Impact of "Internet plus" on manufacturing upgrading
Based on evidence from Chinese manufacturing

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Abstract. Under the new economic normal, Internet plus initiatives has become the new engine of China's economic transformation. Based on China's manufacturing and Internet indicators from 2009 to 2016, this paper analyzes the impact of internet plus initiatives on manufacturing upgrading. The paper found a significant positive correlation between the Internet plus initiatives and the upgrading of the manufacturing industry, which shows that the Internet plus initiatives have a positive impact on the development of manufacturing.

1 Introduction and prior research

Since the 1990s, China's regional economies, especially coastal areas, have achieved rapid growth, but the manufacturing industry has gradually faced the dilemma of upgrading. As countries have successively regarded "Internet plus" as an important strategy for the technological competition, Internet plus initiatives have provided new directions for manufacturing development. Internet plus, as an information processing infrastructure, focuses on cross-enterprise and cross-industry information exchange, more emphasis on platform-based data collection and in-depth application. They can make information open to the market on an equal and transparent basis, and combine the data into tremendous productivity, which will promote the production efficiency of manufacturing enterprises, and promote industrial upgrading. However, how does "Internet plus" drive the upgrading of the manufacturing industry, and what heterogeneity does it show for different sub-sectors?

"Internet plus" has changed the traditional production and management methods of the manufacturing industry. Foreign scholars have done a lot of empirical work to illustrate this point: Jimenez (2012) selected relevant data of American companies and found that the increase in technology investment has greatly improved the actual output, employment, and labor productivity level of the US industrial [1]. Boothy (2010), Bayo (2010) and other foreign scholars have also shown that increasing investment in information and communications technology will bring positive effects to the national economy [2][3]. Chinese scholars have also done relevant research based on different perspectives. Chang Zhongze (2018) believed that Internet can transform manufacturing from high-tech industries through innovation-driven, labor endowment effects and consumer demand [4]. Xu Weicheng (2018) found that Internet technology advancement can drive the heightening of the industrial structure by testing the contribution rate of Internet technology to the three major industries [5]. Han Xianfeng (2014) analyzed in enterprise production and believes that Internet technology can help enterprises reduce the production cost, improve the innovation level and enhance the resource allocation ability [6]. With the development of the Internet, the relevant theoretical research results are gradually enriched, but the research directions and methods are scattered, so making more comprehensive research about this topic is necessary

2 Hypothesis

2.1 "Internet +" affects the effect of manufacturing upgrading

The paper believe that "Internet plus" mainly affects the upgrading of manufacturing industry through three effects.

2.1.1 Platform effect

In the "Internet plus" era, companies and industries gradually realized the point-to-point, end-to-end and direct access of commodity circulation through online platforms, that is, disintermediation. In traditional production and marketing process of manufacturing, part of the value will flow into the middlemen. Disintermediation can greatly reduce the intermediate links, solve information asymmetry between enterprises and consumers. Also, the platform gradually drives the product sales channels to be refined. The current online shopping platform usually has a specific positioning. Taking the Chinese online shopping platforms as an example, Tmall focuses on brand sales and quality assurance, while Suning focuses on the sale of household appliances. The specialized division of labor platform

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helps different products to target drainage, which broad the enterprise's sales channels and save the transaction costs, thus improving the production efficiency of the manufacturing industry.

2.1.2 Aggregation effect

In the past, industrial agglomeration means that industry improves production efficiency by concentrating production factors in a certain area. “Internet plus” has broken regional clusters restriction, and formed network clusters through information and communication technologies and big data applications (Zhang Weihua, 2017) [7].

On the one hand, the “Internet plus” type of industrial agglomeration is conducive to promoting the specialization of labor, generating new jobs and attracting more high-level labor, which helps to accelerates the matching speed of social employment information. On the other hand, “Internet plus” accelerates the exchange of information about production technology within the industry and generates knowledge spillovers, thereby driving industrial upgrading (Liu Jinshan, 2017) [7].

2.1.3 Flexibility effect

More and more countries attach importance to the input of "soft factors" such as product production requirements and management technology now. From the supply side, companies use the Internet to achieve flexible management and production, and use software systems to keep abreast of product inventories and orders, providing managers with more time-sensitive and accurate operating data. From the demand side, the flexibility effect of the Internet plus manufacturing industry can stimulate the long-tail effect of the consumer market [8]. Driven by the Internet, new business models are constantly emerging, and flexible production can meet the needs of more small consumers. Therefore, the “Internet plus” flexibility effect can increase efficiency for enterprises, and expand market demand.

H 1: “Internet plus” can promote enterprise upgrades.

2.2 Impact of "Internet plus" on different manufacturing industries

Since the driving mechanism of the “Internet plus” from the supply side and the demand side is inconsistent, the “Internet plus” has different effects on the subdivision of manufacturing.

