Measure Value Digital in Economy: Case of Vietnam

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Abstract: *Recently, the phrase "digital economy" has been mentioned by the media and even by economists as a fashionable word. Many people "boldly" predict how much the digital economy will account for as a percentage of GDP or how much will the digital economy make growth GDP?*

Some international organizations such as OECD, ADB.UN.. also offer methods to measure the digital economy in the economy. This article tries to provide a method to measure the digital economy in the economy based on the input - output system with the case of Vietnam.

Key Words: *Digital, digitized, economy, input output, Vietnam*

I. Introduction

Recently, the phrase "digital economy" has been mentioned by the media and even by economists as a fashionable word. Many people "boldly" predict how much the digital economy will account for as a percentage of GDP or how much will the digital economy make growth GDP?

Widespread use of telecommunications, Internet, mobile networks, development of new technologies such as Internet of Things, cloud computing, big data science and artificial intelligence in business for see the popularity of IT for economic activities. IT exists in the operation of every business. This fact has spurred research on ICT and its economic impact on the economy. However, to date, quantitative assessment of the impact of IT on the Vietnamese economy has been rare. Only two works showing such endeavors are found, both of which are limited. APO (2018) uses growth accounting to show the contribution of IT capital and labor to national economic growth and labor productivity. Duc and Linh (2018) use the I.O analysis method to analyze the impact of the IT multiplier on the Vietnamese economy. APO (2018) only accounts for the direct impact of IT in the economy while Duc and Linh (2018) have limitations on up-to-date data and only reach the natural impact indicators of IT in Vietnam such as: spread and sensitivity. However, the contributions of Duc and Linh suggested further studies. Therefore, assessing the impact of IT on economies must always take into account the spillover effects of IT to other economic sectors.

The term digital economy was almost mentioned by Don Tapscott (1995) as the Digital Economy with his book titled "The Digital Economy: Promise and Peril in the Age of Networked Intelligence. ". This book was one of the first to look at how the Internet will change the way we do business. In short, the digital economy is digitization to connect manufacturers, products and buyers.

The effects of digitalization on the economy are difficult to measure because much of its value is hidden somewhere in the economy. Using the supply and use tables or the input - output (I.O) table seems to be the best way to measure the value of the digital economy. To improve the visibility of products in the digital products and digital industries, the Organization for Economic Cooperation and Development (OECD) and the Asian Development Bank (ADB) tried to make transparent with the digital economy (aka digital SUTs). In principle, macro metrics such as GVA, GDP of digital SUT and SUT are not different. To facilitate the measurement of the digital economy, the OECD has developed tables digital supply and uses.

Since the I.O table was initiated by W. Leontief (1936, 1941) until now, most countries in the world have completed the I.O table, there are countries like the United States that make and publish it every year. Richard Stone introduced the I.O table into the System of National Accounts (SNA) version 1968 and considers the I.O table to be at the heart of this system. Also since R. Stone put the I.O table into the SNA, GDP is calculated by 3 methods due to the equilibrium of the model. In SNA, 1968 R. Stone also gave an idea of accessing information during IO tabulation in the discussion of mathematics (about 3 pages), he introduced the concept of Make and Use matrices. But until the 1993 and 2008 SNA versions were called Supply and Use tables and the name "input - output" gradually disappeared, the SUT table was mentioned quite a lot in the national account statistics. In recent years, the term digital SUT tables (Supply-Use tables for the Digital Economy or Digital SUTs) has been mention by international organizations such as OECD, UN, and EU... However, if the supply and use tables are designed as recommended by the UN, OECD ... then the IO table will not exist when the number of economic sectors and product industries are different; this has been proven with evidence in one Article by Bui Trinh and Pham Quang Ngoc in 2021.

This article will also apply the input – output system in analyzing the role of the digital sectors in Vietnam economy. This study proposes to measure value digital in economy and defining on basic digital economy,core digital economy, digitalized economy and spillover on digital's final products based on input-output system. In this research, three sectors on digital was defined include IT products, communication and IT content, information technology services. The last official IO table of Vietnam is the IO table, 2012, based on the IO table, 2012 and the data of GSO's enterprise survey, annual living standard survey, Vietnam's IO table, 2016 updated by using the RAS method with a random fixed point. This table is then grouped into 27 sectors as shown in Appendix 1.

