

A Study on Human Resource Flow and Optimal Allocation in Liaoning Province from the Perspective of Regional Coordinated Development

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Abstract: From the perspective of regional coordinated development, the rational flow and optimal allocation of human resources is a crucial support for advancing the construction of the "One Circle, One Belt, Two Zones" in Liaoning Province. In recent years, Liaoning Province has experienced a continuous decline in its total population, a deepening trend of aging, a sustained decrease in the proportion of the working-age population, and a long-term negative natural population growth rate. Although there have been periodic net inflows of inter-provincial population, the scale is limited and insufficient to reverse the overall trend of population contraction and structural aging. The province's human resources exhibit an imbalanced pattern, concentrating in core cities such as Shenyang and Dalian, while less developed areas face continuous outflow, highlighting prominent issues of irrational human resource allocation between regions and between urban and rural areas. This situation directly leads to a widening regional development gap within the province, lagging urban-rural integration, insufficient labor supply, rising labor costs, which undermines the momentum of economic development and also constrains the effective advancement of the regional coordinated development strategy. Based on this, this paper proposes countermeasures and suggestions from three aspects: optimizing the spatial layout of human resources, promoting the orderly flow of human resources between urban and rural areas, and strengthening the development of human resources across all age groups. By balancing regional public services, improving the employment and training systems, and tapping into the potential of human resources across all ages, the efficiency of human resource allocation can be enhanced, alleviating the pressures brought by population aging and contraction, thereby providing stable human resource support for Liaoning Province to achieve regional coordinated development and comprehensive revitalization.

Keywords: Regional Coordinated Development; Human Resource Flow; Optimal Allocation; Population Aging; Liaoning Province

1. Instruction

Within the framework of the Three-Year Action Plan for Promoting the "One Circle, One Belt, Two Zones" Regional Coordinated Development in Liaoning Province, facilitating the rational flow and optimal allocation of human resources has become a core link in achieving regional synergistic development. However, the current demographic structural changes in Liaoning Province pose severe challenges to the implementation of this strategic goal. According to the latest statistics, the resident population of Liaoning Province had dropped to approximately 41.31 million by 2025, a decrease of over 1.2 million compared to 2020. Concurrently, the age structure exhibits characteristics of deep aging, with the proportion of the population aged 60 and above reaching as high as 32.58%, while the share of the working-age population (16–59 years old) fell to 57.18%. A noteworthy turning point is that since 2023, after years of net population outflow, Liaoning achieved a net population inflow from other provinces for the first time; yet, during the same period, the natural population growth rate dropped to a deeply negative level of -6.88%. This indicates that Liaoning is facing a complex situation characterized by the coexistence of a continuing contraction in total population, an accelerating aging structure, and a slight shift in inter-provincial migration trends. This trend of "declining quantity and aging quality" of human resources not only directly weakens the endogenous drivers of economic development but may also exacerbate development imbalances among different

regions within the province, thereby constraining the advancement of the regional coordinated development strategy. Therefore, from the macro perspective of regional coordinated development, systematically analyzing the current characteristics and underlying impacts of human resource flows in Liaoning Province and exploring effective pathways for its optimal allocation hold significant theoretical value and practical urgency.

2. Phenomena and Characteristics of Human Resource Flows in Liaoning Province

2.1 Overall Shrinkage and Profound Population Aging

From a trend perspective, between 2020 and 2025, the supply structure of human resources in Liaoning Province is undergoing profound changes. The dual challenges of sustained total population contraction and deepening age structure aging are reshaping the region's demographic landscape. In terms of total population, as illustrated in Figure 1, the province's resident population has declined from 42.591 million in 2020 to 41.310 million in 2025, marking a cumulative decrease of 1.281 million. This trajectory clearly signals a persistent, long-term trend of population shrinkage. Concurrently, changes in the age structure are even more pronounced. By 2025, the proportion of the population aged 60 and above had risen to 32.58%, approaching one-third of the total population. In contrast, the share of the working-age population (16–59 years old) fell to 57.18%. This structural shift signifies that the province's labor resources are not only diminishing in absolute quantity but are also experiencing accelerated aging within the remaining workforce. Together, these trends point toward the gradual closure of the traditional demographic dividend window, posing significant implications for future economic vitality and social sustainability.