Individual consumers are susceptible to the influence of online marketing, such as Tiktolk's various Internet celebrities. Therefore, the consumer product manufacturing industry with individual consumers as the main customers is more susceptible to consumers' pursuit of personalized, diversified and high-quality products, that is, it is most affected by the “Internet plus” demand side.

Asset manufacturing refers to the industry that provides equipment and other assets for enterprise production and expansion. It mainly relies on the upgrading of industrial management and technology levels, that is, it is driven by the "Internet +" supply-side upgrade. The specific performance is as follows: During the development process, the manufacturing industry continuously absorbs advanced development results such as technology, materials and management methods brought by the Internet, and realizes high-value-added production activities. The production results can affect the intermediate product manufacturing industry and consumer goods manufacturing industry along with the industry chain [9]. Therefore, “Internet plus” can not only promote the upgrading of asset manufacturing industry, but also promote the development of downstream industries through asset manufacturing industry.

Intermediate product manufacturing mainly produces primary products and reprocesses products. Its development mainly depends on product size and equipment processing skills, which are closely related to consumer product manufacturing and asset manufacturing, respectively. Therefore, in general, Intermediate product manufacturing develops with the other two types of manufacturing.

H2a: “Internet plus” has inconsistent effects on the industrial upgrading of consumer goods manufacturing, intermediate manufacturing, and asset manufacturing.

3 RESEARCH DESIGN

3.1 Core variables

The text refers to the relevant research on “Internet plus” by scholars such as Cha Hongwang (2017) and Xu Weicheng (2018), and selects 14 indicators from the Internet infrastructure construction level, information economy development level, social development level, and online government index to establish "Internet +" level index system.

The explanation and data sources of the explained variables and other variables are as follows:

Table1. Variable desctiption

Variable type	variable	Indicator description	Data Sources
Explained	Lsper	Manufacturing profitability	"China Industrial Statistical Yearbook", "China Statistical Yearbook", "China Electronic Information Industry Statistical Yearbook", "China Labor Statistics Yearbook"
explanatory	Net	"Internet +" level indicator	
Controls	Ingdp	GDP per capita	
	Infdi	Regional foreign direct investment	
	Mark	Regional marketization	
	Urban	Urbanization rate	
	Gove	The ratio of urban fiscal expenditure to regional GDP	

3.2 Models

For H1, the paper constructs the following model:

$$Lsperit=a0+ a2\ Lsperit\text{-}1 +a0\ NETit + a3\ LNPGDPit + a4\ GOVEit + a5\ LNFDIit + a6URBANit + a7\ MARKit +\beta it+\lambda it+\mu it \quad (1)$$

For H2, the paper constructs the following models:

$$assetit=a0+ a2\ assetit\text{-}1 +a0\ NETit + a3\ LNPGDPit + a4\ GOVEit + a5\ LNFDIit + a6URBANit + a7\ MARKit +\beta it+\lambda it+\mu it \quad (2)$$

$$midit=a0+ a2\ midit\text{-}1 +a0\ NETit + a3\ LNPGDPit + a4\ GOVEit + a5\ LNFDIit + a6URBANit + a7\ MARKit +\beta it+\lambda it+\mu it \quad (3)$$

$$custit=a0+ a2\ custit\text{-}1 +a0\ NETit + a3\ LNPGDPit + a4\ GOVEit + a5\ LNFDIit + a6URBANit + a7\ MARKit +\beta it+\lambda it+\mu it \quad (4)$$

3.3 Test result

For Hypothesis 1, this paper uses the fixed-effect model of control year and province to test.

Before starting the metrological inspection, the unit root test and the multicollinearity test were performed on the panel data. The results showed that the panel was stationary and VIF=3.15<10, so we can exclude the data with multicollinearity.

Table2. Impact of internet plus on manufacturing

VAR	Fixed effect	Random effects
net	0.576***(7.849)	0.656***(17.95)
mark	0.0712(0.444)	-0.0165(-0.359)
gove	0.0650 (1.242)	0.0617 (1.124)
urban	-0.0498* (-1.776)	-0.0401** (-2.569)
Infdi	-0.004 (-0.198)	-0.0085 (-0.507)
Ingdp	-0.024 (-1.305)	-0.0437* (-1.968)
Constant	0.434** (2.346)	0.426** (2.561)
Observations	240	240
R-squared	0.957	0.997

Table 2 shows the overall regression results of the manufacturing industry. The core explanatory variable index net is significantly positive at the level of 1%, indicating that “Internet plus” can promote the upgrading of the manufacturing industry. In addition, the urbanization indicators in the control variables show an inhibitory effect, which may be because manufacturing companies in china are usually located in rural areas, which are not closely related to the local urbanization process. Even with the advancement of local urbanization, more local residents choose to go to urban, resulting in a lack of labor.

Considering that there may be a lag in the impact of “Internet plus” on the upgrading of manufacturing industries, the SYS-GMM method is used for Hypothesis 2.

