Do Urban Talent Policies Promote Corporate Labor Hiring Adjustments?

Abstracts:

I collated the phenomenon and logic of talent policies in Chinese cities and constructed a model to describe how firms make factor-of-production adjustments in response to talent policies. Then I applied the staggered PSM-DID methodology to validate that talent policies can promote innovation and firms' labor-employment adjustments in city and firm level data. I first verified at the city level that talent policies can promote local innovation, and subsequently found at the firm level that firms adjusted their labor hiring decisions, but do not necessarily expanded their hiring. Firms with larger employment sizes responded more positively to talent policies. In addition, cities with talent policies have improved in terms of environment and urban development

1. Introduction

The talent policy, as a measure targeted by local governments to attract highly skilled personnel, although still characterized by administrative guidance, has retained the effective role of market mechanisms in the allocation of resources, and is essentially a compensatory attraction of skills, as the local government documents do not specify the specific work to be performed by the talents, but only set thresholds in terms of qualifications and assessment standards for attracting talents. In addition to material incentives, the policy also basically eliminates settlement restrictions and makes a series of subsidies in terms of hidden thresholds such as housing, medical care and education, which seriously restrict labor mobility. Further, in addition to one-time incentive subsidies, local governments often make additional efforts to improve the local business environment and the level of urban construction in order to retain talent, responding to the results of market choices in local industrial development, which can partially alleviate the mismatch of human capital in China under the hukou system, improve the level of profitability and the innovation capacity of firms, and influence the labor and employment situation at the city level or at the level of firms.

Considering data availability, and due to the fact that a large number of documents of similar nature have been issued in various places regarding talent policies after 2017, which makes it difficult to determine the exact policy point in time and has the problem of duplicity and competition,

I begin by constructing a theoretical framework that demonstrates that talent policies cause firms to adjust the size of their labor hiring and that the direction of adjustment depends on the form of the firm's production function. Firms with larger employment size are more likely to benefit from talent policies to expand their employment size. I then use the staggered PSM-DID approach to examine the impact of urban talent policies on the city's innovation dynamism and on firms' hiring decisions, using both city- and firm-level data.

2. Background

From 2015-2018 alone, 144 cities in China issued 3,122 talent policy-related documents (Huang and Li, 2021). Talent policy not only emphasizes the human capital itself brought by talents, but also emphasizes

various kinds of patented technologies, scientific research projects, management systems, and startups that go along with it. Thus is also a comprehensive industrial policy: a government-led industrial upgrading plan, but without stipulating the specific industries and targets for development, which alleviates the problem of information disadvantage of the local government in the implementation of the industrial policy Thus it partially circumvents the drawbacks of restricting competition and violating comparative advantage brought about by the failures of traditional selective industrial policy, which reduces production efficiency (Powell, 2005). It also partially avoids the problems of inefficient investment and moral hazard brought about by crude industrial policies, as talent policies generally track the performance of imported talents or start-ups and advocate the use of talents' own initiative to determine the level of incentives and support to be given (Lai and Li, 2014).

China's city-level talent policies take 2017 as the boundary (Zhao, et al, 2018), the talent policies issued before 2017 are relatively few cities, and concentrated in areas with higher degree of economic development and higher degree of opening up to the outside world, targeting mainly a small number of highly-skilled talents from foreign countries and domestic countries, and generally requiring academic qualifications of a master's degree or above from a high-level university or a practitioner with abundant skills, the It clearly exceeds the identification standard that a bachelor's degree and above is recognized as a high-skilled workforce, as suggested by the literature (Yu et al. 2021; Zhang, 2019; Xia and Lu 2015), and focuses on the competition for talents between international and regional levels. Although the direct goal of talent policy is to attract high human capital to the local area, supporting policies generally provide project support, business subsidies, and salary incentives for the process of "attracting talent", and settlement incentives, children's education, and medical insurance for the process of "retaining talent", providing a series of guarantees, In the process of "retaining talents", a series of safeguard measures are made, in which the leading scientific research and production potential brought by the talents themselves is emphasized. For example, the Interim Measures for Encouraging Overseas High-level Talents to Come to Beijing for Entrepreneurship and Work issued by Beijing Municipality in 2009 states that "Overseas high-level talents introduced should generally have obtained their doctoral degrees overseas" and that "the introduction of overseas high-level talents may take the form of introduction of core talents, introduction of teams, introduction of high-tech project development, etc. The purpose of the talent policy is considered to be a subsidy for local industrial upgrading, innovation and entrepreneurship.

Compared with the talent policies previously introduced, the introduction of the city range expanded significantly. And the introduction of the object of the more strengthened the attributes of the competition between the cities, many regions will introduce talents to the academic standards down to the Bachelor's Degree, compared with the previous focus on the introduction of domestic outstanding university graduates. Many regions have lowered the educational for talent admission to bachelor's degree, focusing more on domestic outstanding university graduates than before, and relaxing the requirements for talents to set up their own firms and develop scientific research projects. In some central and western regions and third-and fourth-tier cities where economic development is relatively lagging behind, the talent policies introduced do

not set up a general standard mode of introduction of the evaluation system, but tend to take a targeted attraction mode, that is, according to the number of talents in short supply in the regional institutions, key industries and other sectors, to carry out the annual plan for the introduction of talents in the form of a quantitative "campaign" mode. Instead, it tends to adopt the mode of targeted attraction, that is, according to the number of talents in short supply in regional institutions, key industries and other sectors, to implement the quantitative introduction of talents in a "campaign" mode.

In short, the talent policy before 2017 had the attributes of international competition, the competition and imitation relationship between regions was relatively weak, the scale of introduced talents was relatively small, the intensity of human capital accumulation was relatively high, and the focus was on regional innovation and entrepreneurship and industrial upgrading. After 2017, the regions competitively introduced the talent policy, the scale of introduced talents was significantly enlarged, the requirement of introduced talents for leading scientific research and production was weakened, and the focus was more on human capital aggregation. The requirements are weakened, and more emphasis is placed on the aggregation of human capital.

3. Literature Review

A large number of literature on the characteristics of talent attraction in China's cities has focused on exploring talent mobility. At the level of urban infrastructure, environmental level and public services, several strands of literature have found that the level of education provision (Wang and Bei Ye, 2021), digital infrastructure development (Jiao Hao et al., 2023), controlling house prices (Song and Wu, 2018; Zhang et al. 2017; Zhou et al. 2019), and environmental improvement (Sun et al. 2019) have a positive effect.

China's population mobility restrictions have not been fully liberalized, especially in large cities, where the household registration system is still widespread, which restricts the free movement of population (Cai Fang et al., 2001), and therefore violates the efficiency requirements of the market in allocating resources, resulting in the labor force and the human capital it carries not being able to match with the local natural environment and geographic location, leading to wasted efficiency and regional inequality (Whalley and Zhang, 2007). Whalley and Zhang (2007) find that the productivity loss due to misallocation of resources reaches 30-50 percent in China. In addition to this, regions with strict labor regulation tend to have lower employment and labor force participation rates (Di Tella and MacCulloch, 2005), so theoretically adjustments in response to the hukou system could unleash labor force participation in the labor force, as reflected in an increase in the number of people employed in the region and the size of firms hiring.

