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Construction of a Model Promoting Integration Development of Information Industry

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Through analysing the above models, the paper draws the following conclusions: the impact of information investment on production performance is U curve; the impact of information investment on production performance depends on introduction, assimilation and re-innovation level of information technology, and then depends on interaction of information technology and production factors and then depends on the scale and quality of capital stock, labour input, industrial technology and information technology; the impact of traditional industry and strategic emerging industry on production performance has obvious differences, but in our country, only chemical raw material, chemical product manufacturing industry, nonferrous metal metallurgy and rolling manufacturing industry, transportation equipment manufacturing industry, production of power, thermal power and supply industry can improve production performance among information investments. Therefore, the theoretical contribution of this chapter is mainly: propose the impact of information investment on production performance appears U-curve and interpret productivity paradox exists in industrial information investment; verify traditional industry and strategic emerging industry of our country promote the difference and direction of information investment and integration of information and industrialization; propose impact mechanism of information investment on production performance is the introduction, assimilation and re-innovation of information technology, the reform of scale and quality of production factors and reform of production paradigm.

1. Introduction

The development of information technology brings reform of production mode, business management and economic mode worldwide. Developing and investing information system, optimizing internal process of enterprise, supply chain, inventory management and digital transaction and realize the customization of product and service has become the important information means of affecting enterprise performance and enhancing industrial competitiveness (Lei, 2000). Especially on the background of rapid development of new generation information technology in post-financial crisis period, the deep integration policy of information and industrialization has become the key means of our country to enhance competitiveness. The development of technological innovation and coordinative development of intelligent production, management and industries has become new direction of deep integration of information and industrialization of our country (Elabras and Lilian, 2009).

In order to investigate the direct impact of industrial integration of information and industrialization on performance, it can use information investment to substitute the introduction level of information technology in the integration of information and industrialization and further substitute integration level of information and industrialization. Therefore, the information investment appearing in the paper has the significance of representing integration level of information and industrialization.

2. Modeling construction of information investment performance

2.1 Model construction

Integration of information and industrialization is the process of forming time and space after information technology assimilation and re-innovation. It has gradualness and stage, reflected in industrial or enterprise internal information investment enhancement. The essence is the process of technology importing,

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assimilating and re-innovation. In micro-level, it is reflected in mutual effect on information technology and production factors. Moreover(Li and Wan, 2012), it affects production performance, breaks through the application and penetration of information technology to some industrial activities such as R&D design, manufacturing and operation management and diffuse and penetrate to each production factors within the enterprise so as to promote reform of management mode, the optimization of operational procedures, enhancement of innovation means and improvement of production efficiency, etc.; In meso-level, it changes industrial form, breaks through old industrial boundary, recombines market structure, promotes industrial integration and hasten the derivation of new industry. Therefore, information technology introduces, assimilates and diffuses the integration of information and industrialization so as to promote formation of new productivity, hasten the innovation of production mode, organization mode, management mode, industrial form, etc. and from new technological paradigm and production function. In addition, with the reform of information technology, the integration of information and industrialization changes more technical boundaries, organization character, market structure, etc. These important factors also affect production performance in turn (Zhang, 2015).

Integration of information and industrialization shows the process that enterprise or industry introduces, assimilates and re-innovates information technology in the form of information production, management equipment, production and management software and diffuses it to production, design, sale and management. During the process (Lowe, 1999), information technology exerts decisive effect on production performance (Liu, 2014). The paper considers information investment as technological form of integration of information and industrialization. It deems information investment as the endogenous variable affecting industrial performance and follows endogenous economic growth theory to analyse it empirically by utilizing production function model analysis method. Therefore, this part follows basic method of mainstream literature about information performance research at present, utilizes production function model for empirical analysis so as to investigate the impact of industrial information on investment. On account of our country located in the integration process of information and industrialization (Li and Su, 2012), information investment is mainly realized through increasing information hardware equipment, software system and corresponding investment in human capital. The essence is for information technology introduction, assimilation and re-innovation, so this part takes industrial information investment as a kind of technical form and places it into production function. That is:

$$Y_{it} = AK_{it}^{a} L_{it}^{\beta} T_{it}^{\delta} IT_{it}^{\gamma} e^{\varepsilon_{it}} \tag{1}$$

Including, Y is yield, K and L are tangible capital input and labour input, T is R&D stock input, IT is micro-electronics equipment control original cost in the industry, α is the elastic coefficient of yield on capital input, β is the elastic coefficient of yield on labour input, δ is the elastic coefficient of yield on original technical input and γ is the elastic coefficient of yield on introducing information technology.

$$y_{it} = a + \lambda t + \alpha k_{it} + \beta l_{it} + \delta t_{it} + \gamma it_{it} + \varepsilon_{it} \tag{2}$$

Including, y=log(Y),k=log(K),l=Log(L),t=Log(T),it=log(IT),a is constant term and ε_{it} is error term.

