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How Agglomeration in the Financial Services Industry Influences Economic Growth: Evidence from Chinese Cities

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Abstract
This paper empirically tests the effect of financial knowledge spillovers on agglomeration in China's financial services industry and examines the external effects on cities' economies. The authors apply hierarchical linear modeling to examine a data set that comprises 276 Chinese cities and draw the following conclusions. Firstly, they find that agglomeration in the financial services industry and the Jacobs spillovers of industry diversification both promote financial knowledge spillovers in terms of industry specialization. Secondly, agglomeration in this studied industry has a significant positive influence on a city's economic growth, while financial knowledge spillovers have a significant but negative effect on a city's economic growth. Thirdly, the tendency towards agglomeration in the financial services industry in a few major cities is clear and the clustering significantly influences cities' boundaries. Finally, China's financial services industry is limited by a serious degree of regulation and is dominated by the main banking institutions.

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Keywords Financial services industry agglomeration; industry specialization; knowledge spillovers; city economies; hierarchical linear modeling

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1. Introduction

The modern financial services industry has certain notable characteristics compared with other market sectors. Firstly, it tends to be more dependent on the development of the local economy as well as on local market capacity. Secondly, its investment into physical capital is relatively low and it rather relies on the provision of financial information and on human capital, the use of which has become increasingly intensive. The combination of these features leads the financial services industry to produce more obvious spatial agglomeration effects compared with other sectors.

Western academics began to pay attention to agglomeration in the financial services industry in the 1970s. For example, although Kindleberger (1973) and Gehrig (1998) defined the concept of a financial center from different angles, they agreed that financial centers are typical of agglomeration in this industry. Porteous (1995) explained the development of regional financial centers through the concepts of 'path dependence,' 'asymmetric information,' and the 'information hinterland.' Krugman (1991a) proposed that agglomeration in the financial services industry is clearer than that in the manufacturing industry because knowledge spillovers are typically external and that such a development was an important driving force behind the agglomeration of London's financial services industry. Hall and Appleyard (2009) further pointed out that business knowledge, highly skilled financiers, and the financial labor market were all important factors in the knowledge spillovers in London's financial center. Finally, Keeble and Nachum (2002) stated that knowledge-intensive industries such as the financial sector should aim to explore the benefits of agglomeration from the aspects of knowledge accumulation and the innovation environment.

Industry agglomeration has begun to occur in China over the past three decades. Wen (2004), for instance, pointed out that many of China's manufacturing industries are highly geographically concentrated in several coastal regions and that this geographical concentration has increased since the economic reform. Lu and Tao (2009) also used a large firm-level data set for the period 1998–2005 and found that the extent of industry agglomeration in China's manufacturing industry increased steadily throughout the sample period. Lu (2010) found that the primary sector and private firms are more spatially concentrated than the secondary and tertiary sectors and public firms, respectively. In the same vein, Li et al. (2012) determined a positive correlation between industry agglomeration and firm size for Chinese manufacturing firms from 1998 to 2005 and showed that firms are more likely to become larger by being located with a number of larger firms compared with a larger number of firms. Moreover, researchers have found that protectionism among China's various regions hampers the geographical concentration of manufacturing industries. In this regard, Bai et al. (2004) argued that less geographic concentration is found in industries where the past tax-plus-profit margins and the shares of state ownership are high, reflecting stronger local government protection in these industries.

However, while previous studies of industry agglomeration focus on manufacturing in terms of agglomeration degree, influencing factors, and the role of government in the agglomeration process, there has been little research into agglomeration in the financial services industry. In particular, no studies have thus far explored financial knowledge spillovers and the relation between agglomeration in the financial services industry and economic growth. The present study therefore contributes by bridging a gap in the literature.

Economic researchers began to pay attention to the correlation between financial development and economic growth in the 1990s. For example, King and Levine (1993a, 1993b, 1993c) studied the effect of financial development on economic growth from the aspect of financial function, while Rousseau and Sylla (1999) investigated changes to the US financial system from 1790 to 1840 and found that the real power of modern economic growth comes from financial changes. We build on these findings by asking the following research questions: Does there exist a relationship between agglomeration in China's financial services industry and regional economic growth? What effect on economic development is produced by financial agglomeration and financial knowledge spillovers? And what role does the Chinese government play in financial agglomeration and financial knowledge spillovers? Specifically, this paper analyzes these relations according to the theories of agglomeration economics, new economic geography, and service economics. Methodologically, it tests four hypotheses by using hierarchical linear modeling (HLM) based on a data set that comprises 279 Chinese cities. We predict that agglomeration in the financial services industry promotes financial knowledge spillovers. At the same time, agglomeration and knowledge spillovers in the financial services industry benefit a city's economic growth.

