

Is Insufficient Social Security Confidence an Invisible Shackle on Rural Consumption? Evidence from the China Family Panel Studies

ABSTRACT: The urban-rural consumption expenditure gap poses a significant obstacle to economic development. From a psychological perspective, this study employs a 4-period panel dataset constructed from the CPFS database to empirically analyze the inhibitory effect of insufficient social security confidence on the consumption expenditure of rural residents. The results demonstrate that a one-point decrease (on a 10-point scale) in rural residents' confidence in social security reduces their consumption expenditure by 0.027 ten thousand yuan. Furthermore, it hinders the optimization and upgrading of their consumption structure: notably, a one-point decline in social security confidence reduces developmental and recreational consumption by 0.052 and 0.037 ten thousand yuan, respectively, significantly exceeding the reduction in survival consumption. Additionally, the study finds that rural residents characterized by non-agricultural employment, male gender, higher education levels, or urban residence exhibit stronger tendencies to curtail consumption and accumulate savings when experiencing low social security confidence.

Keywords: Social security confidence; Rural consumption market; Consumer confidence; Consumption willingness; Urban-rural disparities in social security.

1 Introduction

National consumption is one of the primary driving forces behind economic growth and a key engine for promoting sustainable and healthy economic development (Zheng et al., 2024). China is no exception. In 2023, the contribution rate of final consumption expenditure to China's economic growth surged to 82.5%, marking a significant increase of 43.1 percentage points compared to 2022. However, the reality is that a substantial consumption expenditure gap exists between urban and rural residents in most countries, hindering healthy economic development. For example, in 2022, the monthly per capita consumption expenditure of urban residents in India was 6,459 rupees, 71% higher than the 3,773

rupees spent by rural residents¹. Similarly, in China in 2023, the per capita consumption expenditure of urban residents was 32,994 yuan, while that of rural residents was only 55% of the former. This consumption gap not only limits the consumption potential of rural markets but also challenges the endogenous growth momentum and resilience of the overall economy. Therefore, there is an urgent need to implement effective strategies to narrow the urban-rural consumption gap, stimulate consumption vitality in rural areas, and enhance the endogenous growth momentum and resilience of the overall economy.

Social security, as the fundamental guarantee of residents' material needs, plays a crucial role in promoting consumption growth and structural optimization, reducing concerns about future uncertainties, stimulating consumption potential, and contributing to economic prosperity (Jiang, 2021; Shang et al., 2023; Ugwu and Idemudia, 2023; Zhao and Chen, 2024). The Chinese government has committed to ensuring that every individual receives basic satisfaction in areas such as education, healthcare, pensions, employment, and fundamental social security. However, the reality is that rural social security faces challenges such as insufficient investment, mismanagement, imbalanced system development, and weak legal support (Long et al., 2016; Shi et al., 2023). Specifically, the allocation of educational resources between urban and rural areas is uneven. In 2023, 93.09% of full-time teachers in urban junior high schools had a bachelor's degree or higher, while the proportion was only 76.01% for rural teachers². Employment opportunities are also imbalanced, with a national workforce of 740 million people, of which 470 million (63.5%) are urban workers, while only 270 million are rural workers³. In terms of pensions, the basic pension insurance for urban employees covers over 480 million people, while the rural and urban residents' pension insurance covers 550 million people, with urban pension income being significantly higher than that in rural areas⁴. The total number of beds in medical and healthcare institutions nationwide is 10.2 million, with hospitals accounting for 8 million, while township health centers have only 1.51 million beds⁵.

Overall, there is a significant disparity between urban and rural areas in China regarding education, employment, pensions, healthcare, and the coverage and quality of basic social security. This issue has

¹Source: <https://ruralindiaonline.org/en/library/resource/household-consumption-expenditure-survey-2022-23-fact-sheet-august-2022--july-2023/>

² Source: https://www.gov.cn/lianbo/bumen/202405/content_6951436.htm

³ Source: https://www.stats.gov.cn/zs/tjws/tjjc/202301/t20230101_1903922.html

⁴ Source: <http://iple.cass.cn/ldjjyj/ml/202104/W020210409384916909383.pdf>

⁵ Source: https://www.gov.cn/lianbo/bumen/202402/content_6934935.htm

diminished the confidence of rural residents in the social security system. According to the 2020 China Family Panel Studies (CFPS), which surveyed 15,666 rural residents across 25 provinces, the average score given to China's social security system was only 6.093 out of 10. This reflects the relatively low confidence rural residents have in China's social security system.