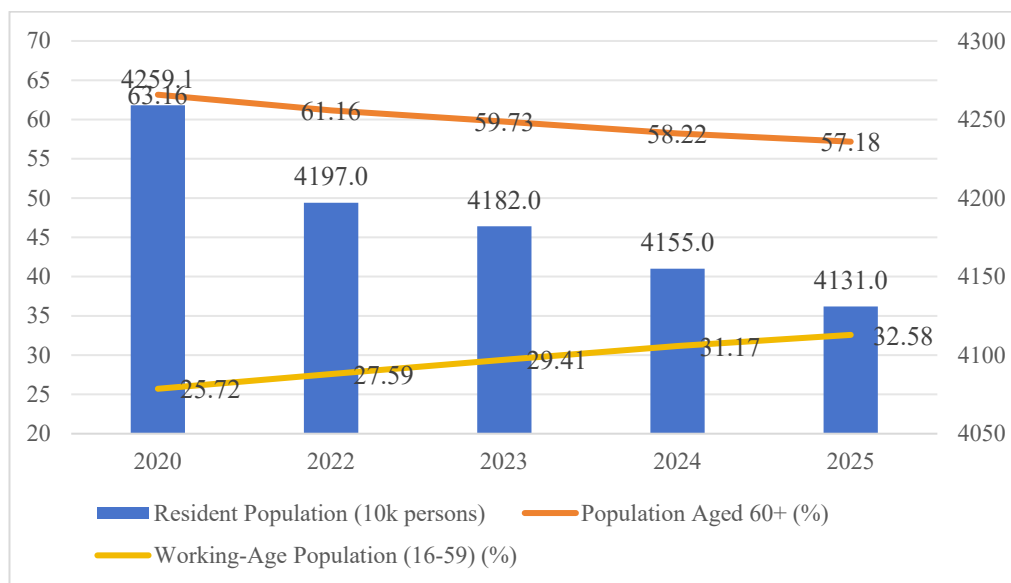


Figure 1 Trends in the Total Resident Population and Age Structure of Liaoning Province

This phenomenon of "contraction and aging" in Liaoning Province stems from the combined and sustained effects of long-term natural population decline and emerging inter-provincial migration dynamics. Key data on recent demographic changes are detailed in Table 1, highlighting a concerning trajectory. The figures reveal that the natural growth rate remains entrenched deeply in negative territory, falling to -6.88% in 2025, a trend that signals the persistence and potential irreversibility of intrinsic population contraction. Although inter-provincial migration shifted from net outflow to net inflow in 2023, providing a partial and much-needed buffer against the ongoing population decline, its current scale remains insufficient to offset the long-term structural deficit caused by natural decrease. Consequently, Liaoning has entered a distinct demographic phase characterized by simultaneous population decline and accelerated aging, wherein the aging of the labor force is becoming increasingly pronounced. This dual pressure directly undermines labor supply, increases social dependency ratios, and weakens the endogenous drivers of regional economic development, posing significant challenges to sustainable growth and equitable development across the province [1].

Table 1 Natural Population Growth Rate and Inter-provincial Migration in Liaoning Province (2020-2025)

<i>Year</i>	<i>Natural Growth Rate (%)</i>	<i>Net Inter-Provincial Inflow (10,000 persons)</i>
2020	(Not reported)	(Not reported)
2021	-4.18	(Not reported)
2022	-4.96	(Not reported)
2023	-5.63	8.6
2024	-5.3	-4.9
2025	-6.88	4.5

Data source: Compiled from the Statistical Bulletins of Liaoning Province, 2020–2025.