The remainder of the paper is organized as follows. Section 2 reviews the relevant literature on financial agglomeration and knowledge spillovers. Section 3 introduces the research design. Section 4 explains the data source and describes the statistics. Section 5 puts forward the research hypotheses and model structure. Section 6 analyzes the estimation results and discusses the implications. Section 7 concludes the findings and offers suggestions for the further research.

2. Literature review

Enterprises that produce identical or related financial products are concentrated in a specific area of the financial services industry, which reduces investment in financial products and transaction costs and thus produces a scale agglomeration effect. Marshall (1890) explained industry clustering by using the theory of external economies of scale. He claimed that specialized division of labor promotes economic growth in the region in which the industry is concentrated. Later, Krugman (1991b), the founder of modern location theory, summarized three types of gains from specialized agglomeration: a shared labor market, non-tradable intermediate inputs, and the production function conversion that follows from knowledge spillovers. Marshall (1890), Arrow

(1962), and Romer (1986) believed that regional clusters can promote knowledge diffusion among different firms in the same industry, thereby improving R&D and innovation. Davis (1990) found that financial agglomeration can promote mutual learning and technological innovation as well as reduce transaction costs through knowledge spillovers. Aydogana and Lyon (2004) also pointed out that central gathering places and two-way communication can realize knowledge spillovers. Finally, according to Sternberg (1996), an informal communication network can effectively build open information exchanges and an innovation environment, strengthening the knowledge flow, accelerating the transformation of know-how, improving overlaps among knowledge sources, and promoting cluster integration.

Agglomeration in the financial services industry and industry diversification influence the type and degree of financial knowledge diffusion and spillover. In a general sense, knowledge spillovers can come from both enterprises in the same industry as well as those in different industries. Knowledge spillovers from the same industry are called MAR externalities in academic circles (Marshall 1890; Arrow 1962; Romer 1986, 1990). For MAR externalities, knowledge spillovers result from information exchange among enterprises in the same industry (e.g., the exchange of production information or flow of professional and technical personnel between enterprises). By contrast, knowledge spillovers that come from different enterprises are called Jacobs externalities (Jacobs 1969). This type of spillover mechanism expands the scope of knowledge spillovers through interaction with other industries. Further, the diversification of geographical agglomeration can promote the enterprise's innovation behavior.

Although the contribution of knowledge spillovers to economic growth has been acknowledged, evidence on the influence of MAR and Jacobs externalities is inconclusive. Glaeser et al. (1992), for example, used data on six large industries in 170 US cities in 1956 and 1987 to verify the effect of Jacobs externalities, but found that MAR externalities negatively affect regional economic growth. Moreover, Henderson, Kuncorn, and Turner (1995) used data on 224 major metropolitan areas in the US in 1970 and 1987 and found MAR externalities but no Jacobs externalities in mature capital-intensive industries. Similar research and different conclusions have also appeared in Italy (Cainelli and Leoncini 1999, Forni and Paba 2002), France (Combes 2000), Spain (De Lucio, Herce, and Goicolea 2002), and the Netherlands (Van Soest, Cerking, and Van Oort 2002) owing to the different country- and regional-level characteristics, degrees of industry organization and development, samples and variables, and validation methods.

3. Research design

3.1 The agglomeration in the financial services industry at the Chinese city level

This paper uses the comprehensive index evaluation method in order to analyze agglomeration in the financial services industry at the Chinese city level (CFAG hereafter). We select banking, insurance, and securities to represent the financial services industry because these three areas account for more than 90% of financial enterprises in China. Table 1 provides more details on the index system. The analytic hierarchy process is then used in order to determine the weight of each index, while the Weaver index method is applied to calculate the sequence and key elements of the different indexes (Table 2).

(Table 1)

(Table 2)

3.2 Industry specialization and diversification

Based on the methods of Glaeser et al. (1992) and Feldman and Audretsch (1999), this paper adopts employment distribution in order to measure the characteristics of industry diversification (CDIV) and industry specialization (CSPE) as follows:

The index definition of industry diversification is $\mathrm{CDIV_i} = 1 - \sum_{j=1}^{19} p_{ij}^2$ (3.1)

Where P_{ij} represents the employment of industry *j* in city *i* as a proportion of the city's total employment. The value of CDIV is thus 0～1. If the index is high and the *Pij* value is low, it indicates that the employment trend is dispersive in different industries, which means that the industry distribution in the city is diverse. Further, there are 19 industry groupings according to the China City Statistical Yearbook (*J*=1–19).

