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On the use of the factor share approach to measure labor market power

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Abstract

The production approach to market power estimation requires accurate measures of output-input elasticities. This note shows that when there is employer or employee market power in labor markets, the cost share approach cannot identify the output-labor elasticity needed to estimate the labor market power indicator. A naïve application of this method biases the labor market power indicator towards perfect competition. Therefore, researchers should implement alternative estimation strategies, as the econometric estimation of the production function.

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1. Introduction

The study of firm-level market power has developed around two primary methodological approaches. The demand approach (Berry, 1994; Berry et al., 1995) requires price and quantity data to recover marginal costs under various profit-maximizing firm behaviors.

Alternatively, the production approach does not rely on behavioral assumptions about competition. This method, which can be traced back to Hall (1988), gained prominence following the work of De Loecker and Warzynski (2012). De Loecker and Warzynski (2012) show that firm price markups can be determined as the ratio of the output elasticity with respect to a flexible input to the expenditure share of that input in revenue.

This approach has since dominated the field of price markup estimation and has been extended to the estimation of labor market power indicators (Yeh et al., 2022; Mertens, 2020, 2022; Casacuberta and Gandelman, 2023). In the presence of firm market power, wages are typically below marginal revenue labor productivity (wage markdowns), while in the case of rent-sharing or employee market power, the opposite occurs.

The key step in the production approach is obtaining an adequate measure of the output elasticity with respect to the flexible input. Thus, measures of product and labor market power are closely linked to productivity analysis.

De Loecker and Syverson (2021) offer a comprehensive review of productivity research from an industrial organization perspective. They discuss the trade-offs between two methods for recovering output elasticities: production function estimation and the cost-share approach. [1]

The cost-share approach assumes that firms minimize costs at each point in time, inputs are flexible, and technology exhibits constant returns to scale. On the other hand, parametric production function estimation deals with several challenges, including simultaneity and selection biases, which have been extensively discussed in the literature (Olley and Pakes, 1996).[2] Therefore, it is tempting to use the factor share approach that does not require any fancy econometrics and does not have convergence problems, nor produces output-input elasticities out of the expected [0,1] range.

In this note, we argue that for the cost-share approach to yield unbiased elasticity estimates, perfect competition in input markets must be assumed. When there is employer or employee market power in the labor market, it becomes impossible to recover the output-labor elasticity independently from the labor market power indicator. Consequently, researchers seeking to analyze market power in labor or other input markets should focus on the econometric estimation of the production function. While the intuition that the cost-share approach is unsuitable for measuring labor market power has appeared in some of the specialized literature, this paper is the first to

[1] A third estimation alternative is Data Envelopment Analysis (DEA) that they do not cover in their review and refer to Cooper et al (2011) for an overview.

[2] The first reference to the simultaneity problem in the economic literature is probably Marschak and Andrews (1944). The control function approach used in Olley and Pakes (1996) was later refined in Levinsohn and Petrin (2003) and Ackerberg, Caves, and Frazer (2015). Another possibility is the methodology proposed by Arellano and Bond (1991) and Blundell and Bond (1998) for the identification of parameters within dynamic panel models.

formally derive why this is so and to provide a size of the biases that arise in an incorrect naïve application.

2. A framework for price markup and labor market power indicators

In this section we develop the labor market power indicator assuming employers' monopsony power. It can be shown that the same labor market power indicator arises from models with employee's market power (Mertens and Mottironi 2023).

For firm *i* at period *t* we assume a production technology given by

$$Q_{it} = Q_{it}\left(L_{it}, M_{it}, K_{it}, \omega_{it}\right) \tag{1}$$

where L_{it} and M_{it} are labor and materials respectively, K_{it} is capital, ω_{it} is a scalar productivity term and Q_{it} is gross output. For cost minimization, the following Lagrangian can be written:

$$L = w_{it}\left(L_{it}\right) L_{it} + pm_{it} M_{it} + r_{it} K_{it} + \lambda_{it}\left(Q_{it} - Q_{it}(\cdot)\right) \tag{2}$$

where w_{it}, pm_{it} and r_{it} are prices for labor, materials and capital respectively.

