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Digital Transformation and Non-Financial Performance in Manufacturing

Chenyu Dai *,† and Jianwen Fang †

School of Business, Soochow University, Suzhou 215000, China; fangjianwen@suda.edu.cn
* Correspondence: 2102408015@stu.suda.edu.cn; Tel.: +86-18352805008
† These authors contributed equally to this work.

Abstract: In the context of the digital economy era, can digital transformation promote the improvement of non-financial performance of manufacturing enterprises? Taking Shanghai and Shenzhen A-share listed manufacturing firms from 2012 to 2021 as instances, this paper decomposes non-financial performance from five dimensions: innovation performance, ESG performance, working capital management performance, organizational resilience, and corporate market competitiveness, and examines the effects and mechanisms of the digital revolution on manufacturing companies' non-financial performance via empirical analysis. The findings are as follows: (1) digital transformation of manufacturing enterprises plays a significant positive role in innovation performance, ESG performance, working capital management performance, organizational resilience, and corporate market competitiveness, and (2) digital transformation can promote the improvement of non-financial performance of manufacturing enterprises by improving the quality of internal control. In addition, the heterogeneity analysis results show that digital transformation contributes more to the non-financial performance of non-state-owned manufacturing enterprises. The study conclusion can provide experience for promoting the sustainable development of manufacturing enterprises and driving high-quality economic development.

Keywords: digital transformation; corporate non-financial performance; manufacturing enterprises

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1. Introduction

In 2022, the added value of China's manufacturing sector increased by approximately 3%, accounting for 27.69% of China's GDP. It is an important pillar of China's national economy and a key driver of economic growth. Therefore, the manufacturing sector holds a pivotal position in China. Currently, the global economy is weak, and the digital economy is growing at an increasingly rapid pace, becoming a major influence in redefining the global economic structure, reallocating global factor resources, and altering the dynamics of global competitiveness. However, manufacturing enterprises are facing difficulties such as rising labor costs and the COVID-19 pandemic, with declining investment growth rates that are significantly lower than other industries [1]. They urgently need to transform. Through digital transformation, manufacturing enterprises can comprehensively upgrade and reform their production [2] and management models, which is beneficial for improving product quality and production efficiency [3], and enhancing the market competitiveness of manufacturing enterprises [4]. However, under the impact of the COVID-19 pandemic, whether digital transformation can help manufacturing firms become more flexible and resilient in addition to enhancing their financial performance is still a topic of much-needed debate in academia.

Current studies on digital transformation in manufacturing firms highlight its influence on the performance of firms in terms of finance, operations and innovation, and the analysis of their mechanisms [5–9]. However, corporate performance is a complex and multidimensional concept. Financial performance is often disclosed in the form of financial

indicators in corporate annual reports, so it can be explicitly measured. In reality, however, focusing on financial performance while ignoring corporate non-financial performance may result in short-sightedness. Therefore, in order to improve the resilience and flexibility of enterprises under the background of digital economy, it is necessary to study how digital transformation affects manufacturing firms' non-financial performance and its mechanism.

In light of this, this article divides corporate non-financial performance into five components: innovation performance, ESG performance, working capital management performance, organizational resilience, and corporate market competitiveness, depending on the classic research of Wang Yu [4], Wang Xueli [10], Zhu Aiping [11] and Liao Shilong et al. [12], Starting from the level of manufacturing enterprises, we also study the impact of digital transformation on corporate non-financial performance and its impact mechanism, with the aim to supplement current studies better.

The contributions of this paper are twofold. First, at the theoretical level, based on classic literature and in combination with the current situation of manufacturing enterprises, this paper decomposes the non-financial performance of enterprises from five dimensions, revealing the effect and mechanism of digital transformation on enterprises' non-financial performance. Second, at the practical level, the conclusions drawn in this paper can provide more of a decision-making basis for manufacturing enterprises.

2. Review of the Literature and Research Hypothesis

2.1. Corporate Performance and Non-Financial Performance

Most of the existing literature uses financial performance as a proxy variable for corporate performance. However, corporate performance reflects the development status of a company, including its profitability, sustainable development capability, and management quality [13]. Financial performance, on the other hand, can only reflect the operating status of a company [14] and cannot fully indicate the development of the company. Therefore, non-financial indicators of enterprises need to be considered for inclusion in measuring corporate performance.

In fact, in the field of management, scholars have conducted further research on the measurement of corporate performance. Reviewing past literature shows that non-financial performance in the field of management is mainly considered from two perspectives: corporate development status and management status [12]. Among them, corporate development status is divided into innovation capability, social benefits, market value, etc., while corporate management status can be analyzed from the dimensions of overall management quality and working capital management performance. Non-financial indicators, as a supplement to financial indicators, bear the mission of making the performance indicator system more scientific and comprehensive, and their importance is becoming more and more prominent as the science of management gradually combines with the art of management. The first advantage of non-financial performance is to explain or try to explain certain relationships or events that are not obvious from the financial statements. For example, we cannot learn from financial statements about the technological development of a company and the broader aspects of the environment in which the company operates, nor do we have information about, for example, the company's competitive advantage, market share, new products, quality control costs, and the development of subsidiaries. Non-financial performance provides information about the performance of the firm's most basic events. The second advantage is that it reveals a serious crisis in which traditional accounting has not responded to the challenges and changes in business operations.

Taking this as a reference, considering that the impact of digital transformation on manufacturing enterprises is long-term and multifaceted, and combining the characteristics of manufacturing enterprises such as high inventory, weak technological innovation ability, backward management systems, and incomplete market competition, the non-financial factors of manufacturing firms are classified into five parts, namely, organizational resilience, innovation performance, working capital management performance, ESG performance,

and corporate market competitiveness, to supplement existing research and further explore the effects of the shift to digital on business processes.

Corporate organizational resilience reflects long-term business capability and crisis response ability to some extent, and can be used to measure corporate performance. Based on this, much of the literature measures organizational resilience from the operational level [15,16].

The innovation capability of enterprises can help them adapt to the ever-changing environment and maintain a competitive advantage. Therefore, many scholars have also conducted research on enterprise innovation performance. A large number of papers calculate the number of patent applications as an index to judge enterprise innovation performance [17–19]. There are also some studies that use R&D investment [20] to measure.

