STUDY ON THE INFLUENCING FACTORS AND IMPROVING COUNTERMEASURES OF REGIONAL FINANCIAL SERVICE FUNCTION - TAKE CORPORATE LOANS AS AN EXAMPLE

Suo Zhang

- Graduate School, Jose Rizal University, Manila, 0900, Philippines
- School of Intelligent Manufacturing and Mechanical Engineering, Hunan Institute of Technology, Hengyang, Hunan, 421002, China

Yixian Wen*

- School of Business, Hunan Institute of Technology, Hengyang, Hunan, 421002, China
- E-mail: wenyixian@hnit.edu.cn

Reception: 27 December 2023 | **Acceptance**: 22 January 2024 | **Publication**: 21 February 2024

Suggested citation:

Zhang, S. and Wen, Y. (2024) **Study on the influencing factors and improving countermeasures of regional financial service function -- Take corporate loans as an example**. *3C TIC. Cuadernos de desarrollo aplicados a las TIC, 13*(1), 62-74. https://doi.org/10.17993/3ctic.2024.131.62-74

ABSTRACT

Focusing on regional financial services, this paper analyzes the variables affecting non-financial businesses getting loans through the region economic services function, and then proposes countermeasures to improve it. The DPC algorithm is applied to the financial analysis in this paper because of its fast speed and high accuracy. The AD-DPC approach is suggested in this study as a solution to the issue that the computation of local density relies on the choice of the truncation length parameter d_c *and the clustering sites must be manually chosen. This strategy lessens the subjectivity and volatility that the fictitious label* d_c *brings. For the DPC algorithm by using a one-step assignment strategy, i.e., assigning the labels of clustering centers to all non-clustering centroids at one time, such a strategy is poorly fault-tolerant, this paper proposes the DAS-DPC algorithm on the basis of AD-DPC. Through experiments, ADAS-DPC is optimal for ARI metrics in the dataset. Among them, the ARI indexes of ADAS-DPC algorithm are 0.832, 0.895, 0.768 and 0.757 in the datasets Iris, Wine, Seed and Sonar. It shows that the ADAS-DPC algorithm can not only handle the datasets with complex shapes, large density differences between clusters and tightly connected clusters, but also improve the clustering performance of the algorithm for high-dimensional data.*

KEYWORDS

Regional financial services; corporate lending; DPC algorithm; AD-DPC algorithm; DAS-DPC algorithm

https://doi.org/10.17993/3ctic.2024.131.62-74

INDEX

https://doi.org/10.17993/3ctic.2024.131.62-74

1. INTRODUCTION

The primary engine of economic growth is finance, and the "vitality", "stability", "prosperity" and "strength" of finance determine the "vitality", "stability", "prosperity" and "strength" of the economy. Determines the "vitality", "stability", "prosperity", and "strength" of the economy, pointing up the crucial role that money plays in economic growth [1-3]. The most potent indicator of increased financial competitiveness is the improvement in the capacity of financial services to contribute to the actual economy, the development of inclusive finance, or the promotion of an equitable growth of the capital market [4]. Regional financial competitiveness, on the other hand, is the expression of financial competitiveness at the regional level, as well as the relative advantage and comprehensive ability of a region in competition with other regions through the process of absorption, control, utilization, ownership and allocation of financial resources [5-6]. Therefore, the level of a region's financial competitiveness directly determines whether the region's financial resources are effectively allocated, it ultimately has an impact on the area's capacity to deliver financial goods to the actual economy, thereby affecting the overall national economic and social development [7-9].

The literature [10] specifically analyzes the causes of regional financial differences and the impact of diffusion methods on regional financial development differences, and finds that financial liberalization has a key impact on the unbalanced development of regional finance, and this unbalance leads to the emergence of administrative power inequality, which makes financial development differences more serious, and a vicious circle is thus formed, and the differences gradually expand. The literature [11] argues that credibility in the financial market has an important influence on the transaction behavior of borrowers and lenders, just as appearance has a positive effect on a person's employment, good credibility has a positive effect on access to loans, and good credit and high market recognition make it easier to obtain loans. The literature [12] suggests that blockchain technology can be applied to supply chain finance projects, which is expected to accelerate the speed of capital operation in the whole supply chain platform, but it is still in the exploration stage. According to the literature [13], while increasing financial growth scale does not significantly affect the outcomes, improving financial growth structure and efficiency are advantageous to enhancing regional innovation potential. The literature [14] found through the study of Internet finance that the relationship between traditional finance and Internet finance is one of competition and integration, and the competitiveness of Internet finance is increasing. By studying the synergy between market-oriented financial competitiveness and government-oriented financial stability, the literature [15] found that there is a high correlation between financial competitiveness and financial stability, and the dispersion of their synergistic effects and economic development are strongly correlated.

The DPC clustering algorithm is known for its simplicity and efficiency, but there are some drawbacks. To address the problem that the calculation of local density depends on the selection of the truncation distance parameter d_c and the clustering centers

 https://doi.org/10.17993/3ctic.2024.131.62-74

need to be selected manually, this paper proposes an adaptive local density and clustering center density peaking algorithm (AD-DPC). The algorithm finds the optimal number of nearest neighbors k through the concepts of "forward neighbors" and "reverse neighbors", and proposes a k adjacent neighbor fuzzy kernel to determine the regional density. This approach reduces the subjectivity and instability caused by artificially specified d_c. In this paper, based on the multiplication of local density and relative offset distance, a new core point evaluation method is proposed, through which core points can be effectively screened. For the DPC algorithm by using a one-step assignment strategy, i.e., assigning the labels of clustering centers to all non-clustering centroids at one time, such a strategy is poorly fault-tolerant, this paper proposes an adaptive multi-step assignment strategy for density peak clustering algorithm (ADAS-DPC) on the basis of AD-DPC. The three primary steps of the suggested method are as follows: the first step employs a particular strategy to locate edge points and high-density points. In the second step, the core point labels are assigned by propagating the assignment strategy. In the third step, a checking mechanism is introduced to check whether the labels of the edge points are optimal. Finally, the ADAS-DPC algorithm is applied to the analysis of factors influencing the function of regional financial services.

2. FINANCIAL ANALYSIS MODEL BASED ON IMPROVED DPC ALGORITHM

2.1. ADAPTIVE DENSITY PEAK CLUSTERING ALGORITHM

In the DPC algorithm, if the truncation distance is not chosen properly, that could have a significant impact on how the regional density of points is calculated and ultimately result in a reduction in the clustering effect, while in this section, an improved local density calculation will be proposed without artificially coming to set the truncation distance. Based on the data provided by its nearby samples, the regional density of a site is precisely determined.

