Peer agglomeration, collusion (reduction) and labor rent share within firms

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Abstract: In recent years, China has experienced a process of accelerated economic agglomeration and a rise in the labor share. This paper links the two phenomena together by exploring the impact of peer agglomeration on the labor rent share within firms. Through theoretical analysis, we have found that collusion reduction is a channel between peer agglomeration and intra-firm labor rent share. This channel is corroborated by an empirical analysis based on a Chinese firm panel data. Our study may contribute to understanding the rise in China's labor share after 2009.

1. Introduction

While many developed countries have observed a declining labor share trend (Barkai, 2016), China has experienced a rise in labor income share since around 2009 (Liu Yalin, 2022). This anomaly demands a thorough understanding, crucial for enhancing labor share in developing countries. Various explanations have been proposed, including the differentiation and convergence of firm sizes (Lu Xueqin,2020), inter-industry labor mobility (Chang Jinxiong,2019), improvements in social security

(Zhang Tongbin,2023), labor-enhancing technological progress (Li Youshu,2023), and openness to foreign markets (Jiang Xuanyu,2022). Recent trends further suggest that imperfect competition in product markets also significantly influences labor share. Renowned scholars like Shen Guangjun (2018), De Loecker & Eeckhout (2018), De Loecker, Eeckhout, & Unger (2018), Brooks et al. (2021), Cali, M., & Presidente, G. (2023) have found a consistent decrease in firms' labor share due to product market monopolistic power. Yet, scarce literature connects the reduction of product market monopoly with the rise in China's labor share (Liu Yalin,2022).

This perspective of product market monopoly reduction increases the labor share necessitates an assumption that the product market monopoly has been diminishing since 2009. Economic agglomeration would be a key force driving this decline of monopoly power. As economies gradually agglomerate, collusion among firms becomes increasingly challenging. An increased number of firms within a region escalates the coordination costs of collusion (Harrington, J. E., 2005), lowers the benefits of collusion, and strengthens the temptation to betray (Vives, 1999). Thus, peer agglomeration can make collusion harder to establish and maintain. In essence, economic agglomeration may reduce monopoly (collusion), subsequently leading to an increase in labor share.

Our research make its marginal contribution due to its exploration of the relationship between collusion and labor-capital bargaining. We delve into this relationship by integrating firm-specific human capital (FSHC) into the excess capacity that firms maintain due to collusion.[1] And the presence of excess FSHC weakens the labor's threat point in the Nash bargaining game between labor and capital. In this way, collusion decreases labor rent share by increasing the excess capacity.

Building on this, we got the relationship between peer agglomeration, collusion, and

[1] As Davidson and Deneckere's theoretical analysis (1990) suggests, collusion leads to firms holding excess capacity.

labor-capital rent distribution, and substantiate this relationship using a large-scale dataset from Chinese enterprise tax surveys. We have found that peer agglomeration of same sub-industry firms reduces the possibilities of collusion between these firms. This in turn reduces the excess capacity hold by these firms and eventually enhance the labor rent share.

The rest of the paper is structured as follows: Section 2 establishes the theoretical relationship between economic agglomeration, firm collusion, and labor-capital distribution; Section 3 presents the econometric model, data, variables, baseline regression, robustness tests, endogeneity, and potential channel analysis; finally, Section 4 discusses policy implications, limitations, and concludes the paper.

2. Theoretical framework

2.1 Peer Agglomeration and Collusion Reduction

The extent of collusion among firms is significantly influenced by monitoring and coordination costs (Feuerstein, S., 2005). Coordination costs emerge when firms attempt to reach consensus on output and pricing. These costs tend to increase with the number of colluding firms, variations in firm size, and technological disparities (Feuerstein, S., 2005). Firms within a collusion agreement have incentives to secretly increase output, thereby betraying the collusive pact. Sustaining such an organization requires mutual monitoring to prevent this behavior, the cost of which escalates with the number of firms and geographical distance (Feuerstein, S., 2005). In essence, the number of firms involved in collusion must be limited to manage coordination costs, while monitoring costs necessitate that collusion is more feasible between proximate firms. Thus, collusion is more likely within an industry that isn't overly saturated within a city. Conversely, in a city with an excess of firms in the same industry, collusion becomes increasingly difficult.