However, in the existing research on social security and resident consumption, scholars have primarily focused on the impact of social security levels on consumption, without considering how to enable rural residents to feel confident in spending. Current studies suggest that pension insurance generally improves the disposable income of low-income groups and residents in economically underdeveloped areas, thereby significantly promoting consumption (Lalive et al., 2023; Li et al., 2024). Health insurance reduces the uncertainty of medical expenses for migrant workers (He, 2023; Probst, 2023), thus decreasing precautionary savings (Wang and Hu, 2023). This, in turn, significantly enhances the proportion of service consumption within the overall consumption structure (Lakdawalla et al., 2017), having a positive effect on residents' perceived quality of life. Furthermore, increasing government spending on education has been shown to promote rural consumption (Huang et al., 2021). The vast gap in social security levels between urban and rural areas remains an undeniable issue. However, current research has not provided a clear answer as to whether the lack of confidence in social security among rural residents leads to a reduction in their consumption expenditure.

Based on the gaps in existing research, this paper seeks to answer the following questions: Does insufficient social security confidence among rural residents suppress their consumption expenditure? How does it affect the consumption structure? And what are the similarities and differences in the consumption behavior of rural residents with different characteristics when their confidence in social security is low? To address these questions, we utilized data from the 2014-2020 CFPS, selecting a sample of rural residents whose social security confidence scored 5 or below. We constructed a four-wave panel dataset to empirically analyze this causal relationship.

The marginal contributions of this paper may lie in: (1) examining rural residents' consumption behavior from a psychological perspective, specifically social security confidence. This research not only significantly enriches the field of consumption behavior studies by diversifying and refining the perspectives, but also provides valuable empirical evidence on how to effectively boost rural residents' consumption willingness. (2) Conducting an empirical analysis of the impact of social security confidence on the consumption structure of rural residents. The findings offer important references for

the government and relevant departments in optimizing the rural social security system, guiding rational consumption among rural residents, and promoting consumption upgrading. (3) Investigating the similarities and differences in the consumption behavior of rural residents with varying characteristics when facing insufficient social security confidence. These results can provide policymakers with more nuanced decision-making insights.

2 Mechanism and Research Hypothesis

2.1 Social Security Confidence and Consumption Expenditure of Rural Residents

As an important mechanism for rural residents to cope with future risks, the level of social security directly affects their confidence in consumption. From the perspectives of the expectation theory and precautionary savings theory, when the social security system is inadequate, or rural residents lack confidence in it, they may have doubts about the stability of their future income and the security of their expenditures. This uncertainty leads to more conservative consumption strategies, where rural residents reduce current consumption and increase precautionary savings to mitigate potential risks (Lugilde et al., 2019). Furthermore, from the viewpoint of behavioral economics, rural residents' consumption decisions are also influenced by psychological factors (Zhang and Dong, 2020). A lack of confidence in social security may cause anxiety, worry, and other negative emotions, which further suppress their willingness to consume (Simpson et al., 2021). When social security confidence is low, rural residents may become concerned about uncertainties such as future medical expenses, pension costs, and educational expenditures, prompting them to reduce current consumption to prepare for potential risks. Therefore, the paper proposes the following hypothesis:

H1: When rural residents have insufficient confidence in social security, it will suppress their consumption expenditure.

2.2 Social Security Confidence and Consumption Structure of Rural Residents

Survival consumption, which includes core necessities such as food, basic clothing, and daily essentials, is characterized by low elasticity (De Brauw and Herskowitz, 2021). Even in the context of economic fluctuations or a lack of confidence in social security, residents still need to ensure that these basic survival needs are met. In contrast, discretionary consumption, which includes entertainment, travel, and luxury goods, while also susceptible to reductions, is more flexible as it falls into the non-essential category (Kannan and Kulkarni, 2022). In rural areas, such consumption expenditures

already account for a relatively small proportion (Ma et al., 2022). When confidence in social security is shaken, rural residents, driven by financial conservatism, tend to moderately reduce discretionary spending to preserve disposable resources. Developmental consumption, which is closely linked to long-term investments in areas such as education, healthcare, and housing, involves future-oriented decision-making and has a longer return cycle (Boon-Falleur et al., 2024). In an unstable social security system, rural residents are more likely to worry about potential risks such as healthcare, unemployment, and retirement, which are difficult to adequately safeguard. As a result, they are inclined to prioritize cutting or delaying such high-potential but high-risk investment expenditures, making developmental consumption the primary target for suppression in the face of social security uncertainty. Based on this, the following hypothesis is proposed:

