

From Demographic Dividend to Industrial Transformation: A Forty-Year Review of Low-Cost Labor and the Development of China's Electronics Assembly Industry

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Abstract

China's electronics assembly industry is a pillar industry that enabled China to undertake international industrial relocation and integrate into global value chains. In the early days, it relied on abundant and cheap labor to form a global contract manufacturing advantage. With the arrival of the Lewis turning point, the increasing aging of the population and the improvement of the awareness of the rights and interests of migrant workers, the traditional low-cost employment model has encountered structural challenges, and industrial transformation is imminent. This article integrates the theories of population, labor and industrial economics, sorts out the 40-year development process of the industry, analyzes the underlying mechanism through which demographic dividends transform into development constraints, and evaluates the effectiveness and limitations of the three transformation paths of industrial transfer, automation upgrading and value chain upgrading. The study found that China's electronics assembly industry has crossed the Lewis first turning point, and the working-age population has continued to shrink and the total dependency ratio has increased; Industrial transformation shows the characteristics of multi-path parallel, and the proportion of industries in the central and western regions and the installed capacity and density of industrial robots have been greatly increased. The existing classical theory is difficult to adapt to China's household registration, land and other institutional environments, and also ignores migrant workers' agency as behavioral actors. For this reason, this paper builds an integrated analysis framework to explain the stage characteristics and constraints of the industry's transformation from labor dependence to technology-driven. The research has made up for the shortcomings of the localization and application of Western theories, deepened the relevant understanding of demographic dividend changes and the transformation of the manufacturing industry, and also provided a realistic reference for the formulation of domestic industrial policies and the adjustment of enterprise development strategies.

Keywords

demographic dividend, low-cost labor, development of China's electronics assembly industry, China's manufacturing industry, industrial transformation

1. Introduction

Since the 1980s, China's electronics assembly industry has experienced 40 years of rapid development. Contract manufacturing firms in the Pearl River Delta, the Yangtze River Delta and other places absorb a large number of rural labor, promote the integration of “Made in China” into global value chains, and become an important pillar of international industrial relocation. Nowadays, the industry pattern is changing, and coastal manufacturing enterprises generally face the problems of difficult recruitment, rising labor costs, and high turnover rate; However, migrant workers are affected by factors such as salary and living costs. The sense of belonging in the city is weak, and the contradiction between labor and management is prominent, which reflects the deep structural transformation of the economic development model and the labor market [1].

The electronics assembly industry has long relied on abundant rural surplus labor and low-cost employment to achieve development. However, with the arrival of Lewis' turning point, the intensification of population aging, and the improvement of the awareness of migrant workers' rights and interests, the traditional development model is unsustainable. According to the data, the working-age population in China decreased from 940 million in 2010 to 880 million, and the total social support ratio reached 46.6%; The average annual salary increase of migrant workers is about 10%, and the industry turnover rate is maintained at 25%-30% all year round. The demographic dividend gradually diminished and turned into a development constraint, and industrial transformation became an inevitable choice for the survival of the industry [2, 3, 4].

The existing theory is difficult to adapt to the current situation of local transformation: The classical population and labor force theory does not carry out research in combination with the institutional background of household registration, land, etc., and the global value chain theory also regards the labor force as a homogeneous factor, ignoring the subjective behavior and demands of migrant workers. In fact, the mobile choices and rights and interests of workers are important micro-driving forces to promote industrial change. For this reason, this article combines the macro-institutional environment and the micro-subject behavior to analyze the inherent logic of the industry from labor dependence to technology-driven, builds an analysis framework that fits the local reality, and interprets the real problems in industrial transformation.

2. Research Objectives

Starting from the basic contradictions and the shortcomings of relevant theories pointed out in the previous introduction, three research objectives are put forward.

First, the conversion nodes and mechanisms involved in the “dividend–constraint” transition should be explained. The development process of the Lewis turning point, the structural status of the working-age population and the long-term changes in the income of migrant workers are all included in the scope of the investigation, and the quantitative method is used to determine the boundary point and motives of the low-cost labor from advantage to limitation.

Second, make an analysis of the effectiveness of the three transformation methods listed in “transfer-substitution-upgrade”. In terms of the transfer of industries in the central and western regions, the use of robots in industry and the rise in the value chain, take examples to examine how the electronics assembly industry faces labor difficulties, and then analyze the cooperation points or potential conflicts of the relevant paths.