We assume material inputs prices are exogenous to firms. Labor is also assumed to be flexible, but instead of an exogenously given wage, firm monopsony power is assumed in the labor market, *i.e.*, $w_{it}\left(L_{it}\right)$ is a positively sloped function.[3]

First order conditions for material inputs and labor are:

$$pm_{it} = \lambda_{it} \frac{\partial Q_{it}}{\partial M_{it}} \tag{3}$$

$$\frac{\partial w_{it}}{\partial L_{it}} L_{it} + w_{it} = \lambda_{it} \frac{\partial Q_{it}}{\partial L_{it}} \tag{4}$$

where λ_{it} represents the marginal cost at a given level of output. Rearranging, we obtain a relation between the output elasticity of materials (θ_{it}^{M}) and the price markup over marginal cost μ_{it}:

$$\theta_{it}^{M} = \frac{\partial Q_{it} / \partial M_{it}}{Q_{it} / M_{it}} = \frac{P_{it}}{\lambda_{it}} \frac{pm_{it} M_{it}}{P_{it} Q_{it}} = \mu_{it} \frac{pm_{it} M_{it}}{P_{it} Q_{it}}. \tag{5}$$

where P_{it} is firm's output price. In other words, the expression for the price markup can be written as:

$$\mu_{it} = \theta_{it}^{M} \left[\alpha_{it}^{M}\right]^{-1} \tag{6}$$

where α_{it}^{M} is the materials share of revenue.

For labor, we obtain:

[3] This could be the result of labor market frictions that introduce costs for workers to switch among firms (e.g., imperfect information, local preferences, moving costs).

$$\theta^{L}_{¿}=\frac{\partial Q_{¿}/\partial L_{¿}}{Q_{¿}/L_{¿}}=\left[\frac{\partial w_{¿}}{\partial L_{¿}}\frac{L_{¿}}{w_{¿}}+1\right]\frac{P_{¿}}{\lambda_{¿}}\frac{w_{¿}L_{¿}}{P_{¿}Q_{¿}}=\left[\varepsilon^{-1}_{Sit}+1\right]\mu_{¿}\alpha^{L}_{¿} \quad (7)$$

where ε^{-1}_{S} is the inverse elasticity of labor supply. Profit maximization in a monopolistic labor market implies that $\left[\varepsilon^{-1}_{Sit}+1\right]$ equals the wage markdown ($\upsilon_{¿}$), that in turn can be defined as the ratio between marginal revenue of labor productivity $MRPL_{¿}$ and the wage $w_{¿}$.

Then, $\upsilon_{¿}\mu_{¿}¿\theta^{L}_{¿}\left[\alpha^{L}_{¿}\right]^{-1}$ (8)

where $\alpha^{L}_{¿}$ is the labor share of revenue.

If the labor market were assumed in perfect competition, as in De Loecker and Warzynski (2012), then $\theta^{L}_{¿}\left[\alpha^{L}_{¿}\right]^{-1}$ would be interpreted as a measure of price markup. Instead, in our setting this term is the interaction of product market markup and wage markdown, $\upsilon_{¿}\mu_{¿}$. Thus, assuming perfect competition in the labor market would lead to estimates confounding two possible sources of firm power: in the final goods market and in the labor market. This point has already been raised in the literature (Mertens 2022, Appendix B3) and this is not the main contribution of our note.

To separately estimate product and labor marker power indicators according to equation (6) and (8) we need estimates of $\alpha^{L}_{¿},\alpha^{M}_{¿},\theta^{L}_{¿}$ and $\theta^{M}_{¿}$. The first two are directly observed in the data as the labor share of revenue and the materials share of revenue. What remains is to estimate the elasticities.

3. Recovering output-input elasticities

A popular approach in production function estimation, that avoids dealing with complex econometric issues, is based on the cost share of each factor in total cost.

Assuming constant returns to scale, the marginal cost equals average cost ($AC_{¿}$), so

$$\lambda_{¿}=AC_{¿}=\frac{TC_{¿}}{Q_{¿}} \quad (9)$$

where the total cost is $TC_{¿}=w_{¿}\left(L_{¿}\right)L_{¿}+pm_{¿}M_{¿}+r_{¿}K_{¿}$

Then, the first order condition in (3) implies:

$$\theta^{M}_{¿}=\frac{\partial Q_{¿}}{\partial M_{¿}}\frac{M_{¿}}{Q_{¿}}=\frac{pm_{¿}M_{¿}}{TC_{¿}} \quad (10)$$

i.e. we can measure the elasticity of output with respect to materials as the cost share of materials.

