Research Article

Research on the Influencing Factors of Technology Path Transformation of Latecomer Enterprises

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This paper adopts the fuzzy set qualitative comparative analysis method to carry out an empirical analysis on Chinese latecomer enterprises and examines the key factors and realization paths that affect the technology path transformation of latecomer enterprises. This paper finds that there are configuration characteristics among the influencing factors of the technological path transformation of latecomer enterprises. The paper reveals the causal complexity mechanism of multiple factors that jointly affect technology path transformation. The key factors that affect the technological path transformation of latecomer enterprises include organizational vigilance, strategic transformation capability, network connections breadth, resource governance depth, dynamics of the technological environment, and the scale of social demand for technology. The above factors not only emphasize that latecomer enterprises should focus on new technologies rather than the market but also reveal that strategic transformation capability and resource governance depth are the keys for enterprises to achieve technology path transformation. In addition, it is pointed out that latecomer enterprises should pay attention to the “window of opportunity” brought about by the scale of social demand for technology. The transition from technology path dependence to technology path transformation of latecomer enterprises is a process in which the key factor becomes stronger.

1. Introduction

Compared with developed countries, most enterprises in developing countries belong to latecomer enterprises, and the technological innovation paths of latecomer enterprises are quite different from those of leading enterprises. When the latecomer enterprises follow the technological track of the leading enterprises once new technological changes occur, the technologies they introduce will fall behind again, and then, they fall into continuous path dependence. As a developing country, China has a relatively large number of latecomer manufacturing enterprises in a state of high resource investment and low efficiency, and the phenomenon that key technical links are constrained by developed countries is serious [1]. For example, the import ratio of core components, such as CNC machine tools, integrated circuit chips, and optical fiber manufacturing equipment, exceeds 60–70%. Huawei company’s business activities have been greatly affected by the ban on the sale of chips in the United States, which has shown that China’s electronic control system industry is heavily dependent on the technology path [2]. Latecomer enterprises can better participate in international competition only by breaking through technological path dependence and strengthening the core technology of the industry [3]. If an enterprise wants to maintain its competitive advantage, it must persist in trying to turn to a new technological path to break the original technological path dependence. Therefore, how to break the path dependence through path transformation to achieve innovation catch-up of latecomer enterprises is an urgent problem to be solved by latecomer enterprises.

There are few pieces of research on technology path transformation. Although the research on technology track provides some reference for the technology path transformation of enterprises, most of the research on technology track transformation is still based on the exploration of the
evolution and development law of the technology itself, and the research perspective also pays more attention at the industrial level and the national level [4, 5]. Therefore, this study intends to explore the technological transformation activities at the enterprise level from the perspective of technological path dependence and technological path transformation.

In addition, scholars mainly study the problem of technology path transformation for leading enterprises [6]. However, latecomer enterprises suffer from the dilemma of external path dependence and internal path dependence. They are faced with greater uncertainty and higher difficulty in breaking path dependence and realizing path transformation than leading enterprises. Moreover, the characteristics of path transformation of latecomer enterprises are obviously different from those of leading enterprises. Therefore, this paper takes the latecomer enterprises as the research object and explores how they break the path dependence on the leading enterprises through path transformation.

The influencing factors of enterprise technology path transformation are still in the stage of theoretical exploration. Although scholars have explored the exogenous, endogenous and resource-based factors that affect the technological path transformation of enterprises [7]. However, it does not consider how these factors jointly affect the technological path transformation of enterprises, and what kind of influence mechanism exists among factors. The research on the interaction and combination effect of factors has been neglected. It must be admitted that the transformation of enterprise technology path is the result of multiple factors. Therefore, after obtaining the key factors of technology path transformation for latecomer enterprises, this study further analyzes how these factors interact to make enterprises complete technology path transformation.

In view of the above research gaps, this study takes latecomer enterprises as the research object, explores the key factors that affect their technology path transformation and the configuration matching relationship of factors, and enriches and deepens the research on path dependence and path transformation. This paper adopts the method of qualitative comparative analysis of fuzzy sets to identify multiple concurrent combined factors and complex causal mechanisms that affect the technological path transformation of latecomer enterprise and clarify the paths of different configurations and technological path conversions composed of multiple antecedents. From the perspective of collaborative configuration, an integrated framework for understanding the influencing factors of technological path transformation of latecomer enterprises is proposed, and the realization path and guiding strategy of technological path transformation and innovation catch-up of latecomer enterprises are constructed and improved.

The rest of the paper is organized as follows: following this introduction, Section 2 reviews the literature, Section 3 describes the research methodology, and Section 4 shows the statistical results. Finally, Section 5 presents the research conclusions, theoretical and practical implications, future research, and limitations.

2. Literature Review

2.1. Research on Technology Path Dependence. Redding [8] defines technology path dependence as the key role played by the initial market, technology management, system, and other factors of technology development in the process of technological innovation. Rycroft et al. [9] pointed out that technological innovation will be decisively affected by various aspects, such as current technology, society, culture, and economy, and it is manifested as the path dependence of technological innovation. Most of the existing pieces of research focus on the enterprises, products, and technologies of developed countries, and there are few pieces of research on the technological path dependence of latecomer enterprises. Xu [10] divides technology path dependence into internal path dependence and external path dependence. Internal path dependence means that an enterprise is locked in a specific technological track because of the influence of factors, such as cultural accumulation and initial technological paradigm within the enterprise in the process of technological innovation [11]. External path dependence means that the technological development path of an enterprise is influenced by competitors in the process of competition and locked in the technological track set by competitors [12]. For leading enterprises, they are only affected by internal path dependence because of their technologically competitive advantage. However, latecomer enterprises are the followers of leading enterprises. Because of the disadvantages of resources and technology, they will be affected by both internal path dependence and external path dependence. With people being troubled by the negative effects brought by external factors in the process of technological evolution and institutional change because of path dependence, some scholars began to focus on the initiative of actors and put forward the concept of path creation to make up for the limitation that path dependence overemphasizes external effects [13]. Garud and Karnøe [14] supplement the path dependence theory and put forward the concept of path creation [15]. Path creation is the conscious strategy deviation behavior of the actor. Therefore, path creation reveals the internal dynamic mechanism of breaking the dependence of technological path. Schienstock [16] believes that technological path creation is the generation of new paths superior to the original technologies. Meyer and Schubert [17] believe that technology paths present different patterns in different development periods, and path dependence and path creation should be integrated. Schienstock [16] pointed out that factors, such as a sense of change, social pressure, and new windows of opportunity, need to be considered when creating a path. To sum up, the breakthrough of path dependence will be affected by both external and internal factors.

