differentials imposed can be interpreted as a minimum difference between productivities that can generate the difference in markups between the two types of firms. If the correlation was not perfect the dispersion in individual and group productivities would have to increase to generate the same divergence in markups.

The model can be used to examine three questions: (1) How much difference in average productivity is needed to reproduce the difference in markups across the two types of firms observed in the aggregate data? (2) What is the corresponding difference in marginal costs in the model? (3) What are the model implied GDP shares of the two types of firms when the markups of firms in business groups match the difference their markups observed in 2010?

3 Data

In order to provide numerical predictions for the aggregate economy through the lens of the model and to identify the effect empirically, I make use of multiple unique firm-level datasets from Statistics Sweden. I construct markups using the variables available in the annual balance sheet and income statement statistics of Swedish firms. Information on firms' total variable costs, sales and other firm characteristics that are used in the construction of markups and later in the regressions are from the Structural Business Statistics dataset provided by Statistics Sweden. The information on firms' group structures come from the Business Registry provided by Statistics Sweden. The Business Registry has information on whether the firm is a singleton, a subsidiary or a mother firm. Based on this data, firms are designated into two categories, namely if they are 'part of groups' or 'operate individually'. The firms with information on both markups and group structures are then merged to the detailed trade data (Foreign trade statistics of Statistics Sweden) which contains information on firms' imported (exported) goods from all countries.

3.1 Markups

Markups are constructed using the method of De Loecker and Warzynski (2012) and Ackerberg et al. (2015) using a Cobb-Douglas functional form and assuming common input prices within 5-digit industries. The usual data restrictions are implemented in the markup estimation: firms must have at least one employee to be included and taking logs of variables naturally excludes negative and zero values when estimating markups. Markups can be constructed for over 36000 firms and over 289000 firm-year observations in the period between 1998-2016. Figure 2 depicts that the simple average markup across firms shows less of an upward trend, and hovers around 1.2 which implies an average 20 percent markup over the marginal cost. When accounting for the size of the firm, however, a more clear upward trend emerges. The weighted average markups reach 1.5-1.6. The weighted averages follow a similar trend irrespective of using costs or sales as weights. The overtime increase in weighted average markups overtime is about 60 percentage unit from approximately 1 to 1.6, or 30 percentage unit when considering the simple average markup.

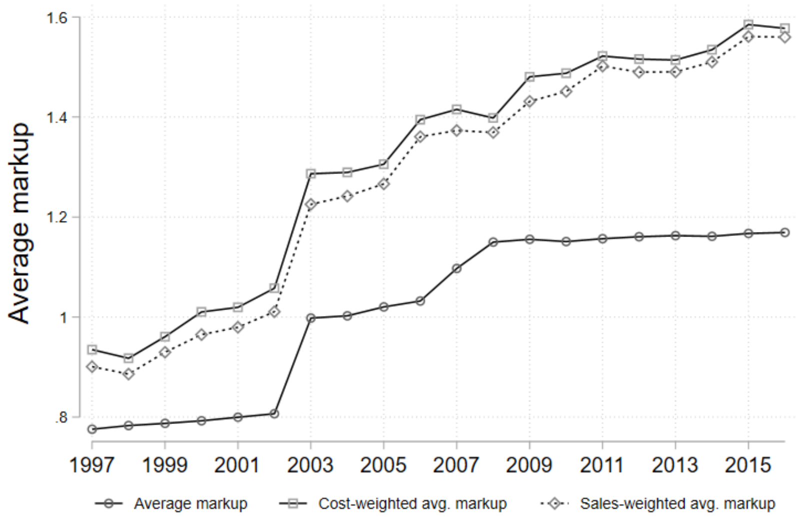


Figure 2: Average markup 1997-2016

Table 1 shows that one standard deviation long-change in the markup between 2000 and 2007 is about 17 percentage unit, and the simple average markup is 0.97 in 2000 and 1.07 in 2007, considering those firms in the economy for which markups and long-changes in markups can be constructed.

