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Review

Policy review of talent competition among Chinese cities: Impacts of hukou and declining fertility

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Abstract: China's cities are increasingly engaged in a "talent war", driven by urban competitiveness and challenges posed by low fertility rates and the Household Registration System. Talent policies have become central to addressing labor shortages, fostering regional innovation, and supporting sustainable urban development. This study uses the method of meta-research to explore the intricate relationship between talent policies and urban competitiveness, analyzing 58 journal articles sourced from the CNKI database. The analysis identifies three main areas of focus: (1) The evolution and characteristics of talent policies in response to economic reforms and demographic shifts; (2) the effectiveness of these policies in enhancing urban technological innovation and industrial restructuring; and (3) the mechanisms by which talent policies influence population mobility, innovation performance, and urban economic transformation. Findings highlight that cities, leveraging their superior resources and autonomy, successfully attract high-skilled talent but contribute to regional disparities. In contrast, smaller cities face challenges such as limited diversity in policy tools and low market-oriented talent allocation. Additionally, the commodification of talent and the competitive nature of local government policies have introduced inefficiencies in regional innovation systems. To achieve sustainable urban development, the study underscores the need for coordinated talent policy frameworks, emphasizing innovation-driven development, regional collaboration, and tailored approaches to attract, retain, and utilize talent effectively. Addressing systemic issues in the Household Registration System and fostering equitable resource distribution will be critical to balancing regional development and ensuring long-term urban sustainability. This research provides actionable insights into the evolving dynamics of talent policies in China's rapidly transforming socioeconomic landscape and provides readers with a clearer and three-dimensional understanding framework to understand China's talent policy.

Keywords: China's cities; talent policies; household registration system; low fertility; human resources competition

1. Introduction

Household registration, or Hukou, is a legal document established under China's domicile registration system, designed to record and maintain the basic information of a household's population. It serves as a fundamental form of identification for Chinese citizens, linking individuals to essential resources such as education, healthcare, and social welfare within a specific administrative region. Consequently, the concentration of economic opportunities and superior social welfare provisions in larger cities has led to a significant migration trend, creating a "population siphon effect" as people gravitate toward these urban centers. Human resources are a key factor in the socioeconomic development, prosperity, and competitiveness of regions, as they

contribute to increasing employment, developing job opportunities, and improving the standard of living for inhabitants [1]. The Chinese government defines talent as individuals possessing specialized knowledge or special skills. These individuals engage in creative endeavors and make significant contributions to society. Essentially, they are highly capable and qualified workers who stand out among the human resource pool [2]. The remarkable progress China has made over the past four decades of reform and opening-up can largely be attributed to the country's strong emphasis on talent policies. From Deng Xiaoping's proposition of "respect for knowledge, respect for talent", to the successive leadership's focus on "revitalizing the country through science and education", "strengthening the nation through talent", and "talent-driven development", China has consistently recognized the critical importance of human capital as a cornerstone of national strategy.

This study explored the talent policies and their impacts on urban competitiveness by analyzing current scholarly articles from the CNKI—China National Knowledge Infrastructure database. The articles were selected within the last ten years of publication since 2015 from prestigious journals and publications. China's talent policies, a strategic effort to build a talent-driven socialist nation, have been a key national priority since the 18th Party Congress in 2012, reiterated at the 2021 National Talent Work Conference and the 20th Party Congress [3]. These policies aim to cultivate, attract, and utilize talent to support socialist modernization by 2035, recognizing that education, science and technology, and talent are fundamental pillars of a modern socialist country. The policies reflect China's evolving economy, technology, education, and industrial structure and are designed to enhance talent competitiveness and drive innovation-led development, particularly in urban areas. Attracting high-level talent is crucial for urban development and sustainable growth. This focus on talent aligns with broader global discussions on sustainable urban development, which emphasize people-centered approaches and the importance of identity, security, and vitality for a city's success.

This review, based on impactful articles published since 2015, examines China's urban talent policies to understand their impact on urban development and the issues that have arisen, especially considering the household registration system and declining birth rate. This paper comprehensively reviews existing literature on China's talent policies, exploring their implementation effectiveness, the correlation between talent and regional innovation, and the impact of these policies on urban technological advancement. It provides context by outlining China's household registration system, discussing global low fertility rates and their challenges to sustainable urban development, and tracing the macro-level evolution of China's urban economic structural transformation and corresponding talent policies. The methodology section clearly defines the research questions, scope, and the types of research articles selected for analysis. The paper then presents the major findings derived from this analysis, culminating in a concluding section offering policy suggestions.

This paper re-examines the aforementioned significant studies through meta-research, utilizing a comprehensive literature review. By doing so, it transcends the geographical and conceptual constraints associated with focusing on a single city, region, or policy. Through meta-research, the study presents a broader and more generalized perspective on the relationship between China's talent policies and urban

development. In comparison to existing research, it offers readers a clearer and more multidimensional framework for understanding the intricacies of China's talent policies.

2. Literature review

2.1. The characteristics of China's talent policies

Han and Xiao [4] summarized the characteristics and framework of China's talent policies over the past three decades of reform and opening-up. Their study revealed that since the initiation of reform and opening-up, China has formulated and issued nearly 1000 guiding policies, laws, regulations, and documents related to personnel and talent, gradually establishing a talent policy system framework with distinct Chinese characteristics. Broadly speaking, the evolution of talent policies since the reform and opening-up can be divided into three main stages: (1) The Early Stage of Reform and Opening-Up (1978–1992): This phase was marked by efforts to restore order and liberate talent. (2) The Period of Socialist Construction with Chinese Characteristics (1992–2003): During this stage, the strategy of revitalizing the nation through science and education took the lead, with a significant emphasis on elevating the status of talent. (3) The Period of Building a Well-Off Society in an All-Round Way (2003–Present): Guided by the strategy of strengthening the nation through talent, this phase has been characterized by a people-centered approach and the goal of building a harmonious society.

Zheng and Zhong [5] argued that since the reform and opening-up, China's policies on high-level talent have exhibited several notable characteristics, including "weak legal formalization", "overemphasis on government-driven incentives", "fragmentation of initiatives", "limited integration with enterprises", and "a greater focus on recruiting international talent rather than fostering domestic talent". Chen et al. [6] found that the talent policies in cities across China primarily target high-level talent, innovation and entrepreneurship talent, university graduates, and professionals with technical expertise. The specific measures adopted include policy tools such as financial subsidies, housing support, and development security policies, with policies categorized and implemented in tiers aimed at achieving the objectives of attracting, retaining, and utilizing talent.

Sheng and Yu [7] analyzed 119 science and technology talent policies issued by Zhejiang Province during the first three years of the Ninth through Twelfth Five-Year Plans, examining them across four dimensions: Policy year, target audience, policy categories, and document types. Li et al. [8] conducted a comparative study of science and technology talent policy texts from three national independent innovation demonstration zones—Wuhan Optics Valley, Beijing Zhongguancun, and Shanghai Zhangjiang—focusing on dimensions such as the timing of policy issuance, scope of application, policy instruments, and the effectiveness of implementation. Han and Yang [9] analyzed the science and technology innovation talent policies of 11 cities in the Guangdong-Hong Kong-Macao Greater Bay Area from 2000 to 2020, exploring the relational networks within the policy texts and their internal and external attributes.