2.2 Spatial Imbalance in Regional Distribution

There is a significant spatial imbalance in the distribution of human resources in Liaoning Province, primarily manifested in a pattern of "core agglomeration and peripheral shrinkage." Core cities such as Shenyang and Dalian, relying on relatively well-developed industries and public services, continue to maintain their appeal to the population. Even against the backdrop of natural population decline across the province, these cities have sustained a basic population size by absorbing people from other regions within the province, resulting in a pronounced population agglomeration effect. Within the "Shenyang Modern Metropolitan Area," this trend is even more evident, as human resources from surrounding areas continuously converge towards the central city, leading to a widening gap between the core and the periphery. Simultaneously, most cities in regions such as northwest and east Liaoning are facing severe population outflow. Cities like Fuxin, Chaoyang, and Tieling have experienced continuous declines in their resident populations, with some counties and districts seeing an average annual population decrease exceeding 1%. These regions, constrained by a relatively homogeneous industrial structure, limited employment opportunities, and comparatively insufficient public services, struggle to retain local young and middle-aged labor forces and fail to attract external populations. This situation is particularly pronounced in some resource-dependent cities, creating a cycle of "shrinking population - slower development - fewer opportunities." Even within the coastal economic belt, cities other than Dalian find it challenging to attract population, revealing considerable imbalance in development within the region.

Shenyang, Dalian, and other core cities with continuous population inflows face increasing pressure on public services such as housing, transportation, and education, and a gradual rise in the cost of living. In contrast, regions with persistent population outflow, such as northwest and east Liaoning, face issues like labor shortages, constrained industrial development, and shrinking consumer markets. The utilization rate of public service facilities declines, making it difficult to maintain normal operations, and regional developmental vitality continues to weaken. Driven by ongoing population mobility, the development gap among different regions within the province is further widened, making the goal of regional coordinated development difficult to achieve effectively. This mismatch between the distribution of human resources and the developmental needs of different regions in Liaoning has become a key constraint on the province's overall coordinated development ^[2].

2.3 Concurrent Natural Decrease and In-migration from Other Provinces

During the 14th Five-Year Plan period, Liaoning Province's population dynamics have exhibited two seemingly contradictory yet coexisting new characteristics. On the one hand, influenced by low fertility rates and deep aging, the trend of natural population decline is pronounced. The province's natural population growth rate was -5.63‰ in 2023, -5.30‰ in 2024, and further dropped to -6.88‰ in 2025. This endogenous contraction continuously reduces the local population base, persistently diminishing the labor supply. On the other hand, significant changes have occurred in population migration. After more than a decade of net population outflow, Liaoning achieved a net inter-provincial population inflow of 86,000 people in 2023 for the first time, indicating a strengthened appeal to populations from neighboring provinces. However, this shifted to a net outflow of 49,000 people in 2024. Although it returned to a net inflow of 45,000 people in 2025, the scale remains limited, suggesting that the trend of in-migration is still unstable and susceptible to changes in the economic environment and job market. This pattern of persistent local decrease coupled with fluctuating external inflows has become a key feature of Liaoning's current population dynamics.

This coexistence has multiple impacts on human resource allocation. Quantitatively, even in years with net inter-provincial population inflow, the scale is far from sufficient to compensate for the gap caused by natural decrease, and the total resident population of the province continues to decline. Structurally, the natural decrease of the local population accelerates the aging of the labor force. Although incoming migrants are predominantly young and middle-aged, which helps partially improve the age structure, the instability of this flow makes the ameliorating effect difficult to sustain. Particularly noteworthy is that inter-provincial migrants are mostly concentrated in central cities like Shenyang and Dalian, which to some extent exacerbates the phenomenon of “core agglomeration and peripheral shrinkage.” Consequently, marginal regions such as northwestern and eastern Liaoning, while grappling with the pressure of local population decline, find it even harder to gain developmental momentum from incoming migrants. Research indicates that this coexistence of negative natural population growth and specific migration patterns in Northeast China intertwines the issues of labor force aging and regional development imbalance, posing a dual challenge to regional revitalization^[3].

3. Major Issues Arising from Human Resource Mobility

3.1 Widening Regional Development Disparities within the Province

The development gap between regions within Liaoning Province continues to widen, with significant disparities evident across multiple dimensions including economic output, industrial structure, and public services. In 2023, the combined GDP of Shenyang and Dalian reached approximately 1.69 trillion yuan, accounting for over 55% of the province's total economic output. In contrast, regions such as northwest Liaoning have long accounted for a disproportionately low share of the economy, highlighting a pronounced imbalance in regional development. Driven by the continuous concentration of population towards core cities, this development gap is becoming increasingly entrenched. The central cities, benefiting from a steady supply of talent, maintain relatively rapid growth, while regions experiencing population outflow suffer from insufficient development momentum and slower overall growth rates.