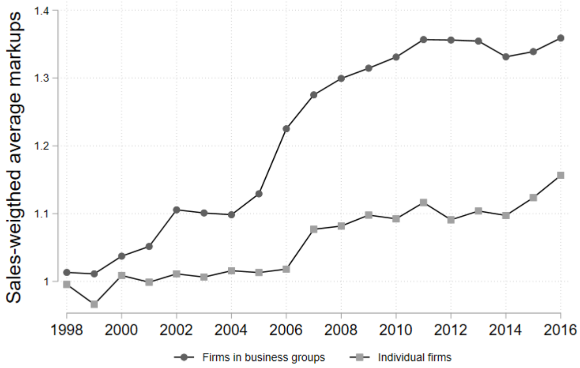
Table 1: Markup summary statistics

	mean	sd	min	max
Markup 2000	.9680334	.1907494	.5045699	2.13918
Markup 2007	1.073976	.2305048	.5045699	2.13918
Δ Markup(2007)	.0819861	.1687215	-1.026182	1.444471
Observations	9238			

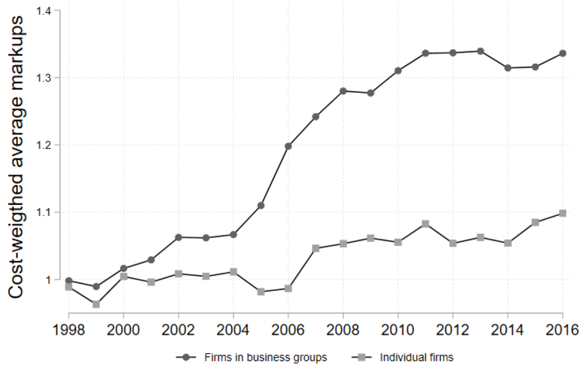
3.2 Groups

Information on both markups and group structures are available for over 34000 firms and over 279000 firm-year observations. From these, over 14000 firms are part of groups and 25000 firms are individual companies. During the entire long period between 1998-2016, 2400 firms are a part of groups and 2400 firms are not part of groups.

Figures 3a and 3b show that markups are rising not only for firms that operate in groups but also for firms that are individual entities, albeit the rise in the markup of individual firms is less pronounced. The increase in the markup of firms that operate in groups between 2000 and 2016 is about 30 percent, while individual firms increased their markups by 10 percent. In addition, the figures depict that there is a persistent and somewhat widening wedge between the markups of firms in groups and individual firms. The difference between the markups of the two types of firms is around 20 percent in 2016.



(a) Sales-weighted average markups



(b) Cost-weighted average markups

Figure 3: Sales-weighted and cost-weighted markups of firms in business groups and individual firms.

3.3 Variable costs and Imported variable costs

The dataset used for the regressions contains log changes between 2000-2007 in total variable costs, markups and import shares. Variable costs are given by salaries, intermediate input costs and raw material costs. Import shares are defined as the firms' imported input costs over their total variable costs. The need for variables in long changes reduces the number of firms participating in the regression to about 2600. From these observations, over 1700 are classified as firms 'in groups' and over 800 are as 'individual' firms. The variables summary statistics are presented in Table 2.

Table 2: Summary statistics, sample of firms

	mean	sd	min	max
Level statistics in 2000				
Markup	.9836436	.2366062	.5045699	2.13918
Import/TVC	.2064818	.2678745	3.30e-06	5.351938
Import/TVC(1998)	.1975532	.2906671	1.47e-07	8.322914
Ch/TVC	.0000295	0	.0000295	.0000295
Level statistics in 2007				
Markup	1.111373	.2755423	.5045699	2.13918
Import/TVC	.2362472	.2442174	2.67e-06	2.257903
Import/TVC(1998)	.1923406	.2408335	1.47e-07	3.20307
Ch/TVC	.0001652	0	.0001652	.0001652
Firms in groups changes				
Δ Markup(2007)	.1093675	.1929636	-.8618488	1.203001
Δ Imports/TVC(2007)	.1989106	1.807319	-11.12931	10.56555
Δ Ch/TVC(2007)	1.723197	0	1.723197	1.723197
Individual firms changes				
Δ Markup(2007)	.0970003	.1711208	-.5516311	1.035296
Δ Imports/TVC(2007)	.0187218	1.915387	-8.853346	8.818932
Δ Ch/TVC(2007)	1.723197	0	1.723197	1.723197
Observations	2615			

4 Numerical predictions using model simulations

According to the model simulations, the 20 percent difference in markups between the two types of firms observed in the data in 2016 can be rationalized by a 600 percent higher average productivity for firms 'in groups' and an 86 percent average lower marginal cost compared to 'individual' firms.

