Analysis of the Influence and Mechanism of the Sustainable Development Model Under The Background of the Big Data Model

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Abstract: This essay meticulously demonstrates the intricate relationship between the digital economy and business sustainability. By leveraging panel data from 280 A-share listed companies in urban areas from 2016 - 2020, a comprehensive analysis is conducted to explore the impact of the digital economy on enterprise sustainable development and its underlying mechanisms. The results reveal that the digital economy significantly bolsters business sustainability, with a more pronounced promotional effect in the eastern regions compared to the midwestern regions. Based on these findings, practical recommendations are put forward, such as establishing a performance evaluation team, cultivating a sustainable corporate culture, and expediting the construction of performance evaluation information.

Keywords: Digital Economy, Sustainable Development, Business Sustainability, Sustainable Corporate Culture

1. Introduction

China's 14 five - year strategy heralds a new paradigm of domestic and global dual cycles [1]. In this context, the digital economy, powered by new - generation information technology, has emerged as a crucial driver for meeting consumer demands and harmonizing local and global economic cycles [2]. In recent years, China has witnessed a remarkable upswing in its digital economy. Data from the "White Paper on the Advancement of China's Computerised Economy (2021)" indicates that China's digital economy accounted for 38.6% of the nation's GDP in 2021, a substantial increase from 14.2% in 2005 [3]. This growth underscores the digital economy's growing significance in China's economic landscape.

Sustainable development (SD), as defined by the United Nations, is a dynamic and multifaceted concept [4]. It encompasses economic prosperity, social well - being, and environmental protection, aiming to meet present needs without compromising the ability of future generations to meet their own. With the advent of the fourth industrial revolution, the digital economy has emerged, bringing both opportunities and challenges. On one hand, it offers potential for innovation, improved resource efficiency, and enhanced social inclusivity. On the other hand, it poses challenges such as data security, digital divide, and job displacement. The overarching objective of this study is to comprehensively understand the relationship between the urban digital economy and enterprise sustainable development. This involves investigating the impact of the digital economy on enterprise sustainable development and its spatial - temporal heterogeneity, analyzing the influencing factors, and formulating policy suggestions for relevant sectors.

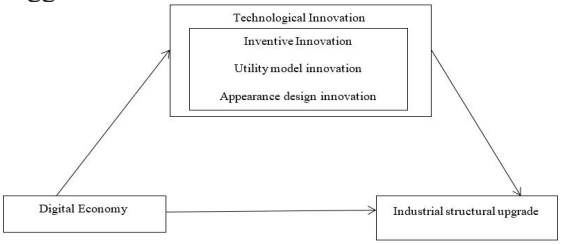

Figure 1. Theoretical Model

2. Literature Review

Previous research on the digital economy, entrepreneurship, sustainable development, and innovation has yet to be integrated into a unified analytical framework. This has led to a fragmented understanding of the complex relationships among these concepts.

2.1 The Connection Between the Digital Economy and Sustainable Enterprise Development

Some scholars have utilized models to explore the impact of the sharing economy on the achievement of sustainable development goals [5]. For example, they may construct three - dimensional indicator systems, which often include economic, social, and environmental dimensions. These systems are then adjusted according to specific research objectives, and available statistical data are used for quantification. However, the selection and weighting of indicators can be complex and subjective. Digital platforms are found to act as mediators in the relationship between the Internet of Things, sustainable digital development, and decision - making [6]. In a study involving 397 Pakistani samples, it was discovered that digital platforms play a crucial mediating role between the Internet of Things and the relationship between sustainable digital development and decision - making. This highlights the importance of digital platforms in facilitating the adoption of sustainable practices in the digital economy. Moreover, the sharing economy in different projects exhibits diverse sustainability implications [7]. Research on 121 online entertainment games revealed that certain projects, such as design, on - demand services, and logistics, are closely associated with sustainability, while some major platform stages do not address sustainability. This indicates that the sustainability of the sharing economy depends on the nature of the projects and the strategies adopted by the platforms.

