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To upgrade or to relocate? Explaining heterogeneous responses of Chinese light manufacturing firms to rising labor costs

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ABSTRACT

This paper studies the heterogeneous responses of Chinese light manufacturing firms to rising labor costs from the perspective of New Structural Economics. Using the first-hand pilot survey data, we find that rising labor costs have been the number one challenge facing firms, and that despite the dominant strategy of technological upgrading, there is a substantial difference in responses across different firms. In addition, we discover that industrial and firm-specific labor intensity are key determinants of the heterogeneous strategies across firms in response to rising labor costs. We conclude that intrinsically more labor-intensive industries and firms are more likely to choose relocation instead of upgrading as a strategy to cope with the rising labor costs.

1. Introduction

After China opened itself up to economic reform and embarked upon market reforms in the late 1970s, it seized the window of opportunity by attracting light manufacturing firms from the East Asian tigers, especially Korea, Hong Kong and Taiwan. Labor-intensive light manufacturing sectors were well in line with the latent comparative advantage of mainland China, which helped to tap into abundant and cheap Chinese labor forces. This reform has enabled China to achieve remarkable economic growth over the past four decades. Such a process of economic structural transformation has been coined as a 'flying geese' model in which a more advanced country (the 'lead goose') transfers capital, technology and management skills to a less developed country (a 'follower goose') (Akamatsu, 1962). From the perspective of New Structural Economics (Lin, 2012a),[1] two key success factors behind China's economic growth miracle are that the production structure has been well aligned with the factor endowment structure since the late 1970s, and that the government has played a facilitating role in turning the latent comparative advantage into a competitive advantage in the global market (Lin, 2012c).

As wages are rising in China, will China turn from a 'follower goose' to a 'lead goose'? Optimists predict that China will become a 'leading dragon' to foster economic structural transformation in the African continent and other low-wage developing world, where a surging youth population is entering the labor market; the scale of the potential industrial transfer from China is unprecedented – about 85 million factory jobs fall into the category of light manufacturing industries in China (Lin, 2012b).

Researchers have tried to examine the extent to which Chinese manufacturing firms have responded to the cost pressure by relocating their manufacturing capacity to low-wage areas. Qu, Cai, and Zhang (2012, 2013) used data from the period of 1998–2008

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[1] New Structural Economics (NSE) is proposed by Justin Yifu Lin, which applies the neoclassical approach to the study of economic structure. NSE aims to address the limitations of the traditional development thinking including old structuralism with an overemphasis on state intervention and neoliberalism with an excessive focus on free market.

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and discovered that increasing labor costs had driven labor-intensive industries to move from eastern coastal areas to the low-cost inland areas since 2004. Xu and Hubbard (2018) matched the Chinese Ministry of Commerce's register of Overseas Direct Investments with China's Industrial Enterprises Survey data from 2011 to 2013 and annual average wage data for prefecture-level cities, and found that labor-intensive light manufacturing sectors related to the textiles, clothing and leather industries are focused on the low-income countries which is consistent with the 'flying goose' effect.

Yet, relocating to low-wage areas is merely one possible coping strategy in response to rising labor costs. Another strategy is to replace labor with capital by upgrading production technologies and enhancing labor productivities. Recent studies have focused on the impact automation on productivity and employment (e.g. Autor & Dorn, 2013; Autor, Levy, & Murnae, 2013; Acemoglu & Restrepo, 2018 and Frey & Osborne, 2017).

Few researches, however, have empirically incorporated relocation and technology upgrading, two major competing solutions, into an integrated framework in response to rising labor costs. Our paper primarily aims to make an empirical contribution to the existing literature by conducting the rigorous firm-level survey of about 640 Chinese light manufacturing firms to explain why firms within the light manufacturing sector may make heterogeneous coping strategies – relocation within China or abroad, and technology upgrading – in response to rising labor costs.[2] In other words, this paper tries to answer why some firms select relocation while others choose technology upgrading in coping with rising labor costs.

New Structural Economics has predicted that as wages are rising in China, labor-intensive light manufacturing firms will relocate their production capacity to low-wage developing countries (Lin, 2012b). Furthermore, it argues that Chinese light manufacturing firms face significant challenges to investing outside China, such as the fear of unknown exacerbated by information asymmetries as well as poor soft and hard infrastructure. Overcoming these challenges requires a facilitating government to facilitate the relocation of light manufacturing production lines from China to low-wage developing countries (Lin & Jiajun, 2019). Yet the existing discussion has primarily focused on the response of the light manufacturing sector in response to rising labor costs, and few has been done to explore whether there is variation in the response of firms among light manufacturing subsectors. From the perspective of New Structural Economics, we may expect that more labor-intensive light manufacturing subsectors may have greater incentive to move abroad given other things being equal as they can save more production costs. But so far little empirical research has been done at the subsector level. Our paper aims to fill the gap by relying on firsthand collected firm-level survey data to test the above hypothesis. By delving deeper into the subsector level, our paper may help to advise decision-makers on how to formulate heterogeneous policies for various types of firms in order to assist them in coping with the challenge of rising labor costs.

This paper proceeds as follows: it first introduces the pilot survey on export-oriented light manufacturing firms, then presents the key findings on the challenges and coping strategies of the surveyed firms. Furthermore, it explores why the firms adopt different coping strategies – to upgrade or to relocate – in response to rising labor costs. It concludes that labor intensity plays a substantial role in explaining the differentiated coping strategies across the light manufacturing sectors.

2. Data

The data used in this paper is a novel dataset based on a pilot light manufacturing survey called "Supporting Economic Transformation - Survey of Chinese Manufacturing Firms", which was conducted in 2017. Although household surveys are well developed in China, firm surveys are facing several challenges especially relating to firm access and quality control.[3] To overcome these challenges, the Institute of New Structural Economics at Peking University in China and the Overseas Development Institute in the United Kingdom jointly initiated the pilot survey on export-oriented light manufacturing firms. The program's two goals are 1) to collect first-hand data in order to better understand how Chinese light manufacturing firms have coped with rising labor costs, and 2) to explore the extent to which Chinese light manufacturers relocate their production capacity to low-wage developing countries, especially in Sub-Saharan Africa. The survey collected firms' basic information, major operational challenges, coping strategies, experience and plans for overseas business activities, and so on.

All firms in the 2017 survey were selected from the China's Industrial Enterprises Database (CIED) in 2013. CIED contains detailed financial and operational information on all of China's industrial firms whose major business revenues exceeded RMB 20 million (approx. US$3 million). Data in the database come mainly from the companies' quarterly and annual summary reports, which were submitted to their local Bureau of Statistics. This article makes full use of both the 2013 CIED variables and the newly added information in the 2017 survey to conduct the analysis. The population of interest for the 2017 survey further meets three requirements. First, only firms in the Yangtze River Delta (YRD) and Pearl River Delta (PRD)[4] are considered, as both are leading bases for Chinese labor-intensive firms. Second, only four types of industries were counted: Home Appliances, Textile Apparels, Footwear,

[2] Classical economic theories demonstrate that cost minimization is a necessary condition for profit maximization. Therefore, this article mainly focuses on firms' production strategies.

[3] Pilot firm-level efforts are exemplified by micro and small enterprises survey led by Xiaobo Zhang at Peking University. But surveys on big export-oriented firms are scant, as challenges such as access to firms are more compelling.

