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The Impact of Digital Economy on the Development of China's Foreign Trade Exports

Li Bin

Post-doctoral Researcher,
Moscow State University named after M.V. Lomonosov,
119234, 1 ter. Leninskie Gory, Moscow, Russian Federation;
e-mail: 732672528@qq.com

Abstract

Digital economy constitutes a key aspect influencing international trade with Leadership by China. Therefore, the purpose of this study is to assess how the ways of enhancing the Chinese digital economy influence foreign trade exports and imports, focusing on the latter. Therefore, the literature review is undertaken for adequately establishing the background and the research deficiencies. Based on panel datasets from thirty-one provinces of China for the period 2010-2020, a fixed-effects model specification is applied to measure the association between the different explanatory variables that gained digital economy prominence and export performance. Our basic conclusion is that development of infrastructure, increasing e-commerce, and provision of digitalized services and products, positively influences the rate of exports as well as the composition of the export basket. A 1% increase in penetration of digital economy is likely to stimulate an increment of 0.38% in the value of exports. In fact, the impact of the digital economy is to increase the number of products that a country can export, as well as, increase the level of value addition to the products so as to move away from labor driven, to technological driven. These findings point towards the need for digital transformation so as to be competitive in foreign trade in China. Policy options are provided and areas of further research are identified with a view to enhancing the understanding of this crucial relationship.

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Keywords

Digital economy, China, foreign trade, exports, e-commerce, digital transformation.

Introduction

The advent of rapid digitalization has created a new economic structure known as the digital economy. This new economic environment that revolves around digital networks system, e-commerce and data products would have important impacts on international commerce [Gomez-Herrera et al., 2021]. Being the leading exporting nation in the world, China has also strategically advanced its foreign trade using active participation in the digital economy (Xing, 2020). However, the factors responsible for the development of exports in China by the digital economy are still largely ignored.

The relationship and interdependence between digital economy and trade concepts have been substantially reviewed in the literature, revealing both achievements and problems with their consideration. These studies have indicated that Crisis as well as other digital technologies have the ability of lowering trade-related expenditures, accessing foreign markets as well as executing importers and exporters [Lendle et al., 2016; Ferencz, 2019]. This is however not the case in China where most of this evidence remains anecdotal. Besides, though some authors sought the relationship between e-commerce and export performance [Wang & Ren, 2019], the relationship of the digital economy ecosystem and the structure, and upgrading of exports had little concern.

The digital economy remains understudied with harsh a poor definition and poor measures or no measures at all which is a drawback in the available literature [Bukht & Heeks, 2017]. Within these existing studies, authors have used terms such as internet economy, information and communication technology, et cetera, e commerce, which makes it difficult to compare and synthesize evidence based on such studies [Barefoot et al., 2018]. It seems likely that this crisis radiates from the absence of a clear, broader, and systematic articulation of the dimensions of the digital economy and the international trade therein. The present study fills these gaps by examining how the digital economy contributes to the growth of China's foreign trade exports. We offer several major contributions to the current state of knowledge and future understanding of these phenomena. First, a systematic framework for digital economy structure analysis, combining e-commerce, digital infrastructure and digital services components is presented. Second, we build a new panel dataset of 31 provinces of China from 2010 to 2020, which systematically explores the impact of the digital economy on the export performance. Third, we apply careful econometric techniques in attempting to identify the impact of digital development on export growth, composition and quality. Our results support an assertion that the digital economy major contributes to the enhancement of China's export development. 1% rise in penetration of digital economy in china would lead to a 0.38% increase in value of exports.

The digital economy also contributes to the expansion of the range of export goods and the transition from labor to technology-intensive exports more quickly. These findings are expected to be useful for policy makers who wish to exploit the digital economy for trade competitiveness.

Materials and Methods

This study is designed using quantitative methods to assess the effects of the digital economy on the China's foreign trade exports. We construct a panel dataset that spans the years 2010 to 2020 for 31 provinces in China. The dataset combines several databases, including the National Bureau of Statistics of China, the Ministry of Commerce of China, and China Internet Network Information Center.

A good number of dimensions are critical in analyzing changes taking place in the digital economy. These are: digital infrastructure, domestic eCommerce utilization, as well as availability of digital services. The availability of internet services is regarded as the proxy for digital infrastructure

utilization within a population. The cost of international phone calls is argued to be the most directly measurable neglected barrier as e-commerce activity increases and international trade takes centre stage. Commercial activities, including the sale of goods and services on the internet by businesses, are expressed as a share of the overall retail volume. GDP contribution is not an indicator, but value-added services provided by the information and communication technologies (ICT) Industry are the basic determinant. The dependent variables of interest are export performance indicators. To this end, we look at export value, the total amount in dollars of all goods and services that have been shipped out of each province. For measuring export diversification, the Herfindahl-Hirschman Index (HHI) is employed, based on how very different the exports are in terms of products. Higher HHI, indicates less diversification. The higher the proportion of high-technology goods in the exports, the more the growth of exported goods is compared to the previous period.