2.2 The Relationship Between the Digital Economy and Regional Development, Business, and Sustainable Development

The digital economy demonstrates a positive non - linear correlation with total factor productivity (TFP) [8]. In an analysis of data from Chinese regions, it was found that the digital economy index has a positive non - linear relationship with TFP, promoting long - term TFP growth. This suggests that the digital economy can drive economic growth by improving the efficiency of production factors. Mobile payment has been shown to promote household entrepreneurship [9]. By using data from the 2017 China Household Finance Survey (CHFS) and applying two - stage least squares regression, it was determined that the use of mobile payment significantly increases the likelihood of household entrepreneurship. This indicates that digital financial services can lower the barriers to entry for entrepreneurship and stimulate economic activity at the household level. The digital economy also enhances the efficiency of the regional green economy, and the green economy can further improve its efficiency through technological innovation. Research on the digital economy index and the green economy efficiency index in 277 Chinese cities showed that the digital economy significantly improves the efficiency of the regional green economy, and the green economy can enhance its efficiency through technological innovation. This implies that the digital economy can contribute to environmental sustainability by promoting the development of green technologies and practices.

3. Proposed Method

3.1 Model

To explore the direct impact of the digital economy on the long - term sustainability of businesses, we employ the fixed - impact model for the observational test. The two - way fixed - effects model is formulated as follows:

$$ie_{it} = y_0 + y_1 digital_{it} + y_2 E_{it} + y_3 C_{it} + year_t + ind_t + \varepsilon_{it} \quad (1)$$

In this model, ie_{it} represents the regional expansion and enterprise activities of the i-th enterprise in $year_t$. y_0 is the intercept term, which captures the overall average effect not accounted for by other variables. y_1, y_2, and y_3 are the coefficients to be estimated. y_1 specifically measures the impact of the digital economy ($digital_{it}$) on the regional expansion and enterprise activities. $digital_{it}$ is the digital economy index for the city where the enterprise is located, which comprehensively reflects the level of digital development in that area. E_{it} and C_{it} represent other explanatory variables and control variables respectively. These variables are included to account for other factors that may influence the dependent variable. $year_t$ and ind_t are the year fixed effect and industry fixed effect, respectively. The year fixed effect controls for the impact of time - specific factors that affect all enterprises in the same year, such as macro - economic policies and technological trends. The industry fixed effect controls for the impact of industry - specific characteristics that are common to all enterprises within the same industry, such as market structure and regulatory environment. E_{it} is the random error term,

which captures the unobserved factors that affect the regional expansion and enterprise activities of the i -th enterprise in $year_t$. The fixed - effects model helps to reduce the bias caused by time - invariant factors and missing variables, providing a more accurate estimate of the relationship between the digital economy and enterprise sustainable development.

3.2 The Variables

Enterprise sustainable development (sde) is the variable under study, with TFP serving as an alternative measurement indicator. In this study, we define economic development from a technological and innovative perspective, considering the long - term development of enterprises. TFP is calculated using the following production function model:

$$Y_{it} = A_{it}L_{it}^{x}K_{it}^{y} \quad (2)$$

where Y is the output, L is the labor input, K is the capital input, and A is the total factor productivity. Taking the logarithm of this model gives::

$$y_{it} = xl_{it} + yk_{it} + \varepsilon_{it} \quad (3)$$

To address issues such as simultaneity bias and sample selection bias, we further transform the equation to::

$$InY_{it} = z_0 + z_1InL_{it} + z_2InM_{it} + z_3InK_{it} + \varepsilon_{it} (4)$$

where M represents intermediate input. This transformation allows us to use more accessible intermediate data inputs, effectively resolving the problem of missing samples.

The digital economy is the most crucial informational variable. The urban digital economy index for 280 cities is constructed using the principal component analysis method, taking into account two factors: Internet development and digital financial inclusion. Specific measurement data include the number of broadband Internet users in ten thousand, the Internet usage percentage, the number of employees in Internet - related fields, and the income from telecom services. These data are used to capture the different aspects of the digital economy, such as digital infrastructure, digital adoption, and digital financial services.

Regional expansion and enterprise exercises (ie) are part of the mechanism, measured by the prefecture - level regional entrepreneurial and innovative thinking index of the Longxin Statistics Study Centre of Peking University.