[4] In line with the official definition of the YRD and PRD, the following cities were selected: Nine cities in the PRD – Guangzhou, Shenzhen, Zhuhai, Foshan, Jiangmen, Dongguan, Zhongshan, Huizhou and Zhaoqing; and twelve cities in the YRD – Shanghai, Nanjing, Hangzhou, Ningbo, Zhoushan, Shaoxing, Huzhou, Jiaxing, Suzhou, Wuxi, Changzhou and Nantong. In summary, the PRD comprises the dense network of cities covering nine prefectures of Guangdong province, and the YRD is a metropolitan region comprising Shanghai, southern Jiangsu province and northern Zhejiang province.

and Toy.[5] These four industries are regarded as typical labor-intensive industries in China. All four light manufacturing sectors have experienced rapid growth of output and exports in the past two decades since China joined the WTO, and they comprise a significant share of manufacturing jobs in China. Collectively they employ about 16 million workers in China. Third, only firms whose export values accounted for > 50% of the sales values are targeted. As the program primarily focuses on the potential flying geese from China (i.e. firms that are most likely to move their production line abroad), the survey thus concentrated on export-oriented firms which are more likely to invest directly abroad. As the firm will have had significant exposure to foreign markets and foreign firms, this will enable them to develop some of the capabilities needed to operate in a foreign country (Dunning & Lundan, 2008). Accordingly, 4503 firms are in the population of interest, of which 1423 firms (31.6%) were sampled from the population.[6] A cluster-based sampling strategy was used, since industrial clustering is crucial in the development of Chinese manufacturing (Huang, Zhang, & Zhu, 2008; Long & Zhang, 2011; Ruan & Zhang, 2009).[7] With a response rate of over 40%, the survey finally obtained 640 valid samples. After matching the survey data with the CEID,[8] we reached a sample of 599 firms on which this study is based.

Table 1 compares various firm characteristics - from the 2013 CIED - of the sample to the population, overall and by region - to evaluate how representative the sample is. Firm characteristics include industrial distribution, age, ownership type, and natural logarithms of total number of employees, total output, total assets, and total debts.

For the YRD, the population and the sample are consistent in almost all characteristics, except that the industrial distribution happens to be reversed. The similarity between population and sample is stronger in PRD. Our analysis is implemented primarily for the whole sample with robustness check being conducted on the PRD subsample.

3. Firms' challenges and strategies

China's economy and the profitability of light manufacturing have stepped into a grim period. Fig. 1 shows China's GDP growth rate and a profit index of light manufacturing in 2010–2017. The profit index was constructed as the ratio of total profits to major business income (multiplied by 100%) for China's light manufacturing firms whose business revenues exceed RMB 20 million. All indicators were from the National Bureau of Statistics of China. The series show that China's GDP growth is getting slower and the profit rate of light manufacturing is generally decreasing. There is an increasing trend for the profit index in 2014–2017, but the 2017 level is still lower than that in 2013. Under such circumstances, light manufacturing firms would be more sensitive to rising labor costs. It is crucial for firms to take actions to deal with such challenges.

Based on the first-hand survey data, this section summarizes the key findings on what challenges firms are facing and what strategies they have taken to cope with the challenges. The survey discovers that rising labor costs have been the number one challenge for firms, and that despite the dominant strategy of technological upgrading, there is a substantial difference in responses across different firms.

3.1. Firms' challenges

In the 2017 survey, firms selected at least three challenges that they had faced in 2014–2016; afterwards, these firms sorted the selected options by the severity of challenges. For convenience, the 18 challenges were grouped into six categories, as shown in Table 2. “Lacking skillful employees” is included in the challenge “Labor costs” because it essentially means that firms had not been able to find enough skillful employees at the current (low) wages or that firms that had not been able to afford an ideal size of skillful workers.

Table 3 further examines the percentages of firms that chose some specific challenges as one of the challenges or as the biggest challenge.

87.1% of firms regard rising labor costs as one of their challenges between 2014 and 2016, and the percentages are the highest in Zhejiang and Guangdong. 58.3% of firms consider increasing non-labor input costs as one of the challenges, and this category proves to be the second largest challenge. The third most serious category of challenges is unfavorable market conditions, and 49.9% firms consider this category as one of the challenges. Percentages remain consistent in terms of the biggest challenge. Nearly one half (48.2%) of firms agreed that rising labor costs is the biggest challenge. The issue of rising labor costs was particularly prominent in Guangdong. The second and third biggest challenges were market conditions and non-labor input costs, each with a percentage point less than half of the percentage of labor costs.

Besides selecting challenges, firms were also asked to rate the degree of severity of the challenges. The rating scale ranges from 1 to 5, with 1 indicating that the challenge was almost insignificant, and 5 indicating that the challenge was of the greatest severity. Nine items posing as potential challenges needed to be rated: rising wages, rising non-wage labor costs, increasing transportation

[5] According to China's 2017 National Economic Industry Classification and Code (GB/T 4754–2017), the four-digit codes for home appliances, textile apparels, footwear, and toy are 3851–3879, 1811–1830, 1951–1959, and 2451–2459, respectively.

[6] At the pretesting stage, we estimated the response rate of firms. In order to ensure the sufficient number of responses, we decided to sample about 30% of the total population.

[7] Counties/districts within the two selected provinces, Guangdong and Zhejiang, were ranked in terms of the number of firms within each selected sector. Then a “short list” was constructed of counties/districts that cumulatively accounted for 30% of the total number of firms in each sector in each province. Accordingly, we conducted our survey in a small number of cities: three cities (Guangzhou, Zhongshan and Dongguan) in the PRD and one, Ningbo, in the YRD.

[8] We use firms' name, address, zip code to match the survey data to CEID.

Table 1
Firm characteristics comparisons between population and sample.

	YRD		PRD		Overall	
	Population	Sample	Population	Sample	Population	Sample
Home appliance (%)	29.6	68.3	35.1	31.7	31.7	44.2
Textile apparels (%)	70.4	31.7	35.4	28.9	56.9	29.9
Footwear (%)	0.0	0.0	15.9	20.8	6.1	13.7
Toy (%)	0.0	0.0	13.6	18.5	5.2	12.2
Firm age in 2013 (year)	10.9	10.8	10.8	10.4	10.9	10.5
Public owned (%)	1.4	0.0	1.6	3.3	1.5	2.2
Private owned (%)	65.4	80.0	24.9	15.7	49.8	37.7
Foreign owned (%)	31.2	19.5	68.1	75.6	45.4	56.4
Other owned (%)	2.0	0.5	5.4	5.3	3.3	3.7
Log(Employee)	5.9	5.8	6.3	6.5	6.1	6.3
Log(Output)	11.0	11.0	11.2	11.3	11.1	11.2
Log(Assets)	10.6	10.7	10.6	10.8	10.6	10.8
Log(Debts)	10.0	10.3	9.9	10.1	10.0	10.2
N	2767	205	1736	394	4503	599

Note: All firm characteristics are from the 2013 CIED. Ownership indicates who owns the largest share of a firm. “Employee”, “Output”, “Assets”, and “Debts” stand for the total number of employees, total output, total assets, and total debts, respectively. All the four terms are in the form of natural logarithm.

costs, increasing land costs, increasing costs of electricity and water, increasing costs of raw materials and components, high financing costs, heavy tax burden, and other. In a similar way as in Table 2, the nine items are integrated into five categories: labor costs, non-labor input costs, financing costs, policy, and other, with the category of market conditions missing. A firm's rating for a category is the average of its ratings of all challenges within the category. Table 4 illustrates the average of ratings for each category of challenges. Since only 12 firms indicated “Other” challenges, this category is dropped in Table 4.