2.2. The implementation effectiveness of China's talent policies

Chen and Yang [10] conducted an empirical study using China's central government's "Thousand Talents Plan" as a case study. From a policy input-output perspective, they concluded that the implementation of the policy has yielded relatively positive outcomes. The experts selected under the "Thousand Talents Program" have produced a significant number of landmark original innovations, overcome a series of major key technologies that previously hindered industrial development, fostered the growth of high-tech industries, and driven reforms and innovations in research, education, and talent development mechanisms. Ge [11] argued that talent policies across different regions remain primarily focused on the "attracting talent" phase, with insufficient attention and policy support for "retaining talent". The recruitment policies, which prioritize household registration over employment, not only fail to guarantee the long-term settlement of high-quality talent but also disrupt the natural flow of talent, thus diminishing local governments' autonomy in nurturing outstanding talent.

Bian et al. [12] used statistical yearbook data from 2006 to 2012 for the Wuhan East Lake New Technology Development Zone to assess the effectiveness of talent policies from two perspectives: Policy input-output and the sustainability of policy outcomes. Guo et al. [13] focused on Shanghai's talent policies since 1995 and conducted a study on the coordination of these policies' goals. Hong et al. [14] employed bibliometric and co-word analysis methods to systematically review the evolution of China's science and technology talent policies from 1978 to 2017.

2.3. The link between talent resources and regional innovation

Numerous studies have demonstrated that scientific and technological talent significantly influences regional innovation capacity and performance, emerging as one of the key factors in explaining regional wealth disparities. Gennaioli et al. [15] highlighted the critical role of human capital in accounting for regional development disparities. Kiuru and Inkinen [16] conducted a case study of the Helsinki metropolitan area, using principal component analysis, ordinary least squares (OLS), and spatial lag models to confirm that innovation thrives in human capital-intensive urban environments. Diebolt and Hippe [17] analyzed a comprehensive dataset on human capital levels across European regions and countries from 1850 to 2010. Through OLS regression, they found that regional human capital is a key determinant in explaining current disparities in innovation and economic development across regions.

At the same time, Chinese scholars have increasingly focused on the relationship between talent policies and innovation capacity. Cao and Yuan [18] conducted a statistical analysis of the innovation talent policies in Shenzhen, Suzhou, and Shenyang, examining these policies through the lens of basic policy tools. Their findings revealed a strong positive correlation between the quantity and diversity of innovation talent policies and regional innovation performance, as well as talent development. They argued that the three fundamental policy tools—demand-oriented, supply-oriented, and environment-oriented—must work synergistically to transform talent advantages into innovation advantages, thereby fostering regional innovation development.

However, some scholars present opposing views, contending that while talent attraction may offer multiple benefits, the impact of competitive talent policies on regional innovation performance is not necessarily positive. Chen and Li [19] pointed out that the current "talent war" is marked by disorder. They argued that the "commodification" of talent has turned competitive talent policies into a financial contest between local governments. Furthermore, local governments often prioritize their own innovation development, failing to adopt a broader perspective that considers the development of other regions. This uneven development has led to the concentration of high-level talent in the economically developed southeastern regions of China, while economically underdeveloped areas face disadvantages in both economic and geographic terms. This has resulted in a series of challenges, including talent drain, stagnating economic development, and insufficient innovation capacity, which in turn exacerbates the regional imbalance in innovation development.

2.4. The influence of talent policies on urban technological innovation

There are heterogeneous effects of talent competitions on urban innovation [20]. Luo and Zhu [21], building on the American Customer Satisfaction Index (ACSI) model, conducted a study to assess satisfaction with regional science and technology talent policies and their impact on the innovation levels of corporate science and technology talent. They found that satisfaction with talent policies positively influences the innovation levels of talent. Liu [22] developed a model to examine the effect of science and technology talent policies on innovation performance, utilizing hierarchical regression analysis. The study focused on the moderating and mediating roles of work engagement and policy perception in the relationship between talent policies and innovation performance. The results indicated that science and technology talent policies have a positive and significant impact on innovation levels.

Zhou and Zeng [23] conducted an empirical analysis using a quasi-natural experiment derived from the innovation city pilot program, which began in 2008. They applied the difference-in-differences (DID) method to examine the impact of being designated as an innovation city on urban innovation performance and the specific mechanisms involved. The study found that industrial structure positively moderates the innovation levels of innovation cities. Being designated as an innovation city significantly enhances urban innovation performance, with a more pronounced effect in eastern cities, cities with higher administrative levels, and large-scale cities.

3. Background and concepts

3.1. Overview of China's household registration system

Historically, China's household registration system, or hukou, was closely linked to land and served as a population management tool centered around families, clans, and lineages. The modern hukou system is a legal framework for collecting, confirming, and registering citizens' basic demographic information, including birth, death, familial relationships, and legal residence. Established in the 1950s, the current household registration system has gradually become tied to a range of residents' rights

and benefits, including employment, education, healthcare, social security, and welfare, thereby exerting a profound and widespread impact on individuals' lives [24].

Nian [25] notes that in 1958, the newly established People's Republic of China implemented a dual hukou system, dividing it into "agricultural" and "non-agricultural" categories, corresponding to rural and urban residents, respectively. Under this system, migration of household registration was tightly controlled through administrative measures. In the early 1980s, with the market-oriented economic reforms of the opening-up period, large-scale population migration began. To accommodate the evolving market economy and urbanization, the Chinese government initiated reforms to the household registration system, making significant progress over time.

After 2000, with rapid urbanization, the pace of reforms accelerated. The reform of the hukou system in small towns advanced significantly, and by decentralizing authority over household registration reforms, the central government empowered large and medium-sized cities to explore measures tailored to local conditions [26]. In 2014, the State Council issued the "Opinions on Further Promoting the Reform of the Household Registration System", which abolished the dual hukou system and established a unified urban-rural registration system. Starting in 2017, many cities began relaxing hukou restrictions and introduced measures such as the point-based household registration system to attract highly skilled, highly educated talent. These reforms aimed to alleviate labor shortages, promote economic transformation and upgrading, and support sustainable urban development [27].

Although the reform of China's household registration system has lowered the threshold for settlement in various cities, the employment system still treats local hukou status as a primary condition for access to certain opportunities. Furthermore, resources are allocated based on the administrative level of the city, with first-tier and provincial capital cities receiving the most resources and offering the best welfare benefits. This has resulted in significant urban stratification. Consequently, cities hold a distinct advantage in attracting talent, while the settlement thresholds in second- and third-tier cities have gradually converged, leading to intensified competition and making it increasingly difficult for these cities to attract talent [28].