2.1.1. IMPROVED LOCAL DENSITY CALCULATION

This section suggests using a fuzzy kernel to estimate local density as a better method of doing so. The idea of k nearest neighbor and k nearest neighbor will be introduced by the suggested fuzzy kernel in this section in order to take the local data structure into account while determining the densities. As described by the proposed fuzzy kernel:

$$\rho_i = \max\left\{1 - \frac{1}{k}\left(\sum_{j \in \mathrm{knn}(x_i)} d\left(x_i, x_j\right)\right), 0\right\} \tag{1}$$

https://doi.org/10.17993/3ctic.2024.131.62-74

where $knn(x_i)$ is the group of close neighbors of point x_i. It's described as:

$$knn\left(x_i\right) = \left\{x_j \mid d\left(x_i, x_j\right) \leq d\left(x_i, x_k\right)\right\} \tag{2}$$

where $d(x_i, x_j)$ is the Euclidean distance among x_i and x_j and x_k is the kth nearest neighbor of x_i. The information on the local density dispersion from nearby samples is combined in the enhanced local density expression. As a result, the fuzzy kernel can effectively extract the local density distribution. The focus on neighbor relationships is appropriate for sets of data with an uneven density dispersion and subpar DPC performance.

2.1.2. FINDING THE OPTIMAL NEIGHBORHOOD SIZE

In the previous section, a way to calculate the local density using k nearest neighbor was proposed, where the parameter k still needs to be set artificially, which also interrupts and destroys the continuous operation of the algorithm to some extent. In this section, the optimal k value is determined by calculation, so that the whole algorithm does not depend on the parameter.

In the present study, we suggest a flexible method for finding the optimal k value. Firstly, by setting the k value initially to 1, the nearest neighbor point of each point is found by definition 1, and then the number of times each point is considered as a neighbor point by other points, i.e., the reverse neighbor proposed by definition 2, is calculated to help iterative finding. Then the optimal k value is finally found by increasing in steps of 1.

The Euclidean distance among two data points x_i and x_j of dimension n is represented by $Dis(x_i, x_j)$. x_i and x_j fit to the set D, x_j is the kth neighbor of x_i, and is sorted by distance from x_i, from smallest to largest.

Definition 1 Positive neighbors and the positive neighbors of point x_i are represented by set $nbr(x_i)$:

$$nbr\left(x_i\right) = \left\{x_m \mid \mathrm{Dis}\left(x_i, x_m\right) < \mathrm{Dis}\left(x_i, x_j\right)\right\} \tag{3}$$

Definition 2 Reverse neighbor, the reverse neighbor point of any point x_i is represented by the set $rnbr(x_i)$, which needs to satisfy equation (4), i.e., a point x_n in the forward neighbor of point x_i. If the forward neighbor point of x_n contains point x_i, then x_n is said to be a reverse neighbor. $rnbr(x_i)$ is used to denote the set of reverse neighbor points of point x_i:

$$\mathrm{rnbr}\left(x_i\right) = \left\{x_n \mid x_i \in nbr\left(x_n\right) \wedge x_n \in nbr\left(x_i\right)\right\} \tag{4}$$

 https://doi.org/10.17993/3ctic.2024.131.62-74

The optimal k value size can be obtained as follows: as the k value increases from 1 and in increments of 1, each point x_i in the set acquires at least one reverse neighbor point, but when all points do not acquire a reverse neighbor point, The k value is regarded as the ideal k value. The termination condition for the optimal k value is expressed using equation (5):

$$T\left(x_i\right) = \begin{cases} \left|rnbr\left(x_i\right)\right|_k - \left|rnbr\left(x_i\right)\right|_{k-1} & k > 1 \\ \left|rnbr\left(x_i\right)\right|_k & k = 1 \end{cases} \tag{5}$$

Where, k starts from 1 with a step size of 1 and sets the upper search limit $l(l = \text{int}(\sqrt{n}))$. $\left|rnbr\left(x_i\right)\right|$ indicates the number of elements of the set of $rnbr(x_i)$. Combining with equation (1), the local density can be obtained.

2.1.3. ADAPTIVE DETERMINATION OF CLUSTERING CENTERS

The DPC algorithm requires visual inspection of the decision diagram to manually set the clustering centers. This human selection approach is unreliable when dealing with complex decision graphs. In order to select the appropriate core points, this section will design a new scoring formula to evaluate each point and then check whether it can be considered as a clustering center based on the threshold value. In this paper, the improved local density and relative offset distance will be used to identify the clustering centers. Then a new scoring method is proposed for scoring all points to determine the clustering centers by scoring, see Equation (6).

$$\text{Pscore}_i = \left(\frac{\rho_i \delta_i}{\max(\rho)\max(\delta)}\right)^2 \tag{6}$$

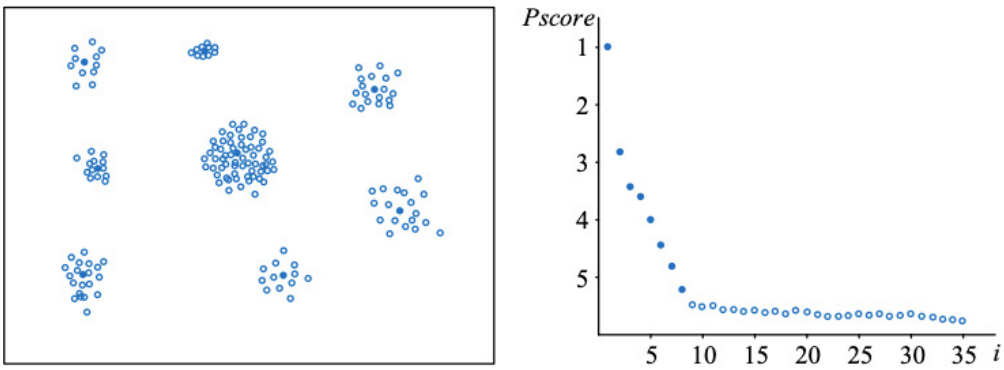
Using the assessment score values $Pscore_i$, each point in the data set is sorted. Higher score values will be assigned to points that have elevated local density and high comparative offset distances, and then the scores are sorted in descending order from highest to lowest. In order to determine the candidate clustering centers a threshold value is needed, by which the clustering centers can be determined adaptively.