Another widely recognized feature of talent policy is industrial upgrading due to innovation (Zhang and Wu, 2022; Yang et al. 2018; Cao et al. 2020). Using panel data of prefecture-level cities from 2010-2018, Yang et al. (2022) found that talent policy significantly promotes the rationalization and advancement of regional industrial structure through the channels of human capital accumulation and innovation increase. Talent policy, as a package introduced by the government to attract talent, has the nature of a direct or indirect administrative subsidy for talent creativity, which is mainly realized through the means of increasing public

expenditure (Wang, 2019). It has been shown in the literature that talent is an important part of firm innovation (Custódio et al., 2017), and government subsidy programs tend to promote firm innovation (Howell, 2017; Bayar et al., 2016). Direct empirical studies on talent policies have also verified the positive impact of policies on the innovation output of cities and firms (Zhong et al. 2021; Le et al. 2021; Sun et al. 2021).

Therefore, the influence of talent policy on labor employment is not only derived from the flow of labor and human capital, but also from the impact of technological progress brought about by industrial upgrading. The impact of technological progress on the level of labor employment, both positive employment creation mechanism, firm scale expansion mechanism (Wei and Gong, 2012), but also negative creative destruction mechanism, mainly from Schumpeter's "creative destruction theory", technology may replace part of the characteristics of the labor force (Acemoglu et al., 2022), for example, Sun and Hou (2019) found that industrial intelligence intensified the substitution of low-skilled labor by smart devices, while the development of the tertiary industry weakened this trend, and employment substitution as a whole showed a polarization phenomenon.

To sum up, there are two main ways in which talent policy affects the level of labor hiring and employment adjustment: first, on the supply side of the labor market, the preferences provided by talent policy attracts the entry of human capital, bringing about productivity and wage increases, which further attracts the rest of the workforce to enter the local labor market and prompts locally operated firms to make labor hiring adjustments. The second is the demand side of the labor market, where innovation and technological advances have created or replaced employment. This paper aims to use empirical tools to verify the relationship between talent policy and labor employment in China, considering both the city and firm levels.

4. Theoretical framework

4.1 Size of firm employment

Consider the labor force to be composed of highly skilled laborH_h and low-skilled laborH_l. The high-skilled labor force is directly affected by the talent policy, while the low-skilled labor force is not directly affected. The direct effect of the city's talent policy, in which the government subsidizes high-skilled labor, on firms is to lower the wage level of high-skilled labor w_h. and does not directly affect other economic variables.

Assume that the firm has a production function of the form CES.

$$Q = AK^{\alpha}\left(H_h^{\beta}H_l^{1-\beta}\right)^{1-\alpha} \qquad 0 < \alpha, \beta < 1$$

of which Q is the output of the firm, and K is the capital invested by the firm, and A is the technology parameter and is endogenously determined by highly skilled labor. α is the output elasticity of capital, and β is the relative elasticity of highly skilled labor in total output.

Profit Maximization Problems for Firms[1]:

$$\pi = Q - w_h H_h - w_l H_l - rK = AK^{\alpha}\left(\mathrm{H_h^{\beta}H_l}^{1-\beta}\right)^{1-\alpha} - \mathrm{w_h H_h} - \mathrm{w_l H_l} - \mathrm{rK}$$

The first-order conditions of K :

$$\frac{\partial \pi}{\partial K} = \alpha A K^{\alpha-1}\left(\mathrm{H_h^{\beta}H_l}^{1-\beta}\right)^{1-\alpha} - r = 0$$

$$r = \alpha A K^{\alpha-1}\left(\mathrm{H_h^{\beta}H_l}^{1-\beta}\right)^{1-\alpha}$$

$$K = \left(\frac{r}{\alpha A\left(H_h^{\beta}H_l^{1-\beta}\right)^{1-\alpha}}\right)^{\frac{1}{\alpha-1}}$$

The first-order conditions of H_h:

$$\frac{\partial \pi}{\partial H_h} = \beta(1-\alpha)AK^{\alpha}\mathrm{H_h^{-1}}\left(H_h^{\beta}{H_l}^{1-\beta}\right)^{1-\alpha} - w_h = 0$$

$$w_h = \beta(1-\alpha)AK^{\alpha}\mathrm{H_h^{-1}}\left(\mathrm{H_h^{\beta}H_l}^{1-\beta}\right)^{1-\alpha}$$

The first-order conditions of H_l:

$$\frac{\partial \pi}{\partial H_l} = (1-\beta)(1-\alpha)AK^{\alpha}H_l^{-1}\left(H_h^{\beta}H_l^{1-\beta}\right)^{1-\alpha} - w_l = 0$$

$$w_l = (1-\beta)(1-\alpha)AK^{\alpha}H_l^{-1}\left(H_h^{\beta}H_l^{1-\beta}\right)^{1-\alpha}$$

$$H_l = \left(\frac{(1-\beta)(1-\alpha)AK^{\alpha}H_h^{\beta(1-\alpha)}}{w_l}\right)^{\frac{1}{1-(1-\beta)(1-\alpha)}} = MH_h^N$$

Among them, $M = (\frac{(1-\beta)(1-\alpha)AK^{\alpha}}{w_l})^{\frac{1}{(1-\beta)(1-\alpha)}}$, $N = \frac{\beta(1-\alpha)}{1-(1-\beta)(1-\alpha)} > 0$.

Using the implicit function derivation rule, I obtain the relationship between w_h and K, H_h, H_l.

Theorem 1: Firms will expand hiring and capital if talent policies to lead to lower wages for highly skilled labor.

[1] I normalized the price index to 1

$$\frac{\partial \mathrm{H_h}}{\partial w_h} = \frac{1}{\beta(1-\alpha)(\beta(1-\alpha)-1)AK^{\alpha}H_h^{(\beta(1-\alpha))-2}H_l^{(1-\beta)(1-\alpha)}} < 0$$

$$K = \left(\frac{r}{\alpha A\left(H_h^{\beta}H_l^{1-\beta}\right)^{1-\alpha}}\right)^{\frac{1}{\alpha-1}} = \left(\frac{r}{\alpha A\left(H_h^{\beta}MH_h^{\mathrm{N}(1-\beta)}\right)^{1-\alpha}}\right)^{\frac{1}{\alpha-1}} = \left(\frac{r}{\alpha A}\right)^{\frac{1}{\alpha-1}} MH_h^{\beta+\mathrm{N}(1-\beta)}$$

$$\frac{dK}{dH_h} > 0$$

From this we establish that w_h and $\mathrm{H_h}$ are inversely variable. So next, for simplicity, we will replace the change in w_h with the change in $\mathrm{H_h}$.

Theorem 2: Firms with larger employment sizes are more elastic in their demand, suggesting that they will hire more in response to a fall in the wages of highly skilled labor.

$$\rho_h = -\frac{\partial \mathrm{H_h}/H_h}{\partial w_h/w_h} = -\frac{w_h}{\beta(1-\alpha)(\beta(1-\alpha)-1)AK^{\alpha}H_h^{(\beta(1-\alpha))-1}H_l^{(1-\beta)(1-\alpha)}} > 0$$

$$\frac{d\rho_{\mathrm{h}}}{dH_h} > 0$$

$$\rho = -\frac{\partial \mathrm{H}/H}{\partial w_h/w_h} = -\frac{\partial(H_h+H_l)/(H_h+H_l)}{\partial w_h/w_h} = \rho_{\mathrm{h}}(1+MNH_h^{\mathrm{N}-1})\frac{H_h}{H_h+H_l} > 0$$

$$\frac{d\rho}{dH_h} > 0$$

From this, I obtain the price elasticity of demand for highly skilled labor ρ_h and the overall price elasticity ρ of high-skilled labor. And as the H_h increases, the elasticity gradually increases. It shows that the larger the hiring scale, when the talent policy reduces the price of high-skilled labor, the more incentives the firms have to expand their hiring scale. Thus, it can be predicted that larger firms have a greater tendency to adjust their labor hiring after a talent policy shock, as well as to adjust more. Further, I show that firm capital size *K* expands with the entry of highly skilled individuals.