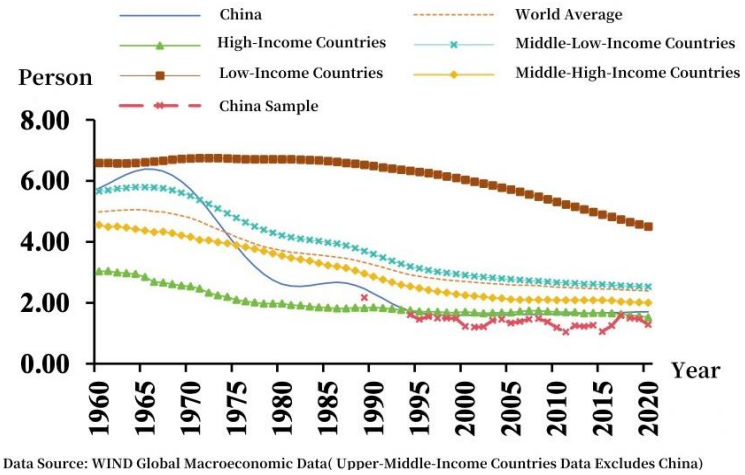
3.2. Global low fertility rates: Challenges to sustainable urban development

The Total Fertility Rate (TFR) is a key demographic indicator that measures the average number of children born to women of childbearing age in a given country or region [29]. In the 1950s, the global average TFR was approximately 5.0, reflecting the high birth rates typical of that period. However, after a relatively brief period of high fertility rates between 1950 and 1970, the TFR began to continuously decline. By the 1990s, the global TFR had decreased to around 2.5, and by 2015, it had further declined to 2.37. Since then, the global TFR has continued its downward trajectory, with projections indicating that it will approach the replacement level of 2.1 by 2050 before gradually declining further in subsequent decades [30] (see **Figure 1**).

This persistent decline in fertility rates worldwide has contributed to a broader phenomenon of low fertility rates. As fertility levels continue to decrease, many

countries are experiencing accelerating population aging. Between 1960 and 2022, the global proportion of the population aged 0–14 fell from 37% to 25%. In over 35% of countries and regions, this proportion has now dropped below 20%, marking the shift toward societies with declining birth rates.

From a regional perspective, fertility rate trends have diverged. More developed regions have seen smaller declines in TFR, with some countries stabilizing at relatively low fertility levels. In contrast, less developed and least developed regions have experienced more significant decreases in fertility rates, and the downward trend is expected to persist. This global shift from higher to lower fertility rates demonstrates a clear pattern: The low fertility phenomenon, which was initially concentrated in developed countries, is now spreading to less developed areas. This pattern highlights a broader global demographic transition, with far-reaching implications for population structure, economic development, and social policy [30].



Data Source: WIND Global Macroeconomic Data(Upper-Middle-Income Countries Data Excludes China)

Figure 1. Total fertility rate of countries with different income levels from 1960 to 2020.

According to World Bank data, the peak for total fertility rates (TFR) has occurred at different times across countries, depending on their income levels. In the case of China, the TFR reached its peak in 1965, after which it began a significant decline. Initially, China's fertility rate fell below the levels of middle- and high-income countries but remained higher than that of high-income nations. By 1994, China's TFR had decreased further, dipping below the fertility rates of high-income countries [31].

The Sixth National Population Census in 2010 revealed that China's TFR had already fallen to 1.18, a rate that was significantly below the replacement level of 2.1, which is necessary to sustain a stable population size. By the time of the Seventh National Population Census in 2020, China's TFR had slightly increased to 1.3, but still remained in the low fertility range, highlighting a persistent trend of low birth rates.

By 2022, China's TFR had further declined, dropping below 1.2, which is well within the range of countries experiencing low fertility rates. This continued decline signifies a demographic shift that poses long-term challenges for China, including population aging, labor force shrinkage, and increased pressure on social services and economic sustainability [32]. These trends underscore the need for comprehensive policy interventions to address the demographic changes and their implications for the country's future development.

Population size and structural changes, particularly the shift towards an aging population and declining fertility rates, have profound impacts on the economy and society. A balanced and healthy age structure is essential for sustaining economic growth, as it ensures an adequate supply of workers to fuel productivity and innovation. As highlighted by Yang et al. [33], the relationship between population age structure and economic growth is crucial. The increase in the proportion of the working-age population has been shown to directly contribute to economic expansion, especially when the workforce is youthful and dynamic. This demographic dividend has been particularly significant in rapidly developing economies, including China, where a large working-age population historically drove economic growth.

However, when the population age structure becomes imbalanced—characterized by a growing proportion of elderly individuals and a shrinking working-age population—there are several negative consequences for economic and social development. Zhang [34] examined the situation in Shandong Province and found that an increasing working-age population had promoted economic growth, with younger age groups contributing more significantly. In contrast, an aging population leads to a reduction in the labor supply, which can depress productivity, increase dependency ratios, and place a greater strain on social services, particularly healthcare and pensions. These shifts can lead to changes in savings and consumption patterns, which in turn affect economic stability and growth.

Further, Wang [35], in his analysis of Northeast China, argued that an aging population suppresses consumption demand, thus reducing economic vitality. This is particularly concerning for regions experiencing population decline, where fewer working-age individuals mean less labor force participation, lower consumer spending, and a higher fiscal burden to support the elderly population. This demographic trend exacerbates the social and economic challenges in these areas, leading to a cycle of stagnation.

The global decline in fertility rates, particularly in developed countries, has led to a diminishing demographic dividend. As fertility rates continue to fall, fewer children are born, and the labor force shrinks, thereby reducing the potential for future economic growth. In this context, countries worldwide have increasingly turned to talent policies to mitigate these challenges. These policies are designed to attract, retain, and develop highly skilled professionals who can contribute to economic growth, technological innovation, and industrial upgrading.

In China, the ongoing "talent war" is a direct response to labor shortages caused by low fertility rates. Cities across the country are competing fiercely to attract skilled individuals, recognizing that talent is the key to urban development and sustainability. Highly skilled talent is central to driving technological progress, economic innovation, and the upgrading of industrial structures. As the global competition for talent intensifies, attracting and retaining talent has become an essential part of national and regional development strategies.

The decline in fertility rates and the aging population have particularly exacerbated labor shortages in China, with a noticeable shortage of young labor. This shortage not only limits the availability of workers but also stifles the dynamic, innovative energy that young workers bring to the workforce. As a result, the ability of cities to sustain economic growth, foster innovation, and adapt to changing market

conditions becomes increasingly constrained. Without a steady influx of talented individuals to replace the retiring workforce, cities risk falling into stagnation, unable to maintain a competitive advantage or achieve long-term development goals.

Thus, talent policies are seen as critical levers for ensuring the sustainable development of cities in the face of demographic challenges. These policies not only address immediate labor shortages but also lay the groundwork for long-term economic resilience by fostering innovation, technological advancements, and industrial transformation. In this way, the talent war and the ongoing competition to attract skilled professionals have become central to the broader discourse on urban development and the future of economic growth in China.