For the proposed $Pscore_i$ design algorithm finds the threshold value. As shown in Figure 1, the values of $Pscore_i$ for most of the data points are concentrated in a lower region, while the values of $Pscore_i$ for only a few points are concentrated in a higher region. The non-clustering center point of $Pscore_i$ decreases almost linearly and slowly. From the critical point $Pscore_i$ value to the non-clustered centroid $Pscore_i$ value, there is a leap gap. The core points are filtered by finding this gap. Firstly, this subsection defines equation (7) to describe the $Pscore$ absolute difference of adjacent consecutive points, and then calculates the mean value of $DPscore$ by equation (8).

$$DPscoree_i = abs(Pscore_i - Pscore_{i+1}) \tag{7}$$

$$\overline{DPscore} = \sum_{i \in D} \frac{DPscore_i}{|D| - 1} \tag{8}$$

In Figure 1(a), the solid blue circles represent the core points and the hollow blue circles represent the non-core, and from Figure 1(b) the vertical coordinates are the scoring values and the horizontal coordinates are the point numbers. We can see that the points behind the core points $DPscore$ are very small. This feature can be used to determine the candidate core points.



(a) Data distribution (b) Pscore values

Figure 1. Data distribution and value ranking chart

When there are multiple candidate centers in a high-density region, they are usually very close to each other. Therefore, it is necessary to determine whether these candidate centers can be identified as the final independent clustering centers. Therefore, to determine each candidate point's k closest neighbor, the candidate cores are adjusted. If, for a point x_i in the candidate set, a k nearest neighbor x_j is found and x_j is also a candidate core, then the values of the Pscore of the two points are compared and the one having the larger Pscore value is kept and the smaller one is removed from the candidate core set. The final actual clustering centers are determined from the candidate set using a fine-tuning process.

2.2. ADAPTIVE MULTI-STEP ALLOCATION STRATEGY DENSITY PEAK CLUSTERING ALGORITHM

Although the AD-DPC algorithm proposed above solves the two problems that the local density calculation in the DPC algorithm depends on the truncation distance and requires human experience to select the clustering centers based on the decision map. When the data set is vast, there are many noisy points, and the area of overlap is complicated, the accuracy index still deteriorates. To address this problem, the

https://doi.org/10.17993/3ctic.2024.131.62-74

adaptive multi-step assignment strategy density peak clustering algorithm, referred to as the ADAS-DPC algorithm, will be proposed on the basis of the AD-DPC algorithm.

2.2.1. NON-CORE POINT DIVISION

The main purpose of this step is to make an initial distinction between non-core, and to first perform a round of division of non-core points by the formula designed in this subsection. This division is not a division of non-core point categories, but a round of data points based on the distribution in the decision diagram. For this purpose, three types of points are divided: cluster centers, high-density points, and edge points. While the density near edge points differs significantly from that of their neighbors, it is similar to that of the high-density points and their neighbors. Depending on how effectively the clustering algorithm interprets the clustering structure, edge point detection accuracy can vary. The sites with substantial density values created by eliminating edge points are the clustering backbones. Each core should roughly preserve the cluster's form and be separated from the others:

$$\mathrm{Avg}(\rho) = \frac{1}{n}\sum_{i=1}^{n}\rho_i \tag{9}$$

where n is the number of points.

Edge points are points surrounding the backbone cluster, so these points have different characteristics from those in the high-density cluster. To express this concept, edge points are points $\left(\rho_i < \mathrm{Avg}(\rho)\right)$ whose local density is lower than the average local density, and their relative offset distance values are lower than the variance $\left(\delta_i < \mathrm{Var}(\delta)\right)$ of the relative offset distance values of all points, and the effect of setting $\mathrm{Var}(\delta)$ is to exclude individual points with abnormal values, see Equation (10):

$$\mathrm{Var}(\delta) = \frac{1}{n}\sum_{i=1}^{n}\left(\delta_i - \bar{\delta}\right)^2 \tag{10}$$

Figure 2 shows the distribution of data points in the decision diagram, with the horizontal coordinates representing the local density and the vertical coordinates representing the relative offset distance. The blue and orange colors represent the core points, the black circles represent the high density points, and the black diamonds represent the edge points. This figure clearly shows the distribution of core, high-density, and edge points in the decision diagram. divides the diagram into two parts, left and right, with core and high-density points on the right side of the diagram and edge points on the left side of the diagram.

https://doi.org/10.17993/3ctic.2024.131.62-74

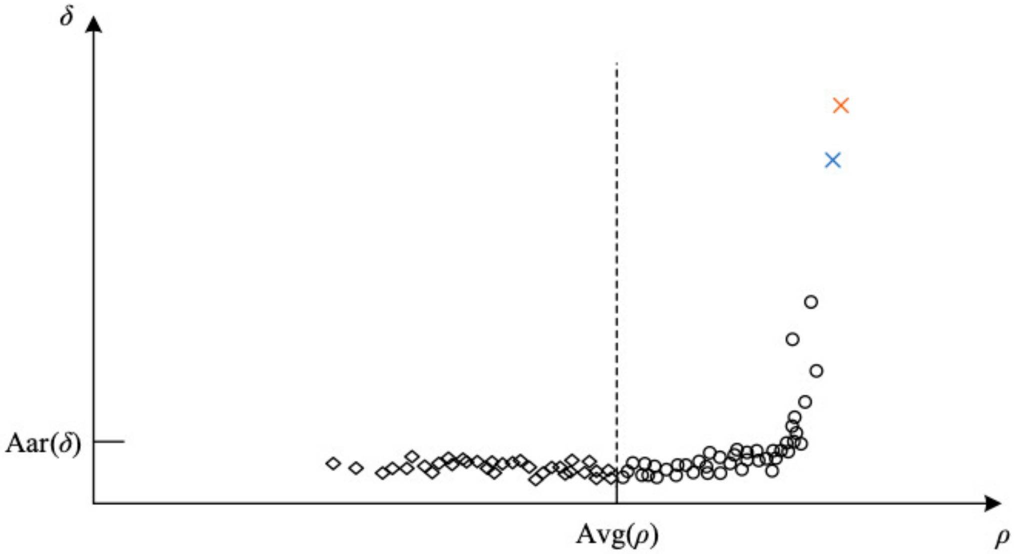


Figure 2. Distribution of data points in the decision diagram

2.2.2. LABEL ASSIGNMENT

This subsection aims to assign clustering labels to non-clustering centroids by three sub-steps: (1) Core points are assigned to high-density points. (2) High-density points are assigned to high-density points. (3) High-density points are assigned to edge points.