From the perspective of business operation, corporate performance should include working capital management performance. Working capital is used for the daily operations of the company, and its management is directly related to the company's capital chain. Many scholars utilize the working capital turnover days in operating activities as a performance indicator when studying corporate working capital management performance [21].

With the continuous emergence of social problems such as resource depletion and ecological damage worldwide, with the trend about globalization, sustainable development is becoming increasingly controversial, and ESG performance has become an important dimension to measure the level of corporate development. ESG, as a corporate evaluation standard that simultaneously considers environment, society, and corporate governance, is an important starting point for enterprises to attain high-quality, sustainable economic growth and points out the direction for enterprise development. Most scholars use the WIND database's CSI ESG score as a proxy indicator, with a higher score indicating better corporate ESG performance [22].

In addition, corporate market competitiveness is also an important indicator reflecting the development situation of an enterprise, which can be included in the consideration scope of enterprise performance. Most studies use market share [23,24] and the Lerner index [25,26] to measure the market competitiveness of enterprises. The Lerner index is generally used to reflect the relative advantageous position of enterprises in the market. The calculation method is: PCM = (main business income − main business cost − management cost − sales cost)/main business income. If the index becomes larger and larger, the industry position of the enterprise will become higher and higher, and its competitiveness will become stronger and stronger.

2.2. Digital Transformation and Corporate Non-Financial Performance

Many applications necessitate the use of newly created technologies, which has led to the birth of Industry 4.0 in China. These technologies come from different disciplines, including information physical systems, the Internet of Things, cloud computing, business process management, and industrial information integration [27]. Industry 4.0 is not gimmicky hype, and the manufacturing industry must join as early as possible [28]. As these technologies transform the production and distribution of goods and services, they will have a profound impact on productivity, skills, and the environment [29], which will facilitate the digital transformation of businesses.

According to the existing literature, significant societal and industrial shifts brought about by the application of digital technology are referred to as "digital transformation." To ensure that they "embrace the impact of digital transformation and drive better operational performance," businesses must develop organizational plans [30]. This article makes the case that digital transformation refers to the strategic behavior of traditional enterprises to enhance their competitiveness and increase profits by integrating various aspects with digital technology [31], thereby promoting comprehensive upgrading of business processes [7].

Digital transformation enterprises apply digital technology to upgrade production methods, streamline the work task operation process, effectively improve enterprise man-

agement efficiency and operational productivity, reduce production costs, and enhance the ability of enterprises to cope with the uncertain environment [32]. According to information asymmetry theory, manufacturing enterprises can improve their information processing capabilities, improve information acquisition methods, reduce information acquisition costs, enhance inter-departmental information communication efficiency, and effectively promote information flow by leveraging digital technology. Enterprises undergoing digital transformation can significantly improve enterprise information asymmetry issues, optimize resource allocation, and enhance the level of enterprise value [33]. Furthermore, enterprises undergoing digital transformation can also improve organizational resilience by alleviating financing constraints and costs, and incentivizing enterprise innovation [34].

In addition, enterprises should quickly adapt to the market environment by restructuring, integrating, and reallocating internal and external resources [35]. Decisions based on market changes enhance the ability to resist risks, and effectively promote the improvement of organizational resilience. Therefore, this paper brings up some hypotheses as follows:

Hypothesis 1a (H1a). *The digital transformation of manufacturing enterprises can significantly enhance organizational resilience.*

The creation of new digital goods and services, improved management techniques, innovative business models, and an increase in enterprise innovation can all result from the digitization of corporate development, which will also boost the innovation's overall performance [8,36]. Innovation performance includes both technological and non-technological aspects. Among them, non-technological refers to the re-engineering and optimization of organizational structure, business processes, business models, production operations, and other areas. On one hand, the integration of digital technology with various disciplines can provide technical support for enterprises and promote technological innovation. By applying the enhanced technology to product development and production processes, enterprises can achieve product and process innovation. On the other hand, data-driven decision-making is a prominent feature of enterprises undergoing digital transformation. Digital enterprises use data-driven decision-making to achieve innovation in internal management [37].

At the same time, enterprises complete organizational innovation by introducing advanced and efficient management tools and reducing the decision-making process of management, thereby enhancing the enthusiasm of management for innovation, promoting the updating of business models, facilitating the rational allocation of existing resources, increasing R&D investment, and improving innovation performance [17]. In addition, digital technology has rapidly narrowed the gap between enterprises and customers. Enterprises use digital technology to collect relevant customer information, grasp consumer preferences and market direction, explore potential market demand, help enterprises clarify innovation direction, and accelerate the innovation process [38]. Therefore, the following hypothesis is put forward in this work:

Hypothesis 1b (H1b). *The numerical transformation of manufacturing enterprises can significantly strengthen their innovation effect.*

The manufacturing industry is highly capital-intensive, and, relying on digital transformation, it can inject a strong impetus into the flow of funds in multiple links of purchase, production, and sales. In one sense, digital technology accelerates the innovation of the supplier management mode, and platform-based procurement removes the obstacles of matching supply and demand and improves the efficiency of purchasing decisions. This not only eases the financing problem, but also reduces the procurement cost. In another sense, digital technology realizes that from order to delivery is completely data-driven, and multi-departmental real-time information interaction and synergy, and input and output efficiency are steadily improved. In addition, the digital marketing model has greatly

broadened sales channels and significantly enhanced the stickiness of old customers while discovering new users. Relying on the digital supply chain financial platform, we actively build a business ecosystem for the whole industry chain, realizing a multi-win situation and effectively accelerating the turnover rate of capital flow.

