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An Analysis of Firm Relocation Characteristics and Driving Factors in Beijing

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Abstract

Firm relocation has become a critical mechanism for optimizing resource allocation and promoting regional economic transformation amid urban functional restructuring and coordinated regional development. Using Beijing firm relocation data from 2010 to 2024, this study examines firm relocation dynamics and determinants at both macro and micro levels. At the macro level, a panel vector autoregression (PVAR) model incorporating firm out-migration, in-migration, and regional GDP is used to analyze their dynamic interactions. At the micro level, relocation data of Beijing-listed firms are analyzed using a zero-inflated negative binomial (ZINB) model to assess the effects of firm size, firm age, and industry characteristics on relocation frequency. Results show that firm relocation exhibits significant path dependence and self-reinforcing dynamics. Short-term out-migration releases spatial resources and facilitates new firm entry, while persistent out-migration may reduce long-term regional attractiveness. The economic effects on destination regions are stage-dependent, shifting from short-term adjustment costs to medium- and long-term growth benefits. Micro-level findings indicate that larger firms relocate more frequently, firm age shows an inverted U-shaped relationship with relocation, manufacturing firms move less often, and high-tech firms tend to remain location-stable. These findings provide empirical insights for understanding firm relocation behavior and inform policies for regional coordination and urban development.

JEL classification numbers: R12, D22, L25.
Keywords: Firm heterogeneity, Panel vector autoregression (PVAR), Zero-inflated negative binomial model (ZINB).

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1. Introduction

In the context of accelerating economic globalization, regional integration, and urbanization, enterprise relocation has emerged as a critical strategy for firms seeking to optimize resource allocation, enhance competitiveness, and respond to increasingly complex market conditions. Both multinational corporations and domestic Chinese firms actively seek regions that provide superior production conditions, access to key markets, skilled labor, and favorable policy environments. Enterprise relocation not only reflects firms' strategic adjustment of resources, institutional settings, and market opportunities but also serves as a micro-level manifestation of regional economic transformation, spatial reallocation of factors, and industrial restructuring. This phenomenon is particularly evident in regions characterized by dense economic activities, high factor mobility, and intensive competition.

In China, enterprise relocation is widespread, extending beyond traditionally developed areas such as the Pearl River Delta and the Yangtze River Delta. Under national initiatives, including the coordinated development of the Beijing-Tianjin-Hebei region and the policy of relocating non-capital functions from Beijing, cross-provincial relocation of Beijing-based enterprises has become increasingly frequent, drawing substantial attention from both scholars and policymakers. As the national capital, Beijing faces pressures from population density, limited land availability, environmental constraints, and industrial concentration. To mitigate these challenges, the municipal government has implemented targeted policies to guide enterprises to relocate outward, while Beijing's strong economic base, innovative capacity, and high-quality talent continue to attract firms from other regions. Consequently, enterprise relocation in Beijing holds strategic significance for firm transformation, regional development coordination, industrial upgrading, and environmental sustainability.

The relocation behavior of Beijing-based enterprises exhibits considerable heterogeneity in motives, pathways, and frequency. Some enterprises proactively pursue better resources, markets, and technological opportunities, while others relocate passively or semi-voluntarily under policy guidance. Existing research primarily emphasizes macro-level drivers, including industrial clustering, institutional frameworks, and policy incentives, while the role of firm-level characteristics and heterogeneity in migration behavior remains underexplored. This study integrates large-scale relocation data from 2010 to 2024, incorporating firm-level features such as enterprise age, size, and industry affiliation, and examines how these factors interact with regional economic conditions. By combining macro- and micro-level perspectives, the research aims to reveal both the dynamic effects of enterprise relocation on regional economies and the underlying decision-making mechanisms at the firm level, providing empirical insights for optimizing regional development policies and guiding strategic enterprise decisions.

2. Literature review

2.1 The Concept of Enterprise Relocation

Research on enterprise relocation abroad can be traced back to the 1950s, initially focusing on relocation phenomena in the United Kingdom, with additional studies examining the Netherlands, West Germany, and France. A large body of international research regards enterprise relocation as a special case of firm location choice, emphasizing that relocating firms differ from newly established firms in that the former explicitly consider substitutability between locations, while the latter typically establish operations in more diversified areas. Relocating firms, in contrast, tend to select regions that are more specialized (Duranton & Puga, 2001). Pellenbarg, Wissen, and Dijk (2002) view enterprise relocation as a particular form of spatial adjustment, where a firm moves from location A to location B. Such relocation arises both from external pressures—such as market changes, consumer preferences, environmental regulations, and technological advances—and from internal organizational adjustments, which may necessitate changes in geographic positioning. Guzman (2024) shows that international relocation of startups involves not only geographic shifts but also access to entrepreneurial ecosystems. Weik et al. (2024) distinguish between partial relocation, involving only some functions such as production, and full relocation, encompassing the entire firm including headquarters. In multinational contexts, Chen et al. (2023) propose a supply-chain-based relocation model in which suppliers relocate production closer to clients to maintain customer relationships.

Within China, scholars generally define enterprise relocation as a process of reselecting and readjusting firm location (Hu, 2023). From a spatial perspective, relocation represents a geographic shift or outward expansion involving all production factors (Hua and Wang,2008), encompassing both full corporate relocation and the establishment of subsidiary branches elsewhere (Zhang, 2017). It constitutes a special form of spatial adjustment, typically occurring in response to changing markets, consumer preferences, environmental regulations, and technological progress (Wang, 2007). Huang and Du (2006) suggest that enterprise relocation is a spontaneous behavior under market conditions, involving either geographic repositioning or outward expansion from one region to another, including both headquarters relocation and subsidiary establishment. Chen and Yang (2025) argue that enterprise relocation is no longer confined to a single geographic adjustment but involves strategic coupling at global, regional, and local scales. Du (2024) emphasizes that relocation is a market-driven choice responding to changes in production costs, consumer preferences, and urban regulations, facilitating factor mobility and market expansion, ultimately improving profitability. From a value-chain perspective, relocation represents spatial adjustments in firm activities, which may involve complete migration - shutting down current operations and transferring them elsewhere - or partial migration, such as establishing branches, relocating headquarters, or moving R&D units (Bai, 2003; Wei and Bai, 2009).Zhong and Shi (2024) conceptualize enterprise relocation as a

growth strategy in response to internal and external environmental changes, reallocating value-chain activities either fully or partially to achieve new development space.

2.2 Characteristics of Enterprise Relocation

Current research on enterprise relocation, both domestic and international, generally identifies several characteristic patterns: small- and medium-sized enterprises (SMEs) exhibit stronger relocation intentions, relocation tends to align with economic and political centers, and relocation behavior demonstrates distance decay effects.

SMEs tend to relocate at higher rates and often cluster in cities dominated by service-oriented industries. In the Netherlands, almost all firm relocations involved small-scale enterprises. Research on Beijing's high-tech enterprise relocations indicates that medium-sized firms constitute the main relocating group, accounting for 23.74% of all relocating firms, with no large enterprises relocating (Zhang et al., 2023). Similarly, in Hangzhou, manufacturing relocation shows a scale-decay pattern: the number of relocating firms declines as firm size increases. Zhang Xiaojuan et al. (2019) found that small-scale enterprises dominate the total relocating firms, forming a "pyramid" structure consistent with prior findings that smaller firms have higher relocation propensity. Relocation alignment with economic centers indicates that firms often target politically and economically central locations. In France, 91% of multinational headquarters are in Paris; in Sweden, 66% are in Stockholm; in Austria, 45% are in Vienna—again aligning with economic centers. Japan exhibits a similar pattern, with Tokyo hosting 47.7% of listed companies' headquarters and over 70% of Japanese Fortune 500 firms. In Australia and China, key target cities for headquarters relocation include Beijing, Shanghai, Chengdu, and Guangzhou, which correspond to the country's political and economic centres and major regions. Coastal developed cities remain primary relocation destinations, influenced by airport accessibility, favorable tax conditions, lower average labor costs, high-quality business services, and industry agglomeration (Bai, 2016).

Enterprise relocation also exhibits industry-specific characteristics. Service-sector relocations are larger in number and faster-growing than manufacturing relocations. In 1994, in the Netherlands, 3,700 manufacturing and 3,620 construction firms relocated. In Poland, firm relocations vary by industry, size, and lifecycle, with high-tech firms demonstrating higher mobility (Dej et al., 2019). In Beijing, relocated enterprises are predominantly processing and manufacturing firms, with private enterprises forming the majority. Industrial relocation in Beijing mainly involves general manufacturing, high-consumption industries, and selected tertiary sectors such as regional logistics hubs and professional markets (Song et al., 2018).

