# Firm Market Power in Intermediate Input and Labor Markets*

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**Abstract**

In order to understand the nature of firm market power in intermediate input and labor markets, we study the determinants of the prices that firms pay for their inputs. Traditional studies on monopsony power rely on demand-shift instruments to identify supply elasticities, and infer monopsony power from estimating an upward-sloping supply curve. Our research departs from this approach, showing that when input prices and wages are influenced by bargaining processes, demand shocks may no longer be valid instruments. To address this problem, we leverage uniquely rich and highly disaggregated data from textile firms in the Brazilian state of São Paulo. This data includes transaction-specific prices for every purchase of intermediate inputs and detailed information on employment levels and wages by occupation-education categories. The fine granularity of the data enables us to implement novel identification strategies, and our results reveal that market power manifests in ways that differ significantly from those identified in previous research.

**Keywords:** Market power, monopsony, oligopsony, input markets
**JEL Classification:** D22, J42, L13

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# 1 INTRODUCTION

In recent decades, industry concentration, markups, and corporate profit rates have increased at unprecedented levels (e.g., Grullon et al. [2019] and De Loecker et al. [2020]). This trend has raised concerns among scholars and policymakers, highlighting issues such as common ownership, killer acquisitions, reduced trade barriers, and weaknesses in competition policy enforcement as potential drivers of increasing firm market power. However, the role of monopsony power in input and labor markets has received far less attention, despite its potential to significantly influence competition in output markets. Firms with the ability to pay lower prices for their inputs and labor would reduce their marginal costs, thereby gaining a competitive advantage and unleveling the playing field for competition. Numerous case studies and anecdotal evidence suggest that firms like Walmart and Amazon achieve lower input prices through their bargaining power.[1] However, systematic empirical evidence on the mechanisms driving these dynamics remains scarce.

Traditional studies of monopsony power rely on demand-shift instruments to identify upward-sloping supply curves. The rationale is straightforward: just as a firm with market power in output markets faces a downward-sloping demand curve and thus has an incentive to restrict output to keep prices high and increase profits, a firm with market power in input or labor markets faces an upward-sloping supply curve. This means it can strategically limit the demand for inputs or labor to keep prices and wages below competitive levels. However, identifying an upward-sloping supply curve in practice is more challenging. Unobserved characteristics of inputs and workers often correlate with both prices and quantities, causing OLS estimates to suffer from endogeneity. To address this issue, the literature uses demand shocks in output markets as instruments for input quantities and labor. The key assumption underlying this approach is that firm demand shocks in the market for outputs will only affect input prices through the increase they induce in input quantities and labor force.

The presence of bargaining in determining input prices and wages can compromise the exogeneity of demand-shock instruments. In a bargaining setting, a positive demand shock in the output market may not only increase the quantity that the firm demands but also alter the firm's bargaining position vis-à-vis its suppliers or workers. For instance, a surge in demand for the firm's output can enhance the firm's revenue prospects and make it more willing to pay a higher price or wage to secure timely delivery or maintain a stable workforce. Conversely, a negative shock that reduces demand for the firm's output might force the firm

[1] See, for example, Bonanno and Goetz [2012] and Weise [2019].

to cut back on inputs and labor, prompting renegotiation with suppliers and workers to lower costs. In both scenarios, the effect of the demand shock on input prices is no longer channeled solely through changes in quantities. Instead, the bargaining process itself drives part of the observed price variation, violating the key exclusion restriction that underlies the standard instrumental variable approach.[2]

In this paper, we address these challenges by leveraging a uniquely rich and highly disaggregated dataset from the textile sector in the Brazilian state of São Paulo, covering 3,535 plants between 2011 and 2017. This dataset includes transaction-specific prices for intermediate inputs, detailed information on the identities of buyers and sellers, and fine-grained characteristics of the products transacted. For labor markets, it provides employment levels and wage bills disaggregated by occupation-education categories. First, we document substantial price variation across buyers of a product sold by a given supplier firm. This implies the law of one price does not hold, and suppliers sell the same product at different prices to different buyers. Second, we find significant variation in wages paid by different firms to workers within the same occupation-education category. These patterns underscore the role of bargaining in our setting, implying that demand shocks affect prices not only through changes in quantities demanded but also via negotiation outcomes. As a result, traditional demand-shift instruments would fail to satisfy the exclusion restriction in this context, highlighting the need for alternative methodologies that account for the complexities introduced by bargaining.

The granular nature of our dataset allows for a rigorous analysis of the determinants of input prices and wages while accounting for the presence of bargaining. By leveraging detailed transaction-level data on both intermediate inputs and workforce composition, we can control for unobserved heterogeneity in products and worker characteristics, thereby circumventing common endogeneity issues in the estimation of supply models. We do this by employing high-dimensional fixed effects to control for confounding factors—such as unobserved product and worker characteristics—thus allowing for the identification of how prices and wages are determined even in the presence of bargaining.

Our analysis reveals several key insights about the nature of firm market power in input markets. First, we find evidence of quantity discounts, with larger purchases associated with significant reductions in unit prices—up to 26% in our baseline specification. This contrasts

[2] To formalize this finding, we present a simple model in which buyer firms and suppliers (or workers) negotiate input prices (or wages) using Nash-bargaining. This very stylized framework shows that downstream demand shocks and productivity shocks received by the buyer will have a direct impact on input prices (or wages), rendering those shocks invalid instruments in bargaining environments.

sharply with previous work, which interprets upward-sloping supply curves as evidence of monopsony power. Instead, our findings suggest that intermediate input prices often decrease with higher demand. Second, we find that buyer firms with more suppliers are able to induce competition among them, negotiating lower input prices. Third, we uncover direct evidence of rent-sharing: firms partially share positive demand or productivity shocks with their suppliers by paying higher prices for the same inputs. For labor markets, we do not find significant variation in prices as firms higher more workers. However, we do observe rent-sharing between firms and workers, as firms share some of their higher profits from positive shocks by increasing wages.[3]

The contribution of our work lies in exploiting a uniquely rich and highly disaggregated dataset to study the nature of firm market power in both input and labor markets where bargaining is present. By observing transaction-specific input prices and detailed wage data, we are able to depart from classical approaches that rely on demand-shift instruments—an assumption that does not hold when bargaining processes directly affect prices and wages. Our findings reveal that firms wield market power in accessing inputs and paying wages in ways not previously identified by traditional monopsony models. More generally, our results imply that market power in input markets can have important repercussions for competition in output markets and consumer welfare.[4] Consequently, the connection between market power in input and output markets deserves careful consideration in the design and enforcement of competition policy.