H2: In an environment of insufficient social security confidence, developmental consumption of rural residents is the most significantly suppressed, while discretionary consumption is reduced to a lesser extent, and survival consumption is least affected by the lack of social security confidence.

3 Research Design

3.1 Data Source

The data for this study are drawn from the China Family Panel Studies (CFPS) database, a nationally representative household survey conducted biennially since 2010. Given the specific requirements of this research design, we systematically organized the CFPS questionnaire data and, based on data availability and sample reliability considerations, selected the survey data from 2014, 2016, 2018, and 2020 as the foundation for our analysis. Using the household head as the financial respondent, we excluded inapplicable data, missing values, samples with social security confidence scores higher than 5, and urban household registrations. The resulting comprehensive dataset covers 25 provinces across China and includes a total of 7,656 valid samples.

3.2 Model Construction

To test Hypothesis 1, we constructed the following baseline regression model:

$$Consumption_{it} = \beta_0 + \beta_1 Confidence_{it} + \sum \beta X_{it} + \varepsilon_{it} \quad (1)$$

Where $Consumption_{it}$ represents the consumption expenditure of rural residents i in year t , $Confidence_{it}$ represents the social security confidence of rural residents i in year t , the control

variables are represented by X , ε_{it} is the random disturbance term, β_0 is the intercept term, β_1 is the coefficient for social security confidence, and β is the coefficient for the control variables.

3.3 Variable Selection and Definition

Table 1 shows the descriptive statistics, indicating that the average annual consumption of rural households in China is approximately 104,400 yuan. The mean social security confidence score is only 2.974, suggesting that the gap in social security between urban and rural areas has had a significantly negative impact on the confidence of rural residents. Additionally, the gender ratio in the sample is relatively balanced, with the majority being middle-aged and young adults. The sample selection is reasonable and meets the conditions for empirical analysis.

Table 1 Variable definitions and descriptive statistics (N = 7656)

Variable type	Variable name	Definition	Mean	Sd
dependent variable	Consumption	Consumption expenditure equals the total of survival, development, and enjoyment-oriented consumption expenses throughout the year. Survival consumption includes property fees, heating costs, housing expenses, food costs, and clothing expenses. Development consumption covers expenditures on home appliances, furniture, transportation, communication, education, and healthcare. Enjoyment consumption includes spending on cultural entertainment, beauty services, automobile purchases, tourism, and wellness.	10.44	0.889
independent variable	Confidence	Social security confidence among rural residents comes from their self-perception of social security issues. In the CPFS questionnaire, rural residents are asked to rate five issues in China: employment, education, healthcare, housing, and social security (total of five items). The scale ranges from 0 (not serious at all) to 10 (extremely serious). For research purposes, the results were processed to reflect confidence (with 0 indicating no confidence and 10 indicating full confidence). The average score was calculated, and samples with a confidence level greater than 5 were excluded to represent the social security confidence of rural residents according to the research needs.	2.974	1.326
Control variable	Gender	Householder gender. Male =1;female =0	43.71	13.23
	Age	The age at which the head of household was surveyed	0.542	0.498
	Education	Householder education status. 1 = unschooled, 2 = primary school, 3 = junior middle school, 4 = vocational high school, 5 = senior high school, 6 = junior college, 7 = bachelor degree, 8 = master's degree, PhD degree = 9	2.791	1.222
	Marriage	Householder marital status. Married = 1; others = 0	0.888	0.315

Health	Health level from good to bad :1-5	2.939	1.163
Income	Total household income in the past year (Ten thousand yuan)	10.90	0.933
Socialize	Gift expenditure in the past year (Ten thousand yuan)	7.864	1.022
Agricultural_if	Whether they work in agriculture.Yes =1; No =0	0.593	0.491
F_size	Total family size	4.081	1.769
Land	Land endowment is estimated based on agricultural income (ten thousand yuan)	3.225	6.437