The index definition of industry specialization is $\mathrm{CSPE_I} = {p_i}/{P}$ (3.2)

Where p_i represents a city's financial industry employment as a proportion of its total employment and *P* represents the proportion of national financial industry employment as a proportion of total employment. The value of CSPE is thus 0～1. If the index is high, it indicates that the city's proportion of financial industry employment is higher than the national average. This measure represents that the level of specialized financial services in the city is higher than the national average.

3.3. The application of HLM

According to Kreft, De Leeuw, and Aiken (1995) and Krasnikov, Jayachandran, and Kumar (2009), HLM is a statistical method for processing nested data. Social science data often have a hierarchical structure, which not only describes the individual variables, but also shows the higher-level variables formed by individuals. All the variables analyzed in the general regression method are at the same level. The premise of the general regression method is therefore random error independence and homogeneity of variance among all variables. For multilayer nested data, the analysis of all the variables in a level includes both individual factors and repeated measurement factors. Hence, the hypothesized premise of the general regression method is not always true because the results of the data have an unreasonable or incorrect interpretation. HLM can divide the random variation into two parts by defining different levels of the model: the first level of individual differences, which are independent of each other, and the second level between the variables that are independent of each other. Therefore, HLM also includes the variation caused by different levels.

Because this test used herein relates to two levels of data, namely the city nested in the province, the differences between these two levels should be taken into account in the empirical testing. Cities in the same province may not be independent of each other because they share policies, have a unified approach to administrative management, and similar cultural traditions, climatic conditions. Thus, the test errors are divided into two parts. One is the error among the individual differences of different cities; here, the measurement error is assumed to be independent of each other. Secondly, the error at the provincial level among the different provinces is assumed to be independent of each other.

4. Data sources and descriptive statistics

4.1 Data sources

This empirical study used a sample of 279 prefecture-level cities belonging to China's 25 provinces in 2011 (excluding the four municipalities directly under the central government and the less prefecture-level cities of Qinghai and missing data in Tibet). Because the financial services industry is mainly concentrated in cities, the spatial range of our single sample data set did not include counties. The data were derived from the relevant 2012 statistical yearbooks. The empirical test of the main variables involved CFAG, CDIV, CSPE, and the city's economic growth index (CECO), which is the log of the city's GNP in 2012.

4.2 Control variables

In addition to the main variables above, we used separate control variables for the province level and city level (Table 3). There were five control variables at the city level. High productivity is one of the effects of industry agglomeration. Andersson and Loof (2011) suggested a learning effect in that agglomeration enhances productivity. The higher the degree of openness of the city, the greater is FDI and the higher is the agglomeration of the financial services industry. Zhao, Zhang, and Wang (2004) argued that the higher the position of a financial enterprise in an information center, the lower is the cost of the information obtained. Therefore, information infrastructure is important for financial agglomeration. Meanwhile, human capital in the city is good for industry development and higher wages attract more financial enterprises.

There were also five control variables at the province level. The financial output contribution rate (PFVC) and financial value of the location (PAPS) improve the city's economic development and thus financial agglomeration. Moreover, R&D expenditure input intensity (PRD) and the patents granted rate (PAT) reflect knowledge spillovers. In addition, in order to separate the provincial- and city-level agglomeration in the financial services industry, we used the Herfindahl index (PHPS) of provincial financial services in the regression equation. The higher this index, the more concentrated the financial services industry in this province is in a few cities (Table 3).

(Table 3)

4.3 Descriptive statistics

In order to calculate the correlations between the province-level variables and city-level variables, we follow Fu et al. (2010) by disaggregating the former into the latter. The results are presented in Table 4. We find that CFAG is positively correlated with CSPE ($r=0.211$, $p<0.01$) and CECO ($r=0.605$, $p<0.01$) and that CSPE and CDIV are positively correlated ($r=0.368$, $p<0.01$). Further, the correlation between CSPE and CECO is significant but negative as is that between CDIV and CECO. These results provide partial support for the research hypotheses, which are tested in more detail by using HLM in Section 5. Here, we introduce independent variables into two models (A and B) in turn in order to eliminate the influence of multicollinearity. The L1, L2, and mixed-model equations are available on request.

(Table 4)

5. Research hypotheses and model structure

5.1 Research hypotheses

According to literature review and study methodology, we thus propose the following four research hypotheses:

Hypothesis 1: Agglomeration in the financial services industry is positively related to the effect of specialized knowledge spillovers.

Hypothesis 2: Jacobs spillovers based on industry diversification are positively related to financial knowledge spillovers.

Hypothesis 3: Agglomeration in the financial services industry is positively related to the city's economic growth.

Hypothesis 4: Financial knowledge spillovers are positively related to the city's economic growth.