The data fact that average markups rose from approximately 1 to 1.6 between 2000 and 2016 and, at the same time, markups of firms in business groups rose by a similar magnitude, suggesting that little of the aggregate markup increase is attributed to firms operating individually. Operating in groups, however, does not seem to be the dominant institutional form in the data as more than 25000 firms in the markup sample operate individually and only around 14000 firms operate in groups. It would, therefore, be plausible to believe that a relatively large pool of 25000 singleton firms may also enjoy a significantly large market or GDP share. The GDP share of individual firms (10 percent) is much smaller than the GDP share of firms in groups (90 percent) in 2000. Furthermore, the GDP share of firms in group is increasing overtime, it reaches 96 percent in 2016, whereas the GDP share of individual firms declines to 4 percent. The model simulations, which can generate a rise in markups of 20 percent by an 86 percent exogenous decrease in firms' marginal costs, suggest that a 20 percent large divergence in markups between the two types of firms can only be consistent with a GDP share of firms in groups that is around 98 percent. This statistic is an outcome of the numerical simulation that is much more in line with the data than initially expected.

5 Empirical Estimation

This section uses firm-level data on markups and firm characteristics to test the prediction of the model that firms in groups take advantage of positive aggregate shocks to a higher degree, such that they reduce their marginal costs more than firms that operate individually, enabling an increase in their markups.

5.1 Instrumental Variable Approach

In the main specification, I estimate an instrumental variable (IV) regression. The IV regression predicts the effects of exogenous changes in the marginal cost of firms on their markup. The variable that proxies endogenous changes in marginal costs is the log change in the share of the firms' imports to its total variable cost, where total variable costs are calculated as the net of salaries, raw material input and intermediate material input costs. The implicit assumption in this regression is that, other things equal, an increase in the imported input share of the firm is correlated with a drop in the firm's marginal cost. As firms access cheaper imported inputs their input costs decrease. A reduction in the variable and thus the marginal cost can also be seen as a positive productivity shifter. The IV regression examines the long change in markups between 2000 and 2007, a year before and 7 years after China's accession to the WTO in 2001.

$$\Delta\mu_{it+7} = \alpha + \beta\left(\Delta\frac{M_{it+7}}{TVC_{it+7}} \times I_{t,group=0,1}\right) + \gamma\Delta\frac{M_{it+7}}{TVC_{it+7}} + \xi I_{t,group=0,1} + \epsilon_{it} \quad (27)$$

where $\Delta\mu_{it+7}$ denotes the log change in the firm's markup between 2000 and 2007; and $\Delta\frac{M_{it+7}}{TVC_{it+7}}$ denotes the log change in the firm's imports to total variable cost ratio between between 2000 and 2007. Total variable costs are defined as the firm's raw material input costs, intermediate good costs and wages paid to workers.

γ and ξ, respectively, estimate the average effect of the change in the firm's import to total variable cost ratio and the average differences between the markup changes of firms that are in groups and not in groups. Coefficient β on the interaction term $\Delta\frac{M_{it+7}}{TVC_{it+7}} \times I_{t,group=0,1}$ shows the percentage difference in the log markup change between firms that are in groups and not in groups upon a change in their costs.

The endogenous change in the firms' import share is instrumented by a China shock-type instrument Autor, Dorn and Hanson (2013, 2016, 2021). The instrument is defined as the interaction between the 7-year change in the imports of all Swedish firms from China relative to their total variable costs ("the shift") and the firm's import to total variable cost ratio predetermined in 1998 ("the share"). The increase in the aggregate share of Chinese imports is considered to be a supply-driven exogenous shifter resulting from a reduction in the trade costs of Chinese firms and not a result of increased demand for Chinese goods.

The shift-share instrument for $\Delta\frac{M_{it+7}}{TVC_{it+7}}$ is the interaction of the log change in aggregate imports from China relative to the aggregate variable costs $\Delta\frac{Ch_{t+7}}{TVC_{t+7}}$ and the firm's predetermined 1998 imports to total variable cost ratio $\frac{M_{i1998}}{TVC_{i1998}}$. The first-stage is

$$\Delta\frac{M_{it+7}}{TVC_{it+7}} = \alpha + \delta\left(\frac{M_{i1998}}{TVC_{i1998}} \times \Delta\frac{Ch_{t+7}}{TVC_{t+7}}\right) + \epsilon_{it}. \tag{28}$$

Other things equal, an increase in the relative share of cheaper inputs from China is expected to reduce the imported input to total variable cost ratio.

