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Article

Does E-Commerce Provide a Sustained Competitive Advantage? An Investigation of Survival and Sustainability in Growth-Oriented Enterprises

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Abstract: Enterprises should find a new business model for their development, so as to make better use of their own advantages. At the same time, with rapid development of the economy and of science technology, the competition between small and medium-sized enterprises (SMEs) and large enterprises is inevitable, so it is very important for small and medium-sized enterprises to find better ways to improve their ability to compete. E-commerce is a new medium of commerce in this 21st century, so as to promote the quantity development of SMEs and enhance the risk management ability of enterprises. However, at present, many of China's small and medium enterprises face many challenges in the process of electronic commerce's development, such as, which factors hinder the performance of electronic commerce, and what aspect of enterprises should be improved? This paper is based on the above problems, using theoretical analysis and empirical research methods to explore the root of these problems and find the solutions. In the empirical section, we explore how e-commerce influences sales growth in the short- and long-term. Through analysis of e-commerce performance, we further explore the causality relationship and influence degree. The results show that: first, IT Investment is the most important factor to achieve success, what competitive advantage can be achieved largely depends on whether enterprises will effectively use the network technology; second, the expansion of the enterprise size can promote transaction volume increase of SMEs in the short term; third, internet availability

has a positive effect on the trade volume of e-commerce, but the intensity is not obvious, and the effect is relatively stable.

Keywords: e-commerce; competitive advantage; SMEs; sustainability; business value; causality test; China

1. Introduction

With the process of economic globalization and information technology development, electronic commerce as a new business model has an effect on people's lives more and more. The emergence of electronic commerce changes the previous business model, not only expanding the marketing channels for enterprises and reducing the operation cost of enterprise; more important is the mode of electronic business affairs to strengthen the coordination between the upstream and downstream enterprises in the supply chain, and promote cooperation between enterprises [1].Compared with the traditional business model, e-commerce has the strength as streamline distribution, lower cost, no time restriction and other advantages, at the same time, electronic commerce also has the advantages of less investment, easy to learn, flexible operation, *etc*. [2,3]. These characteristics fully meet the development model of small and medium-sized enterprises (SMEs); therefore, SMEs can improve their business performance effectively by using electronic commerce. According to the "China SME e-commerce development report", the data show that the income has increased significantly in the SMEs that engage in e-commerce. Commerce development of small and medium-sized enterprises operating income has increased significantly, the growth of the business income in SMEs that engage in e-commerce is nearly 1.35 times that of similar enterprises that do not engage in e-commerce.

However, there still exist many problems in the process of e-commerce development among the majority of SMEs in China [4]. First of all, some small and medium-sized enterprises are not fully aware of the importance of e-commerce on enterprise development, whether to development the e-commerce is still in wait-and-see stage [5].Secondly, most enterprises lack a standard and method to evaluate the performance of e-commerce, which means that these enterprises cannot make a reasonable analysis of electronic commerce development [6]. At the same time, small and medium-sized enterprises tend to ignore the process of enterprise information construction, personnel training and management innovation in the development of electronic commerce [7,8]. Most SMEs just rely on the disposable website construction by the Network Company, and do not make real use of e-commerce business processes for enterprise informatization. In addition, they do not strengthen the collaboration in the supply chain of this informatization process, so it is difficult to enhance the enterprise operation efficiency through the electronic commerce [9–11].

According to the above problem in the process of developing electronic commerce, this paper tries to analyze e-commerce application in SMEs and find out the main factors affecting the performance of enterprise electronic commerce.

Since the 1980s, many scholars began to study e-commerce on marketing activities of small and medium-sized enterprises. Most scholars believe that with the development of Internet technology, the performance of e-commerce applications in small and medium-sized enterprises has a significant

promotion effect; in addition, some scholars also found some problems in the implementation of e-commerce enterprises, and put forward the path and strategy of enterprises to optimize the mode of electronic commerce [12,13]. Kim [14] researched the impact of information technology on firm productivity, and confirmed the technology really can offer benefits. Michael and Victor [15] explored the impact of information technology on the competitive environment, and how to use internet technology to improve the competitive advantage of enterprises. They pointed out that the formation of information technology to promote the competitive advantage of the specific way mainly includes three aspects: first, the development of information technology has changed the industrial structure; second, the implementation and application of Internet technology to support the enterprise low cost and differentiation strategy; third, it promote the enterprises to develop new business, and bring more business opportunities for the enterprise. David and Lorna [16] analyzed more than 40 SMEs from Canada, China, Japan and Mexico which develop the electronic commerce in the international market. The result shows that electronic commerce can reduce product and service cost in a unique way, and combine the information and capital at the same time, then enhance enterprise competitive advantage. Henrique and Luis [17] pointed out that Internet technology has made great contributions to society. At the same time, it also completely changed the traditional ways of marketing and business. In the fierce global competition environment, small and medium-sized enterprises also have to face the open competition environment—commerce is an effective way to cultivate the competitiveness of small and medium-sized enterprises, while small and medium enterprises also need to meet the new demand from customer and business partners. Kim [18] researched the internationalization of electronic commerce, and find out that the internet can shorten the social and cultural distance. Seung [19] pointed out the business value that e-commerce provides depends on the use of the business network. The basic mode of e-commerce refers to the enterprise to use the electronic network only for carrying out simple data exchange activities. In contrast, cooperation mode of e-commerce can build channel cooperation between enterprises. Therefore, the improvement of e-commerce performance is not from the e-commerce technology itself, but from inter-enterprise cooperation.