Next, I explore whether the firm's capital-labor ratio changes:

Theorem 3: Firms expand both capital inputs and employment, and changes in the capital-labor ratio depend on the form of the production function

$$\frac{K}{H} = \frac{\left(\frac{r}{\alpha A}\right)^{\frac{1}{\alpha-1}} MH_h^{\beta+\mathrm{N}(1-\beta)}}{H_h + MH_h^{\mathrm{N}}}$$

$$\frac{dK/H}{dH_h} = \left(\frac{r}{\alpha A}\right)^{\frac{1}{\alpha-1}} M \frac{\big(\beta + N(1-\beta)\big)(H_h + MH_h^N) - (H_h + NMH_h^N)}{(H_h + MH_h^N)^2}$$

$$= \left(\frac{r}{\alpha A}\right)^{\frac{1}{\alpha-1}} M \frac{\big(\beta + N(1-\beta)\big)(H_h + MH_h^N) - (H_h + NMH_h^N)}{(H_h + MH_h^N)^2}$$

$$\frac{dK/H}{dH_h} = \left(\frac{r}{\alpha A}\right)^{\frac{1}{\alpha-1}} M \frac{(\beta + N(1-\beta) - 1)H_h + (M\beta - MN\beta)H_h^N}{(H_h + MH_h^N)^2}$$

The relationship between the ratio of capital to labor depends on the firm's production function in α The relationship between β The relationship between the ratio of capital to labor and the ratio of H_h . For example, when α is smaller and β larger, the highly skilled individuals in the firm's labor force have more influence, when the firm tends to expand the scale of investment. And when α is larger and β smaller, the firm's labor force contributes less to output and the highly skilled labor force has no significant influence, the firm tends to scale down its investment.

On this basis, since both the firm's capital and labor inputs increase, then it is intuitively obvious that the firm's output increases. I then explore whether there is an increase in the productivity of the firm's labor force:

Theorem 4: Talent policies do not affect the labor productivity of a firm's low-skilled workforce, and changes in the labor productivity of high-skilled workforce depend on the production function.

$$MPL_h = \frac{\partial Q}{\partial H_h} = (1-\alpha)\beta\, AK^{\alpha} H_h^{\beta(1-\alpha)-1} H_l^{(1-\beta)(1-\alpha)}$$

$$MPL_h = (1-\alpha)\beta\, AK^{\alpha} H_h^{\beta(1-\alpha)-1} (MH_h^N)^{(1-\beta)(1-\alpha)} = (1-\alpha)\beta\, AK^{\alpha} M^{(1-\beta)(1-\alpha)} H_h^{\beta(1-\alpha)-1+(1-\beta)(1-\alpha)N}$$

$$MPL_l = \frac{\partial Q}{\partial H_h} = (1-\alpha)(1-\beta) AK^{\alpha} H_h^{\beta(1-\alpha)} H_l^{(1-\beta)(1-\alpha)-1}$$

$$MPL_l = (1-\alpha)(1-\beta) AK^{\alpha} M^{(1-\beta)(1-\alpha)-1} H_h^{\beta(1-\alpha)+N[(1-\beta)(1-\alpha)-1]}$$

Since the positivity and negativity of $\beta(1-\alpha) - 1 + (1-\beta)(1-\alpha)N$ is determined by α and β , so it is not clear whether the productivity of high-skilled labor increases. When α is smaller and β When it is larger $\beta(1-\alpha) - 1 + (1-\beta)(1-\alpha)N > 0$, when high-skilled labor rises as H_h increases, similar to the conditions under which firms expand their capital investment.

And substituting N $N = \frac{\beta(1-\alpha)}{1-(1-\beta)(1-\alpha)}$ into $\beta(1-\alpha) + N[(1-\beta)(1-\alpha) - 1]$, it is found that$\beta(1-\alpha) + N[(1-\beta)(1-\alpha) - 1] = 0$ Therefore talent policies do not have an impact on the labor productivity of firms with low-skilled labor.

Next I examine changes in the marginal output of capital.

Theorem 5: Capital productivity of the firm will increase

$$MPK = \frac{\partial Q}{\partial K} = \alpha A K^{\alpha-1}\left(\mathrm{H_h}^{\beta}\mathrm{H_l}^{1-\beta}\right)^{1-\alpha} = \alpha A K^{\alpha-1} M^{(1-\alpha)(1-\beta)} H_h^{\beta(1-\alpha)} H_h^{(1-\alpha)(1-\beta)N}$$

$$MPK = \alpha A K^{\alpha-1} M^{(1-\alpha)(1-\beta)} H_h^{\beta(1-\alpha)+(1-\alpha)(1-\beta)N}$$

Since $\beta(1-\alpha)+(1-\alpha)(1-\beta)N > 0$, the marginal output of capital must fall with w_h falling as well as H_h rises.

I have thus completed my analysis of firms affected by talent policies. Firms have a tendency to expand the size of hiring and capital inputs, but the ratio of capital to labor inputs cannot be determined. In addition, the elasticity of labor adjustment increases with the size of hiring, suggesting that larger firms may be more likely to be incentivized by talent policies to adjust the size of hiring. It can be shown that firms' marginal output of low-skilled labor and capital increases, but the productivity of high-skilled labor does not necessarily increase.

4.2 Inequal policies and other potential alternative pathways

Since urban talent policies must rely on China's local governments, which require many administrative processes to verify the qualifications of both the highly skilled labor and the firms, in many cases the local government determines the success of the talent-firm match. Therefore, I can infer that not all firms benefit equally from the policy, and that certain type of firms may be more favored by the government and have the most opportunities to hire high-skilled labor. 3.1 analyzes the responses of benefiting firms in a static situation, but when there are benefiting as well as non-benefiting firms in a region, different behaviors are possible: benefiting firms may be able to increase their productivity and profit levels, and thus expand the productivity and profitability of firms in the region, thus expanding production and lowering price levels. Unbenefited firms, however, have not been able to compensate from the decline in the cost of high-skilled labor, but have suffered from increased competition in the market, and thus this type of firm is likely to suffer under an unbalanced talent policy, resulting in the opposite outcome to that of benefited firms. That is, firms that do not benefit may be forced to scale back their hiring levels.

The unchangeability of capital inputs in the short run also limits the firm's decision to expand employment. If the capital investment cannot be changed in the short term, and the return is in the form of Leontief relative to the number of labor inputs, then the firm will not bring any benefit by merely expanding the scale of employment, but may encounter the loss of increased employment costs. Therefore, the firm may also be out of labor cost saving considerations, reduce the scale of employment or replace the original low-skilled personnel with high-skilled personnel, from the overall employment scale does not increase, and may even reduce the employment. Another possibility is that the entry of high-skilled personnel into the firm improves the technological level of the firm. If this technological improvement is labor-saving, then the optimal choice

for the firm is to reduce the size of its labor force.

Thus, if the talent policy is unequal, or if firms face other constraints and endogenous effects on their production function and production conditions, then firms do not necessarily choose to expand their hiring size, yet firms' adjustments to their hiring size can be thought of as a spontaneous response to the talent policy. This suggests that greater access to the local market for highly skilled labor does change firms' hiring decisions.