Table 1. Presents the Variable Definitions

Variable Types	Variable Symbol	Variable Name	Calculation
Explained Variable	sde	Sustainable growth	Explained in equation (3)
Principal Explanatory Factor	digital	Digital Economy Index for Cities	Calculated using the earlier model
System Variable	ie	Regional Entrepreneurship and Innovation Index	-
Control Variables	size	The size of the business	Ln (total personnel)
Control Variables	age	entrepreneur age	Ln (year of listing + current year)
Control Variables	roa	return on assets totals	Net profit as a percentage of total assets at the start and the end of the period
Control Variables	gov	Government grants	Ln (public assistance)
Control Variables	lev	monetary leverage	total assets minus entire liabilities
Control Variables	board	Ln (1 + board size)	-
Control Variables	ocon	ownership concentration	Ln (1 + the greatest shareholder's percentage of shares)
Control Variables	popu	Size of the urban population	Ln (total population of urban areas)
Control Variables	GDP	Urban economic development's scope	Ln (GDP)

3.3 Data Sources

The study utilizes data from 2016 - 2020. Marker data at the enterprise level are sourced from firms' annual reports, WIND, and CSMAR. Firms' annual reports provide detailed information about the financial performance, corporate governance, and strategic initiatives of each enterprise. WIND and CSMAR are well - known financial data platforms that offer a wide range of financial and market - related data, ensuring the comprehensiveness and reliability of the enterprise - level data. The source data for calculating the urban digital economy index are obtained from territorial statistical yearbooks. These yearbooks contain data on various economic and social indicators at the regional level, which are used to construct the digital

economy index. To conduct the endogeneity test, latitude and longitude data from the Google map database are used to calculate the actual distances between each city and Beijing. This information is used to address potential endogeneity issues related to the location of the cities.

After data processing, which includes deleting ST/PT enterprise data, data from prior to the IPO, data from the financial industry, and data that are outliers (issued and delisted by one percent), a total of 14,217 valid sample observations are obtained. All data processing is carried out using STATA17.0, and Arcgis10.7 programming is used to create relevant maps. The data processing steps are crucial for ensuring the quality and reliability of the data, as they help to eliminate noise and outliers that could affect the results of the analysis.

4. Results of Big Data Analysis.

4.1 Digital Economy Level

The digital economy in different regions exhibits distinct development trends from 2016 - 2020. The eastern region boasts a higher digital economy index. For example, in 2020, the digital economy index in the eastern region reached 9.7, while the national average was 9.1. The high index in the east can be attributed to several factors. The eastern region has a more developed digital infrastructure, with a higher density of broadband networks and more advanced communication technologies. It also has a more educated and tech - savvy workforce, which is conducive to the adoption and development of digital technologies. In contrast, the central and western regions lag behind. However, the western region's digital economy has been growing rapidly since 2016. This growth may be attributed to the implementation of the western development strategy and the Belt and Road Initiative. These initiatives have attracted significant investment in digital infrastructure in the western region. For instance, cities like Chongqing, Chengdu, and Guiyang have seen the construction of large - scale data centers and the development of digital industries. The Belt and Road Initiative has also opened up new markets for western - region enterprises, promoting the growth of the digital economy.

4.2 Performance Evaluation

Combining grey correlation and TOPSIS can more accurately assess program quality. Grey correlation analysis measures the degree of similarity between sequences, taking into account both the magnitude and the trend of the data. TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) determines the relative proximity of alternatives to the ideal solution. By integrating these two methods, we can better reflect the geometric and dynamic changes between data. In the context of evaluating the performance of enterprises in the digital economy, this combined approach can provide a more comprehensive and accurate assessment of their sustainability performance. It helps in identifying not only the best - performing enterprises but also those that have the potential for improvement.

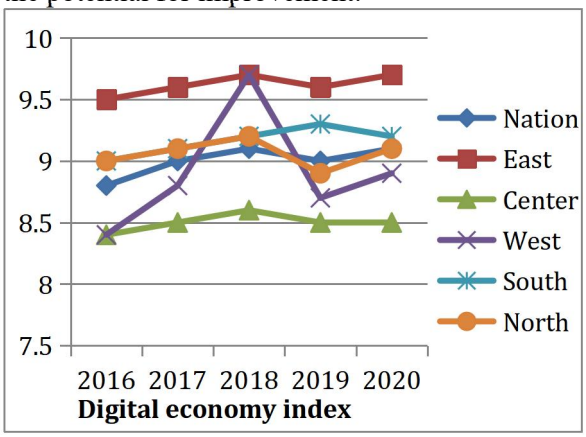

Figure 2. Regional Trends in the Level of the Digital Economy.