The closest papers to ours belong to the literature studying market power of firms in labor markets. This is a long literature going back to Robinson [1933], well summarized in Manning [2021], that is gaining renewed attention in the last years with important contributions such as Naidu et al. [2016], Azar et al. [2019], and Goolsbee and Syverson [2023], among others. The methodological approach of this literature considers that identifying an upward-sloping labor supply curve facing an individual employer proves the existence of monopsony power. We refer to this type of employer market power as "classical monopsony". Under classical monopsony, an employer's power to pay wages below the marginal product of labor arises from the ability to restrict employment below its competitive equilibrium level. Because usual datasets do not include information on the skill and composition of firm's labor force and the quality and characteristics of firm intermediate inputs, simple OLS estimates will suffer from endogeneity. To circumvent this issue they resort to instrumental variable

[3] A comprehensive review of previous works also documenting evidence of rent-sharing between firms and workers can be found in Card et al. [2018].

[4] This is also supported by Huang [2022], who empirically documents how a dynamic monopsonistic cartel strategy in upstream markets affects downstream markets and reduces consumer welfare.

identification strategies that, as we argue in this paper, can render positively biased supply elasticities in contexts where bargaining is present.

This approach has been taken in a variety of industries and markets, including nurses (Sullivan [1989]; Staiger et al. [1999]), grocery store workers (Ransom and Oaxaca [2010]), educators (Ransom and Sims [2010], Goolsbee and Syverson [2023]), migrant workers [Naidu et al., 2016], and occupations represented in job vacancy data [Azar et al., 2019]. Following the same empirical strategy, Rubens [2023] and Morlacco [2020] analyze the existence of monopsony power in intermediate input markets. The closest paper to ours in this literature is Prager and Schmitt [2021], who find evidence of reduced wage growth of hospital workers as a result of the increasing labor market power of employers following hospital mergers. However, Prager and Schmitt find no evidence of employment suppression, and conclude that, at least in their setting, labor market power is more consistent with models of wage setting involving bargaining or search frictions.

This article also relates to the literature studying price discrimination in firm transactions. The closest papers to ours in this literature are Brugués [2023] and Ignatenko [2023]. To the best of our knowledge, these are the only two papers using data on firm-to-firm transaction prices that include information on the seller identity and the product being transacted, allowing to exploit variation across buyers of a given product. On the one hand, Brugués [2023], using information for 107 firms in Ecuador, documents the importance of long-term relations between buyers and sellers in shaping transaction prices. On the other hand, Ignatenko [2023] documents price discrimination in imports of Paraguayan firms. Following Katz (1987), she shows how larger importers have a more credible threat of vertically integrating and, as a result, obtain lower prices for the same input product. Other empirical papers that, without such rich information, study the patterns and implications of price discrimination in firm-to-firm trade include Cajal-Grossi et al. [2023], Dhyne et al. [2022], and Heise [2019]. Price discrimination in firm-to-consumers relations has been analyzed in Simonovska [2015], Gerardi and Shapiro [2009], and Attanasio and Pastorino [2020]. There is also an important literature implementing an structural empirical analysis of contracting in vertical markets, well summarized in Lee et al. [2021], and including papers such as Collard-Wexler et al. [2019], Ho and Lee [2019], and Grennan [2013]. These papers depart from considering theoretical models of contracting and bargaining that they take to the data to estimate structural models and obtain predictions of counterfactual policy choices. Finally, Stole [2007] and Armstrong [2006] provide excellent reviews of the theory of price discrimination in oligopoly.

The results in this paper have important implications for a number of fields. First, they are relevant to the literature studying the dynamics and determinants of firm market power in output markets (e.g., Berry et al. [1995], Gutiérrez and Philippon [2017], De Loecker et al. [2020] and Autor et al. [2020]).[5] Second, understanding the determinants of intermediate input prices and labor wages carries implications for a number of topics in Macroeconomics including the literature on buyer-supplier production networks (see Bernard and Moxnes [2018]), the propagation of shocks across firms (e.g., Carvalho et al. [2020], Acemoglu et al. [2012], Di Giovanni et al. [2014], Baqaee and Farhi [2018] and Baqaee and Farhi [2019]), the decreasing labor share in GDP (see Elsby et al. [2013] and Dorn et al. [2017]), and the transmission of monetary policy shocks Abbritti et al. [2021]. Last but not least, since differences in input prices can affect the allocation of production across firms, our paper is relevant for understanding resource misallocation (e.g., Baqaee and Farhi [2020] and Hsieh and Klenow [2009]).

The rest of the paper is structured as follows. Section 2 introduces the data. Section 3 lays out the empirical strategy, discussing challenges in identification, explaining shortcomings in previous work and detailing our solution. Section 4 presents the results, and Section 5 concludes.

## 2 DATA

This article uses novel administrative datasets from the Department of Finance of São Paulo (SEFAZ/SP) with anonymized information for firms in the textile sector.[6] The state of São Paulo is the most important of the 26 states in Brazil, producing about one third (34%) of the country's GDP and being home to over a fifth (22%) of its population.[7] Nationwide, the textile industry represented 2.5% of the GDP in 2015 and was responsible for almost 17% of total employment in the industrial sector, making Brazil the fifth largest textile producer worldwide with a market share of 2.7% (see Lucato et al. [2017] and De Oliveira Mendes Junior [2017]). Moreover, São Paulo stands out as the main driver of the economic relevance of the textile industry in Brazil, producing 37.4% of its gross value (see De Oliveira

[5]Furthermore, the existence of firm market power in input markets has implications for the correct estimation of firm markups (see Morlacco [2020]).

[6]Other papers using data from SEFAZ/SP include Gerard et al. [2018], Gerard and Naritomi [2021] and Naritomi [2019] among others. However, none of these papers have information on transaction-specific prices as we do.

[7]Actually, the economy of São Paulo is the biggest in South America, and second to Mexico in Latin America.

Mendes Junior [2017]).[8]

On the one hand, we use firm-to-firm transaction level data for every input acquired by firms in the textile sector from January 2011 to December 2017.[9] For each transaction we have information on the identities of the seller firm, buyer firm, product being transacted at the 8-digit code, and product characteristics.[10] Moreover, for each transaction, we have information on the measurement units of the product being transacted (kilos, meters, gallons, units, etc.) and the corresponding number of units (or quantities). We define a product as the triple of 8-digit product - measurement unit - product characteristics. With this information at hand, we are able to calculate unit values (that we will refer to as prices) for each transaction as the ratio between total transaction costs over number of units.[11] On the other hand, regarding labor, we use data coming from RAIS that contains monthly information on the number of employees and the wage bill at the firm level.[12] The data is disaggregated by occupation at the 2-digit code (99 occupations) and by level of education, which comprises 11 categories (ranging from high-school dropout to PhD). Importantly, this level of disaggregation will allow us to control for differences in quality and composition of the labor force.