5. Data and Empirical Strategies

5.1 Description of data sources and variables

In order to identify the policy point, the talent policies of each city included in the "Policy Guide for Introducing Overseas Talents in Science, Technology and Innovation in Chinese Provinces and Municipalities" prepared by the Ministry of Science and Technology in 2013 were used as the main basis, and the time of issuance of the documents with detailed rules and regulations of the policies included in the guide was selected as the policy node for identification. Since all provinces have successively introduced talent policies, the provincial talent policy indicator is of little significance because the initial level gap at the city level has been captured by fixed effects, and the introduction of talent at the city level already reflects the degree of difference in the implementation of talent policies within the same province, and the differences between provinces can be controlled by other variables. However, to ensure the comprehensiveness of the sample, following Zhong Teng et al. (2021), provinces that have introduced a provincial-level talent policy but not a city-level talent policy are recognized as having introduced a talent policy in their capital city, although Tibet, where data are severely missing, is excluded. Potential pitfalls also include other cities that have introduced similar talent policies that are not included in the guide, although given that the cities included in the guide are the most representative, exemplary and instructive, proving that they have introduced talent policies that are stronger and more effective; it is also possible to find the best-matched control cities to mitigate this through the PSM approach.

City-level data are mainly from the China Urban Statistical Yearbook, the China Urban Construction Statistical Yearbook and the CSMAR Cathay Pacific database, innovation index data are from the China Cities and Industries Innovativeness Report 2017 provided by the Center for Industrial Development Research of Fudan University, city-level patent data are from the CNRDS China Research Data Service Platform, and firm-level data are from the Industrial Firm Database and Tax Survey Database. After excluding a small number of cities with serious missing data, at the city level, the time span of the study is 2005-2016, this is because 2007 is the first time point included in the guide where talent policies were explicitly introduced, and since it takes time for talent policies to take effect, the sample period was advanced to 2005 and delayed to 2016, while after 2016, various places have successively After 2016, a new batch of talent policies were introduced in various regions, and therefore not included in the sample limit.

The Industrial Firms Database is updated to 2014, although the quality of the data is relatively high prior to 2007; while the Tax Survey Database covers the period 2007-2016. Therefore, in order to maximize sample

completeness, the data from 2005-2006 of the industrial firm database are merged with the data from 2007-2016 of the tax survey repository. Among them, the tax survey data started to lack key information such as the time of establishment of firms in 2012, so the information on the time of establishment of firms is obtained from various years of the industrial firm database and other sources through the information of legal person code to match with the tax survey database. In addition, referring to Li Bing and Li Rou (2017), samples of firms (1) lacking key variables such as total assets, employed persons, and sales, (2) violating accounting standards, such as current assets are larger than the total assets of the firms (3) employing fewer than 8 persons, and (4) shrinking the tails of the required key variables to ensure the accuracy of reported data are eliminated.

In order to measure employment adjustment at the firm level, the extent of employment adjustment is the focus of my interest. This is because an increase in firms' innovative and managerial capabilities brought about by talent policies does not necessarily environmentthat firms will necessarily expand or reduce the size of their employment; for example, firms' profitability may increase as a result of the entry of highly skilled human capital, but firms may either expand the size of their employment as a result of increased labor productivity, or replace the original labor force as a result of the acquisition of highly skilled individuals, or replace or expand labor as a result of the technological advances and replace or expand labor. In any case, however, since the entry of high-skilled personnel brought about by talent policies is not a mandatory measure, for individual firms, the adjustment of labor employment reflects the spontaneous adjustment of firms in the face of the exogenous shock of the lowering of the entry threshold of high-skilled personnel, and the question of whether the talent policy can produce an effective outcome in the adjustment of firms' production decisions. I therefore expect a significant change in the rate of employment adjustment at the firm level.

Since both firing and hiring decisions of firms may be effective means of adjustment in the face of shocks, I follow (Autor, 2007) and compute an indicator of the employment adjustment rate of firms:

$$EAR_{ijct} = \frac{|E_{ijct} - E_{ijct-1}|}{(E_{ijct-1} + E_{ijct})/2} \qquad (1)$$

where i, j, c, and t denote individual firms, industries, cities, and year identifiers, respectively, and$Eijct$ denotes the employment level of firm i in year t. When there is a large change in the labor employment of the firm in year t, the adjustment, whether negative or positive, will be reflected in the increase of the indicator, and if the firm does not react to the exogenous shocks in terms of hiring, the employment adjustment indicator will be 0, which proves that the talent policy does not have any impact on the hiring decision of the firm.

5.2 Staggered DID estimation strategy

Because of the variation in whether and when talent policies are introduced across regions, a standard approach is to use a staggered Difference-in-Difference (DID) approach to study the relationship between regional talent policies and the labor hiring and returns I am interested in. Although China has introduced

talent policies at the national, provincial, and city levels, however, considering that the introduction of policies at the high administrative level tends to be guidance-based, and that each province has introduced relevant policies, as well as the informational advantages of the low administrative level, it is assumed that the implementer of talent policies is primarily the city government, and the time of introduction of the policy in the city is chosen as the policy point in time. If the factors affecting the introduction of talent policies in cities can be captured directly by the control variables, the double-difference method is an effective framework for estimating the difference between cities that have introduced talent policies and those that have not.

Specifically, I include city i, which introduced a talent policy between 2005 and 2013, as the experimental group and city j, which did not introduce a talent policy, as the control group. The effect of the policy is verified if there is a significant gap between the experimental group that introduced the policy compared to the control group that did not introduce the policy on labor hiring and returns.

Since this study is concerned with the impact of innovation and industrial upgrading on labor characteristics as a result of talent policies, it is necessary to test the effectiveness of talent policies. Although I was unable to obtain reliable data on firms' R&D output in the required years, because the talent policy directly affects the city's innovation capacity and does not rely on direct subsidies to most firms to promote firms' innovation, it is only necessary to test it at the city level, and the general staggered DID model for testing the effectiveness of the policy is

$$Inno_{ct} = \alpha + \beta_0(treat_i \times time_t) + \lambda \mathrm{X}_{ct} + \theta_t + \kappa_c + \epsilon_{ct} \qquad (2)$$

where c stands for city, t stands for year, and$Innoct$ is the explanatory variable, measured using the annual number of patents obtained by the city, the city innovation index, and the industrial advancement index, which is used to prove that the talent policy has achieved the direct purpose of policy design. Among them, the industrial advanced index is calculated as the ratio of the value added of the tertiary industry to the value added of the secondary industry (Fu et al., 2013; Cai and Xu, 2017). If city i has introduced a talent policy during the observation period, it is $treat_c$ takes 1, and vice versa takes 0. Among the cities that have introduced policies, if they are introduced in year t, then the subsequent $time_t$ takes 1 and vice versa takes 0. X_{ct} are city-level control variables, including GDP per capita, total GDP, secondary and tertiary industry shares, population size, and fiscal expenditures. κ_c are region fixed effects, θ_t is the year fixed effect, and ϵ_{ct} is the disturbance term. It is worth noting that in addition to the local economic development status, the level of infrastructure, environmental conditions and housing prices also affect the effectiveness of cities in attracting high-skilled talent (Luo et al. 2019; Jiao et al. 2023; Zhang et al. 2017; Song and Wu 2020; Zhou et al. 2019), and therefore additional control variables are added to the per capita road area, Internet users per 10,000 people broadband access, average air PM2.5 concentration, and average house price to control for the above effects.