2.2. Research on Technology Path Transformation. Compared with path dependence, the technology path transformation emphasizes that enterprises develop new technologies to obtain core competitiveness. Path-switching technological innovation is faced with brand-new
technology and market knowledge, and it is difficult to obtain support from existing organizational and technological models [18]. Sydow et al. [19] believe that the continuity of technological development leads to a large cost of technological transformation, which is an important reason for leading enterprises to be reluctant to develop new technological paradigms. Lee and Lim [20] studied the relationship between path transition and technology track and pointed out that there are two ways of path-creating catch-up and path-jump catch-up. How to choose a technology track suitable for the enterprise itself and how to convert the track is still a “black box” for latecomer enterprises. The current research on technology trajectory and technology catch-up still mainly focuses on the national and industry level [7]. From the perspective of industry, the existing research analyzes that the formation of new technology track stems from three factors, namely technology accumulation, market demand, and institutional environment [6]. The accumulation of technology refers to the formation of new technology tracks when there are fundamental advances in scientific research and major technological breakthroughs [19]. Market demand and scale are the economic factors affecting the trajectory of new technologies [20]. Institutional environmental factors mean that the dynamic changes of environment and institutional will promote the renewal of technological track [20]. In addition, most of the research on technology transformation takes technology evolution itself as the research object and pays more attention to the law of technology development at the industrial level while ignoring the technological transformation from the perspective of enterprises.

3. Methodology

3.1. Research Methods. According to the contingency theory and the architecture theory, different influencing factors have different influences on the technological path transformation of enterprises. It leads to the difference in the matching relationship among the factors, which will directly affect the result of the technical path transformation. The fuzzy-set qualitative comparative analysis (fsQCA) method is considered to be an effective method to explore joint effects and interaction relationships [21], and it has been widely used in various fields of management disciplines in recent years. fsQCA is an ensemble analysis method, which considers that the influence of variables on the results is not independent, and its effect depends on its combination with other variables [22]. Thus, fsQCA treats the study case as a configuration of conditions, uses the set theory to conceptualize the causal conditions and consequences of the study as sets, and analyzes the relationships among subsets [21]. By adopting the fsQCA method, researchers can find out the logical relationship among matching patterns with different conditions and results through cross-case comparison, that is to say, we should explore the configurations of conditional variables that can lead to the appearance of result variables and the conditional configurations that can lead to the disappearance of result variables to further identify the synergistic effect of multiple conditional variables on the premise of acknowledging causal complexity [22].

Compared with quantitative research based on regression analysis and qualitative research based on case analysis, the advantages of fsQCA are as follows: firstly, traditional quantitative research methods, such as the regression analysis method and structural equation method, assume that the relationship among variables is linear. However, by adopting the method of fuzzy sets qualitative comparative analysis, complex phenomena can be regarded as a set of relevant conditions. The method of fsQCA focuses on the necessary and sufficient conditions to produce a certain result, and it is less susceptible to the negative effects of autocorrelation and multicollinearity [23]. Secondly, through cross-case comparison of large, medium, and small samples, researchers can ensure the external generalization of empirical results to a certain extent on the basis of identifying the mechanism of action of conditional variables [22]. Thirdly, traditional statistical methods based on the independence of independent variables, one-way linear relationship, and causal symmetry are difficult to explain the interdependence of independent variables. By adopting the fsQCA approach, researchers can also identify conditional configurations with equivalent outcomes, which can help people understand the differential driving mechanisms that lead to outcomes in different case scenarios [23]. Fourth, the traditional regression analysis method is mainly suitable for exploring the net effect of a single factor, while fsQCA can find the configuration relationship among various factors and achieve the same goal by different routes [21]. Fifth, although other methods, such as cluster analysis and factor analysis, can also test configuration relationships, the biggest limitation of these methods is that they cannot effectively identify the interdependence among conditions configuration equivalence and causal asymmetry. Using the fsQCA method, researchers can further compare the conditional configurations that lead to the emergence and disappearance of results and broaden their theoretical interpretation dimension for specific research problems. The reason is that under the logical premise of causal asymmetry, the conditions that lead to the emergence of the outcome variable may not be the same as the conditions that lead to the “no set” of the outcome variable.

In this paper, the fsQCA method is adopted, which breaks through the limitation of multicondition interdependence analysis in the past. From the perspective of configuration, the antecedent complexity and causal asymmetry are deeply explored, and the influence mechanism of the collaborative configuration of antecedent conditions on technology path transformation is fully explored. Adopting fsQCA method to study the technology path transformation of latecomer enterprises can help reveal complex causal mechanism of multiple influencing factors. However, the previous methods such as factor regression and structural equation are mainly suitable for analyzing the problem of linear regression and cannot analyze the causal configuration.
3.2. Sample Selection and Data Collection. The purpose of this paper is to explore the key factor configuration relationship of the technological path transformation of latecomer enterprises. In selecting case samples, we followed the principles of typicality, availability of research data, and fitting of the research topic. Based on the principle of selecting typicality, this paper mainly focuses on Chinese high-tech manufacturing enterprises, whose technical activities are more complex and representative. Based on the principle of data availability, this paper mainly selects listed companies in high-tech manufacturing enterprises because the information disclosure of listed companies is more detailed and authoritative. It can ensure the authenticity of the research. Based on the principle of fitting research topics, this paper selects the typical products or technologies in the sample enterprises as the research objects. The main reason is that the performance of enterprise technology path transformation is directly reflected in the pros and cons of products or technologies. Hence, it is more appropriate to take products as research objects.

In terms of data collection, this study adopts the methods of secondary data, structured interviews, and enterprise internal data. Through the MBA alumni association of Shanxi University of finance and economics, 34 high-level technology enterprises in China were contacted and investigated. Beginning in September 2021, after 4 months, interviews were conducted with the relevant personnel of the sample enterprises one by one. 34 enterprises were selected for research, and questionnaires were distributed. Each item of all variables was filled out on a 5-point Likert scale, with 1-5 representing “very consistent” to “very inconsistent.” We distributed 299 questionnaires to managers, R&D engineers, and project supervisors at different levels in various departments of enterprises. After eliminating invalid questionnaires, 277 valid questionnaires were recovered, with an effective recovery rate of 93%. The control variables are enterprise scale and enterprise establishment time. Among the 34 enterprise members surveyed, 71.3% are male, 63.7% have worked for 10 to 15 years, 67.5% are department managers or deputy managers, 2.4% are chairman or general manager, and 97.5% have undergraduate and above degree. We randomly selected project technical directors, R&D engineers, and executive secretaries of 34 enterprises to conduct interviews, and we revised the questionnaire according to the results of the trial filling and the interviews. According to the requirements of fsQCA, two authors and a doctoral student formed a 3-person data collection and coding team to collect multiple data sources and conduct cross-validation and specific coding. On this basis, the key factors of each sample are assigned in combination with the assignment criteria of each factor.