Leveraging a continuous inflow of highly skilled talent, Shenyang and Dalian are progressively advancing the development of high-tech industries and modern services, with a relatively fast pace of industrial structural upgrading. In comparison, regions like northwest and east Liaoning have long grappled with brain drain. The transformation of their traditional industries lacks adequate technological and human capital support, the cultivation of emerging industries is slow, industrial competitiveness continues to weaken, and they are gradually being marginalized within the province's regional division of labor. As a result, the level of open economic development in Liaoning exhibits marked spatial disparities. Shenyang and Dalian concentrate a large share of resources and advantages, while the openness and development levels of western and northern Liaoning lag significantly behind.

Differences in population flows are also continuously widening the gap in public service levels between regions. Shenyang and Dalian, with their ongoing population inflows, face strong demand for public services such as education and healthcare. Consequently, fiscal investment is continually increasing, and service capacity is steadily improving. In contrast, cities like Fuxin and Tieling, experiencing continuous population outflow, see lower utilization rates of public service facilities, leading to idle resources in some areas. Limited local investment capacity makes it difficult to improve service levels. This gap in public services further diminishes the attractiveness of less developed regions, exacerbating the problem of talent loss and perpetuating a lack of development momentum. This situation creates significant pressure on achieving the province's goal of coordinated regional development under the "One Circle, One Belt, Two Zones" framework.

3.2 The Problem of Uncoordinated Urban-Rural Development Has Become Increasingly Prominent

The issue of uncoordinated urban-rural development in Liaoning Province is evident in multiple aspects. Regarding income, the absolute income gap between urban and rural residents continues to widen. The per capita disposable income difference was 22,926 yuan in 2020, which expanded to 26,115 yuan by 2025. Although the urban-rural income ratio decreased from 2.31:1 to 2.09:1, the pressure on increasing rural residents' income remains substantial. In terms of demographic structure, the rural population continues to decline, dropping from 11.865 million in 2020 to 10.48 million in 2025, a net decrease of 1.385 million over five years. Concurrently, the province's aging trend is intensifying, with the proportion of the population aged 60 and above rising from 25.72% in 2020 to

32.58% in 2025. In resource allocation, the declining rural population has led to lower utilization rates of public service facilities and a relative decline in the quality of public services such as education and healthcare. This further diminishes the attractiveness of rural areas to talent, creating a vicious cycle. The overall level of integration between urban and rural areas across economic, social, and public service dimensions remains low, and unbalanced resource allocation constrains coordinated development^[4]. The main changes in the aforementioned indicators of urban-rural development are detailed in Table 2.

Table 2 Main indicators of urban-rural development in Liaoning Province, 2020–2025

<i>Year</i>	<i>Urban Income (¥)</i>	<i>Rural Income (¥)</i>	<i>Inc Ratio</i>	<i>Urban Pop (10k)</i>	<i>Rural Pop (10k)</i>	<i>Urb Rate (%)</i>
2020	40376	17450	2.31:1	3072.6	1186.5	72.14
2021	43051	19217	2.24:1	3079.4	1150	72.81
2022	44003	19908	2.21:1	3064	1133	73.00
2023	45896	21483	2.14:1	3074	1108	73.51
2024	47982	22744	2.11:1	3082	1073	74.18
2025	50057	23942	2.09:1	3083	1048	74.63

Data source: Compiled from the Statistical Bulletins of Liaoning Province, 2020–2025.