Table 1 shows descriptive statistics on data aggregated at the quarterly frequency for the 3,535 firms in our sample. Since firms enter and exit our data, for each quarter we have on average information on 2,158 firms, each of them employing almost 44 workers on average, with a very skewed distribution. Firms buy on average 75 different input products

[8]The textile industry primarily uses as inputs natural fibers (cotton, silk, wool, etc.), artificial filaments (viscose, acetate, etc.) derived from natural materials, and synthetic filaments (polyester, nylon, lycra, etc.) derived from petrochemicals. Its main tasks are spinning to make threads, weaving and knitting to produce fabrics and processing such as dyeing, stamping and laundry. Afterwards, it sells its output to the apparel industry (for a more detailed description of the textile industry see De Oliveira Mendes Junior [2017]). The whole process is depicted in Figure B.1. in Appendix B.

[9]Data on firm purchases and sales is collected electronically from invoices. One of the key advantages of the Brazilian electronic invoice data over other newly available datasets is that all firms must use electronic invoicing irrespectively of the tax regime they choose, reducing the usual concerns of misreporting. In addition, mechanisms to reduce tax evasion such as the "Nota Fiscal Paulista", introduced in 2008, increased the quality of the data (see Naritomi [2019]). Moreover, the data is linked to administrative records containing the total number of employees and payroll.

[10]For each transaction we have two pieces of information. First, on the origin of the products. This refers to the degree of imported content in the products being transacted, ranging from 1 "fully domestic" to 7 "foreign". Second, on the characteristics of the transactions. This takes the values of "production", when the good was manufactured by the firm selling it, "commercialization", when the good is merely resold, and "others".

[11]Because qualities of the input products being sold by different sellers, even within our narrow definition of product, can differ (e.g., some firms sell high quality cotton and others sell low quality) we will conduct our analysis exploiting variation across buyers of a given seller-product-time.

[12]Relacao Anual de Informacoes Socials (RAIS) is administrative data from the Ministry of Labor and Employment (MTE) that covers about 97% of the Brazilian formal market.

per quarter from about 25 different suppliers. Again, the distribution of these variables is very skewed with some large firms buying a large number of products from a large number of providers. On average a firm buys inputs from six different 2-digit sectors, which implies a firm has more than one supplier per sector.

**Table 1: Descriptive statistics**

| | (1) Mean | (2) SD | (3) Median |
|---|---|---|---|
| **Number of firm** | 2158 | 71.7 | 2190 |
| **Number of employees** | 43.5 | 121 | 11 |
| **Number of products bought** | 74.9 | 130.4 | 27 |
| **Number of providers** | 24.7 | 41.2 | 10 |
| **Number of 2-digit sectors** | 6.36 | 5.29 | 5 |

Note: Quarterly data for 3,535 firms in the textile sector in the State of São Paulo covering years 2011 to 2017.

# 3 EMPIRICAL STRATEGY

## 3.1 CHALLENGES IN IDENTIFICATION

Previous work has tried to infer the existence of market power of firms in input markets by identifying the residual supply curve that a firm faces when buying intermediate inputs (the same applies when hiring labor). Basically, this requires the estimation of a firm supply curve in which input prices are a function of demanded quantities and an error term. This is shown in Equation 1, where the subscripts $b$ and $t$ refer to buyer firm and time period, respectively. Identifying a positive supply curve, i.e. input prices are increasing in demanded quantities, is taken as evidence of the existence of market power for the buyer firm. That is, a firm facing an upward sloping supply curve has an incentive to reduce demanded quantities to lower input prices and increase profits. Intuitively, this resembles the case of a monopolist in output markets that reduces production to increase output prices and hence profits.

$$p_{bt} = \alpha \ + \beta q_{bt} + \epsilon_{bt} \tag{1}$$

However, directly identifying $\beta$ in Equation 1 is problematic. The reason is that the error term contains unobserved variation across buyer firms in the determinants of the prices that they pay for their inputs. One fundamental driver of these differences in input prices is likely to be unobserved differences in the quality of inputs. Because quantities in equilibrium are a function of these unobserved input qualities, OLS estimates will suffer from endogeneity.

### 3.2 PREVIOUS WORK AND IDENTIFICATION THREATS

The literature has tried to solve this problem by using firm demand shocks in output markets to instrument input quantities. The validity of these instruments relies on the assumption that firm demand shocks in the market for outputs will only affect input prices through the increase they induce in input quantities. For example Goolsbee and Syverson [2023] instrument size of tenure and non-tenure track faculty in US universities with the number of student applications. They argue that the number of student applications should affect the decision of universities about how much faculty to hire but should not affect wages of faculty through any other channel. Kroft et al. [2023] instrument number of workers in construction firms with quasi-random variation in the assignment of procurement contracts. Again, a firm getting a procurement contract will need to hire more workers but this should not affect wages directly. Finally, Rubens [2023] instruments firm demand of intermediate inputs using firm productivity shocks. With the same logic as before, a positive productivity shock should only affect input prices through the increase it induces in input demand.

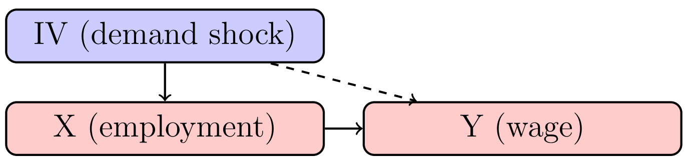
The main concern for the validity of demand sock instruments comes from the existence of bargaining, both between firms and workers, and firms and suppliers.[13] An abundant literature documents that firm shocks pass through to wages in labor markets. This implies that firms receiving positive shocks will share part of their good luck with workers.[14] Moreover, in the results section we will show how firm shocks also pass through to input prices in intermediate input markets. To understand how bargaining poses a threat to the exclusion restriction of standard instruments let's consider the already mentioned paper of Kroft et al. [2023]. In their framework, they use variation induced by the quasi-random assignment of procurement contracts to construction firms. When firms receive a procurement contract,

[13]Appendix A presents another threat to the validity of demand shock instruments that can apply in many settings and has not been considered previously in the literature. We consider rent sharing to be a concern that applies more generally in all situations in which there is no posted prices and price bargaining exists in some extent. For this reason we present this as the main concern for the validity of demand shocks instruments for the identification of market power of firms in upstream markets.