2.3 Characteristics of Enterprise Relocation

Guzman (2024) confirmed that relocating to Silicon Valley significantly enhanced startup performance, especially for firms leaving less-developed entrepreneurial ecosystems, demonstrating the strategic value of knowledge spillovers and agglomeration economies. Dewit et al. (2019), analyzing 28 OECD countries, found that employment protection policies significantly restrained outward relocation, particularly for labor-intensive, large, and high-productivity manufacturing firms, underscoring the institutional environment's importance in relocation decisions.

Internally, relocation decisions are influenced by strategic positioning, lifecycle stage, management quality, revenue growth, and managerial decisions. Long and Zhong (2025) assert that firms are the direct decision-makers, with relocation ultimately guided by economic rationality and strategic considerations. Economically, relocation aims to reduce production costs, investment risks, and enhance profitability; developmentally, it facilitates structural adjustments, supply chain expansion, network building, and market access. Thus, relocation reflects a rational choice weighing transaction costs and relational assets, showcasing firms' adaptive capacity to environmental changes. Chen Yuantong and Yang Chun (2025) found that electronic MNCs relocating to Vietnam reflect a complex interplay of global strategies, regional integration policies, and local business environments, demonstrating multiscale strategic coupling.

Bao Qun et al. (2023) note that post-relocation, firms weigh the cost of sourcing new suppliers against maintaining existing ones. Lu Jinyong et al. (2024) indicate that rising comprehensive business costs drive foreign enterprises' relocations in China. Wage increases and interregional production cost disparities further incentivize spatial relocation, particularly under resource constraints (Li et al., 2022; Zhang & Chen, 2021). Zhao Ming (2024) finds that provincial differences in environmental protection taxes induce relocation, especially among high-pollution firms establishing subsidiaries in lower-tax regions. Resource abundance and cluster effects also guide firm relocation, reducing transaction costs and enhancing innovation (Xu and Wu, 2025). Zhang Zhibin et al. (2025) highlight factors such as development zone infrastructure, labor costs, proximity to city centers, industrial land prices, and environmental regulation intensity as determinants of relocation decisions. Sun Xiangdong et al. (2025) and Zhu Bangyao (2025) underscore the centrality of agglomeration economies, with mature industrial clusters retaining high-tech firms despite diffusion trends, illustrating strong path dependency in location choice. Early startups often relocate within central urban areas and nearby suburbs due to transportation, public service provision, and access to research outputs (Liao et al., 2025). Shen Jinhui (2022) further notes that the information richness of the local environment affects relocation decisions.

Modern enterprise relocation is highly sensitive to government policies and institutional environments. Li Bin et al. (2024) incorporated policy factors such as export controls, reshoring policies in developed countries, and local attractiveness into evaluation frameworks for manufacturing supply chain relocation. Policy

uncertainty and inadequate support also drive outward relocation. Beijing's strict industrial restrictions and environmental standards have objectively induced some firms to relocate, while favorable policies in other provinces attract enterprises (Ma, 2022). Central environmental inspections and related measures have significantly reduced private and high-pollution firms' entry, affecting investment and relocation willingness. Liu et al. (2020) empirically show that higher local governance risks reduce the likelihood of listed firms relocating headquarters to that area and increase the probability of leaving. Outflow-inducing government policies often aim at industrial restructuring and land resource optimization, creating space for high-value-added industries and promoting high-quality economic transformation. Relocating authorities use policy thresholds, access adjustments, and functional relocation to guide or enforce enterprise migration, breaking path dependency and location stickiness to rebalance regional economic structures (Long & Zhong, 2025). Yi Guodong et al. (2025) note that when government subsidies exceed strategic costs, enterprises adopt compliance-motivated relocation. Even if net benefits are positive locally, rational firms will relocate for higher net returns. Firms may also relocate for environmental or social responsibility considerations. Environmental regulations significantly influence relocation: strict policies increase market entry and reduce exit for technology-intensive firms, while capital- and labor-intensive firms experience higher exit rates and lower entry rates. Ju Xiaosheng et al. (2024) find that lower local factor transaction efficiency increases the likelihood of headquarters relocation, highlighting potential mechanisms affecting performance. Additionally, inadequacies in the innovation and entrepreneurial environment, especially Huang Wenbin (2024) using a spatial general equilibrium model incorporating population movement, firm relocation, and trade, demonstrates that central transfer payments can create mismatches between internal population flows and enterprise relocation within provinces.

2.4 Enterprise Relocation in Beijing

Research on intra-urban enterprise relocation in China has primarily focused on large cities, empirically examining the evolution of firms' or industries' spatial distribution within cities. With the elevation of the Beijing-Tianjin-Hebei (BTH) coordinated development strategy to a national priority, a new wave of enterprise relocations has emerged across the BTH region (Li et al., 2015). Additionally, the degree of openness has a weak influence on the relocation of polluting industries (Duan and Wen, 2018). Overall, the combined effects of regional industrial structure optimization, strengthened environmental constraints, and factor cost differentials drive the outward relocation and reallocation of polluting firms.

Cui Xianghua (2015) emphasized the importance of understanding the relationship between function relief and factors such as industry and population, while maintaining a systemic and holistic perspective. Zhang Keyun and Cai Zhibing (2015) further pointed out that Beijing's non-capital functions stem from the negative effects of its inherent capital attributes, and relieving these non-capital

functions aims to eliminate such adverse impacts without undermining the city's capital role. Therefore, industrial relocation has become a crucial approach to alleviating Beijing's non-capital functions (Lin Enquan, 2013; An Shuwei & Xiao Jincheng, 2015), particularly involving industries inconsistent with Beijing's future development direction, such as high-pollution, high-energy, and labor-intensive sectors. Pi Jiancai and Yang Hairui (2017) studied the locational choices of industrial transfers within the BTH economic region. They suggested that Beijing enterprises can relocate either within the region (to Tianjin or Hebei) or outside the region. Their research indicates that specific locational choices are influenced by collaborative effects, cross-boundary pollution levels, and residents' environmental preferences. Zhang Xiaoping and Sun Lei (2012) found that Beijing's manufacturing sector exhibits a trend of gradually dispersing from central urban clusters to suburban areas. Wang et al. (2018), along with Feng Jian and Zhou Yixing , observed that high-tech manufacturing enterprises in Beijing typically relocate from central districts to inner suburbs and other provinces. Ma Xiaochun (2022) found that during the Thirteenth Five-Year Plan period, with the deepening of non-capital function relief, many Beijing enterprises, including high-tech firms, relocated externally. Xin et al. (2016) and colleagues, using an agglomeration perspective, analyzed industrial relocation in Beijing under non-capital function relief. They assessed the advantages of recipient locations based on agglomeration benefits and found that Tianjin serves as a key agglomeration point for Beijing's manufacturing relocations. Zhang et al. (2025), using micro-level enterprise data and graphical analysis, examined the intra-city spatial reallocation of high-tech manufacturing enterprises in Beijing. Combining this with lifecycle theory, they explored the characteristics of enterprise relocation, finding that medium-sized firms constitute the majority of relocating enterprises, and the relocation patterns of high-tech manufacturing firms are significantly associated with their lifecycle stages.

3. Current Status and Characteristics of Enterprise Migration

3.1 Characteristics of Enterprise Migration in China

Enterprise relocation is an important strategic decision in the process of corporate development, reflecting a company's comprehensive evaluation of the business environment and its strategic choices. Patterns such as headquarters relocation and capital movement can indirectly indicate the quality of a region's business environment. This chapter analyzes recent data on Beijing-based enterprise relocations from 2016 to 2024 to examine corporate choices under the Beijing-Hebei coordinated development framework. In this study,"enterprise relocation" encompasses three types of activities: cross-province headquarters relocation, cross-province investment, and cross-province establishment of branch offices.

In recent years, enterprise relocation in Beijing has exhibited a clear "net outflow" trend. Both outflows and inflows have shown fluctuating growth, but outflows have consistently exceeded inflows, leading to a continuous expansion of net outflow.

From 2016 to 2024, the total number of instances in which Beijing enterprises relocated to other provinces reached 323,222, whereas the total number of relocations into Beijing was 165,356. This comparison indicates that the scale of enterprise outflows is significantly greater than that of inflows, with the number of outflows approximately twice that of inflows. Specifically, regarding outflows, Beijing enterprises cumulatively relocated 323,222 times from 2016 to 2024, showing an overall upward trend. The number of relocations peaked in 2021 at 42,869, representing a 67.8% increase over 2016, reflecting both the deepening implementation of the non-capital function relief policy and the impact of a high-cost operating environment on enterprise relocation. Although outflows slightly declined to 37,488 in 2022, they rebounded to a historical high of 46,479 in 2023, indicating persistent pressure for enterprises to relocate externally. Regarding inflows, the cumulative number of enterprises relocating into Beijing during the same period was 165,356, exhibiting steady growth but at a pace clearly lagging behind outflow growth. In 2024, inflows totaled only 17,678, representing merely 41.7% of outflows, suggesting that Beijing's attractiveness to enterprises may be relatively limited. From the perspective of net outflows, the total net outflow of enterprises from Beijing reached 157,866 between 2016 and 2024, with an average annual net outflow exceeding 17,500. This underscores the "net outflow" characteristic of Beijing enterprises, with 2023 recording the highest net outflow of 19,355 in recent years. The continuous expansion of net outflow reflects both the effectiveness of the non-capital function relief policy and the ongoing challenges Beijing faces in optimizing its business environment and enhancing corporate attractiveness.