3.3. The macro evolution of China's urban economic transformation and talent policies

Since the founding of the People's Republic of China in 1949, the country has undergone two distinct economic development models: the planned economy model (1957–1978) and the market economy model (1978–present). Under the framework of the planned economy, which prioritized the development of heavy industry, economic efficiency was greatly hindered by centralization and rigid administrative control. On the eve of the reform and opening-up in the late 1970s, China's economy was facing severe challenges, with stagnating growth and systemic inefficiencies [36].

Following the economic reforms initiated in 1978, the market economy gradually replaced the planned system, leading to substantial improvements in resource allocation efficiency and fostering rapid economic growth. This shift resulted in an unprecedented economic boom, which is regarded not only as a remarkable achievement in Chinese history but also as a significant phenomenon on the global scale. The global financial crisis of 2008 marked a key turning point, dividing China's economic development into two distinct phases. From 1978 to 2008, market-oriented reforms were implemented at an accelerated pace, propelling China's economy to a remarkable 10% average annual growth rate over three decades. However, from 2008 to 2018, both domestic and international challenges contributed to a slower growth trajectory, with the average annual growth rate falling below 8%. This marked the beginning of a "new normal", signaling the end of high-speed growth and the onset of a more moderate and adjusted phase of economic development, characterized by emerging structural bottlenecks [37].

The report from the 19th National Congress in 2018 highlighted a critical shift in China's economic trajectory, noting that the economy had moved from a phase of high-speed growth to one focused on high-quality development. At this juncture, China's economy is undergoing a transformation in its development model, optimizing its economic structure, and transitioning its growth drivers. However, this transformation is accompanied by a series of medium- and long-term challenges. The aging population has intensified pressures on the social pension system, the widening income gap has made achieving common prosperity a pressing concern, and the growing urgency of climate change calls for a green and low-carbon transition in the economic development model [38].

Talent policy refers to a set of government or organizational measures designed to attract, retain, cultivate, utilize, evaluate, and motivate talented individuals. These policies encompass not only specific plans and guidelines but also the regulatory frameworks and legal mechanisms that underpin them [39]. The transformation of social and economic structures is deeply tied to the allocation of talent resources. As China's economy and society have evolved, so too has its talent policy, which has undergone several phases of development in response to changing needs and priorities. These phases are as follows:

In the early years following the founding of the People's Republic of China in 1949, the country faced numerous challenges, with all sectors urgently requiring talent. However, talent resources were in short supply. To address this issue, China established a unified planning and allocation system characterized by administrative controls. The coordinated deployment of professional and technical cadres played a vital role in efficiently utilizing talent to meet the needs of national economic development. After the first Five-Year Plan, China's planned deployment system for talent resources was essentially solidified, and this system remained largely unchanged for the next two decades.

In 1978, China shifted its focus to socialist modernization, marking the beginning of a new era of reform and opening-up. As the country embarked on these reforms, the approach to talent resource allocation also entered a new phase.

At the outset of the reform period, following the chaos of the late 1970s and early 1980s, the primary task for the country was to restore and stabilize social production and daily life. During this time, talent policies largely revolved around rectifying the disarray caused by the previous period and implementing policies focused on intellectuals. The core concept of these policies was "respecting knowledge and valuing talent", which guided the country's broader approach to talent management.

The breakthrough in China's contemporary talent policy came with the issuance of the "Regulations on Several Issues Concerning the Reform of the Cadre Management System" by the Organization Department of the CPC Central Committee in October 1983. This marked the beginning of a reform period characterized by efforts to dismantle the old system. Major reforms followed, including changes in the economic system, science and technology, education, and professional title evaluation. These reforms profoundly impacted talent training, management, mobility, and incentives.

In 1996, the Chinese government issued the "Interim Regulations on Talent Market Management", which formalized the construction of the talent market through national administrative regulations. This move signaled the official entry of the talent market into a phase of legalization and institutionalization.

As the new century unfolded, the rise of the knowledge economy marked a period of significant development in China's talent policies. These policies expanded in both scope and number, addressing a broader range of groups and fields. They became more interconnected, presenting a rich variety of approaches to talent management [40]. **Figure 2** illustrates the three stages of China's talent policy development since 2000: (1) the exploration phase (2000–2006), (2) the rapid development phase (2007–2012), and (3) the mature and stable phase (post-2012) [41].

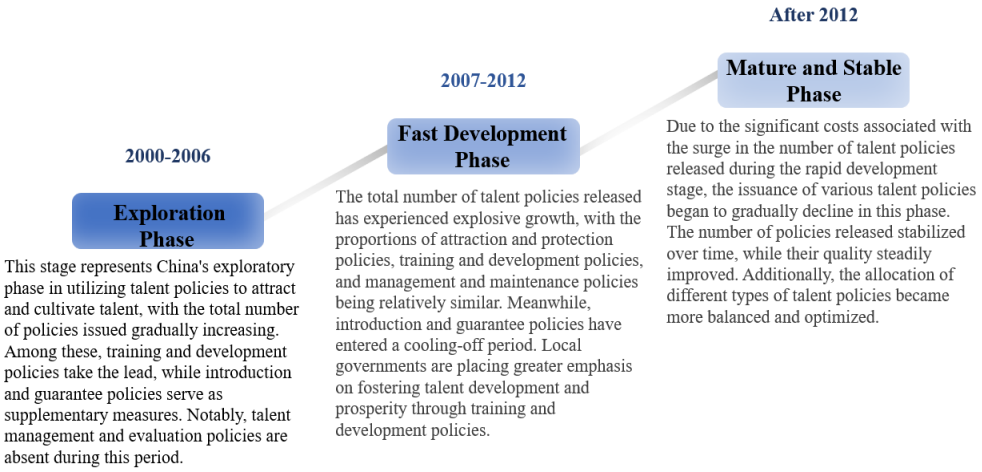


Figure 2. China's talent policy development stage.

Source: In-depth analysis report on the comparison and effectiveness evaluation of talent policies in 31 Chinese provinces and cities by Qianzhan Industry Research Institute. https://bg.qianzhan.com/report/detail/2105201610197397.html

In recent years, various regions have intensified their efforts to attract and retain talent. Starting in 2017, Wuhan City launched the "One Million Talents Retention Plan", followed by Chengdu's "Rongpiao Plan" and Xi'an's promotion of the "most relaxed household registration policy in history". These initiatives marked a new phase in the competition for talent, particularly in the central and western regions of China, raising the stakes in what has been described as the "Talent Championship". With the accelerated development of provincial capitals and central cities, urban economies have undergone structural transformations, and diverse talent pools have become a key driving force for development. The competition for talent, especially urban talent, has emerged as one of the central issues in urban and regional development [42].