5.2 Test model structure

The hypothesis test focuses on two models. Model A tests the industry specialization and knowledge spillovers caused by agglomeration in the financial services industry, in which financial knowledge spillovers is the dependent variable and agglomeration in the financial services industry and industry diversification are the independent variables. Model B tests whether agglomeration in the financial services industry and financial knowledge spillovers significantly affect the city's economic growth. Here, the city's GDP is the dependent variable, while agglomeration in the financial services industry, financial knowledge spillovers, and industry diversification are the independent variables. The specific models are described below.

Model **A**:

$$\mathbf{L1}: \mathrm{CSPE} = \beta_{0j} + \beta_{1j}\mathrm{CFAG} + \beta_{2j}\mathrm{CDIV} + \beta_{3j}\mathrm{CPRO} + \beta_{4j}\mathrm{COPE} + \beta_{5j}\mathrm{CIE} + \beta_{6j}\mathrm{CSH} + \beta_{7j}\mathrm{CWA} + \varepsilon_{ij};$$

$$\mathbf{L2}: \beta_{0j} = \gamma_{00} + \gamma_{01}\mathrm{PFVC} + \gamma_{02}\mathrm{PAPS} + \gamma_{03}\mathrm{PHPS} + \gamma_{04}\mathrm{PRD} + \gamma_{05}\mathrm{PAT} + \mu_{0j}$$

$$\beta_{1j} = \gamma_{10} + \mu_{1j};\ \beta_{2j} = \gamma_{20} + \mu_{2j};\ \beta_{3j} = \gamma_{30} + \mu_{3j};\ \beta_{4j} = \gamma_{40} + \mu_{4j};\ \beta_{5j} = \gamma_{50} + \mu_{5j};\ \beta_{6j} = \gamma_{60} + \mu_{6j};\ \beta_{7j} = \gamma_{70} + \mu_{7j} \qquad (5.1)$$

Model **B**:

$$\mathbf{L1}: \ln\mathrm{CECO} = \beta_{0j} + \beta_{1j}\mathrm{CFAG} + \beta_{2j}\mathrm{CDIV} + \beta_{3j}\mathrm{CSPE} + \beta_{4j}\mathrm{CPRO} + \beta_{5j}\mathrm{COPE} + \beta_{6j}\mathrm{CIE} + \beta_{7j}\mathrm{CSH} + \beta_{8j}\mathrm{CWA} + \varepsilon_{ij};$$

$$\mathbf{L2}: \beta_{0j} = \gamma_{00} + \gamma_{01}\mathrm{PFVC} + \gamma_{02}\mathrm{PAPS} + \gamma_{03}\mathrm{PHPS} + \gamma_{04}\mathrm{PRD} + \gamma_{05}\mathrm{PAT} + \mu_{0j}$$

$$\beta_{1j} = \gamma_{10} + \mu_{1j};\ \beta_{2j} = \gamma_{20} + \mu_{2j};\ \beta_{3j} = \gamma_{30} + \mu_{3j};\ \beta_{4j} = \gamma_{40} + \mu_{4j};\ \beta_{5j} = \gamma_{50} + \mu_{5j};\ \beta_{6j} = \gamma_{60} + \mu_{6j};\ \beta_{7j} = \gamma_{70} + \mu_{7j};\ \beta_{8j} = \gamma_{80} + \mu_{8j} \qquad (5.2)$$

The first-level (L1) data in Models A and B are the city samples and the second level (L2) data are the province samples. The L1 model is similar to the general regression model, while the economic explanations of the coefficients of the variables are also similar. Although the intercept and slope of the regression equation are not assumed to be constant, they act as explanatory variables of in L2 regression equation (Gu 2010). In order to simplify the analysis, however, this paper only adds the L2 control variables into the intercept β_0 of L1.

Model A indicates that PFVC, PAPS, PHPS, PRD, and PAT at the provincial level affect financial knowledge spillovers controlling for industry specialization. Model B indicates that the control variables at the provincial level influence the city's economy by affecting its GDP. At the same time, the dependent variable slope of L1 in the L2 does not join the explanatory variables. This limit for the two models indicates that the effect strength of the dependent variables for industry specialization in L1 and the city's GDP in L2 only suffer the influence of random factors when the control variables are introduced into the intercept $\beta_{0.}$

6. Empirical results and discussion

6.1 Empirical results

First, we construct the null model, which has no control variables but predicted variables at both levels, in order to decompose the differences caused by cities and provinces belonging to two parts. The null model can thus be used to analyze the need to choose HLM. The two null models corresponding to equations (5.1) and (5.2) are then estimated separately by using a maximum likelihood estimation given that the rank correlation coefficients of Model A and Model B are 0.0551 and 0.1892, respectively. The 0.0551 in Model A shows that approximately 5.51% of financial knowledge spillovers derive from the differences in different provinces, while the 0.1892 in Model B shows that approximately 18.92% of the city's economic development derive from the differences in different provinces. The regression results presented in Table 5 and Table 6 introduce the different predicted variables and establish the complete models. The results can be divided into random effects (chi-square value, p test, degree of freedom) and fixed effects (intercept, coefficient of slope, standard error, p test).