In summary, the current pattern of enterprise relocation in Beijing is characterized by "large outflow scale, slow inflow growth, and high net outflow." Between 2016 and 2024, Beijing-based enterprises relocated to other provinces a total of 323,222 times. The top ten destination regions for these relocations were primarily concentrated in the economically developed eastern coastal provinces, as well as key areas in the central and western regions. Among them, Shandong Province ranked first with 34,414 relocations, accounting for 10.65% of the total, highlighting its attractiveness as a major economic province. Guangdong Province and Tianjin followed closely with 33,708 (10.43%) and 29,488 (9.12%) relocations, respectively, reflecting Tianjin's significant role as a core regional city under the Beijing-Hebei coordinated development strategy. Hebei Province ranked fourth with 28,320 relocations (8.76%), demonstrating the notable effectiveness of the non-capital function relief policy within the region. From a regional distribution perspective, the eastern coastal areas - Shandong, Guangdong, Jiangsu, Zhejiang, and Shanghai - collectively accounted for 50.82% of all relocations, serving as the primary destinations for Beijing enterprises. Among these, Jiangsu Province recorded 26,442 relocations, ranking fifth and accounting for 8.18%. With its well-developed manufacturing sector and favorable business environment, Jiangsu has become a major destination for enterprises leaving Beijing. Zhejiang Province, benefiting from a vibrant private economy and a business-friendly environment,

attracted 23,556 relocations from Beijing, ranking seventh and representing 7.29% of the total. These regions have successfully attracted large numbers of enterprises due to their well-established industrial chains, favorable business environments, and market potential. Meanwhile, central and western regions such as Henan (14,163 relocations, 4.38%) and Sichuan (14,653 relocations, 4.53%) also demonstrated strong absorptive capacity, reflecting a trend toward more balanced regional economic development. Notably, Hainan Province entered the top eight with 14,996 relocations (4.64%), likely due to the policy benefits of the Free Trade Port and its strategic industrial layout.

3.2 Current Status and Characteristics of Enterprise Migration in Beijing

To conduct a detailed analysis of enterprise relocation behavior in Beijing, this study focuses on Beijing-listed companies as the primary research subjects. Listed companies possess significant advantages in terms of scale, capital strength, and information transparency, enabling a relatively accurate reflection of strategic decision-making and relocation motivations. Therefore, they are highly representative when studying the characteristics of enterprise migration. According to statistical data, by the end of the study period, Beijing-listed companies recorded a cumulative total of 13,390 relocations during the research period (2010-2024), whereas all enterprises collectively recorded approximately 370,000 relocations. Thus, relocations by listed companies accounted for about 3.62% of the total. Although numerically a small proportion, the substantial scale and representativeness of listed companies allow their relocation behavior to effectively reflect the overall migration trends of Beijing enterprises.

Among Beijing-listed companies that relocated, the age distribution exhibits a pronounced “high in the middle, low at both ends” pattern. Data from 2010 to 2024 show that relocated listed companies were primarily concentrated within the 10–25-year age group. Specifically, companies established for 10–15 years accounted for the largest proportion at 22.93%, with 2,865 relocations; those established for 15-20 years accounted for 22.45%, with 2,805 relocations; and companies established for 20-25 years accounted for 17.47%, with 2,183 relocations. Together, these three groups constitute over 60% of relocations, indicating that companies in the mature stage are more inclined to relocate, potentially due to factors such as scale expansion, strategic adjustment, or cost pressures. In contrast, younger (0–5 years) and older (over 30 years) listed companies accounted for a smaller share of relocations. Companies established for 0–5 years relocated only 660 times, representing 5.28%, suggesting that start-ups may have limited resources and weaker risk resilience, resulting in lower relocation propensity. Companies aged 5–10 years recorded 2,161 relocations, accounting for 17.29%, slightly higher than start-ups but still lower than mature companies. For enterprises over 30 years old, relocations accounted for only 6.38% of the total: 30–35 years, 486 relocations (3.89%); 35–40 years, 305 relocations (2.44%); and 40–45 years, merely 6 relocations (0.05%). This indicates that long-established companies, due to stable operations and strong regional

dependence, exhibit relatively low relocation motivation.

Among Beijing-listed companies that relocated, the size characteristics are prominent, mainly reflecting a "small-scale" tendency. In this study, a company's registered capital is used as the variable to represent its scale. The data show that among relocated listed companies, those with registered capital under 5 billion RMB recorded the highest number of relocations, totaling 7,349 times and accounting for 70% of all relocations. Companies with registered capital between 5 billion and 10 billion RMB ranked second, accounting for 10% of relocations. Companies with registered capital exceeding 10 billion RMB accounted for only 30% of the total relocation instances.

Overall, during the period from 2010 to 2024, the relocation of listed companies across Beijing's districts exhibited a clear "core-heavy, periphery-light" distribution pattern. The districts with the highest number of outbound relocations were concentrated in economically developed areas, including Haidian, Chaoyang, Xicheng, and Dongcheng, which not only serve as Beijing's economic core but also host a high concentration of enterprises. Between 2010 and 2024, Haidian District recorded a total of 3,416 outbound relocations of listed companies, while Xicheng and Chaoyang districts accounted for 2,821 and 1,852 relocations, respectively. Collectively, these three districts accounted for 8,134 relocations, approximately 65% of the total relocations of listed companies in Beijing.

4. Empirical Study on Influencing Factors of Enterprise Migration in Beijing

4.1 Analysis of regional heterogeneity based on PVAR model

4.1.1 Model construction

The Panel Vector Autoregression (PVAR) model extends the traditional Vector Autoregression (VAR) model, introduced by Christopher A. Sims (1980), to panel data by incorporating individual and time effects. Unlike VAR, which is designed for single time series, PVAR captures both cross-sectional heterogeneity and dynamic interdependencies among variables, making it suitable for studying complex economic systems such as regional development or firm behavior. For estimation, the Generalized Method of Moments (GMM) is commonly used due to its ability to address endogeneity. GMM employs lagged endogenous variables as instruments, ensuring consistent estimates while handling heterogeneity and serial correlation in panel data, thereby enhancing robustness.

Therefore, this section employs the PVAR model and the GMM estimation method to examine the dynamic relationship between Beijing's enterprise migration (both outflows and inflows) and regional economic development (in both origin and destination regions). In the model, i denotes different provinces (enterprise origin/destination), t represents different years, j indicates the lag order of the model, $Y_{i,\ t}$denotes endogenous variables such as the number of firm relocations and the level of economic development of the corresponding destination/source

regions; β_i represents individual fixed effects; γ_t represents time fixed effects; and$\varepsilon_{i,\ t}$ denotes the stochastic error term.

$$Y_{i,\ t} = \alpha_0 + \sum_{j=1}^{n} \alpha_j Y_{i,\ t-j} + \beta_i + \gamma_t + \varepsilon_{i,\ t} \quad (1)$$

To facilitate the analysis, this study first applies logarithmic transformations to the number of firm out-migrations, the number of firm in-migrations, and provincial GDP. This is motivated by the potential presence of heteroskedasticity and nonlinear relationships in the raw data. Logarithmic transformation effectively mitigates heteroskedasticity, linearizes the relationships among variables, and allows for a more intuitive interpretation of elasticities. In addition, taking logarithms reduces the influence of extreme values and renders the data distribution more symmetric, thereby enhancing the robustness of model estimation. To address the potential presence of zero values in the firm migration counts, this study adopts the log (x + 1) adjustment to ensure the feasibility of the logarithmic transformation. Through these transformations, the analysis more clearly captures the dynamic relationships between firm out-migration and in-migration from Beijing and provincial GDP, providing a solid foundation for the subsequent empirical analysis. The firm migration data used in this study are obtained from Shangqi Industry Information and cover firm relocation activities involving Beijing from 2010 to 2024. The dataset primarily includes two indicators: out-migration frequency (OutMig), defined as the annual number of firms relocating from Beijing to the other 30 provinces, with a cumulative total of 372,500 relocations; and in-migration frequency (InMig), defined as the annual number of firms relocating from other provinces to Beijing, with a cumulative total of 186,100 relocations. Regional economic development is measured by the annual gross domestic product (GDP) of the corresponding destination or source regions, with data obtained from the National Bureau of Statistics of China. Together, these data provide a reliable empirical basis for analyzing firm migration behavior involving Beijing and the economic development levels of both origin and destination regions.