In view of industrial performance is also affected by other various factors in reality, so it needs to add other control variable to the above model. We use average scale of enterprise to measure the industry with different market concentrations. Thus, we add control variable---market structure level to the model, which is expressed as Struct. The model can be set as:

$$y_{it} = a + \lambda t + \alpha k_{it} + \beta l_{it} + \delta t_{it} + \gamma it_{it} + \varphi \mathrm{struc}_{\mathrm{it}} + \varepsilon_{it} \tag{3}$$

In order to measure assimilation and diffusion between information technology and various production factors within industry in the integration process of information and industrialization, the paper takes the production of information and capital stock, and the product of R&D and labour capital stock as the interpreted variable and put into the equation:

$$y_{it} = a + \lambda t + \alpha k_{it} + \beta l_{it} + \delta t_{it} + \gamma it_{it} + \varphi \mathrm{struc}_{\mathrm{it}} \times \phi \mathrm{t}_{\mathrm{it}} + \mathrm{it}_{\mathrm{it}} + \eta \mathrm{l}_{\mathrm{it}} \times \mathrm{it}_{\mathrm{it}} + \kappa \mathrm{k}_{\mathrm{it}} \times \mathrm{it}_{\mathrm{it}} + \varepsilon_{it} \tag{4}$$

Including, ϕ represents the impact of interaction between information technology and traditional technology on yield or productivity; η represents the impact of interaction between information technology and labour capital on yield or productivity; κ represents the impact of interaction between information technology and capital stock on yield or productivity. Roodman has ever pointed out eliminating endogenous error in model

estimation through dynamic panel data metering method. In view of two endogenous variables t and it existed in the model (5), and in order to prevent the setting error of basic metering model, the paper introduces lag term of variable to expand formula (5) as the following dynamic model:

$$y_{it} = a + \lambda t + \alpha k_{it\text{-}1} + \beta l_{it\text{-}1} + \delta t_{it\text{-}1} + \gamma it_{it\text{-}1} + \varphi \mathrm{struc}_{\mathrm{it\text{-}1}} \times \phi \mathrm{t}_{\mathrm{it\text{-}1}} + \mathrm{it}_{\mathrm{it\text{-}1}} + \eta \mathrm{l}_{\mathrm{it\text{-}1}} \times \mathrm{it}_{\mathrm{it\text{-}1}} + \kappa \mathrm{k}_{\mathrm{it\text{-}1}} \times \mathrm{it}_{\mathrm{it\text{-}1}} + \varepsilon_{it} \quad (5)$$

2.2 Setting of major variables

The paper measures net amount of capital stock according to age-price function, which substitutes computing depreciation function, so as to solve the impact caused by thorough of geometrical depreciation. The paper applies the estimated result of net amount of capital stock, utilizes all industries plus total proportion of total industrial output value and state-owned holding value of gross output to compute total amount of state-owned holding capital stock by industry, utilizes the proportion of net amount of fixed capital stock in each industry to compute total amount of capital stock in each industry, and converts the ex-factory price indices of industrial product into net amount of constant price capital stock.

The paper redefines the economic significance of capital depreciation and creates quantity of capital input-price pairing computational system. That is, on the condition of competition equilibrium. The current purchase price of capital goods is equal to the sum of expected leasing income discounting in the future:

$$P(\mathrm{t}) = \sum_{\tau=0}^{\infty} d(\tau) \pi \frac{1}{1 + r(t+s)} p_k(t+\tau+1) \quad (6)$$

Including, P(t) represents asset price of t period, P(t) represents leasing price of asset in t period, while d(τ) represents asset relative efficiency, represents discount factor, r(t) is asset capital return of t period. Make the first difference, it can get:

$$P(\mathrm{t}) - \left[1 + r(t)\right] p(t-1) = -p(t) - \sum_{\tau=0}^{\infty} [d(\tau) - d(\tau-1)] \pi \frac{1}{1 + r(t+s)} p_k(t+\tau) \quad (7)$$