4. Methodology

4.1. Research questions

This study examines the relationship between China's talent policies and urban sustainable development within the broader context of declining global fertility rates and the domestic household registration system. Specifically, the study seeks to address the following research questions:

1) What impact have talent policies had on regional socioeconomic development, competitiveness, and the sustainable growth of urban areas?

2) How have these policies evolved in response to economic reforms and the changing demands of China's labor market?

3) What mechanisms do talent policies employ to enhance regional innovation performance, and what challenges exist in ensuring their positive impact on innovation outcomes?

4) How are Chinese cities leveraging talent policies to address labor shortages and maintain economic vitality amidst demographic shifts?

To address these questions, the study utilizes a combination of a literature review and content analysis of talent policy and urban development. The methodology involves a comprehensive review of existing academic literature and empirical studies

related to talent policies, population mobility, and urban development dynamics in China.

4.2. Research method

Meta-research, as a theoretical reflection on the review, evaluation, and analysis of existing research results, can systematically organize and integrate research achievements in related fields. Through a systematic review of past literature, meta-research can reveal common themes that have long been overlooked within the subject area and explore and summarize common research conclusions and patterns across time and space. Meta-research evaluates key elements such as research design, methodological applications, theoretical frameworks, and data analysis of existing studies, revealing biases, errors, and shortcomings in the research process. This evaluation helps maintain the rigor of academic research and improve overall quality, providing more reliable references for policy makers and practitioners. Meta-research has become a common research method in the field of policy analysis. This research attempts to use the methodology of meta-research to analyze and discuss the current research on China's talent policy with limited themes so as to provide a more comprehensive perspective to examine the relationship between talent policy and urban sustainable development.

4.3. Analysis scope

CNKI—China National Knowledge Infrastructure is one of the most comprehensive academic resources in China, encompassing a wide range of academic documents across various disciplines. A total of 58 journal articles were selected based on their impacts from the CNKI database for data analysis. The articles selected for this study primarily focus on issues related to economic development, population migration and its constraints, regional development, and talent policies in the last ten years since 2015.

This study analyzes 58 articles on China's talent policies. Among them, a substantial portion of the research (approximately 24 studies) consists of macro-level mixed studies examining the broad effects of population mobility, economic restructuring, and low fertility on national talent policies. These articles provide a wide-angle perspective on policy operation at national and regional levels, focusing on overarching frameworks and their regional impact. The majority of the research (around 34 studies) comprises micro-level case studies focusing on specific cities or regions. These studies explore how local governments design and implement talent policies to optimize economic structures and promote sustainable development within their jurisdictions, providing detailed insights into local contextual factors influencing policy effectiveness. The criteria and steps for literature screening are shown in **Figure 3**.

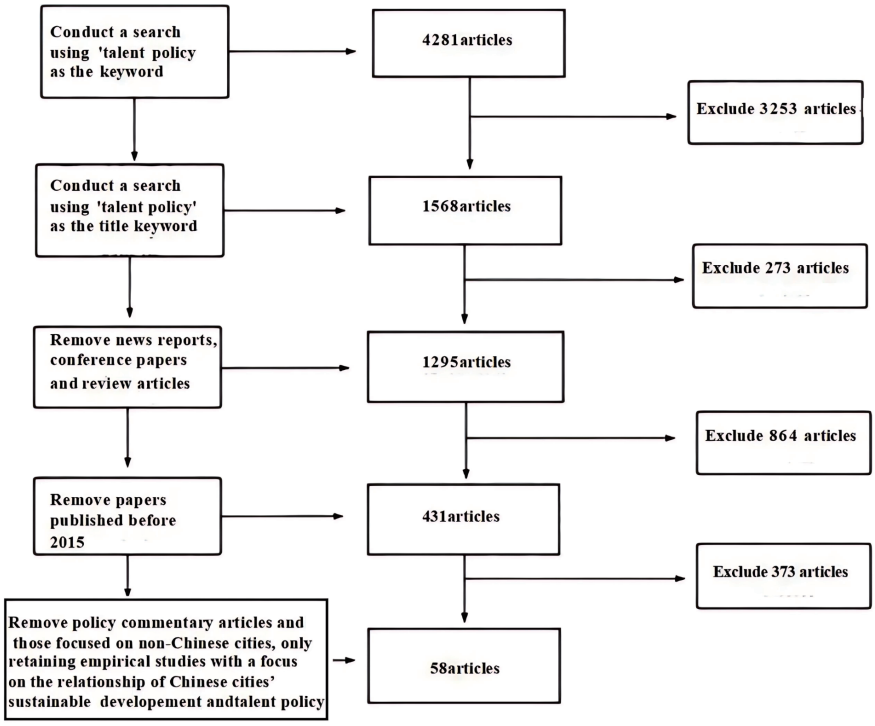


Figure 3. Diagram of literature screening criteria and steps.

Among those articles, two of the empirical studies specifically analyzed global and Chinese fertility trends and their implications for population mobility and talent policy design, providing valuable insights into the impact of demographic change on labor markets. One of the content analysis papers systematically reviewed and synthesized the findings, focusing on key themes, trends, and patterns in talent policy evolution, their impact on urban development, and the role of demographic factors. This paper aims to deepen our understanding of how talent policies contribute to urban sustainable development in China, particularly considering demographic shifts and economic restructuring.

In summary, this methodology combines analysis of quantitative and qualitative approaches to provide a comprehensive examination of China's talent policies, their impact on urban development, and their evolution in response to changing demographic and economic conditions.

5. Findings

In the context of declining fertility rates and the gradual liberalization of household registration systems, China's talent policies are becoming increasingly integral to urban development. The impact of talent on urban growth and regional innovation is indisputable, and talent policies continue to be a central driver of the sustainable development of Chinese cities. The significance of these policies is particularly evident in the following areas:

5.1. Talent policy and its impact on urban population mobility and development

Talent policies play a crucial role in shaping the mobility and settlement decisions of the migrant population, ultimately influencing the long-term sustainability of urban development.

First, talent policies directly affect the willingness of the migrant population to stay in urban areas. Various talent policies, particularly guarantee-type policies, have been found to effectively enhance the willingness of migrants to settle in cities. The implementation of these policies shows significant variation across cities at different levels. In general, more advanced cities tend to achieve better outcomes in terms of policy implementation [43]. Moreover, the impact of talent policies on migrants' willingness to stay is heterogeneous across different youth groups. High-income young talents are more likely to be attracted to guarantee-type policies, whereas lower-income youth prefer reward-based policies. Development-oriented policies, however, have a positive impact on both groups. The effectiveness of talent policies also varies across age groups, industries, city levels, and targeted policy beneficiaries. For instance, talent policies have a more pronounced effect on the residential intentions of young talents aged 26–35 and 36–45, particularly those working in the tertiary industry. Similarly, talent policies in first-tier and new first-tier cities tend to have a stronger impact on the residence intentions of young talents, as do policies that target a more diverse group of beneficiaries [44].