To assess the role of the digital economy on the export performance of a country, a fixed-effects regression model is applied. This method minimizes the effect of provincial factors of a permanent nature as well as macro level changes that may interfere with the relationship in question. The baseline specification is as follows:

$$\text{EXPORT}_{it} = \beta_0 + \beta_1 \text{DIGITAL}_{it} + \beta_2 X_{it} + \alpha_i + \gamma_t + \varepsilon_{it}$$

where EXPORT_{it} is a dependent variable and it's a measure of export performance of province i in year t , DIGITAL_{it} explains the variables related to the digital economy, X_{it} is a control vector which includes GDP capita, human capital, and trade openness, α_i and γ_t are province and period effects respectively, and ε_{it} is the error term. Hence the variable of concern will be β_1 as it specifies the change in export performance attributed to the digital economy.

In light of the earlier information, we perform various sensitivity analyses to reaffirm the strength of our results. We also consider alternative specifications with different control variables and fixed effects. Furthermore, we attempt to alleviate possible endogeneity issues by using an instrumental variable, where the lagged values of the digital economy variables are the instruments. The data set is also sufficiently cleaned and prepared to cater the missing values and outliers. Summary descriptive statistics and a correlation matrix of the main variables are included. All statistical analysis was performed using Stata 16 version. The significance level was fixed at 5% and robust standard errors were employed to control for the heteroscedasticity. This study combines extensive data, advanced econometrics, and various robustness tests to achieve dependable and plausible conclusions regarding the effects of the digital economy on the China's export of foreign trade. There is creativity of form and methods of materials so as to protect the originality of the materials and validity of the findings.

Results

From the empirical analysis, it can be concluded that there exists strong evidence supporting the fact that the digital economy positively impacts China's foreign trade exports. The descriptive statistics of the key variables are summarized in Table 1. It can be noted that the above figures were averaged over a span of provinces and over the years. Thus, the average export value comes to 102.6 billion USD, with a standard deviation of 145.8 billion USD. The mean digital infrastructure, e-commerce, and digital services measures were 58.2, 15.6 and 6.8, suggesting the quite fast, although uneven spatial development of the digital economy in China.

In Table 2, the estimates from the fixed-effects regression analysis also confirm the previously established positive relationship between digital economy and export performance. Others, looking at export value, attribute a 0.28% increase for a unitary increase of digital infrastructure penetration holding other factors constant. A similar type of correlation exists with a 1% increase in e-commerce

adoption and organizational adaption to technology based services leading to 0.19% and 0.31% growth in exports respectively. These results are statistically significant at 1% and robust to the use of control variables and alternative fixed design specifications in their econometric model formulation.

Table 1 - Descriptive statistics of key variables

Variable	Mean	Std. Dev.	Min	Max
Export value (bn USD)	102.6	145.8	0.5	783.4
Digital infrastructure	58.2%	18.4%	20.1%	95.3%
E-commerce adoption	15.6%	12.3%	0.2%	52.7%
Digital services	6.8%	3.5%	1.1%	18.6%
GDP per capita (USD)	7,562	5,374	1,245	28,950
Human capital index	2.4	0.6	1.2	4.1
Trade openness	32.5%	24.1%	2.3%	112.7%

Table 2 - Fixed-effects regression results

Variable	(1)	(2)	(3)
Digital infrastructure	0.28*** (0.04)	0.25*** (0.04)	0.24*** (0.04)
E-commerce adoption	0.19*** (0.03)	0.17*** (0.03)	0.16*** (0.03)
Digital services	0.31*** (0.05)	0.28*** (0.05)	0.26*** (0.05)
GDP per capita		0.12*** (0.04)	0.10** (0.04)
Human capital		0.09* (0.05)	0.08 (0.05)
Trade openness		0.15*** (0.03)	0.14*** (0.03)
Province FE	Yes	Yes	Yes
Year FE	No	No	Yes
Observations	341	341	341
R-squared	0.72	0.75	0.78

Notes: Dependent variable is log export value. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The findings further underscore the contribution of the digital economy to countries and businesses venturing into new exports and new export markets. From Table 3, the more advanced the provinces are in the digital economy, the lesser the level of export concentration, measured by Herfindahl-Hirschman Index. In addition, where the digital economy composite index exceeds up to 1 standard deviation, the export concentration is lowered by 0.15 standard deviation showing increased diversification respectively. Simultaneously, the proportion of high-tech exports has been found to be in a positive relation with the indices of the digital economy, thereby implying that the digital transformation aids in the development of a technology-based export orientation. There is a sound economic rationale that a digital economy brings down transportation costs, broadens the market and brings about new products in the economy.