Zhuang and Albert [20] studied the influence of human resources, business resources and technology resources on the performance of enterprises by using the resource management theory. The results proved that electronic commerce technology resources have a significant impact on enterprise performance. However, the technology investment should match the scale of the enterprise; an excessive technology investment will not have a significant effect on the performance of enterprises. Katia and Ayman [21] discuss the impact of electronic commerce on SMES from the diversity business perspective. In the broadband economy, small and medium-sized enterprises interact and communicate with the customer through the network platform. A good electronic commerce platform and application technology is the key to the implementation of e-commerce in small and medium sized enterprises. However, enterprises often ignore maintenance of the website and related technology, because of funding and scale limits. Therefore, the enterprise need to continuously improve the technology and IT services, in order to meet the needs of customers and partners. Numerous studies have demonstrated that technology is an effective way to improve e-commerce performance, so that, information technology is the most important factor to e-commerce application, and will have positive effects one-commerce performance.

There are also some researches about how to improve the operation efficiency through the electronic commerce information system, such as Ramanathana [22]; Ashworth [23] and Yao, [24]. Delone [25] studied

how enterprise resources will impact e-business performance; the results proved that e-commerce technology resources can have a significant impact on firm performance. However, the technology resources must match the scale of the enterprises. Therefore, the impact of enterprise size to e-commerce performance is uncertain. At the same time, many Chinese scholars made research about the impact of electronic commerce application on enterprise performance. Shao and Cai [26] made empirical research on e-commerce performance of listings of corporations in China; results show that e-commerce application has a positive effect on income increase. It is undeniable that the development of e-commerce will increase the operating costs of enterprises, but, because of the increase of operation efficiency is more obvious, the enterprise obtains in the revenue exceeded the cost. Wu and Yang [27] investigate the pathway between electronic commerce application and firm performance; results showed that the application of e-commerce can help enterprises to improve the coordination ability. To evaluate the performance of e-commerce, Zhang and Deng [28] pointed out that as a new business model under the background of informatization, the electronic commerce puts forward the new challenge to the enterprise management, so that the enterprise should constructing new evaluation index for electric business. Fei [29] divided the e-commerce performance into four parts by using AHP method, namely the business section, customer section, financial section and enterprise development section. Through empirical analysis, results show that the main index is still the profitability, at the same time, "customer satisfaction", "growth rate" and "information processing" is also the important factor to evaluate the business performance.

To sum up, most scholars agree that the electronic commerce will have positive impact on enterprise performance, and made sufficient research about how the electronic commerce influence the business performance. However, scholars have not carried out the related research about a comprehensive evaluation for different indicators of electronic commerce, such as how to implement e-commerce successfully, how to achieve the desired effect, *etc*. Which factors hinder the performance of electronic commerce, and what aspect of enterprises should be improved? In view of this, this paper attempts to construct an e-commerce evaluation index as "Organizational factors", "Technical factors" and "Environmental factors", then makes a comprehensive evaluation of e-commerce performance in SMEs.

2. Data and Methodology

2.1. Data Sources and the Variable Description

In this paper, the variables involved are "e-commerce sales volume", "Technical factors", "Organizational factors" and "Environmental factors". E-commerce sales volume is the dependent variable and organizational factors, technical factors, environmental factors are three independent variables that will influence the dependent variable. The variable definitions are shown in Table 1; we also made the expected sign of all the variables according to previous research. In these variables, e-commerce sales volume refers to the quantity of product that has been actually sold in a certain period of time. There are many methods to analyze e-commerce performance, but we choose e-commerce sales volume as the variable in this paper according to the research contents. Therefore, we measure the volume of e-commerce transactions in Beijing City, and consider it as the evaluation criteria of the electronic commerce performance in SMEs.

Table 1. Variable definitions.

Categories	Variables	Definition	Abbreviation	Expected Signs
E-commerce	E-commerce sales volume	the quantity of product that has been actually sold in a certain period of time	SV	
Technical factors	IT investment	the level of information technology in enterprises	TEC	++
Organizational factors	Enterprise size	the scale of the enterprise	ORG	+ or −
Environmental factors	Internet availability	the external market environment and the network facilities	ENV	+

"++" means strong positive effect; "+" means general positive effect; "−" means negative effect.

The first independent variable is technical factors; the technical factor refers to the informatization investment accounted for the proportion of total investment. Numerous studies have shown that the technical level is the most important factor to the construction of enterprise informatization. Therefore, by using the definition of informatization investment in the China information Yearbook, the formula of technical factor as TEC = informatization investment/total investment. The second independent variable is organizational factors, organizational factors mainly analyze whether the scale of the enterprise will beneficial to the development of enterprise e-commerce activities. In general, large enterprises have more resources to promote the realization of electronic commerce. Therefore, the scale of enterprise is also an important factor in the e-commerce application, the formula of technical factors as ORG = the number of medium-sized enterprises/the total number of SMEs. The third independent variable is environmental factors; the uncertainty of the environment is also a key factor that affects the diffusion of innovation. Environmental factors refer to the external market environment and the network facilities, the formula of environmental factors as ENV = the number of Internet access/the number of households. In addition, we made the expected sign of all the variables, we expect that technical factors will have obvious influence on thee-commerce sales volume, and environmental factors will also have a positive influence on thee-commerce sales volume, but the impact strength is weaker than the technical factors. However, the organizational factors will have positive or negative impacts one-commerce sales. Because SMEs have certain characteristics in China, the influence of organizational factors on e-commerce still needs be researched. All the data is collected from the China statistic year book [30], the 2013 market report of China e-business [31] and Beijing statistical information network [32], in the period from 2000 to 2013. In order to avoid the effect of heteroskedasticity, we made Log processing for all data, note as LnSV, LnTEC, LnORG, LnENV.