II. Approach

Inter-sectorial relationships can be analyzed through a comprehensive definition of an industry and its linkages with other industries. Linkage in input-output analysis has many measures. The simple form of the linkage are the backward and forward linkages which can be derived from the Leontief inverse matrix. The more complex form of economic linkages between sectors has been derived from the sub-matrix structure and extracted in the context of measuring interindustry linkages, then known as Hypothetical extraction method (HEM). This approach to industry groups was first published in Schultz. Many authors have subsequently tried to discover suitable methods to measure total industry linkage using (HEM) including; Hewings, Harrigan and McGilvray, Cella, Dietzenbacher, (Dietzenbacher, van der Linden, and Steenge, and Lahr & Miller in Cella, Hung.DM, Trinh. B. The general concept of HEM is: estimate the change in output due to the influence of other sectors of the economy on both the supply and demand sides.The relation of the traditional I.O system has the form:

$$X = (I - A)^{-1}.Y \qquad (1)$$

With: X is a matrix ò outputs that induced by factors of final demand; I is the unit matrix, A is matrix of direct input coefficient and Y is final demand matrix

With: X_1 is output vector of digital sectors group and X_2 is a output vector rest of sectors group (RSG); The coefficient of direct input A was divided to sub-matrix such as A_{11} presents coefficient of digital sectors used products themselves for intermediate inputs; A_{12} is coefficient matrix that products of digital sectors to be intermediate input of RSG; A_{21} is coefficient matrix that products of RSG to be intermediate input of digital sectors group; A_{22} is coefficient matrix of RSG products themselves. So, the equation (1) can be rewritten when studying the intersectoral relationship as follow:

$$\begin{bmatrix} X_1 \\ X_2 \end{bmatrix} = \left(\begin{bmatrix} I & 0 \\ 0 & I \end{bmatrix} - \begin{bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{bmatrix} \right)^{-1} . \begin{bmatrix} Y_1 \\ Y_2 \end{bmatrix} \qquad (2)$$

Or:

$$\begin{bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{bmatrix} , \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} + \begin{bmatrix} Y_1 \\ Y_2 \end{bmatrix} = \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} \qquad (3)$$

Explicitly relation (3) we have:

$$A_{11},X_1 + A_{12}.X_2 + Y_1 = X_1$$

In the case of only taking into account the relationship between the production of one industry group and the other, we have:

$$X_1 - A_{11}.X_1 = A_{12}X_2$$
$$X_1(I - A) = A_{12}.X_2$$

So:

$$\mathbf{X_1 = (I - A_{11})^{-1}. A_{12}. X_2} \qquad (4)$$

And:

$$\mathbf{X_2 = (I - A_{22})^{-1}.A_{21}. X_1} \qquad (5)$$

The relations (4) and (5) show that the change on output of one industry group induces to the output of another industry group.

So:

$(I - A_{11})^{-1}. A_{12}$: Represents the demand of industry group 1 for 1 unit increase of industry group 2 or output of industry group 2 spreading (stimulating) to output of industry group 1

Similar:

$(I - A_{22})^{-1}. A_{21:}$ Represents the demand of industry group 2 for 1 unit increase of industry group 1 or output of industry group 1 spreading (stimulating) to output of industry group 2

Put:

$$B = \left(\begin{bmatrix} I & 0 \\ 0 & I \end{bmatrix} - \begin{bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{bmatrix} \right)^{-1} = \begin{bmatrix} B_{11} & B_{12} \\ B_{21} & B_{22} \end{bmatrix} \qquad (6)$$

Backward linkage of sectors group 1 was included:

$$BL_1 = (B_{11} + B_{21}) = (I - A_{11})^{-1} + (B_{11} - (I - A_{11})^{-1}) + B_{21}$$

So, output requirement include Multiplier effects: $(I - A_{11})^{-1}$), interregional feedback effects: $(B_{11} - (I - A_{11})^{-1})$ and spillover effects: B_{21}.