Third, we should think about problems in a way that integrates the system and the strategy of actors. Don't stick to the independent views of demographic economics or industrial economics, but bring the rights concepts and career choice attitudes of migrant workers into an overall analysis model about household registration, large-scale land system, and then give an explanation plan for industrial transformation suitable for China's reality.

3. Theoretical Framework

3.1 The Lewis Turning Point and the Hypothesis of Unlimited Labor Supply

In development economics, the dual economic model proposed by Lewis (1954) pointed out that when there is a large amount of surplus labor in the traditional agricultural sector, the modern industrial sector can achieve unlimited employment at a constant low wage level [3, 5]. Once the surplus labor is absorbed, wages

will continue to rise, which is the “first Lewis turning point”; When the marginal products of the two sectors are equal, they will enter the “second Lewis turning point”. This theory provides a core explanation for the rapid expansion of China's electronics assembly industry in the early days - it is the continuous output of low-cost labor from rural areas that supports the golden age of the contract manufacturing model. However, whether the 40-year development trajectory of China's electronics assembly industry strictly follows this linear process or presents a special form shaped by the institutional environment is the proposition to be examined in depth in this article.

3.2 Demographic Dividend and Changes in the Dependency Ratio

Demographic dividend refers to the population window period conducive to economic growth created by the high proportion of working-age population and low dependency ratio. The framework of Bloom and Williamson (1998) shows that the demographic structure affects industrial competitiveness through three channels: labor supply, savings rate and human capital investment [6]. Since the reform and opening up, China has enjoyed a 30-year “demographic dividend period” with its large and young working population. However, 2010 became a turning point in China's population structure: the working-age population began to decline from a peak of 940 million to 880 million in recent years; At the same time, the ratio of elderly support and the ratio of child support both rose, and the total ratio reached 46.6%. This means that the population base that supports the low-cost expansion of the electronics assembly industry is irreversibly dissolving [4, 6].

3.3 Global Value Chains and Theories of Industrial Upgrading

The theory of global value chain put forward by Gereffi (1999) and other scholars divides industrial upgrading into four types of paths: process upgrading, product upgrading, functional upgrading and inter-sectoral upgrading [7]. For a long time, China's electronics assembly industry has been locked in the sub-construction assembly link at the bottom of the value chain. The essence of industrial transformation is to promote the industry to climb up in the global value chain system. Studies have confirmed that the threshold for process upgrading and product upgrading is low and the landing is faster; The shift from sub-production to independent design and brand operation has the greatest resistance to upgrading functions, and the industry has been in a low-end lock-in dilemma for a long time. This practical problem is also the core content of this article's key interpretation in combination with the Chinese institutional situation. It should be noted that the above classical theory provides a basic analysis tool for this article, but it fails to fully take into account China's special systems such as household registration and land, and does not pay attention to the behavioral logic of migrant workers as the main body of action. This theoretical short board is not only the core direction of the literature review, but also the research focus that this article tries to break through [7, 8].

4. Literature Review

4.1 Debates on the Lewis Turning Point and the Transformation of China's Labor Market

As for whether China has passed the Lewis turning point, there are two opposing perspectives in the academic community to discuss at present. According to Cai Yu (2010) and the scholars represented, the wages of migrant workers have risen by an average of 10% per year in the past, and the proportion of agricultural labor has declined for a long time, which means that the Lewis first turning point has been crossed from 2004 to 2010 [2]. The reasoning is that if agricultural labor cannot be supplied to the industrial sector endlessly at the original price, then the continuous growth of wages is a clear sign that the turning point has really appeared.

However, the views held by Knight and Yueh (2022) are different [9]. According to their thinking, the “incomplete labor market” is caused by the household registration system - even if migrant workers have been in the city, their identity is still linked to the countryside, and urban service resources cannot be used equally. From this institutional perspective, the actual wage will not reach the marginal output level, and the Lewis turning point may be delayed. The focus of the discussion is that institutional factors should not be treated as exogenous and irrelevant backgrounds, but should be treated as the core of analysis. In short, the Lewis turning point encountered in China is not only a matter of economic balance, but also an issue concerning identity differentiation in institutional sociology [9, 10].