Table3. Internet plus upgrade heterogeneity in manufacturing

VAR	Overall industry	Consumer goods industry	Intermediate goods industry	Assets industry
L.lsper	0.452*** (2.400)			
L.cust		0.598*** (3.570)		
L.mid			0.261*** (1.988)	
L.asset				0.0151*** (4.177)
net	0.343*** (2.004)	0.151*** (5.572)	0.097*** (3.142)	0.151 (1.317)
mark	0.063(1.175)	0.021(0.758)	0.004 (0.308)	0.0071 (0.143)
gove	0.084* (0.427)	-0.0005 *(-0.610)	-0.005 (-0.159)	0.053 (0.651)
urban	0.002 (0.701)	0.001 (0.440)	0.001 (0.009)	0.001 (1.174)
Infdi	-0.003 (-1.344)	-0.002 (-1.659)	-0.006* (-2.076)	-0.001 (-0.894)
Ingdp	-0.042 (-0.888)	-0.033 (-1.581)	-0.037 (0.925)	-0.020 (-0.920)
Constant	13.10 (1.334)	5.692* (1.795)	-1.345(-1.581)	1.941(0.020)
AR(2)	0.20	0.54	0.38	0.55
sargen	0.34	0.10	0.38	0.33
Observations	210	210	210	210

We can see in Table 3 that the impact of “Internet plus” on manufacturing upgrades shows a positive significance at the 1% level, which is consistent with our test results of H1. In terms of grouping, the impact of consumer product manufacturing and intermediate product manufacturing is positively significant at the 1% level, with coefficients of 5.57 and 3.14, in contrast, the significance of asset manufacturing is not obvious. This means that in the process of the impact of “Internet plus” on the upgrading of manufacturing industries, the effects of different manufacturing industries are inconsistent. Among them, the driving effect of “Internet plus” is in order: consumer goods manufacturing, intermediate goods manufacturing and assets manufacturing.

4 RObust test

In order to ensure the reliability of the research conclusions, this paper refers to Guo Kesha's classification of industrial upgrading, and further subdivides industrial upgrading indicators into output value enhancement (PS), asset enhancement (NS), and technology enhancement(RS), and verifies the results.

Table4. Impact of internet on ps,ns and rs

VARIABLES	PS	NS	RS
Net	0.302***(13.72)	0.122***(7.501)	1.906***(22.92)
Infdi	0.00672**(3.168)	0.00650***(8.562)	0.00868***(3.772)
Ingdp	0.00295**(3.228)	0.000573(1.891)	0.0112***(10.99)
mark	0.00533(0.0613)	0.0672*(2.058)	0.257(1.748)
urban	-0.0500(-1.781)	-0.0194(-1.832)	-0.187***(-7.574)
gove	0.159***(8.231)	0.127***(5.734)	0.345***(25.01)
constant	0.242(1.026)	0.0194(0.202)	0.890***(3.937)
observations	240	240	240
R-squared	0.573	0.665	0.856

In Table 4, the “Internet plus” level index is positively significant at the 1% level for output value structure, asset structure, and technology structure index, which shows that “Internet plus” can promote manufacturing upgrading in three aspects. Besides, the level of foreign investment (lnfdi), government intervention (gove), and economic

development (lngdp) also have a significant positive correlation. This may indicate that a high openness degree is prone to technology spillovers, thereby improving the manufacturing technology level and production efficiency. Government intervention provides a good infrastructure for manufacturing, which contributes to the improvement of industrial efficiency. And the high level of regional economic development helps increase the demand for local products, thereby promoting the upgrading of manufacturing industries.

5 COnclusions

This article studies the relationship between "Internet +" and manufacturing upgrading. After theoretical derivation and empirical research, we found that “Internet plus” has a positive role in promoting the upgrading of manufacturing industries. The specific methods are promoting the expansion of manufacturing enterprises' production scale, production efficiency, and production technology. At the same time, we found that “Internet plus” has different effects on the upgrading of subdivision manufacturing. Among them, consumer goods manufacturing is greatly affected by “Internet plus”, while intermediate and asset manufacturing is weaker.

We suggest two caveats regarding our results. First, actively implement the “Internet plus” strategy to promote the upgrading of the manufacturing. The government should strengthen the construction of Internet infrastructure and encourage the manufacturing industry to absorb new knowledge and equipment to improve production efficiency. Besides, enterprises should keep pace with the development of the internet, use the platform effect and aggregation effect brought about by “Internet plus”. Second, the regional government can formulate policies based on the characteristics of different manufacturing industries. For the consumer goods manufacturing industry, attention should be paid to the impact of consumer market demand. Market research and data analysis should be used to obtain accurate market dynamic information. For the asset manufacturing industry, it is necessary to increase the application of internet on production and management, strong system construction of the enterprise, and actively absorb advanced technology and knowledge at home and abroad.

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