Second, the implementation of talent settlement policies is closely linked to reforms in China's household registration system. These policies are part of broader efforts to reform the household registration system, and their effects have been gradually increasing over time. An increasing number of cities are lowering the settlement thresholds for target groups, thereby facilitating the free movement of talent and supporting local economic development and innovation. Research has shown that the implementation of settlement policies within talent policies has significantly enhanced urban innovation performance. This indicates that the talent settlement policy not only increases the quantity and aggregation of talent but also contributes to the optimization of the urban population's age structure. The resulting improvement in innovation performance is more significant than the potential negative crowding effects associated with population growth [45].

At present, talent policies mainly focus on cultivation and development orientation, which accounts for 82% of the total talent policies. Talent introduction and incentive policies account for 9%, talent management and maintenance policies account for 5%, and talent evaluation and assessment policies account for 4% [41]. The specific breakdown is shown in **Figure 4**.

In sum, talent policies that focus on attracting and retaining skilled professionals are instrumental in promoting urban population mobility and driving sustainable urban development.

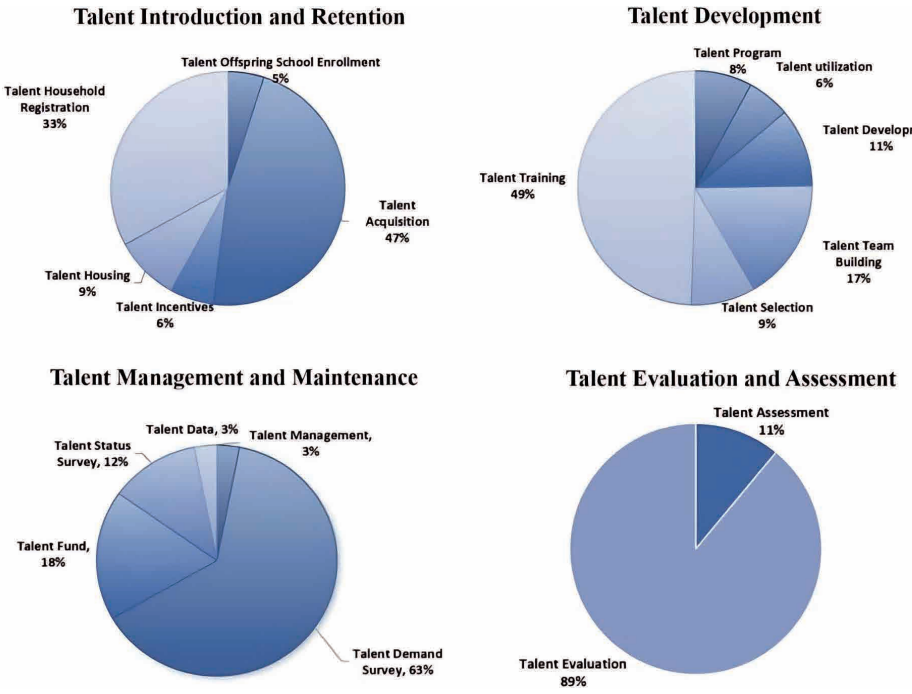


Figure 4. Proportion of talent policy segmentation categories.

Data source: In-depth analysis report on the comparison and effectiveness evaluation of talent policies in 31 Chinese provinces and cities by Qianzhan Industry Research Institute. https://bg.qianzhan.com/report/detail/2105201610197397.html

5.2. The coordination mechanism of talent policies and its role in driving urban scientific and technological innovation

Building a regional talent policy coordination mechanism is both a necessary and practical choice for contemporary China, aimed at promoting the integrated development of urban agglomerations and establishing world-class talent centers and innovation hubs. The composition of talent policies within urban agglomerations is complex, encompassing a wide range of factors that form a diverse and intricate system.

In Chinese city clusters, talent coordination is primarily achieved through policies, with the effectiveness of coordination being heavily influenced by horizontal intergovernmental relations. Therefore, the talent policy coordination mechanism must account for two main analytical dimensions: Top-down power relations and horizontal intergovernmental competition and cooperation. The mechanism should adhere to principles of competition and cooperation, balancing commonality with individuality and integrating both localized and broader, systemic perspectives. The process of talent policy coordination begins with the cooperative motivation mechanism, which includes political, economic, and social incentives that promote cooperation and help achieve consensus.

The interest balance mechanism is fundamental to ensuring effective talent policy coordination. This mechanism involves forming interest communities and establishing an interest compensation system that is crucial for the cohesion of these communities. These systems can be categorized into incentive, punitive, vertical central-local, and horizontal intergovernmental compensation mechanisms. Finally, the implementation guarantee mechanism ensures the coordinated execution of talent policies. It includes

feedback and consultation systems to facilitate communication and timely intervention during policy implementation, as well as training and exchange mechanisms to ensure consistent interpretation and understanding of policies among policy implementers. The assessment mechanism ensures that individual interests are aligned with the broader goals of the policy, facilitating greater compatibility between local and overall interests [46].

The "talent competition", manifested through the use of talent policies, serves as a key driver of innovation. From the perspective of policy tools, this competition between cities has led to positive effects on talent development. On one hand, the application of diverse policy tools has effectively promoted systemic reforms in areas such as talent training, recruitment, mobility, evaluation, utilization, and incentives, leading to breakthroughs that induce institutional changes through policy innovation. On the other hand, by optimizing and innovating talent policy tools, cities have been able to establish competitive advantages and facilitate the rational flow of innovation factors, with talent resources at the core [47]. This has created a feedback loop where talent agglomeration drives industrial agglomeration, and talent innovation propels industrial upgrading. However, the selection of talent policy tools by local governments also presents challenges, and there are evident problems and negative effects stemming from these choices [48].

Table 1 presents the common requirements for talents; the information was gathered and summarized from the Talent Introduce Network [49]. The information suggested that the government seek highly educated, skilled, and experienced professionals who can contribute to economic growth, innovation, and societal development. Key characteristics include advanced degrees from prestigious institutions; relevant work experience in high-demand industries; specialized technical or professional expertise; youth and vitality, with a focus on long-term contributions; significant academic or research achievements; a track record of innovation and entrepreneurship; recognition for social contributions; alignment with local industrial priorities; language proficiency for international integration; and a clean record and strong ethical standards. These criteria reflect a strategic approach to attracting talents who can drive innovation, support industrial development, and contribute to the overall progress of society. It is worth noting that while most talent policies have historically favored individuals under the age of 45, shifts in industrial structure, the diversification of talent policy development, and changes in population demographics have led to the introduction of initiatives like the "Silver-Age Plan", which transcends traditional age limits. This marks a significant step in breaking the age bias previously embedded in talent policies. The Silver-Age Plan, for example, allows teachers in higher education or basic education to continue working post-retirement, typically up to the ages of 65 or 70. Such measures signal a positive shift toward improving the efficiency of human resource utilization across society.

Table 1. Common requirements for talents in chinese cities' talent policies.

