Miscalling Mismeasurement as Misallocation

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Abstract

Hsie and Klenow (2009) find sizable gaps in marginal products of labor and capital across plants in China and India compared with the United States. We will show that these results are sensitive to the parameters of the factor accumulation and the production function. Importantly, the optimal dispersion depends on the parametrization, so one can't address the misallocation without a country specific calibration of the model.

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I. Introduction

Hsieh and Klenow (2009) (henceforth HK) show resource misallocation can lower aggregate total factor productivity (TFP) using micro data on manufacturing establishments in China and India. They find that moving from China and India to the "U.S. efficiency" could increase TFP by 30%–50% and 40%–60%, respectively. However, this novel quantitative finding is challenged by recent papers. In particular, Bils, Klenow and Ruane (2017) show that the misallocation measured by the gap between revenue per unit of inputs in the U.S. and India could be the result of measurement errors in revenues and inputs.

In this paper, we show that the previous findings of misallocation rely substantially on their assumptions of parametrization. In doing so, we estimate the model that is employed by HK to measure misallocation using the moments reported in HK for China and India. Then, we produce simulated data using the estimated model and redo the calculation of HK by different parameters. The results show that a small variation in either the aggregation parameter or the elasticity of output with respect to capital wipes out the efficiency gap reported in HK. That is, it is likely that there would be no misallocation in China and India, and the previous findings rest on the specific choices of parameters. We conclude that it is necessary to focus deeply on calibrations, when measuring misallocations as a quantitative exercise.

The structure of the paper is as follows. We review the literature of relation between misallocation and input distortion in Section II. Section III focuses on the HK model and shows the importance of mismeasurement in parameters. Finally, results and counterfactuals are reported in Section IV.

II. Literature Review

Other papers have challenged the robustness of previously mentioned finding of HK. In particular, Bils, Klenow and Ruane (2017) show that identifying mismeasurement in output is crucial in the investigation of the impact of dispersion on efficiency gain. There are a few papers that show the misallocation is sensitive to modelling. For example, Guan Gong and Hu (2016) show when the constant return to scale assumption fails, HK is actually overestimating the resource misallocation in China. They estimate a new production function by allowing an increasing return to scale functional form and find less misallocation than what reported by HK. We think it is obvious that reframing production function would change the results of misallocation, so probably it is not a duly robustness check and the results of two exercises are not comparable. However, the necessary validation is whether the findings are robust to a variation in underlying parameters, knowing that the true parameters are different in two countries. This difference in parameters mainly stems from different technologies and stages of a production chain.

To understand the importance of why we focus on parameter values, consider a Cobb-Douglas production function as employed by HK. The aggregate TFP, up to the first order condition, is a linear combination of misallocations in labor and capital weighted by their elasticity to production. Moreover, if firms in a country are more capital intensive than their counterparts in the US, then capital should be delivered more to productive firms in this country than the US. If one wrongfully assumes the two countries have the same capital elasticity, she would find a distortion in the capital distribution and accordingly concludes the aggregate misallocation. Moreover, the aggregation parameter highlights to what extent a distortion in a sector would affect the aggregate misallocation. This parameter depends on how firms in a country are located vertically in production, and the intensity of distortions passes on between them. Furthermore, if the sectors are roughly isolated from each other, then the optimal allocation of resources would be treated separately. However, if they are linked to each other, then a social planner may consider reshuffling capital to less productive sectors in a way to include the externality they may have on other stages of production. We will discuss these tradeoffs below.

Previous studies stress their concerns on fixing parameters across sectors, countries, and time. For example, HK admit that a fixed σ across goods are a simplified assumption. Noticeably, in developing countries like India and China, we expect a higher capital share than the US. Miao and Peng (2011), Chang lui and Spiegel (2013), and Batini et al. (2010) estimate the share of labor in production from 0.42 to 0.67 in India and China. Importantly, Bill et al. (2017) highlight that if we fix these parameters along times, we would face a declining allocative efficiency in the U.S., which shows that we might have very sensitive framework to upcoming shocks and measurement errors.