At the same time, the sound operation of the manufacturing industry requires the implementation of dynamic real-time, normalized scientific control of funds, and digital empowerment can strengthen the monitoring of funds to ensure that the amount of money in and out is in an orderly cycle. Digital technology achieves a high degree of customer and product fit, and raw materials to cash flow outflow; in addition, inflow planning is more rational and the conversion efficiency is faster, reducing many redundant non-value-added links. Inventory liquidity significantly enhances the ability to ensure the risk is effectively controlled.Therefore, this paper puts forward the following hypothesis:

Hypothesis 1c (H1c). *Manufacturing companies may greatly enhance working capital management performance by undergoing a digital transformation.*

Digital transformation improves corporate ESG performance by alleviating information asymmetry. To achieve sustainable and high-quality development, enterprises need to fulfill their social responsibilities and improve their ESG performance. Currently, due to the imperfection of China's relevant systems, the fulfillment of social responsibilities by enterprises is somewhat opaque, and the quality of ESG information disclosure by enterprises varies. Digital technology makes it much easier for the public to access corporate information. As a result, companies are less information asymmetric and more transparent [39]. To enhance corporate reputation, increasing public scrutiny is pushing companies to take on more ESG social responsibility, thereby improving corporate ESG performance. Moreover, enterprise digital transformation can help enterprises access a large amount of information and optimize their internal management systems. This can effectively improve resource allocation, and enhance the efficiency and accuracy of corporate decision-making, which is conducive to improving ESG performance.

The use of numerical technology could help firms to quickly identify and analyze social problems. For catering needs of stakeholders, firms will tend to fulfill their social responsibilities and promote the improvement of their ESG performance [40]. In addition, it has been shown in the literature that advanced manufacturing technologies can improve operational excellence, cost-effectiveness, and eco-efficiency [41]. Therefore, through digital transformation, companies can improve their technological processes, reduce production costs, and improve product quality, thereby effectively reducing environmental problems [42] and improving their environmental performance [43]. In light of the above analysis, the following hypothesis is put forward in this paper:

Hypothesis 1d (H1d). *The ESG performance of manufacturing companies may be greatly enhanced by digital transformation.*

China's manufacturing sector is just beginning its digital revolution. According to enterprise lifecycle theory, most manufacturing enterprises are in the growth stage of digital change. For these businesses, digital transformation is conducive to forming characteristics in products and services, thereby gaining competitive advantages [44]. However, the combination of digital technology with various departments and links within the enterprise helps enterprises to achieve refined and intelligent production process management, improve management efficiency, production efficiency, and resource utilization efficiency, achieve cost reduction and efficiency improvement [21], and enhance product quality and sales ability. By producing higher quality products at lower cost, companies can satisfy consumers while pursuing low-price strategies, thereby gaining more profits, customers, and market share.

Digital transformation can help enterprises understand their resources and improve resource utilization, and integrate enterprises, thereby enhancing their market competitiveness. At the same time, enterprises can continuously gain competitiveness by transforming data into knowledge [45]. Another significant aspect influencing market competitiveness is the effectiveness of its factor allocation. Manufacturing enterprises, through digital transformation, can improve operations and management mechanisms, break information barriers between departments, and enhance the efficiency of internal information exchange, thereby reducing factor mismatch, improving the rate of factor allocation, and promoting factor circulation [26].

In addition, enterprises undergoing digital transformation can utilize digital technology to collect and analyze external information, and understand market demand and trends. This can help enterprises to improve service efficiency and create new sales channels, thereby expanding market space, improving product circulation rate, and enhancing corporate market competitiveness. Therefore, this paper establishes the following hypothesis:

Hypothesis 1e (H1e). *The digital transformation of manufacturing enterprises can significantly enhance their market competitiveness.*

2.3. Digital Transformation, Internal Control Quality and Corporate Non-Financial Performance

In fact, enterprise digital transformation is not a panacea, with two-thirds of digital transformation projects ending in failure or with results below expectations. The procedures of digitalization of transformation of company, managerial, organisational, skill-related, and technical complementarities are very important for the success of the transformation [46]. Therefore, only by truly applying digital transformation to internal governance and improving the quality of internal controls can companies contribute to business development, in terms of both financial and non-financial performance.

Internal control refers to an important mechanism formed by enterprises to achieve operational management objectives and improve operational efficiency, including the control environment, information communication, risk assessment, etc. Internal control systems, as one of the important ways for enterprises to carry out internal governance and enterprises to carry out digital transformation of the objectives, have a certain degree of overlap, and they help enterprises in the process of assessing their own suitability for digital transformation, and will lead to the improvement of risk assessment capabilities, with the help of digital technology to enhance operational efficiency at the same time. They can also further improve the speed of communication within the enterprise, and effectively improve the internal governance environment and the ability to quickly react after the identification of problems, that is, improve the quality of internal control of enterprises. The ability to react quickly after identifying problems improves the quality of an enterprise's internal controls. Research already conducted suggests that businesses can greatly improve the quality of internal control by implementing digital transformation. Organizations going through digital transformation, on the one hand, make use of cutting-edge digital technology to maximize internal control management tools. Facilitating communication between the enterprise's business and internal control systems enhances internal control quality [45]. Digital technology, on the other hand, improves internal business environments, reduces the expense of information coordination and communication, increases the effectiveness of information circulation, and removes internal business information barriers. All of these benefits help to raise the caliber of internal controls [47].

Enterprises can balance the power of management, restrict self-interest behavior of management, alleviate principal-agent problems [48], reduce interest losses of enterprises, and then contribute to the sustainable development of enterprises by improving the quality of internal control. An effective internal control system can smooth the information communication channel between enterprises and the government, and alleviate information asymmetry between the two, thus helping enterprises obtain more government support. It is beneficial for long-term business operations [49]. In addition, enterprises with high

internal control quality tend to have strong supervisory and information collection capabilities that allow them to quickly identify and analyze internal and external potential risks, and make responses, thereby reducing enterprise risks and promoting the improvement of organizational resilience [50]. Therefore, this paper proposes a hypothesis:

Hypothesis 2a (H2a). *Manufacturing companies that undergo digital transformation can greatly increase organizational resilience through raising internal control quality.*

The improvement of corporate innovation performance is closely related to a reasonable and effective corporate innovation incentive mechanism. However, the issue of information asymmetry within enterprises can reduce the efficiency of information communication, thereby affecting the effectiveness of internal incentives. Improving the quality of internal control can effectively alleviate the issue of information asymmetry, and enhance the understanding of corporate governance layers towards management and core employees [51], thereby better motivating employees' innovation enthusiasm and improving corporate innovation performance.