The cluster centers will each be given a different label, after which the tags of the comment cluster centers will be discovered by searching for the cluster centers' mutually dense nearest neighbors. The marks with all these assigned labels will then be used as starting points, and each nearest neighbor will then be found dynamically. This concept is expressed by equation (11), where $Label(x_i)$ denotes the label of x_i.

$$\text{Label}\left(x_i\right) = \begin{cases} \text{Label}\left(x_j\right) & x_i \in rnbr\left(x_j\right) \\ 0 & \end{cases} \tag{11}$$

Figure 3 illustrates the specifics of the suggested label assignment technique for arbitrary data. Figure 3(a) highlights that the clustering centers have been identified using the AD-DPC algorithm proposed in this paper. The proposed approach in this chapter is then used to identify high-density points and border points, with high-density points highlighted by hollow black circles and black hollow diamonds indicating edge points. The tags of a cluster centers are transmitted to their dense neighbors, as shown in Figure 3(b). The left cluster's trunk points are depicted in this figure as blue, as well as the right cluster's trunk points as orange.

The second stage in this work tries to transmit the clustering tags to the edges by assigning the tags of the closest trunk points in order to decrease computation time.

https://doi.org/10.17993/3ctic.2024.131.62-74

Equation (12) is used to determine the total of each edge point's distances from all of its backbones' nearest neighbors for this purpose:

$$\mathrm{SumDis}\left(x_b, M^c\right) = \frac{1}{k} \sum_{x_i \in nbr\left(x_b, M^c\right)} \| \, x_b - x_i \, \| ^{\,2} \qquad (12)$$

where x_b is an edge point, M^c is a collection of dense nodes from the crd trunk, and $\| \, x_b - x_i \, \| ^{\,2}$ depicts the distance in Euclidean terms between the two spots. $\mathrm{SumDis}\left(x_b, M^c\right)$ is the average of all the distances between x_b and the closest neighbors of M^c in k. The edge point x_b will obtain the trunk label with the smallest distance from itself. The purpose of using the exponential function in Eq. (13) is to magnify the gap and avoid the inability to distinguish the size due to insufficient number of calculated bits when the distances are extremely close:

$$\text{Label } \left(x_b\right) = \underset{c \in C}{\mathrm{argmin}} \, e^{\mathrm{SumDis}\left(x_b, M^c\right)} \qquad (13)$$

where C is the total number of detected trunks. This method is repeated until cluster labels have been assigned to each edge point. The proposed method's assignment of the labels to edge points x_b is depicted in Figure 3(c). The figure demonstrates that point x_b has been given by the blue label using the method described in this study because the average amount of the distances added by the blue labels is less than the average value of the distances added by the orange labels.

Figure 3(d) shows the edge point rechecking mechanism, which starts to execute after the labels of all edge points have been assigned, to detect whether the edge point label assignment is reasonable.

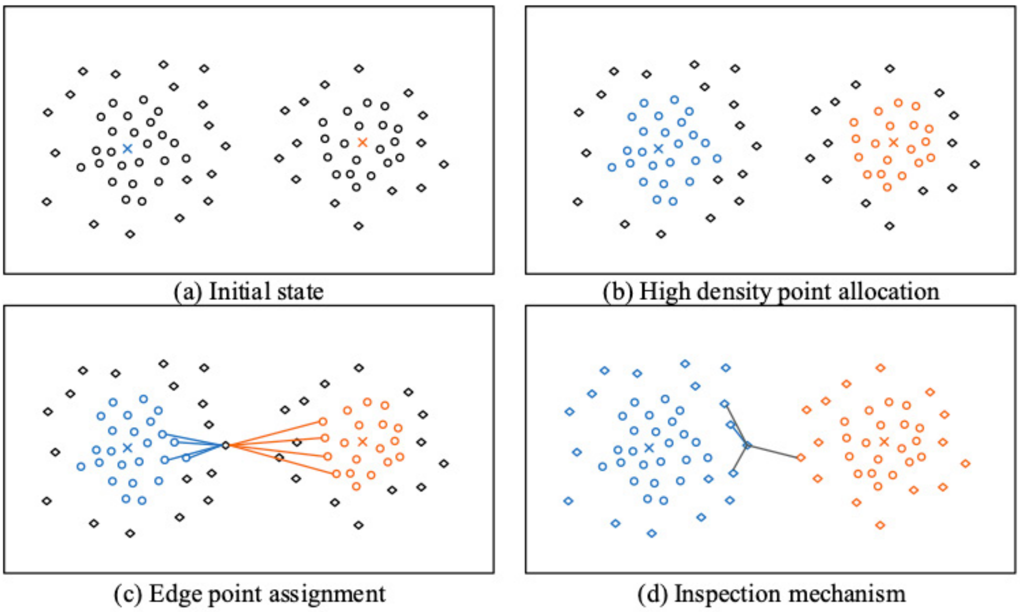


Figure 3. Example of a multi-step allocation strategy

https://doi.org/10.17993/3ctic.2024.131.62-74

2.3. PERFORMANCE ANALYSIS OF THE ALGORITHM

To verify the effectiveness of the algorithm, comparative experiments are conducted using UCI datasets, which contain a wide variety of sizes and types. Some of these datasets also have clusters of various complex shapes, and the data distribution of the specific UCI datasets is exposed in Table 1. It is visible from the table that these seven UCI datasets basically cover a wide variety of datasets (size, complexity and data characteristics). The performance and robustness of the algorithm can be detected by such a variety of types of data with complex distribution. This section tests the performance of the ADAS-DPC, AD-DPC, and DPC algorithms by using the evaluation metrics FMI and ARI, showing the best values for each test dataset.

Table 1. UCI data set

Data set	Number of data	Dimensionality	Number of classes
Inis	150	4	3
Wine	178	13	3
Seed	210	7	3
Sonar	208	60	2
Ecoli	336	8	8
WDBC	569	30	2
Balance	625	4	3

Figure 4 shows the results of FMI for the clustering algorithm on the seven datasets. From the overall results the ADAS-DPC algorithm has the highest FMI metrics in the datasets. Among them, in the datasets Iris, Wine, Seed, Sonar, and WDBC, the FMI values of ADAS-DPC are all over 0.8, which shows that the ADAS-DPC algorithm is effective for the improvement of the AD-DPC algorithm proposed in this paper, especially when facing the datasets with larger dimensionality, ADAS-DPC has a certain degree of improvement compared with the algorithms participating in the comparison experiments. Degree of improvement.