[14]In words of Lamadon et al. [2022] "...idiosyncratic value added shocks to a firm transmit significantly to the earnings of its employees". For a literature review on how firm shocks pass through to wages see Card et al. [2018].

they need to hire more workers in order to complete the works. For the instrument to be valid we need the demand shock (the assignment of a procurement contract) to affect wages only through the increase it induces in firm employment (see solid line in Figure 1), and not through any other channel. However, if construction firms share part of their good luck with workers, wining a procurement contract will also induce direct increases in workers' wages (see dashed line in Figure 1). This is actually happening in the context of Kroft et al. [2023], where they show how the assignment of a procurement contract induces an increase in the wages of incumbent workers.[15] This implies that the assignment of a procurement contract affects average firm wages directly, and not only through the increase in number of workers, which invalidates the exclusion restriction and generates positively biased elasticity estimates.

**Figure 1: Identification strategy**




To formalize the rent-sharing between both firms and workers, and firms and suppliers, we present a simple bargaining model that shows how input prices directly depend on buyer demand or productivity shocks, precluding the possibility of using these shocks as instruments of input quantities. In equation 2 we consider a Nash-bargaining problem between a seller firm, denoted by $s$, and a buyer firm, denoted by $b$, that negotiate the price ($p_{sb}$) at which they will trade. The first term in square brackets represents the profit of the seller from this match, which depends on the quantity transacted ($M_{sb}$), and the margin between the price and the marginal cost of production ($c_s(M_{sb})$). The second term represents the buyer profits from this match, given by the difference between the marginal revenue and the marginal cost of the relation. The marginal revenue ($\pi_b$) generically depends on all determinants of firm demand in output markets and all determinants of firm production costs. These include firm demand shocks in output markets ($D_b$), quality of the output ($\eta_b$), firm productivity ($A_b$), labor ($L_b$) and capital ($K_b$), amount of other intermediate inputs ($M_b$) and the quantity transacted in this relation ($M_{sb}$). The relative bargaining power of the seller in the relation is given by $\phi_{sb} \in (0, 1)$.

[15]See Table 1 in their paper.

$$\max_{p_{sb}} \left[ M_{sb}[p_{sb} - c_s(M_{sb})] \right]^{\phi_{sb}} \left[ \pi_b(D_b, \eta_b, A_b, L_b, K_b, M_b, M_{sb}) - M_{sb}p_{sb} \right]^{1-\phi_{sb}} \tag{2}$$

The Nash-Bargaining solution of this problem shown in equation 3 implies that the negotiated price depends not only on the marginal cost of the seller, but also on the marginal profit of the buyer. In other words, all determinants of firm demand in output markets and firm production costs will directly affect prices. As a result, a positive demand shock to the buyer firm in output market or a positive productivity shock will pass through into higher input prices, generating rent-sharing between the seller and the buyer. Consequently, the validity of using firm demand or productivity shocks as instruments in estimating a supply function would be compromised. The same exact reasoning follows if we consider the negotiation of wages between firm and workers. Notice, moreover, that for this argument to pose a threat to the exclusion restriction of demand shock instruments we do not need input prices to be fully determined by a bargaining process between firms and suppliers, or firms and workers, but the existence of some rent-sharing between firms and sellers and firms and workers would invalidate its use.

$$p^*_{sb} = \phi_{sb} \frac{\pi_b(D_b, \eta_b, A_b, L_b, K_b, M_b, M_{sb})}{M_{sb}} + (1 - \phi_{sb})c_s(M_{sb}) \tag{3}$$

### 3.3 PROPOSED SOLUTION

The arguments presented above preclude the strategy of using traditional demand instruments to estimate Equation 1. All shocks in output markets that affect input quantity demand by a firm (firm productivity shocks, firm demand shocks, shocks to competitors, market liberalizations, etc.) will in turn affect firm marginal profits from a relation with a supplier, and hence pass-through into input prices as explained in the previous section. The same applies when we think of a firm hiring labor. This prevents the option of estimating a residual supply curve with traditional instruments and requires an alternative approach.

In this paper we leverage the high quality of our data to circumvent endogeneity concerns in the estimation of a supply equation to identify the determinants of the prices that a firm pays for its inputs. We start by presenting our strategy for intermediate input markets. In this case, the high granularity of our data allows us to exploit variation across buyers whilst controlling for all factors affecting quality and costs of a product. Firstly, we exploit variation across different buyers of an specific product. Consider Equation 4 where the price of input product $k$, sold by seller $s$, to buyer $b$, in time period $t$, is a function of quantities. By introducing product-seller-time fixed effects ($\lambda_{kst}$), we exploit differences in the quantities demanded by different buyers of an specific product. This way, we are able to estimate the impact of demanded quantities on prices, whilst controlling for all product unobserved characteristics. Usual datasets do not have information on transaction prices and identifiers of the specific product being transacted, precluding this estimation strategy.

$$p_{ksbt} = \alpha + \beta q_{ksbt} + \lambda_{kst} + \epsilon_{ksbt} \tag{4}$$

However, this demanding specification may still not account for some identification concerns, as it is possible that serving some customers is costlier than serving others. For example it seems reasonable to believe that serving customers located far away is more expensive than serving customers located very close to the seller firm, and this should affect prices. To address this concern, we exploit variation for a given buyer of a seller-product over time by introducing product-seller-buyer fixed effects ($\gamma_{ksb}$) to Equation 4, which delivers Equation 5

$$p_{ksbt} = \alpha + \beta q_{ksbt} + \lambda_{kst} + \gamma_{ksb} + \epsilon_{ksbt} \tag{5}$$

In addition, Equation 5 may still suffer problems of endogeneity since buyers can receive time-specific shocks. For instance, if a firm is located in a region where a natural disaster just occured, we can expect the costs of selling to this firm to increase and pass-through to prices. To address this concern we add buyer-time fixed effects ($\delta_{bt}$) to Equation 5, resulting in Equation 6, which is going to be our baseline specification.

$$p_{ksbt} = \alpha + \beta q_{ksbt} + \lambda_{kst} + \gamma_{ksb} + \delta_{bt} + \epsilon_{ksbt} \tag{6}$$

This very refined specification controls for all plausible systematic factors that could affect the cost that a firm bears when serving a client.[16] Additionally, we conduct a number of robustness tests that support the use of this specification as our baseline. We will also use this model to study how buyer input reliance and buyer demand shocks affect input prices by including extra variables in the baseline specification.