Enterprises are often unable to obtain the necessary amount of funds to meet their investment and innovation needs due to financing constraints, which reduces the efficiency of resource allocation and thus inhibits corporate innovation. Existing literature indicates that internal control has the potential to enhance the level of disclosure of internal information and information transparency, thereby reducing financing costs and encouraging the enhancement of firm innovation [52]. Therefore, this paper proposed the following hypothesis:

Hypothesis 2b (H2b). *By raising internal control quality, industrial companies undergoing the shift to digital can greatly enhance corporate innovation performance.*

Improving the efficiency and effectiveness of business operations is one of the objectives of internal control. Internal control can improve the level of business management, thereby positively affecting the performance of working capital management [53]. Inventory and financial fund management can be improved with the use of internal control systems. Therefore, raising the bar for internal control helps ensure that money and stock are secure, thereby improving the turnover speed and efficiency of monetary funds and inventory. Moreover, the improvement of internal control quality helps to enhance corporate rationality, and improve decision-making quality and investment efficiency, thereby improving the level of working capital management. Therefore, this essay puts out the following hypothesis:

Hypothesis 2c (H2c). *By strengthening internal control quality, industrial companies undergoing digital transformation may greatly enhance working capital management performance.*

From the perspective of fulfilling social responsibilities, enterprises with high-quality internal control can better control social responsibility risks and integrate the concept of fulfilling social responsibilities into daily decision-making. It is beneficial for enterprises to fulfill their social responsibilities [54,55]. From the perspective of environmental protection, high execution of internal control can reduce the short-sighted behavior of management, comply with relevant regulations of environmental protection departments, and increase the intensity of environmental protection investment [56]. This is beneficial for improving the environmental protection performance of enterprises. In addition, the optimization of the intrinsic controlling system could enhance the efficiency and credibility of enterprise information communicating, alleviate information asymmetry problems, reduce moral hazards [57], and improve corporate ESG performance. Therefore, the following hypothesis is put out in this work:

Hypothesis 2d (H2d). *The digital transformation of manufacturing enterprises may significantly raise their level of ESG performance by enhancing internal control quality.*

Improving internal control quality is beneficial for enterprises to conduct real-time monitoring of resource utilization, which can enhance the ability of enterprises to utilize resources and effectively reduce resource depletion. Furthermore, enterprises with high internal control effectiveness have obvious advantages in absorbing external resources and optimizing resource allocation, providing guarantees for enterprises to enhance market competitiveness [58].

Strong internal control capability can help enterprises quickly and accurately assess changes in the market environment. As a result, enterprises are able to identify high-quality development opportunities and quickly adjust their development direction, which helps them to continuously accumulate market advantages, improve their market position, and gain more recognition [59]. Therefore, this paper puts forward this hypothesis:

Hypothesis 2e (H2e). *Manufacturing companies' digital transformation may dramatically increase their market competitiveness by enhancing internal control quality.*

3. Design of Research

3.1. Sample Selection and Data Source

The original samples for the paper are panel data of A-share manufacturing businesses listed between 2012 and 2021 in Shanghai and Shenzhen. The reason for this choice is that firstly the panel data can be used to analyze the characteristics of each sample in the time series, so as to obtain a more profound comprehension of the long-term effects of digital transformation, and the data of the last 10 years can satisfy this purpose. Secondly, the listing standards of A-shares are high, listed companies generally have stable operations, the disclosure format of their annual reports is standardized and informative, and their financial data are usually true.

On the basis of the initial sample, this paper does the following sample screening: (1) exclude ST and *ST samples because their financial data lack authenticity; (2) exclude samples with gearing ratios greater than 1 because they are insolvent and regarded as bankrupt; (3) exclude samples that have only one period within the sample period because they are unable to analyze the temporal trend; and (4) exclude samples that have serious missing data. Meanwhile, in order to reduce the impact on singular values, this paper shrinks all variables with continuity by 1% before and after. Finally, 1308 samples with a total of 8073 observations were used for analyzing.

Based on the samples screened above, this paper obtained their data from the following channels: (1) this paper downloaded the annual reports of firms from the Shanghai Stock Exchange and Shenzhen Stock Exchange's official websites, and crawled the raw data of enterprises' digital transformation in them using python version 3.10.0; (2) this paper obtained the patent data of enterprises from the CNRDS database; (3) this paper obtained the ESG from the Wind database data; (4) this paper obtained the data on the quality of enterprise internal control from the DIB database; and (5) this paper obtained other corporate financial data from the CSMAR database and regional economic data from the China Statistical Yearbook.

3.2. Model Building

To assess how the level of digital transformation affects manufacturing companies' non-financial performance, we constructed a two-way fixed effects model:

$$Y_{i,t} = \alpha_0 + \alpha_1 DCG_{i,t} + \alpha_2 Controls_{i,t} + year_t + \mu_i + \epsilon_{i,t} \quad (1)$$

Considering that the digital transformation of Chinese firms has very distinct time trends and individual characteristics, we control for time fixed effects and individual

fixed effects in our model. μ_i and $year_t$ are individual and year effects. $\epsilon_{i,t}$, respectively, are random error terms.

3.3. Variable Definition

3.3.1. The Explained Variables

The explained variables are ESG performance, organizational resilience, innovation performance, corporate market competitiveness, and working capital management performance. This article takes the stance of most scholars, using the Huazheng ESG scoring data, operating income growth rate (Growth), patent applications (Innovation), the Lerner index (PCM), and working capital turnover from operating activities to represent these variables (WCC). Working capital turnover from operating activities is computed using the methodology developed by scholars such as Wang Zhuquan [60]. According to different channels, working capital in operating activities can be divided into working capital in marketing channels, working capital in production channels, and working capital in procurement channels. Therefore, the formula for calculating working capital turnover from operating activities is: working capital turnover from operating activities = working capital in operating activities/(annual operating income/360) = (working capital in marketing channels + working capital in production channels + working capital in procurement channels)/(annual operating income/360). The longer the turnover period is, the worse is the working capital management performance.

3.3.2. Explanatory Variable

The explanatory variable is the extent of businesses' digital transformation. Currently, most scholars use textual analysis to measure the extent of the shift to digital by the frequency of occurrence of digital transformation words in corporate annual reports. This article follows the approach of Wu Fei [61] et al's framework, which divides digital transformation into five categories: big data, blockchain, cloud computing, artificial intelligence, and digital technology application. The annual reports of quoted companies are then used to calculate the overall frequency of 76 keywords related to these categories. Meanwhile, considering that these data have a right-skewed characteristic, the total frequency of words is added by 1 and then logarithmically transformed to obtain a gauge for assessing the extent to which businesses are transforming digitally.