5.2 The reduced form difference-in-differences estimator

The reduced form of the IV regression is a difference-in-differences estimator given by

$$\Delta\mu_{it+k} = \alpha + \eta\left(\frac{M_{i1998}}{TVC_{i1998}} \times \Delta\frac{Ch_{t+7}}{TVC_{t+7}} \times I_{it}\right) + \kappa\frac{M_{i1998}}{TVC_{i1998}} + \rho I_{it} + \epsilon_{it}. \tag{29}$$

where η measures if firms in groups with a higher exposure to an increase in aggregate Chinese import share charge a higher markup conditional on their initial exposure and the average change in their markup due to being part of a group. The main threat to identification can be summarized by the parallel trends assumption. If firms in groups and firms not in groups set different markups before the China shock in 1998-2000, it is plausible that other confounding channels may also be in place. A visual inspection of figures 3a and 3b suggest that the two groups had similar trends before 2001.

6 Results

The IV estimates show that firms in groups set an approximately 6 percent higher markup when their import to total cost ratios change by one percent compared to individual firms.

Table 3: Instrumental variable regression

	$\Delta\ Markup_{i,t+7}$
group=1×$\Delta\ M/TVC_{i,t+7}$	0.0574*
	(0.0286)
$\Delta\ M/TVC_{i,t+7}$	-0.0209
	(0.0245)
group=1	0.00471
	(0.0101)
Observations	2615

According to the summary statistics for the variables in the regression, the average change in firms' import share relative to their total variable costs increased approximately 20 percent between 2000 and 2007, from 0.2 to 0.24. The aggregate increase in import shares, absent other processes in the economy, could therefore support a much larger increase in markups then the 50-60 percent observed in the Swedish data.

6.1 First stage

The first stage shows a strong negative correlation between a change in Chinese import shares and the change in the imports to total variable cost of the firm for a given level of initial import exposure. The estimated coefficient implies that a firm which imports all of its total variable costs in 1998, deceases its import share by 45 percent between 2000 and 2007, when the share of Chinese imports of the Swedish economy increases by one percent. Swedish firms import ratios are on average 0.2 with a standard deviation of 0.3 in 1998. For the average firm, therefore, the estimated increase in the input share would mean a 9 percent decrease in the import ratio between 2000 and 2007.

Table 4: First-stage regression

	$\Delta\ M/TVC_{i,t+7}$
$M/TVC_{i,1998} \times \Delta\ Ch/TVC_{t+7}$	-0.447***
	(0.0891)
Observations	2615

6.2 Reduced form

Table 5 shows the reduced form regression. The interaction coefficient suggests that firms in groups increase their markups 2 percent more than firms that operate individually upon an exposure to a negative cost shock.

Table 5: Reduced form regression

	$\Delta\ Markup_{i,t+7}$
group=1×$M/TVC_{i,1998} \times \Delta\ Ch/TVC_{t+7}$	0.0211**
	(0.00734)
group=1	0.0107*
	(0.00450)
$M/TVC_{i,1998}$	-0.0198
	(0.0125)
Observations	81255

The exclusion restriction holds if the increase in the Chinese import ratio is purely supply driven and firm's import to variable cost ratios in 1998 are correlated with their current ratios, but not with the percentage change in the ratio between 2000 and 2007. A threat to the validity of the instrument and the exclusion criteria is if firms who had the largest initial import shares in 1998, increased their import shares the most between 2000 and 2007. In other words, if the instrumented endogenous proxy variable for marginal cost changes was to a high degree correlated with the firms' choice of their pre-period input bundle. This is not supported by the data [include table].

7 Discussion

The empirical framework utilized data on imported input shares and Chinese import shares to identify the cost complementarity channel. These variables therefore can also be used to indicate the potential importance of a specific cost complementarity channel that stems from cost reductions due to cheaper imports. For this mechanism via cheaper imports to have a non-negligible effect, the imported input share would have to be increasing (or non-decreasing) and the share of cheaper imported inputs would have to be increasing. The net of these two processes should yield a sufficiently large change which can support a potentially significant difference in markups between the two types of firms and, consequently, an increase in the average markup. Since the regression results estimate a partial equilibrium mechanism, an aggregate back-of-the-envelope calculation of the mechanism can only describe the potential maximum effect and not the actual general equilibrium outcome.