Educational Background	Most cities set clear educational requirements for high-level talents, typically mandating a master's or doctoral degree, with a preference for graduates from renowned overseas universities.
Work Experience	Some cities require candidates to have a certain number of years of relevant work experience, particularly in specific fields or industries.
Professional Skills	Talents are expected to possess specialized professional or technical expertise, especially in high-demand sectors such as high-tech, finance, healthcare, and education.
Age Limits	Many cities impose age restrictions, generally requiring candidates to be under 45 years old, though exceptions may be made for exceptional talents.
Academic Achievements	For scientific research talents, high academic accomplishments are often required, such as publishing high-impact papers, holding patents, or participating in major research projects.
Innovation and Entrepreneurship	Some cities emphasize innovation and entrepreneurial capabilities, seeking individuals with successful entrepreneurial track records or significant innovative potential.
Social Contributions	Certain policies consider the social contributions of talents, such as national or provincial-level awards and honorary titles.
Industry-Specific Focus	Cities tailor their talent acquisition strategies to align with local industrial development needs, prioritizing sectors like information technology, biomedicine, and new energy.
Language Proficiency	For overseas talents, proficiency in Chinese or English communication may be required.
Integrity and Compliance	Talents must demonstrate a clean record, free from legal or disciplinary violations.

5.3. Talent policy and the transformation and upgrading of regional industrial structures

As early as the beginning of the 21st century, Chinese scholars recognized that talent is a core factor in the transformation of resource-depleted cities [50]. During periods of industrial transformation, the promulgation and implementation of talent policies have played a significant role in improving the rationalization and sophistication of regional industrial structures. Notably, the impact of talent policies on the sophistication of industrial structures has proven to be greater than their impact on the rationalization of industrial structures. From the perspective of policy types, environmental talent policies are more effective in driving industrial structure transformation and upgrading than supply-oriented talent policies, with supply-oriented policies also outperforming demand-oriented ones. The role of talent policies in promoting the transformation and upgrading of urban industrial structures primarily operates through two channels: human capital accumulation and R&D innovation [51].

The effectiveness of talent policies varies depending on the socioeconomic conditions of cities and the operational characteristics of local enterprises. Studies have shown that the implementation of talent policies can significantly promote the entry of new enterprises. For each additional talent policy introduced in a city, the number of new enterprises per thousand people increases by approximately 0.197. The inflow of high-skilled human capital and the diversification of the floating population are two key channels through which talent policies impact new enterprise entry. Talent policies are particularly effective in cities with a relatively low degree of population aging and a favorable business environment and in small and medium-sized cities. In labor-intensive industries and the service sector, talent policies have a more substantial effect on promoting the establishment of new enterprises [52].

Furthermore, talent policies have been shown to significantly facilitate the transformation of small and medium-sized enterprises (SMEs) into "specialized,

refined, special, and innovative" firms. However, this effect is heterogeneous, depending on the internal business conditions of the enterprises. Specifically, urban talent policies are most effective in transforming SMEs with strong marketing capabilities, robust product market competitiveness, a high proportion of senior executives holding shares, and weak stock liquidity [53].

Talent policies also face certain conditional limitations in fostering innovation and entrepreneurship in cities. Research indicates that the upgrading of talent policies does not always result in significant improvements in the growth of the registered population or in the number of invention patents locally. This suggests that local governments cannot necessarily achieve optimal outcomes in talent competition by relying solely on talent policy innovation. Additionally, local fiscal revenue plays a critical role in determining the effectiveness of these policies. When local fiscal revenue is high, the innovation and upgrading of talent policies have a positive effect on the growth of the registered population, with a particularly strong impact on innovation, entrepreneurship, and talent attraction. However, the relationship between fiscal revenue and the effectiveness of talent policies on invention patent growth is more complex. On one hand, higher fiscal revenue does not significantly enhance the effect of talent policies on patent growth; on the other hand, when fiscal revenue is high, protection-type and innovation-type talent policies have a positive effect on invention patents. In contrast, cultivation-type talent policies may have a negative impact on patent growth in such circumstances [54].

5.4. Addressing challenges in current talent policies for urban development

While numerous cities have introduced a wide array of talent policies, these policies often lack systematic coherence and comprehensiveness. Moreover, the authority and effectiveness of talent incentive policies are frequently insufficient. These factors contribute to weak implementation and limited impact. First, although the talent policies of various cities are generally comprehensive at the time of formulation, deviations often occur during implementation due to a variety of reasons. A primary issue is the mismatch between the capabilities of policy executors and the specific needs of the local context. Second, there is often insufficient initiative in policy formulation. Many cities introduce policies to attract talent in response to national directives, but these policies are sometimes developed reactively rather than proactively and may not reflect genuine local needs or strategic goals [55].

Additionally, while conditions for settling in cities have significantly relaxed compared to the past, and the efficiency of settlement procedures has improved, most cities' talent policies primarily focus on offering large housing subsidies. However, these are largely "welfare policies" and lack "developmental policies" that would enable sustained growth and career progression for talented individuals [56]. Besides, talent policies driven by economic rationalism can easily lead to short-sighted and utilitarian behavior in the commodification of talent. This is not conducive to the sustainable development of the industry and human resources and can also easily lead to resource loss and vicious competition. As a result, while these policies may attract talent in the short term, they fail to foster long-term development or create an

environment conducive to sustained innovation and economic growth. The deficiencies within the talent policies themselves, coupled with the deviations in their implementation, hinder the long-term sustainable development of cities. Thus, improving and refining current talent policies is essential for promoting the continuous and sustainable growth of urban areas.

6. Conclusion

Low fertility rates have posed a challenge for most developed countries and some developing nations for over a century. This demographic trend affects future talent pools, which, in turn, influences the formulation and implementation of talent policies. Unlike many Western countries, China's talent policies are intricately tied to the household registration system. Within the global context of declining fertility rates and the domestic framework shaped by the household registration system, Chinese cities have introduced a continuous stream of talent policies, resulting in what has been termed a series of "talent wars" [57]. Overall, China's talent policies are characterized by their comprehensiveness, diverse approaches, and substantial variations across cities at different tiers.

China's talent policies aimed at promoting urban innovation can be categorized into three distinct pathways: (1) Dual Innovation-Oriented: This approach focuses on encouraging scientific and technological talents to engage in both innovation and entrepreneurship. It also aims to enhance the social environment to support talent development, fostering a synergistic relationship between individual initiatives and the broader community. (2) Cycle-Driven: This pathway centers on talent development itself, with an emphasis on promoting the transformation of scientific and technological achievements. The goal is to reinvest the outcomes of these achievements into talent development, thereby creating a sustainable cycle of innovation and investment in human capital. (3) Normative Guarantee: This approach emphasizes the standardization of market order and the assurance of a high quality of life for talents [58]. By establishing clear regulations and providing comprehensive support, it seeks to create a stable and attractive environment that fosters talent retention and growth.