3.3.3. Intermediate Variable

The mediating variable is internal control quality (IC). Drawing on existing literature, this article uses the internal control index/100 to measure it.

3.3.4. Control Variables

Factors such as firm characteristics, asset structure, and the level of internal governance can affect firms' non-financial performance. The control variables include the company's age (AGE), asset-liability ratio (LEV), book-to-market ratio (BM), shareholding ratio of major shareholders (SH), Tobin's Q value (TobinQ), nature of property rights (SOE), and duality of positions (DUAL).

In addition to this, the paper controls for the HHI index (HHI) to control for the effect of the level of industry competition on firms' non-financial performance. This paper also controls the GDP (GDP) and its secondary industry GDP share (Industry) to control the influence on economic development and structure of the area where the firm is placed on the firm's non-financial performance. For the specific meanings, please refer to Table 1.

Table 1. Meanings of main variables.

Variable Name	Symbol	Meaning of Variables
ESG performance	ESG	Huazheng ESG score data
Working capital management performance	WCC	Operating cash flow turnover period
Corporate market competitiveness	PCM	(main business income − main business cost − management cost − sales cost)/main business income
Organizational resilience	Growth	Operating income growth rate
Innovation performance	Innovation	Patent applications
Enterprise digital transformation	DCG	The natural logarithm of the total words in the company's annual report that contain digital keywords plus 1.
Internal control quality	IC	Internal control index/100
Company age	AGE	ln(year of reporting period − year of enterprise establishment + 1)
Asset-liability ratio	LEV	Total liabilities/total assets
Book-to-market ratio	BM	Net fixed assets/total assets
Shareholding ratio of major shareholders	SH	Number of shares held by the largest shareholder/total share capital
Tobin Q value	TobinQ	Market value/total assets at end of period
Nature of property rights	SOE	Businesses owned by the state receive 1, while everyone else receives 0.
Duality of positions	DUAL	Take 1 if the general manager also serves as the chairman of the board of directors; otherwise, take 0.
Degree of competition in the industry	HHI	Herfindahl–Hirschman Index
Level of economic development	GDP	Ln(regional GDP)
Economic structure	Industry	Secondary GDP/GDP

4. Empirical Results and Analysis

4.1. Descriptive Statistics

Table 2 shows the descriptive statistics for the key variables. Among these, the mean value of the Digital Change Degree (DCG) is 1.284, with the largest level of 4.779 and the lowest level of 0. This indicates that there is a significant difference in numerical transformation between different companies. Growth is recorded with an average value of 0.177, a maximum of 1.987, a low of −0.421, and a standard deviation of 0.337. This indicates that there is a significant difference in organizational resilience among different enterprises. The mean value of Innovation is 3.419, with a standard deviation of 1.485, a maximum of 6.872, and a minimum of 0. This suggests that innovation performance varies significantly across various firms. The mean value of WCC is 123.4, with a median of 99.35, indicating that most enterprises have a poor level of working capital management; the standard deviation is 125.0, demonstrating the notable variations in the efficacy of working capital management across different businesses. The mean value of ESG is 73.13, with a standard deviation of 4.896, a maximum of 83.50, and a minimum of 57.83. This indicates that most enterprises have a significant gap from the average ESG performance and significant variations exist in the ESG performance of various businesses.

Table 2. Characteristic statistics for primary variables.

Variable	N	Mean	Median	Std. Dev.	Min	Max
DCG	8073	1.284	1.099	1.291	0	4.779
Growth	8073	0.177	0.122	0.337	−0.421	1.987
Innovation	8073	3.419	3.497	1.485	0	6.872
WCC	8073	123.4	99.35	125.0	−108.9	600.1

Table 2. *Cont.*

Variable	N	Mean	Median	Std. Dev.	Min	Max
ESG	8073	73.13	73.35	4.896	57.83	83.50
PCM	8073	0.116	0.106	0.0940	−0.159	0.424
IC	8073	6.459	6.658	1.122	0	8.166
BM	8073	0.904	0.663	0.778	0.120	4.254
TobinQ	8073	1.998	1.660	1.086	0.885	6.943
AGE	8073	2.927	2.944	0.271	2.197	3.584
LEV	8073	0.423	0.421	0.177	0.0890	0.850
SH	8073	0.328	0.310	0.135	0.0960	0.705
SOE	8073	0.304	0	0.460	0	1
Dual	8073	0.297	0	0.454	0	1
HHI	8073	0.104	0.0810	0.0780	0.0240	0.385
GDP	8073	10.44	10.67	1.395	3.200	11.73
Industry	8073	0.416	0.434	0.0900	0.113	0.554

4.2. Baseline Regression Results

Table 3 reports the effect of digital transformation on non-financial performance. The regression results are consistent with expectations, indicating that digital transformation can significantly improve non-financial performance. Column (1) of Table 3 shows that DCG is significantly positively correlated with Growth at the 0.05 level, indicating that digital transformation can significantly promote the growth of corporate operating income. The higher the level of digital transformation in manufacturing companies is, the greater the value of creation capability is, and the higher the organizational resilience is, and H1a is established. Column (2) of Table 3 shows that DCG is significantly positively correlated with Innovation at the 0.01 level. This indicates that when the degree of digital transformation in manufacturing enterprises is higher there are more patent applications, that is, the corporate innovation performance is higher, and the H1b hypothesis is supported. Column (3) of Table 3 shows that the impact coefficient of DCG on WCC is −2.653, and it is significant at the 0.05 level, indicating that the higher the degree of digital transformation in manufacturing enterprises is, the less is the turnover period of working capital. Therefore, digital transformation of manufacturing enterprises can effectively promote the improvement of working capital management performance, which supports the hypothesis of H1c. Column (4) of Table 3 shows that DCG is significantly positively correlated with corporate ESG performance at the 0.01 level, showing that if the degree of digital transformation in manufacturing enterprises becomes higher, the corporate ESG will perform better, and H1d is confirmed. Column (5) of Table 3 shows that DCG is significantly positively correlated with PCM at the 0.01 level. This suggests that manufacturing organizations that have undergone digital transformation are more likely to have higher Lerner index values. This implies that digital transformation can significantly contribute to the greater market competitiveness of manufacturing enterprises, and H1e holds.