4.2 Industrial Relocation and the Substitution Effects of Automation

Regarding the content of industrial transfer, Li et al. (2019) have pointed out some situations that should be noted: The so-called transfer of the central and western regions is mostly the result of preferential land and policy benefits, not based on actual costs or market factors [11]. According to this logic, the transferred enterprise may not have significant efficiency improvements. “Replication transfer” rather than “upgrading-oriented relocation” is a common practice. That is to say, setting up factories in inland areas is only an extension of low-wage labor, which is not equivalent to adopting new methods and making technical breakthroughs [11, 12].

In the discussion on automation, the “employment polarization” framework is a common idea put forward by Acemoglu and Restrepo (2020) [13]. According to this framework analysis, industrial robots basically take medium-skilled positions as substitutes, but they may promote a polarized employment structure of high and low-skill coexistence. Judging from domestic information, China’s electronics assembly industry currently has 246 robots/10,000 people, which is higher than the general level of the world's manufacturing industry. However, there is a “skill gap” that is growing with an obvious trend: automation has programming, debugging and maintenance requirements for high-skilled engineers, and the current skills of migrant workers cannot meet this demand well. The so-called skill gap precisely shows that automation may not optimize the employment situation [13].

4.3 Interdisciplinary Studies on Migrant Workers’ Behavioral Strategies and Institutional Constraints

In recent years, labor sociology and institutional economics have analyzed the “unstable mobility” involved in migrant workers. Zhang (2018) proposed the concept of “short-term employment among migrant workers”, which can explain why migrant workers always leave and change jobs - the average annual turnover rate is 25% to 30%, which is much higher than the level of the manufacturing industry in general countries [1].

At present, there are two obviously opposite views on the academic analysis of this phenomenon. The first category is “rational choice school”: migrant workers change their workplaces according to their own wishes, pursuing hidden interests such as immediate earnings and non-payment of social security, which is an actively designed coping method. The second category is “institutional exclusion”: various institutional restrictions on household registration, housing or children's education hinder the thorough urban life of migrant workers, so “migratory-bird-like” mobility should be regarded as forced and helpless adaptation. The main point of the argument between the two sides is: do migrant workers use their behavior as a strategy? This unsolved problem just shows that the existing theory does not have a middle-level analysis framework that combines institutional constraints with individual actions [10].

4.4 Summary of Research Gaps

In summary, there are already literatures that have made complete discussions and analysis on the three aspects of labor force changes, technical substitution and behavioral characteristics. However, there is still a lack of clear intrinsic connection between the three clues involved: how can the regulations on household registration or land in the system promote population change and drive industrial upgrading? How do individual activities of migrant workers affect the technology adopted by enterprises? If the above questions cannot be answered, it is difficult for the current discussion to explain the complex phenomena actually experienced by China's electronics assembly industry. What this article wants to deal with is this theoretical gap, trying to give a comprehensive framework for thinking or analysis.

5. Core Findings

5.1 The Dual Critical Point Mechanism of the “Dividend–Constraint” Transition

The first core finding of this article: the situation about China's electronics assembly industry is that it has broken through the Lewis first turning point represented by rising wages, and has begun to experience the stage of the local second turning point.

The situation discussed is different from the logic of wage increase determined by market supply and demand in the past. At this time, the main drivers of labor costs and high-frequency flow should be regarded as the institutional constraints of the growth of migrant workers' awareness of rights, the lack of reform of the household registration system and the inadequation of urban services. The high turnover rate of 25%-30% per year in the relevant industries is not equal to an irrational phenomenon, but is a rational arrangement when migrant workers lack long-term investment in urban life: Using mobility to obtain short-term income and avoid institutional obstacles is actually the conclusion that it is difficult for the existing system to stabilize employment in reality and economically.

The findings mentioned in the article supplement the classic Lewis model and incorporate institutional costs into the thinking of the unlimited supply of traditional labor. According to the old analysis, the labor force is regarded as a homogeneous object and the market is considered perfect. However, in terms of China's reality, the turning point of the labor force not only comes from natural population changes, but also is guided by basic systems such as household registration and land. It is the product of the interaction and mutual constraints of the market mechanism and institutional factors, and cannot be attributed to one party.