4 Empirical Results Analysis

4.1 Baseline Regression Analysis

Table 2 reports the impact of insufficient social security confidence on the consumption expenditure of rural residents. After controlling for provinces and time, columns (1) to (3) of Table 2 gradually introduce individual-level and household-level control variables. The coefficient for social security confidence remains significantly negative at the 1% level. The results in column (3) indicate that for every 1-point decrease in social security confidence, the consumption expenditure of rural residents decreases by an average of 0.027 million yuan. Therefore, Hypothesis 1 is supported.

Regarding the control variables, age and whether one is engaged in agricultural work have a significant negative effect on rural residents' consumption expenditure. The possible reason is that as people age, their dependence on the social security system increases, particularly in areas such as health insurance and pensions. If confidence in the social security system is lacking, older individuals may be more inclined to save to prepare for future uncertainties, thus reducing non-essential consumption, such as leisure activities and non-basic goods purchases. Agricultural workers, on the other hand, face risks such as weather changes and market price fluctuations. If the social security system cannot provide effective coverage, residents engaged in agriculture may need to rely on self-protection by increasing savings and reducing consumption to prepare for potential risks, thereby suppressing consumption expenditure.

Table 2 Baseline regression results

	(1)	(2)	(3)
	Consumption	Consumption	Consumption
Confidence	-0.063*** (0.007)	-0.033*** (0.007)	-0.027*** (0.006)
Age		-0.011***	-0.008***

		(0.001)	(0.001)
Gender		-0.030	-0.005
		(0.020)	(0.017)
Education		0.090***	0.043***
		(0.009)	(0.008)
Marriage		0.340***	0.122***
		(0.030)	(0.027)
Health		0.023***	0.043***
		(0.008)	(0.007)
Income			0.242***
			(0.011)
F_size			0.089***
			(0.005)
Socialize			0.155***
			(0.009)
Agricultural_if			-0.231***
			(0.021)
Land			0.000**
			(0.000)
Constant	10.655***	10.310***	6.507***
	(0.119)	(0.127)	(0.161)
Control variable	YES	YES	YES
Province	YES	YES	YES
Year	7656	7656	7656
R ²	0.211	0.268	0.434

Note: standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Subsequent tables follow the same notation.

4.2 Endogeneity Treatment and Robustness Test

4.2.1 Endogeneity Treatment

To address the issue of endogeneity, this study employs instrumental variables for processing and verification to ensure the robustness of the results. According to the criteria for selecting instrumental variables, the study chooses rural residents' perceptions of government integrity and the wealth gap as instrumental variables for the following reasons: First, they meet the relevance criterion, as rural residents' perceptions of government integrity and the wealth gap may directly influence their confidence in social security. Second, they meet the exclusion criterion, as consumption expenditure is directly tied to income, but rural residents' perceptions of government integrity and the wealth gap do not directly affect their consumption expenditure. Column (1) of Table 3 reports the results after

addressing endogeneity. First, the instrumental variables passed various tests, including relevance, weak instruments, over-identification, and endogeneity tests, indicating that the choice of instrumental variables is appropriate. Second, even after using instrumental variables to address endogeneity, the coefficient of social security confidence on consumption expenditure remains significantly negative at the 1% level, demonstrating the robustness of the baseline regression results.

4.2.2 Robustness Test

To ensure the robustness of the results, the study further verified the findings by excluding samples of rural household registrations but residing in urban areas, excluding samples from municipalities, and using the OLS model. Column (2) of Table 3 shows the regression results after excluding the sample of rural household registrations but residing in urban areas. The coefficient for social security confidence is -0.015 and is significant at the 10% level, indicating that even after removing these relatively special samples, the results remain stable, confirming that insufficient social security confidence reduces the consumption expenditure of rural residents. Columns (3) and (4) of Table 3 report the regression results after excluding samples from municipalities and using the OLS model, both of which remain significantly negative at the 1% level. In summary, Hypothesis 1 is supported, and the results are robust.