Table 3. Baseline regression results.

Variable	(1) Growth	(2) Innovation	(3) WCC	(4) ESG	(5) PCM
DCG	0.015 **	0.041 ***	−2.653 **	0.283 ***	0.003 ***
	(0.006)	(0.014)	(1.146)	(0.070)	(0.001)
Controls	yes	yes	yes	yes	yes
Individual	yes	yes	yes	yes	yes
Year	yes	yes	yes	yes	yes
N	8073	8073	8073	8073	8073
R^2	0.251	0.792	0.810	0.567	0.717

** $p < 0.05$, *** $p < 0.01$.

4.3. Robustness Test

4.3.1. Replace the Core Explanatory Variable

The relationship between digital transformation of manufacturing enterprises and non-financial performance may be affected by the way the explanatory variables are measured. Therefore, in order to avoid measurement errors that may lead to inaccurate regression results, this article make the reference about the research of Ye Yongwei et al. [62], decomposes the digital transformation indicators into two secondary indicators, "underlying technology" (DCG1) and "practical application" (DCG2), and conducts a robustness test.

During the corporate digital transformation process, first of all, businesses will put more of an emphasis on using "digital technology technology-driven" approaches to improve and change the original technology system and the level of production system digitalization, and this modification depends on how important fundamental technologies are developed and laid out. Among them, technologies such as artificial intelligence, blockchain, cloud computing, and big data make up the fundamental technology architecture of enterprise digital transformation. Secondly, enterprise digital transformation is ultimately to form effective innovation output and application in the market, so, in a more in-depth stage, this innovation and transformation will gradually touch the core market business from the first level of technological innovation and embedded upgrades to the business of the deeper changes, from the back-end of the enterprise business chain, of technological empowerment to enhance the gradual transfer to the front-end market scenarios in the application.

The regression results of the replacement of explanatory variables are shown in Table 4. From this table, it can be seen that the regression results of innovation performance, working capital management performance, ESG performance, and corporate market competitiveness with DCG1 are distinct. The regression results of organizational resilience, innovation performance, working capital management performance, and ESG performance with DCG2 are significant. Moreover, the signs of their regression coefficients are consistent with the baseline regression outcomes. Furthermore, the regression results of organizational resilience with DCG1 are not distinct. This can be stated by the fact that the current underlying technology for digitization of manufacturing enterprises is in its infancy and there is still room for improvement in terms of scenario fit. So it cannot improve organizational resilience well. The regression results of corporate market competitiveness with DCG2 are not significant. This may be due to the complexity of the market situation and the lack of sophistication in the digital technology application, so that the practical use of digital technology does not significantly affect market competitiveness.Therefore, although individual regression coefficients are not significant, overall, the outcome of the regression on the decomposed explanatory variables is usually the same as all those above. Digital transformation can still effectively improve non-financial performance of manufacturing enterprises. The basic regression results of this article are relatively robust.

Table 4. Regression Results of replacing the explanatory variable.

Variable	Growth		Innovation		WCC		ESG		PCM	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
DCG1	−0.005		0.024 ***		−1.218 *		0.217 ***		0.002 ***	
	(0.004)		(0.009)		(0.689)		(0.042)		(0.001)	
DCG2		0.023 **		0.028 *		−2.436 ***		0.194 **		0.002
		(0.011)		(0.016)		(1.209)		(0.076)		(0.001)
Controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Individual	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
N	8073	8073	8073	8073	8073	8073	8073	8073	8073	8073
R^2	0.251	0.251	0.792	0.792	0.809	0.809	0.567	0.566	0.717	0.717

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

4.3.2. Incorporate the Joint Fixed Effects of Province and Time

To control for economic fluctuations at the provincial level, we re-estimate the equation by incorporating the joint fixed effects of provinces and years. The outcomes of the regression are displayed in Table 5. The regression coefficients of corporate numerical transformation on organizational resilience, innovation performance, working capital management performance, ESG performance, and corporate market competitiveness are all significant and consistent in signs with the baseline regression. This indicates that the core conclusions of this paper are highly robust.

Table 5. Regression with the joint fixed effects of province and time.

Variable	(1) Growth	(2) Innovation	(3) WCC	(4) ESG	(5) PCM
DCG	0.014 **	0.040 ***	−2.212 *	0.277 ***	0.003 ***
	(0.006)	(0.015)	(1.170)	(0.071)	(0.001)
Controls	yes	yes	yes	yes	yes
Individual	yes	yes	yes	yes	yes
Year	yes	yes	yes	yes	yes
Province × Year	yes	yes	yes	yes	yes
N	8073	8073	8073	8073	8073
R^2	0.287	0.802	0.820	0.587	0.733

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

4.3.3. Endogeneity Problems

To avoid endogeneity problems caused by selection bias, this paper employs propensity score matching (PSM) for endogeneity testing. This section draws on the approach of scholars such as Zhang Yongkun [63] and adopts propensity score matching (PSM) for robustness testing. Initially, the critical value in this study is determined by taking the median of the degree of digital transformation. If the sample is greater than the critical value, it is assigned a value of 1; otherwise a value of 0. Then, all control variables are used as covariates to calculate propensity scores.

As shown in Table 6, the standardized deviations after matching are all much less than 10%. This suggests that the characteristics of the treatment group and control group samples are quite similar after propensity score matching, completing the balance test. Table 7 describes the regression results after matching the samples within a radius of 0.05. From the parameter estimation results in Table 7, the regression coefficients of corporate digital transformation on organizational resilience, innovation performance, working capital management performance, ESG performance, and corporate market competitiveness are all significant and consistent in signs with the baseline regression. This implies that this paper's primary conclusions are highly robust.

Table 6. Balance test.