Through the collection of data, we made an analysis of the basic statistics of variables; the result is shown in Table 2. The time range of data is quarterly data from 2000 to 2013, we select 366 SMEs in Beijing as samples, including 80 medium-sized enterprises (21.85%), 212 small-sized enterprises (57.92%) and 74 micro-sized enterprises (20.21%).Among them, there are 64 manufacturing companies, 127 wholesale and retail companies, 32 transport companies, 29 accommodation and catering companies, 25 software companies, 16 Financial Services Company and 73 other service companies. From Table 2, we can find that the mean of e-commerce sales volume is 2307.8 (unit is 100 million RMB), the minimum and maximum values are 197 and 6700, which shows that the e-commerce sales volume increased very fast in Beijing. It was only 19.7 billion at the beginning of year 2000 and increased nearly 30 times in

the past 13 years. Further, we can get that this growth is stable and sustained. The mean of technical factors is 0.0411, the minimum and maximum values are 0.0044 and 0.0317, it shows that the technology investment accounted for a little proportion of the total investment, and enterprise is gradually pay attention to the technology investment in recent years. At the same time, the mean of organizational factors is 0.6543 and the minimum and maximum values are 0.5902 and 0.7696; it shows that the proportion of medium-sized enterprises is relatively stable. The mean of environmental factors is 0.3185 and the minimum and maximum values are 0.0165 and 0.8892, it shows that the network infrastructure has been developed rapidly in China; the network coverage rate reached more than 80% in 2013.

Table 2. Descriptive statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
E-commerce sales volume	366	2307.857	2155.797	197	6700
Technical factors	366	0.0411564	0.0807953	0.0044	0.03174
Organizational factors	366	0.6543957	0.0497154	0.5902	0.76962
Environmental factors	366	0.3185501	0.2929789	0.0165	0.88926

2.2. Methodology

The organizational environment refers to the internal and external factors that influence enterprise performance, including the effects of organizational factors, technical factors and environmental factors. Founded on the summary of the related innovation theory, Tornatzky [33] first put forward the TOE (Technology-Organization-Environment) model. The framework of TOE is a theoretical model based on the organizational level; the model tries to explain three different factors that influence enterprise decision making, these three kinds of elements are: technology, organization and environment.

The TOE model of e-commerce performance mainly studies three kinds of value chain of e-commerce. According to the feedback of e-commerce application in SMEs, e-commerce can help enterprises to improve their response to market changes, and help the enterprises to expand sales channels and maintain customer relationship. In the enterprise, electronic commerce can improve their production and business operation efficiency when the presence of other complementary resources is adequate. At the same time, the application of e-commerce can make up for deficiencies in the traditional business model as the communication and exchanges, enterprises can also improve the cooperation between other enterprises and reduce transaction cost through this way.

In the model, technical factors are the most important section of electronic commerce value, the value of e-commerce to be achieved largely depends on whether the enterprise effectively uses the network technology, and whether the enterprise is combined with network technology and business process. In the technical section, mainly consider three factors as which technology they use, the network client function, interaction between enterprise foreground and background. Technical preparation is the key value of electronic commerce, the network technology is more important in the market today, as providing consumers with fast, personalized products and services is a basic requirement for the survival and development of enterprises. In the part of the organization, mainly consider three factors: the enterprise scale, the scope of business and financial resources. The influence of enterprise scale in the innovation mechanism has been widely discussed. In general, large enterprises have more resources to promote the realization of electronic commerce. However, large enterprises do not have the same

operation flexibility as SMEs; large enterprises tend to be more limited in the process of the development of electronic commerce and technology innovation due to the problems of scale and cost. The environmental factors include the competition intensity and uncertainty. Competition intensity refers to the influence degree of the enterprise that influenced by other competitors in the market. Through the application of IT technology, the enterprise may change the market competition rules and then influence the industrial structure. According to the TOE model, the uncertainty of the environment is mainly the key factor that affects the diffusion of innovation. Because of the differences between e-business and the traditional business model, the enterprise has more uncertainty for the e-commerce information security, transaction risk and policy support, this will also hinder the diffusion of information in enterprises.

2.3. The Current Situation of SMEs' E-Commerce

According to the China Electronic Commerce Research Center data [34] show that in 2013, China's e-commerce transaction volume has exceeded 10 trillion, RMB, an increase of 24.5% over last year compared with the same period. At the same time, in 2013, China's Internet users reached 600 million, and the Internet penetration rate exceeded 44%. According to the statistical data [34], it shows that China's online shopping market is relatively mature, the volume of online shopping and e-commerce transactions are in a rapid growth phase, so that the e-commerce market has good prospects for development.

Because of China's economic development has regional differences, thee-commerce industry appears in an obvious geographical spatial pattern. According to the statistic report [31], e-commerce developed fast in the eastern coast and cities as Beijing, Shanghai, Chongqing and Hangzhou in China. Beijing is the capital in China, where the 2013 annual e-commerce transaction volume exceeded 650 billion, ranking second. At the same time, Beijing has many e-commerce enterprises and most headquarters of the Network Company were located here. Residents were familiar with the use of e-commerce. According to the statistical data from the Beijing municipal commission of commerce (BJCOC) [35], the trade volume of e-commerce in 2013 has exceeded 650 billion RMB, an increase of 20% over last year. We summarized the e-commerce transaction data during 2008–2013 in Beijing, as shown in Figure 1. In Figure 1, the primary Y-axis (left side) indicates the volume of e-commerce transactions, the unit is one hundred million RMB; secondary Y-axis (right side) indicates the growth rate, the unit is percentage. In Figure 1a, it shows that the e-commerce transaction in 2008 is only 215 billion, and e-commerce transactions growing rapidly and reached 650 billion in 2013.At the same time, the Beijing City electronic commerce transaction growth rate has decreased since 2010, but remained at around 20%.Therefore, the Beijing e-commerce market has great potential, e-commerce has become an important method of daily consumption. In addition, by comparing the trend of online and offline transaction scales during 2008–2012, the result was shown in Figure 1b. In Figure 1b, it can be seen that online e-commerce transactions accounted for 10% of the overall transaction volume. In addition, this proportion has a significant growth trend, so that electronic commerce has become an important part in the business process. At the same time, the e-commerce transaction volume only calculates the number of online sales, but ignores the function of electronic platform promotion. This part belongs to offline transaction, but electronic commerce has played a crucial role in these transactions. Therefore, it means that e-commerce has become an important instrument to enterprises' daily sales management; it can promote technology innovation and improve efficiency.