4. Analysis of Influencing Factors

Based on the existing literature, drawing on the mature scales of scholars, and on the basis of in-depth interviews with enterprises, this paper identifies various dimensions of influencing factors, such as strategic logic, resource orchestration, and social construction of technology. Strategic logic includes organizational vigilance and strategic transformation capability. Resource orchestration includes the network connection breadth and resource governance depth. Social construction of technology includes dynamics of the technological environment and the scale of social demand for technology. The variable measurement dimensions and references of each factor are shown in Table 1.

4.1. Organizational Vigilance. Kirzner [24] believes that organizational vigilance is the ability attributes of organizational managers’ environmental perception, insight ability, and innovation consciousness closely related to opportunity recognition. Mitchell et al. [25] proposed that organizational vigilance is the strategic anticipation and systematic foresight of chasing subjects for complex environmental changes. As a dynamic cognitive process, it includes not only scanning and searching new information, such as technology and market, but also combining and constructing prior knowledge, opportunity evaluation, and various fragmented information, which mainly emphasizes the ability of chasers to gain an insight into the external environment and integrate internal resources of the organization. Hu and Wang [26] explore and analyze the process of organizational vigilance from corporate decision-making, and they confirm that this process goes through three stages: individual attention, group interpretation, and overall judgment, and actions after decision-making will react to individual attention. Chang et al. [27] analyzed how organizational vigilance promoted the construction of value propositions. The research proves that the focus of organizational vigilance will change with the transition of enterprise development stages, and then, it affects the transformation of value propositions. This paper measures organizational vigilance in terms of context perception, insight capability, and innovative awareness.

4.2. Strategy Transformation Capability. Lengnick-Hall and Wolff [28] pointed out that strategic transformation capability is a self-organizing capability system composed of environment identification capability, resource integration capability, management control capability, and continuous innovation capability. The formation and dynamic evolution of the strategic transformation capability are the result of the coordinated interaction between the organization and the external environment. Lian et al. [29] found that as the gap between business expectations increases, the degree to which corporate managers take strategic turns also increases. Strategic transformation capability prompts latecomers to change from market-oriented to technology-oriented in the process of technology catching up. The process of strategic transformation is mainly divided into the process of identification and implementation [30]. To achieve effective strategic transformation, enterprises must first make scientific and reasonable judgments, identify opportunities through environmental scanning, and make timely decisions on strategic transformation [31]. After that, the new strategy needs to be implemented through the push of the
4.3. Network Connection Breadth. Network connection breadth refers to the scope of cross-level and cross-domain acquisition and integration of resources by an enterprise under the condition of limited resources. Resource patching is the reorganization and utilization of existing resources, which is beneficial to the organization to obtain profits [32]. The resources needed in the process of technological catch-up of latecomer enterprises can be subdivided into capital resources, equipment resources, technical resources, knowledge resources, human resources, policy resources, and industrial resources [33]. Latecomer enterprises also need to build a business ecosystem and manage resources, capabilities, innovation, and value resources. For example, they need to establish a business network to obtain external supplier resources and external IT resources. Enterprises mainly improve their flexibility by accumulating and expanding existing internal and external resources to quickly respond to uncertain changes in the environment [34]. A network represents a collection of certain relationships among nodes, and the relationships among nodes include collaboration, information flow, materials, financial resources, and services [35]. Network members are connected to each other through a variety of resources. The purpose of building an external relationship network for latecomer enterprises is to build a high-quality network relationship platform to better obtain external heterogeneous resources, specialized knowledge and skills, and services and accelerate the development of latecomer enterprises [34]. Therefore, this paper measures the network connection breadth from three aspects: technical resource network connection, business resource network connection, and network relationship interaction.

4.4. Resource Governance Depth. Resource governance depth refers to the level of refinement and complexity of obtaining and integrating a certain type of resource, i.e., the vertical dimension of resource governance in a specific field [36]. Resource governance is a process from shallow to deep. In the process of catching up with technology, enterprises manage survival resources, development resources, and strategic resources in turn. Among them, survival resources are the basic resources used by enterprises to maintain production and survival. Development resources are the resources that promote enterprises to expand production and occupy more markets. Strategic resources are the resources that help enterprises develop global markets and advance their layout. Taking industrial chain resources as an example, the cooperative supporting equipment and processes of each node in the industrial chain belong to survival resources, upstream and downstream cooperative R&D belongs to development resources, and global R&D alliances belong to strategic resources [37]. This paper examines the resource governance depth through the level of governance of survival resources, development resources, and strategic resources by latecomer enterprises.

4.5. Dynamics of the Technological Environment. To achieve technological catch-up in the fierce market competition, latecomer enterprises need to continuously improve their internal R&D investment, and the speed of product innovation and manufacturing technology innovation in both the industry and upstream and downstream industries has been greatly improved, resulting in an endless stream of high value-added products [38]. Therefore, to obtain sustainable competitive advantage, enterprises will inevitably withdraw from low value-added industries and move to the high end of the industrial chain. In addition, disruptive technological innovation also forces enterprises to adopt new manufacturing technologies to produce new alternative products. As a result, the dynamics of technology and the environment force companies to make business adjustments [39]. In addition, because of the infinite subdivision trend of downstream industries, enterprises will continue to introduce new products to meet the diverse needs of customers to occupy the market segment. From the perspective of
4.6. The Scale of Social Demand for Technology. Nowadays, the speed of technology transfer is accelerating, and the topology structure of enterprise innovation network is becoming more complex. Li and Zhao [41] believe that when people understand the connection between technology and society, they do not consider that technology grows in the context of society. The technological social construction theory believes that all technologies do not exist independently of society but are an inseparable part of the social system, and social interest groups, concepts, and habits will affect the manufacture, design, and corresponding services of technology [40]. The external environment involves many factors, such as society, economy, culture, market, technology, and policy. The interaction between these factors leads to the complexity of the external environment system [42]. Latecomer enterprises must adjust technology and production in response to market demand, maintain or increase market share, and adapt to social, economic, cultural, and policy-oriented requirements. The measurement of the scale of social demand for technology is based on the size of the market demand, the complexity of the environment, and the structure of the market. At the same time, large-scale market demand is often accompanied by the guidance of government policies.