5.2 The Asynchronous Synergistic Pattern of “Relocation–Substitution–Upgrading”

The second core finding of this article: the three transformations of industry space transfer, automation substitution and value chain upgrading cannot occur at the same time. The actual coordination encountered is that space transfer is earlier, automation is faster, and value chain upgrading is slightly slower.

Space transfer is one of the first transformation methods to be implemented. The difficulties in coastal employment have been significantly alleviated. The figure of the proportion of the output value of the electronics industry in the central and western regions has increased from less than 15% to 30% or higher, and the geographical distribution of industries has begun to be rebalanced. However, industrial transfer is generally a kind of “replication transfer” practice. Most of the enterprises involved have transferred coastal old-fashioned production lines to the central and western regions. They have not updated their technology and have not broken free from the low-value-added contract manufacturing status.

The alternative progress of automation has begun to unfold rapidly, and the installed capacity of industrial robots involved is 78. 30,000 units and an installed density of 246 units/10,000 people have a great advantage over the average of the world manufacturing industry, and can significantly promote the accuracy and efficiency of standard assembly. However, this kind of replacement also has its own technically determined boundaries. It is only suitable for dealing with procedural or repetitive fixed-post operations, such as precision wiring and irregular parts installation, which require flexible thinking steps or manpower.

The three paths involved in value chain upgrading are currently the slowest progress. The industry with long-term low-end subcontracting as the norm has formed some dependence and technical vacancies, resulting in basic obstacles to leaping to high value-added fields such as research and development or branding. Continuous subcontracting cannot guarantee that enterprises will obtain a large number of high-end capabilities, and “machine replacement” itself may not contribute to the leap. The conclusion in the article negates the simple linear view of “automation naturally promotes industrial upgrading” and points out that technological substitution cannot naturally bring the industry into the high-end stage [14, 15].

5.3 An Integrated Explanatory Model of “Institution–Action” Dual Embeddedness

The third basic conclusion mentioned in the article is the overall theoretical analysis of the dual embedding of “institution-action”, that is, to explain the intermediary within the industry transformation.

According to the analysis of the listed model, the micro-behaviors of migrant workers such as “short-term employment” and “high mobility” should be understood as a rational response to the restrictions of the household registration system, living expenses, and social security cross-provincial links, that is, if they cannot live in the city for a long time, they can rely on frequent mobility to increase their short-term earnings; When encountering difficulties in social security connection, take the initiative to pay less or no social security and get actual remuneration in a faster way.

The micro-labor phenomenon will also promote the transformation of enterprises: if the employment is highly fluid and not easy to control, then replacing manpower with machines becomes the first choice, which

can avoid various costs caused by employee changes or requirements and social security. “High-frequency labor loss enterprises accelerate the threshold of machine replacement job skills to further marginalize low-skilled migrant workers” is the closed loop.

Based on this, this article puts forward a core theoretical proposition: the completion of industrial transformation in the electronics assembly industry not only involves technical and economic aspects, but also fundamentally a matter of institutional coordination. If the system of household registration or land, public services, etc. is not improved accordingly, it is easy to cause structural difficulties in the labor market by relying on technical means alone. The analysis method used is no longer a way of homogeneous treatment of labor in general theory, but a combination of macro-system, industrial reality and individual behavior to make a holistic and unified investigation.

6. Discussion

6.1 Practical Implications

In terms of enterprise strategy, if we only do more automation without setting up a method to retain skilled talents, it is likely to lose equipment benefits due to the frequent movement of personnel. For employees, short-term separation is a waste of training resources, so enterprises should consider adopting the idea of human-machine cooperation: using automated equipment to complete fixed processes and let people handle complex assembly parts that are difficult to grasp. The automated savings obtained at this time can be used to improve the actual situation of workers, that is, to arrange food and accommodation, and help solve children's educational difficulties, so as to promote them to become the builders of their cities smoothly.

If you look at the industrial policy, the central and western regions cannot mechanically apply the existing contract manufacturing practices in the east when receiving industrial transfers. At the same time, it is necessary to deal with services such as the household registration system, children's schooling with them and inter-provincial social security to prevent the cost advantages they rely on from being lost too quickly. In addition, special funds for technological progress should be raised to encourage enterprises to turn the purchase of machines into self-created technology, so that technology spillover has more room for development.