III. Estimation and Methodology

We focus on HK model in which the capital and output distortion leads to the aggregate misallocation. The final output is

$$Y = \sum_{i=1}^{M} \left(Y_i^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$$

Where σ is elasticity of substitution between plants' value-added, Y is value added of each firms, and Y_i is intermediate firm's value-added. Firms compete in a monopolistic competitive market, and the production function for each differentiated product is given by a Cobb-Douglas function of firms as $Y_i = A_i\, k_i^{\alpha}\, L_i^{1-\alpha}$ where α represents the capital share (for our exercise it's constant , L_i shows the labor hired by the firms i, and k_i is rental capital of this firm. HK show that with regular CES aggregate production and firm's Cobb-Douglas production function, the ratio of actual production to the efficient one is:

$$\frac{Y}{Y_{eff}} = \left(\sum_{i=1}^{M} \left(\frac{A_i}{\bar{A}} \frac{\overline{TFPR}}{TFPR_i} \right)^{\sigma-1} \right)^{\frac{1}{\sigma-1}}$$

TFPR is the productivity of revenue for each firm, and the bar sign is used to show the averages. As mentioned previously, our goal is to conduct the same exercise as HK but with different values of σ and α to study the robustness of their results. Moreover, we need to simulate what they have, because we do not have their dataset. To do so, we need to estimate their model by using moments reported in the paper.[2] After the estimation of their model in which replicate exactly the same moments as their paper, we can simulate it and generate firm observations for our exercises. Finally, we use these firm observations to replicate their results, but with different values of σ and α.

HK employ three shocks as the distortion on capital, production, and productivity to build their model. These shocks in principal would be characterized by nine coefficients: three for the averages and six for variance-covariance matrixes. We generate the shocks from three standard normal distribution of the Cholesky matrix of the covariance of Σ. Then, we map them to a lognormal distribution for productivity and beta distributions for capital and production distortion. To obtain these coefficients, we benefit from nine moments reported in HK for each country.

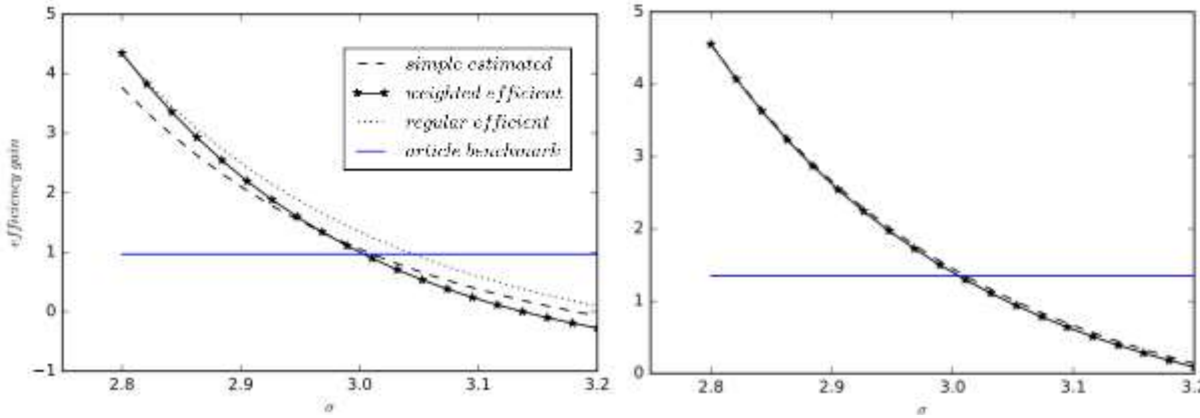
IV. Results

We estimate the nine coefficients in the model using nine moments from HK: dispersion of TFPR (mean and its 75% quantile), percentage gain of efficient allocation, and correlations between distortions (capital & labor, labor & labor, productivity & labor, productivity & labor, productivity & capital). We employ three different weights for the SMM method: equal weights, high weights on two important moments of TFPR dispersion, efficient weights equal to the inverse of the variance of the simulated moments. Results of coefficients and moments fit are shown in the online appendix.[3] Having country specific estimated model, we simulate data and replicate the HK results using different values of parameters. We are interested in TFP gain due to variations in parameters. Therefore, in each exercise we keep one parameter as is used in HK while vary the other parameter, and find the corresponding TFP gains. Results are shown in Fig. 1 (different values of σ) and Fig. 2 (different values of α).