4.7. Technology Path Transformation. The measurement of the degree of technological path transformation mainly investigates two aspects: the degree of technological paradigm innovation and the degree of technological track innovation. The degree of technological paradigm innovation examines the degree of the control of enterprises over new technologies, i.e., the practicality, novelty, and creativity of technologies [43]. Practicality means that the new technology of the enterprise can be manufactured and used, i.e., it can produce actual production benefits [43]. Novelty means that the new technology developed by the enterprise adopts a different technological paradigm from the traditional technology [43]. Creativity means that compared with traditional technology, the new technology of enterprises has outstanding new characteristics and remarkable progress [43]. The degree of technological track innovation is the tendency of technological path selection. Generally, it can be divided into following track tendency, deviance track tendency, and derailment tendency [44]. Following track tendency means that the latecomer enterprises only engage in production and operation activities in mature markets in the early stage of technological catch-up and only focus on mature product technologies [44]. Deviance track tendency means that latecomer enterprises consciously deviate from the original technological paradigm and turn to the research and development of new technologies in the process of technological path transformation [45]. Obviously, the deviance track tendency is different from the following track tendency, which emphasizes the differentiation of technological innovation and needs the support of resources. Derailment tendency refers to the behavior that latecomer enterprises completely switch from traditional technology to new technology after breaking through the principles of new technology [46].

According to the literature and questionnaire survey, this paper constructs the influence mechanism model of key factors as shown in Figure 1.

In this paper, SPSS 26.0 and AMOS 26 were used to test the reliability and validity of the measurement model. The KMO test value is 0.961, and the Bartlett sphere test statistical value significance probability is 0.000, which shows that it completely meets the feasibility standard of principal component analysis. The standard load, Cronbach’s α, combined reliability (CR), and mean variance extraction (AVE) of each factor are shown in Table 1. It can be seen that Cronbach’s α, composite reliability (CR), and average variance extracted (AVE) of the scale are all greater than 0.7, and the average variance extracted (AVE) is greater than 0.5, which shows that the scale has good internal consistency and convergence validity (as shown in Table 2).

After calculating the data of each dimension in the scale and the overall data of the scale, based on the correlation analysis results of this case data, as shown in Table 3, all correlation coefficients are marked with * (* means P < 0.05), and all correlation coefficients are greater than 0, which means that all dimensions are significantly positively correlated.

5. Fuzzy Set Qualitative Comparative Analysis

5.1. Variable Assignment. The fuzzy-set qualitative comparative analysis (fsQCA) method emphasizes the membership scores of variables, and the values of variables are between 0 and 1. There are many methods to create fuzzy sets. The common methods to convert original data into fuzzy sets are the four-valued method (0, 0.33, 0.67, 1), six-valued method (0, 0.2, 0.4, 0.6, 0.8, 1), and continuous value method [47]. As to which method to choose, Ragin [21] pointed out that it is up to researchers to decide how many fuzzy sets of numbers to use. The basic criterion of developing fuzzy sets is that researchers must use practical and theoretical knowledge to calibrate membership scores. To ensure the maximum utilization of sample data, this paper refers to the fuzzy set processing method used by Chen and Xu [48]. That is to say, the continuous value method is adopted for continuous variables, and the classical four-value method in f5QCA is adopted for discontinuous variables. It should be noted that for continuous variables, after obtaining the original data, it is necessary to use the
Social construction of technology
Network connection breadth
Organizational vigilance
Dynamics of the technological environment
Strategy transformation capability
Collaborative linkage
Resource governance depth
Social construction of technology
The scale of social demand for technology

**Figure 1:** The influence mechanism model of key factors on technological path transformation.

**Table 2:** Measurement of the variable.

<table>
<thead>
<tr>
<th>Latent variable</th>
<th>Observed variable</th>
<th>Standard loading</th>
<th>Cronbach’s α</th>
<th>Composite reliability</th>
<th>Average variance extracted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational vigilance (OV)</td>
<td>OV1</td>
<td>0.696</td>
<td>0.848</td>
<td>0.7555</td>
<td>0.5078</td>
</tr>
<tr>
<td></td>
<td>OV2</td>
<td>0.686</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OV3</td>
<td>0.754</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strategy transformation capability (STC)</td>
<td>STC1</td>
<td>0.682</td>
<td>0.862</td>
<td>0.7571</td>
<td>0.5099</td>
</tr>
<tr>
<td></td>
<td>STC2</td>
<td>0.739</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>STC3</td>
<td>0.720</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Network connection breadth (NCB)</td>
<td>NCB1</td>
<td>0.791</td>
<td>0.885</td>
<td>0.7972</td>
<td>0.5676</td>
</tr>
<tr>
<td></td>
<td>NCB2</td>
<td>0.710</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NCB3</td>
<td>0.757</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resource governance depth (RGD)</td>
<td>RGD1</td>
<td>0.807</td>
<td>0.903</td>
<td>0.8247</td>
<td>0.6109</td>
</tr>
<tr>
<td></td>
<td>RGD2</td>
<td>0.799</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>RGD3</td>
<td>0.737</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamics of the technological environment (DTE)</td>
<td>DTE1</td>
<td>0.841</td>
<td>0.866</td>
<td>0.8077</td>
<td>0.5856</td>
</tr>
<tr>
<td></td>
<td>DTE2</td>
<td>0.663</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>DTE3</td>
<td>0.781</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The scale of social demand for technology (SSDT)</td>
<td>SSDT1</td>
<td>0.661</td>
<td>0.911</td>
<td>0.7832</td>
<td>0.5485</td>
</tr>
<tr>
<td></td>
<td>SSDT2</td>
<td>0.772</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SSDT3</td>
<td>0.829</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 3:** Correlation matrix of main variables.

<table>
<thead>
<tr>
<th></th>
<th>OV</th>
<th>STC</th>
<th>NCB</th>
<th>RGD</th>
<th>DTE</th>
<th>SSDT</th>
<th>TPT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational vigilance</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strategy transformation capability</td>
<td>0.698**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Network connection breadth</td>
<td>0.621**</td>
<td>0.586**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resource governance depth</td>
<td>0.584**</td>
<td>0.649**</td>
<td>0.700**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamics of the technological environment</td>
<td>0.648**</td>
<td>0.651**</td>
<td>0.823**</td>
<td>0.828**</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The scale of social demand for technology</td>
<td>0.633**</td>
<td>0.687**</td>
<td>0.751**</td>
<td>0.897**</td>
<td>0.836**</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Technology path transformation</td>
<td>0.616**</td>
<td>0.699**</td>
<td>0.606**</td>
<td>0.739**</td>
<td>0.708**</td>
<td>0.730**</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: ** means $P < 0.01$, * means $P < 0.05$. 
calibration program of fsQCA to convert them into fuzzy set scores.