Table 4 reaffirms that the category of rising labor costs is the most extensive challenge. Both Tables 3 and 4 clearly state that, rising labor costs are the leading challenges faced by labor-intensive firms in recent years.

3.2. Firms' coping strategies

In the 2017 survey, firms first selected – from 11 options – at least three strategies that had been implemented in the 2014–2016 timeframe as responses to the challenges; afterwards, the firms sorted the chosen strategies by the degree of priority. For convenience, the initial 11 strategies were grouped into 6 categories, as shown in Table 5.

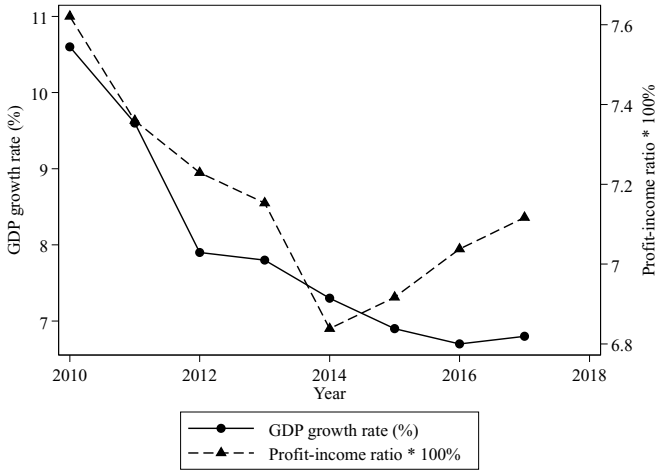

Fig. 1. GDP Growth Rate and Profit Index of Light Manufacturing in China, 2010–2017.
Source: National Bureau of Statistics of China.

Table 2
Grouping 18 challenges to six categories.

Category of challenges	Original challenges
Labor costs	Rising wage
	Rising non-wage labor costs
	Lacking skillful employees
Non-labor input costs	High land costs
	Increasing costs of raw materials and components
	Increasing costs of R&D and design
	Increasing costs of electricity, water and transportation
Financing costs	Capital shortages or high financing costs
Market conditions	Price-reduction pressure from consumers
	Declining market demand or orders
	Increasing competition and decreasing market shares
	Insufficient suppliers
	Social or political environment
Policy	Tax burden
	Business supervision pressure
	Lacking supporting services in the industrial chain
	Lacking policy supports compared to other industries
Other	Other

Note: Firms chose at least three challenges, from 18 options, faced by them in 2014–2016 and sorted the selected options by the extent of challenges. For the sake of convenience, we grouped the 18 challenges to six categories as above.

Table 3
One of firms' challenges and firms' biggest challenges.

Category of challenges	One of the challenges			The biggest challenge		
	YRD	PRD	All	YRD	PRD	All
Labor costs (%)	85.4	88.1	87.1	39.0	53.0	48.2
Non-labor input costs (%)	59.5	57.6	58.3	28.3	19.0	22.2
Financing costs (%)	13.2	5.3	8.0	1.5	2.0	1.8
Market conditions (%)	46.3	51.8	49.9	24.4	23.6	23.9
Policy (%)	29.8	20.1	23.4	4.9	1.8	2.8
Other (%)	1.0	1.0	1.0	0.0	0.3	0.2
None (%)	2.0	0.3	0.8	2.0	0.3	0.8

Note: Definitions of categories of challenges are expressed in Table 2. Numbers below “One of the challenges” indicate the percentages of firms choosing a challenge of a category as one of the challenges faced by them in 2014–2016. Numbers below “The biggest challenge” stand for the percentages of firms choosing a challenge of a category as the biggest challenge faced by them in 2014–2016. “None” means the percentages of firms reporting zero challenge. Numbers in each column below “The biggest challenge” sum up to 100%.

Table 4
Extent of challenges, rated from 1 to 5.

Extent of challenge (1–5)	YRD	PRD	All
Labor costs	3.3	3.7	3.5
Non-labor input costs	2.6	2.9	2.8
Financing costs	2.5	2.4	2.4
Policy	2.9	3.0	2.9

Note: The rating scale is from 1 to 5, with 1 indicating that the challenge was almost impractical, and 5 indicating that the challenge was of the greatest severity. Nine challenges are originally rated: rising wages, rising non-wage labor costs, increasing transportation costs, increasing land costs, increasing costs of electricity and water, increasing costs of raw materials and components, high financing costs, heavy tax burden, and other. In a similar way to Table 2, the nine challenges are integrated into five categories: labor costs, non-labor input costs, financing costs, policy, and other, with the category of market conditions missing. A firm's rating for a category is the average of its ratings of all challenges in the category. Numbers in the table are the average of ratings for each category of challenges. As only 12 firms rate for other challenges, the category of “Other” is dropped from the table.

Table 5
Re-grouping 11 strategies into 6 categories.

Category of strategies	Original strategies
Relocation	Relocating firms to other provinces with lower production costs
	Relocating firms to other countries with lower production costs
Technology upgrade	Technology upgrade: labor replaced by machines
	Standardized production
	Online purchases of raw materials and online sales
Input costs control	Input costs control
Market adjustment	Changing product or business
	Expanding new markets and distribution channels
Size adjustment	Mergers and acquisitions
	Discontinued or downsized
Other	Other

Note: Firms selected at least three strategies which were actually implemented in 2014–2016, from 11 options, as responses to the challenges faced by them and sorted the chosen strategies by the degree of priority. For the sake of convenience, we grouped the 11 strategies to six categories as above.

Table 6
One of firms' strategies and the strategies with top priority.

Category of strategies	One of the strategies		Strategies with top priority	
	All firms	Top challenge: labor costs	All firms	Top challenge: labor costs
Relocation (%)	8.5	10.4	5.5	7.3
Technology upgrade (%)	72.1	72.7	39.2	42.9
Input cost control (%)	45.9	50.2	18.9	21.8
Market adjustment (%)	62.3	55.0	24.4	16.3
Size adjustment (%)	19.0	19.7	7.8	7.3
Other (%)	1.2	1.0	0.5	0.7
None (%)	3.8	3.8	3.7	3.8

Note: Definitions of categories of strategies are expressed in Table 5. Numbers below "One of the strategies" indicate the percentages of firms choosing a strategy of a category as one of the strategies implemented in 2014–2016. Numbers below "Strategies with top priority" stand for the percentages of firms choosing a strategy of a category as the top priority implemented in 2014–2016. "None" means the percentages of firms reporting zero coping strategy. "All firms" includes all the 599 firms in the 2017 survey. "Top challenge: labor costs" only takes into account the firms reporting rising labor costs to be the biggest challenge. Numbers in each column below "Strategies with top priority" sum up to 100%.