If PD(t) represents depreciation, according to the relationship between relative efficiency and death rate, it can get:

$$P_D(\mathrm{t}) = \sum_{\tau=0}^{\infty} m(\tau) \pi \frac{1}{1 + r(t+s)} p_k(t+\tau) \quad (8)$$

On such basis, suppose average depreciation rate is Δp(t), the depreciation can be expressed as:

$$\Delta p(\mathrm{t}) = \frac{\sum_{\tau=0}^{\infty} m(\tau) \pi \frac{1}{1 + r(t+s)} p_k(t+\tau)}{\sum_{\tau=0}^{\infty} d(\tau) \pi \frac{1}{1 + r(t+s)} p_k(t+\tau)} \quad (9)$$

While in the geometrical relative efficiency mode, if efficiency lost is δ, it can prove that:

PD(t)=ΔP(t). It means average depreciation rate, average resetting rate and relative efficiency rate are equal at present and geometrical relative efficiency model maintains the consistence between efficiency resetting and value depreciation. Therefore, net amount of capital stock can be estimated based on the asset page price function got in the geometrical and hyperbola mode and the data of fixed asset formed in recent years. PD(t)=ΔP(t) is net amount of capital stock, AP(t) is age-price function of asset and I(t−τ) is fixed asset in recent years.

$$NK(\mathrm{t}) = \sum_{\tau=0}^{\infty} AP(\tau) I(t-\tau) \quad (10)$$

Labour input. The paper selects average number of total employees to substitute labour input. Industrial technology. The paper adopts R&D stock to substitute the development and application level of industrial technology during production process of enterprise, utilizes the proportion of total value of enterprise and

state-owned holding total industrial output value by industry to compute total amount of capital stock in each industry and converts the ex-factory price indices of industrial product into net amount of constant price capital stock.

Information investment. According to the investigation way about information capital of enterprise from American IDG, enterprise information capital data comes from the estimation of annual value of enterprise information equipment and corresponding investment by executive management of enterprise information, mainly including computer hardware such as CPU, personal computer and terminal accessory devices, etc. and communication equipment such as router, concentrator, WAN and LAN equipment, switchboard, telephone, etc. Information investment is the original price of introducing information technology, namely the original price of owing and utilizing micro electric technique to control, observe and measure machine and equipment. Therefore, information investment level represents the information technology form introduced to enterprise. In order to avoid repetitive computation of price, the paper adopts the proportion of original price controlled by micro electric control equipment in equipment used in production management to substitute information technology level.

Average scale of enterprise. The paper refers to methods proposed to verify the impact of average scale of enterprise within industry on production performance on the condition of information technology. The specific computational formula is: average scale of enterprise in industry I = total output value of industry I /the total number of enterprise in industry i. (L and C, 2012).

2.3 Statistical analysis

The sample quantity of industry is 222, the average value of industrial value by industry is 195.91504 billion Yuan, the average value of capital stock is 891.32469 billion Yuan, average number of employees is 463,794, average value of information input proportion is 0.13, industrial level, namely average level of R&D input is 1.16458 trillion Yuan and market structure situation is 764.41 million Yuan. The paper makes simple statistic description of the above variables in Table 1. Production output value, capital store, industrial technology level in 2003-2007 appears rising, information technology and average industrial scale appears obvious rising trend in 2003-2007, but inflection points appears respectively in 2008. In addition, the information input level of strategic emerging industry is higher than that of traditional industries, namely strategic emerging industry has the attribute of high content of information technology input; in addition, R&D input level of strategic emerging industry is higher than traditional industry in 2003-2008, which accords with high technology-based characteristics of strategic emerging industry by and large.

Table 1: Statistical description of the main variables

	2003	2004	2005	2006	2007	2008
Y(Yuan)	10697217	7720059	17228830	20062297	22946751	28893872.55
K(Yuan)	85210262	77668069	81547366	85073756	90751506	114543852.9
L(People)	423381.2	533368.2	420126.5	496855.1	408976.4	500058.5676
T(Yuan)	79672.01	113821.8	112125.2	128513.4	147658.6	177120.4572
IT	0.102801	0.108553	0.12332	0.158579	0.156705	0.135137467
Struc(Yuan)	34921.85	32046.91	92640.31	116901.9	116295.2	64881.26755