https://doi.org/10.17993/3ctic.2024.131.62-74

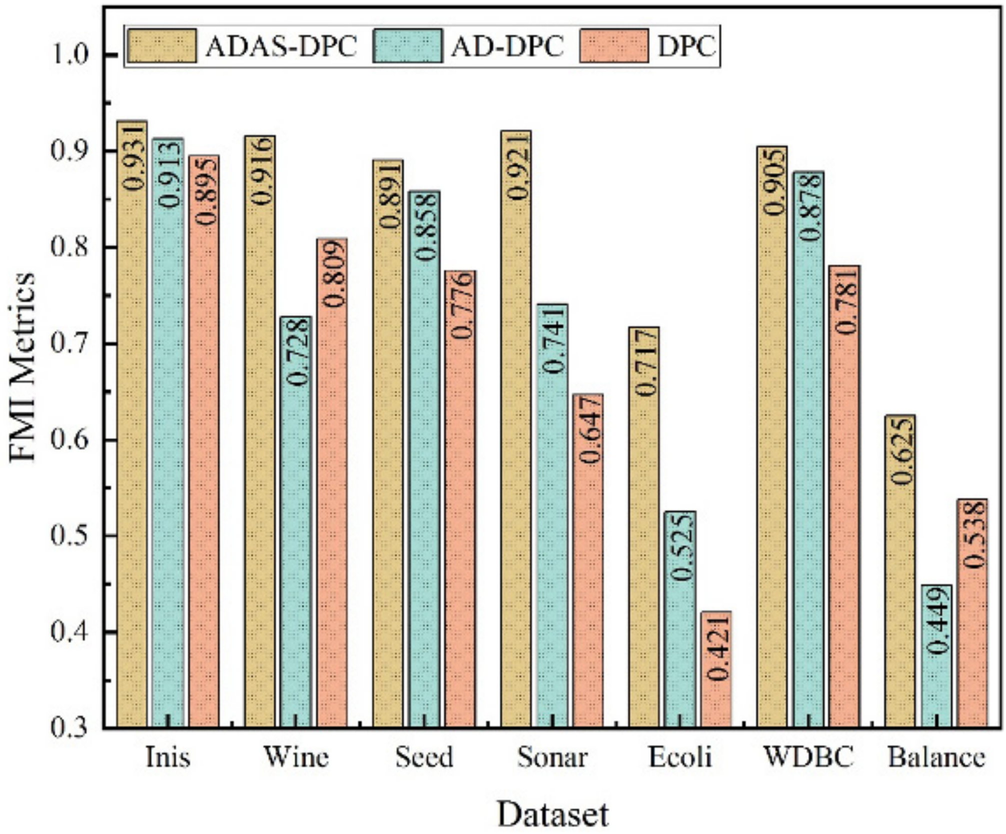


Figure 4 Experimental results of FMI in UCI dataset

Figure 5 shows the results of the clustering algorithm for the ARI metrics in the seven datasets. The overall results show that ADAS-DPC has the best ARI metrics in the datasets. Among them, in the datasets Iris, Wine, Seed, and Sonar, the ARI metrics of the ADAS-DPC algorithm are 0.832, 0.895, 0.768, and 0.757, which shows that the ADAS-DPC algorithm is effective for the improvement of the AD-DPC algorithm proposed in this paper. In the Ecoli, WDBC, and Balance datasets, although ADAS-DPC achieves the optimum, the ARI metrics are too low, indicating that it is difficult for these eight algorithms to deal with these three datasets effectively.

https://doi.org/10.17993/3ctic.2024.131.62-74

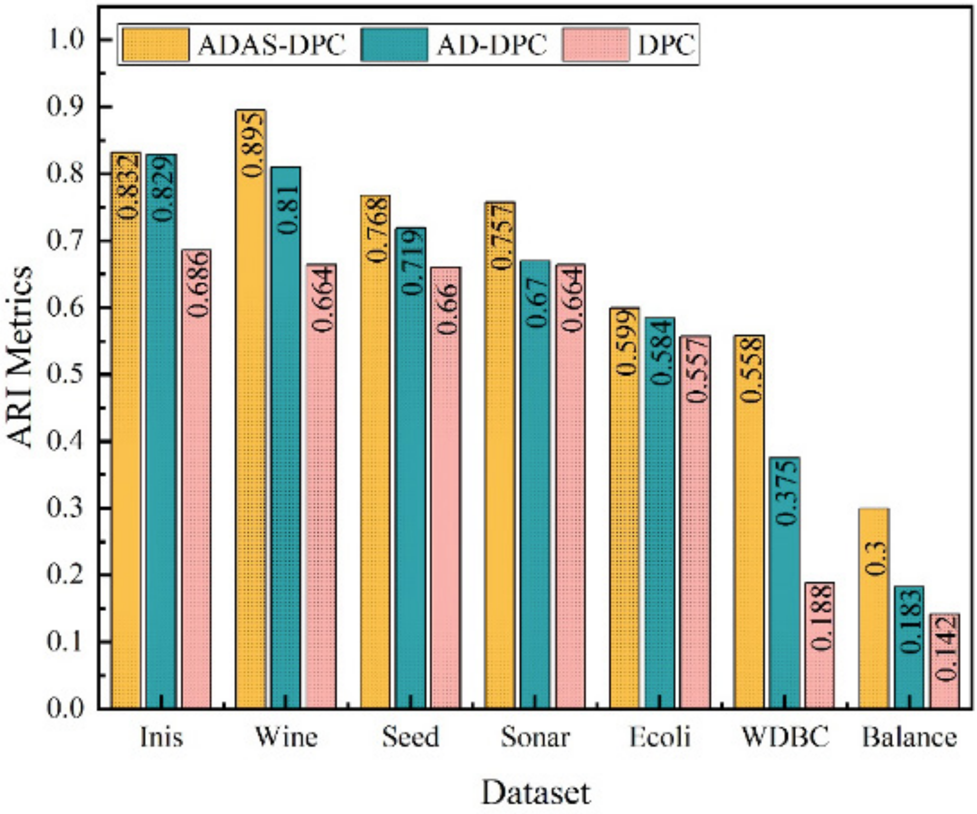


Figure 5. ARI in the UCI dataset Experimental results

3. STUDY ON THE IMPACT FACTORS OF REGIONAL FINANCIAL SERVICES FUNCTION

3.1. RESEARCH PROGRAM

3.1.1. RESEARCH HYPOTHESIS

As Internet finance and the actual economy grow, so do the funding options available to businesses. However, whether it is a bank or other financing platform, they all play the role of intermediaries for enterprise financing, collecting and lending funds from multiple and scattered sources, Consequently, it may be said that one of the key variables affecting how much money is lent out is the number of deposits. The reserve minimum ratio stated by the bank's governor indirectly influences the total quantity of loans in alongside the total number of deposits. Based on this, the following hypotheses are put out in this article, which takes into account non-financial company deposits, household deposits, and the required reserve ratio as variables affecting the lending amount provided by non-financial corporations and institutions.