In this article, "Relocation", "Technology upgrade", and "Input costs control" are defined as production-side strategies,[9] whereas "Market adjustment" is a demand-side strategy. "Size adjustment" relates to production, but it will not be analyzed because some strategies in it are not relevant to research (for example, being discontinued or downsized). The "Technology upgrade" category does not only include traditional production upgrading (i.e. replacing labor with machines), but also counts in the optimization of production process (i.e. standardized production) and the adoption of information technologies (i.e. online purchase and sales[10]). If a firm selected "Input costs control", the firm had to further mention which type of input costs need to be controlled; the control method is unknown. Ideally, firms that chose "Input costs control" should be assigned to the categories of "Relocation" or "Technology upgrade". However, due to the ambiguity of the "Input costs control" category, it is not possible to treat "Relocation" and "Technology upgrade" as alternative production-side strategies. Table 6 displays the percentages of firms that chose a category as one of the strategies or as a strategy with top priority.

8.5% of firms reported relocating to less-costly regions to be one of the coping strategies. The percentages of firms that reported technology upgrading and input costs control are 72.1% and 45.9%, respectively. For the firms regarding rising labor costs as the biggest challenge, the percentages choosing relocation, technology upgrading, and input costs control all increased, while the percentage selecting market adjustment declines, implying that relocation, technology upgrading, and input costs control are more likely to be the strategies in response to rising labor costs, the largest challenge faced by firms. 5.5%, 39.2% and 18.9% firms treat relocation, technology upgrading, and input costs control as the top priority, respectively. The three numbers add up to 59%, indicating production-side strategies are firms' primary coping strategies; this justifies the focus of this article. When restricting the

[9] If a firm selected "Input costs control", the firm had to further mention which type of input costs need to be controlled; the control method is unknown. Ideally, firms that chose "Input costs control" should be assigned to the categories of "Relocation" or "Technology upgrade". However, due to the ambiguity of the "Input costs control" category, it is not possible able to treat "Relocation" and "Technology upgrade" as alternative production-side strategies.

[10] Online sale is a strategy amid the production and market. On the one hand, it helps open up new markets for selling, and on the other hand, it is an effective way of reducing operating costs within a firm. In this article, online sales, along with online purchases of raw materials, are treated as production-side technology upgrade.

Table 7
Determinants of choosing firm relocation as a strategy or as he top priority.

	(1) Relocation is a strategy	(2) Relocation is the top priority	(3) Relocation is a strategy & labor cost is a challenge	(4) Relocation is the top priority & labor cost is a challenge
TA	0.064	0.041	0.062	0.035
	(0.021)***	(0.018)**	(0.022)***	(0.018)*
Footwear	0.281	0.160	0.300	0.173
	(0.060)***	(0.052)***	(0.066)***	(0.057)***
Toy	−0.002	−0.001	−0.015	−0.007
	(0.032)	(0.029)	(0.032)	(0.031)
Firm age	−0.004	−0.001	−0.003	−0.001
	(0.002)**	(0.002)	(0.002)	(0.002)
Private	−0.074	−0.112	−0.071	−0.123
	(0.124)	(0.121)	(0.135)	(0.131)
Foreign	−0.037	−0.092	−0.043	−0.105
	(0.121)	(0.118)	(0.132)	(0.128)
Other	−0.004	−0.115	0.006	−0.130
	(0.143)	(0.129)	(0.158)	(0.141)
Ln(Output)	0.003	0.015	0.007	0.020
	(0.009)	(0.009)	(0.013)	(0.013)
Ln(Emp.)	0.047	0.041	0.047	0.039
	(0.015)***	(0.013)***	(0.015)***	(0.014)***
Ln(Assets)	−0.002	−0.005	−0.006	−0.008
	(0.016)	(0.015)	(0.017)	(0.017)
Ln(Debts)	0.001	−0.007	0.001	−0.006
	(0.011)	(0.010)	(0.011)	(0.010)
Constant	−0.301	−0.215	−0.339	−0.215
	(0.219)	(0.207)	(0.225)	(0.221)
City	Y	Y	Y	Y
R^2	0.16	0.11	0.17	0.12
N	599	599	522	522

Note: Columns (1) and (2) use all the 599 firms, while (3) and (4) are based on the firms who chose rising labor costs to be one of the challenges. Dependent variables in all columns are from the 2017 survey. In Columns (1) and (3), the dependent variable equals one for a firm if relocation is one of the firm's strategies and equals zero if relocation has never been in the firm's agenda. In Columns (2) and (4), the dependent variable takes the value of one for a firm if relocation is the top priority of the firm and is zero if relocation is not the firm's top priority (but may be one of the firm's strategies). All independent variables are pre-determined firm characteristics from the 2013 CIED. The list of explanatory variables includes industrial dummies (Home Appliances as the reference group; "TA" for Textile Apparels), firm age in 2013 (year), ownership dummies ("Public owned" as the reference group; "Private", "Foreign", and "Other" for "Private owned", "Foreign owned", and "Other owned"), natural logarithms of total output, total number of employees ("Emp." for employees), total assets, and total debts. Cities dummies and constant terms are also included in all linear regressions. Robust standard errors are reported in parentheses.

*** $p < .01$.
** $p < .05$.
* $p < .1$.

sample to the firms whose biggest challenge is rising labor costs, the percentage of firms that consider production-side strategies as the top priority rises to 72%. These two categories of strategies are the top priority of over 40% firms, and the percentage exceeds 50% if a firm's largest challenge is rising labor costs.

4. Why different strategies?

Why have some firms decided to follow the relocation strategy, while some others have emphasized technology upgrading? This section examines which firm characteristics are mostly correlated with choosing a particular strategy, and then it explores reasons for the correlations. Table 7 shows results for regressions of dummy variables indicating whether a firm chose relocation as one of its strategies or as the top priority in 2014–2016 based on various pre-determined firm characteristics in 2013. In other words, the dependent variables are from the 2017 survey while the independent variables are all from the 2013 CIED; this helps to avoid reversed causality. Columns (1) and (2) use all of the 599 firms, while (3) and (4) are based on the firms who chose rising labor costs to be one of the challenges. In Columns (1) and (3), the binary dependent variable equals 1 for a firm if relocation was one of the firm's strategies, or it equals zero if relocation has never been on the firm's agenda. In Columns (2) and (4), the binary dependent variable equals 1 if relocation was the top priority of the firm, or it equals zero if relocation was not the firm's top priority (but it may have been one of the strategies). The list of independent variables includes industrial dummies (Home Appliances as the reference group; "TA" for Textile Apparels), firm age in 2013 (in years), ownership dummies ("Public owned" as the reference group; "Private", "Foreign", and "Other" for "Private owned", "Foreign owned", and "Other owned"), natural logarithms of total output, total number of employees ("Emp." for employees), total assets, and total debts. City dummies and constant terms are also included in all linear regressions. Robust standard errors are reported in parentheses.

Two sets of variables are statistically related to adopting the strategy of firm relocation. First, firms in Textile Apparels or

Table 8
Determinants of choosing firm relocation as one strategy or the top priority, firm labor intensity included.