So, we can see the outputs of digital sectors (X_1) and the rest of sectors (X_2) was defined as follow:

$X_1 = B_{11}.Y_1 + B_{12}. Y_2$ (7)

$X_2 = B_{21}. Y_1 + B_{22}. Y_2$ (8)

Equations (7) and (8) imply that the output of economy is generated by its own final demand and from inter-sartorial feedback effects between sectors (With: I,j = 1.2)

And the added value of industry groups 1 and 2 is determined:

$GVA_1 = v_1.X_1 = v_1.(B_{11}.Y_1 + B_{12}. Y_2)$ (9)

$GVA_2 = v_2.X_2 = v_2.(B_{21}. Y_1 + B_{22}. Y_2)$ (10)

Where v_1 and v_2 are vectors of the coefficients of value added relative to production value

So we can defined $GVA_{\text{digital}} = GVA_{\text{core digital}} + GVA_{\text{spillover digitized economy}}$, such as equation (9) and (10)

In which:

$GVA_{\text{core digital}} = v_1.(B_{11}.Y_1 + B_{12}. Y_2)$ (11)

$GVA_{\text{spillover digitized economy}}, = v_2.B_{21}. Y_1$ (12)

Equation (11) shows $GVA_{\text{core digital}}$ was induced by final use of themselves and production of the rest of economy when used products of digital products for intermediate input. Equation (12) implies that the final products of digital industries spills over into the value added of other sectors in the

This study defines: $v_1.B_{11}.Y_1 = GVA_{\text{basic digital}}$ was induces by final products of themselves;

$v_1.(B_{12}. Y_2) = GVA_{\text{digitized}}$ was induced by production of other sectors

$v_2.(B_{21}. Y_1 = GVA_{\text{Spillover digital}}$ It is understood as the value added of other industries in the economy that is induced by the final products of the digital industry group.

$GVA_{\text{core digital}} = GVA_{\text{basic digital}} + GVA_{\text{digitized}}$

So, the contribution of digital economy ϕ_{digital} includes core digital economy ($GVA_{\text{core digital}}$) and spillover induced by final products of digital sectors:

$\phi_{\text{digital}} = GVA_{\text{core digital}} + GVA_{\text{Spillover digital}}$

III. Some Findings and discussions

Table 1 shows that in general, how much will an increase of 1 million Vietnam dong in IT output stimulate other sectors of the economy? Specifically, an increase in the output of the IT products manufacturing industry by 1 million Vietnam dong will stimulate other sectors of the economy by 300,000 Vietnam dong, and the content and communications industry will increase output by 1 million Vietnam dong, which will stimulate other industries to increase their output. 390 thousand Vietnam dong, the output of IT service industry increased by 1 million Vietnam dong, increasing the output of other industries by 280,000 Vietnam dong. The remaining 24 sectors in the research modelare shown in Table 1 below.

Table 1. Spillover effects of a unit increase of ICT's final products (times): $(I - A_{22})^{-1}.A_{21}$

	IT products	**content and communications**	**IT services**
Agriculture	0.0029	0.0084	0.0036
forestry	0.0057	0.0063	0.0050
Fishing	0.0006	0.0017	0.0008
Metal ores and mineral products	0.0093	0.0117	0.0113
Processed foods	0.0026	0.0072	0.0034
Beverages and cigarettes	0.0001	0.0003	0.0001
Textile and leather products	0.0016	0.0033	0.0027
Wood and paper products	0.0135	0.0165	0.0153
Chemicals, petroleum, coal, rubber, plastic products	0.0375	0.0551	0.0401
Non-metallic mineral products	0.0088	0.0051	0.0201
Base metals and other metal products	0.0563	0.0161	0.0259
Machines, equipment, tools and their accessories	0.0558	0.0192	0.0195
Transport equipment	0.0002	0.0004	0.0002
Other processed and manufactured products	0.0176	0.0167	0.0095
Electricity and water	0.0065	0.0264	0.0179
Construction	0.0013	0.0065	0.0057
Wholesale and retail trade	0.0372	0.0378	0.0254
Shipping services	0.0170	0.0511	0.0226
Financial and accounting services	0.0112	0.0654	0.0318
Scientific services, business, employment	0.0048	0.0238	0.0146
Public services	0.0015	0.0072	0.0015
Educational service	0.0003	0.0032	0.0029
Health care service	0.0000	0.0003	0.0001
Entertainment and other services	0.0003	0.0039	0.0007
Total spillover effects	**0.2925**	**0.3937**	**0.2806**