4.1.2 Model construction

1) Unit Root Tests

The Levin, Lin, and Chu (2002) test (LLC) is a widely used panel unit root test that is applicable to strongly balanced panel data, where each cross-sectional unit has the same time dimension and no missing observations. In addition, the Augmented Dickey–Fuller (ADF) test is another commonly used unit root test designed for univariate time series data. By extending the standard Dickey–Fuller test, the ADF test accounts for higher-order serial correlation. Both tests share the same null hypothesis that the panel data contain a unit root, implying non-stationarity, while the alternative hypothesis is that the panel data do not contain a unit root and are therefore stationary. Acceptance of the null hypothesis indicates non-stationarity, whereas rejection of the null hypothesis implies stationarity. In this section, the LLC

and ADF tests are applied to the logarithmically transformed panel data to assess the presence of unit roots; if no unit root is detected, the series is considered stationary, and vice versa.

Table 1: Unit Root Test Results

Variables	LLC Test		ADF Test	
	Statistic	**p-value**	**Statistic**	**p-value**
log_OutMig	-6.7893	0.0000	416.7862	0.0000
log_InMig	-5.6492	0.0000	176.3455	0.0000
log_GDP	-8.3308	0.0000	390.6426	0.0000

As shown in the results reported in Table 1, at the 1% significance level, the logarithm of the number of firm out-migrations from Beijing (log_OutMig), the logarithm of the number of firm in-migrations to Beijing (log_InMig), and the logarithm of regional GDP (log_GDP) all reject the null hypothesis in both the LLC and ADF unit root tests. This indicates that none of the three variables contains a unit root and that all selected variables are stationary. Consequently, the data satisfy the prerequisite conditions for PVAR model estimation, allowing for subsequent model construction and dynamic relationship analysis.

2) Lag Order Selection

According to the results reported in Table 2, the BIC attains its minimum value at a lag order of one, whereas both the AIC and HQIC reach their minimum values at a lag order of three. Taking these results into consideration, this study selects a lag length of three as the optimal specification. Accordingly, a PVAR model with three lags is estimated, in which information from the preceding three periods is used to explain current outcomes, allowing for an examination of the dynamic relationships and interaction effects among the three variables. The choice of a three-lag specification not only better captures the medium- and long-term dynamic linkages among the variables and avoids the omission of important information due to insufficient lag length, but also enhances the economic interpretability and predictive accuracy of the model. This provides a more reliable foundation for subsequent impulse response analysis and variance decomposition.

Table 2: Determination of Optimal Lag Order for the PVAR Model

lag	AIC	BIC	HQIC
1	-3.08089	-2.0741*	-2.68179
2	-3.05168	-1.88585	-2.58812
3	-3.27797*	-1.93102	-2.74069*
4	-3.19221	-1.63662	-2.56966
5	-2.58363	-.784418	-1.86114

3) Granger Causality Test

This study employs the Granger Causality Wald Tests to examine the causal relationships among the number of firm out-migrations from Beijing, the number of in-migrations, and regional GDP. As shown in the table, the results indicate that the number of firm out-migrations from Beijing and the GDP of the destination regions exhibit a bidirectional causal relationship at least at the 5% significance level. Specifically, the number of out-migrations Granger-causes the GDP of the destination regions, and conversely, destination GDP also Granger-causes the number of out-migrations, indicating a two-way causal linkage between Beijing's firm out-migrations and destination GDP.

Additionally, the number of out-migrations significantly Granger-causes the number of in-migrations, and the GDP of the source regions for firms relocating to Beijing also significantly affects in-migration counts at the 5% significance level. However, the number of in-migrations does not significantly Granger-cause either out-migrations or regional GDP, suggesting that, in the short term, firm in-migration has limited impact on out-migration and GDP. Since Granger causality tests primarily capture short-term causal effects, these results may imply that the short-term influence of in-migration behavior on out-migration and regional economic performance is relatively weak.

Table 3: Granger Causality Test Results

Null Hypothesis	p-value	Conclusion
log_OutMig does not Granger-cause log_InMig	0.003	Reject the null hypothesis
log_OutMig does not Granger-cause log_GDP	0.002	Reject the null hypothesis
log_InMig does not Granger-cause log_OutMig	0.348	Fail to reject the null hypothesis
log_InMig does not Granger-cause log_GDP	0.157	Fail to reject the null hypothesis
log_GDP does not Granger-cause log_OutMig	0.001	Reject the null hypothesis
log_GDP does not Granger-cause log_InMig	0.023	Reject the null hypothesis

4) Panel Variance Decomposition

Through panel variance decomposition, we observe that in the short term (period 1), the variations in Beijing's firm out-migration and regional GDP are entirely explained by their own shocks (100%). However, over time, the explanatory contribution of the number of firm in-migrations gradually increases. By period 5, in-migration accounts for 3.1% of the variation in out-migration and 2.2% of the variation in regional GDP. By period 10, in-migration explains nearly 5% of the variations in both out-migration and regional GDP. These results suggest that, in the long run, the number of firm in-migrations in Beijing does exert a measurable impact on both out-migration and regional economic performance.

Table 4: Panel Variance Decomposition Results

Period	Contribution of In-Migration to Out-Migration	Contribution of In-Migration to Regional GDP
1	0.0%	0.0%
5	3.1%	2.2%
10	4.5%	4.6%

1) Analysis of GMM Estimation Results

Under the conditions of confirmed variable stationarity and an optimal lag order of three, a three-lag PVAR model can be established. In this study, the logarithmic values (growth rates) of Beijing's firm out-migration (log_OutMig), in-migration (log_InMig), and regional GDP (log_GDP) are used as endogenous variables in the PVAR model. The model parameters are efficiently estimated using the Generalized Method of Moments (GMM) approach in STATA 17.

Table 5: PVAR Model Estimation Results

Variable	L.Variable	Coef.	std. err.	P>|z|
h_log_OutMig	h_log_OutMig L1.	0.585	0.101	0.000
	h_log_InMig L1.	0.205	0.068	0.003
	h_log_GDP L1.	-2.430	0.938	0.010
	h_log_OutMig L2.	0.050	0.083	0.549
	h_log_InMig L2.	-0.025	0.053	0.647
	h_log_GDP L2.	1.681	0.527	0.001
	h_log_OutMig L3.	0.132	0.087	0.127
	h_log_InMig L3.	-0.119	0.051	0.020
	h_log_GDP L3.	0.173	0.572	0.762
h_log_InMig	h_log_OutMig L1.	0.220	0.132	0.096
	h_log_InMig L1.	0.602	0.104	0.000
	h_log_GDP L1.	-0.970	1.053	0.357
	h_log_OutMig L2.	-0.091	0.099	0.359
	h_log_InMig L2.	0.217	0.082	0.008
	h_log_GDP L2.	1.439	0.635	0.024
	h_log_OutMig L3.	0.063	0.096	0.515
	h_log_InMig L3.	-0.162	0.069	0.019
	h_log_GDP L3.	-0.648	0.691	0.348
h_log_GDP	h_log_OutMig L1.	0.040	0.015	0.007
	h_log_InMig L1.	-0.008	0.010	0.414
	h_log_GDP L1.	0.420	0.202	0.038
	h_log_OutMig L2.	0.011	0.016	0.504
	h_log_InMig L2.	-0.008	0.010	0.411
	h_log_GDP L2.	0.052	0.108	0.629
	h_log_OutMig L3.	0.036	0.018	0.044
	h_log_InMig L3.	0.026	0.008	0.003
	h_log_GDP L3.	0.130	0.115	0.257

When the logarithm of Beijing's firm out-migration is used as the dependent variable, its first-lag coefficient is significantly positive. This indicates that the relative change in out-migration exhibits a positive and statistically significant effect on the current period's out-migration, suggesting a certain degree of persistence in firm relocation behavior. In contrast, the second-and third-lag coefficients of out-migration are not significant, implying that past out-migration beyond the first lag does not have a notable effect on current out-migration. The first-lag coefficient of the logarithm of Beijing's firm in-migration is significantly positive. This indicates that the relative change in in-migration in the previous period has a significant positive effect on the current period's out-migration, meaning that an increase in the number of firms relocating to Beijing from a given region in the prior period tends to stimulate growth in the current period's out-migration from Beijing. In the short term, as in-migration increases, the market in the destination region may become gradually saturated and competition intensifies. This heightened competition can lead to resource constraints and rising costs, thereby encouraging firms to relocate elsewhere. Conversely, the third-lag coefficient of in-migration is negative, indicating that the relative change in in-migration over the preceding three periods has a significant inhibitory effect on current out-migration. This suggests the presence of a medium-term adjustment effect in firm relocation behavior: increased in-migration in earlier periods may restrain out-migration in the medium term. Specifically, rising in-migration can promote industrial chain agglomeration and the formation of industrial clusters, a favorable business environment may effectively reduce the propensity of Beijing-based firms to relocate.