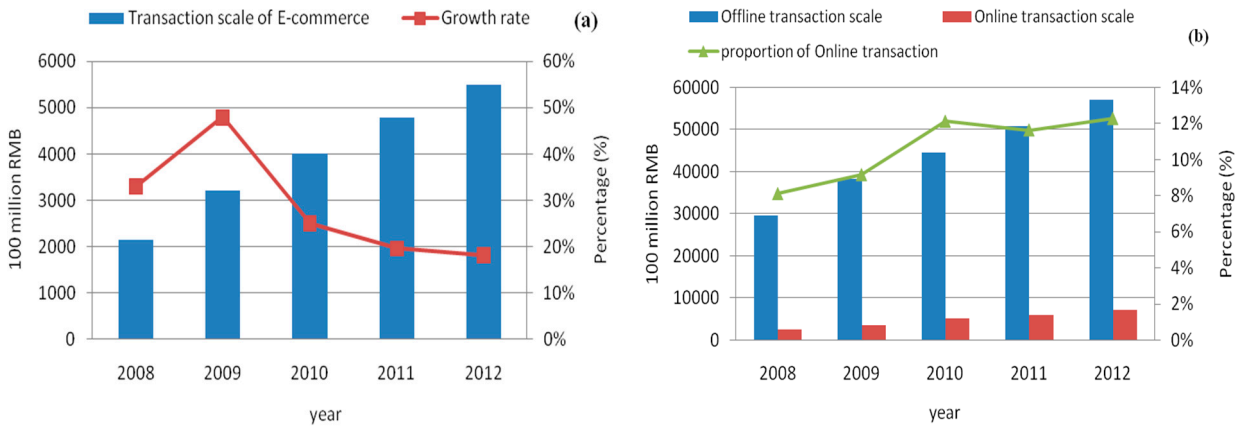

Figure 1. (**a**) E-commerce transactions and growth rate in Beijing during 2008–2012; (**b**) Offline and Online transaction scale in Beijing during 2008–2012.

With the continuous development of China's marketization process, vigorously developing small and medium-sized enterprises has become a necessary part of the process of social development in China, and has received the support of the government. At the same time, because SMEs have the characteristic of flexibility, it is easy to carry out technical innovation and to be stronger in terms of high-tech industry development potential. With the rapid development of information technology and e-commerce, how to use information technology to improve the competitiveness and operational efficiency in SMEs will become particularly important for SMEs' future development. According to the "China SMEs Yearbook" [36] and "Beijing statistical information network statistics" [32], the numbers of small and medium enterprises in Beijing city breakthrough 38,000 in 2013, the income amounted to 4.4 trillion RMB and create a profit of 549.1billion RMB. At the same time, the small and medium-sized enterprises provide174.3 billion RMB tax for the government every year, and provide 3.01million jobs. According to the classification standard of SMEs from national bureau of statistics in China [37], we make the statistic analysis of SMEs at about three different scales: micro-sized, small-sized and medium-sized, the results as shown in Figure 2a. In Figure 2a, we can get that the total income of SMEs in Beijing amounted to 5 trillion in 2013, and the amount of profit achieved 0.76 trillion. Among them, medium-sized enterprises' income reached 3.3 trillion RMB, profit 0.51 trillion RMB, the profit rate is 15.68%; small-sized business income 1.3 trillion RMB, profit 0.11 trillion RMB, profit rate is 8.2%; micro-sized enterprise income 0.42 trillion RMB, profit 0.13 trillion RMB, profit rate is 31.76%.It shows that the profit rate in SMEs is higher, and has potential for future development. Therefore, using e-commerce to maintain high-speed development is important for SMEs, e-commerce can help small and medium enterprises expand their sales channel, and also help enterprises to construct the information system, then improve the business efficiency in enterprises. Through the analysis of industry distribution in small and medium-sized enterprise, the result was shown in Figure 2b. In Figure 2b, we can get that the number of wholesale and retail enterprises is the most; the total number is 7771 and accounted for 26% of SMEs. Other major industries are the real estate industry, leasing industry, construction industry, service industry and the financial industry. The electronic commerce has internal effect and external effect for the small and medium enterprises. For its internal, the application of e-commerce can help improve the operation efficiency, constructing a comprehensive management information system for enterprises. For external, e-commerce can broaden the sales channels and reduce intermediate links, also improve product sales.

Therefore, the development of e-commerce in SMEs is a necessary means to face the competition; also it is an important way to increase the profit and operation efficiency.

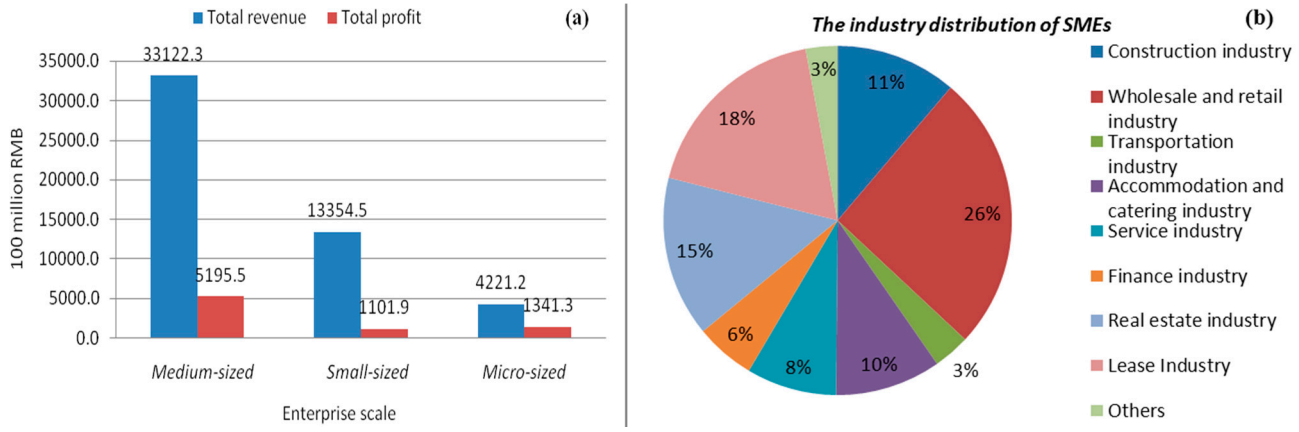

Figure 2. (**a**) The scale and profitability analysis of SMEs; (**b**) The industry distribution analysis of SMEs.