Hypothesis 1: The volume of loans made by non-financial institutions and corporations has a positive correlation with the deposits made by households and

https://doi.org/10.17993/3ctic.2024.131.62-74

non-financial businesses. The ratio of reserve requirements to loans made to non-financial institutions and corporations has a negative relationship with both variables.

Hypothesis 2: Loans to non-financial institutions and firms and loans to households have a favorable correlation.

Hypothesis 3: The number of lending to non-financial businesses and institutions is inversely connected with the reduction of loss-making businesses.

Hypothesis 4: Index of consumer prices Loans made to organizations and businesses that are not in the financial sector have a negative correlation with the CPI. Negative correlation exists between the quantity of loans placed by non-financial firms and organizations and the Shanghai Interbank Offered Rate (SHIBOR).

3.1.2. RESEARCH METHODOLOGY

This study expanded the research area of the number of loans positioned by non-financial businesses to the research topic of the number of loans positioned by non-financial businesses and institutional groups by using the number of loans positioned by non-financial businesses and governmental groups as the predictor variables. Table 2 displays the variables.

Table 2. Selection of variables

Variable Code	Variable name
Y	Amount of loans to non-financial enterprises and institutions
X1	Deposits in non-financial enterprises
X2	Household deposit
X3	Household loan
X4	Reduction rate of loss-making enterprises
X5	CPI
X6	SHIBOR rate
X7	Deposit reserve ratio

3.1.3. DATA SOURCES

Based on the proposed research question, this paper chooses the following variables for the period of 2017 to 2021 in Hunan Province: non-financial corporate and institutional loan placement, non-financial corporate deposits, household deposits, household loans, loss-making enterprises reduction rate, CPI, SHIBOR 1-month interest rate, and deposit reserve ratio. Based on the numerous interest rate

https://doi.org/10.17993/3ctic.2024.131.62-74

term varieties published by SHIBOR, this paper selects the interest rate term variety for SHIBOR term variety with the 1-month interest rate from January 2017 to December 2021 as the choice of interest rate term variety. Since the 1-month SHIBOR rate changes every few trading days with the market and for the convenience of data selection, this paper selects the official January SHIBOR rate on the first trading day of each month as the 1-month SHIBOR rate data. Regarding the data itself, in order to further investigate the effect that outside influences of non-financial enterprise loans on enterprise loans, this paper selects data of loan placement of non-financial businesses and related groups in Hunan Province over the last five years with the variables of non-financial entrepreneurship deposits and household deposits.

3.2. ECONOMETRIC TESTS OF FACTORS INFLUENCING CORPORATE LENDING

The results of the ADAS-DPC algorithm test were obtained using the amount of loans to non-financial businesses and organizations as the variable that is dependent and variables like funds to non-financial businesses and funds to households as separate variables. The information is shown in Table 3.

Table 3's results make it clear that X1 is unimportant and X7 has a positive correlation with Y, which is inconsistent with the hypothesis. As a result, the variables are examined for multicollinearity, which can produce unimportant variables and the incorrect sign of the coefficient of regression.

Table 3. ADAS-DPC estimation results

Variables	coefficient	Standard deviation	T-value	P-value
C	-1.305	2.344	-553	558
X1	116	90	1.660	112
X2	281	57	3.765	-12
X3	1.005	92	11.237	3
X4	-3.194	8.344	-3.790	-1
X5	-1.016	4.636	-2.180	22
X6	-2.954	9.178	-3.228	14
X7	2.579	1.150	2.230	26

Table 4 displays the straightforward correlation coefficient matrix. Variable X7 exhibits strong multicollinearity amongst the variables since it is substantially linked with variables X2, X3, and X4 in a two-by-two fashion. Therefore, despite the fact that the number of loans placed and the X7 deposit reserve ratio are theoretically

https://doi.org/10.17993/3ctic.2024.131.62-74

negatively connected, as the deposit reserve ratio rises, banks have comparatively less money to use for lending.

Table 4. Simple correlation coefficient matrix

	X1	X2	X3	X4	X5	X6	X7
X1	1.000	587	576	-314	-75	109	-367
X2	587	1.000	993	-870	225	-507	-928
X3	576	993	1.000	-825	251	-550	-945
X4	-314	-870	-825	1.000	-439	658	861
X5	-75	225	251	-439	1.000	-334	-330
X6	109	-507	-550	658	-334	1.000	703
X7	-367	-928	-945	861	-330	703	1.000

On the basis of this, after deleting the variable for the X7 deposit reserve percentage, the ADAS-DPC estimation was re-run to obtain Table 5. For the original hypothesis Ho: , given the significance level , F(6, 53)=6.48, F=211>6.48 in the table, the original hypothesis Ho should be rejected, demonstrating the significance of the regression equation. Also, it can be inferred that the factors X1, X2, X3, X4, X5, and X6 are significant at the x=5% significance threshold from the p-values in Table 5 that are less than 0.05, showing that the regress of the chosen explanatory factors with the explanatory variables is significant. Among them, non-financial corporations and organizations are positively correlated with non-financial corporate deposits, household deposits and household loans, CPI and SHIBOR 1-month interest rate are inversely connected with the rate of loss-making businesses.

Table 5. ADAS-DPC estimation consequences

Variables	Coefficient	Standard deviation	T-value	P-value
C	3.479	9.815	3.559	12
X1	252	75	3.493	15
X2	214	86	3.134	-9
X3	896	75	11.578	-7
X4	-3.712	8.33	-4.478	-5
X5	-1.46	4.357	-3.35	13
X6	-1.88	8.096	-2.341	26

This led to an analysis of the interconnections between the variables, which is depicted in Table 6. The regression results of the explanatory variables X2 and X3 passed the test statistics in Table 4 of the estimation findings, and there is a strong

 https://doi.org/10.17993/3ctic.2024.131.62-74

correlation between X4, X2, and X3. In order to make the data smoother and to eliminate the problems of multicollinearity and heteroskedasticity of the model, the results of ADAS-DPC estimation after taking logarithms for Y, X1, X2, and X3 are shown in Table 7, and the variables are significant after taking logarithms for the variables of interest.