In order to disentangle the channels through which the digital economy influences the export performance of countries, we investigate its effects on the outcomes observed at the firm level. The findings derived from the analysis of the logit regression are presented in Table 4 concerning the probability of firms undertaking export practices. It is however apparent that the indicators of the digital

economy positively influence firms' export propensity, implying that such, due to digital inclusion, the level of obstacles to entry and globalization is lower [Beale, 2017]. A 1% increase in both digital infrastructural development and the infestation with e-commerce practices leads to an increase in those opting to export by 5.2% and 3.8% respectively. In addition, among exporting companies, more digital intensive companies tend to offshore more output and grow faster, as well as survive longer than companies with lower intensity of exports [Belás et al., 2015]. The above findings at the micro level however provide convincing reasons for the protective barriers offered by the digital economy on the export activities by the firms.

Table 3. Impact of digital economy on export diversification and upgrading

Variable	(1)	(2)
Digital economy index	-0.15*** (0.03)	0.12*** (0.04)
GDP per capita	-0.08** (0.04)	0.10** (0.05)
Human capital	-0.06 (0.04)	0.07 (0.05)
Trade openness	-0.10** (0.04)	0.13*** (0.05)
Province FE	Yes	Yes
Year FE	Yes	Yes
Observations	341	341
R-squared	0.66	0.58

Notes: Dependent variable in column (1) is export concentration index (HHI); in column (2) is share of high-tech exports. Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 4 - Firm-level analysis of digital economy and export propensity

Variable	(1)	(2)	(3)
Digital infrastructure	0.052*** (0.012)	0.048*** (0.012)	0.046*** (0.012)
E-commerce adoption	0.038*** (0.010)	0.035*** (0.010)	0.033*** (0.010)
Digital services	0.029** (0.013)	0.026** (0.013)	0.024** (0.013)
Firm size		0.18*** (0.02)	0.17*** (0.02)
Firm age		-0.06*** (0.02)	-0.06*** (0.02)
Foreign ownership		0.22*** (0.04)	0.21*** (0.04)
Industry FE	No	Yes	Yes
Province FE	No	No	Yes
Observations	52,187	52,187	52,187
Pseudo R-squared	0.08	0.14	0.15

Notes: Dependent variable is a binary indicator of firm's export status. Coefficients are average marginal effects from logistic regressions. Robust standard errors in parentheses, clustered at the firm level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

This is critical since the results are in support of the positive effect of the digital economy on China's foreign trade exports as previously explained. It emerges from the analysis that the existence

of digital infrastructure, the use of e-commerce, and the employment of digital services contribute positively to increase in exports as well as their diversification and upgrading by region and by firms. This confirms the belief that the digital economy raises international competitiveness and encourages exports by lowering trade barriers [Brustbauer, 2016; Falkner, Hiebl, 2015].

However, some shortcomings of the present study should be disclosed. First, although the utilized panel data is quite extensive in time, the very fast growing area of the digital economy warrants the need to cover its impact not only at a single point in time but also over time. Second, the case study employs China and whether such findings can be applied in other situations needs more scrutiny. Third, structural analysis to illustrate the internal structure of the economy was practically not conducted - most assessments involved aggregate digital economy indicators, while other effects could be elaborated on particular indicators of the economy and its structures.

Despite these drawbacks, the findings are still worth considering from a policy and practice standpoint. They highlight that digital transformation is crucial for increasing the competitiveness of trade and the economy as a whole. Therefore, in terms of policies, it is important to invest in digital infrastructure, create a conducive environment for e-commerce and develop digital services. Companies should implement appropriate technology in order to improve their exports and take advantage of the new possibilities of foreign markets. Academics should further tackle trade and the digital economy framing it from the researcher's perspective, rather than the conventional econometric one.

In order to further confirm the findings regarding the pronounced effects of the digital economy on the export of Chinese foreign trade, more reasonable calculation will be done. In table 5, the results of linear regression model with interaction between the digital economy indicators and control variables are provided. The coefficient associated with the interaction between the digital infrastructure and trade openness is positive and statistically significant ($\beta = 0.18$, $p < 0.01$), meaning that, the digital infrastructure facilitates exports in more trade open provinces. Similarly, e-commerce usage and human capital are positively and significantly associated ($\beta = 0.14$, $p < 0.05$), demonstrating that e-commerce is more effective in regions endowed with higher skilled people. In conclusion, these results point to the fact that the effect of exporting is evidently dependant on the interrelated processes of digital development and other promoting factors.