3. Results and Discussion

3.1. ADF Unit Root Test

In statistics and econometrics, an augmented Dickey–Fuller test (ADF) is a test for a unit root in a time series sample. By using augmented Dickey-Fuller unit root tests, the result is shown in Table 3. Through the test results in Table 3, it shows that the test statistic of LnSV is −2.043, and not satisfied the conditions of 5% critical value, so LnSV is unstable in the condition of 5% critical value. In addition, the test statistic of LnORG, LnTEC, LnENV are −2.335, −1.334, −2.240, so all the data are non-stationary at 5% critical value. Then we made differential calculation to all the data and find d.LnSV, d.LnORG, d.LnTEC and d.LnENV are stable at a 5% critical value, so that the VAR model can be used to analyze the data.

Table 3. Result of augmented Dickey-Fuller teat.

Variables	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	Result
LnSV	−2.043	−3.750	−3.000	−2.630	unstable
LnORG	−2.335	−3.750	−3.000	−2.630	unstable
LnTEC	−1.334	−3.750	−3.000	−2.630	unstable
LnENV	−2.240	−3.750	−3.000	−2.630	unstable
D.LnSV	−3.952	−3.750	−3.000	−2.630	stable
D.LnORG	−3.867	−3.750	−3.000	−2.630	stable
D.LnTEC	−3.751	−3.750	−3.000	−2.630	stable
D.LnENV	−4.868	−3.750	−3.000	−2.630	stable

LnSV = log(e-commerce sales volume); LnTEC = log(informatization investment/total investment); LnORG = log(the number of medium-sized enterprises/the total number of SMEs); LnENV = log(the number of internet access/the number of households).

3.2. VAR Model

According to the analysis above, we try to use VAR regression model to test the impact of technical factors, organizational factors and environmental factors to the e-commerce sales volume. First, we make the empirical analysis of LnSV and LnTEC. Before constructing the VAR model, the lag of VAR Model should be determined. By using STATA software to calculate the lag length, the result shows that the optimal lag length is at lag 2. By choosing lag 2, then the VAR model for LnTEC and LnSV can be shown as Formula (1). According to the result, it shows that the technical factors will promote the e-commerce sales volume. LnTEC at lag 1 period increased one percentage will lead LnSV increased by 1.051 percentage, and LnTEC at lag 2 period increased one percentage will lead LnSV increased by 0.608 percentage. Therefore, the effect of LnTEC to LnSV is obvious. On the other hand, we can get that technical factors has persistent effect on e-commerce performance, that means technical investment and innovation will impact on e-commerce sales volume in the long-term. Therefore, the financial effect is an important factor and will have positive effect to e-commerce performance.

$$LnSV = 0.953 + 1.051LnTEC + 0.608LnTEC + 2.193LnSV - 1.292LnSV \quad (1)$$

$$LnSV = -0.806 + 1.488LnORG - 1.287LnORG + 1.024LnSV - 0.914LnSV \quad (2)$$

$$LnSV = 1.021 + 0.218LnENV + 0.115LnENV + 1.117LnSV - 0.6LnSV \quad (3)$$

Then, we make the empirical analysis of LnORG and LnSV. In general, large enterprises have more resources to promote the realization of electronic commerce. However, large enterprises do not have the operation flexibility as SMEs, large enterprises tend to be more limited in the process the development of electronic commerce and technology innovation due to the problem as large scale and cost. By using STATA software to calculate, the VAR model for LnORG and LnSV can be shown as Formula (2). According to the result; it shows that LnORG at lag 1 period increased one percentage will lead LnSV increased by 1.488 percentage, and LnORG at lag 2 period increased one percentage will lead LnSV decreased by −1.287 percentage. The result shows that the organizational factors will have positive effect on e-commerce performance in the short-time, but this effect will not be sustained. Also, the sustained increase of enterprise scale will have negative effect on e-commerce performance.

Finally, we make the empirical analysis of LnENV and LnSV. According to the TOE model, the uncertainty of the environment is mainly the key factor that affects the diffusion of innovation. By using STATA software to calculate, the VAR model for LnENV and LnSV can be shown as Formula (3). According to the result, it shows that the environmental factors will also promote the e-commerce performance, but the effectiveness is weak. LnENV at lag 1 period increased one percentage will lead LnSV increased by 0.218 percentage, and LnENV at lag 2 period increased one percentage will lead LnSV increased by 0.115 percentage. The result shows that the organizational factors will have a positive effect on e-commerce performance in SMEs. Therefore, the external market environment and the network facilities are also an important factor that will impact on the performance of e-commerce application in SMEs.

3.3. Granger Causality Test and Johnson Co-Integration Test

At the same time, by using granger causality test to analyze the relations between the VAR models, the result is shown in Table 4. From Table 4, the result shows that LnSV rejected the null hypothesis as "Excluded LnTEC as the granger reason to LnSV", so that LnSV is the granger reason to LnSV, which means technical factors are the reason for the promotion in the e-commerce transaction increase. In addition, LnSV is the granger reason to LnTEC, which means the increase of e-commerce transactions will also promote technical investment in SMEs. At the same time, we can find that LnSV rejected the null hypothesis as "Excluded LnORG as the granger reason to LnSV", so that LnORG is also the granger reason to LnSV. However, it shows that LnSV is not the reason for LnORG. From the point of view of environmental factors, we can find that LnENV is the granger reason to LnSV, but the result was not as significant as the first two variables.