Table 6. Simple correlation coefficient matrix

	X1	X2	X3	X4	X5	X6
X1	1.000	594	583	-306	-66	100
X2	594	1.000	999	-868	228	-531
X3	583	999	1.000	-858	242	-557
X4	-306	-868	-858	1.000	-415	666
X5	-66	228	242	-415	1.000	-363
X6	100	-531	-557	666	-363	1.000

Table 7. ADAS-DPC estimation results after logarithm

Variables	Coefficient	Standard deviation	T-value	P-value
C	3.060	1.069	2.877	15
LNX1	93	45	2.212	43
LNX2	3.187	88	3.617	9
LNX3	413	43	9.834	-11
X4	-140	40	-4.229	7
X5	-628	212	-3.029	1
X6	-806	364	-2.126	31

A unique technique for determining whether macroeconomic, monetary, and financial information series are stable and exhibit specific statistical properties is the root unit test of stability. Unit root tests can be performed in a number of ways, including the ADF test, PP test, DF test, KPSS test, ERSPO test, and NP test, among others. ADF test is primarily utilized in this paper, as shown as Figure 6.

ADF statistics for lnY, lnX1, lnX2, lnX3, X4, X5, and X6 were all above the critical values with confidence levels of 1%, 5%, and 10%. This indicates that at levels of significance of 1%, 5%, and 10%, lnY, lnX1, lnX2, lnX3, X4, X5, and X6 are non-stationary sequence. From this, the ADF test then is completed to evaluate the first-order distinctions D(lnY), D(nX1), D(lnX2), D(lnX2), D(lnX3), D(X4), D(X5), and D(X6) of lnY, lnX1, lnX2, lnX3, X4, X5, and X6, and the findings demonstrate that the ADF

https://doi.org/10.17993/3ctic.2024.131.62-74

statistical data are all smaller than the significance level with levels of confidence of 1%, 5%, and 10%, which demonstrates that InY, InX1, InX2, InX3, X4, X5, and X6 of the first-order difference series are all smooth series. The single integer series InY, InX1, InX2, InX3, X4, X5, and X6 are all first-order ones.

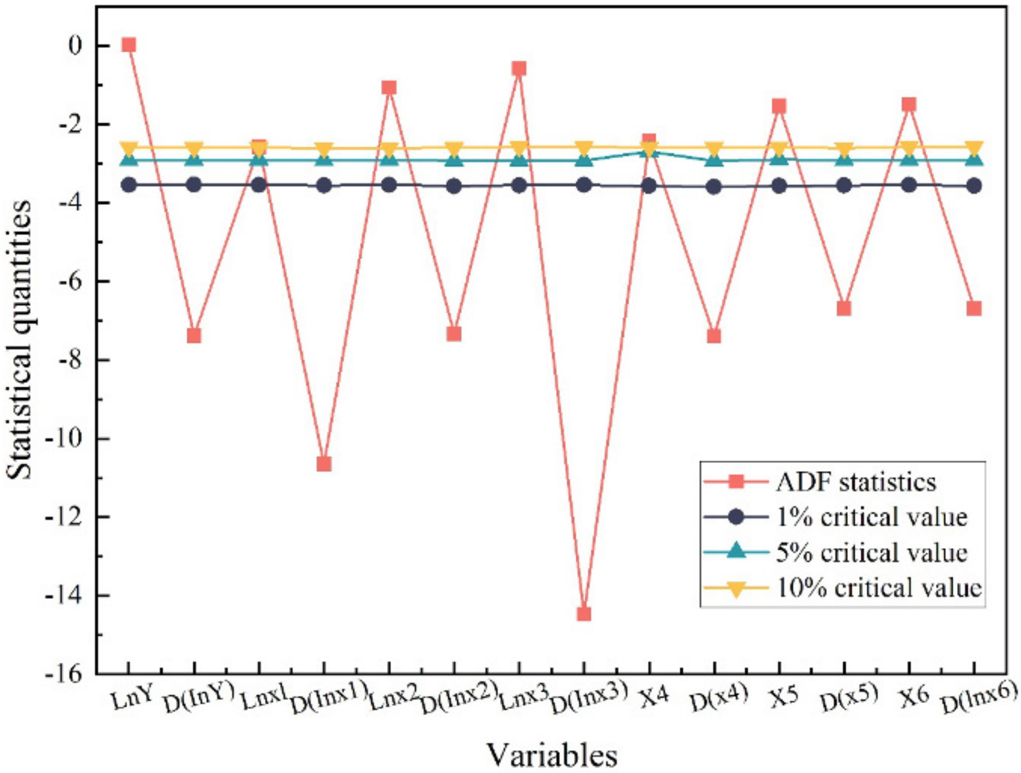


Figure 6. Stationarity test results of variables

4. SUGGESTIONS FOR COUNTERMEASURES

1. Accelerate the progress of financial sector integration and create a healthy ecosystem for regional financial markets

A strong credit system, financial guarantee system, and supervision system make up the bulk of a favorable financial market ecological environment. It is urgent to create a new and effective regional financial guarantee system and credit system, enhance the credit guarantee system, and reform the regulatory system in order to effectively contribute to the enhancement of the loan volume of non-financial enterprises and encourage the financing of small and medium-sized enterprises. At the moment, many studies pointed out that the guarantee system as well as credit system to be enhanced for the loans of small and medium-sized enterprises is one of the major reasons for financing difficulties.

2. Optimize loan structure and improve policy benefits

Based on an analysis of the existing situation of the country's macroeconomic system, China has continued to pursue a cautious monetary policy in recent times,

 https://doi.org/10.17993/3ctic.2024.131.62-74

providing some support and vigor to the actual economy in order to revive the market. At the microeconomic level, the main types of loans are concentrated in the real economy, and it is necessary to actively optimize the structure of loan investment, so as to more effectively encourage the growth of the actual economy and maximize the advantages. On the other hand, the promotion of preferential policies should be improved, and special online and offline policy consultation and direct services divided by industry or enterprise nature should be set up, so that the benefit of the policy can be effectively improved and enterprises eligible for preferential policies can be precisely benefited, and the problem of information asymmetry can be further alleviated.

3. Accelerate the creation of the financial digital economy.

With the policy-oriented construction of the digital economy of regional finance, first of all, online and offline financing should promote the sharing of information and the interconnection of financial institutions, so as to further improve the efficiency of resource allocation of financial services. Nowadays, the majority of non-financial enterprise loans and financial originates from bank loans. But, as Internet finance has developed and associated laws and regulations have been introduced, financing sources outside of banks have also become more prevalent. Online and offline financing methods each tend to diversify, but the effective and sufficient links between financial institutions and financial institutions, online financial institutions and Internet financing platforms have not been obtained, resulting in a greater cost of finding effective information, which to a certain extent affects the amount of non-financial enterprise loan placement, thus accelerating the construction of the digital economy of finance.