In fsQCA, calibrating refers to the process of assigning set membership to cases [49]. Specifically, researchers need to calibrate variables into sets according to existing theoretical knowledge and case situations, and the membership degree of the calibrated sets is between 0 and 1 [22]. To calibrate the values of conditional variables to the range of 0–1, researchers need to combine the actual value distribution of conditional variables in the case and select the values that can reflect the intermediate degree of conditional variables according to the actual situation of the case to select the calibration anchor points, i.e., full membership, cross-over point, and full nonmembership [21, 48]. To judge the degree of technology path transformation in detail, this paper adopts the method of scoring each principle independently to evaluate. The comprehensive value range is 0–15, and each principal score is 0–7.5, where 0 represents the weakest and 7.5 represents the strongest. The sum of the scores of the two principles is the comprehensive degree value of technology path transformation. At this time, the transformation degree of technical path is a continuous value, and fsQCA software should be used to convert the data into the corresponding set dependent value. Referring to the critical value setting method of Chen and Xu [48], the critical values are set as the lower quartile, the average value, and the upper quartile, respectively, in this paper. Combined with the data of technology path transformation degree of sample enterprises, the three critical values determined in this paper are shown in Table 4.

In this paper, fsQCA3.0 software is used for analysis. After that, we can generate the truth table of the fuzzy set. On the basis of the truth table, we can use Boolean algebra operations to get the combination of key factors of technology path transformation of latecomer enterprises. By analyzing the relationship between factors in these combinations, we can investigate how latecomer enterprises realize technology path transformation.

The measurement of technology path dependence degree is opposite to the degree of technology path transformation. If the score of each dimension is 0, the score of technology path dependence degree is 15 points. At this time, the degree of technology path dependence is also a continuous value, and the data is converted into corresponding set dependent values according to the lower quartile, average value, and upper quartile by fsQCA3.0 software. Combined with the technical path dependence data of the sample, the critical values determined are shown in Table 5.

5.2. Data Processing. According to the data coding table of the sample, this study uses the fsQCA3.0 software developed by Ragin to process the data [21]. We transform the continuous values in the data encoding table into collection dependent values for subsequent construction of the truth table. The degree of the technical path transformation and technical path dependence in the data coding table are continuous values, which need to be converted into set dependent values using the calibrate function of fsQCA 3.0.

The function formula operation of the transformation is $Y - f_2 = \text{Calibrate}(X, n1, n2, n3)$, where $N1, N2,$ and $N3$ are the threshold values set when assigning values. To ensure that all the independent variables are the causes of the change of the result variables, it is necessary to use the necessary condition analysis operation to determine that all the independent variables are the subsets of the outcome variable, i.e., the consistency value is less than 1. Otherwise, it needs to be deleted. In this paper, the necessity detection results of each independent variable are shown in Table 6.

It can be seen from Table 6 that the consistency values of the six factors are all less than 1, indicating that they are all sufficient but not necessary conditions for enterprise technology path transformation and technology path dependence, and they can all be included in fsQCA for further calculation. Directly import the data in the truth table into fsQCA 3.0 and run the “Fuzzy Truth Table Algorithm” program for calculation. There are three kinds of results in the calculation, which are complex solution, intermediate solution, and parsimonious solution. The intermediate solution is between the two, which will neither violate the facts nor appear invariably according to the variable settings in the sample, which can best explain the problem. Therefore, this paper adopts intermediate solution for analysis. In the expression of solution results, this paper refers to the practice of Ragin and Fiss [21, 22], using “*” to indicate that the cause condition appears, using “0” to indicate that the cause condition does not appear, and blank space to indicate that the cause condition is irrelevant to the result.

6. Result Analysis

6.1. Factor Combination of Enterprises Falling into Technology Path Dependence. Table 7 shows the combination of factors that lead to the technology path dependence of latecomer enterprises. From the data in the table, we can see that the overall consistency of the samples is 0.827916, which is greater than 0.8 required by the fsQCA method, and it has high reliability. The total coverage of the sample is 0.714915, i.e., the combination of the two factors can explain 71% of the total sample, which has a good explanatory. The specific explanation of each combination is as follows:

6.1.1. Combination 1: $\sim OV \ast \sim STC \ast \sim RGD \ast \sim DTE \ast \sim SSDT$. The combination shows that the aggregation relationship leading to technology path dependence of latecomer enterprises is as follows: low organizational vigilance, low strategy transformation capability, low resource governance depth, low dynamics of the technological environment, and low scale of social demand for technology.

This configuration shows that enterprise practices and beliefs are solidified and hardly adjusts the enterprise’s technology strategy orientation. The organizational learning ability and external cooperation ability of enterprises are weak, and they cannot effectively and fully utilize external innovation resources. Resource governance depth is low. The technological development in the industry is slow, and new opportunities are difficult to emerge. At the same time,
the technological environment in the industry is relatively closed, and core technologies are monopolized by leading enterprises, making it difficult for latecomer enterprises to access these core technologies. The market demand is very single, and it is less likely to break the path dependence by relying on the external environment. No matter how many resources an enterprise can obtain from the external organization network, it will hardly be used in the research and development of new technologies, and it is difficult to achieve path transformation. Combined with the above analysis, it can be seen that the enterprises in this combination can only choose the following track tendency strategy to carry out production and operation activities but cannot seize the opportunity of technological innovation to carry out technological path transformation. For example, Rueasy fell into the trap of innovation catch-up and path dependence in the early stage, mainly because the executives of the enterprise lacked sufficient attention to new technologies, and the ability to implement new strategies was relatively weak. Under this circumstance, the technological environment in the industry changes relatively weakly, which greatly weakens the technological path transformation ability of enterprises.

6.1.2. Combination 2: $\neg OV \cdot STC \cdot NCB \cdot \neg RGD \cdot \neg DTE$. This combination shows that the aggregate relationship that leads to the technological path dependence of latecomers is
as follows: low organizational vigilance \times \text{low strategic transformation capability} \times \text{high network connection breadth} \times \text{low resource governance depth} \times \text{low scale of social demand for technology}.

Based on the analysis of the factors, it can be seen that enterprises hardly adjust and change new product development procedures, information sharing mechanisms, and knowledge bases. Such enterprises are not sensitive enough to new technologies and cannot identify opportunities for strategic transformation, which means that they have insufficient executive power to generate new strategies, and there are great obstacles to strategy transformation. At this time, under the circumstance of the lack of internal resources of the enterprise, latecomer enterprises still rely on the talents, capital, and technology introduced from the external organization network to invest in the research and development of new technologies but do not internalize the resources introduced from the outside. It is difficult for enterprises to conduct comprehensive and in-depth governance of the introduced resources, and it is only a simple patchwork of resources. It is precisely because of the lack of vertical management capabilities of enterprise resources that enterprises can only choose the strategy of following the track. Poor technological social construction conditions and failure to adjust and reallocate resources according to the market demand also lead to the technological path dependence of enterprises. The reason why Chinese integrated circuit design and manufacturing enterprises represented by SMIC and Silan Microelectronics have fallen into continuous path dependence is largely because of the lack of in-depth management of resources. Chip design and manufacturing is a typical technology and capital-intensive industry, and enterprises, such as SMIC, mainly rely on obtaining sufficient technical talents and financial support from the outside instead of conducting independent research and development to breakthrough core technologies, resulting in long-term technological path dependence.