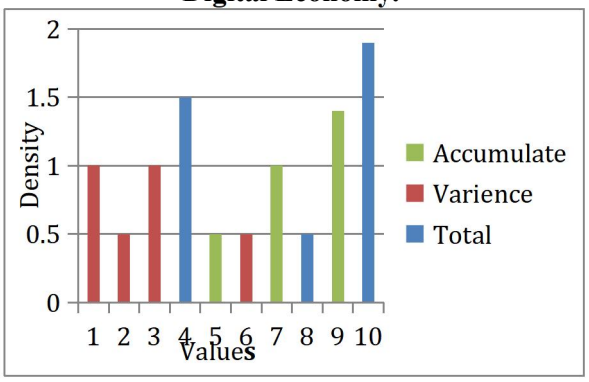

Figure 3. Total Variance Explained

Descriptive statistical analysis shows significant differences in the degree of sustainable development of firms. The standard deviation of SDE of enterprises is 1.025, with a maximum value of 12.423 and a minimum value of 4.565. This indicates a wide range of variation in the sustainable development performance of firms, suggesting that some firms are more successful in implementing sustainable practices than others. The "small mean and large standard

deviation" characteristics of the urban digital economy index indicate uneven development, while the "large mean and relatively small standard deviation" of the regional innovation and entrepreneurship index suggest relatively smaller regional variances. This implies that while there is significant variation in the development of the digital economy across cities, the level of regional innovation and entrepreneurship is more evenly distributed.

Table 2. Descriptive statistics

Variables	N	Mean	Standard Deviation	Minimum	Maximum
Sde	22,341	8.253	1.025	4.565	12.423
Digital	19,573	10.243	1.322	5.222	12.632
Ie	15,723	82.153	21.532	0.452	100
Size	22,451	7.532	1.251	1.789	13.642
Age	22,534	1.736	0.923	0	3.566
Lev	22,435	0.423	0.231	0.006	3.412
Roa	22,653	0.032	0.072	-1.426	0.752
Board	17,435	2.345	0.176	0	2.937
Ocon	22,143	3.524	0.452	0.531	4.345
Gov	21,353	16.632	1.834	5.231	23.153
GDP	19,624	8.453	1.103	4.211	10.353
Popu	19,462	6.432	0.634	2.943	8.224

4.3 Regression Analysis

Quantile regression, conducted every 5% from the 10 - 90% quantiles, shows that the digital economy's influence on the regression coefficient grows over time. For example, as the quantile of the digital economy's regression coefficient increases from 0.1 to 0.9, the coefficient value ranges from 0.2678 to 0.5929. This indicates that the impact of the digital economy on enterprise sustainable development becomes more significant as the quantile increases, suggesting that the digital economy has a stronger positive effect on firms with higher levels of sustainable development. Endogeneity tests, using the two - stage least squares method and logarithmic transformation of variables to address heteroscedasticity, rule out endogenous issues. The digital economy significantly promotes the sustainable growth of enterprises, especially in provinces with better resource endowments. These provinces often have more advanced digital infrastructure, a more educated workforce, and better - developed financial markets, which are conducive to the development of the digital economy and the sustainable growth of enterprises. The two - way fixed - effect regression results, with and without control variables, are consistent, indicating the reliability of the benchmark regression findings. This provides strong evidence for the positive relationship between the digital economy and enterprise sustainable development.

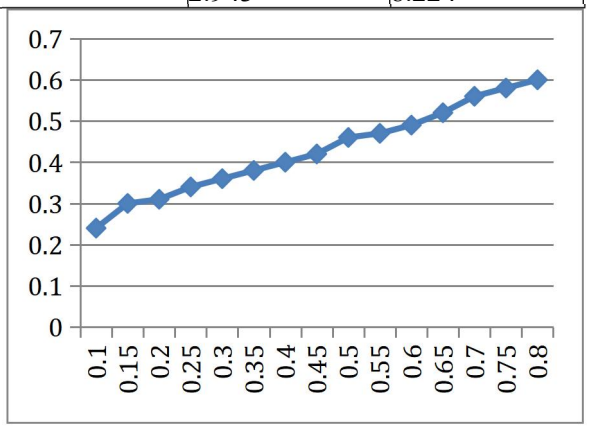

Fig4. The Digital Economy's Regression Coefficient Graphic at Each

5. Conclusion

This study constructs a fixed - impact model based on panel data to explore the effect of the digital economy on the sustainable growth of enterprises. The main findings are as follows: The digital economy shows a "decreasing from east to west and from south to north" distribution in core developed cities. It directly and significantly contributes to the sustainable growth of enterprises, and the mechanism lies in the fact that the local digital economy can foster entrepreneurship and innovation. There is geographical variance in its impact on enterprise sustainable growth, with eastern developed areas being more conducive to enterprise sustainable growth.

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