	(1) Relocation is one strategy	(2) Relocation is the top priority	(3) Relocation is one strategy & labor cost is a challenge	(4) Relocation is the top priority & labor cost is a challenge
TA	0.066	0.042	0.063	0.036
	(0.021)***	(0.018)**	(0.022)***	(0.018)**
Footwear	0.285	0.163	0.304	0.176
	(0.061)***	(0.052)***	(0.066)***	(0.058)***
Toy	0.008	0.006	−0.005	0.001
	(0.032)	(0.029)	(0.031)	(0.030)
Firm age	−0.002	0.000	−0.002	0.000
	(0.002)	(0.001)	(0.002)	(0.002)
Private	−0.079	−0.116	−0.076	−0.126
	(0.122)	(0.119)	(0.133)	(0.129)
Foreign	−0.026	−0.083	−0.033	−0.098
	(0.121)	(0.117)	(0.132)	(0.127)
Other	−0.007	−0.118	0.002	−0.133
	(0.141)	(0.127)	(0.156)	(0.139)
Ln(Output)	0.015	0.024	0.020	0.030
	(0.010)	(0.011)**	(0.013)	(0.014)**
Ln(Assets/Emp.)	−0.029	−0.027	−0.030	−0.026
	(0.011)**	(0.010)***	(0.012)**	(0.011)**
Ln(Debts)	0.017	0.006	0.014	0.003
	(0.009)*	(0.008)	(0.010)	(0.009)
Constant	−0.214	−0.146	−0.273	−0.165
	(0.203)	(0.196)	(0.217)	(0.216)
City	Y	Y	Y	Y
R^2	0.15	0.11	0.17	0.11
N	599	599	522	522

Note: Columns (1) and (2) use all the 599 firms, while (3) and (4) are based on the firms who chose rising labor costs to be one of the challenges. Dependent variables in all columns are from the 2017 survey. In Columns (1) and (3), the dependent variable equals one for a firm if relocation is one of the firm's strategies and equals zero if relocation has never been in the firm's agenda. In Columns (2) and (4), the dependent variable takes the value of one for a firm if relocation is the top priority of the firm and is zero if relocation is not the firm's top priority (but may be one of the firm's strategies). All independent variables are pre-determined firm characteristics from the 2013 CIED. The list of explanatory variables includes industrial dummies (Home Appliances as the reference group; "TA" for Textile Apparels), firm age in 2013 (year), ownership dummies ("Public owned" as the reference group; "Private", "Foreign", and "Other" for "Private owned", "Foreign owned", and "Other owned"), natural logarithms of total output, assets-employees ratio ("Emp." for employees), and total debts. Cities dummies and constant terms are also included in all linear regressions. Robust standard errors are reported in parentheses.

*** $p < .01$.

** $p < .05$.

* $p < .1$.

Footwear are more likely than those in Home Appliance to relocate in response to the challenges. Firms in toy have a statistically equal tendency to relocate as those in Home Appliances. Second, other factors being constant, firms with more employees are more likely to relocate. This paper first explains the second factor, and then explores stories behind industrial dummies.

The number of employees represents one of the major inputs of a firm. The other crucial input is capital, measured by total assets. Given total assets, more employees are associated with a greater probability of relocation; given the number of employees, a larger scale of assets is linked to a smaller chance of being relocated, though statistically insignificant. A likely hypothesis is that more labor-intensive firms are more inclined to relocate than less labor-intensive firms. The labor intensity could be measured by the ratio of total assets to the number of employees (or a firm's per capita assets). The larger the ratio is, the less labor intensive the firm would be. Table 8 verifies the hypothesis by replacing natural logarithms of employees and assets with the natural logarithm of the assets-employees ratio.

Table 8 confirms that a more labor-intensive firm has a larger probability of relocation. Quantitatively, other things being equal, if the per capita assets in a firm halve (or the labor intensity doubles), the probability of relocation will rise by about 0.02 (2 percentage points). Table 6 shows that only 5.5% to 10.4% of firms emphasize the importance of relocation. Therefore, the effect of firm labor intensity on the likelihood of relocation is remarkable.

What can be learned from this result? If the input composition of assets and labor is determined by cost minimization, then a firm with higher labor intensity must have faced lower costs of hiring or higher prices of investment than a firm with lower labor intensity. It is possible that the former firm's product mainly relies on less-skillful workers, or the production technology for the goods of the former firm progresses more slowly so that it is more difficult to replace workers with machines, or the owner of the former firm is better at searching for cheap workers, and so on. Even though new technologies can be easily obtained by firms with higher labor intensity, they may still tend to relocate probably because their profits, under the circumstances of rising labor costs, are thinner than those hiring smaller portions of labor forces and thus it is more difficult for more-labor-intensive firms to afford technology upgrading. To test this hypothesis, we regress the total profit of firms on the industry of firms, firms' age, ownership, labor intensity, and

Table 9
Natural logarithms of average assets-employees ratios by industry.

	All firms	Firms with rising labor costs being a challenge
Home appliances	5.7	5.8
Textile apparels	5.0	4.9
Footwear	4.6	4.6
Toy	5.5	5.5

Note: We first calculate the average of assets-employees ratios for firms in an industry, and then take the natural logarithm of the average for the industry. The first column of numbers is calculated based on all firms, while the second is from the firms reporting rising labor costs to be one of the challenges only.

city effects, as shown in Table A1 in the Appendix. Regression estimates confirm that firms with lower per capita assets (higher labor intensity) have lower profits, which may partly explain why they chose relocation rather than spending on technology upgrading. As a result, when facing rising labor costs, technology upgrading may be too costly for firms with higher labor intensity; consequently, relocating firms to regions with cheaper workers could be the most cost-saving strategy for such firms. In other words, a previously more labor-intensive firm signifies that a strategy towards maintaining or even increasing its labor intensity could be the optimal choice.

Following the idea of firm labor intensity, the coefficients of industrial dummies may be a reflection of industrial labor intensity. A hypothesis is that firms in Textile Apparels or Footwear are more likely to be relocated in response to rising labor costs than those in Home Appliances or Toy because the first set of firms is more industrially labor intensive than the later set. The higher labor intensities of Textile Apparels and Footwear may be directly related to the common features of products in the two industries. Commodities in home appliances and toy are highly standardized, and thus machines may have replaced a great number of human laborers in the two industries. In contrast, clothing and shoes are relatively personalized or customized, and sufficient workers are still needed in Textile Apparels and Footwear to assemble the products of various styles and high complexity. Table 9 calculates the natural logarithm of the average of assets-employees ratios for each industry, for all 599 firms and for the 522 firms reporting rising

Table 10
Determinants of choosing firm relocation as one strategy or the top Priority, industrial dummies replaced by industrial labor intensity.