The first-lag coefficient of the relative change in destination GDP is significantly negative. This indicates that the previous period's growth rate of destination GDP has a significant negative effect on the current relative change in Beijing's firm out-migration: the higher the short-term growth in destination GDP, the lower the relative change in out-migration. Therefore, a short-term increase in destination GDP growth may temporarily suppress the out-migration of Beijing-based firms. However, the second-lag coefficient of destination GDP growth is 1.680884 with a p-value of 0.001, indicating a significant positive effect on the current relative change in out-migration. In other words, higher GDP growth in the destination region over the preceding two periods leads to higher out-migration from Beijing. This suggests that firms may exhibit a sensitive short-term response to the economic growth of potential destination regions when making relocation decisions, reflecting a dynamic adjustment in their migration behavior.

When the logarithm of Beijing's firm in-migration (i.e., the relative change in in-migration) is used as the dependent variable, the effect of Beijing's firm out-migration exhibits a phased pattern. The first-lag coefficient of out-migration is 0.220 with a p-value of 0.096, which is not statistically significant but approaches the 10% significance level. This suggests that, in the short term, the relative change in out-migration may have a modest positive effect on in-migration, potentially reflecting market adjustments or policy changes that attract some firms back to

Beijing or draw new entrants. The second-and third-lag coefficients are not significant, indicating that the long-term effect of out-migration on in-migration is negligible and diminishes over time. The logarithm of in-migration itself exhibits a significant path dependence effect. The first-lag coefficient is significantly positive, indicating that past in-migration behavior in the short term further attracts new firms to relocate to Beijing. The second-lag coefficient is also positive and significant, reflecting the city's sustained medium-term advantage in attracting firms. However, the third-lag coefficient is significantly negative, suggesting that over a longer period, in-migration may lead to market saturation or competitive inhibition effects, reducing the willingness of new firms to relocate to Beijing.

The logarithm of regional GDP (i.e., the relative change in economic growth) exhibits a complex effect on Beijing's firm in-migration. First, the first-lag coefficient of regional GDP is not significant, indicating that short-term economic growth in other regions has a weak and statistically insignificant influence on the attraction of firms to Beijing. Additionally, in the short term, economic growth in other provinces may primarily manifest as market volatility or policy adjustments, which do not immediately attract firms to Beijing. Second, the second-lag coefficient of regional GDP is significantly positive, indicating that, in the medium term, economic growth in other regions can effectively attract firms to relocate to Beijing. This suggests that the stimulative effect of regional economic development on firm migration behavior begins to materialize over time.

When the logarithm of regional GDP (i.e., the relative change in GDP) is used as the dependent variable, the first- and third-lag coefficients of the logarithm of Beijing's firm out-migration are both significantly positive. This indicates that increases in Beijing's firm out-migration contribute to economic growth in the destination regions in both the short and longer term. In the short term, an increase in out-migration from Beijing may bring capital, technology, and talent to the destination, enhancing local productivity and market vitality. These regions can rapidly absorb and utilize these resources, injecting new dynamism into the local economy and producing an expansion effect. Furthermore, such migration may stimulate the development of upstream and downstream industries, fostering industrial clusters and strengthening regional economic competitiveness. Over the longer term, this positive effect remains significant, likely because destination regions gradually integrate the resources and technologies brought by relocating firms, which, through interactions and technology spillovers among enterprises, further enhance local firms' innovation capacity and industrial sophistication. Additionally, the entry of migrating firms may drive improvements in local institutional and market environments, triggering deeper structural adjustments and industrial upgrading. The first- and second-lag coefficients of Beijing's firm in-migration are not significant, while the third-lag coefficient is significantly positive, suggesting that in the long term, firm in-migration to Beijing has a notable positive impact on the GDP of source regions. Regarding the lagged effects of regional GDP itself, the first-lag coefficient is significantly positive, indicating a strong self-reinforcing effect of regional economic growth. In the short term, this accumulation

effect implies that current economic growth can further promote future development through mechanisms such as capital accumulation, technological progress, and market expansion. This positive feedback demonstrates the endogenous growth characteristics of regional economies, whereby the existing economic base and development level provide a stable foundation for subsequent growth, ensuring a degree of sustained short-term economic expansion.

2) Analysis of Impulse Response Results from the PVAR Model

Figure 1 presents the impulse response functions of the logarithmic values of Beijing's firm out-migration, in-migration, and regional GDP. In the figure, the central red solid line represents the impulse response of a variable to a one-standard-deviation shock in another variable. The shaded area surrounding the solid line denotes the 95% confidence interval, which is obtained from 200 Monte Carlo simulations. The vertical axis indicates the magnitude and direction of the response, while the horizontal axis represents the time horizon over which the response is observed.

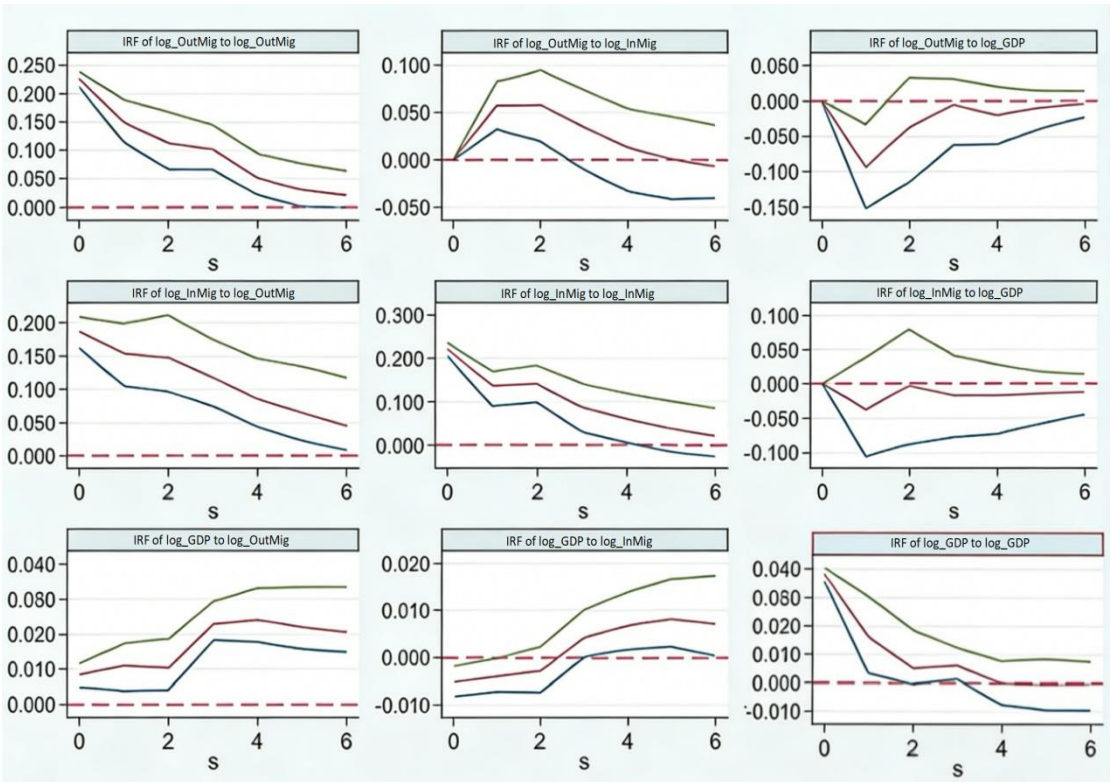

Figure 1: Impulse Response Functions

In the first row of Figure 1, the left panel illustrates the response of Beijing's firm out-migration (log_OutMig) to its own shock. It can be observed that the impact of out-migration on itself is strongest in the first period. Over the subsequent six

periods, the response remains positive but gradually declines, eventually approaching zero. The middle panel shows the response of out-migration to a shock in in-migration (log_InMig). During the first three periods following the shock, an increase in Beijing's firm out-migration significantly stimulates in-migration from other provinces to Beijing, with the response coefficient peaking in the first period. The right panel depicts the response of out-migration to a shock in regional GDP (log_GDP). The impulse response analysis indicates that in the first two periods following the shock, Beijing's firm out-migration exerts a significant negative effect on the GDP of the destination regions. This inhibitory effect reaches its maximum in the first period and gradually weakens thereafter.

In the second row of Figure 1, the left panel illustrates the response of Beijing's firm out-migration to a shock in in-migration. The impulse response analysis shows that, over six periods, the impact of an in-migration shock on out-migration remains positive throughout, but its magnitude exhibits a clear declining trend over time. The middle panel depicts the response of in-migration to its own shock. The results indicate that during the first five periods, the response remains positive, while its intensity monotonically decreases over time and essentially converges to zero by the sixth period. The right panel presents the response of in-migration to a shock in the GDP of the origin regions. The impulse response displays a persistent negative effect, which gradually weakens and eventually converges over time. When firms relocate from their original locations to Beijing, this movement directly leads to a loss of production factors in the origin regions. In particular, the relocation of high-quality firms entails the outflow of key resources such as capital, technology, and talent, thereby generating an immediate negative impact on local GDP. This adverse effect is most pronounced in the first period and then progressively attenuates.