Table 3 Results of Endogeneity Treatment and Robustness Test

	(1)	(2)	(3)	(4)
	Consumption	Consumption	Consumption	Consumption
Confidence	-0.053*** (0.009)	-0.015* (0.008)	-0.027*** (0.006)	-0.030*** (0.006)
Perception of Government Integrity (IV1)	0.235*** (0.005)			
Perception of the Wealth Gap (IV2)	0.262*** (0.005)			
Underidentification test (LM statistic)	3325.009 [0.000]			
Weak identification test (F statistic)	2921.961 {19.93}			
Sargan statistic	0.174 [0.676]			

Endogeneity test	10.928			
	[0.000]			
Constant	6.479***	6.796***	5.696***	6.417***
	(0.159)	(0.254)	(0.705)	(0.158)
Control variable	YES	YES	YES	YES
Province	YES	YES	YES	YES
Year	YES	YES	YES	YES
N	7656	4456	7319	7656
R ²	0.406	0.408	0.431	0.407

Note: p-values are provided in square brackets; Stock-Yogo critical values at the 10% statistical level are presented in curly braces.

4.3 Heterogeneity Analysis

4.3.1 Heterogeneity in Consumption Structure

To further examine the impact of insufficient social security confidence on the consumption structure of rural residents, this study divides rural consumption into survival consumption, developmental consumption, and discretionary consumption for regression analysis. Table 4 reports the regression results. As shown in columns (2) and (3) of Table 4, for every 1-point decrease in social security confidence, expenditures on developmental consumption and discretionary consumption decrease by 0.052 million yuan and 0.037 million yuan, respectively, which is much higher than the reduction of 0.019 million yuan in survival consumption. Thus, we can conclude that when rural residents' confidence in social security decreases, they will primarily reduce expenditures on developmental and discretionary consumption. In other words, insufficient social security confidence hinders the upgrading of rural consumption structure, making it difficult to improve rural residents' quality of life and promote healthy economic development. Therefore, Hypothesis 2 is supported.

Table 4 Analysis results of the heterogeneity in consumption structure

	(1)	(2)	(3)
	S_Consumption	D_Consumption	E_Consumption
Confidence	-0.019***	-0.052***	-0.037***
	(0.006)	(0.010)	(0.014)
Constant	6.471***	4.941***	0.253
	(0.161)	(0.270)	(0.346)
Control variable	YES	YES	YES
Province	YES	YES	YES
Year	YES	YES	YES

N	7656	7656	7656
R ²	0.416	0.203	0.481

4.3.2 Discussion on the Heterogeneity of Rural Residents' Individual Characteristics

To enhance the depth and breadth of the study and make policy recommendations more closely aligned with actual needs, we incorporated the heterogeneity of work categories, gender, education level, and residential areas into the research framework. This provides more detailed empirical evidence for policymakers.

(1) Heterogeneity in Occupational Categories

Columns (1) and (2) of Table 5 report the regression results for occupational heterogeneity. Rural residents engaged in non-agricultural work reduce their consumption more significantly than those engaged in agricultural work when their confidence in social security declines. This could be due to two factors. First, rural residents engaged in non-agricultural work may live in more urbanized areas and face higher living costs. This means that when social security confidence declines, they need more funds as a safety net to cope with unexpected financial needs. Second, rural residents engaged in non-agricultural work frequently move between urban and rural areas and are more aware of the social security gap between urban and rural regions. They have higher expectations for rural social security and are more sensitive to changes in it. As a result, when social security confidence is insufficient or declines, the reduction in consumption is more pronounced among those in non-agricultural work.

(2) Heterogeneity in Gender

Columns (3) and (4) of Table 5 report the regression results for gender heterogeneity. When social security confidence declines, male residents reduce their consumption more significantly. The possible reason for this is that in Chinese culture and society, men often bear greater financial responsibilities, such as being the primary breadwinner or economic pillar of the family. Therefore, when social security confidence decreases and they perceive a threat to future economic security, men are more likely to reduce consumption and increase savings to ensure they can cope with potential economic difficulties.

(3) Heterogeneity in Education Level

We categorized rural residents with a high school education or lower as the group with relatively lower education levels, and those with higher than high school education as the group with relatively

higher education levels. Columns (5) and (6) of Table 5 report the results of the heterogeneity analysis based on education level. When social security confidence declines, rural residents with higher education levels react more strongly, with a larger reduction in consumption expenditure. This could be because higher-educated rural residents may have lived in large cities with much higher levels of economic development and more comprehensive social security systems for three to four years or more. When confronted with rural social security issues, they may compare rural and urban social security systems and adopt a more pessimistic attitude, leading to increased precautionary savings and reduced consumption expenditure.