Reviewing the the imports to total cost ratios between the two types of firms, figure 4 depict relatively stable ratios between 1998 and 2016. Firms in groups imported about 16 percent, whereas individual firms imported around 2 percent of their total variable costs.

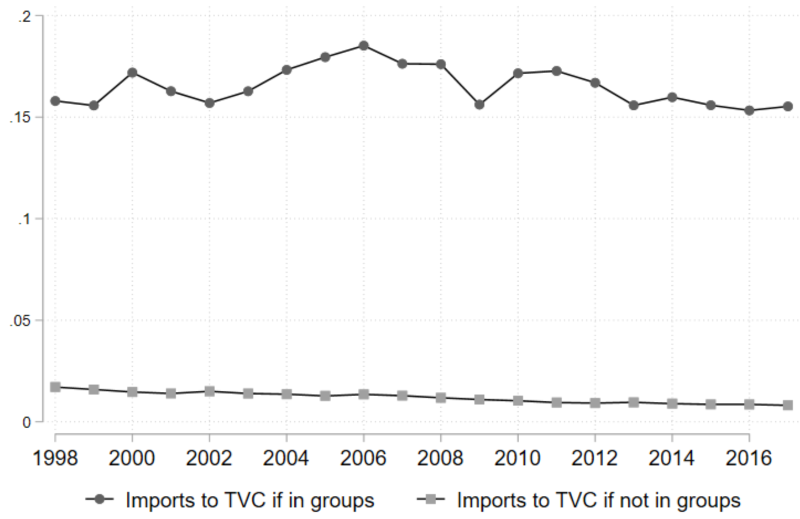


Figure 4

While these variables remained stable at the firm level, figure 5 depicts that Sweden has undergone large industrial restructuring. The manufacturing sector's GDP share significantly shrunk and the country's import penetration ratio grew substantially (approximately 8.3 percent between 1998 and 2022).

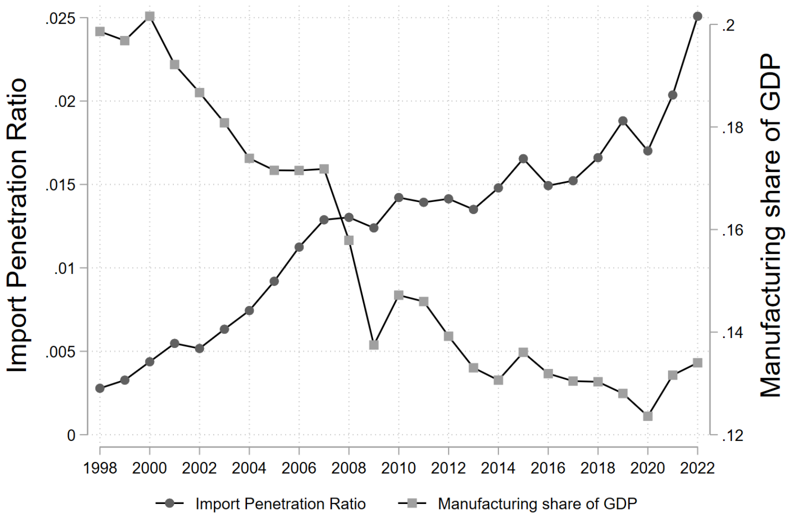


Figure 5

In addition, imports of cheaper (or lower quality) goods, such as those supplied by low income countries, has significantly increased. Figure 6 highlights that the low income country share of Sweden's imports increased by approximately 5 percent between 1998 and 2022.