[16]The existence of some types of non-systematic factors affecting prices could pose a problem to our identification strategy. For instance, if supplier firms decide to randomly alternate high and low prices for the same product across different buyers over time our estimates would be compromised. We consider the existence of this type of threats unlikely.

Our strategy for estimating the residual labor supply that a firm faces when hiring workers follows a similar approach. Exploiting our high quality data we try to control for all unobserved factors affecting wages such us the composition of the labor force. Thus, we use Equation 7 as our baseline specification where $w_{kft}$ is the wage paid by firm $f$ to workers in an occupation-education category $k$ in time period $t$. First, wage depends on the number of workers in this firm by occupation-education category by time ($n_{kft}$). Because workers of different occupation-education categories can be expected to receive different wages we can control for occupation-education category by time fixed-effects ($\lambda_{kt}$), and study variation across firms for a given occupation-education category and period.

Moreover, there can be differences in wages across firms, for instance, due to differences in the availability of workers of different skills or characteristics across municipalities. To control for this we include occupation-education category by firm fixed effects ($\gamma_{kf}$).

Finally, we control for firm by time fixed effects ( $\delta_{ft}$). This way, we exploit variation across different education-occupation categories within a firm, whilst controlling for aggregate changes at the firm level. For example, this would account for the case that firms pay a wage premium as they grow. Hence, our baseline specification takes the following form:

$$w_{kft} \; = \; \alpha \; + \; \beta \; n_{kft} \; + \; \lambda_{kt} \; + \; \gamma_{kf} \; + \; \delta_{ft} \; + \; \epsilon_{kft} \tag{7}$$

# 4 RESULTS

## 4.1 INTERMEDIATE INPUT MARKETS

To address endogeneity concerns in the analysis of the determinants of the prices that firms pay for their inputs, we exploit the variation in prices paid by different buyers for the same seller-product. Our first step is to verify whether buyers of a given seller-product indeed pay different prices. Table 2 shows that the coefficient of variation across buyers for the same seller-product-quarter is, on average, 0.334. This indicates that there is no single market price for that product— the same supplier charges different prices to different buyers. Such price dispersion strongly suggests that bargaining, whereby suppliers and buyers negotiate prices based on their respective bargaining power or contractual relationships, plays a decisive role in determining input prices.

## Table 2: Variation in prices

| | (1) Mean | (2) SD | (3) Median |
|---|---|---|---|
| **Coefficient of variation across buyers of a firm product in a quarter** | 0.334 | 0.413 | 0.166 |

Note: Information on 1,104,483 product-quarter observations corresponding to all purchases of intermediate inputs by firms in the textile sector from 2011 to 2017.

After documenting the existence of price variation across buyers, we proceed to study its determinants. To do so, following Equation 6, we regress the log of transaction price on the log of quantity. In the first column (Basic I) of Table 3 we control for seller-product-quarter fixed effects and find that an increase in quantities of 100% is associated to decreases in prices of almost 17%. Further controlling for seller-product-buyer fixed effects (Basic II) estimates go up to 26%. Finally, after adding buyer-quarter fixed effects (Baseline) the estimated reduction on prices remains unchanged at 26%.

To test the robustness of this result, in subsequent columns we show estimated effects under variations of the baseline specification. Firstly, in Column 4, instead of controlling for buyer-quarter fixed effects we control for buyer-product(2-digit)-quarter fixed effects. Doing this we exploit variation across the different providers of a buyer firm of products at the 2-digit code. Secondly, Column 5 replicates the baseline specification in Column 3 but using controls at the monthly level instead of quarterly level. A potential concern is that the seller-product-buyer fixed-effect remains constant over the sample period, generating problems if, for instance, the conditions of a contract between a buyer and a seller change over time. To address this issue, thirdly, in Column 6 we limit our sample period to year 2015, as in this reduced time span contract characteristics are less likely to change. Once again, results are robust to this alternative specification. Additionally, factors such as taxes involved in a transaction can also affect prices. To address this concern, fourthly, in Column 7 we control non-parametrically for VAT taxes paid in each transaction, and find how this does not affect the results.[17] Moreover, in previous work, Brugués [2023] finds how the duration of a business relation between a buyer and a supplier affects transaction prices. Therefore, fifthly, controlling again non-parametrically for the duration of the business relation, results remain unchanged.[18]

[17] We control for VAT tax rate (ICMS rate) that applies to each transaction linearly and quadratically.

[18] For each triple buyer-seller-product we obtain the quarterly date at which the first transaction took place, creating the variable first-date. We control for the impact of first-date considering its effects are

These results imply the existence of quantity discounts such that firms face a decreasing supply curve when buying intermediate inputs. However, it is possible that the estimated negative effect of quantities on prices is explained by the presence of fixed costs at the transaction level. In this case, an increase in quantities would lead to a decrease in the fixed-cost per unit, making prices decreasing in quantities. Moreover, the presence of transaction-specific fixed-costs would imply that the estimated quantity discounts should be decreasing in quantities. To reject this hypothesis, lastly, in Column 9, we introduce as a regressor log-quantity squared and actually find the opposite, i.e. quantity discounts are increasing in quantities. This is at odds with the potential existence of fixed costs being the main driver of our results.

## Table 3: Effect of quantities on prices

**Dependent variable: Log of transaction price**

| | (1) Basic I | (2) Basic II | (3) Baseline | (4) Extra Controls | (5) Monthly Controls | (6) Year 2015 | (7) Control for Taxes | (8) Control for Duration | (9) Quantity Squared |
|---|---|---|---|---|---|---|---|---|---|
| **Log quantity** | -0.168*** | -0.264*** | -0.262*** | -0.305*** | -0.278*** | -0.272*** | -0.269*** | -0.269*** | -0.244*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| **Log quantity squared** | | | | | | | | | -0.00280*** |
| | | | | | | | | | (0.0000) |
| **Observations** | 6,835,226 | 6,835,226 | 6,835,226 | 6,835,226 | 6,835,226 | 944,509 | 6,835,226 | 6,835,226 | 6,835,226 |
| **Seller-product-date FE** | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| **Seller-Product-Buyer FE** | | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| **Buyer-date FE** | | | Yes | | Yes | Yes | Yes | Yes | Yes |
| **Buyer-product2d-date FE** | | | | Yes | | | | | |
| **Controls for taxes** | | | | | | | Yes | | |
| **Controls for relation duration** | | | | | | | | Yes | |

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ .

We are also interested in analyzing other factors that can potentially affect intermediate input prices. First, we consider the effect that differences in buyers' bargaining power have on transaction prices. Intuitively, firms with more suppliers have more bargaining power as a result of relying less intensively on each seller and inducing more competition among them. To study how relying less intensively on the input product provided by a supplier allows the buyer firms to negotiate lower prices, we introduce in our baseline specification the share

heterogeneous for each quarter in our sample. This implies that for the transactions taking place in every quarter we are flexibly controlling for the impact of the business duration.

that a given product that the buyer is purchasing from a seller represents in its total amount of inputs. This is characterized by the following equation:

$$p_{ksbt} = \alpha + \beta q_{ksbt} + \pi Input\ reliance_{ksbt} + \lambda_{kst} + \gamma_{ksb} + \delta_{bt} + \epsilon_{ksbt} \quad (8)$$

The regression in the first column of Table 4 includes as a regressor the log of the share that the transacted product represents in total quarterly inputs. To calculate this, we sum the value of every transaction in which buyer and seller exchange the same product during a quarter, and divide this by total value of inputs acquired by the buyer in that quarter. We find this has a positive impact on transaction prices, which suggests that the lower the reliance on a given seller-product, the lower the negotiated price. In Columns 2 to 4 we use alternative measures of input reliance. In Column 2 we introduce as a regressor the share that the transacted product represents in the total amount of inputs that the firm is purchasing from the (2-digit) sector of the seller firm in a quarter. In Column 3 we use the share that the transacted product represents in the total inputs that the firm is purchasing of the corresponding 2-digit product in a quarter. Finally, in Column 4 we define instead product groups at the 8-digit level, which is the highest level of disaggregation in our data. The results confirm the positive impact of input reliance on negotiated prices.[19][20]

To conclude our analysis for intermediate input markets we want to check whether a firm pays higher prices to its suppliers after receiving a positive demand or productivity shock. This would be consistent with the existence of rent-sharing in buyer-seller relations, similar to what previous literature has documented for firm-worker relations. Moreover, finding evidence of rent-sharing in intermediate input markets confirms the endogeneity of demand as instrumental variables in supply function estimation. To test the pass-through of buyer shocks to intermediate input prices we consider a specification which includes buyer-quarter demand shocks in output markets or productivity shocks received by the seller and controls for transaction quantities, input reliance, seller-product-quarter fixed-effects and

[19]The decrease in the estimates as we use a more narrow product group in the denominator could be explained by the varying importance that different input products have in the production process. It seems reasonable to believe that an increase in input reliance in non fundamental input suppliers (e.g. office supplies for a textile firm) will not have a big repercussion in the bargaining position of the firm and on negotiated prices. By contrast, an increase in input reliance of fundamental suppliers (e.g. those representing a large share of total inputs such as thread for a textile firm) will have a much larger impact on negotiated prices. This could explain the observed decrease in the estimates.

[20]We find that large firms benefit more from quantity discounts (they buy larger quantities per transaction) and also rely less intensively on their suppliers as a result of having a larger number of them. Results available upon request.

## Table 4: Effect of input reliance on prices

**Dependent variable: Log of transaction price**

| | (1) Total | (2) Sector | (3) 2-digit Product | (4) 8-digit Product |
|---|---|---|---|---|
| **Log quantity** | -0.367*** | -0.333*** | -0.315*** | -0.282*** |
| | (0.00) | (0.00) | (0.00) | (0.00) |
| **Log share in total inputs** | 0.361*** | | | |
| | (0.00) | | | |
| **Log share in sector inputs** | | 0.259*** | | |
| | | (0.00) | | |
| **Log share in 2-digit product** | | | 0.205*** | |
| | | | (0.00) | |
| **Log share in product** | | | | 0.155*** |
| | | | | (0.00) |
| **Observations** | 6,835,226 | 6,835,226 | 6,835,226 | 6,835,226 |
| **Seller-product-date FE** | Yes | Yes | Yes | Yes |
| **Seller-product-buyer FE** | Yes | Yes | Yes | Yes |
| **Buyer-date FE** | Yes | Yes | Yes | Yes |

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ .

seller-product-buyer fixed-effects.[21]

$$p_{ksbt} = \alpha + \mu \; Shock_{bt} + f(q_{ksbt}, Input\ reliance_{ksbt}) + \lambda_{kst} + \gamma_{ksb} + \epsilon_{ksbt} \tag{9}$$

We construct residual demand shocks in two ways. First, we calculate, for each firm, the value of total sales at the 4-digit product-quarterly level and then retrieve the residual from regressing the log of this variable on product and quarter fixed-effects. Column 1 shows a positive correlation between this demand shock and transaction prices, which is consistent with rent-sharing between a firm and its suppliers. Second, we alternatively construct firm demand shocks using the Arellano-Bond estimator controlling for quarter fixed-effects.[22] Once again results are consistent (see column 2). We also construct supply shocks in two different ways by estimating firm production functions and obtaining estimates

[21] Notice that since our measure of shocks is at the buyer-quarter level we cannot include buyer-quarter fixed effects as in the baseline specification.

[22] See Arellano and Bond [1991].

of firm productivity. First, we obtain firm employment productivity at the quarterly level by dividing firm quarterly revenues on total number of workers in each quarter. Column 3 shows a positive correlation between this supply shock and transaction prices, indicating the presence of rent-sharing. Second, we alternatively construct firm productivity using Ackerberg-Caves-Frazer estimation strategy.[23] Once again results are consistent (see column 4).

These results confirm the existence of rent-sharing in buyer-seller relations. Consequently, demand and productivity shocks are not valid instruments in supply estimation since they have a direct impact on prices violating the exclusion restriction.