2.2 Collusion (Reduction) and Excess Capacity (Reduction)

Collusion among firms results in supernormal profits, which inevitably attracts potential entrants. The influx of these entrants escalates competition intensity and diminishes monopoly profits. Consequently, colluding firms must discourage potential entrants. A prevalent strategy is to maintain excess capacity, using it as a deterrent. New entrants often face higher production costs; thus, if incumbent firms augment output and lower prices, newcomers would sustain losses and be forced out of the market. In addition to this, incumbent firms hold excess capacity to penalize defectors (Davidson, C., & Deneckere, R., 1990). Firms betraying the collusion agreement by secretly overproducing can be disciplined using this excess capacity. Thus, collusion is often accompanied by firms maintaining excess capacity.

2.3 Excess Capacity (Reduction) and Labor-Capital Rent Distribution

While most economic papers view excess fixed assets as excess capacity since it cannot be rapidly increased in the short term. However, when considered as human capital, labor falls into two categories: general and firm-specific. While general human capital is quickly attainable from the external market, firm-specific human capital cannot be as readily acquired.[2] Furthermore, FSHC and physical capital are co-specialized and inseparable. Consequently, firms in collusion need to retain excessive firm-specific human capital alongside physical capital as excess capacity. This enabling them to promptly and cost-effectively augment production, deterring new entrants and traitors.

According to Aoki (1980) and Rajan and Zingales (1998), it is firm-specific human

[2] Developing firm-specific human capital involves on-the-job learning, training, and familiarization with the firm's environment, hence it takes time.

capital (FSHC), rather than general human capital (GHC), that facilitates employees' rent-sharing. The presence of excessive FSHC could potentially impact labor's rent share by weakening their bargaining position. To demonstrate this, we build a simple mathematical model. This model's basic premise is that if the amount of FSHC attempting to leave exceeds the surplus, the firm will externally recruit general human capital to compensate for the FSHC shortage. This substitution, however, is inefficient and costly. The more excess FSHC the firm holds, the lower the loss caused by employees leaving.

We assume that only a subset of the FSHC participates in bargaining, while the remaining employees are wage takers. Both bargainers and takers ultimately receive the same wage, sharing the firm's rent equally. In the event of a breakdown, only the bargainers (represented by proportion 'l') will leave, with the remaining employees accepting the employer-determined wage level.

We can construct a cooperative bargaining Nash product model in Equation 1, where *rentT* represents the total rent to be distributed. *beta* represents the proportion of rent shared by labor, while *(1-beta)* represents the proportion shared by capital. *b* represents the relative bargaining power of labor, and *(1-b)* represents the relative bargaining power of capital. The 0 inside the parentheses on the left side indicates after leaving, the rent obtained by the leaver is 0. *Corent* inside the parentheses on the right side represents the rent obtained by the capital after some labor has left.

$$Y = \left(rentT \cdot beta \cdot l - 0\right)^{b} \cdot \left(rentT \cdot \left(1 - beta\right) - Corent\right)^{1-b} \quad (1)$$

The *beta* that maximizes *Y* is the distribution that satisfies a set of desirable properties. These properties include: individual rationality, Pareto efficiency, strategy-proofness, independence of irrelevant alternatives, and scale invariance.