3.3 Population Aging Weakening the Momentum of Economic Development

With the declining proportion of the working-age population and the rapid rise in the proportion of the elderly population in Liaoning Province, the fundamental supporting conditions for economic development are undergoing changes. Specifically, the proportion of the working-age population aged 16–59 decreased from 63.16% in 2020 to 57.18% in 2025, a decline of approximately 6 percentage points over the five-year period. Meanwhile, the proportion of the population aged 60 and above increased from 25.72% to 32.58%, with the pace of this age-structure reversal notably faster than expected. The contraction of the labor force and the deepening of population aging are exerting multifaceted pressures on economic operations. Traditional industries such as manufacturing and construction are generally facing labor shortages, forcing enterprises to raise wages to attract and retain workers. The resulting increase in labor costs is squeezing corporate profit margins. At the same time, the growing elderly population has significantly increased expenditures on social security, such as pensions and medical care. The share of fiscal funds allocated to social welfare has risen, correspondingly reducing resources available for industrial development and infrastructure investment. Relevant research indicates that population aging constrains long-term regional economic growth by reducing labor supply and suppressing capital formation, among other channels^[5].

From a spatial perspective, the impact of population aging varies significantly across regions. Core cities like Shenyang and Dalian, due to their development opportunities and public service advantages, continue to attract young migrants, thereby partially mitigating the pace of local aging. However, peripheral regions such as northwestern and eastern Liaoning face the dual challenge of continuous outflows of local young and middle-aged labor and a higher proportion of the elderly among the remaining population. This situation means these regions bear a heavier burden of elderly support while having significantly fewer resources available for development. This regional divergence in population structure may further widen disparities in fiscal capacity and industrial vitality across different areas, posing new challenges to advancing the coordinated regional development strategy of the "One Circle, One Belt, Two Zones." Therefore, addressing population aging and optimizing the allocation of human resources have become crucial for promoting sustainable economic development and regional coordination in Liaoning Province.

4. Recommendations for Optimizing Human Resource Allocation

4.1 Optimizing the Spatial Distribution of Human Resources

Based on the "One Circle, One Belt, Two Zones" regional coordinated development framework in Liaoning Province, optimizing the spatial distribution of human resources can effectively change the current imbalanced state of population concentration in a few cities and continuous outflow from certain areas, thereby better aligning human resource allocation with the development needs of

different regions. Central cities such as Shenyang and Dalian should continue to leverage their industrial and public service advantages to attract talent suited for high-end industries and modern services, while also driving surrounding cities to improve employment opportunities and living conditions, thereby alleviating pressures on housing, transportation, and public services caused by excessive population concentration. In areas experiencing population loss, such as northwestern and eastern Liaoning, it is essential to develop distinctive industries based on local resources, create stable employment opportunities, enable the local workforce to work and live stably nearby, and gradually mitigate the issue of labor outflow.

Narrowing the gap in public services between regions is a key measure to guide the rational distribution of human resources. Efforts should be accelerated to improve basic conditions such as education, healthcare, and transportation in areas experiencing population loss, reduce the disparity in living standards compared to central cities, and enhance the attractiveness of these areas. At the same time, a unified provincial employment information platform should be established to promote the sharing of job information between cities, facilitate the matching of labor supply and demand, and guide the orderly flow of human resources. Through rational industrial layout, increased policy support, and balanced public services, the current imbalance in human resource distribution can be gradually addressed, ensuring that all regions receive stable human support and better advancing the coordinated regional development of Liaoning Province.

4.2 Promoting the Flow of Human Resources between Urban and Rural Areas

Promoting the orderly flow of human resources between urban and rural areas is an important pathway to narrowing the urban-rural development gap and enhancing the efficiency of human resource allocation in Liaoning Province. At present, a large number of rural laborers in Liaoning move unidirectionally to cities, leading to a continuous decline in the rural population, insufficient vitality for rural development, and increased pressure on urban public services. This significantly constrains the integrated development of urban and rural areas. The rational flow of agricultural labor can optimize the urban-rural economic structure, promote the efficient allocation of urban and rural factors, and play a significant role in narrowing the urban-rural development gap. Breaking down the barriers to urban-rural mobility, enabling laborers to not only find stable employment in cities but also to willingly return to their hometowns to start businesses or seek employment, is fundamental to alleviating the imbalance in human resource allocation between urban and rural areas^[6].