Variable	Type	Mean		%Reduct		*t*-Test	
		Treated	Control	%Bias	|Bias|	t	$p > \|t\|$
AGE	Unbalanced	2.963	2.898	24.20	10.79	0	0.950
	Balanced	2.963	2.973	−3.500	85.50	−1.500	0.133
LEV	Unbalanced	0.424	0.422	0.900	0.380	0.705	0.85 *
	Balanced	0.424	0.417	4.100	−379.5	1.780	0.0750
BM	Unbalanced	0.847	0.950	−13.40	−5.960	0	0.78 *
	Balanced	0.847	0.822	3.300	75.50	1.490	0.137
SH	Unbalanced	0.319	0.336	−13	−5.810	0	1.030
	Balanced	0.319	0.318	0.800	94.20	0.330	0.745

Table 6. *Cont.*

Variable	Type	Mean		%Reduct		*t*-Test	
		Treated	Control	%Bias	|Bias|	t	$p > \|t\|$
TobinQ	Unbalanced	2.088	1.925	15	6.740	0	1.23 *
	Balanced	2.087	2.160	−6.700	55.60	−2.580	0.0100
SOE	Unbalanced	0.250	0.347	−21.10	−9.380	0	
	Balanced	0.251	0.259	−1.800	91.40	−0.800	0.422
Dual	Unbalanced	0.328	0.261	14.70	6.580	0	
	Balanced	0.327	0.312	3.300	77.60	1.360	0.174
HHI	Unbalanced	0.102	0.105	−4	−1.790	0.0740	0.86 *
	Balanced	0.102	0.100	2.100	48.10	0.910	0.362
GDP	Unbalanced	10.65	10.27	27.80	12.31	0	0.74 *
	Balanced	10.65	10.60	3.400	87.70	1.690	0.0900
Industry	Unbalanced	0.401	0.428	−30.30	−13.47	0	0.83 *
	Balanced	0.401	0.399	2.100	93	0.890	0.376

* $p < 0.1$.

Table 7. Regression results after propensity score matching.

Variable	(1) Growth	(2) Innovation	(3) WCC	(4) ESG	(5) PCM
DCG	0.017 **	0.043 ***	−3.223 **	0.277 ***	0.003 ***
	(0.007)	(0.016)	(1.300)	(0.078)	(0.001)
Controls	yes	yes	yes	yes	yes
Year	yes	yes	yes	yes	yes
N	8073	8073	8073	8073	8073
R^2	0.376	0.279	0.792	0.813	0.731

** $p < 0.05$, *** $p < 0.01$.

4.4. Influence of Mechanism Test

4.4.1. Modeling of Mediation Effect

To test whether the digital transformation of manufacturing enterprises affects their non-financial performance by improving internal control quality, this paper draws on the research of scholars such as Wen Zhonglin [64], and constructs the following mediation effect model:

$$IC_{i,t} = \beta_0 + \beta_1 DCG_{i,t} + \beta_2 Controls_{i,t} + year_t + \mu_i + \epsilon_{i,t} \quad (2)$$

$$Y_{i,t} = \gamma_0 + \gamma_1 DCG_{i,t} + \gamma_2 IC_{i,t} + \gamma_3 Controls_{i,t} + year_t + \mu_i + \epsilon_{i,t} \quad (3)$$

The specific process for testing the mediating effect is as follows:

Firstly, if β_1 in model (2) is significantly positive, it indicates that digital transformation of enterprises can improve the level of internal control. Secondly, if γ_2 in model (3) is significantly positive, it indicates that improving the level of internal control can further promote non-financial performance. Meanwhile, compared with the coefficient α_1 in model (1), the absolute value of the coefficient γ_1 in model (3) is smaller, which indicates that the link between digital transformation and non-financial performance is mediated by internal control.

It should be noted that if the coefficient γ_1 in model (3) is not significant then internal control plays a fully mediating effect. If it is significant, internal control plays a partial mediating role.

4.4.2. Test Results of Mediation Effect

The previous research results have shown that the digital transformation of manufacturing enterprises has a promoting effect on corporate non-financial performance. Therefore, this section only estimates the parameters of models (2) and (3), and the test

outcomes are shown in Table 8. Among them, column (1) is the parameter estimation result of model (2); and columns (2)–(6) are the parameter estimation results of model (3).

Table 8. Test of intermediate mechanisms of internal control quality.

Variable	(1) IC	(2) Growth	(3) Innovation	(4) WCC	(5) ESG	(6) PCM
DCG	0.037 **	0.012 **	0.040 ***	−2.352 **	0.266 ***	0.002 **
	(0.017)	(0.005)	(0..014)	(1.421)	(0.058)	(0.001)
IC		0.064 ***	0.024 **	−8.217 ***	0.453 ***	0.012 ***
		(0.005)	(0.011)	(0.954)	(0.053)	(0.001)
Controls	yes	yes	yes	yes	yes	yes
Individual	yes	yes	yes	yes	yes	yes
Year	yes	yes	yes	yes	yes	yes
N	8073	8073	8073	8073	8073	
R^2	0.376	0.279	0.792	0.813	0.573	0.731

** $p < 0.05$, *** $p < 0.01$.

Column (1) of Table 8 shows that the regression results of DCG and IC are significant, that is, β_1 is significant. The parameter estimation results of model (3) show that the estimated coefficients of DCG and IC are significant. Among them, the regression coefficients with Growth, Innovation, ESG performance, and PCM are significantly positive, while the regression coefficient with WCC is significantly negative. This indicates that the manufacturing firms' digital transformation can raise corporate operating income growth rate, patent applications, ESG performance, and the Lerner index, and reduce turnover of operating activities' working capital by improving internal control quality.

The above analysis indicates that there is a partial mediation effect of internal control quality. The digital transformation of manufacturing enterprises can enhance organizational resilience, innovation performance, working capital management performance, ESG performance, and market competitiveness through the improvement of internal control quality. Therefore, H2a–e are verified.

4.5. Heterogeneity Test

This study passes the robustness test and looks at how digital transformation affects manufacturing companies' non-financial performance from a whole sample viewpoint in the baseline regression. The impact of digital transformation on the non-financial performance of manufacturing firms, however, may vary depending on the type of business. Research on this situation can help form differentiated policy guidance. Therefore, this paper regroups enterprises by their property rights and conducts heterogeneity tests. Table 9 reports the results of regression by property rights. Columns (1), (3), (5), (7), and (9) present the regression results for non-state-owned enterprises, while columns (2), (4), (6), (8), and (10) present the regression results for state-owned enterprises.

Table 9. Heterogeneity test.