In equation (2), *(1+r)* represents the total potential workload of an individual labor, but typically only 1 unit is utilized, while the remaining *r* units are reserved. The

quantity of FSHC labor in the firm is 1, and *(1-l)* represents the number of remaining FSHC labor after some FSHC labor has left. When a portion of FSHC labor departs, the remaining FSHC labor fully utilizes their workload to compensate for the vacancy but cannot fully compensate for it. The third term on the right side of equation (2) represents the rent that the employer needs to pay to the remaining labor. The pay maintaining the constant compensation rate of actual FSHC workload. The second term on the right side of equation (2), $\Delta cost$, represents the cost increase incurred due to the hiring of additional GHC. The magnitude of $\Delta cost$ is determined by the quantity of additional GHC employed.

$$Corent = rentT - \Delta \cos t - (1-l)(1+r)\cdot rentT \cdot beta \tag{2}$$

In conclusion, equation (2) represents the employer's "threat point" *(Corent).*

To simplify, let's assume that in the short term following the breakdown of negotiations, the firm maintains its production and prices to preserve its market share. This assumption is reasonable because regaining lost market share is not easily. For long-term profits, the firm needs to ensure that its production remains unaffected by the leave of some FSHC labor. We express the above argument using equation (3), where after the departure of some FSHC, the firm maintains its production level by hiring additional z*GHC and letting the remaining *(1-l)* labor fully utilize their work potential *(1+r).*

$$q = 1^{a} \cdot hc_G{}^{(1-a)} = \left((1-l)(1+r)\right)^{a} \cdot \left(hc_G + z \cdot hc_G\right)^{(1-a)} \tag{3}$$

$$\Delta \cos t = w \cdot z \cdot hc_G = \left(-hc_G + \left(hc_G{}^{1-a}\left((1-l)(1+r)\right)^{-a}\right)^{\frac{1}{1-a}}\right)w \tag{4}$$

Due to the assumption of unchanged production and price, the increase in costs *(Δ cost)* is equivalent to the decrease in rent. The wage of GHC is set to be fixed *w*. By solving equation (3) for z, we can get the expression for the costs increase in equation (4). Substituting equations (4) and (2) into equation (1), and then differentiating *Y* with respect to *beta*, we obtain equation (5).

$$\partial_{beta} Y = \frac{\left(betal \cdot rentT\right)^{b} \left(\Delta \cos t - beta \cdot rentT \left(\left(l-1\right)r + l\right)\right)^{-b}}{beta} \times \left(b \cdot \Delta \cos t - beta \cdot rentT \left(\left(l-1\right)r + l\right)\right) \tag{5}$$

$$\partial_{beta} Y = 0 \tag{6}$$

$$beta = \frac{\Delta \cos t \cdot b}{\left(l - \left(1-l\right)r\right) \cdot rentT} \tag{7}$$

Based on equations (5) and (6), we can solve for *beta* in terms of *r*, as represented in equation (7). This expression represents the relationship between the rent-sharing *beta* and the excess capacity *r*. To express this relationship, we need to differentiate *beta* with respect to *r*, as shown in equation (8).

$$\partial_r beta = \frac{m \cdot w \cdot ln(a+1)}{\left(-1+a\right)\left(1+r\right)\left(l+\left(-1+l\right)r\right)^{2} rentT} \tag{8}$$

The denominator is negative in equation (8), the sign of the derivative depends on the term *m.*

$$m = \left(1-a\right) \cdot hc_G \cdot \left(1-l\right)\left(1+r\right) + \left(hc_G{}^{1-a} \left(\left(1-l\right) \cdot \left(1+r\right)\right)^{-a}\right)^{\frac{1}{1-a}} \left(a - \left(1-l\right)\left(1+r\right)\right) \tag{9}$$

We can find in equation 9, when *a-(1-l)(1+r)>0, m>0.* Therefore, when the contribution of FSHC in production (represented by *a*) is larger than the remaining workload of FSHC (represented by *(1-l)(1+r)*). Then *beta* will decrease with *r* ($\partial_{\mathrm{r}}\mathrm{beta} < 0$).