Cities need to further improve supporting safeguards, lower the threshold for household registration, and implement equalized services for migrant workers in housing, education, healthcare, and social security, ensuring that rural laborers can stay and settle stably. At the same time, reliance on industrial development should provide more stable job opportunities, improving employment quality and income levels. Rural areas should leverage rural revitalization to enhance infrastructure and living conditions, develop industries such as specialty cultivation, agricultural product processing, and rural tourism, and increase local employment opportunities. Attracting young and middle-aged individuals to return to their hometowns for development can be achieved through entrepreneurship subsidies and technical guidance. Accelerating the establishment of a unified urban-rural employment information platform to achieve information sharing and resource interoperability will reduce the costs of mobility. Through coordinated efforts between urban and rural areas and improved institutional safeguards, the smooth two-way flow of human resources can be promoted, continuously narrowing the urban-rural development gap and providing strong support for the coordinated regional development of Liaoning.

4.3 Enhancing Human Resource Development across All Age Groups

In response to the reality of Liaoning's declining working-age population and deepening aging trend, strengthening human resource development across all age groups is a key measure to alleviate labor shortages and enhance the momentum for economic development. The continuous decrease in labor force size and the overall aging of the workforce have already led to issues such as recruitment difficulties and rising labor costs in multiple industries, including manufacturing and services. Only by fully mobilizing the employment potential of all age groups and comprehensively improving the quality of the workforce can the multiple challenges brought by demographic changes be better addressed. The persistent contraction of the labor supply in Liaoning and its leading position in terms of aging nationally mean that human resource development and human capital enhancement across all age groups can effectively mitigate the labor gap, thereby laying a solid human foundation for coordinated regional development^[7]. Providing capacity-building and employment support tailored to

different demographic groups can make human resource allocation more efficient and rational. For the young and middle-aged workforce, the focus should be on regular skill training in areas such as advanced manufacturing, modern services, the digital economy, and modern agriculture, thereby improving job adaptability and employment competitiveness. For healthy, younger seniors, flexible employment, technical rehiring, and knowledge transfer can be utilized to continue leveraging their skills and experience, alleviating labor shortages in certain industries. Simultaneously, a vocational training and employment service system covering both urban and rural areas should be improved, expanding its reach and reducing the costs of learning and employment, enabling more people to enhance their capabilities and participate stably in the workforce. By fully tapping into the potential of all age groups, the adverse effects of population aging can be effectively mitigated, providing sustained and stable human support for the coordinated regional development of Liaoning Province.

5. Conclusion

Liaoning Province is currently facing the reality of a continuously decreasing total population and deepening aging, with the proportion of the working-age population declining year by year and the natural population growth rate remaining in negative territory for an extended period. Although there has been periodic in-migration from other provinces, the scale is small and insufficient to reverse the overall trend of population contraction and structural aging. The population and labor force are heavily concentrated in core cities such as Shenyang and Dalian, while regions like northwestern and eastern Liaoning experience continuous population outflow. The province's human resources exhibit a distribution pattern of "core agglomeration and peripheral shrinkage," resulting in a clear mismatch between human resource allocation and development needs across regions. The combined effects of population aging and imbalanced regional allocation of human resources will continue to reduce the efficiency of labor supply and constrain the overall progress of coordinated regional development in the province^[8].

The uneven distribution and irrational flow of human resources have widened the development gaps between different regions within Liaoning Province, exacerbating the lack of coordination between urban and rural areas in terms of resident income, public services, and resource allocation. Issues such as labor shortages, rising corporate labor costs, and increasing social security pressures directly undermine the momentum of economic development and hinder the advancement of the province's regional coordinated development strategy of the "One Circle, One Belt, Two Zones." In response to these challenges, Liaoning must guide the rational distribution of human resources within the province, promote the two-way flow of labor between urban and rural areas, strengthen skills training and employment support for all age groups, and fully tap into the potential of the existing human resources. At the same time, it is essential to continuously narrow the gaps in public services between regions and between urban and rural areas, and improve employment services and policy safeguards. Only by making the flow of human resources smoother and their allocation more rational can Liaoning effectively address the pressures brought by population decline and aging, reduce regional and urban-rural development disparities, and provide stable and reliable human support for achieving coordinated regional development and long-term revitalization.

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