6.2. Factor Combination for Enterprises to Realize Technology Path Transformation. In this paper, fsQCA3.0 software is used to obtain the combination of three groups of factors to realize the technological path transformation of latecomer enterprises, as shown in the following table. According to the data in Table 8, the solution consistency of the sample is 0.93318, which is greater than 0.8 required by the fsQCA method, and it has high reliability. The solution coverage of the sample is 0.648, i.e., the combination of these three groups of factors can explain 64.8% of the whole sample, which is highly explanatory. The specific explanation of each combination is as follows:

6.2.1. Combination 3: STC\times NCB\times RGD\sim DTE. This combination shows that the factor set relationship of latecomer enterprises to realize the technology path transformation is as follows: high strategic transformation capability \times high network connection breadth \times high resource governance depth \times high scale of social demand for technology.

This combination of enterprises is mainly through the effective management of enterprise resources to obtain competitive advantage to achieve technological path transformation. This combination emphasizes that the value of resources should not only pay attention to how many heterogeneous resources enterprises have but also pay attention to how to effectively integrate and allocate resources. Enterprises not only rely on accumulating internal resources, including technology and management experience, to create value and gain competitive advantage in the market but also integrate the resources in their relationship network to realize resource sharing and complementarity among network members. Managers integrate and reconfigure internal and external resources in the dimensions of breadth (through the scope of the enterprise), life cycle (different stages of the enterprise), and depth (through the different levels of the enterprise), which can effectively deal with the dynamics of the external environment. It can also jointly resist the impact of the external environment under the influence of strategic orientation and build its technology transformation capability through resource orchestration. Xiaomi has independently developed and produced mobile phone peripheral products through investment and shareholding and expanded its offline channels by strengthening cooperation with retailers such as Suning and Gome. Xiaomi is constantly making strategic adjustments, such as user participation in mobile phone updates and time-limited purchases caused by fan effects, all of which indicate that Xiaomi adapts its own strategic behavior to adapt to changes in market demand. At the same time, Xiaomi is good at using the external network relationship of enterprise to obtain resources, integrate resources, and establish its own competitive advantage.

6.2.2. Combination 4: OV\times STC\times NCB\times RGD\times SSDT. This combination shows that the aggregate relationship that leads to the technological path transformation of latecomers is as follows: high organizational vigilance \times high strategic transformation capability \times high network connection breadth \times high resource governance depth \times high scale of social demand for technology.

Through the analysis of the above three groups of factors, it can be seen that the level of key factors under this combination is relatively high. Enterprises have a high sense of innovation and organizational vigilance and focus on technology research and development, and they continuously improve their strategic transformation capabilities, providing a pull for path transformation. At the same time, strong social construction of technology creates opportunities for technological catch-up. The large scale of demand also reflects the urgency of the demand, and the increase in the resource governance depth will help accelerate the improvement of technical capabilities. In this case, the technological path selection tendency of the enterprise includes following track tendency, deviance track tendency, and derailment tendency. For example, before Huawei developed distributed base stations, it first learned the technologies of leading enterprises using the tendency of
following the track, and then Huawei discovered the shortcomings of traditional macro base stations and small base stations, which is also an innovation opportunity discovered on the basis of continuous exploration. Based on this opportunity, Huawei chose to deviate from the track, paid attention to the research and development of new distributed base stations, and finally achieved success. After the successful research and development of the project, Huawei chose the derailment tendency, continuously explored the European market based on distributed base stations, gained a large number of orders and market share, and realized the transformation of technology path.

6.2.3. Combination 5: OV∗STC∗∼NCB∗RGD∗DTE∗SSDT. This combination shows that the aggregate relationship that leads to the technological path transformation of latecomers is as follows: high organizational vigilance × high strategic transformation capability × low network connection breadth × high resource governance depth × high dynamics of the technological environment × low scale of social demand for technology.

Through the analysis of the above three types of factors, it can be seen that when the network connection is not extensive enough and it is not easy to obtain external innovation resources, enterprises are faced with the problem of insufficient innovation resources. Under this circumstance, latecomer enterprises should increase their strategic patience if they want to realize the technology path transformation. They should not only insist on investing in innovative elements for new technology research and development but also prepare for long-term technological competition with leading enterprises. At the same time, managers must have strong environmental awareness, insight, and innovation. To make up for the lack of resources, enterprises also need to acquire knowledge through in-depth cooperation with upstream and downstream enterprises in the industry. In addition, from the above combination, it can be seen that the social demand for technology faced by the enterprise is relatively large, indicating that the market demand is huge. If the government has strong policy guidance at this time, it can provide a guarantee for the enterprise’s foreign cooperation. Based on the above analysis, in this case, the enterprise will not only choose the tendency to follow the track but also can change the tendency of technology path selection into the tendency of deviance track and derailment tendency to carry out technology path transformation. Nuxinili Light Source first accumulated its own lighting technology and manufacturing capabilities through the tendency to follow the track. Then, in order to completely break the technological dependence of leading companies, such as Osram and Philips, Xinli Light Source has invested a lot of resources and solved the lighting stroboscopic problem that leading enterprises cannot solve through long-term independent research and development.

6.3. Analysis of Core Elements in Configurations. In reality, considering the influence of the company’s own scale and technical characteristics, it may be difficult to achieve a high level of all six factors. However, the qualitative comparative analysis of fuzzy sets shows that the strategic transformation capability and the resource governance depth play a central role in the technological path transformation. The conditions that appear in both concise solution and intermediate solution are the core elements, which shows that they are the conditions that have an important influence on the results. As shown in Table 8, by comparing the three configurations of technology path transformation, it is found that the strategic transformation capability and the resource governance depth in the concise solution also appear in the intermediate solution, which shows that these two factors play a central role in technology path transformation.