Based on the theoretical analysis in sections 2.1 to 2.3, we can draw the following conclusion: As the peer agglomeration increases, the amount of excessive FSHC reduces (equation 10a), and the rent distribution within firms becomes more favorable towards labor (equation 10c).

$$\partial_g \mathrm{r} < 0 \tag{10a}$$

$$\partial_{\mathrm{r}} \mathrm{beta} < 0 \tag{10b}$$

$$\partial_g \text{beta} > 0 \tag{10c}$$

3. Empirical design

3.1 Econometric model

The three econometric models used in this research are as follows:

$$beta_{icj} = a + \beta_1 \cdot agglomeration_{cj} + \beta_2 \cdot control\_firm_{icj} + \beta_3 \cdot control\_city_c + j + t + \sigma_{icj} \tag{1}$$

$$overcapability_{icj} = a + \beta_4 \cdot agglomeration_{cj} + \beta_5 \cdot control\_firm_{icj} + \beta_6 \cdot control\_city_c + j + t + \sigma_{icj} \tag{2}$$

$$beta_{icj} = a + \beta_{10} \cdot overcapability_{icj} + \beta_{11} \cdot control\_firm_{icj} + \beta_{12} \cdot control\_city_c + \beta_{13} \cdot agglomeration_{cj} + j + t + \sigma_{icj} \tag{3}$$

Here, the subscript 'j' refers to sub-industries, 'c' stands for Chinese prefecture-level cities (inclusive of the relevant counties or districts), and 'i' signifies companies.

In these models, 'beta' represents the labor share of rent within a firm, 'agglomeration' signifies the count of peer firms within a city, 'control_firm' represents the firm-level control variables, and 'control_city' denotes the city-level control variables. The firm-level control variables encompass labor productivity, the capital-labor ratio, firm size, inventory ratio, and debt ratio. The city-level control variables include the city's GDP level, total number of industrial firms, and the employed labor force. 'Overcapability' indicates a firm's excess capacity, 'j' refers to the industry dummy variable, 't' symbolizes the time dummy variable, and ' σ ' is the error term.

Model 1 serves as the baseline regression of this study, suggesting that the count of peer firms within a city affects the labor share of rent within firms. Model 2 and Model 3 conduct channel analyses, with Model 2 demonstrating the number of peer

firms within a city influences firms' excess capacity, and Model 3 indicating this excess capacity subsequently impacts the labor share of rent.

3.2 data

The data for this study is sourced from the "National Enterprise Tax Survey" from 2007 to 2015 and the "China City Statistical Yearbook." The "National Enterprise Tax Survey database" contains a large number of cities, each with numerous enterprises, making it suitable for the research topic of this paper. The database provides continuous statistics on basic information of enterprises, such as industry category, province, city code, legal person code, and registration type.

Information for each enterprise includes indicators such as industrial output value, industrial value-added, fixed assets, total assets, number of employees, total liabilities, average net value of fixed assets, total wage payable, and other financial indicators.

Following standard procedures, abnormal observations were eliminated. Firstly, observations with missing information, such as employee count, total assets, or net value of fixed assets, were excluded. Secondly, observations with less than 8 employees were excluded. Observations with total assets less than current assets, total assets less than net value of fixed assets, or accumulated depreciation less than current depreciation were also eliminated. Thirdly, following the criteria established by Bai et al. (2009), observations with profit margins lower than 0.1% or higher than 99% were excluded. Enterprises with abnormal profit margins are either due to managerial or statistical errors or may indicate rental anomalies. Lastly, only manufacturing sector enterprises were retained.

3.3 variables

The dependent variable, 'beta', is computed as the ratio of labor rent to total rent.

Labor rent is the total wage payable minus the reservation wage payable, where the reservation wage is the minimum wage necessary to sustain the labor supply and is determined by the lowest wage rate in the same industry within the province. Total rent is the sum of labor rent and operating profit, with the operating profit representing the rent earned by capital in the form of profits.

The independent variable, 'agglomeration', is a measure of peer agglomeration and is represented by the number of firms in the same sub-industry within a given city.