In order to verify the hypotheses, the control variables are first entered into the model, followed by the explanatory variables and interaction terms. The results of Model A and Model B provide several important conclusions. First, the coefficient of CFAG in model Ma-2 is 0.29, which explains 4.3% of the residual L1 variance in financial knowledge spillovers at the 1% level (L1, ΔR^2=0.043), indicating agglomeration in the financial services industry brings about significantly positive financial knowledge spillovers: if the difference in the degree of agglomeration in the financial services industry between two cities is 0.1, other factors being held, their financial knowledge spillovers will differ by 29%. Thus, Hypothesis 1 is supported. Meanwhile, the coefficient of CFAG in model Mb-4 is 1.13, which explains 40.9% of the residual L1 variance in the city's economic growth at the 1% level (L1, ΔR^2=0.409), indicating that agglomeration in the financial services industry significantly and positively affects the city's economic growth. Thus, Hypothesis 3 is also supported.

The coefficient of CDIV in model Ma-3 is 1.64, which explains 9.1% of the residual L1 variance in financial knowledge spillovers at the 1% level (L1, ΔR^2=0.091), indicating that diversified Jacobs spillovers significantly and positively affect financial knowledge spillovers. Thus, Hypothesis 2 is supported. In the model of the city's economic growth, only the factor of diversified Jacobs spillovers is positive (r=1.43, p<0.05, model Mb-3); however, when CFAG and CDIV both affect the city's economic growth, the effect on the city's economy of CFAG is significant (r=1.13, p<0.01, model Mb-5), where the effect of CDIV is not significant. This finding indicates that although CDIV influences the city's economic growth, when CFAG is significant in the city, CDIV is not significant.

The coefficient of CSPE in model Mb-2 is -0.25, which explains 2.1% of the residual L1 variance in the city's economic growth at the 5% level (L1, ΔR^2=0.021), indicating CSPE significantly, but negatively affects the city's economic growth, Thus, Hypothesis 4 is rejected. This finding indicates that China's financial services industry is still under the strict control of the government and the administrative control system is quite clear. The city's administration can thus use various means to intervene and influence the behavior of the financial services industry. The lateness of China's financial legislation coupled with local government protectionism, the transmission of financial information and financial innovations derived from top-down government guidance, and administrative command all make knowledge spill over among financial enterprises, while other industries lack an effective diffusion mechanism. By contrast, the city's economic growth not only does not play a market-oriented role, it even has a significant negative effect.

(Table 5)

(Table 6)

In addition, the coefficient of CPRO is significantly positive (p<0.01), which shows that the city's productivity significantly and positively affects financial MAR spillovers and its economic growth. Thus, the city's information facilities significantly positively influence financial MAR spillover, but significantly negatively affect the city's economic growth. This finding suggests that the supervision of financial administration in China's cities suppresses financial knowledge spillovers based on information transmission and diffusion. From Model B, the coefficient of CSH is significantly positive (p<0.01), which shows that the positive effects of human capital on the city's economic growth is significant. Further, the coefficient of PFVC is significantly positive (p<0.01), implying that the financial contribution rate at the provincial level also has a significant positive effect on the city's economic growth. By contrast, the coefficients of PAPS and PHPS are significantly negative (p<0.01), implying that the degree of the difference in the agglomeration in the financial services industry is larger in different cities belonging to the same province. Thus, the tendency for financial services to agglomerate in a few major cities is clearly. Therefore, on average, the provincial-level agglomeration of the financial services industry and the distribution in cities has a negative effect on the city’s economic growth.

6.2 Discussion and recommendations

The results of the empirical analysis suggest that agglomeration in the financial services industry and diversified Jacobs spillovers promote financial knowledge spillovers, while the former has a significantly positive influence on the city’s economic growth. In addition, diversified Jacobs spillovers have no significant effect on the city’s economic growth, while the effect of financial knowledge spillovers on the city’s economic growth is significant but negative.

To realize China’s city-level economic growth, it is necessary to promote and facilitate the role of the financial services industry as a representative of a modern tertiary sector. Supporting and accelerating the development of service sectors as a financial strategy concurs with the latest socioeconomic development trends and can promote sustainable economic development at the city level. In this regard, financial reform is a key requirement of economic transition, with relaxing controls and speeding up financial innovation the primary concerns of the government and financial authorities.