In the long term, the integration of information and industrialization is the crossing process realized by industrial technology with constant progress of information technology. For each technological crossing process, information investment and production performance have U-curve relation. As is shown in Diagram 1, the impact of information investment on production performance in the long run appears P curve, namely in the long term, the impact of information investment on production performance appears S curve as a whole, but inflection points exist within each integration period of information and industrialization, namely production performance decreases firstly then rises. It is worth to note during the alternation process of information technology, the production performance is the superposition effect of the impact of the previous information technology introduction on production performance and the impact of the latter information technology introduction on production performance so that production performance decreases in the long term, appearing U curve relation. It is worth to note and illustrate that the integration process of information and industrialization is always the upgrading and crossing process of industrialization. Information investment is not the sole factor affecting production performance, and proper arrangement and constant increasing of scale in information investment, labour force, capital, industrial technology, etc. are the key factors to enhance industrial production performance. This also verifies the crossing of information technology finally change

leading community, information technology paradigm, production performance and economic growth mode. This also verifies the conclusion we analysed in the previous context, namely only when the production factors such as information capital, labour force, capital stock, industrial technology, etc., reach a certain scale and a certain configuration structure, then the impact of information investment on production performance is positive. That is to say, inflection points exist in the impact of information investment on production performance.

3. Performance analysis of production information

In the estimated result of GMM model, three cross terms kit, lit and tit are all obviously positive, it indicates information and capital stock, labour and industrial technology has positive influence relation and information technology enhances industrial production performance through interaction of various production factors. In addition, in the estimation of GMM model by levels, the estimation coefficient of itit−1 is negative, but it cannot hereby determine information input has inhibiting effect on industrial growth, because the impact of information input on production performance, on one hand, comes from the pulling effect of information investment on production performance; on the other hand, enhances production performance through introducing and assimilating information technology and enhancing original production factor structure and efficiency.

Table 2: Strategic emerging industry compared with the traditional industry information and industrialization fusion

	SYS-GMM					
	Strategic emerging industries			The traditional industry		
	(1)	(2)	(3)	(1)	(2)	(3)
L.lny	0.813***	0.873***	0.832***	0.356*	0.681**	0.542***
	(3.31)	(4.24)	(3.84)	(1.76)	(3.68)	(3.12)
K_{it-1}	-0.197	0.148	0.205	0.710***	0.138	0.159**
	(-0.98)	(1.00)	(1.30)	(2.63)	(1.23)	(2.57)
L_{it-1}	0.263	0.497**	0.333***	0.449**	0.607**	0.215**
	(1.66)	(2.54)	(2.91)	(2.07)	(2.57)	(2.47)
It_{it-1}	0.127	-0.095	0.174	0.250	0.070	0.395***
	(1.08)	(-1.18)	(1.01)	(1.39)	(0.61)	(4.15)
$Struc_{it-1}$	1.201**	-0.287	-0.559	-1.606**	-0.601	-0.424***
	(2.58)	(-1.65)	(-1.59)	(-2.36)	(-1.51)	(-4.09)
K_{it-1}	0.124	0.144*	0.140*	0.405***	0.346**	0.214***
	(1.04)	(1.84)	(1.79)	(3.71)	(3.53)	(3.87)
L_{it-1}	-1.455**			1.646**		
	(-2.52)			(2.37)		
T_{it-1}		0.390*			0.673*	
		(1.73)			(1.69)	
N_{it-1}			0.631*			0.409***
			(1.75)			(4.06)

4. Conclusion

Through analysing the above models, the paper draws the following conclusions: the impact of information investment on production performance is U curve; the impact of information investment on production performance depends on introduction, assimilation and re-innovation level of information technology, and then depends on interaction of information technology and production factors and then depends on the scale and quality of capital stock, labour input, industrial technology and information technology; the impact of traditional industry and strategic emerging industry on production performance has obvious differences, but in our country, only chemical raw material, chemical product manufacturing industry, nonferrous metal metallurgy and rolling manufacturing industry, transportation equipment manufacturing industry, production of power, thermal power and supply industry can improve production performance among information investments. Therefore, the theoretical contribution of this chapter is mainly: propose the impact of information investment on production performance appears U-curve and interpret productivity paradox exists in industrial information investment; verify traditional industry and strategic emerging industry of our country promote the difference and direction of information investment and integration of information and industrialization; propose impact

mechanism of information investment on production performance is the introduction, assimilation and re-innovation of information technology, the reform of scale and quality of production factors and reform of production paradigm.

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