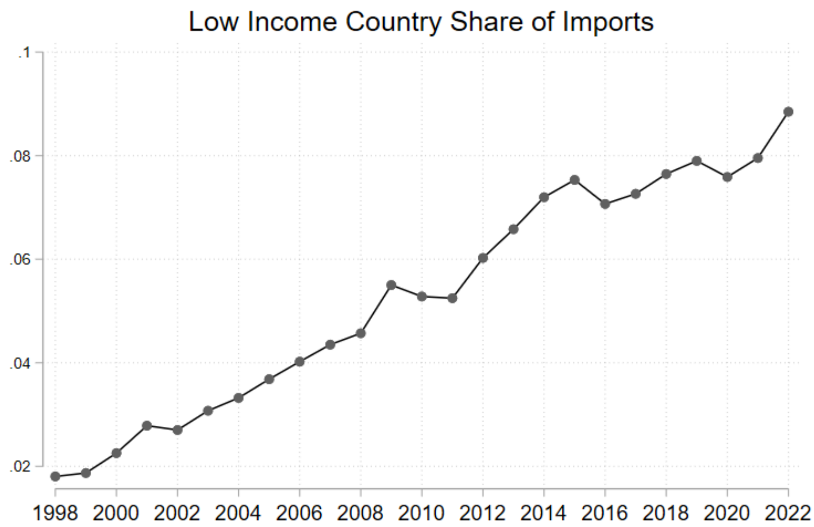


Figure 6

Most remarkably, China's share of Swedish imports, depicted in figure 7 have also increased by approximately 5 percent between 1998 and 2022. While China is not a low income country, it has had a comparative advantage in producing cheaper goods, partly due to the reduction in trade costs after its accession to the WTO.

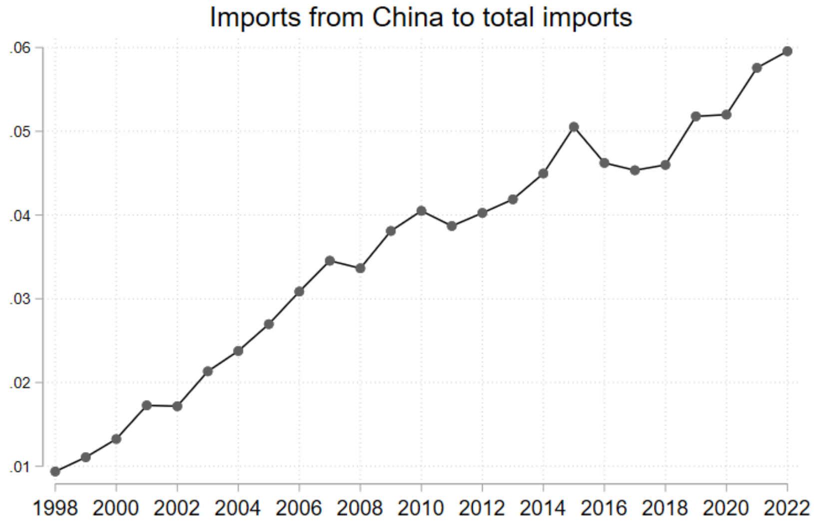


Figure 7

These large shifts in the Swedish economy suggest that domestic production in the manufacturing sector and the use of locally produced intermediate inputs have been substituted by cheaper imported products. The growth in China's and the low income countries' import shares has increased during a time when share of imports to total variable costs remained constant.

In terms of the two types of firms, figure 8 depicts that the increase in the Chinese import share is overwhelmingly driven by the input mix adjustments of firms that operate in groups. Firms 'in groups' increased their imports from China from one percent to almost 6 percent between 1998 and 2016. Individual firms have only marginally increased their imports from China.

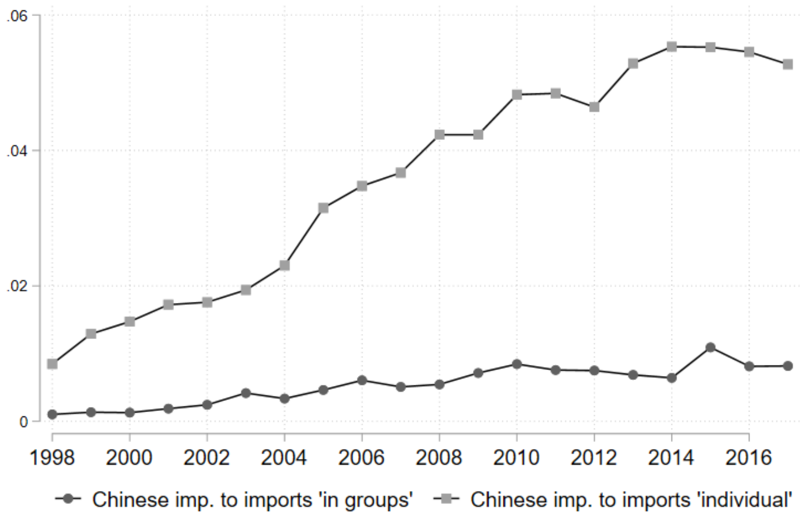


Figure 8

These aggregate and average trends and the estimates suggests that the 5 percent relative increase in cheaper input use could generate a 29 percent relative increase in markups, which is substantially more than the observed 20 percent difference in markups 2016. These findings suggest that the cost complementarity channel via imported input cost complementarities is a significant driver of the aggregate change in the average markup and has the potential to explain the difference between markup growth across different types of firms.