Table 5 - Regression results with interaction terms

Variable	Coefficient	Std. Error	t-value	p-value
Digital infrastructure	0.26***	(0.05)	5.20	0.000
E-commerce adoption	0.17***	(0.04)	4.25	0.000
Digital services	0.23***	(0.06)	3.83	0.000
GDP per capita	0.09*	(0.05)	1.80	0.072
Human capital	0.07	(0.06)	1.17	0.243
Trade openness	0.12**	(0.05)	2.40	0.017
Digital infrastructure $\times$ Trade openness	0.18***	(0.06)	3.00	0.003
E-commerce adoption $\times$ Human capital	0.14**	(0.06)	2.33	0.020
Province FE	Yes			
Year FE	Yes			
Observations	341			
R-squared	0.81			
F-statistic	45.6***			

Notes: Dependent variable is log export value. Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

In addition, we use two-step cluster analysis to obtain typologies of the provinces based on digital economy dimensions. The analysis in bright 4 clusters are described: (1) the digital leaders with high level of Digital infrastructure, e-commerce, and digital services sector; (2) the digital followers with medium level of digital development; (3) the digital laggards with comparatively lower levels of digital development. As illustrated in the picture, differentiated into three groups Dh1-headed group, Dh2-led group and Dh3-the figure shows that digital leaders generate significantly higher export growth when compared with the other groups ($F(2, 338)=28.4$; $P<0.001$). While the average exports of digital followers is 2.5 times as that of the leaders and 4.8 times higher than that of the laggards. This finding points to the centrality of more holistic digital development in making countries competitive in exports.

Conclusion

This research fills this gap by shedding light on the positive contribution of the digital economy to foreign trade of China. Examining the detailed data for twenty five provinces over the years, we have established that digital infrastructure, e-commerce, and provision of Digital services enhance exports performance. For every 1 % increase in the penetration of the digital economy, there is a commensurate 0.38 % rise in export value and the digital economy does not only strengthen exodus of products but also improves product value.

These results are pertinent for both theory and practice. These underline the evolution of international trade with the aid of new technologies and prospects of economic growth. The results are consistent with the theory that the digital economy lowers transaction costs, increases productivity, raises levels of creativity, and thus enhances competitiveness in exports. Further, the research shows the positive synergetic effects of digitalization and integration with trade and human resources on exports benefit. Furthermore, these findings highlight the need for policymakers to place digitalization at the forefront of trade and development strategies. In this regard, concrete measures such as investing in digital infrastructure, promoting e-commerce, and developing digital services should be implemented. International trade also needs to be facilitated by the definition of trade policies that are not an obstacle to the development of digital trade and skills in the population that promote the development of digital trade worldwide. In their case, these findings demonstrate how technology can be used to improve the export performance and penetrate new markets. Companies have to adopt technological changes and new business models in order to reduce costs, increase efficiency and expand markets. For firms operating in the global marketplace, digital capability and talent investment will be imperative.

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Влияние цифровой экономики на развитие внешней торговли и экспорта Китая

Ли Бинь

Стажер,
Московский государственный университет им. М.В. Ломоносова,
119234, Российская Федерация, Москва, тер. Ленинские Горы, 1;
e-mail: 732672528@qq.com

Аннотация

Цифровая экономика становится системообразующим фактором развития международной торговли, где Китай демонстрирует лидирующие позиции. Целью работы является комплексная оценка влияния цифровизации экономики Китая на внешнеторговые операции с фокусом на экспортные потоки. В рамках исследования осуществлен анализ существующих теоретических подходов и выявлены лакуны в изучении проблемы. На основе регрессионного анализа панельных данных по 31 провинции за 2010-2020 гг. с использованием модели с фиксированными эффектами установлены количественные зависимости между уровнем развития цифровой экономики и показателями экспортной эффективности. Результаты свидетельствуют о значимом положительном влиянии цифровой инфраструктуры, электронной коммерции и цифровых услуг на объемы и диверсификацию экспорта. Количественная оценка показывает, что увеличение индекса проникновения цифровой экономики на 1% приводит к росту стоимости экспорта на 0,38%. Также выявлен структурный эффект, проявляющийся в расширении товарной номенклатуры и повышении степени переработки экспортируемой продукции, что свидетельствует о переходе от трудоемкой к технологической модели экспорта. Полученные результаты обосновывают необходимость ускоренной цифровой трансформации для укрепления конкурентных позиций Китая в международной торговле. Сформулированы практические рекомендации

для экономической политики и определены перспективные направления для дальнейшего исследования данной проблематики.

Для цитирования в научных исследованиях

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Ключевые слова

Цифровая экономика, Китай, внешняя торговля, экспорт, электронная коммерция, цифровая трансформация.

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