Since the direct impact of talent policies is innovation and industrial upgrading at the city level, as a test of effectiveness, it is sufficient to conduct it at the city level only. Subsequently, I use a similar regression

strategy to estimate the impact of policy on firms' labor adjustment, with the specific DID model:

$$EAR_{ijct} = \alpha + \beta_0(treat_i \times time_t) + \gamma \mathrm{H}_{ijct} + \lambda \mathrm{X}_{ct} + \phi_i + \theta_t + \eta_j + \kappa_c + \epsilon_{it} \qquad (3)$$

where i denotes an individual firm, j denotes an industry marker, c denotes location, t denotes year, ϕ_i denotes individual fixed effects, η_j denotes industry fixed effects, EAR_{ijct} denotes the employment adjustment rate indicator in (1), and H_{ijct} denotes firm-level control variables, referring to Cai et al. (2020), which control for firm size, debt rate, profitability and other variables. Other variables have the same meaning as in the previous test of city data.

5.3 Endogenous Problems and Solution Strategies

However, as city-level talent policies are determined by city governments themselves, the introduction of policies and their specific timing may be related to the city's own level of economic development and willingness to upgrade its industries. For example, after the household registration reform, the rural labor force goes to the city to work, which increases the need for industrial upgrading, and the local government needs to attract high-skilled talents as well as supporting related projects, so the region that introduces the policy may be because of demand-driven, which is not fully consistent with the assumption of quasi-natural experiment, and may have endogenous pitfalls.

In order to address potential endogeneity risks, it is first necessary to include city-level fixed effects. City governments decide whether or not to introduce talent policies based on regional characteristics, and if these characteristics are not related to the year, then when studying the city level, all endogeneity problems can be controlled for by fixed effects alone because the city's geographic location does not change; when studying the firm level, the same effect can be achieved if firms do not change their geographic location.

However, since the introduction of talent policies by cities is likely to be affected by factors that change over time, such as the city's economic growth rate, and in fact, the economic growth rate gap between regions in China has always existed and has a tendency to widen (Sheng, et al., 2018), another issue is that, since I can't directly observe how many high-skilled talents and matching funds are attracted by the introduction of talent policies by cities specifically, the policies shocks are likely to change with city and year, and it is possible that regions with high levels of economic development attract more highly skilled individuals and therefore also have a greater impact on industrial upgrading and labor and wages. Theoretically these factors can be captured by adding more control variables, so I include several potentially effective control variables, such as variables measuring the level of local fiscal spending, total and per capita GDP, and the share of the three types of industries.

Another feasible and widely used strategy to eliminate endogeneity is the use of propensity score matching (PSM), the basic principle of which is to choose appropriate factor criteria and select cities with and without talent policies that are most similar in these aspects, which can successfully eliminate systematic bias between the experimental group and the control group (Dehejia and Wahba, 2002), and the method of PSM-DID has been widely used in various types of policy evaluation (Zhou Yulong, et al., 2018; Li and Wang,

2023). However, since the cities that have introduced talent policies are fewer compared to the total number of cities and are concentrated in regions such as Beijing-Tianjin-Hebei and the Yangtze River Delta region, which are economically developed and have a high level of openness to the outside world, there will be a higher loss of samples during the matching process, and the selection of each evaluation factor is inevitably affected by subjective choices, and is therefore used in the benchmarking regression only as evidence of the robustness of the results to enhance the robustness of the results.

6. Empirical results

6.1 PSM matching results

At the city level, since the main purpose of using the PSM strategy is to control the tendency of cities to introduce talent policies and to find the experimental and control groups with the most similar initial tendency, which is mainly affected by the city's willingness to attract human capital and industrial upgrading, the influencing factors that need to be controlled are mainly the variables related to the level of the city's economic development. To this end, I control the ratio of the second and third industries, log science and technology expenditure as a proportion of fiscal expenditure, log fixed asset investment, log GDP, log GDP per capita, average salary, road area per capita and Internet broadband access per 10,000 people as the influencing factors, and estimate the probability of the city's introduction of a talent policy using a probit binary regression (the city that introduces it is labeled with treat=1, otherwise treat=0), and the cities with the closest characteristics are matched as nearest neighbors based on the propensity score of each factor. Since only 36 cities in the experimental group introduced talent policies between 2005 and 2013, the nearest-neighbor 1:4 matching was chosen to expand the sample selection, and the bias of the vast majority of the factors was significantly reduced after matching (see Figure 1), demonstrating the usefulness of the PSM technique in eliminating the initial differences between cities. Figure 2, on the other hand, shows the distribution of cities with policies in place and those used for control after matching. Dark blue are cities with talent policies in place, light blue are paired cities after PSM, and the rest are cities not included in the PSM data.

Figure 1. Deviation of each influence factor before and after application of PSM technique

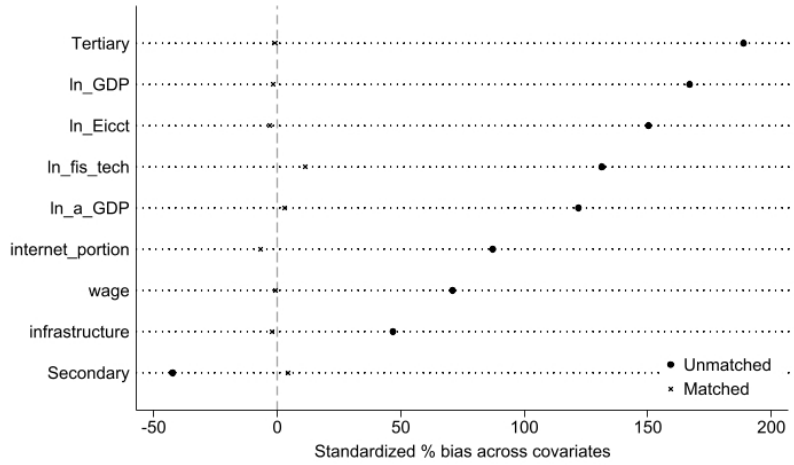
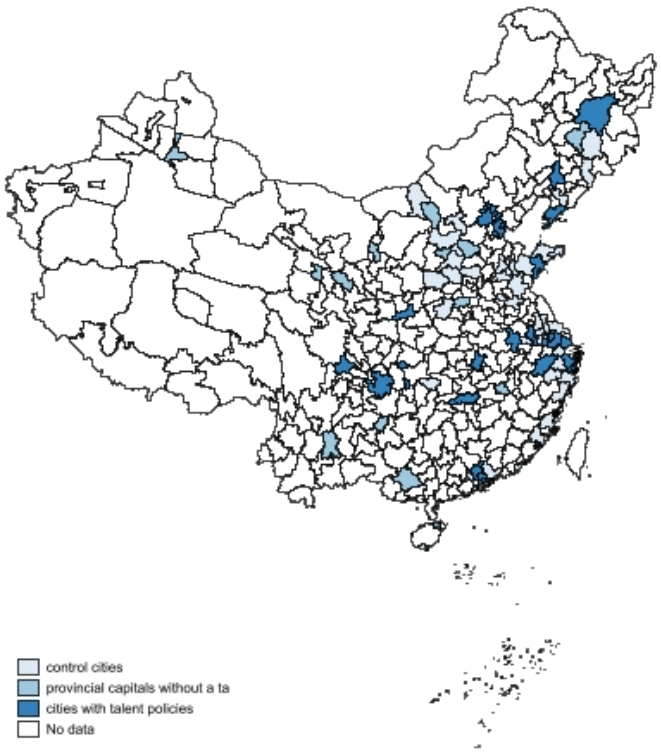


Figure 2. Group of cities with talent policies in place between 2005 and 2013 and their matched control group



6.2 Validation of policy effectiveness

First, I utilize equation (2) at the city level to validate the effectiveness of talent policies, with the main choice of explanatory variables including (1) the city innovation index (2) the number of patents recognized in the city (3) the amount of R&D input in the city (4) the percentage of R&D personnel in the city as a percentage of the population. Because in addition to city-level talent policies, talent policies are also introduced at the provincial level, provincial fixed effects are additionally controlled.