Source: Authors calculated by I.O table, 2016

Table 2 shows how the change of digital sector will lead to the change in other sectors of the economy; in this study, the output of the digital sector is assumed to increase by 2 and 5%. The results show that if digital output increases 2% stimulate GDP growth of 1.21%, and a 5% increase in digital output will spread to 3.02% GDP growth. The sectors in the economy with an average level greater than unit are those stimulated good by the growth of the digital economy.

Table 2. Rest of economy was induced by digital sector (%): $\Delta V_2 = v_2 (I - A_{22})^{-1}.A_{21}. \Delta X_1$

The rest of economy changed	Output of digital sector increase 2%	Output of digital sector increase 5%	**Average**
Agriculture	1.16	2.89	1.07

forestry	1.38	3.46	1.28
Fishing	1.12	2.80	1.03
Metal ores and mineral products	1.25	3.13	1.15
Processed foods	1.14	2.85	1.05
Beverages and cigarettes	0.96	2.40	0.88
Textile and leather products	1.07	2.69	0.99
Wood and paper products	1.28	3.20	1.18
Chemicals, petroleum, coal, rubber, plastic products	1.29	3.22	1.19
Non-metallic mineral products	1.00	2.51	0.92
Base metals and other metal products	1.65	4.12	1.52
Machines, equipment, tools and their accessories	1.71	4.27	1.57
Transport equipment	1.16	2.90	1.07
Other processed and manufactured products	1.54	3.86	1.42
Electricity and water	0.82	2.05	0.76
Construction	0.61	1.53	0.56
Wholesale and retail trade	1.47	3.68	1.36
Shipping services	1.12	2.81	1.04
Financial and accounting services	0.77	1.92	0.71
Scientific services, business, employment	0.76	1.90	0.70
Public services	1.12	2.79	1.03
Educational service	0.35	0.88	0.33
Health care service	0.55	1.39	0.51
Entertainment and other services	0.75	1.87	0.69
GVA	**1.21**	**3.02**	

Source: Authors calculated by I.O table, 2016

Note: Call Vi is vector of value added of sectors i and vi = Vi/Xi

Table 3 shows that when the final demand for the production of IT products increases by 1 million dong, it will stimulate the spillover to the output of other industries of 348 thousand dong, the communication and IT content industry will increase by 1 million dong. spread to the output of other industries is 464 thousand dong and an increase of 1 million dong in IT services will spread to the output of other sectors of the economy is 399 thousand dong. Specific spillovers to 24 sectors of the economy are shown in Table 3.

Table 3. Rest of economy was induced by digital industries' final demand (times): B_{21}

	Sản xuất sản phẩm CNTT	**Truyền thông và nội dung CNTT**	**Dịch vụ CNTT**
Agriculture	0.003	0.010	0.005
forestry	0.007	0.007	0.007

Fishing	0.001	0.002	0.001
Metal ores and mineral products	0.011	0.014	0.016
Processed foods	0.003	0.008	0.005
Beverages and cigarettes	0.000	0.000	0.000
Textile and leather products	0.002	0.004	0.004
Wood and paper products	0.016	0.020	0.021
Chemicals, petroleum, coal, rubber, plastic products	0.045	0.065	0.057
Non-metallic mineral products	0.010	0.007	0.027
Base metals and other metal products	0.067	0.020	0.040
Machines, equipment, tools and their accessories	0.066	0.023	0.031
Transport equipment	0.000	0.001	0.000
Other processed and manufactured products	0.021	0.020	0.014
Electricity and water	0.008	0.031	0.024
Construction	0.002	0.008	0.008
Wholesale and retail trade	0.044	0.045	0.037
Shipping services	0.020	0.060	0.032
Financial and accounting services	0.013	0.076	0.043
Scientific services, business, employment	0.006	0.028	0.020
Public services	0.002	0.008	0.002
Educational service	0.000	0.004	0.004
Health care service	0.000	0.000	0.000
Entertainment and other services	0.000	0.004	0.001
Total impacts	**0.348**	**0.464**	**0.399**