	(1) Relocation is one strategy	(2) Relocation is the top priority	(3) Relocation is one strategy & labor cost is a challenge	(4) Relocation is the top priority & labor cost is a challenge
Industrial Ln(Assets/ Emp.)	−0.190	−0.112	−0.170	−0.097
	(0.034)***	(0.028)***	(0.031)***	(0.026)***
Firm age	−0.003	0.000	−0.002	−0.001
	(0.002)	(0.001)	(0.002)	(0.002)
Private	−0.078	−0.115	−0.085	−0.132
	(0.119)	(0.118)	(0.129)	(0.127)
Foreign	−0.030	−0.085	−0.047	−0.106
	(0.118)	(0.116)	(0.128)	(0.126)
Other	0.002	−0.113	0.006	−0.131
	(0.137)	(0.125)	(0.151)	(0.137)
Ln(Output)	0.018	0.026	0.027	0.034
	(0.011)*	(0.011)**	(0.014)*	(0.015)**
Ln(Assets/Emp.)	−0.031	−0.028	−0.033	−0.028
	(0.011)***	(0.010)***	(0.012)***	(0.010)***
Ln(Debts)	0.019	0.007	0.016	0.005
	(0.009)**	(0.008)	(0.010)*	(0.009)
Constant	0.870	0.492	0.698	0.393
	(0.235)***	(0.202)**	(0.229)***	(0.212)*
City	Y	Y	Y	Y
R^2	0.13	0.10	0.12	0.09
N	599	599	522	522

Note: Columns (1) and (2) use all the 599 firms, while (3) and (4) are based on the firms who chose rising labor costs to be one of the challenges. Dependent variables in all columns are from the 2017 survey. In Columns (1) and (3), the dependent variable equals one for a firm if relocation is one of the firm's strategies and equals zero if relocation has never been in the firm's agenda. In Columns (2) and (4), the dependent variable takes the value of one for a firm if relocation is the top priority of the firm and is zero if relocation is not the firm's top priority (but may be one of the firm's strategies). All independent variables are pre-determined firm characteristics from the 2013 CIED. The list of explanatory variables includes the industrial natural logarithm of assets-employees ratio ("Emp." for employees), firm age in 2013 (year), ownership dummies ("Public owned" as the reference group; "Private", "Foreign", and "Other" for "Private owned", "Foreign owned", and "Other owned"), natural logarithms of total output, assets-employees ratio, and total debts. Cities dummies and constant terms are also included in all linear regressions. Robust standard errors are reported in parentheses.

*** $p < .01$.
** $p < .05$.
* $p < .1$.

Table 11
Industrial differences in firm relocation explained by labor intensities among industries.

		Textile apparels	Footwear
Column (1)	Overall	0.066	0.285
	Explained	0.134	0.213
	%	204.2	74.7
Column (2)	Overall	0.042	0.163
	Explained	0.079	0.125
	%	186.0	76.7
Column (3)	Overall	0.063	0.304
	Explained	0.141	0.193
	%	223.5	63.6
Column (4)	Overall	0.036	0.176
	Explained	0.081	0.110
	%	223.3	62.8

Note: Numbers in panels of Columns (1)–(4) are calculated based on coefficients in Columns (1)–(4) of Tables 8 and 10, respectively. The columns of "Textile Apparels" and "Footwear" show to what extent industrial labor intensity has explained the firm relocation probability difference between Textile Apparels and Home Appliances, and the probability difference between Footwear and Home Appliances, respectively. In each panel, the row of "Overall" shows the overall difference in probability of relocation obtained from Table 8. The rows of "Explained" and "%" show the extent and percentage explained by the industrial labor intensity. For example, in the panel of Column (3), the number 0.304 for Footwear comes from the coefficient of Footwear in Column (3) of Table 8, representing the difference in relocation probability between Footwear and Home Appliances. The part explained by industrial labor intensity is $(-0.170)*(4.641–5.777) = 0.193$, where -0.170 is from Column (3) of Tables 10, and 4.641 and 5.777 are from the second column of Table 9 (Table 9 keeps one decimal for all numbers.).

labor costs to be one of the challenges.

Table 9 shows that no matter whether all firms or just the firms with rising labor costs being one of the challenges, the ranking of labor intensity of the four industries remains the same. Home Appliances and Toy have similarly low labor intensity, which is consistent with statistically insignificant differences in the probability of relocation between Toy and Home Appliances. The labor intensity of Textile Apparels and Footwear are both higher than home appliances, echoing the notion that firms in Textile Apparels and Footwear are more likely to be relocated than those in home appliances. Particularly, firms in Footwear have the highest labor intensity, and thus the coefficients for Footwear dummies in Tables 7 and 8 are also the largest. To sum up, Table 9 verifies the hypothesis that industries with higher chances of relocation happen to be those with greater labor intensity.

It remains to be determined to what extent could industrial gaps of labor intensity explain industrial differences in the probability of firm relocation shown in Tables 8 and 9, 10. Replacing industrial dummies of Table 8 with the natural logarithm of industrial average assets-employees ratios, Table 10 reports the results for linear regressions of being relocated on the industrial labor intensity and other firm characteristics. As expected, industrial labor intensity is strongly correlated with the likelihood of firm relocation.

Table 11 shows to what extent the industrial labor intensity explains the industrial differences in firm relocation. Numbers in panels of Columns (1) to (4) are calculated based on coefficients in Columns (1) to (4) of Tables 8 and 10, respectively. The columns of Textile Apparels and Footwear show to what extent industrial labor intensity explains the firm relocation probability difference between textile apparels and home appliances, and the probability difference between Footwear and Home Appliances, respectively. In each panel, the row for "Overall" shows the overall difference in probability of relocation obtained from Table 8. The rows for "Explained" and "%" show the extent and percentage explained by the industrial labor intensity. For example, in the panel of Column (3), the result 0.304 for Footwear comes from the coefficient of Footwear in Column (3) of Table 8, representing the difference in relocation probability between Footwear and Home Appliances. The part explained by industrial labor intensity is $(-0.170)*(4.641–5.777) = 0.193$, where -0.170 is from Column (3) of Tables 10, and 4.641 and 5.777 are from the second column of Table 9 (Table 9 keeps one decimal for all numbers.). Results in Table 11 imply that industrial labor intensity fully accounts for the gap of relocation probabilities between Textile Apparels and Home Appliances, which explains a major part of the probability difference between Footwear and Home Appliances.

Table 5 indicates that a firm may relocate to other provinces in China or to other countries. The major destinations of domestic relocation are China's inner provinces, which are less developed and provide cheaper workers. Overseas relocation is primarily directed to Southeast Asian countries where labor costs are even lower than in China's inner provinces. Table 12 examines what determines the choice between domestic and overseas relocation. In Column (1), the dependent variable equals 1 for a firm if domestic relocation was one of the firm's strategies, and it equals zero if domestic relocation has never been in the firm's agenda. In Column (2), the dependent variable equals 1 for a firm if domestic relocation was the top priority of the firm, and it is zero if domestic relocation was not the firm's top priority (but might have been one of the firm's strategies). The meanings of the dependent variables in Columns (3) and (4) are similar. The list of independent variables is identical to Table 8. Coefficients of textile apparels remain robust between Columns (1) and (3), and between (2) and (4), which indicates that firms in textile apparels have not shown clear preferences on the new location of firms. In contrast, the coefficient of footwear in Column (3) is more than two times of that in Column (1), and the coefficient in Column (4) is even five times of that in Column (2), which implies that firms in footwear tend to move to other countries rather than other provinces. It is possible that, due to the highest labor intensity of footwear, firms in the

Table 12
Determinants of domestic relocation versus overseas relocation.