At present, the dominance of banks and government regulation are the two basic characteristics of the financial system. These two characteristics have played an important role in China over the past 30 years of economic reforms in terms of controlling inflation and providing cheap capital support for the development of the country’s industrialization. However, this excessive administration has restrained financial knowledge spillovers and innovation, hindering the financial services industry, especially the development of high-tech firms. Further, opportunism and rent-seeking behavior by the financial authorities has led to rising regulation costs. Therefore, financial knowledge spillovers based on financial agglomeration can offer a diffusion mechanism through which to develop the financial services industry. In particular, the Chinese government and financial enterprises should aim to accelerate financial market reforms, broaden the number of self-managing as opposed to state-owned entities, and gradually improve the financial environment.

Financial enterprises must also strengthen the close connections among individuals; agglomeration not only relates to geographical proximity, it can also generate an agglomeration economy effect and provide an appropriate diffusion mechanism, allowing financial knowledge and innovations to spread among potential users through knowledge diffusion mechanisms as well as improving financial efficiency and the competitiveness of all the enterprises in the agglomeration. Despite the large differences in China’s financial agglomeration, agglomerating enterprises are all facing important barriers to deepening the financial reforms and accelerating financial innovations and knowledge diffusion. Therefore, different cities in various regions must formulate apt policies characterized by relatively independent financial legislation and an independent judicial and law enforcement system. Cities that have a high degree of financial agglomeration should make full use of their roles as regional financial centers in order to provide a broad knowledge exchange platform through financial knowledge spillovers for financial knowledge transmission and diffusion. This approach can promote financial innovation by strengthening relations among enterprises, customers, and the government. By contrast, cities that have a low degree of financial agglomeration should exploit their comparative advantage in order to improve their ability to absorb the financial knowledge that is spilt over.

7. Conclusion and future research directions

This paper presented a theoretical and empirical analysis that examined the financial knowledge spillovers caused by agglomeration in China's financial services industry. Based on the foregoing, we can draw the following three main conclusions. First, the agglomeration of the financial services industry is an important driving force behind the economic growth of Chinese cities, notably affecting a city's productivity and human capital resources. Agglomerating financial enterprises can use the city's human capital to enrich and improve the overall quality of the financial industry. Meanwhile, the city's productivity can be integrated into the value chain in order to improve financial efficiency. Second, the spread of agglomeration in the financial services industry is large and the tendency towards clustering in a few major cities is clear. In this regard, agglomeration in the financial services industry significantly influences cities' boundaries. Finally, China's financial services industry is limited by a serious degree of regulation and is dominated by the main banking institutions. Information sources and the internal and external transfer of financial know-how are influenced by top-down government direction and executive orders, while financial knowledge spillovers have no available diffusion mechanism.

In terms of future research avenues, authors might aim to expand the topic in the following directions. Firstly, based on the spatial characteristics of agglomeration in the financial services industry, researchers could introduce further spatial geographic factors in order to examine the influence of spatial knowledge spillovers and spatial correlations on regional economic growth by using spatial econometric models with dynamic panels. Secondly, while the empirical testing of financial agglomeration in this paper includes banking, securities, and insurance as the three major groups of financial institutions, future investigation into specific agglomeration and economic development could focus on certain segments of the financial services industry in order to provide more targeted policy suggestions on the development of this sector. In addition, knowledge spillovers are a complex process, especially those in the financial services industry. Consequently, the method of measuring knowledge spillovers must develop further. Finally, further research could focus on the micro mechanisms of industrial knowledge spillovers.

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Tables

Table 1: Evaluation index of the agglomeration in the financial services industry at the city level

Industry	Sub-industry (Ai)	Evaluation index system (Bi)
CFAG	Banking (BAG)	Financial assets state (B1, %), Financial employment contribution rate (B2, %), Financial employment location (B3), Deposit income ratio (B4, %), Deposit-loan difference (B5), Loan-to-deposit ratio (B6,%)
	Insurance (IAG)	Property insurance premium income (I1), Property insurance density (I2, Yuan/per), Property insurance depth (I3, %), Personal insurance premium income (I4), Personal insurance density (I5, Yuan/per), Personal insurance depth (I6, %)
	Securities (CAG)	Number of listed companies/ten thousand people (C1), Share of the total transaction volume/ten thousand people (C2, millions of dollars), Shares of IPO raised capital/ten thousand people (C3, millions of dollars)
Note: The calculation of city-level agglomeration in the financial services industry does not include the securities industry.		