### Table 5: Effect of buyer shocks on prices

**Dependent variable: Log of transaction price**

| | **(1)** | **(2)** | **(3)** | **(4)** |
|---|---|---|---|---|
| **Demand shock I** | 0.0336*** | | | |
| | (0.001) | | | |
| **Demand shock II** | | 0.0105*** | | |
| | | (0.001) | | |
| **Employment productivity** | | | 0.0382*** | |
| | | | (0.001) | |
| **TFP productivity** | | | | 0.0410*** |
| | | | | (0.001) |
| **Observations** | 6,835,226 | 6,835,226 | 6,835,226 | 4,328,184 |
| **Seller-product-date FE** | Yes | Yes | Yes | Yes |
| **Seller-product-buyer FE** | Yes | Yes | Yes | Yes |
| **Buyer-date FE** | | | | |

Note: All regressions control for log of quantity, log share in total inputs, log share in sector inputs, log share in 2-digit product, and log share in product. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

## 4.2 LABOR MARKETS

In labor markets, we also observe substantial variation in the wages that different firms pay to workers in the same occupation-education category, indicating that there is no single

[23] See Ackerberg et al. [2015].

market wage for these workers. Table 6 shows that the coefficient of variation across firms in a given occupation-education category-quarter is 0.51. This significant dispersion suggests that wages are not determined solely by competitive market forces but rather reflect bargaining processes or other firm-specific factors that allow for wage discrimination among workers performing the same job with the same level of education.

**Table 6: Variation in wages**

| | (1) Mean | (2) SD | (3) Median |
|---|---|---|---|
| **Coefficient of variation across firms in the wages paid to workers of a given occupation and education category** | 0.512 | 0.235 | 0.487 |

Note: Information on 7,416 2-digit category-quarter observations.

We analyze how the impact on wages in an occupation-education category-firm-quarter depends on the number of workers on that occupation-education category-firm-quarter. However, in our baseline regression we include several fixed effects. For example, because workers of different occupation-education categories should receive different wages we can control for occupation-education category and quarter fixed effects and study variation across firms. Moreover, it can be that a firm has to pay higher wages because, for instance, it operates in a more competitive market or its located in a very secluded region. To control for this we include occupation-education category and firm fixed effects. And finally we can control for firm and quarter fixed effects. Hence, our baseline specification takes the following form:

$$w_{kft} = \alpha + \beta n_{kft} + \lambda_{kt} + \gamma_{kf} + \delta_{ft} + \epsilon_{kft} \tag{10}$$

Our estimates for the impact of the log of employment on the log of wages are displayed in Table 7. In the first column, just studying variation across firms, only including position-education-quarter fixed effects, we find a positive impact of employment on wages, statistically significant but quantitatively small. Previous literature has typically found elasticities around 4%, which is about 100 times larger than our result. In the second column we further control for firm-position-education-quarter fixed effects and study variation over time and our already-low estimates are further reduced by 75%. In our baseline specification, when we include firm-quarter fixed effects the estimate actually turns negative, but again very small in magnitude. This is not like the downward-slope supply curve that we found for intermediate input markets but clearly contrasts the results documented so far in the literature. Our results are maintained if instead of quarterly controls we include monthly controls.

## Table 7: Effect of Employment Levels on Wages

**Dependent variable: Log of wages**

| | (1) Basic I | (2) Basic II | (3) Baseline | (4) Monthly controls |
|---|---|---|---|---|
| **Log employment** | 0.0488*** | 0.0126*** | -0.0180*** | -0.0210*** |
| | (0.000491) | (0.000842) | (0.000841) | (0.000864) |
| **Observations** | 1,988,354 | 1,988,354 | 1,988,354 | 1,988,354 |
| **Position-education-date FE** | Yes | Yes | Yes | Yes |
| **Firm-position-education FE** | | Yes | Yes | Yes |
| **Firm-date FE** | | | Yes | Yes |

Note: $*p < 0.10$, $**p < 0.05$, $***p < 0.01$.

Once again, we are interested in analyzing how shocks to the firms impact the wages they pay to their workers to see if there is evidence of rent-sharing. This is not only interesting in its own right but also because it would cast doubt on the identification strategies followed in the literature that finds monopsony power of firms in labor markets. To study this, we regress log wages at the worker-category and firm level on a firm shock whilst controlling for number of workers, category-quarter foxed-effects, category-firm fixed-effects and firm-date fixed-effects. This is characterized by the following equation:

$$w_{kft} = \alpha + \mu \ Shock_{ft} + \beta^s n_{kft} + \lambda_{kt} + \gamma_{kf} + \delta_{ft} + \epsilon^s_{kft} \tag{11}$$

Analogously to the case of the intermediate product market, we use the same demand and supply shocks. Results are displayed in Table 8, showing a positive impact of firm demand and productivity shocks on wages.

## Table 8: Effect of Buyer Shocks on Wages

**Dependent variable: Log of wages**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| **Log employment** | 0.00811*** | 0.00802*** | 0.00493*** | 0.00872*** |
| | (0.000839) | (0.000838) | (0.000839) | (0.00110) |
| **Demand shock I** | 0.00880*** | | | |
| | (0.00124) | | | |
| **Demand shock II** | | 0.0105*** | | |
| | | (0.000449) | | |
| **Employment productivity** | | | 0.00945*** | |
| | | | (0.000517) | |
| **TFP productivity** | | | | 0.0194*** |
| | | | | (0.000692) |
| **Observations** | 1,988,354 | 1,988,354 | 1,988,354 | 1,268,643 |
| **Position-education-date FE** | Yes | Yes | Yes | Yes |
| **Firm-position-education FE** | Yes | Yes | Yes | Yes |
| **Firm-date FE** | | | | |

Note: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

## 5 CONCLUSIONS

In this paper we contribute to understanding the nature of firm market power in input markets by studying the determinants of the prices that firms pay for intermediate inputs and labor. To do so, we use administrative data for firms in the textile sector in São Paulo, Brazil, which includes information on transaction-specific prices for every purchase of intermediate inputs as well as firm employment levels and wages for different occupation-education categories. The fine granularity of the data allows us to circunvent usual problems in this type of frameworks and provide clear-cut stylized facts about the determinants of the prices that firms pay for their inputs.

For intermediate inputs, we exploit variation across different buyers of a given product and over time. This sheds light on some of the factors explaining why some firms pay lower prices than others for the same input product. First, we find firms buying higher quantities enjoy lower prices as a result of quantity discounts. Second, buyers relying less intensively on a given supplier pay lower prices. And third, buyers pay higher prices for the same input after receiving a positive demand or productivity shock. For labor, we do not find evidence of firms needing to pay higher wages to hire more workers. Moreover, we show that firms increase wages after receiving a positive shock.

These results show how the nature of firm market power in input markets requires a more thorough analysis to understand its determinants and implications. Fortunately, the increasing availability of datasets as the one employed in this paper facilitates this endeavor. This should allow researchers to look at old questions such as monopsony power with new eyes, constructing theories based on solid empirical evidence. This research agenda would include de following steps. First, finding clear-cut empirical evidence about the determinants of input prices. Second, building solid theories and well-identified models accounting for the discovered stylized facts. And third, studying the implications of firm market power in input markets for downstream competition, unifying upstream and downstream market power in a single framework.