Control variables include both firm-level and city-level controls. At the firm level, these include labor productivity, represented by the average industrial value-added per labor; firm size and the capital-labor ratio, represented by the average net value of fixed assets and the net value divided by the number of employees, respectively; and inventory ratio and debt ratio, calculated using the methods proposed by Sheng and Lu (2016). At the city level, control variables include the logarithms of the number of employed staff, the number of industrial firms, and the city's GDP. Year and industry dummy variables are also controlled for.

Channel variables include excess capacity, calculated using the Panel stochastic frontier method, and the product market markup of the firm, calculated as the ratio of operating income to operating costs.

Table 1: Descriptive Statistics of Variables

VARIABLES	N	mean	sd	min	max
beta	436,842	0.545	0.26	0.00	0.93
LS	440,167	0.681	0.273	0.08	0.98
Debt ratio	438,331	0.715	71.61	0.00	0.98
Inventory ratio	433,387	0.269	0.282	0.00	0.92

Capital density	353,075	3.578	1.614	-1.26	6.97
City size	440,608	3.964	1.232	1.65	6.47
Firm size	353,075	7.873	2.34	1.79	13.08
Labor productivity	311,164	3.682	1.748	-1.87	7.03
Manufacturing scale	440,608	7.151	1.387	4.49	9.77
Agglomeration	440,608	3.235	1.66	0.00	6.98
City GDP	440,608	16.59	1.341	14.01	19.11

Log all variables except ratio variables.

3.4 baseline regressions

The baseline regression, represented by econometric Model (1), uses the labor share of rent within firms (beta) as the dependent variable and the number of peer firms within cities (agglomeration) as the independent variable. The results consistently show a positive and significant effect of agglomeration on beta, regardless of whether city-level control variables are included and whether pooled OLS or fixed effects regression is used.

Among the control variables, the inventory ratio positively influences the labor share of rent, aligning with the findings of Sheng and Lu (2016). This suggests that when firms face unfavorable operating conditions, they increase the share of labor rent to retain employees.

Contrary to common expectations, this study found no evidence that the debt ratio decreases the share of labor rent; in fact, the coefficient of the debt ratio is non-negative in the regression results.

The capital-labor ratio, representing the relative abundance of fixed assets compared to labor in a firm, inversely impacts beta. The implication is that the more physical capital a firm possesses relative to labor, the smaller the share of rent that's naturally

allocated to labor.

Labor productivity also exhibits a negative impact on beta, indicating that highly productive firms need to allocate a smaller share of rent to labor to remain competitive in the labor market.

At the city level, the quantity of the labor force contributes to an increase in beta, aligning with the theoretical reasoning of Herish (2022).

Table 2: Agglomeration and labor rent share

Model	model1	model2	model3	model4
Method	Ols	Ols	Fe	Fe
Variable	*beta*	*beta*	*beta*	*beta*
Agglomeration	0.00538***	0.00652***	0.00514***	0.00499***
	6.097	6.929	9.044	8.803
Inventory ratio	0.0480**	0.0489**	0.0517***	0.0516***
	2.24	2.222	14.48	14.49
Dabte ratio	0.0167*	0.0165*	0.00391	0.00393
	1.813	1.81	1.172	1.169
Capital density	-0.0503***	-0.0502***	-0.0146***	-0.0145***
	(-67.29)	(-66.64)	(-18.12)	(-18.00)
Labor productivity	-0.0303***	-0.0299***	-0.00801***	-0.00804***
	(-58.03)	(-58.51)	(-21.50)	(-21.56)
Firm size	-0.00867***	-0.00874***	-0.00148	-0.00139
	(-12.69)	(-12.20)	(-1.346)	(-1.261)
City GDP		-0.0110***		-0.0250***
		(-3.093)		(-4.924)
Manufacturing		0.00327*		-0.0154**

scale				
		1.662		(-2.448)
City size		0.00381		0.0306***
		1.131		6.94
Constant	0.790***	0.926***	0.561***	0.958***
	60.76	21.33	71.95	11.52
Year	Control	Control	Control	Control
Industry	Control	Control	Control	Control
R-squared	0.325	0.326	0.053	0.054

The calculation of the dependent variable, beta, in the baseline regression assumes that the minimum wage rate in the same industry-province represents the reservation wage. However, if this assumption proves inaccurate, alternative representations of the dependent variable may be considered. For instance, labor wage share within firms can serve as a proxy variable for beta, as it reflects the level of rent sharing within firms. Regression results using the wage share as a proxy variable largely mirror those of the baseline regression, with the main coefficients being slightly smaller. This is to be expected, as the labor wage share depends on both rent sharing and the reservation wage, meaning the coefficients should naturally be smaller compared to the baseline regression.