8 Conclusion

The theoretical predictions show that firms in business groups with higher group-level productivity can charge a higher markup than firms that operate individually because firms in groups can take advantage of cost complementarities and face lower marginal costs. Lower marginal costs in the model are connected to larger market shares which give rise to 'market power' for the most productive firms, allowing them to charge a higher markup. According to the model simulations, a 20 percent difference between the markups of individual firms and firms in groups can be rationalized with a minimum 86 percent lower marginal cost for firms in groups.

The IV regressions confirm the model predictions and show that firms in groups increase their markups by 6 percent when the share of their imported inputs rise by one percent. It is plausible that this partial equilibrium effect can explain the full 20 percent divergence in growth between the markups of the two types of firms because the share of cheaper, Chinese imported inputs of firms in business groups rose by 5 percent more than for individual firms.

These pattern are consistent with the finding that cost complementarities between firms in groups allow firms to charge a higher markup than firms who operate individually, which results in rising economy level markups since the GDP share of firms in groups is large and increasing overtime.

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A Robustness with sales shares

	Δ Markup(t+1)	Δ Markup(t+2)	Δ Markup(t+3)	Δ Markup(t+4)
group=1 × Δ Imports/Sales(t+1)	0.069			
	(0.050)			
group=1 × Δ Imports/Sales(t+2)		0.066*		
		(0.032)		
group=1 × Δ Imports/Sales(t+3)			0.079**	
			(0.029)	
group=1 × Δ Imports/Sales(t+4)				0.089**
				(0.028)
Observations	41975	39196	36861	35025

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

	Δ Markup(t+2)	Δ Markup(t+3)	Δ Markup(t+4)
group=1 × Δ Imports/Sales(t+2)	0.065*	0.094*	0.098*
	(0.031)	(0.043)	(0.047)
Observations	39196	34975	33188

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

	Δ Markup(t+1)	Δ Markup(t+2)	Δ Markup(t+3)	Δ Markup(t+4)
group=1 × Δ Ch/Sales(t+1)	0.028			
	(0.019)			
group=1 × Δ Ch/Sales(t+2)		0.040*		
		(0.018)		
group=1 × Δ Ch/Sales(t+3)			0.059**	
			(0.020)	
group=1 × Δ Ch/Sales(t+4)				0.063***
				(0.018)
Constant	0.012***	0.022***	0.030***	0.043***
	(0.002)	(0.004)	(0.004)	(0.005)
Observations	41986	39205	36875	35036

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

	Δ Markup(t+2)	Δ Markup(t+3)	Δ Markup(t+4)
group=1 × Δ Ch/Sales(t+2)	0.040*	0.060*	0.067*
	(0.018)	(0.025)	(0.026)
Constant	0.022***	0.030***	0.042***
	(0.004)	(0.004)	(0.005)
Observations	39205	36875	35036

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

	Δ Markup(t+1)	Δ Markup(t+2)	Δ Markup(t+3)	Δ Markup(t+4)
group=1 × Δ Ch/Sales(t+1)	0.030			
	(0.016)			
Δ Markup(t)	-0.327***			
	(0.023)			
group=1 × Δ Ch/Sales(t+2)		0.033*		
		(0.014)		
Δ Markup(t+1)		0.692***		
		(0.029)		
group=1 × Δ Ch/Sales(t+3)			0.031*	
			(0.014)	
Δ Markup(t+2)			0.765***	
			(0.032)	
group=1 × Δ Ch/Sales(t+4)				0.024*
				(0.012)
Δ Markup(t+3)				0.765***
				(0.030)
Constant	0.015***	0.014***	0.016***	0.018***
	(0.003)	(0.003)	(0.002)	(0.003)
Observations	36926	36932	34547	32764

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

	Δ Markup(t+2)	Δ Markup(t+3)	Δ Markup(t+4)
group=1 × Δ Ch/Sales(t+2)	0.033*	0.040	0.039
	(0.014)	(0.024)	(0.025)
DeltaCDmarkup1	0.692***	0.606***	0.557***
	(0.029)	(0.024)	(0.020)
Constant	0.014***	0.023***	0.037***
	(0.003)	(0.004)	(0.004)
Observations	36932	34613	32830

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$