In the third row of Figure 1, the left panel shows that the impulse response of Beijing's firm out-migration to a shock in destination-region GDP exhibits a progressively accelerating growth pattern. The impulse response analysis indicates that this effect remains positive throughout the horizon, and the attractiveness of destination-region GDP growth for the relocation of Beijing-based firms strengthens over time. The impact is relatively modest in the first two periods, accelerates after the second period, reaches a peak in the fourth period, and then stabilizes. The middle panel indicates that, in the first two periods following the shock, growth in the GDP of the origin regions exerts a negative effect on firms' in-migration to Beijing. This short-term inhibitory effect may operate through two mechanisms. First, short-term improvements in regional economic conditions may temporarily reduce firms' incentives to relocate. Second, during periods of economic expansion, local governments often intensify firm-retention policies, further dampening outward relocation. The right panel shows that the response of regional GDP to its own shock displays a clear pattern of decay and convergence. The magnitude of the response continuously weakens over time and eventually stabilizes.

4.2 Industry- and Firm-Level Heterogeneity Analysis Based on the ZINB Model

4.2.1 Model construction

This study focuses on heterogeneity at the industry and firm levels, with particular emphasis on two key firm-specific characteristics—firm age and firm size—in order to explore the channels and mechanisms through which they influence firm migration behavior. This study takes publicly listed firms in Beijing as the primary research sample. According to the statistics, by the end of the study period, the cumulative number of relocation events involving Beijing's listed firms during 2010–2024 amounted to 13,390, while the total number of firm relocations over the same period was approximately 370,000. Thus, relocations by listed firms account for about 3.62% of all firm migration events. Although listed firms represent only a small share in terms of quantity, they are typically larger in scale and more representative; therefore, their relocation behavior can effectively reflect the overall migration trends of firms in Beijing. The data used in this study are obtained from the firm migration monitoring module of the Shangqi Industry Information platform, covering interprovincial relocation activities of Beijing's listed firms from 2010 to 2024. In accordance with the research objectives, the raw data were systematically and cleaned by removing observations with missing information or evident outliers, thereby ensuring data validity and analytical reliability. The final dataset consists of 572 listed firms, with a total of 13,390 recorded relocation events over the period 2010–2024.

The explained variable is the number of relocation events undertaken by listed enterprises originally registered in Beijing, which is intended to capture the frequency of firms' interprovincial relocation. Registered capital and firm age are taken as the core explanatory variables, and a set of control variables is further introduced to ensure a more comprehensive explanation of firms' relocation behavior.

This study further incorporates multiple control variables to enhance the explanatory power of the model. Regional economic conditions are measured using the gross domestic product of the district in which the firm is located and the GDP of the destination region to which the firm relocates. In addition, a dummy variable for high-tech enterprises is introduced to control for differences in relocation decisions between high-tech and non-high-tech firms, and another dummy variable is included to indicate whether a firm belongs to the manufacturing sector. To further improve model fit and explanatory capacity, fixed effects are incorporated into the regression framework. Specifically, year fixed effects are included to control for intertemporal variations, and district-level fixed effects are added to account for heterogeneity across regions.

Table 6: Please write your table caption here

		Variable	Variable definition	Mean	Std. dev.	Min	Max
Dependent Variable		MOVE	Number of Relocations by Listed Enterprises	1.561	3.970443	0	428
Explanatory Variables		ln_RC	Log of Firm Registered Capital	11.56731	2.183629	5.010635	17.389
		AGE	Firm Age at Relocation	15.32905	8.266557	0	43
Control Variables	Firm Characteristics	HNTE	High-Tech Enterprise: Yes = 1, No = 0	0.5207618	0.4995874	0	1
		MFG (manufacturing)	Manufacturing Enterprise: Yes = 1, No = 0	0.3981779	0.4895408	0	1
	Regional Variables	AREA	District in Beijing where the Firm is Located	9.712173	3.918475	1	16
		QGDP	GDP of the Firm's District in Beijing	4311.596	3278.968	67.7	12907.1
		SGDP	GDP of the Destination Province	26702.23	33448.94	0	141633.8
	Time Controls	YEAR	Year of Relocation	2017.321	4.113541	2010	2024

In the practical application of firm relocation data, a large proportion of zero values is often observed. In such cases, traditional Poisson or negative binomial regression models may produce substantial bias and fail to accurately capture the true characteristics of relocation behavior. To more effectively explain and predict data structures characterized by a high proportion of zeros and significant heterogeneity across firms, this study employs a Zero-Inflated Model (ZIM) for analysis.

To evaluate the goodness-of-fit of different models, this study estimated four models: Poisson regression, negative binomial regression, zero-inflated Poisson regression (ZIP), and zero-inflated negative binomial regression (ZINB), and compared their Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) values. The results indicate that the AIC and BIC of the negative binomial model are substantially lower than those of the Poisson model, suggesting that the negative binomial model outperforms the Poisson model. Similarly, the AIC and BIC of the ZINB model are significantly lower than those of the ZIP model, demonstrating that under the zero-inflated framework, the negative binomial

specification also outperforms the Poisson specification. Among all models, the ZINB model achieves the lowest AIC and BIC values, with an AIC of 32,886.04 and a BIC of 32,976.06, indicating superior fit in simultaneously addressing both overdispersion and zero inflation in the data. Therefore, considering both model fit and data characteristics, this study ultimately adopts the ZINB to model the number of firm relocations, allowing for a more accurate capture of the patterns of firm relocation behavior and its underlying determinants.

Table 7: Comparison of Model Information Criteria

Model	AIC	BIC
Poisson	37072.72	37125.23
Negative Binomial	32993.98	33061.5
ZIP	36634.81	36732.34
ZINB	32886.04*	32976.06*

Accordingly, this study assumes that the dependent variable follows a ZINB distribution and estimates the model using the Maximum Likelihood Estimation method. The resulting model can be expressed by the following equation:

$$E(MOVE_{i,\ t}) = exp(\alpha + \beta_1 ln\_RC_{it} + \beta_2 AGE_{it} + \sum_{i=1}^{n} \delta_i C_{it} + \sum YEAR + \sum AREA + \mu_{it}) \quad (2)$$

Where i denotes a specific firm, and t denotes a specific year; $\mathrm{MOVE}_{\mathrm{i},\ \mathrm{t}}$ represents the number of relocations by the firm in year t; $\mathrm{ln\_RC}_{\mathrm{it}}$ and $\mathrm{AGE}_{\mathrm{it}}$ are the explanatory variables, specifically the logarithm of the firm's registered capital and firm age, respectively. C_{it} represents a set of other control variables that may affect the dependent variable, $\sum$YEAR captures year fixed effects, $\sum$AREA captures district fixed effects, and μ denotes the random error term.

4.2.2 Empirical Results

Initial model estimation indicates that the specification excluding the GDP of the destination region achieves better goodness-of-fit and greater variable significance compared with the alternative model, aligning more closely with the actual characteristics of firm relocation from Beijing.

1) Analysis of Industry Heterogeneity Results

Regarding industry-specific characteristics, the empirical results from the count component indicate that high-tech enterprises and manufacturing firms exhibit significantly fewer relocations compared with other types of firms.

This pattern likely reflects the high spatial stickiness of high-tech enterprises. Compared with conventional firms, high-tech enterprises often rely heavily on local scientific and technological resources, research institutions, specialized talent, and knowledge externalities, making their relocation behavior subject to stronger

geographic constraints. Moreover, as Beijing serves as the national center for technological innovation, it provides high-tech firms with a favorable policy environment and an integrated innovation ecosystem, thereby reducing the incentives for outward relocation. Balancing costs and collaborative advantages, high-tech enterprises tend to "stay in place" rather than engage in interregional moves. Similarly, the significantly lower relocation frequency of manufacturing enterprises partly reflects the high barriers to relocation in this sector. Manufacturing firms typically exhibit strong physical and industrial chain dependencies, with substantial fixed-asset investments, high relocation costs, and complex site-selection considerations, all of which contribute to a generally lower propensity to relocate. Moreover, although Beijing has actively promoted industrial restructuring and the relocation of non-capital functions in recent years—encouraging some manufacturing enterprises to move to neighboring provinces or other regions—the practical outcomes have been limited. Many firms continue to face real-world challenges such as land-use approvals, policy coordination, and supply chain reorganization, leaving them in a cautious or slow relocation phase; thus, overall relocation behavior has not yet fully materialized. In the ZINB model, the zero-inflation component is used to identify the likelihood that certain observations correspond to "structural zeros," that is, firms that will never relocate. This component predicts the probability that an observation belongs to the latent subgroup that is "always zero."