Table 4. Causal relationship test through granger causality analysis.

Equation	Excluded	chi^2	df	Prob > chi^2	Result
LnTEC	LnSV	13.643	2	0.001	reject
LnSV	LnTEC	26.359	2	0.000	reject
LnORG	LnSV	16.705	2	0.094	accept
LnSV	LnORG	4.7187	2	0.000	reject
LnENV	LnSV	3.9975	2	0.777	accept
LnSV	LnENV	0.50437	2	0.036	reject

chi^2 means chi-squared test, Prob > chi^2 means the probability that the null hypothesis was established.

At the same time, we take the Johnson co-integration test to analyze the long-term relations between these three factors and e-commerce sales volume, the result was shown in Table 5. Two or more time series are co integrated if they share a common stochastic drift, if two or more series are individually integrated but some linear combination of them has a lower order of integration, then the series are said to be co integrated. From the result, it shows that only the technical factor has co-integration with e-commerce transaction, and there exist at least one co-integration relationship between these two variables.

Table 5. Johnson co-integration test.

Rank	Parms	LL	Characteristic Value	Statistic	5% Significant level
0	6	25.653892		8.1213 *	15.41
1	9	29.678554	0.63438	0.0720	3.76

*: Means that rank 0 is the optimal rank that there exists at least one co-integration relationship, Abbreviation LL is log likelihood.

3.4. Impulse-Response Analysis and Variance Decomposition

Impulse-response function and cholesky variance decomposition can be used to further analyze the VAR model. An impulse response refers to the reaction of any dynamic system in response to some external change. The variance decomposition indicates the amount of information each variable contributes to the other variables in the auto regression. It determines how much of the forecast error variance of each of the variables can be explained by exogenous shocks to the other variables. The result

of LnTEC to LnSV, LnORG to LnSV and LnENV to LnSV was shown in Figure 3. In Figure 3, the X-axis indicates the time period, and the Y-axis indicates the strength of response. Figure 3a is the impulse-response analysis of LnTEC to LnSV and Figure 3b is the variance decomposition of LnTEC to LnSV. In Figure 3a, the result shows that when LnTEC received one unit impact, it will lead LnSV increase currently. LnSV is 0.011 at t = 1 period and increase to 0.023 at t = 3 period, then LnSV will reach the max at t = 4 period and then begin to stabilize. It illustrates that a technical investment will impact on e-commerce performance significantly, and there is a long-term effect. In Figure 3b, the result shows that the contribution degree of LnTEC to LnSV divided into two stages. In the short term, the contribution degree of LnTEC to LnSV is 41% at t = 1 period and then return back to the initial value at t = 2 period; in the long time, the contribution degree gradually increased after t = 4 period. This shows that technical factors has significant effect on e-commerce performance, and can explain the improving the e-commerce transaction.

Figure 3c is the impulse-response analysis of LnORG to LnSV and Figure 3d is the variance decomposition of LnORG to LnSV. From Figure 3c, the result shows that when LnORG received one unit impact, it will lead LnSV reach the maximum at t = 1 period. LnSV is 0.019 at t = 1 period and then began to decrease. It shows that the influence of organizational factors factor will be effective only in the short term. From Figure 3d, the result shows that the LnORG has stable contribution degree to LnSV, the contribution degree of LnORG to LnSV is 0 at t = 1 period and about 26% in the all time period, that means LnORG has a weak contribution to LnSV. Therefore, the change of enterprise scale has limited explanation to e-commerce performance.

Figure 3e is the impulse-response analysis of LnENV to LnSV and Figure 3f is the variance decomposition of LnENV to LnSV. In Figure 3e, the result shows that when LnENV received one unit impact, it will lead LnSV increase currently and LnSV will reach the maximum at t = 3 period. LnSV is 0.039 at t = 3 period and then began to decline, finally, to return to the initial state and be stable at t = 8 period. This means that the environmental factor has short-term effects to e-commerce performance and the degree of effectiveness is weak. In Figure 3f, the result shows that the contribution degree of LnENV to LnSV is gradually increased from the stage 2, the contribution degree of LnENV to LnSV is 0 until t = 2 period and then increase to 18%, it means the contribution degree of LnENV to LnSV will not affected by the time period, but the contribution degree is weak.