Table 3: Agglomeration and Labor Wage Share

Model	model1	model2	model3	model4
Method	Ols	Ols	Fe	Fe
Variable	*LS*	*LS*	*LS*	*LS*
Agglomeration	0.00313***	0.00593***	0.00310***	0.00298***
	2.769	5.23	5.097	4.9
Constant	0.900***	1.061***	0.619***	0.892***

	50.51	19.99	72.87	9.71
Control	Control	Control	Control	Control
Year	Control	Control	Control	Control
Industry	Control	Control	Control	Control
R-squared	0.241	0.243	0.05	0.05

3.5 Endogeneity

Endogeneity in econometrics emerges from three main sources: 1) measurement errors, 2) reverse causality, and 3) omitted vital control variables. For measurement errors, it is challenging to accurately measure the retained wages of labor, which subsequently limits the precision of the dependent variable, beta. This section seeks to address endogeneity resulting from reverse causality and omitted variables, making the results of the baseline regression more robust.

Concerning reverse causality, there is a possibility that an increase in the labor rent share, prompted by certain factors, could lead to a decrease in firm profits and subsequently reduce the number of surviving firms. This implies a negative reverse causality relationship between beta and agglomeration. If this reverse causality isn't addressed, it could result in underestimated coefficients in the baseline regression.

In relation to omitted variables, it's possible that a surge in product demand could lead to an increase in the number of firms (agglomeration) and an increased demand for industry skills. Consequently, an increase in market demand would simultaneously elevate both the agglomeration and beta, potentially leading to a spurious regression if the demand effect isn't controlled for. Also, since market demand is unobservable, this can lead to another endogeneity issue.

To tackle the second endogeneity issue, I use the two-stage least squares (2SLS) instrumental variable method. And for the third endogeneity issue, I include the sales

volume and growth rate of the sub-industry in the control variables for correction.

As for the instrumental variable, we use the average capital size of firms in the same sub-industry at the national level as a proxy for the number of peer firms. The rationale is that 1) industries with larger average capital sizes tend to have fewer firms, indicating that the average capital size of the industry correlates with the number of peer firms within the city, and 2) changes in rent sharing within the city-industry will not influence the industry's capital size at the national level, thus avoiding reverse causality.

Table 4 displays the estimation results using IV-2SLS. Model 1 depicts the baseline regression results using OLS, which align with Model 2 in Table 2. Model 3 and Model 5 represent the IV-2LS regression using OLS and fixed effects, respectively. The coefficients estimated by IV are significantly larger than those estimated by OLS, signifying that the second endogeneity issue leads to an underestimation of coefficients by OLS.

Models 2 and 3 demonstrate a significantly negative correlation between industry average capital size and the number of firms under both OLS and FE, indicating the absence of weak instrumental variable problems.

To address the third endogeneity issue, we incorporate the demand size and growth rate of the sub-industry in OLS. The results demonstrate that the parameter of agglomeration maintains its positive significance, while the two variables representing demand are not significant, suggesting that the second endogeneity issue doesn't significantly distort the results. Due to space constraints, the results of the third endogeneity issue are not presented.