In the Zero-Inflated Negative Binomial (ZINB) model, the zero-inflation component is used to identify the likelihood that certain observations represent "structural zeros," namely, firms that will never relocate. This component predicts the probability that an observation belongs to the latent subgroup that is "always zero." It is modeled using a logistic regression framework, allowing the analysis of which factors significantly influence the probability of a firm not relocating at all.

Regarding industry-specific characteristics, the empirical results from the zero-inflation component indicate that high-tech enterprises are more likely to belong to the "zero-relocation" subgroup. After controlling for firm-level characteristics, industry attributes still exert a significant influence on whether a firm is part of the "never relocate" group. Specifically, the coefficient for the high-tech enterprise variable is positive and significant at the 1% level, indicating that high-tech firms are more likely to remain in the "zero-relocation" subgroup. In contrast, manufacturing enterprises are less likely to belong to the "zero-relocation" group. The coefficient for manufacturing firms in the zero-inflation component is negative and significant at the 1% level, suggesting that manufacturing enterprises are more likely to exit the "zero-relocation" subgroup and engage in actual relocation. This tendency may be related to their more frequent spatial adjustments and higher sensitivity to production factor costs.

It is noteworthy that manufacturing enterprises exhibit a pronounced dual pattern in relocation behavior. On one hand, in the zero-inflation component, manufacturing firms are less likely to belong to the "never relocate" group, indicating a higher probability of initiating their first relocation. On the other hand, in the count

component, the relocation frequency of manufacturing firms is significantly lower than that of non-manufacturing enterprises. Although these results may appear contradictory, they reveal a "polarized" pattern in the relocation behavior of manufacturing firms. Once motivated to relocate, manufacturing enterprises can more easily break their original locational stability and undertake an initial move. However, due to strong spatial stickiness and substantial fixed-asset investments, their subsequent relocation frequency remains relatively low. Relocation decisions are often accompanied by high uncertainty costs and production disruption risks; therefore, after the first relocation, firms tend to seek a stable long-term location, reducing the likelihood of frequent subsequent moves.

2) Analysis of Firm Heterogeneity Results

In the count component of the model:

First, firm registered capital has a significant positive effect on the number of relocations. The results indicate that the logarithm of registered capital (ln_RC) is positively and significantly associated with relocation frequency, which contrasts with the findings of most existing studies suggesting that smaller firms are more likely to relocate than larger ones. Further plotting of marginal effects shows that as the logarithm of firm registered capital increases, the number of relocations grows proportionally. This discrepancy may stem from differences in the definition of "firm relocation." In this study, the definition is broadened to include not only changes in the registered location but also outward investment and the establishment of branch offices, thereby capturing a more comprehensive set of relocation pathways. Under this broader definition, larger firms do not necessarily forgo relocation due to their size; instead, they may be more motivated to undertake "partial" relocations—such as establishing branch offices in other regions or making outward investments—when faced with spatial constraints at their original location or strategic expansion needs. This explains why larger firms exhibit higher relocation frequencies in this context.

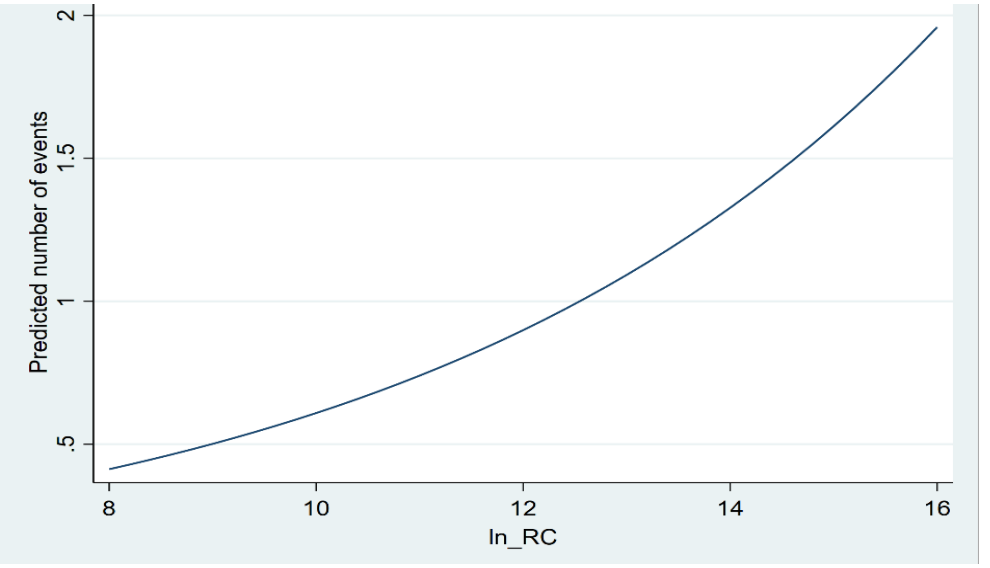

Figure 2: Marginal Effect of Registered Capital on the Number of Relocations

Second, firm age exhibits an inverted U-shaped relationship with the number of relocations. In initial analyses, when only firm age was included in the model, the regression results were not significant, indicating that relocation frequency does not have a linear relationship with firm age. Therefore, both firm age and its squared term were incorporated into the model to examine potential non-linear effects. The regression results show that the coefficient of firm age is negative while the coefficient of the squared term is positive, and both are statistically significant. This indicates an inverted U-shaped relationship between firm age and relocation frequency, suggesting that firms' propensity to relocate initially increases during their growth phase and subsequently declines as they mature. Further plotting of the marginal effects illustrates that relocation frequency peaks during the middle-age stage of firms and gradually decreases thereafter. Figure 3 presents this trend in the form of a marginal effect plot, with the horizontal axis representing firm age and the vertical axis representing predicted number of relocations, accompanied by 95% confidence interval bands. The plot shows a clear inverted U-shaped pattern: firms exhibit relatively few relocations during the initial stage (0–5 years), then relocation frequency gradually increases with age, reaching a maximum around 20 years. As firms further mature and stabilize, their propensity to relocate diminishes, and predicted relocation frequency decreases despite increasing age. This non-linear trend highlights the significant life-cycle characteristics of firm relocation behavior. In the figure, the length of the error bands (95% confidence intervals) slightly expands as firm age increases, particularly in the higher-age range, indicating greater uncertainty in the relocation behavior of older firms. This may be related to the relatively smaller number of high-age firms in the sample and their stronger heterogeneity.

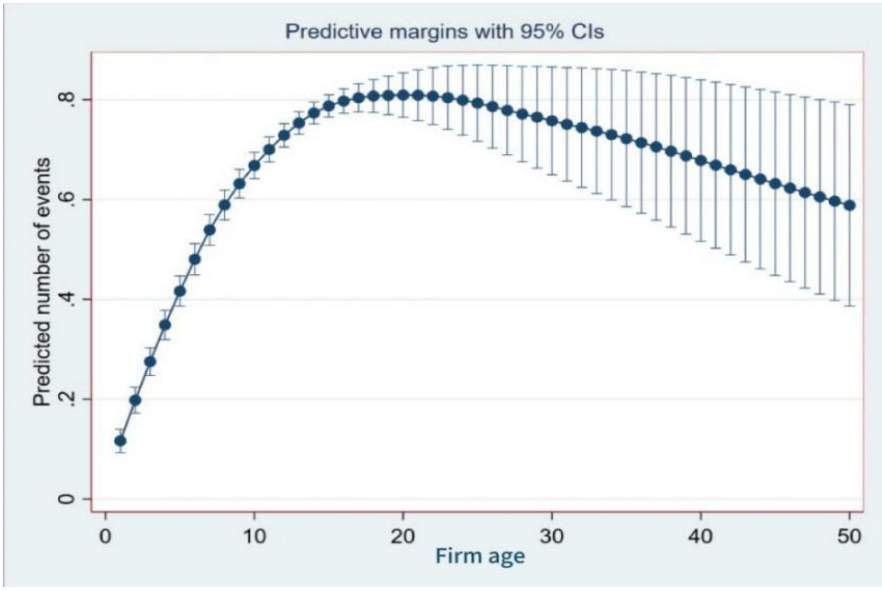

Figure 3: Marginal Effect of Firm Age on the Number of Relocations

For the zero-inflation component:

First, firm size, as measured by registered capital, is not a key determinant of "structural zero" relocation. According to the model estimates, the regression coefficient of firm registered capital (ln_RC) in the zero-inflation component is 0.019. Although positive, it is statistically insignificant with a p-value of 0.882. This indicates that, after controlling for other factors, registered capital has no significant effect on whether a firm belongs to the group that "never relocates." In other words, firms of different sizes—small, medium, and large—may all be in a non-relocation state, and firm size, as proxied by registered capital, does not constitute a decisive factor in determining "structural zero" relocation behavior. This study adopts a broader definition of firm relocation than most existing research, encompassing not only changes in the registered address but also geographic expansion behaviors such as the establishment of branch offices and outward investment. Under this more inclusive definition, the behavioral boundary of relocation is substantially widened and the associated costs are relatively lower. As a result, firm registered capital does not exhibit significant discriminatory power in determining whether a firm remains in a "structural zero" relocation state.