Panels 1A and 1B, show the results of the panel regressions, controlling for year, province and individual fixed effects for the baseline panel regressions. The estimated coefficients of DID are significantly positive, whether measuring the city innovation index and the number of patents obtained at the innovation output level, or R&D expenses at the input level, and controlling for variables that may affect the level of innovation in cities as mentioned in the past literature such as house prices, infrastructure development, and the level of environmental pollution. Further, since talent policies may take some time to attract the inflow of highly skilled personnel, similar positive results are obtained by considering the lagged one-, two-, and three-period effects of the policies, which further strengthens the hypothesis of policy effectiveness.

In order to find a suitable control group to eliminate potential bias, panel regressions are re-run after finding a control group using PSM, and similar findings are obtained except for the positive but insignificant results in the column of the indicator of advanced industrial structure. Since PSM loses samples, it is used only as a reference and robustness check. Figures 3, 4 and 5 carry out the parallel trend verification, plotting the

changes of the dependent variables between the experimental and control groups before and after the policy introduction, indicating that in the three years before the policy introduction, the coefficients of the interaction between the innovation index, patents, and index of industrial structure advancement and the year are basically close to 0, which suggests that the trend of urban growth in the experimental group and the control group is basically the same, and therefore roughly satisfies the parallel trend hypothesis, and that after the policy point in time, there is a The obvious rising trend after the policy point basically indicates that the urban talent policy has achieved the role of encouraging innovation and promoting industrial upgrading at the beginning.

Panel 1A.

	(1)	(2)	(3)	(5)
VARIABLES	Innovation	Patent	IS	RD people
Treat×Post	40.282***	8,265.918***	0.104***	0.056***
ln(GDP)	5.605	2,150.936**	-0.305***	0.016*
house price	-0.000	-0.043	0.000	0.000
fis expenditure in tech	15.981	11,242.020*	-2.623***	-0.173***
infrastructure	-0.570*	-62.704*	-0.002	-0.000
environment	-0.064	-78.960***	-0.002**	-0.000
R-squared	0.707	0.795	0.906	0.946

Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: The key variable is $Treat \times Post$, if the city introduces a talent policy between 2005 and 2013, then $Treat = 1$, at and after the point of introduction $Post = 1$, otherwise $Treat = 0$. $Post = 0$. $Innovation$ denotes the city innovation index, sourced from the Industrial Economics Research Center of Fudan University, calculated by weighting the total number of patents in the city in the year by the number of citations to patents. $Patent$ denotes the total number of patents obtained by the city. IS denotes the index of advanced industrialization of the city, calculated by the formula of $IS = \frac{\text{Value added of tertiary sector}}{\text{value added of secondary sector}}$. The formula is RD denotes the ratio of R&D personnel to population in the city in that year. $House\_price$ denotes the average house price of the city. $fis\ expenditure\ in\ tech$ denotes the proportion of local government expenditure on science and technology in that year. $environment$ denotes the air quality of the city, and $infrastructure$ denotes road area per capita. All control for year, province and individual fixed effects.

Panel 1B.

VARIABLES	(1) Innovation(PSM)	(2) Patent(PSM)	(3) IS(PSM)	(4) RD(PSM)
Treat×Post	32.010***	4,905.928***	0.006	0.037***
ln(GDP)	23.088	11,583.099*	-0.260*	0.157***
house price	-0.001	-0.123*	0.000	0.000
fis expenditure in tech	-52.749	12,023.581	-2.886***	-0.151**
infrastructure	-2.715**	-242.107**	-0.008**	-0.003
environment	-0.089	-183.691**	-0.002*	-0.001
R-squared	0.758	0.820	0.942	0.954

Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Figure 3. Trend of change in city innovation index before and after the introduction of talent policies

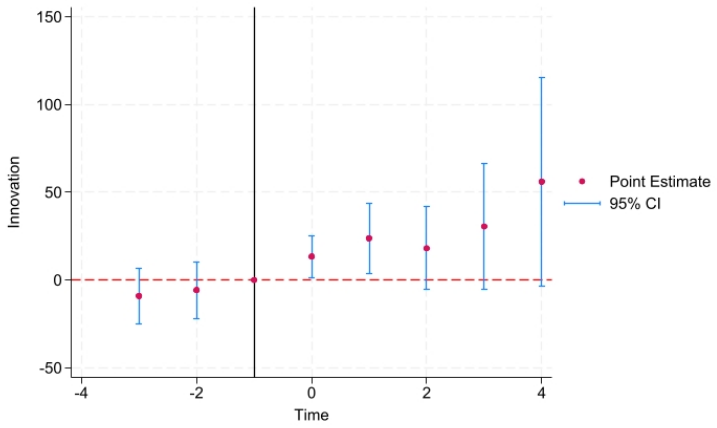


Figure 4. Trend of change in patent before and after the introduction of talent policies

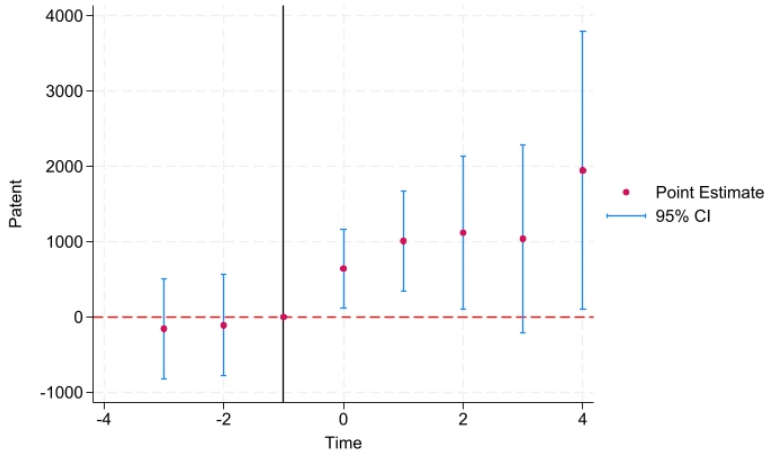


Figure 5 Trend of change in industrial structure index before and after the introduction of talent policies