From a functional perspective, China's talent policies can be categorized into four types [59]: (1) Talent Introduction and Retention Policies: These policies aim to attract and retain high-caliber individuals by offering incentives such as financial subsidies, housing support, and career development opportunities. The goal is to make cities more appealing to skilled professionals and ensure their long-term presence. (2) Talent Cultivation and Development Policies: Focused on nurturing and developing talent, these policies seek to enhance the skills and expertise of individuals. For instance, Qingdao integrates the characteristics of urban development with a strong emphasis on attracting and cultivating industrial talent, ensuring that talent development aligns with the city's economic needs. (3) Talent Management and Maintenance Policies: These policies are centered on the effective management and maintenance of talent resources [59]. They involve creating efficient administrative systems, providing continuous professional development, and ensuring that talent is optimally utilized within their respective fields. (4) Talent Evaluation and Assessment Policy: The basis

for objectively evaluating the abilities, performance, and contributions of talents in the region (see **Figure 5**) [41].

Talent policies in China are driven by two primary motivations: (1) Demand-Driven: The economic development levels and fiscal revenues of cities significantly influence the formulation and dissemination of urban science and technology innovation talent policies. As cities experience economic growth, the demand for skilled talent increases, which is essential for sustaining and advancing that growth [60]. (2) Pressure-Driven: Administrative directives, intergovernmental competition, and public opinion pressures play key roles in shaping and spreading science and technology innovation talent policies [61]. In response to these pressures, governments implement policies designed to enhance their competitive advantage and meet societal expectations [60].

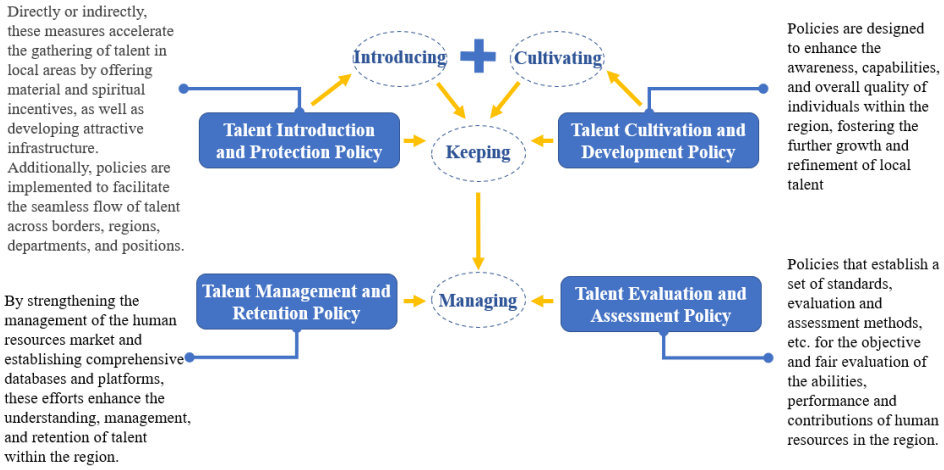


Figure 5. Talent policy mechanism diagram.

Source: In-depth analysis report on the comparison and effectiveness evaluation of talent policies in 31 Chinese provinces and cities by Qianzhan Industry Research Institute. https://bg.qianzhan.com/report/detail/2105201610197397.html

Limited by the constraints of the national household registration system, first- and second-tier cities enjoy greater autonomy in talent settlement, making them more attractive to skilled professionals. Moreover, city clusters benefit from higher levels of economic development and more comprehensive talent policies [62]. For example, the Yangtze River Delta city cluster offers extensive public services for talent and employs more sophisticated attention and scientific management practices compared to other regions [63]. This cluster outpaces other city groups in terms of regional talent aggregation, talent mobility, and talent sharing. In contrast, talent policies in small and medium-sized cities face several significant challenges [64].

(1) Limited Diversity in Talent Policy Instruments: These cities primarily emphasize material and service-based incentives, neglecting crucial areas such as urban infrastructure, intellectual property protection, and support for the commercialization of scientific and technological innovations.

(2) Narrow Focus of Talent Policies: The predominant focus is on attracting, cultivating, and incentivizing talent, with insufficient attention given to aspects of talent management, including development, mobility, and post-settlement services.

(3) Homogeneous Policy Content: Talent policies exhibit significant similarity in terms of objectives, content, and implementation tools, resulting in a lack of differentiation and innovation in policy approaches.

(4) Limited Market-Oriented Talent Allocation: The dearth of commercial human resource service agencies and the absence of specialized services—such as high-end talent recruitment and talent project evaluation—lead to insufficient and imprecise talent market information. This impedes the efficient, effective, and appropriate allocation of talent based on talent stock, flow, and societal needs.

(5) Lack of Diversified Policy Guidance: Small and medium-sized cities, constrained by limited economic resources and urban capacities, face difficulties in enhancing their talent introduction and cultivation efforts. As a result, their talent policies fail to significantly surpass those of first- and second-tier cities.

(6) Insufficient Diversity in Policy Promotion: Regional disparities in the promotion of talent policies are limited, with the content disseminated through media largely uniform across regions. This lack of differentiated and targeted promotional strategies, tailored to various talent levels, diminishes the effectiveness of policy outreach and reduces its overall impact.

In conclusion, China's talent policies are influenced by a confluence of historical constraints—most notably the household registration system—along with an urgent need for innovation and increased competition among cities. While first- and second-tier cities benefit from greater autonomy and more comprehensive policy measures, small and medium-sized cities face significant challenges. These include limited policy tools, narrowly focused incentives, and a lack of market-driven resource allocation, all of which impede their ability to attract, develop, and retain skilled professionals. To address these challenges, the development of more diverse, market-oriented, and strategically tailored policies will be essential for cultivating robust talent ecosystems across the full spectrum of China's urban landscape. We may take action in the following areas: (1) Build a more attractive talent introduction mechanism and develop a more accurate talent introduction catalog around major national strategies and industrial development needs; (2) encourage employers such as enterprises, universities, and research institutions to independently introduce talents, explore the establishment of international talent cooperation networks, and build a global talent introduction network; (3) establish a talent evaluation system guided by innovation ability, quality, and contribution. Pay attention to examining the actual abilities and performance achievements of talents, and avoid simply discussing heroes with "titles"; (4) improve the talent service system to address any concerns. To provide convenient and efficient services such as residency, visa, medical care, and children's education for talent introduction in order to create a good living environment; (5) build a talent big data platform to achieve talent information sharing and improve the efficiency of human resource allocation; (6) utilize various channels and methods to strengthen the promotion and interpretation of talent policies in order to increase their awareness and influence.

However, more crucial than the specific actions mentioned above is addressing the challenge of balancing policy effectiveness with short-sighted utilitarianism. Talents should be viewed as vital contributors and human resources for social development, rather than mere commodities. Consequently, current talent policies

should transition from a focus on attraction to a greater emphasis on cultivation, fostering a sustainable, long-term, and inclusive talent ecosystem.

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