According to the academic understanding, the “system-action” analysis mentioned here should be promoted to labor-intensive industries such as clothing or toys. It is necessary to examine its usability and explanatory power in various situations, and analyze the common points and special circumstances of industrial transformation.

6.2 Research Limitations

First, the data used is not sufficient. The main information about the wages and separation of migrant workers in the article is taken from macro statistics or sample surveys. Enterprises or individuals are not included in the scope of panel analysis, and it is not possible to clearly identify the situation that the household registration system and other variables are highly related to the flow of people. The relevant conclusions should be supplemented with more detailed data.

Second, the research involved has its focus. At present, the discussion focuses on the supply side of labor, and the supply chain changes caused by the cycle and geographical situation of the consumer electronics industry itself are not analyzed. When a large number of foreign customers transfer to other countries, the evolution of the industry has been very different. At this time, the thinking about external risks may not be fully explained in the original framework.

Third, the research method used at present is relatively thin. The article is mostly a quantitative survey, and lacks the analysis of subjective phenomena such as career ideas or family choices of migrant workers. The statistics on the separation rate are not equivalent to the explanation of the actual individual's motivation. Later, it is appropriate to use qualitative means such as interviews to make a more complete explanation of the behavior of small-scale subjects (individuals).

6.3 Future Research Directions

If artificial intelligence and flexible robots have made great progress, fully automated factories for electronic assembly can be built within about ten years. At this time, the main contradiction of the industry is no longer the labor price itself, but the employment changes and skill updates involved in technology substitution.

Institutional coordination is an indispensable part of the implementation of technology. Even if full automation is achieved, social reality should be considered. It is an important topic to deal with the problems arising from the replacement of a large number of low-skilled workers - that is, how to use lifelong education or security systems to alleviate structural unemployment. For future research, human-machine collaboration is a basic perspective. Technological changes should be linked to all levels of the labor market, and it should be pointed out that all kinds of people may gain or lose opportunities in the face of industrial renewal.

7. Conclusion

This article reviews the 40-year development vein of China's electronics assembly industry and analyzes the evolutionary logic of its transformation from demographic dividend to industry. Combined with the institutional environment and the subject behavior analysis framework, relying on the data of labor supply, industrial transfer, automation transformation, etc., the following conclusions are drawn:

The first point is that the industry has now crossed the dual Lewis turning point and entered a period of dividend constraints. In addition to the so-called labor-market turning point, the household registration system, the lack of services or the development of workers' rights themselves contribute to the second type of institutional turning point. The high turnover rate of 25%-30% is a rational behavior forced by institutional conditions, which provides a supplementary explanation for the institutional costs ignored by traditional theories.

The second point is that industrial transformation is currently mainly based on transfer, rapid replacement, and difficult to upgrade. Although the transfer of industries to the central and western regions can partially alleviate the tight coastal labor situation, it cannot break out of the low-level contract manufacturing state; Using automated equipment to improve the efficiency of standard operations may not meet the requirements of flexible assembly; The technological path dependence and shortcomings cultivated by long-term contract manufacturing of the value chain, so that automation is no longer the absolute driving force for industrial upgrading as imagined.

The third point is that the system and market entities should jointly participate in the transformation. According to the current household registration and housing policies, many migrant workers are only short-term mobility, which is therefore promoted to adopt automated means, resulting in a cycle of "labor loss - machine replacement - skill fault - worker marginalization". Obviously, the upgrading of the industry is not only solved by technology, but also by institutional cooperation.

Theoretically speaking, the article gives three concepts of institutional Lewis turning point, transformation asynchronous coordination idea and institutional-action dual embedding model, which supplements the existing theory and connects and analyzes macro-system and micro-behavior. In terms of practice, enterprises should start the arrangement of automation and talent retention at the same time; Industrial policies should consider industrial transfer, household registration adjustment and service supply together; the proposed ideas can be used as a reference or inspiration for the reform of labor-intensive industries. In the past 40 years, China's electronics assembly industry has been a typical example of balancing efficiency, fairness, technology and system in the global context. Now it is undergoing a more thorough technological transformation. The future trend involves both industrial renewal and urban life of workers, which is the focus of the next study.

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Conflicts of Interest

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