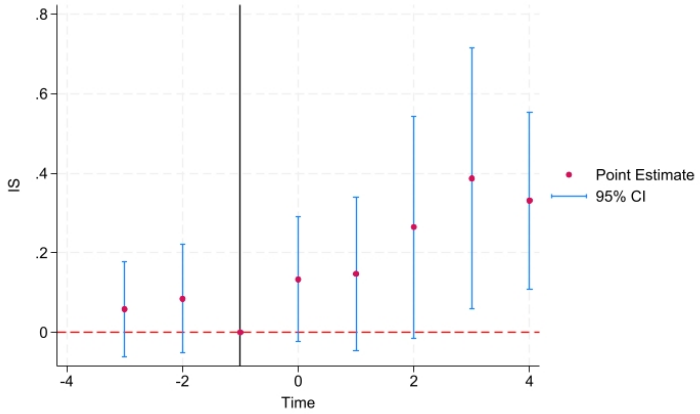
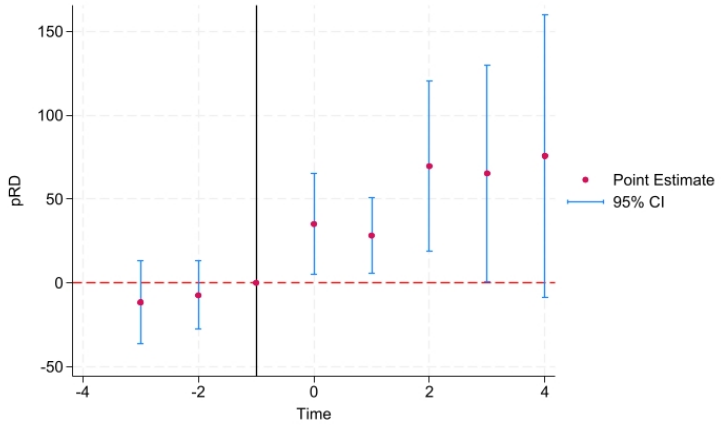


Figure 6 Trend of change in R&D people before and after the introduction of talent policies



6.3 Impact on labor hiring practices in firms

First in the benchmark regressions, I estimate the impact of the talent policy on firms' employment

adjustment rates in the full sample and by applying the PSM methodology, i.e., in a firm-level regression model, respectively. In column (1), I control for the sample's individual, city-level characteristics and include industry fixed effects with a view to capturing the impact of city-and industry-level changes due to the talent policy. In column (2), I take into account that industry structure and market power are also important factors reflecting firms' willingness to adjust their labor hiring intentions (Prager & Schmitt, 2021), and therefore I additionally compute the Herfindahl index for the industry, as well as the firm's mark-up rate (Nucci and Pozzolo, 2010), where the mark-up rate is defined as $\text{markup} = \frac{\text{sale}}{\text{sale}-\text{profit}}$, in addition to controlling for firms' debt ratio index. I find that talent policies do affect firms' labor hiring decisions, and a positive effect of talent policies on firms' hiring adjustment rates is found regardless of whether PSM is applied or not.

Panel 2

	(1)	(2)	(3)	(4)
VARIABLES	EAR	EAR	EAR(PSM)	EAR(PSM)
Treat×Post	0.005***	0.005***	0.007***	0.007***
ln(sale)	-0.032***	-0.032***	-0.029***	-0.029***
ln(GDP)	0.023***	0.023***	0.031***	0.029***
HHI		-0.023***		-0.024***
markup		0.000***		0.000***
debt rate		0.000**		0.000***
R-squared	0.432	0.433	0.431	0.432

Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

6.4 Identification of start-ups

Because talent policies may also promote the creation of new firms and may also increase the probability that a firm enters within the sample set by expanding its size, the direct use of employment data for the full sample of firms may distort the adjustment in labor employment due to the creation of new firms. This is because the first year that a new firm is founded and enters the sample cannot be used to calculate the EAR indicator due to the lack of prior period data, but the new employees hired by the firm reflect the effective adjustment of the labor market to the talent policy shock, and thus the EAR data for vacant new firms may underestimate the impact of talent policy on the adjustment of the regional labor market. And if the talent policy's choice of employment adjustment for firms that only entered the sample set thanks to the policy's expansion of operations is non-neutral, i.e., such firms may adjust their labor hiring higher or lower than the

rest of the firms, then again, the lack of EAR data on initial entries into the sample set can distort the coefficient estimates of the policy's impact on EAR.

At the same time, since the database does not include all firms that existed in each year, firms entering the database for the first time cannot simply be recognized as start-ups. For this reason, based on the year of establishment, I define firms that have been in existence for less than two years as start-ups, and firms that have been in existence for two years or more as continuing firms, and set the employment adjustment rate for start-ups entering the database for the first time to 2 (Wang et al., 2021).

The results of the adjusted EAR index regressions are reported in Panel 3, with the adjusted explanatory variables for startups being New EAR. It can be seen that talent policy still has a significant effect on the adjusted EAR of firms, and it is noteworthy that the regression coefficient for policy is larger than the coefficient when no adjustment is made, suggesting that the impact of policy on firms' labor hiring decisions is more significant after accounting for the impact of startups, not only reinforcing the finding that talent policy affects firms' labor hiring, but also providing the evidence that talent policy can have a positive impact at the level of newly created firms evidence of a positive impact.

Panel 3

	(1)	(2)	(3)	(4)
VARIABLES	New EAR_	New EAR	New EAR(PSM)	New EAR(PSM)
Treat×Post	0.016***	0.018***	0.006***	0.008***
Ln(sale)	-0.054***	-0.054***	-0.044***	-0.044***
Ln(GDP)	0.063***	0.063***	0.031***	0.031***
HHI		-0.051***		-0.045***
markup		0.000***		0.000***
debt rate		0.000***		0.000***
R-squared	0.471	0.472	0.462	0.463

Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

To further test whether talent policies have an impact at the startup level, I revert to the city level and use the number of new startups per 100 people in each city during the sample period obtained from the Firm Search database for further testing. Since founding a new business requires support from a range of sources such as finance and institutional environment, I draw on Bai Junhong (2022) and add city financial support (the ratio

of year-end loan balances of financial institutions to GDP, proxied by finance) and marketization index (the ratio of GDP to fiscal expenditures, proxied by market) to the control variables. As well as since the willingness to start a business depends on the benefits being higher than the personal retention utility, the average wage of urban workers is also added as a control variable. Positive regression results are obtained in Panel 4, providing further evidence of the role of talent policies in promoting new firm creation.

Panel 4

	(1)	(2)
VARIABLES	Start-ups	Start-ups(PSM)
Treat×Post	0.272***	0.230**
infrastructure	0.003	-0.001
environment	0.002	-0.009
market	-138.042	-269.187
finance	-0.000	-0.000
R-squared	0.826	0.838

Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

6.5 Direction of employment restructuring and changes in the number of persons employed

While my main objective is satisfied whenever firms adjust their labor hiring decisions, it is still possible to further explore whether the scale of hiring has expanded as expected in 3.1. To find evidence that talent policies affect the direction and magnitude of labor hiring at the city and firm level, I use the total number of employees in the city (denoted as $city\ workers$), the number of firms' hiring adjustments (denoted by $firm\ workers$) and an alternate Employment Adjustment Rate, which is not adjusted for absolute values, are used as explanatory variables. Regression results are reported in Panels 5 and 6, respectively.

At the city level, consistent with theoretical expectations, I find that talent policies generally increase the total amount of employment in the city, which can also be partly explained by the fact that talent policies promote an increase in the number of startups. At the firm level, regressions of the EAR index without the absolute value treatment yield insignificant or even negative results, again in line with the theoretical prediction that different firms spontaneously adjust their optimal employment size due to the impact of the talent policy, and thus do not necessarily exhibit positive employment adjustment rate movements at the firm level. However, a direct regression on the number of employees in the firms gives another positive result, indicating that although the overall employment adjustment rate of the firms is positive, since the size of the EAR index is related to the size of the firms and the size of the firms is obtained in the benchmark regression

has a dampening effect on the EAR changes, it is possible that larger firms benefit more from the talent policy to expand their hiring size, but smaller firms are more influenced by the policy to downsize their hiring size, and that there are more larger firms that expand hiring than smaller firms that reduce hiring. I test this potential finding further when I conduct the heterogeneity analysis in Section 6.