# Appendix A

Another reason why traditional instrumental variable identificacion strategies may present indentificacion problems is based on the stylized fact that firms producing high quality outputs employ high quality inputs (see Atkin et al. [2017], De Loecker et al. [2016], and Kugler and Verhoogen [2012]). Consider the case of a firm that at some point gets access to higher quality inputs for its production process, coming these at a higher price. This will increase the quality of outputs and consumer demand. However, the econometrician will just observe the increase in output demand, together with an increase in input demand and input prices, while input and output quality remain unobserved. This can lead him to wrongly conclude that the increase in product demand generated an increase in input demand that in turn increased input prices, providing evidence of an upward sloping supply curve.

To be more specific about this first concern, consider Equation 12 representing the downstream demand function for the products that firm $b$ produces ($q^d_{bt}$), which depends on the product price ($p^d_{bt}$) as well as on unobserved demand shocks ($\epsilon^d_{bt}$). These demand shocks depend on the unobserved quality ($\eta^d_{bt}$) of the products of firm $b$. At the same time, the price that firm $b$ pays for its inputs is captured by the upstream supply function in Equation 13, and depends on the quantity of inputs ($q^u_{bt}$) and an unobserved supply shock ($\epsilon^u_{bt}$). Again, this supply shock depends on the unobserved quality of inputs ($\eta^u_{bt}$). If, as previously argued, input quality and output quality are correlated, the strategy to instrument input quantities with demand shocks is compromised because the exclusion restriction of the instrument is invalidated.[24] Many works could be subject to this criticism. For instance, in the aforementioned paper of Goolsbee and Syverson [2023], size of tenure and non-tenure track faculty in US universities is instrumented with the number of student applications. The following argument could pose a threat to their identification strategy. If a university exogenously increases the quality of its faculty (e.g. by hiring a Nobel Laureate), this will, on the one hand, increase the average faculty wage (because higher quality faculty earns higher wages), and, on the other hand, increase student applications (because student demand will react to the increase in quality of the University). Estimating a supply equation using as an instrument for faculty size the number of student applications would deliver positively biased elasticity estimates, wrongly leading to conclude the existence of market power in the form of an increasing supply curve. The unobserved quality of inputs (faculty in this case) generates an increase in input prices and an increase in output demand. But, obviously, the

[24]See Bastos et al. [2018] for a paper providing evidence of the correlation betwen input and output product quality.

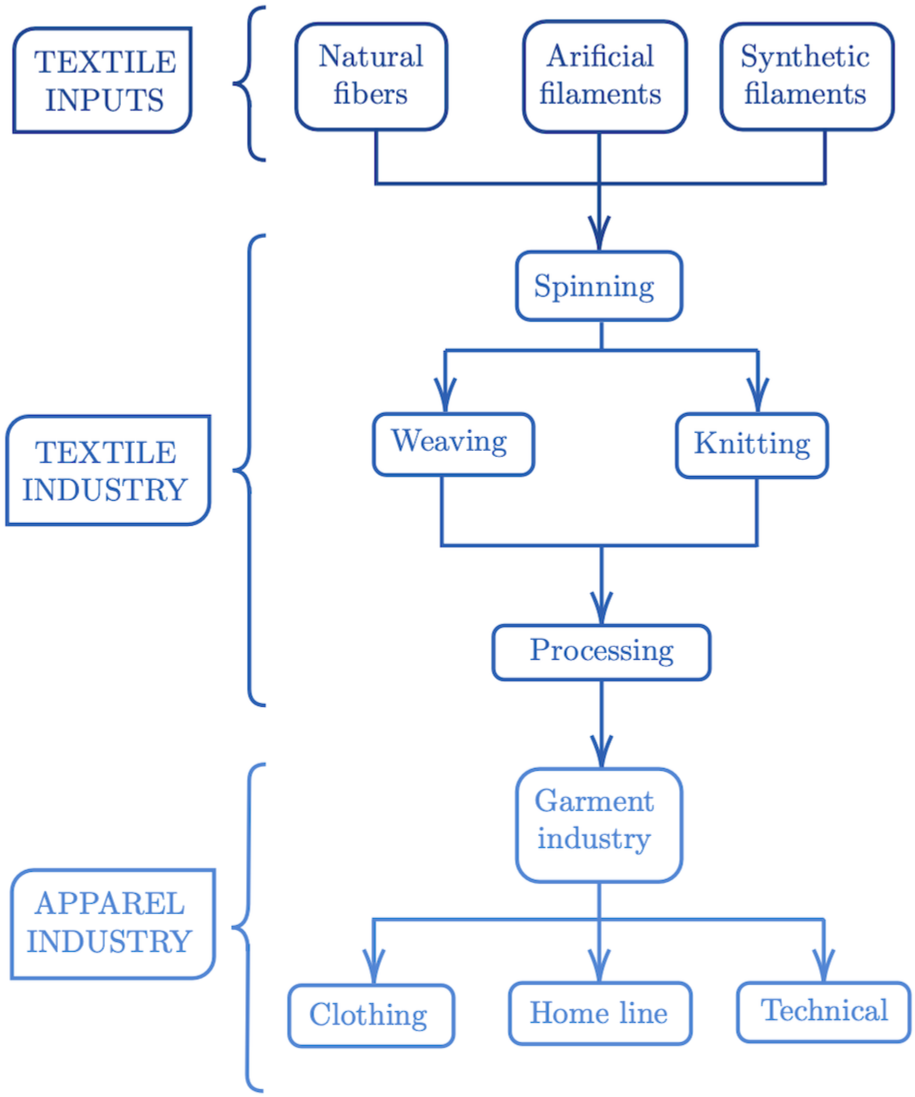
increase in demand is not a good instrument for the effect of faculty size on wages in this case.

$$q_{bt}^d = \alpha^d + \beta^d p_{bt}^d + \underbrace{f(\eta_{bt}^d) + u_{bt}^d}_{=\epsilon_{bt}^d} \tag{12}$$

$$p_{bt}^u = \alpha^u + \beta^u q_{bt}^u + \underbrace{h(\eta_{bt}^u) + u_{bt}^u}_{=\epsilon_{bt}^u} \tag{13}$$

## Appendix B

**Figure 2: Textile industry chain production flow**




Source: Adapted from De Oliveira Mendes Junior [2017].

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