In the innovative context of the digital economy era, the ambiguity of industrial boundaries has gradually increased, the heterogeneity of market demand has continued to increase, and the characteristics of uncertainty faced by latecomer enterprises have become increasingly prominent, which increases the difficulty for enterprises to achieve technological path transformation and brings new challenges to the decision-making process of their strategic change. Improving the strategic transformation capability is the key link for latecomer enterprises to form technology-oriented strategy and start technology catch-up. Once the strategic transition is delayed or failed, the opportunity of technology catch-up will be missed. The choice of
technology paradigm innovation or market track innovation is the process of continuously narrowing or even catching up with the technological gap between latecomer enterprises and international leading enterprises in the same industry. The technological transformation of latecomer enterprises is bound to be accompanied by the continuous strengthening of enterprise strategic logic. Based on combination 3, combination 4, and combination 5, it can be known that the resource governance depth of an enterprise is the core factor for latecomer enterprises to transform their technological paths. For latecomer enterprises, only by adjusting and optimizing the external integrated resource system and effectively excavating and absorbing the internal and external resources of enterprises can they update their technologies and reconstruct their technological systems and promote the transformation of technological paths.

6.4. Comparative Study

6.4.1. Configuration Comparison of Technology Path Dependence. Comparing the coverage indicators of configuration N1 and configuration N2, it is found that the two indicators are similar, and both explain about 54% of the resulting variables, i.e., most enterprises fall into technology path dependence through N1 and N2. By comparing the above two configurations, the network connection breadth and the dynamics of the technological environment also play a substitute role in explaining technology path dependence. Even when the network connection is not wide and the dynamics of the technology environment are low, as long as the organization vigilance is poor and the strategic transformation capability is weak, or the resource governance depth is not strong and the scale of social demand for technology is small, it will lead to technology path dependence.

6.4.2. Configuration Comparison of Technology Path Transformation. By comparing the three configurations that affect technology path transformation, it is found that according to the coverage index, H5 is nearly twice that of H3 and nearly three times that of H4, which explains 92% of the result variables and is more likely to effectively promote technology path transformation, i.e., most enterprises convert their technology paths through H5. It fully demonstrates that the strategic logic, resource governance depth, and the dynamics of the technological environment can deeply and powerfully affect the economic activities of enterprises. By comparing the three configurations, it is also found that network connection breadth and the strong resource governance depth have complementary effects. At the same time, the network connection breadth and the scale of social demand for technology involved in the three paths play a substitution role in explaining the transformation of technology paths. That is to say, if network connections breadth and the scale of social demand for technology are high, as long as the single condition of organizational vigilance is met, or the two conditions of strategic transformation capability and resource governance depth are met at the same time, the technological path transformation of enterprises can be promoted.

6.4.3. Overall Comparison among Configurations. Upon comparing the conditional configurations of technology path transformation and technology path dependence, it is found that the number of conditions in the configurations that lead to technology path transformation is significantly more than the configuration of the factors driving technology path dependence. There are 4 to 5 core or edge conditions in the 3 paths corresponding to the configuration of technology path transformation, and there is only one core condition in the configuration path corresponding to the technology path dependence. It means that the diversification of driving factors plays a positive role in promoting the technology path transformation. It also fully reflects the diversity of innovation system and technology path selection.

7. Conclusion and Implications

7.1. Main Findings. Through the analysis of the above-mentioned factor combinations calculated by fsQCA, this study obtains the combination of five factors that lead to the technology path dependence and technology path transformation of enterprises. After analyzing the above combinations, this paper has the following findings:

First of all, this paper finds that there is a “configuration” feature among the influencing factors of the degree of technical path transformation. Previous studies have mainly investigated the independent effects of factors and have not yet explored the impact of the combination of influencing factors on technology path transformation from the perspective of configuration. This paper finds that the influencing factors of technology path transformation have comprehensive characteristics, involving not only the internal factors of the enterprise, namely organizational vigilance and strategic transformation capability, but also the resource factors of the enterprise, i.e., the network connection breadth and the resources governance capability, as well as the technical environment, i.e., the dynamics of the technological environment and the scale of social demand for technology. This paper finds that the independent effects of the above factors cannot lead to the technological path dependence or path transformation of latecomer enterprises but must be combined with other factors to play the role.

Secondly, this paper finds that the high interactive efficiency of strategic transformation capability and resource governance depth is the core driving factor for promoting the technology paths transformation of latecomer enterprises. The reason why the above factors are obtained is that the research finds that these two factors are at a relatively high level in the combination that realizes the technology path transformation, and both are at a low level in the combination of technology path dependence. It can be seen that the strategic transformation capability and the resource governance depth have a significant impact on the transformation of technology paths. How to better perceive and
respond to environmental changes and breakthrough the original internal oriented constraints of strategic orientation by the realization of technological paradigm innovation and market track innovation process is the key for latecomer enterprises to realize the technology path transformation. At the same time, enterprises can internalize organizational knowledge and enterprise innovation strategy through organizational learning using more information about customer needs and knowledge obtained from the relationship of the whole enterprise value chain and allocating relevant resources, which undoubtedly plays a key role in realizing the whole enterprise value chain and allocating relevant resources, which undoubtedly plays a key role in realizing the whole enterprise value chain and allocating relevant resources, which undoubtedly plays a key role in realizing the whole enterprise value chain and allocating relevant resources, which undoubtedly plays a key role in realizing the whole enterprise value chain and allocating relevant resources, which undoubtedly plays a key role in realizing the whole enterprise value chain and allocating relevant resources, which undoubtedly plays a key role in realizing the whole enterprise value chain and allocating relevant resources, which undoubtedly plays a key role in realizing the whole enterprise value chain and allocating relevant resources, which undoubtedly plays a key role in realizing the whole enterprise value chain and allocating relevant resources, which undoubtedly plays a key role in realizing the whole enterprise value chain and allocating relevant resources, which undoubtedly plays a key role in realizing the whole enterprise value chain and allocating relevant resources, which undoubtedly plays a key role in realizing the whole enterprise value chain and allocating relevant resources, which undoubtedly plays a key role in realizing the whole enterprise value chain and allocating relevant resources, which undoubtedly plays a key role in realizing the whole enterprise value chain and allocating relevant resources, which undoubtedly plays a key role in realizing the whole enterprise value chain and allocating relevant resources, which undoubtedly plays a key role in realizing the whole enterprise value chain and allocating relevant resources, which undoubtedly plays.