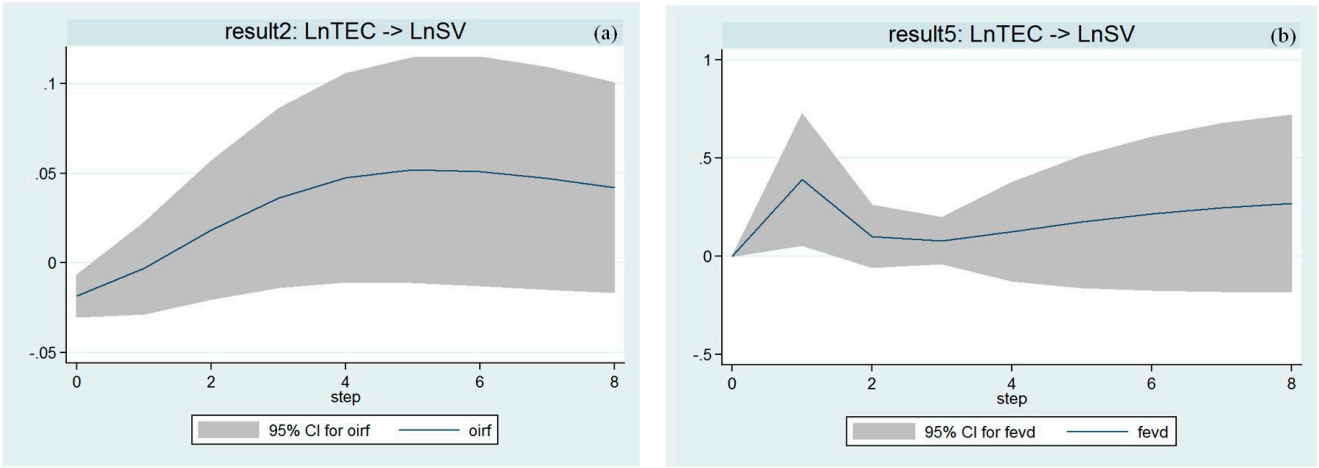

Figure 3. *Cont.*

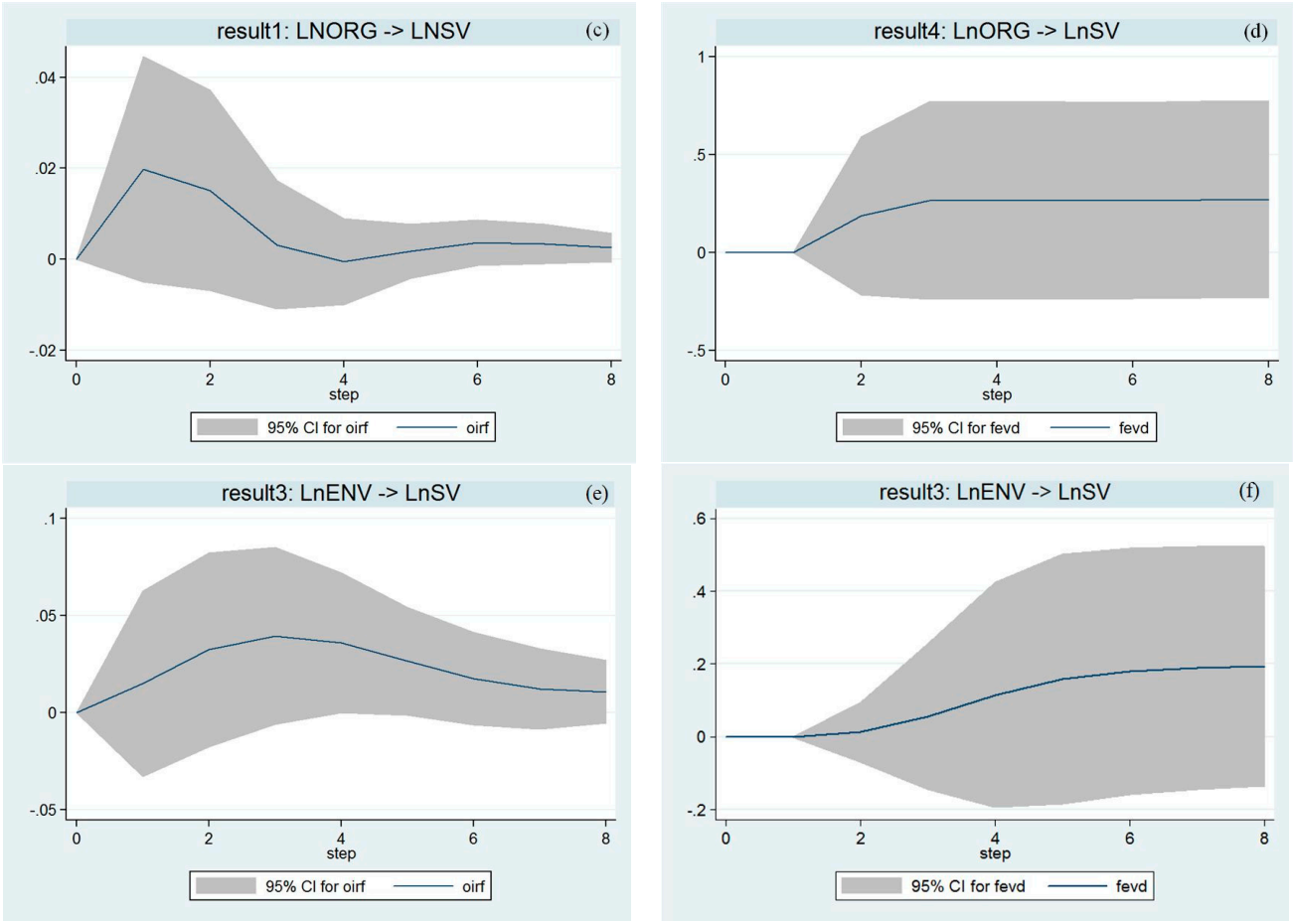

Figure 3. Impulse-response analysis and variance decomposition.(**a**) Impulse-response analysis for LnTEC; (**b**) Contribution degree ofLnTEC to LnSV; (**c**) Impulse-response analysis for LnORG; (**d**) Contribution degree of LnORG to LnSV; (**e**) Impulse-response analysis for LnENV; (**f**) Contribution degree of LnENV to LnSV.

4. The Defects of E-Commerce Application in SMEs

Through the above analysis, we can understand the development of e-commerce in small and medium sized enterprises in Beijing City. The data shows that the application level of electronic commerce is gradually strengthening, and more and more small and medium-sized enterprises begin to realize that electronic commerce can result in new development opportunities. The development of e-commerce has had a huge impact on the economy and society, which break the sales limited in time and space, and play an important role in the construction of information system, logistics, capital flow and information flow. It shows that the development of e-commerce can promote the innovation of business model. However, we can also find some problems and defects in the process of developing electronic commerce in small and medium-sized enterprises, and it will affect the enterprises' development if these problems cannot be effectively solved in the future. These problems include lack of talent in technology, lack of understanding of business e-commerce, and not enough assessment for market positioning.