Panel 5

	(1)	(2)
VARIABLES	city workers	city workers(PSM)
Treat×Post	52.000***	29.552***
ln(GDP)	6.198	-74.601
house price	-0.000	-0.000
infrastructure	0.104	0.818
R-squared	0.892	0.883

Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Panel 6

	(1)	(3)	(2)	(4)
VARIABLES	real EAR	firm workers	real EAR(PSM)	firm workers(PSM)
Treat×Post	-0.002	4.591***	0.001	5.848***
ln(sale)	0.059***	30.547***	0.053***	31.309***
Ln(GDP)	-0.044***	12.011***	-0.081***	10.672*
HHI	0.063***	25.841***	0.064***	28.247***
markup	-0.000***	0.000	-0.000***	0.000
debt rate	-0.000**	0.003***	-0.000**	0.003***
R-squared	0.249	0.888	0.260	0.883

Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

6.6 Discussion of Omitted Employment Adjustment Rates

While previously setting the employment adjustment rate for start-ups at 2 partially mitigated the missing sample problem caused by the inability to calculate the employment adjustment rate due to the lack of prior employment data for firms that are new to the sample set, the employment adjustment rate for continuing firms entering the sample set for the first time cannot be simply set at 2 without overestimating the magnitude of the firm's actual employment adjustment. If firms are able to enter the sample set after the talent policy due to an expansion in asset size, and the magnitude of employment adjustment for firms near the asset size that are able to happen to enter the sample set is inconsistent with the average employment adjustment for the full sample, it is possible that their direct exclusion from the sample set may have overestimated or underestimated the impact of the talent policy on the firm's employment adjustment rate. However, I do not have direct access to the number of prior employments for continuing operations firms entering the sample set for the first time, so following Ma et al. (2015), I conservatively set the employment adjustment magnitude of continuing operations firms at the time of their initial entry into the sample set to 0. Since talent policies have been found to have a positive effect on the employment adjustment rate of firms within the rest of the extant sample set, if a uniformly set value of 0 correction for the employment adjustment margin of continuing operations firms, the regression coefficients of talent policies on firm employment adjustment rates remain significant, reinforcing the main conclusion that omitting unknown firm employment adjustment rates does not affect the baseline regressions. The regression results reported in Panel 7 indicate that policy still has a positive effect.

Panel 7

	(1)	(2)	(3)	(4)
VARIABLES	Adjusted EAR	Adjusted EAR	Adjusted EAR (PSM)	Adjusted EAR (PSM)
Treat×Post	0.038***	0.030***	0.032***	0.024***
ln(sale)	-0.039***	-0.039***	-0.031***	-0.032***
ln(GDP)	0.048***	0.050***	0.042***	0.040***
HHI		-0.067***		-0.071***
markup		0.000***		0.000***
debt rate		-0.000		0.000**
R-squared	0.377	0.380	0.379	0.383

Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

7. Heterogeneity analysis and other findings

7.1 Size of business employment

Since large firms may have higher internal management costs, they may be more hesitant to adjust labor employment in the face of changing business conditions, and it is also possible that large firms have stronger ties to local officials and are more able to profit from urban talent policies from 3.2. The theory suggests that firms with larger employment sizes are more resilient to the effects of talent policies. From the benchmark regression, it can also be seen that the average employment size of firms has expanded, but the change in the direction of the firm employment adjustment rate is not significant or even negative. Therefore, it can be inferred that the direction of the firm's employment adjustment is related to the firm's original size. I distinguish the type of firms as private invested firms (PIE), state-owned firms (SOE), and foreign invested firms (FIE) by the three-digit taxpayer identification number. Panel 8 reports regression results after controlling for the interaction term between firm employment size (workers_post) and policy, and grouping regressions by firm nature. I find, consistent with the theoretical predictions in 3.2, that firms with originally larger employment size are more responsive to policy, with positive effects found across all types of firms.

Panel 8

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	EAR	EAR	EAR	EAR(PSM)	EAR(PSM)	EAR(PSM)
Treat×Post	0.005***	0.010	0.005	0.007***	0.007***	0.007***
Workers×post	0.000**	0.000***	0.000***	0.000**	0.000**	0.000**
ln(sale)	0.032***	0.016***	0.029***	-0.029***	-0.029***	-0.029***
ln(GDP)	0.023***	0.001	0.036**	0.029***	0.025***	0.026***
HHI	0.023***	-0.038	-0.045**	-0.024***	-0.025***	-0.029***
Markup	0.000***	0.000	0.000***	0.000***	0.000***	0.000***
debt rate	0.000**	-0.000	0.000**	0.000***	0.000***	0.000***
Type	PIE	SOE	FIE	PIE	SOE	FIE
R-squared	0.433	0.499	0.424	0.432	0.434	0.432

Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

After I replace the explanatory variable with the true EAR indicator that does not take absolute values, I still find the same result on all three types, the larger the original hiring size, the more inclined the firms are to utilize the talent policy to expand their hiring size. It is also possible that this is because larger firms have more ties to the government and therefore are better able to utilize government policies to obtain highly

skilled personnel.

7.2 Environment and urban development

An additional finding is that the regressions we report in Panel 9 suggest that the introduction of talent policies by cities reduces regional pollution emissions (proxied by sulfur dioxide emissions) and the level of urban construction (proxied by the number of public toilets as well as the construction of urban internet facilities), potentially because the talent policies introduced by cities as a package, in order to attract talent more efficiently, not only can they compete directly in the form of subsidies. They can also indirectly gain access to highly skilled labor by improving the urban environment and adopting stricter environmental regulatory measures to appeal to high-skilled workers (Diamond, 2016).

It is also possible that the inflow of highly skilled labor has improved the technological level of firms, thus reducing pollution emissions and improving the industrial structure so that highly polluting and low-productivity firms have been replaced, leading to an improvement in the city's air quality.

Panel 9

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Toilet	Toilet(PSM)	SO2	SO2(PSM)	Internet	Internet(PSM)
Treat×Post	0.322**	0.191**	17,145.000**	16,699.033**	0.068***	54.108**
R-squared	0.911	0.938	0.863	0.887	0.710	0.522

Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

8. Conclusion

I examine the effectiveness of China's urban talent policies and how they affect firms' hiring decisions, both in terms of theoretical modeling and empirical tests. Although the direct purpose of talent policy is to promote the level of local innovation and industrial upgrading, it is itself equivalent to lowering the threshold for firms to absorb high-skilled talent, and thus the most direct impact pathway is the labor market. However, the improvement of firms' innovation level, or profitability does not necessarily environmentthat labor hiring scale will expand, so the labor productivity indicator EAR is mainly set when measuring labor hiring changes, and both positive and negative hiring scale adjustment behaviors of firms are included. Relying on the staggered DID as well as the PSM method, I find that talent policies do improve regional innovation capacity, while at the same time prompting firms to positively adjust their hiring scale at the firm level, and that larger firms with larger hiring scales are more inclined to expand their hiring scales. Moreover, the talent policy has other additional benefits: improved urban development and environmental quality.

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