Table 4, Reverse Causality

Model	model1	model2	model3	model4	model5
Method	OLS	First-stage	IV-OLS	First-stage	IV-FE
Variable	*beta*	*agglomeration*	*beta*	*agglomeration*	*beta*
Agglomeration	0.007***		0.017***		0.015***
	6.93		2.74		2.96
Industry capital		-0.196***		-0.210***	
		(-2.66)		(-18.17)	
Constant	0.926***	3.083**	0.781***	7.530***	0.872***
	21.33	1.96	3.34	21.45	13.53
Control	Control	Control	Control	Control	Control
Industry	Control	Control	Control	Control	Control
Year	Control	Control	Control	Control	Control
R-squared	0.326	0.166	0.364	0.064	0.069

3.6 Channel analysis

Peer agglomeration and collusion

This paper constructs a collusion-overcapacity-threat mechanism to explain the relationship between agglomeration and rent sharing. The mechanism proposes that the number of peer firms within a city reduces the extent of collusion, which in turn decreases excess capacity and eventually increases the share of rent given to labor. To validate this mechanism, I first use a regression model to examine the relationship between the number of peer firms (agglomeration) and collusion among firms. Since collusion is illegal and often occurs through covert or tacit communications, direct evidence of collusion between firms is unavailable. Thus, this paper relies on indirect evidence to infer the likelihood of collusion.

According to Harrington (2005), a high markup rate (pricing power) of firms is often used as evidence of collusion. However, relying solely on markup rates to infer collusion is not convincingly robust. Harrington's criteria, such as sudden changes in firm behavior, require long-term data, which is often scarce. Therefore, alternative indirect evidence needs to be identified. Collusion leads to a smaller dispersion of markup rates (Brooks, 2016). Therefore, the dispersion of markup among firms in the same industry-city can be used as an indicator of collusion. We combine the two criteria mentioned above: if firms in a city, within the same sub-industry, exhibit both high markup rates and low dispersion of markup rates, there is a greater likelihood of collusion.

In Models 1 and 2 of Table 5, it is shown that there is a negative correlation (positive correlation) between the average markup rate (dispersion) at the city-industry level and agglomeration. We consider the coexistence of high markup rates and low dispersion as an indicator of potential collusion and regress it on agglomeration. Model 3 reveals that agglomeration reduces the likelihood of collusion. These regressions are conducted at the city-industry level, and we introduce per capita GDP as a control variable.

Table 5, Agglomeration and Collusion

Model	model1	model2	model3
Method	FE	FE	FE
Variables	*Mean markup*	*Dispersion*	*Collusion*
Agglomeration	-0.212***	0.031***	-0.077***
	(-2.09e+15)	4.41E+14	(-3.68)
GDP per-capita	0.549***	0.426***	-0.068***
Year	Control	Control	Control

Excess Capacity and labor rent share

As it is elucidated by researchers (such as Davidson, C., & Deneckere, R., 1990) that collusion promotes excess capacity. Therefore, we skip the verification of the relationship between collusion and excess capacity, and instead focus on verifying the relationship between excess capacity and rent distribution. If firms do harbor an excess of FSHC labor as a part of excess capacity (due to collusion), the threat point of FSHC labor will be diminished. As a consequence, excess capacity leads to a decrease in the proportion of rent shared by employees. In this section, we utilize excess capacity as the channel variable and peer agglomeration as the independent variable to verify the relationship between peer agglomeration, excess capacity, and labor rent share.

Building on the overcapacity-threat mechanism, collusion-induced excess capacity decreases the share of rent that goes to labor. This process occurs because as firms harbor more FSHC labor than they need, this labor surplus weakens the position of labor in rent-sharing negotiations. Consequently, a smaller share of the rent is allocated to labor.

To test this, we first need to examine if the agglomeration of firms in a city-industry indeed leads to a reduction in excess capacity. Excess capacity can be estimated by several means, and in this paper, we adopt the panel stochastic frontier method, a widely accepted method for estimating excess capacity.

Table 6, Agglomeration, Excess Capacity, and Rent Share[3]

Model	model1	model2	model3
Method	FE	FE	FE

[3] It can be found that the channel is a little weak (1/7) here. If we use OLS instead of FE, the channel will be very much stronger. Here we use FE in line with the previous regressions.