4.1. Lack of E-Commerce Talent in Small and Medium-Sized Enterprises

In recent years, the development of small and medium-sized enterprises is rapid, and it has gradually become an important part in the national economic system. As small and medium-sized enterprises pay more and more attention to the diversification of marketing, many small and medium-sized enterprises begin to establish e-commerce platform to develop sales business. Because of the low salary of employees, it will be difficult for small and medium-sized enterprises to attract the talents who have innovative and technological skills, and these problems may hinder the development of online business of small and medium-sized enterprises. Enterprises of electronic commerce need a large number of professionals in personnel management and e-commerce business, and also need to train more talents in software work. There are also some technical staff have low management capabilities, and they cannot do a good job in marketing and distribution work. These problems have become the key restricting factors in development of e-commerce.

4.2. Lack of Reasonable Planning and Understanding of E-Commerce

Although the application of e-commerce plays an important role in the development of SMEs, the technology has not been widely accepted by enterprises. Because network construction and talent training are required to pay a certain cost, some enterprises hesitate to develop e-commerce. According to relevant data, small and medium-sized enterprises in Beijing city have more than 70% to develop network marketing, but the numbers of SMEs which fully establish e-commerce system are less than 20%currently. Strengthening the application of the electronic commerce needs further improvement in SMEs. Many small and medium-sized enterprises gradually realize the important role of e-commerce, but how to develop e-commerce business is not clear. Some small and medium-sized enterprises want to achieve online sales through independent construction of the network platform, but they just pay attention to the design of Webpage and have unreasonable marketing strategy, and some enterprises have not realized the unification of Internet marketing and logistics distribution. In addition, once the traditional business pattern is formed, it will be very difficult for SMEs to adapt to electronic commerce business very quickly. Above all, it is difficult for SMEsto achieve good sales in the early development of e-commerce business.

4.3. Positioning of Target Market is Not Clear

Small and medium enterprises choosing the target market is to choose the customer groups. In the process of market positioning, the difference of product and service will attract customers and retain customers. There is a big difference between electronic business and traditional business in operation mode; small and medium-sized enterprises are often unable to choose the goal market reasonably at first, which leads to the failure of network marketing. Therefore, SMEs need to do a series of researches, and analyze the needs of network users in order to find a good market position.

To sum up, although the SMEs in Beijing have nearly 70% of the enterprises that have e-commerce business, we must realize that the majority of small and medium-sized enterprises have these problems in the process of developing e-commerce. First of all, some small and medium-sized enterprises are not fully aware of the importance of e-commerce; secondly, most enterprises lack related evaluation systems

of e-commerce performance, which hinder these enterprises to make reasonable analysis for the electronic commerce situation and its influence. At the same time, small and medium-sized enterprises tend to ignore the development of information construction, personnel training and management innovation. In the process of developing electronic business, it is difficult to improve the efficiency if enterprises just rely on the investment of website construction, and neglect the collaboration in the supply chain.

5. Conclusions

In conclusions, the result shows that: First, IT Investment is the most important factor to achieve success, the competitive advantage can be achieved largely depends on whether enterprises will effectively use the network technology. Second, the expansion of the enterprise size can promote transaction volume increase of SMEs in the short term. Third, internet availability has a positive effect on the trade volume of e-commerce, but the intensity is not obvious, and the effect is relatively stable.

In the process of empirical analysis, we take the SMEs in Beijing city as the research object, then explore how e-commerce influences the sales growth at the short- and long-term. Through analysis of e-business performance, we further explore the causality and influence degree. At the same time, we discussed the relationship between electronic commerce and enterprise performance on the basis of empirical analysis, analyzed the impact of unfavorable factors to e-commerce performance. On this basis, we put forward related suggestions from the enterprise level, the policy level and the social environment level, in order to promote the application of e-commerce for small and medium-sized enterprises.

First, SMEs should improve the software and hardware facilities of e-commerce. Because in SMEs there exists the problem of shortage of funds, they should make the budget and select the equipment with high technological content and strong applicability. In the aspect of hardware purchase, SMEs should also pay attention to the after sale service as repair is a huge expenditure. In addition, the soft input to increase e-commerce business is also very important. With the rapid development of information technology today, the upgrading of technology is very fast; a little carelessness will lead to consumer dissatisfaction. Therefore, managers of small and medium enterprises need to pay attention to personnel training, and to improving the soft power of enterprises.

Second, enterprises should train more talents in electronic business management. Small and medium-sized enterprise development electronic commerce business needs not only the technical development personnel, also need to the person who has e-business management skills. Then, they can promote the establishment and improvement of the marketing system of the electronic commerce industry. However, e-business managers in small and medium-sized enterprises are lacking. Therefore, the enterprise human resources management department needs to develop a reasonable plan of staff recruitment and improve the employee salary level, focusing on exploring management talents, in order to lay a foundation for long-term development of small and medium enterprises.

Third, government departments need to actively cooperate with the e-commerce activities of small and medium-sized enterprises, and provide technical guidance. The electronic commerce not only provides many opportunities for the enterprise, at the same time, it improves the interactive trading between enterprises, suppliers and consumers, and has created new opportunities for small and medium enterprises. However, the small and medium-sized enterprise has a natural disadvantage in scale and capital, so the government should support the development of e-commerce business in SMEs, assigned

a number of staff to solve problems in the network construction and online service. Government should actively create good financing and investment environment, provide some preferential policies and small and help medium-sized enterprises to set up a special fund.

Finally, the government should strengthen the social credit system. The establishment of the credit certification system is the necessary condition in e-commerce. Some small and medium-sized enterprises made a series of e-commerce business innovation activities, such as new website construction, product innovation, *etc.* However, due to the establishment of China's certification system is still have some drawbacks, fake and inferior commodities still exist on the network platform. This counterfeit behavior not only disrupted the market order, but also has serious negative impact to the development of small and medium-sized enterprises.

Author Contributions

This paper represents a result of teamwork. All the authors designed the research together; Qingyi Chen contributed to data collection, data processing and draft paper; Ning Zhang contributed to data analysis. All authors read and approved the final manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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