Second, firm age exerts a negative effect on the likelihood of entering a zero-relocation state. The coefficient of firm age in the zero-inflation component is negative and statistically significant, indicating that older firms are less likely to belong to the group that "never relocates." By contrast, the squared term of firm age has a significantly positive effect, suggesting a non-linear, inverted U-shaped relationship between firm age and the probability of zero relocation. Specifically, both younger firms and very mature firms are more inclined to remain in a zero-relocation state, whereas mid-aged firms are the least likely to exhibit zero

relocation. This pattern is consistent with real-world dynamics, as firms in their middle stage of development are more likely to engage in relocation due to expansion needs or structural adjustments.

Table 8: Estimation Results of the Zero-Inflated Negative Binomial (ZINB) Model

		Variable	Coef.	Std. Err.	z-value	p-value
Count Component (ZINB)		ln_RC	0.195	0.006	33.960	0.000
		AGE	-0.014	0.005	-2.670	0.008
		AGE^2	0.001	0.103	2.090	0.037
		Located GDP	0.002	0.050	3.130	0.002
		Log of Destination GDP (ln_GDP)	.0613	.0121	5.070	0.000
		HNTE	-0.090	0.026	-3.490	0.000
		MFG	-0.289	0.023	-12.610	0.000
Zero-Inflation Component (inflate)	Including Destination GDP	ln_RC	0.000	2723.433	-0.000	1.000
		AGE	0.000	2364.617	0.000	1.000
		AGE^2	0.000	63.19976	-0.000	1.000
		QGDP	0.000	10437.56	-0.000	1.000
		RGDP	0.000	5800.027	-0.00	1.000
		HNTE	0.000	11529.61	-0.000	1.000
	Excluding Destination GDP	ln_RC	0.019	0.129	0.150	0.882
		AGE	-2.205	0.583	-3.780	0.000
		AGE^2	0.054	0.015	3.680	0.000
		QGDP	1.556	0.608	2.560	0.010
		HNTE	-2.059	0.689	-2.990	0.003

At the same time, the gross domestic product (GDP) of the origin region has a significant positive effect on the number of firm relocations. The model results indicate that firms from economically more developed regions are more likely to engage in interprovincial relocation. On one hand, economically advanced regions typically have a higher concentration and density of firms, which exhibit greater activity and more outward-oriented business characteristics, thereby increasing the probability of relocation. On the other hand, rising factor prices associated with regional economic growth—such as higher land rents and labor costs—may impose greater cost pressures on firms, motivating them to seek more favorable development environments elsewhere. Moreover, firms in economically developed regions generally possess stronger resource integration capabilities in terms of capital, information, and management, enabling them to better overcome uncertainties and institutional frictions encountered during relocation, thus enhancing the feasibility of cross-regional moves.

Furthermore, to control for the systematic impact of macro-level temporal trends on firm relocation behavior, this study incorporates year fixed effects into the regression model, capturing time effects that are invariant across individual firms. The regression results show that the fixed-effect coefficients for the vast majority of years are positive and statistically significant, indicating that, after controlling for other variables, firm relocation activity has increased significantly relative to the baseline year (2010). This upward trend is particularly pronounced in several specific years.

Starting from 2012, firm relocation activity showed a marked increase, which further intensified after 2014, with the coefficients for 2014–2016 all significantly positive. Notably, 2014 represented a key policy milestone: in February, the State Council released the preliminary outline of the "Beijing-Tianjin-Hebei Coordinated Development Plan," and Beijing subsequently launched the "Relocation of Non-Capital Functions" strategy, explicitly proposing the gradual outward transfer of general manufacturing, regional logistics hubs, and certain educational and medical resources, thereby promoting a rational spatial allocation of industries toward surrounding regions such as Hebei and Tianjin. In 2015, the Beijing-Tianjin-Hebei coordinated development strategy was further clarified when the National Development and Reform Commission formally issued the "Beijing-Tianjin-Hebei Coordinated Development Plan Outline" in April, setting a clear direction for optimizing Beijing's urban functions—namely, "controlling increments and reducing stock"—while planning the establishment of Beijing's sub-center and advancing the construction of the Xiong'an New Area. Data show that the year fixed-effect coefficient for 2015 is positive and significant, indicating that firms began to accelerate relocation in response to policy guidance. The peak of relocation activity occurred in 2017, coinciding with a critical stage of Beijing's comprehensive push to relocate non-capital functions. In its 2017 Government Work Report, the Beijing municipal government emphasized the need to "fully advance the special action for relocation, rectification, and enhancement," marking 2017 as a pivotal year for urban function restructuring. Policies were implemented to strictly limit the expansion of low-end industries, expedite industrial exit and relocation, and in July of the same year, the Xiong'an New Area was established to centralize the relocation of non-capital functions from Beijing. In the subsequent years (2018–2021), relocation activity remained relatively high, likely reflecting the continued implementation of the policies and the gradual manifestation of spillover effects along industrial chains. By 2024, the year fixed-effect coefficient declined to a negative value and was no longer significant. This change may be associated with macroeconomic uncertainties, strategic contraction by firms, or the fact that enterprises responsive to earlier policies had already completed their relocations, leaving remaining firms with weaker relocation incentives and relatively stable behavior.

Table 9: Year Fixed Effects Results from the ZINB Model

YEAR	Coef.	Std. Err.	z-value	p-value
2011	0.138	0.075	1.830	0.067
2012	0.553	0.071	7.800	0.000
2013	0.146	0.076	1.930	0.054
2014	0.277	0.074	3.760	0.000
2015	0.374	0.072	5.230	0.000
2016	0.546	0.071	7.670	0.000
2017	0.746	0.07	10.620	0.000
2018	0.512	0.074	6.910	0.000
2019	0.55	0.077	7.140	0.000
2020	0.604	0.077	7.820	0.000
2021	0.745	0.08	9.340	0.000
2022	0.552	0.084	6.600	0.000
2023	0.636	0.086	7.380	0.000
2024	-0.04	0.103	-0.390	0.695

5. Conclusions and Insights

Based on firm relocation data in Beijing from 2010 to 2024, this study systematically analyzes the characteristics and mechanisms of enterprise relocation at both macro and micro levels. At the macro level, a panel vector autoregression (PVAR) model incorporating the number of outbound and inbound relocations and regional gross domestic product (GDP) was constructed to reveal the dynamic relationship between firm relocation and regional economic development. The findings indicate that Beijing's firm relocation behavior exhibits clear path dependence and self-reinforcing patterns: in the short term, outbound relocations help release locational resources and attract new firms, whereas sustained long-term relocations may weaken the region's attractiveness and competitiveness. Additionally, the impact of firm relocation on the economy of the destination region displays stage-specific characteristics, transitioning from short-term adaptation costs to medium- and long-term promoting effects, with GDP growth in the destination region progressively enhancing the attractiveness for outbound relocations. At the micro level, analysis using the Zero-Inflated Negative Binomial (ZINB) model on the relocation data of Beijing-listed firms reveals that firm size has a significant positive effect on relocation frequency, firm age exhibits an inverted U-shaped relationship with relocation frequency, manufacturing enterprises have relatively lower overall relocation frequency, and high-tech firms are more likely to remain in a "never relocate" state. These results indicate that firm characteristics play a key role in relocation decisions, with different types of firms exhibiting varying sensitivities to regional policies and market conditions.

In summary, firm relocation in Beijing is influenced not only by firm-specific characteristics but also exhibits complex dynamic effects under the macroeconomic

environment, exerting significant direct and indirect impacts on regional economic development.

Based on a systematic analysis of firm relocation behavior in Beijing, this study finds that enterprise relocation is influenced not only by firm-specific characteristics but also by the macroeconomic environment, regional policies, and industrial layout. Relocation patterns exhibit significant heterogeneity across firm types, industry attributes, and stages of the firm life cycle, while also showing dynamic evolution across space and time. In light of these findings, the following policy recommendations are proposed to promote coordinated regional economic development, optimize resource allocation, and enhance urban attractiveness.

First, by rationally arranging industries, improving infrastructure, and strengthening public services, Beijing can enhance its overall attractiveness to a diverse range of firms. Such measures help to alleviate the negative consequences of long-term outbound relocations while fostering a more favorable business environment. Second, improving the regional development environment allows for more efficient allocation of resources, as enterprises are guided toward locations and sectors that match their strategic needs. This not only supports individual firm growth but also contributes to the optimization of the city's industrial structure. Third, a well-developed and attractive urban environment encourages firms to remain or expand locally, reducing excessive outward migration and maintaining Beijing's competitiveness as a national and regional economic hub. This creates a virtuous cycle in which urban development and firm retention mutually reinforce each other.

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