Variable	Growth		Innovation		WCC		ESG		PCM	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
DCG	0.016 **	0.015	0.047 ***	−0.019	−2.532 *	−1.809	0.253 ***	0.337 ***	0.003 ***	−0.002
	(0.007)	(0.012)	(0.017)	(0.028)	(1.385)	(2.062)	(0.084)	(0.132)	(0.001)	(0.002)
Controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Individual	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
N	5452	2621	5452	2621	5452	2621	5452	2621	5452	2621
R^2	0.275	0.208	0.768	0.837	0.805	0.842	0.571	0.588	0.700	0.777

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

According to the empirical findings, the state-owned manufacturing enterprises' digital transformation has no effect on their corporate organizational resilience, innovation

performance, working capital management performance, or market competitiveness. At the 5% level, there is a substantial positive regression coefficient for the business ESG performance. In contrast, the digital transformation regression coefficients on market competitiveness, organizational resilience, innovation performance, working capital management performance, and ESG performance for non-state-owned manufacturing firms all passed significance tests and were in line with the baseline regression outcomes. Digital transformation in both state-owned and non-state-owned manufacturing firms has a significant positive impact on firms' ESG performance, but the effects in non-state-owned firms are significant at the 1% level, which is a higher level of significance than in state-owned firms. This implies that industrial enterprises that are not state-owned stand to benefit more from the favorable impact of digital transformation on ESG performance. According to the study's findings, non-financial performance of manufacturing companies that are not state-owned is more significantly impacted by the promotion effect of digital transformation.

So, on one hand, nation-obsessed manufacturing enterprises have higher internal control quality, and the improvement effect of digital transformation on internal control quality is not obvious, resulting in the poor promotion effect of enterprise digital transformation on non-financial performance. However, non-state-owned manufacturing enterprises significantly improve internal control quality through digital transformation, which in turn results in a noteworthy enhancement in non-financial performance. On the other hand, due to their natural advantages such as high corporate reputation and low pressure of financing constraints, state-owned manufacturing enterprises face little market competition pressure. So, they pay little attention to digital technology, have a weak willingness for digital transformation, and have a low degree of enterprise digital transformation. However, non-state-owned enterprises, in order to gain a foothold under increasing market competition pressure, often take the initiative to promote the process of digital transformation. As a result, non-state-owned manufacturing enterprises have a stronger willingness to promote digital transformation, they have a higher degree of digital transformation, and their non-financial performance is significantly improved.

5. Conclusions

5.1. Research Conclusions

Digital transformation has significant strategic significance for enhancing the non-financial performance of manufacturing enterprises and achieving high-quality, sustainable development. First of all, this paper combines the existing literature and the characteristics of manufacturing enterprises, and innovatively constructs a system of non-financial performance of manufacturing enterprises, including innovation performance, ESG performance, working capital management performance, organizational resilience, and corporate market competitiveness. Then, this paper theoretically examines how the digital revolution of manufacturing companies affects their non-financial performance and the related mediation mechanism. In light of the data of Shanghai and Shenzhen A-share listed manufacturing companies from 2011 to 2021, this paper uses empirical testing to examine how the digital transformation of manufacturing companies affects their non-financial performance, thereby providing theoretical and empirical evidence for the economic effects research on the integration of digital economy and real economy. The study draws the following conclusions. First, digital transformation can significantly enhance the non-financial performance of manufacturing enterprises. This conclusion remains valid after robustness tests such as replacing the core explanatory variables, adding joint province-time fixed effects, and propensity score methods (PSMs). Second, digital transformation can promote the enhancement of manufacturing companies' non-financial performance by improving internal control quality. Third, further research found that there is heterogeneity in the effects of digital transformation on non-financial performance of manufacturing enterprises. Compared with state-owned manufacturing businesses, non-state-owned

manufacturing enterprises see a greater promotion effect from digital transformation on their non-financial performance.

5.2. Policy Suggestions and Managerial Implications

The research conclusion shows that digital transformation can effectively optimize the non-financial performance of manufacturing companies. In order to fully realize the role of digital transformation in improving corporate non-financial performance, the following tips are brought up.

To start with, the government should vigorously support the digital transformation of manufacturing firms. Firstly, to encourage enterprises to carry out digital transformation, the government should strengthen its policy backing for digital transformation by, among other things, lowering or eliminating taxes and offering enterprise managers and staff digital transformation training to enhance their digital perspective and skills. Secondly, the government needs to focus on the pain points in the digital transformation of manufacturing enterprises, investigate fresh avenues for digital transformation, and formulate more policies that benefit manufacturing enterprises. Thirdly, when formulating relevant policies, the government should effectively consider the differences between different types of manufacturing enterprises and accurately help manufacturing enterprises with their digital transformation. Finally, the government should encourage and guide internet giants to build digital platforms using their own advantages, so as to help manufacturing enterprises complete their digital transformation.

Manufacturing enterprises should accelerate the process of digital transformation. Digital transformation can help elevate the non-financial performance of manufacturing enterprises. Manufacturing enterprises should seize the opportunity, combine their own situations, choose the appropriate path of digital transformation, systematically develop a digital transformation plan, and regularly check the progress, thereby promoting the sustainable development of manufacturing enterprises.

Manufacturing enterprises should also promote better the positive role of digital transformation in non-financial performance. Firstly, manufacturing enterprises should use digital technology to reduce costs and improve quality, and increase R&D investment, so as to enhance corporate innovation performance and market competitiveness. Secondly, manufacturing enterprises need to strengthen the digital transformation of enterprise decision-making, using digital technology to improve enterprise dynamic capabilities, optimize enterprise factor allocation, and promote the improvement of corporate working capital management performance and market competitiveness. Finally, manufacturing enterprises should use digital technology to upgrade enterprise management systems, improve enterprise reputation, and encourage the enhancement of corporate ESG manifestation.

5.3. Restrictions and Prospective Research Paths

This research employs various robustness check techniques to guarantee the validity of the research findings, but certain restrictions still apply. Firstly, although the research results of this paper indicate that the digital transformation of manufacturing enterprises can improve internal control quality, thereby positively affecting non-financial performance, the mediation effect of internal control quality is only partial. There are still many mediation pathways for the digital revolution in industrial companies to promote non-financial performance, which require further in-depth research. Secondly, research samples for this study come from manufacturing companies registered on the A-share market in Shenzhen and Shanghai. In order to broaden the scope of research, future empirical research can be conducted using manufacturing data from more countries to generalize the results.

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