(4) Heterogeneity in Residential Areas

Columns (6) and (7) of Table 5 present the results of the heterogeneity analysis based on residential areas. Rural residents living in urban areas reduce their consumption significantly more than those living in rural areas when social security confidence is undermined. This may be due to the fact that, despite living in cities, rural residents face issues such as unequal pay for the same work, making their income lower than that of urban residents and creating substantial financial pressure. This disparity likely fosters a strong sense of frustration. Additionally, while rural residents may live in urban areas, they may not enjoy urban social security benefits due to household registration restrictions. As a result, to cope with potential economic risks, they increase precautionary savings, leading to further reductions in consumption expenditure.

Table 5 Heterogeneous outcome

	(1)	(2)	(3)	(4)
	Job category		Gender	
	Agriculture	Non-agricultural	Male	female
Confidence	-0.013 (0.008)	-0.046*** (0.009)	-0.037*** (0.009)	-0.017* (0.009)
Constant	6.475*** (0.387)	6.183*** (0.218)	6.392*** (0.216)	6.659*** (0.244)
N	4542	3114	4149	3507
R ²	0.393	0.427	0.457	0.409

	(5)	(6)	(7)	(8)
	Educational level		Residential area	
	High	Low	Village	City
Confidence	-0.025*** (0.007)	-0.062*** (0.022)	-0.015* (0.008)	-0.043*** (0.009)

	6.514*** (0.178)	6.289*** (0.548)	6.796*** (0.254)	6.218*** (0.223)
N	6993	663	4456	3200
R ²	0.422	0.392	0.403	0.435
Control variable	YES	YES	YES	YES
Province	YES	YES	YES	YES
Year	YES	YES	YES	YES

5 Research Conclusions and Policy Recommendations

5.1 Research Conclusions

We have observed a significant consumption expenditure gap between urban and rural residents, and we also note the negative impact of an inadequate rural social security system on residents' confidence in consumption. To explore whether insufficient social security confidence among rural residents is one of the factors contributing to the consumption expenditure gap between urban and rural areas in China, we utilized the rich data resources from the China Family Panel Studies (CFPS) and conducted an empirical analysis focusing on the dimension of rural residents' social security confidence. The research conclusions are as follows:

1. Insufficient social security confidence among rural residents directly leads to a reduction in their consumption expenditure.
2. The analysis of heterogeneity in consumption structure reveals that insufficient social security confidence significantly hinders the optimization and upgrading of the consumption structure of rural residents. Specifically, reductions in developmental and discretionary consumption expenditures are much greater than in survival consumption.
3. Rural residents with characteristics such as engaging in non-agricultural work, being male, having higher education levels, and living in urban areas exhibit stronger precautionary saving motives when their confidence in social security is insufficient, which in turn limits their consumption expenditure.

5.2 Policy Recommendations

Based on the research conclusions and the practical issues in China, this paper offers the following policy recommendations:

1. The government should improve the rural social security system to enhance rural residents'

confidence in social security. This includes establishing and refining a comprehensive social security system covering pension insurance, medical insurance, and other key areas, while raising the level of protection to alleviate rural residents' concerns about future uncertainties. Additionally, the government should increase policy publicity efforts, using multiple channels and formats to enhance rural residents' awareness and trust in policies, thereby boosting their confidence in consumption.

2. The government should provide employment security and skill training opportunities for rural residents engaged in non-agricultural work to mitigate the reduction in consumption caused by declining social security confidence. Additionally, through education and outreach, the government should guide rural residents to properly understand and assume economic responsibilities, encouraging them to reasonably plan their household income and expenditures. For rural residents with higher education levels, the government should strengthen communication and coordination between urban and rural social security policies to reduce the negative effects of the urban-rural gap, while offering more career development opportunities and entrepreneurial support. For rural residents who have migrated to urban areas but are not yet enjoying urban social security benefits, the government should accelerate the pace of household registration reform to ensure they receive equal social security benefits and services as urban residents.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

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