Source: Authors calculated by I.O table, 2016

Calculation results from table I.O, 2016 show that the value added of core digital economy accounts for 6.61% of GDP, In which: Value added of “basic digital" contributed about 5,7% GDP and digitized economy accounts for about 1,04% of GDP, so the total impacts of final products of digital sectors will be 8,87% of GDP.

Table 4.1 shows that the final products of the digital sectors (Y_1) is not only induced to value added of digital sectors (V1), but also induced to values added of other sectors (V_2). Similar, other sectors also induced to value added of digital sectors; spillover of final demand of other products to value added to be relatively low (0,6%), This proves that the digitalization in the economy is very low.

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Table 4,2 shows value added induced by final products of themselves (84,27%) and 15,73% of value added induced by final products of other sectors; Similar, final products (Y_1) of digital sectors induced to value added of other sectors (V2) is about 1,27% and final products of other sectors (Y2) induced to value added themselves (V2) is about 98,73%.

Table 4.1 Value added induced by final demand (%)

	Y1	Y2
V1	71.2	0.6
V2	28.8	99.4
Total impacts of final products	100.0	100.0

Table 4.2 Value added induced by final demand (%)

	Y1	Y2	Total (Core digital)
V1	**84.27**	**15.73**	**100.00**
V2	**1.27**	**98.73**	**100.00**

IV. Conclusion

Today when digital has entered almost every area of life, from production to final consumption. Therefore, measuring and quantifying the role of digital is an urgent requirement.

This study attempts to quantify the role and value of digital economy in a relatively general way based on input-output system with the case of Vietnam..

Basic research attempts to measure the effects of the final products of the digital sectors induced to value added of the economy and not only on the value added of the digital economy sectors.

Research results show that the contribution of the digital economy (according to the method of this article) to 2019 is only 8.87%. Thus, Vietnam's goal of making the digital economy's contribution to account for 20% by 2025 and 30% by 2030 in GDP (Vietnam Prime Minister, 2020) is very difficult to come true. The most important indicator is the digitization of the economy (B12.Y2 or V1.B12.Y2); currently, this index accounts for 1.04% of GDP, this ratio increases as the economy uses digital inputs to increase.

The results show that it is a bit surprising that Vietnam has implemented a lot of support for IT development for economic development. Currently, the policy on information technology has been developed from the Government's Resolution 49/CP in 1993 on information technology development in Vietnam. Directive No. 58-CT/TW of 2000 of the Central Committee of the Party is often considered the most important guiding document on IT development in Vietnam due to the fact that it is issued by the highest leadership body of the country and it also shows a broader view of the position and role of IT in economic development. In 2010, the Prime Minister signed Decision 1755 / QD-TOT approving the project "Make Vietnam a strong country in ICT" emphasizing the determination of the Vietnamese government in developing the industry. IT & IT. However, from the results it is shown that, in the two aspects of supply and demand effects, IT stimulates the economy mainly on the supply side - that is, IT uses a lot of products from economic sectors of other industries. than other industries that use IT products and services to grow.

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Appendix 1: sectors

Code	Name
1	Agriculture
2	forestry
3	Fishing
4	Metal ores and mineral products
5	Processed foods
6	Beverages and cigarettes
7	Textile and leather products
8	Wood and paper products
9	Chemicals, petroleum, coal, rubber, plastic products
10	Non-metallic mineral products
11	Base metals and other metal products
12	IT production
13	Machines, equipment, tools and their accessories
14	Transport equipment
15	Other processed and manufactured products
16	Electricity and water
17	Build
18	Wholesale and retail trade
19	Shipping services
20	Communication and IT content
21	IT Services

22	Financial and accounting services
23	Scientific services, business, employment
24	Public services
25	Educational service
26	Health care service
27	Entertainment and other services