Thirdly, this paper identifies the combination of influencing factors corresponding to technology path dependence and technology path transformation. In addition, it is the process in which the influence of key factors continues to strengthen from technology path dependence to complete path transformation. The latecomer enterprises have a dynamic evolution law from the technology path dependence to the technology path transformation. For example, as shown in configuration 5 in Table 8, in the early stage of development, enterprises aim to survive in the fierce competition, and most of them show a tendency to follow the track. At this time, to get rid of path dependence, latecomer enterprises should cultivate their own strategic transformation capabilities and actively explore new technologies and opportunities. Only when an enterprise has a high strategic transformation capability can it provide a window of opportunity for the technology path transformation of the enterprise, otherwise, the enterprise will fall into long-term technology path dependence. With the in-depth exploration of innovation opportunities, enterprises gradually show the characteristics of deviance track tendency, as shown in configuration 3 in Table 8. Under the deviance track tendency, enterprises tend to develop new and old technologies alternately. Not only should they continue to invest in R&D resources for new technologies, but also should they ensure the smooth production of traditional technologies. It is necessary to increase and deepen the coordination, linking, and enrichment of external resources, which is more conducive to the innovation of enterprises. As shown in configuration 4 in Table 8, with the control of new technologies, enterprises gradually show the derailment tendency to completely turn to new technology paths. Of course, these require entrepreneurs to have high organizational vigilance and strategic transformation capabilities. On the one hand, enterprises need to continuously innovate new technologies and accelerate the application and transformation of technologies to ensure long-term technological advantages. On the other hand, enterprises also need to pay attention to market expansion and technological demand scale, broaden the connection with external innovation networks, and obtain more external innovation resources before they can begin to break the foreign technological monopoly.

7.2. Theoretical Implications. Firstly, this paper identifies the key influencing factors of technological path transformation of latecomer enterprises, including strategic logic, resource orchestration, and social construction of technology. These factors are more in line with the characteristics of latecomer enterprises, which also improve the traditional research on technology path transformation of latecomer enterprises. Secondly, this paper finds out that the factors for the latecomer enterprises to realize the technological path transformation have comprehensive characteristics. The traditional research on enterprise path transformation mostly emphasizes the key role of a single factor. However, this study uses the method of a qualitative comparative analysis of fuzzy sets to obtain different conclusions from traditional research. This paper analyzes the matching relationship of key influencing factors of technological path transformation of latecomer enterprises from the perspective of configuration. We put more emphasis on the comprehensive effect or configuration effect of factors and improve the current theoretical research on path dependence and path transformation. In addition, based on the statistical analysis results of the fsQCA method, this paper further extracts the core factors of technology path transformation of latecomer enterprises, i.e., strategic transformation capability and resource governance depth. This paper also points out that latecomer enterprises should pay attention to the “window of opportunity” brought by the scale of social demand for technology. Compared with traditional research, this study mainly reveals the dynamic evolution law of technology path transformation of latecomer enterprises. With the strengthening process of key factors, the technology path selection tendency of latecomer enterprises has changed from the initial trend of following track to deviance track, and finally to the derailment tendency. This complements the existing research on path transformation to a certain extent. At the same time, this paper takes latecomer enterprises as the research object, which not only improves the research on enterprise path transformation but also indirectly deepens the research on innovation catch-up.

7.3. Practical Implications. The complexity of the technological path transformation of latecomer enterprises and the complexity of the environment they face determines that the process of realizing technological innovation and leapfrogging will be affected by many factors. From the perspective of combination, this paper deeply explores the influencing factors of technology path dependence and transformation of latecomer enterprises, discusses the internal relationship among the influencing factors, and guides enterprises to formulate the development strategy of technological path transformation to help latecomer enterprises eliminate the obstacles of technological innovation. In this way, the technological level of enterprises can be continuously improved, progressed, and leapfrogged, and a solution strategy is provided for the latecomer enterprises to achieve innovation and catch up.

Firstly, this paper explores and analyzes organizational vigilance, strategic logic, and the social construction of technology, which can provide feasible experience and reference for the catch-up strategic deployment of latecomer
enterprises. Especially in the context of trade frictions and the technological cold war, it has become increasingly difficult for Chinese enterprises to catch up. The interpretation of organizational vigilance, strategic logic, and social construction of technology in this paper is helpful for enterprises to improve their vigilance and reduce the risk of catching up failure. The interpretation of organizational vigilance, strategic logic, and the social construction of technology in this paper is helpful for enterprises to improve their vigilance and reduce the risk of failure to catch up.

In addition, the latecomer enterprises should have the strategic transformation capability and the resource governance depth in the process of technology path transformation. Strategic transformation capability is an important cornerstone of technological path transformation for latecomer enterprises. Latecomer enterprises should build an innovation system of enterprise path transformation based on the core elements and noncore elements of their strategic layout, give full play to insight and innovation consciousness to create an innovation environment, activate innovation factors, and accelerate the optimization and integration of all elements, all personnel, and all time and space and leapfrog development and innovation. Latecomer enterprises should also seize the opportunity of path transformation, continuously strengthen the integration of technological paradigm innovation and market track innovation, and devote themselves to consolidating core technologies, improving R&D systems, strengthening innovation management, and focusing on strategic innovation. Therefore, enterprises should also concentrate superior resources, actively cultivate their own core capabilities, and make reasonable use of external technological innovation networks to actively create new technologies, which lays the necessary foundation for the implementation of technological transcendence strategies. On the other hand, the lack of innovation resources of latecomer enterprises is an important reason that hinders them from catching up with innovation. This study found that compared with the extensive acquisition and piecing together of external resources, enterprises should sort out the internal knowledge process, establish the mechanism of internalizing external knowledge, enhance value activities, reconstruct resources and effectively carry out in-depth governance of resources. Therefore, enterprises need to establish cooperative relationships with network relationship partners to prompt latecomer enterprises to quickly embed into the value relationship networks, and enhance the ability of combing knowledge processes, technological innovation and reconstructing and effectively utilizing valuable resources outside enterprises.

Finally, the role of social construction of technology in the path transformation of latecomer enterprises cannot be ignored. In the technological environment with high social demand for technology, it is easier for latecomer enterprises to carry out technical cooperation with other enterprises and research institutes in the process of realizing technological path transformation. The government should formulate policies to guide and support the latecomer enterprises to obtain the supporting technologies, products, and market channels needed by the industry and improve the technological environment to enhance the technological innovation ability of the latecomer enterprises.

7.4. Limitation. Based on the view of the architecture theory, this paper explores the influence of the combination of strategy logic, resource orchestration, and social construction of the technology of latecomer enterprises by adopting the fuzzy set qualitative comparative analysis method. However, there are huge differences in economic level, development level, industrial structure, technical level, and so on in different regions, and the conclusions drawn by putting them together for impact factor analysis may have certain errors with the reality. However, the fuzzy set qualitative comparative analysis method considers only the combination effect among factors but does not consider the role of control variables and intermediary variables. In the future, when discussing the control variables, we should also consider other factors besides the enterprise scale and the establishment time of the enterprise. Further research can be carried out using the regression analysis method and can be compared with the conclusions of the paper to further study the mechanism of the above factors on the technology path transformation of latecomer enterprises.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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References