Variable	*Overcapacity*	*beta*	*beta*
Overcapacity			-0.120***
			(-31.36)
Agglomeration	-0.007***	0.007***	0.006***
	(-3.37)	9.4	8.01
Constant	4.564***	0.447***	0.977***
	56.27	15.06	29.22
Control	-	-	-
Year	Control	Control	Control
R-squared	0.324	0.05	0.154

In our analysis, we first run a regression of excess capacity on agglomeration (model1). Consistent with our theory, the results indicate that a higher degree of agglomeration leads to a decrease in excess capacity. We then run a regression of labor rent share (beta) on both agglomeration and excess capacity (model3). Our findings show that while excess capacity has a negative impact on labor rent share, agglomeration still has a positive and significant effect.

These results support our theory: Agglomeration reduces excess capacity, and this reduction in excess capacity enhances the share of rent allocated to labor.

4. Conclusion, Discussion and policy implications

This research explores the positive link between intra-firm labor rent share and the peer agglomeration of firms in the same industry. Through theoretical analysis, this paper proposes the viewpoint that collusion among firms can serve as a channel for this link. Specifically, peer agglomeration makes collusion among firms more difficult, and the reduction of collusion among firms in turn reduces the extent of excess capacity held by firms. Furthermore, we incorporate excess firm-specific human

capital into the concept of excess capacity to establish the connection between excess capacity and labor-capital bargaining (labor rent share). Finally, we use a large-scale panel data of Chinese firms to verify the relationship between peer agglomeration and collusion, as well as the link between peer agglomeration, excess capacity and labor-capital rent distribution. We have found strong supporting evidence for our theoretical reasoning in the empirical analysis.

This study may be met with two challenges: 1) Because in the empirical analysis of this paper, we use collusion measurement indicators and peer agglomeration indicators at a city-industry level. The empirical analysis also verifies the relationship between collusion and peer agglomeration at a city-industry level. In fact, agglomeration and collusion do not necessarily occur at the city level, they may occur on a larger or smaller level. In addition, the state of peer agglomeration in surrounding cities can affect collusion among firms in the city. For example, if there are also many peer companies in surrounding cities, the product market competition from surrounding companies will make it impossible for peer companies in the city to collude. Based on the above two considerations, future empirical research needs to verify at different spatial scales and consider the spatial lag effect. 2) If holding excess capacity enhances a firm's capital income share, why don't all firms choose to maintain excess capacity? To answer this question readers would notice that firms operate differently in highly concentrated versus low-concentrated areas. In high-density clusters, firms compete on labor productivity, and suppressing the labor share by maintaining excess capacity may not be beneficial. In contrast, firms in less dense areas rely on monopolistic profits where suppressing labor share could be lucrative. Consequently, the former may choose not to hold excess capacity while the latter does.

Our findings lead to several policy implications.

Firstly, given that product market monopolies (collusion) reduce the labor income

share, there is a need for government intervention to curtail such monopolies if the aim is to increase labor's share in the economy. This could involve enforcing anti-trust laws more stringently, promoting competition, and taking measures to prevent or break up collusive practices.

Secondly, managers should be mindful of potential collusion among peer firms in areas with low agglomeration. Recognizing the signs of collusion early can help firms to adapt their strategies accordingly and potentially protect their workers from decreased wage shares.

Lastly, it is crucial for policymakers to consider the benefits of economic agglomeration. Rather than pursuing spatially balanced development at the expense of agglomeration, the government should recognize the potential benefits that can be derived from the concentration of similar firms in a specific region, including increased labor rent share. While balancing regional development remains an important policy goal, it should not come at the cost of restricting economic agglomeration, which could be detrimental to the labor income share.

In conclusion, our research provides new insights into the relationship between peer agglomeration, monopolies, and labor income distribution. Our findings suggest that policies aimed at promoting competition and encouraging agglomeration could potentially lead to a more equitable distribution of income between labor and capital.

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