	(1) Domestic relocation is one strategy	(2) Domestic relocation is the top strategy	(3) Overseas relocation is one strategy	(4) Overseas relocation is the top strategy
TA	0.045	0.020	0.032	0.023
	(0.018)**	(0.014)	(0.013)**	(0.012)*
Footwear	0.089	0.026	0.217	0.137
	(0.045)**	(0.028)	(0.054)***	(0.048)***
Toy	0.003	0.002	0.002	0.004
	(0.029)	(0.023)	(0.017)	(0.016)
Firm age	−0.002	−0.001	0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Private	−0.006	0.046	−0.131	−0.162
	(0.082)	(0.024)*	(0.119)	(0.118)
Foreign	0.025	0.062	−0.103	−0.145
	(0.081)	(0.021)***	(0.118)	(0.117)
Other	0.102	0.078	−0.175	−0.196
	(0.108)	(0.049)	(0.119)	(0.117)*
Ln(Output)	0.007	0.009	0.013	0.016
	(0.008)	(0.006)	(0.008)	(0.008)*
Ln(Assets/Emp.)	−0.019	−0.021	−0.011	−0.006
	(0.010)*	(0.007)***	(0.007)	(0.006)
Ln(Debts)	0.007	0.003	0.009	0.003
	(0.007)	(0.005)	(0.007)	(0.007)
Constant	Y	Y	Y	Y
	−0.011	−0.029	−0.202	−0.117
City	(0.157)	(0.098)	(0.178)	(0.176)
R^2	0.05	0.03	0.16	0.12
N	599	599	599	599

Note: Dependent variables in all columns are from the 2017 survey. In Column (1), the dependent variable equals one for a firm if domestic relocation is one of the firm's strategies and equals zero if domestic relocation has never been in the firm's agenda. In Column (2), the dependent variable takes the value of one for a firm if domestic relocation is the top priority of the firm and is zero if domestic relocation is not the firm's top priority (but may be one of the firm's strategies). Meanings of dependent variables in Columns (3) and (4) are similar. All independent variables are pre-determined firm characteristics from the 2013 CIED. The list of explanatory variables includes industrial dummies (Home Appliances as the reference group; "TA" for Textile Apparels), firm age in 2013 (year), ownership dummies ("Public owned" as the reference group; "Private", "Foreign", and "Other" for "Private owned", "Foreign owned", and "Other owned"), natural logarithms of total output, assets-employees ratio ("Emp." for employees), and total debts. Cities dummies and constant terms are also included in all linear regressions. Robust standard errors are reported in parentheses.

*** $p < .01$.

** $p < .05$.

* $p < .1$.

industry need to spend the most efforts searching for the cheapest possible labor forces.

Table 6 shows that the percentage of firm relocation is low. The low percentage may result from the fact that our survey was not able to track the firms that completely moved to other places. In other words, the firms reporting relocation in our data are those transferring only parts of the production capacity to other locations so that we could still find them at the original addresses. The underestimate of the percentage of firm relocation, however, may not bias our regression estimation. The "flying geese" theory predicts that firms with higher labor intensity tend to relocate earlier or more completely. In other words, the firms that we failed to track were likely to be those with higher labor intensity and stronger inclination of relocation. Even though this part of sample is included, our findings that high labor intensity leads to relocation still remain.

The tendency of relocation for firms with high labor intensity is not only supported by our regression estimation but also confirmed by many real cases. Quartz (2018) reported that Vietnam has surpassed China and become Nike's and Adidas' top suppliers of footwear due to China's rising labor costs. China was even overtaken by Indonesia on Adidas' list of footwear suppliers. It also reported that Uniqlo, a major apparel company based in Japan, has rebalanced businesses between China and Vietnam by largely increasing production capacity in Vietnam. All the cases are consistent with our empirical findings.

So far, the analyses in this section highlight what drives firms to choose relocation. However, there are a few alternative strategies where technology upgrading is likely to be an opposite strategy of relocation. If the arguments for relocation are reasonable, it is fair to argue that firms with low labor intensity may have been intrinsically suitable to adopting new technologies, and they could be further inclined to upgrade production technologies. When repeating regressions of Table 8 by only changing the dependent variables to dummies indicating whether technology upgrading is a firm's strategy, the argument is essentially supported by the regression results (not shown in this article). Compared to Home Appliances, firms in Textile Apparels or Footwear are less likely to upgrade technologies, where Footwear is least willing to do so. Firms in Toy are not found to be statistically different from home appliances in

Table 13
Industrial differences in technology upgrading explained by labor intensities among industries.

		Textile apparels	Footwear
Column (1)	Overall	−0.179	−0.365
	Explained	−0.203	−0.321
	%	113.0	88.1
Column (2)	Overall	−0.074	−0.280
	Explained	−0.158	−0.251
	%	213.5	89.6
Column (3)	Overall	−0.177	−0.380
	Explained	−0.221	−0.302
	%	124.5	79.6
Column (4)	Overall	−0.083	−0.267
	Explained	−0.163	−0.222
	%	196.3	83.3

Note: Numbers in panels of Columns (1)–(4) are calculated based on coefficients of regressions which are the same with Columns (1)–(4) of Tables 8 and 10 but replace relocation in the dependent variables with technology upgrading. The columns of Textile Apparels and Footwear show to what extent industrial labor intensity has explained the technology upgrading probability difference between Textile Apparels and Home Appliances, and the probability difference between Footwear and Home Appliances, respectively. In each panel, the row of "Overall" shows the overall difference in probability of technology upgrading. The rows of "Explained" and "%" show the extent and percentage explained by the industrial labor intensity. Similar to Tables 11, 9 is also engaged in the calculation of 13.

Table 14
Determinants of whether investing on automation equipment and the amount of investment.

	(1) Whether investing	(2) Whether investing, for firms with labor costs being a challenge	(3) Ln(Investment)	(4) Ln(Investment), firms with labor costs being a challenge
TA	−0.302	−0.315	0.142	0.144
	(0.045)***	(0.049)***	(0.280)	(0.292)
Footwear	−0.349	−0.346	−0.150	−0.117
	(0.067)***	(0.074)***	(0.419)	(0.435)
Toy	0.002	0.014	0.015	−0.016
	(0.074)	(0.076)	(0.298)	(0.305)
Firm age	0.001	0.001	−0.035	−0.049
	(0.003)	(0.003)	(0.017)**	(0.018)***
Private	0.032	0.001	−0.871	−1.457
	(0.114)	(0.123)	(0.731)	(0.831)*
Foreign	0.047	0.080	−1.223	−1.859
	(0.105)	(0.113)	(0.704)*	(0.797)**
Other	0.145	0.182	−0.916	−1.363
	(0.148)	(0.160)	(0.778)	(0.864)
Ln(Output)	0.069	0.075	0.253	0.304
	(0.029)**	(0.041)*	(0.193)	(0.223)
Ln(Assets/Emp.)	−0.012	−0.022	0.407	0.437
	(0.024)	(0.025)	(0.111)***	(0.121)***
Ln(Debts)	0.003	0.007	0.113	0.109
	(0.018)	(0.020)	(0.099)	(0.107)
City	Y	Y	Y	Y
Constant	−0.087	−0.136	1.457	1.596
	(0.297)	(0.375)	(1.745)	(1.886)
R^2	0.15	0.15	0.28	0.31
N	599	522	232	205

Note: The dependent variable in Column (1) equals one if a firm invested on automation equipment in 2016 for the purpose of replacing labors and equals zero if the firm didn't invest. Column (2) shares the same dependent variable but restricts the sample to the firms reporting rising labor costs being one of the challenges. The sample for Column (3) includes the firms which invested in 2016 and the dependent variable is the natural logarithm of the investment amount. Based on Column (3), Column (4) further restricts to the firms with rising labor costs being one of the challenges. All independent variables are pre-determined firm characteristics from the 2013 CIED. The list of explanatory variables includes industrial dummies (Home Appliances as the reference group; "TA" for Textile Apparels), firm age in 2013 (year), ownership dummies ("Public owned" as the reference group; "Private", "Foreign", and "Other" for "Private owned", "Foreign owned", and "Other owned"), natural logarithms of total output, assets-employees ratio ("Emp." for employees), and total debts. Cities dummies and constant terms are also included in all linear regressions. Robust standard errors are reported in parentheses.