Table 2: Explanation of the main variables in the evaluation index

Variable	Function	Calculation method
B1 Financial assets state	Deposits and loans are the most important instruments in the financial industry This index measures the financial development of cities.	B1=Deposits balance in city + Loans balance in city /city GDP that year.
B2 Financial employment contribution rate; B3 financial employment location	These two indexes measure the city's financial employment contribution to national financial employment and concentration degree.	B2 = City's financial employment/national financial employment; B3 = (city's financial employment/city's employment)/(national financial employment/national employment).
B4 Deposit-income ratio; B5 Deposit-loan difference; B6 Loan-to-deposit ratio	These three indexes measure the city's financial reserves capacity and financial capital supply into demand service ability	B4 = Deposits balance in city/city GDP that year; B5 = Deposits balance in city-Loans balance in city at the end of the year; B6 = Loans balance in city/deposits balance in city at the end of the year.
I2 Property insurance density; I5 Personal insurance density	This index measures the level of the city's insurance industry development and the degree of people participating in it	City's insurance premium income/city's total population that year.
I3 Property insurance depth; I6 Personal insurance depth	This index measures the status of the city insurance industry in the national economy. It depends on the national overall economic development level and the insurance industry development speed.	City insurance premium income/city's GDP that year.

Table 3: Explanation of the control variables

Level 1: City level	Control variable		Calculation method
	CPRO	Productivity	City's output/city's inputs
	COPE	Openness degree	Foreign capital used in the city/city's GDP that year
	CIE	Information infrastructure	Postal and telecommunication income/city's GDP
	CSH	Human capital	The number of normal schools/city's total population
	CWA	Wages	The city's annual average wage
Level 2: Province level	PFVC	Financial output contribution rate	Provincial financial services industry output/national financial services industry output
	PAPS	Financial value of the location	(Provincial financial services industry output/provincial GDP)/(national financial services industry output/national GDP).
	PHPS	Herfindahl index	$n \times \sum_{i=1}^{n}(\frac{p_i}{p})^2$ *n* is the number of cities belonging to this province, p_i is the industry employment of the city's financial services, *P* is the industry employment of provincial financial services.
	PRD	R&D expenditure input intensity	Provincial R&D expenditure/provincial GDP
	PAT	Patents granted rate	Three kinds of domestic patents granted by the province/total number of patents granted

Table 4: Correlations and Statistical description of All Variables in the Study

Statistical description of variables														
Variables	CPRO	COPE	CIE	CSH	CWA	PFVC	PAPS	PHPS	PRD	PAT	CFAG	CDIV	CSPE	lnCECO
Mean	3.28	1.86	6.49	0.26	0.38	3.07	0.82	2.04	1.16	4.00	1.18	0.82	1.15	6.09
SD	1.83	2.09	4.87	0.11	0.08	3.11	0.28	0.65	0.53	6.65	0.50	0.09	0.54	1.06
Minimum	0.76	0.00	0.70	0.70	0.19	0.41	0.40	1.25	0.41	0.08	-0.05	0.42	0.14	3.67
Maximum	19.04	16.25	29.12	0.91	0.74	11.26	1.70	3.58	2.17	26.82	2.29	0.92	3.22	9.35
Number	25					279					25			
Correlation coefficient between variables														
Variables	CPRO	COPE	CIE	CSH	CWA	PFVC	PAPS	PHPS	PRD	PAT	CFAG	CDIV	CSPE	lnCECO
COPE	0.094													
CIE	-0.34**	-0.165**												
CSH	-0.145*	-0.269**	0.274**											
CWA	0.349**	0.192**	-0.286**	-0.267**										
PFVC	-0.306	0.138	-0.047	-0.068	0.389									
PAPS	0.116	-0.009	0.032	0.150	0.183	0.552**								
PHPS	0.042	0.086	0.016	-0.002	0.435	0.114	0.002							
PRD	-0.363	0.060	0.187	-0.079	0.280	0.740**	0.219	0.315						
PAT	-0.238	0.028	-0.023	-0.080	0.261	0.937**	0.512**	0.039	0.731**					
CFAG	0.072	0.276**	-0.058	-0.257**	0.426**	0.192	-0.089	-0.365	0.110	0.160				
CDIV	-0.031	-0.240**	0.240**	0.224**	-0.262**	-0.282	-0.132	-0.445*	-0.319	-0.180	-0.05			
CSPE	0.078	-0.150*	0.348**	0.092	-0.040	-0.141	0.113	-0.252	-0.290	-0.066	0.211**	0.368**		
lnCECO	0.417**	0.373**	-0.536**	-0.433**	0.532**	-0.110	-0.095	-0.124	-0.128	-0.131	0.605**	-0.199**	-0.243**	
Notes: ** and * denote 1%, 5% significance respectively.														