[2] We know the assumed values for σ and α in HK, so we only estimate other parameters in their paper.
[3] Codes are available at http://gsme.sharif.edu/~rahmati

Figure 1: efficiency gains for different values of σ

China India

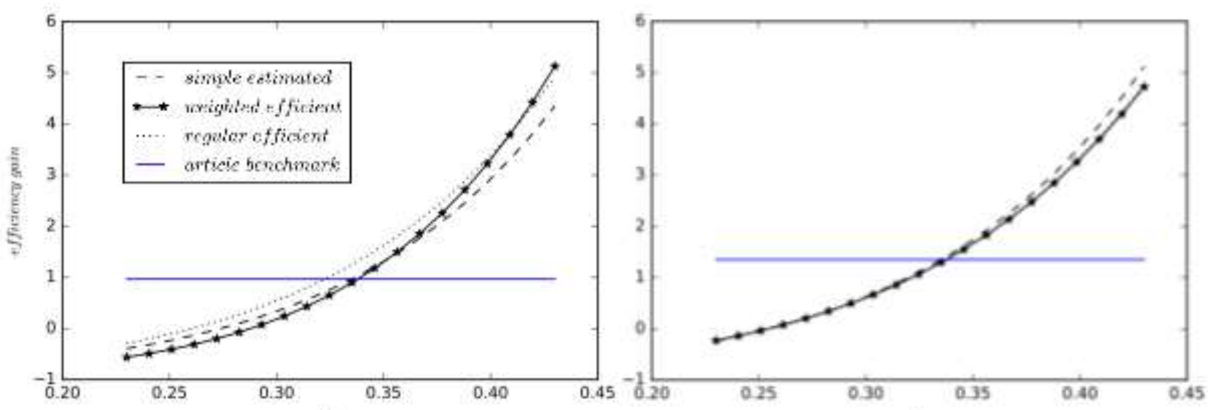


Note: efficiency gain means the how much the value added of final good will increase if we equalize all the TFPR across the firms. We see the effect of elasticity of substitution between intermediate firms. Negative efficiency gain in higher value of σ in India shows we lost efficiency in higher σ in that country.

Recall that for the assumption of $\sigma = 3$ and $\alpha = 0.33$, HK find 86.6%, and 127.5% efficiency gains due to reallocation of resources to efficient distribution in China and India in 2005, respectively. We reach to the same results under their assumption of parameters, however when we slightly decrease elasticity of substitution to $\sigma = 2.8$ we observe that the efficiency gain increases by fourfold. The reallocation gain comes from the fact that when the elasticity of substitution is low, inefficient firms will produce more as their market power enhance so with omitting the distortion we will get more efficiency. Strikingly, if the elasticity increase to $\sigma = 3.2$ the allocation of resources in two countries approaches to zero meaning that there would be no gain in reallocation of resources.

Figure 2: efficiency gains for different values of α

China India



Note: efficiency gain means the how much the value added of final good will increase if we equalize all the TFPR across the firms. We see the effect of elasticity of substitution between intermediate firms. We see the upward reaction of the efficiency to increase in the share of capital

Fig. 2 indicates that changes in the labor share can alter the efficiency gain even more. To see why the efficiency gain is increasing in α, note that distortion is derived from capital and value added, so by increasing the share of capital, the loss of efficiency caused by capital would increase and efficiency gain by equalizing TFPR goes up. Therefore, if the estimates of labor share in production is lower in developing countries as asserted in literature, we expect more efficiency gain in reallocation of resources than what predicted by HK.

As a conclusion, we observe that the HK results are highly dependent on the measurement of the elasticity of substitution and capital share in production. Therefore, the assumption of the same parameters for all three countries could misguide us to a wrong measurement of the true effects of misallocation and may the proper estimation of these parameters leads us to completely different perception of the effect of dispersion on efficiency. The danger of misguiding of this sensitivity is also asserted by Bill et al. (2017). Because of the important policy implication of HK results, the findings of this paper call for the true estimation of parameters when studying the impact of misallocation on aggregate TFP.

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