*** $p < .01$.

** $p < .05$.

* $p < .1$.

the tendency of technology upgrading. Different from relocation, firm-level labor intensity is not a statistically significant determinant of selecting the strategy of technology upgrading. Following similar steps as in Tables 11, 13 presents to what extent industrial labor intensity could account for probability differences in technology upgrading among industries. Again, industrial labor intensity fully accounts for the probability gaps between Textile Apparels and Home Appliances, and explains most of the differences between Footwear and Home Appliances.

In addition to whether a firm had chosen the strategy of technology upgrading, the 2017 survey also collected information on both whether a firm invested in automation equipment in 2016 to replace laborers, and if so, the amount of that investment. Table 14 presents the driving factors for automation equipment investment decisions, including whether to invest and how much to invest. The dependent variable in Column (1) equals 1 if a firm invested in automation equipment in 2016 for the purpose of replacing laborers, and it equals zero if the firm did not invest. Column (2) shares the same dependent variable, but it restricts the sample to the firms reporting rising labor costs being one of the challenges. The sample for Column (3) includes the firms which invested in 2016. The dependent variable is the natural logarithm of the investment amount. Based on Column (3), Column (4) further is restricted only to the firms with rising labor costs being one of the challenges. The list of explanatory variables is the same as in Table 8.

Columns (1) and (2) in Table 14 reaffirm that textile apparels and footwear have lower probabilities of investing on automation, while (3) and (4) show that, given a firm having invested in automation, the firm-level labor intensity is negatively correlated with the amount of investment. In other words, industrial labor intensity is associated with the decision of whether or not to upgrade technologies, while firm labor intensity predicts the degree of the upgrade.

The type of industries has been proven to be crucial predictors for the choice of strategies. As a robustness check, this paper reruns all the linear regressions of Table 8 only for the firms in PRD where all the four industries exist and the sample industrial distribution is consistent with the population, and the regression results remain stable (not shown in this article).

5. Conclusion and future research

Using a 2017 firm survey focusing on challenges faced by China's labor-intensive firms, as well as the 2013 CIED indicating those firms' characteristics, this article finds that most firms considered rising labor costs as one of the challenges – or the biggest challenge – between 2014 and 2016. In response to these challenges, on the production side, relocation and technology upgrading are the two major strategies implemented by the firms. It is important to note that there were remarkable differences in the tendency of relocation or technology upgrading among various industries. Industrial labor intensity could explain most of the differences among industries. This finding is useful in the sense that policy makers could predict firms' behaviors and conceive appropriate policies based on a primary indicator – industrial labor intensity. Particularly, firms in industries that are traditionally more labor intensive (e.g. Textile Apparels and Footwear) are more likely to relocate, while those intrinsically less labor intensive (e.g. Home Appliances and Toy) are more likely to upgrade production technology. Other than the industrial capital-labor structure, firm-level labor intensity also plays a role in firms' strategic responses to rising labor costs. Depending on the industry, firms previously more labor intensive are more likely to relocate, while firms traditionally less labor intensive tend to invest more on automation equipment to replace the labor force. The finding that industrial labor intensity and firm-specific labor intensity play different roles in relocation or technology upgrading could enrich our understanding of the relationship between labor intensity and firms' strategies and help the government design policies in a more proactive manner.

Due to the increasing affluence of capital and currently low levels of fertility, labor forces in China are becoming relatively scarcer, which results in rising labor costs. Labor intensive firms, once the engines for rapid growth, have reached the crossroad of transformation. Traditionally, replacing labor forces by technology has been regarded as the appropriate model for firms to follow when adapting to the new environment. However, this article finds that it may be economically costly or technically difficult for intrinsically for firms in labor-intensive industries to upgrade their technology. For firms in such industries, relocation to regions with lower labor costs could be a viable strategy, particularly at the current stage of development. The Chinese government should regularly monitor labor intensities at the industry and firm levels, and identify expected strategies adopted by firms. For firms with higher labor intensity and greater tendency of relocation, the government should provide information about the locations where the firms are expected to relocate. Host governments should play a facilitating role in strengthening the soft and hard infrastructure to attract the relocation of Chinese light manufacturing firms. For firms with lower labor intensity and larger likelihood of technology upgrading, the Chinese government should update information about new technologies to lower firms' searching costs and provide the training program to enhance the labor skill of using and maintaining new technologies.

To uncover the underlying causal mechanisms, it is useful to conduct in-depth case studies in the future in an effort to find out why the Footwear and Textile Apparels have higher labor intensity than Home Appliances and Toy and how the higher labor intensity affects the firm-level strategy of coping with rising labor costs. In addition, it is helpful to test alternative explanations of the variation in coping strategies across sectors. For instance, supply chains may be relatively simpler in Footwear and Textile Apparels compared to Home Appliances and Toy, so that the reduction of wage costs is more likely to compensate for the rising logistic costs in Footwear and Textile Apparels. While such alternative hypotheses are difficult to be tested by quantitative survey data, it is worth of conducting further investigation in order to gain a better understanding of the underlying causal mechanisms.

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Appendix A

Table A1
Effects of labor intensity on firms' profits.

	Total profit (thousand yuan)
TA	−2763.803
	(2551.997)
Footwear	18.605
	(3770.211)
Toy	−4093.067
	(2888.289)
Firm age	2.269
	(117.849)
Private	−51,915.570
	(49,231.682)
Foreign	−50,485.385
	(48,614.079)
Other	−44,729.433
	(50,592.061)
Ln(Assets/Emp.)	6029.788
	(3163.700)*
Constant	41,489.104
	(41,359.536)
City	Y
R^2	0.11
N	599

Note: The regression uses all the 599 firms. The dependent variable is from the 2013 CIED, representing firms' total profits (thousand yuan). All independent variables are firm characteristics from the 2013 CIED. The list of explanatory variables includes industrial dummies (Home Appliances as the reference group; "TA" for Textile Apparels), firm age in 2013 (year), ownership dummies ("Public owned" as the reference group; "Private", "Foreign", and "Other" for "Private owned", "Foreign owned", and "Other owned"), the natural logarithm of assets-employees ratio ("Emp." for employees). In order to alleviate endogeneity, except for firms' labor intensity, other variables about firms' production and finance, such as total output and total debts, are excluded from the regression. Cities dummies and the constant term are also included in the regression. Robust standard errors are reported in parentheses.

* $p < .1$.

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