The setting proposed for firm labor market power assumes an upward-sloping labor supply curve which is directly related to monopsony power. Taking this into account, with respect to labor the first order condition has an extra term (compared to the first order condition for materials). The first order condition is given by (4), from which we obtain:

$$\theta_{¿}^{L} = \frac{\partial Q_{¿}}{\partial L_{¿}} \frac{L_{¿}}{Q_{¿}} = \upsilon_{¿} \frac{w_{¿}}{\lambda_{¿}} \frac{L_{¿}}{Q_{¿}} = \upsilon_{¿} \frac{w_{¿} L_{¿}}{TC_{¿}} \qquad (11)$$

In this case the elasticity of output with respect to labor equals the cost share of the labor expenditure times the labor market power indicator $\nu_{¿}$. Thus, it is not possible to independently estimate $\upsilon_{¿}$ and $\theta_{¿}^{L}$ under these assumptions.

If a researcher unaware of this result tries to use the cost share approach it will induce a bias in the labor market power estimation.

Suppose the researcher estimates $\theta_{¿}^{L}$as the labor share in total cost $\hat{\theta}_{¿}^{L} = \frac{w_{¿} L_{¿}}{TC_{¿}}$.Using this elasticity in equation (8) will produce

$$\hat{\upsilon}_{¿}^{L} = \hat{\theta}_{¿}^{L} \left[\alpha_{¿}^{L} \mu_{¿} \right]^{-1}. \qquad (12)$$

Then, the bias in absolute terms resulting in the labor market power estimation is:

$$\hat{\upsilon}_{¿}^{L} - \upsilon_{¿} = \left[\hat{\theta}_{¿}^{L} - \theta_{¿}^{L} \right] \left[\alpha_{¿}^{L} \mu_{¿} \right]^{-1} = \left[\frac{1 - \upsilon_{¿}}{\upsilon_{¿}} \right] \theta_{¿}^{L} \left[\alpha_{¿}^{L} \mu_{¿} \right]^{-1} \qquad (13)$$

From where it follows that the percentage bias in the wage markdown estimation is:

$$\frac{\hat{\upsilon}_{¿}^{L} - \upsilon_{¿}}{\upsilon_{¿}} = \frac{\left(1 - \upsilon_{¿}\right)}{\upsilon_{¿}} \qquad (14)$$

The bias is a function of the true value of the labor market power parameter $\upsilon_{¿}$. This gives clear indications about when the naïve use of the cost share approach will have more severe effects. The estimator will be unbiased only when there is no market power in the labor markets $\upsilon_{¿} = 1$.

In a model with monopsony power (as the one presented above) where the wage markdowns are expected to be greater than 1 ($\upsilon_{¿} > 1$) the use of the cost share will introduce a downward bias in its estimate. Conversely, if there is employee-side market power that could result from an efficient bargaining model as in Dobbelaere and Mairesse (2013) and Mertens (2022), then wage markdowns are expected to be below 1 ($\upsilon_{¿} < 1$), hence the use of the cost share will introduce an upward bias in the estimator. In sum, the use of the cost share will bias labor market power estimations towards 1, i.e. towards the absence of firm or employee market power.

Thus, researchers interested in assessing labor market power must engage with the econometric estimation of production functions. This is not to say that such estimations are free from identification challenges. The control function approaches developed by Olley and Pakes (1996), Levinsohn and Petrin (2003), and Ackerberg, Caves, and Frazer (2015) address the endogeneity problem in production function estimation by inverting a firm's decision (regarding investment or intermediate input demand). Doraszelski and Jaumandreu (2023) argue that, since a firm's planned output is unobserved by the econometrician, to properly perform the required inversion one must either assume that there are no differences in demand and conduct across firms and time, or that these differences can be fully controlled for by observables. They discuss the biases introduced in markup estimation and propose, as an alternative, the dynamic panel data approach (Arellano and Bond, 1991; Blundell and Bond, 1998). While the literature has not yet provided definitive solutions, the analysis of alternative econometric methods for production function estimation in De Loecker and Syverson (2021), as well as the critique by Doraszelski and Jaumandreu (2023), are essential references. We refer the reader to these works, as resolving these issues falls beyond the scope of this note.

4. Conclusions

The factor share approach to estimating output-input elasticity is straightforward and appealing because it avoids the econometric challenges associated with parametric production function estimation. However, if firms or employees exert market power in the labor market, this approach does not allow for the separate estimation of output-labor elasticities and labor market power. Ignoring this issue biases the results toward perfect competition. When employers have market power the wage markdown will be downward-biased, while the opposite occurs when employee market power is present. Consequently, researchers interested in market power in labor or other input markets must rely on econometric techniques for estimating the production function.

Disclosure of interest

The authors report there are no competing interests to declare

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