4. An innovative financial services system is reviving the local financial services industry.

The real economy benefits from finance. As China continues to attach importance to innovation, while innovating, the financial service system is also in urgent need of innovation, so as to effectively build a financial support innovation economic system. From the service territory of regional finance, a strong regional financial service system may be established to generate green finance by innovating the financial service mechanisms in accordance with various regional features and inadequacies. From the regional finance's service objectives, it encourages the productive fusion of finance + agricultural, finance + research and technology, finance + pension and other sectors, thereby fostering industrial transformation and upgrading.

5. CONCLUSION

DPC has been widely used in image recognition, marketing, bioinformatics and financial analysis due to its speed and accuracy, the DPC algorithm is frequently used in the financial analysis, marketing, bioinformatics, and image recognition industries. For the large scale of financial service information and complex overlapping regions, which can seriously affect the clustering algorithm's ability to segmentation, this paper proposes the density peak clustering algorithm with adaptive multi-step assignment strategy (ADAS-DPC). Comparative experiments are conducted using the UCI dataset, and the overall results show that ADAS-DPC is optimal for both FMI metrics and ARI metrics in the dataset, indicating that the ADAS-DPC algorithm is effective for the improvement of the AD-DPC algorithm proposed in this paper. Finally, we use the algorithm to analyze the influence factors of regional financial service function by using enterprise loans as an example to get the following conclusions:

1. Deposits of non-financial corporations and households are positively correlated with loans to non-financial corporations and organizations

Deposits can basically be split into two categories, one is the deposits available for lending by commercial banks and the other is the legal deposit reserve. An increase in the directness of deposits of non-financial corporations and households will have an immediate impact on commercial banks' total deposits, which will be transmitted to the amount of loans placed by non-financial corporations. There is a positive correlation between non-financial deposit and household loans, according to the regression assessment of these variables with other independent factors on the loan placing of non-financial firms and organizations.

2. Positive change of household loans on the volume of loans to non-financial enterprises and institutional groups

Residential leverage will, to a certain extent, cause the income benefit to outweigh the crowding out impact of residential leverage on consumption growth, thus to a certain extent, it is not conducive to amplify consumer demand, but as far as enterprises are concerned, residential leveraging will amplify consumer spending power, boost loans to non-financial businesses and the amount of financial investments made by businesses, whereas residential leveraging and loan growth both increase debt risk.

3. The change in the amount of loans to non-financial firms and organizations is inversely correlated with the decline in the number of loss-making enterprises, CPI, and SHIBOR 1-month rate of interest.

According to the stationary behavior unit root test and integration test, the rate of rise in loans to non-financial firms declines when the SHIBOR interest rate rises. The loss-making business reduction rate gauge, which is calculated based on all of the businesses in the area, provides insight into the industry's overall development environment and trend. The majority of area businesses attain profitability, and the business environment is favorable, according to a greater percentage of loss-making business reduction.

https://doi.org/10.17993/3ctic.2024.131.62-74

ABOUT THE AUTHORS

Suo Zhang, a teacher of the School of Intelligent Manufacturing and Mechanical Engineering, Hunan Institute of Technology, graduated from Hunan University, majoring in MBA. Currently he is a Ph.D. candidate in business administration at Jose Rizal University. His main research interests are international marketing, and consumer behavior.

Yixian Wen, associate Professor of Business School of Hunan Institute of Technology, graduated from Changsha University of Science and Technology with a master's degree in educational economics and management. Currently she is a PhD candidate in educational leadership at Adamson University. Her main research interests are regional economics and educational economics.

FUNDING

1. This research was supported by Education Department of Hunan Province: Regional trade agreement deepens the research on the impact of cross-border data flow and its regulatory mechanism (23B0831).

2. This research was supported by the Project: Research on the deep integration of intelligent, service and green manufacturing industry in Hunan Province under the background of digitalization (23C0408).

REFERENCES

(1) Min, X. U. (2013). The Regional Differences of the Rural Financial Service Level and Influencing Factors Analysis. *West China Finance*.

(2) Wang, G. J., & Wang, L. (2015). Coupling Coordination Degree Research on Financial and Regional Economic System of Bohai Rim. *Resource Development & Market*.

(3) Delgado, M. F., Esenarro, D., Regalado, F. F. J., et al. (2021). Methodology based on the NIST cybersecurity framework as a proposal for cybersecurity management in government organizations. *3c TIC: cuadernos de desarrollo aplicados a las TIC, 10*(2), 123-141.

(4) Xing, G., & Liu, C. (2018). Regional Financial Development, Technological Innovation and Industrial Structure Optimization: An Empirical Study Based on Shenzhen 2001-2016 Data. *Macroeconomics*.

(5) Qian, M. H., & Ri-Dong, H. U. (2013). Research on the Ability of the Establishment of Regional Financial Service Center. *Economic Geography*.

(6) Zheng, C., Zhang, C., & Sun, P. (2019). Impact of Co-agglomeration between Financial Service Industry and Manufacturing Industry on Regional Labor Productivity and Its Spatial Spillover Effect: Based on Panel Data of 69 Counties in Zhejiang Province. *Technology Economics*.

(7) Huang, H. R. (2013). Strategy on Building Regional Financial Service Center: Taking Fuling County of Chongqing City for Example. *Value Engineering*.

(8) Jie, Y. U. (2018). Research on Operation Mechanism and Financial Service Innovation of Regional Sci-tech Finance. *Journal of Guangdong University of Petrochemical Technology*.

(9) Kaseng, F., Lezama, P., Inquilla, R., et al. (2020). Evolution and advance usage of Internet in Peru. *3c TIC: cuadernos de desarrollo aplicados a las TIC, 9*(4), 113-127.

(10) Liu, Q. (2018). Construction of Regional Sci-tech Financial Service Linkage Mechanism: A Case Study of Chongqing City. *Science and Technology Management Research*.

(11) Duarte, J., Siegel, S., & Young, L. (2012). Trust and Credit: The Role of Appearance in Peer-to-peer Lending. *Review of Finance Studies*.

(12) Hofmann, E., Strewe, U. M., & Bosia, N. (2017). Supply Chain Finance and Blockchain Technology: The Case of Reverse Securirisarion.

(13) Yuan, B., Amp, Z. R., & University, T. V. (2016). Research on the Innovation and Development of Regional Financial Service System—In the Perspective of Zhangjiakou. *Journal of Hebei Radio & TV University*.

(14) Etsuya, S., & John, R. H. (2012). Electronic Finance: An Overview of the Issues. *Bis Papers Chapters, 7*(1), 1-12.

(15) Zheng-Hui, L., & Jin, Y. (2012). A Study on the Measurement of the Synergistic Effects of the Financial Stability and the Financial Competitiveness and its International Comparison. *Statistics & Information Forum, 2012*(2), 3-8.

 https://doi.org/10.17993/3ctic.2024.131.62-74