Table 5: Estimation Results of the HLM Model: Model A

Variables	CSPE			
	Ma-1	Ma-2	Ma-3	Ma-4
Intercept	1.13**(0.03)	1.13**(0.04)	1.13**(0.03)	1.13**(0.04)
Level 1 control variables				
CPRO	0.08**(0.02)	0.08**(0.02)	0.07**(0.02)	0.07**(0.02)
COPE	-0.03*(0.01)	-0.04*(0.02)	-0.02(0.01)	-0.02*(0.01)
CIE	0.044**(0.01)	0.04**(0.007)	0.04**(0.008)	0.03**(0.007)
CSH	0.001(0.36)	0.15(0.40)	-0.05(0.33)	0.02(0.34)
CWA	-0.36(0.51)	-0.79(0.48)	-0.43(0.43)	-0.49(0.42)
Level 2 control variables				
PFVC	0.03(0.03)	0.03(0.04)	0.03(0.03)	0.03(0.04)
PAPS	-0.017(0.15)	-0.018(0.21)	-0.02(0.15)	-0.02(0.21)
PHPS	-0.13*(0.06)	-0.13*(0.07)	-0.13*(0.06)	-0.13*(0.07)
PRD	0.22(0.15)	0.22(0.15)	0.23(0.15)	0.23(0.15)
PAT	-0.02*(0.01)	-0.02*(0.02)	-0.02*(0.01)	-0.02*(0.01)
Independent variable(level 1)				
CFAG		0.29**(0.07)	0.22**(0.05)	0.22**(0.05)
CDIV			1.64**(0.26)	1.59**(0.27)
Sigma square	0.23	0.22	0.20	0.20
Tau	0.02	0.02	0.02	0.02
Chi-square	40.27**(19)	42.83**(19)	45.67**(19)	45.67**(19)
Pseudo R2 change(Level 1)		0.043	0.091	0.091

Note: The values in brackets are standard errors for the corresponding estimates. Level 1 = city level; Level 2 = province level. **and * denote 1% and 5% significance, respectively.

Table 6:Estimation Results of the HLM Model: Model B

Variables	lnCECO					
	Mb-1	Mb-2	Mb-3	Mb-4	Mb-5	Mb-6
Intercept	6.00**(0.05)	6.00**(0.05)	6.00**(0.06)	6.02**(0.06)	6.02**(0.06)	6.02**(0.06)
Level 1 control variables						
CPRO	0.08**(0.02)	0.11**(0.03)	0.09*(0.03)	0.08**(0.02)	0.08**(0.02)	0.12**(0.02)
COPE	0.08**(0.02)	0.07**(0.02)	0.08**(0.02)	0.03*(0.01)	0.03(0.01)	0.01(0.01)
CIE	-0.08**(0.01)	-0.17**(0.01)	-0.07**(0.01)	-0.08**(0.01)	-0.08**(0.01)	-0.06**(0.01)
CSH	-1.19*(0.60)	-0.19*(0.59)	-1.43*(0.56)	- 0.59(0.54)	-0.56 (0.51)	-0.62(0.45)
CWA	3.94**(1.02)	3.85**(1.04)	4.06**(1.01)	2.29**(0.67)	2.24**(0.71)	2.02**(0.70)
Level 2 control variables						
PFVC	0.14**(0.04)	0.14**(0.04)	0.14**(0.04)	0.14**(0.04)	0.14**(0.04)	0.14**(0.04)
PAPS	-0.6**(0.18)	-0.6**(0.18)	-0.6**(0.18)	-0.59**(0.18)	-0.59**(0.18)	-0.59**(0.18)
PHPS	-0.25*(0.09)	-0.25*(0.09)	-0.25*(0.09)	-0.25*(0.09)	-0.25*(0.09)	-0.25*(0.10)
PRD	0.15 (0.17)	0.15 (0.17)	0.14 (0.17)	0.08 (0.17)	0.08 (0.17)	0.05 (0.18)
PAT	0.001(0.01)	0.001(0.01)	0.001(0.01)	0.004*(0.01)	0.004(0.01)	0.005(0.01)
Independent variable(level 1)						
CFAG				1.13**(0.05)	1.13**(0.05)	1.25**(0.05)
CDIV			1.43**(0.62)		-0.20 (0.51)	0.64(0.62)
CSPE		-0.25*(0.07)	-0.27**(0.10)			-0.54**(0.10)
Sigma square	0.47	0.46	0.44	0.26	0.26	0.20
Tau	0.05	0.05	0.05	0.08	0.08	0.10
Chi-square	43.40**(19)	44.70**(19)	46.98**(19)	81.44**(19)	81.15**(19)	108.10**(19)
Pseudo R2 change(Level 1)		0.021	0.043	0.409	0.409	0.231

Note: The values in brackets are standard errors for the corresponding estimates. Level 1 = city level; Level 2 = province level. **and * denote 1% and 5% significance, respectively.