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# **FAST AND SUSTAINABLE DEVELOPMENT IN DIGITAL REVOLUTION: AN APPLICATION OF KUZNETS CURVE**

**Ly Dai Hung<sup>1</sup>**

<sup>1</sup>Vietnam Institute of Economics, Hanoi

<sup>1</sup>ORCID ID: <https://orcid.org/0000-0003-2693-7996>

<sup>1</sup>Email: [hunglydai@gmail.com](mailto:hunglydai@gmail.com)

## **Abstract**

### Objective:

The paper investigates the fast and sustainable development pattern with the digital revolution by employing the Kuznets curve. The data is a cross-section sample of 180 economies over 1990-2021 time period. And the research objective is to consider whether there exists a fast and sustainable development space in the current digital revolution around the world.

### Methodology:

The research methodology combines the qualitative and quantitative analysis. The qualitative analysis examines the application of well-known social and environmental Kuznets curve in the digital revolution. Then, the quantitative analysis explores the empirical evidence on the relationship of economic growth with the social and environmental results, under the impact of the digital revolution.

### Findings:

The qualitative analysis shows that the Kuznets curve is well-recorded in the literature of income inequality and environmental reservations. And the digital revolution tends to push forward the achievement of social and environmental results. Moreover, the quantitative analysis records that both the social and environmental Kuznets curves exist. And the digital revolution can change the pattern of Kuznets curve in the direction that enhance the fast and sustainable development.

### Implications:

The evidence suggests that the digital revolution is crucial for the fast and sustainable development cross economies around the world. Thus, one possible policy mechanism can be the stimulation of digital revolution so that an economy can first achieve the social Kuznets curve then the environmental Kuznets curve.

**Keywords:** Digital Revolution; Fast and Sustainable Development; Kuznets Curve.

## 1. INTRODUCTION

The fast and sustainable development is crucial for an economy to catch up with the world leading economy. The fast development creates the financial resources for the sustainable development, while the sustainable development, in turn, can ensure the fast development. By that way, the concept of fast and sustainable development is mainly employed in the public policy architecture, especially on the long-term strategy development.

The current paper analyzes the fast and sustainable development by referring to the recent digital revolution. There are many contribution of digital revolution toward the economic development, one of which is to the fast and sustainable development. The paper records that the dependence pattern of fast and sustainable development on the digital revolution can follow one inverted-U shaped curve. Since these curves can be depicted as one Kuznets curve, the impact of digital revolution on the fast and sustainable development can be imaged as one extension of Kuznets idea on the economic growth and economic inequality over the development space.

The paper belongs to the literature on the nexus between economic growth and sustainable development. The economic growth depends on the technology progress since at the long run equilibrium, the output per capita grows with the total factor productivity growth rate (Solow, 1956; Swan, 1956). And the sustainable development refers to the combination of economic, social and environmental aspects of development stage (Schumpeter and Backhaus, 2003).

The paper makes a contribution on the economic growth and sustainable development literature. Its evidence shows that the digital revolution can contribute significantly on the achievement of fast and sustainable development. In particular, our evidence extends the Kuznets curve on the relationship between economic growth and income inequality to the environmental protection, under the impact of digital revolution.

The paper is structured as follows. The first section on Introduction would briefly describe the main results. Then, the second section on Framework analyzes the theory and data, while the third section on Evidence investigates the fast and sustainable development. Finally, the fourth section on Conclusion would summarize the paper and discuss the public policy.

## **2. ANALYSIS FRAMEWORK**

### **2.1.Theory**

The fast and sustainable development is one quite new concept on the economic development literature. The sustainable development is well-recorded a state of development in which the economic growth goes along with the social achievement and environmental protection. And the fast development arises mainly from the strategy architecture along the development process, which is also realized on the recent long-term social economic strategy in the Vietnam economy.

There are two types of sustainable development, including the weak sustainability and strong sustainability. Indeed, the weak sustainability is attained at the intersection between the economic, social and environmental aspects of the development process. And the strong sustainability is attained at each stage of economic development, which also requires the social and environmental achievement at the same time.

The weak sustainability is originated from the seminal paper by Hotelling (1931) on the exhaustible resources. Accordingly, the resource has a limited supply, then, tends to reduce over time. The optimal way is to explore the resource so that the growth rate of the resource price is equal to the real interest rate on the financial market. Apply this concept, usually mentioned as Hotelling rule, many authors such as Solow (2014), has extended this line of research and form the weak sustainability. In general, this type of sustainability is based on the idea that the natural capital, which is given by the nature, can be substituted by the physical capital, which is created by the human.

The strong sustainability is developed along with the literature on the ecology (Daly, 1990; Harwick, 1978). This concept considers that the natural capital can not be perfectly substituted by the physical capital. Therefore, the economic development needs to be equipped with the social and environmental achievement at each economic stage. This concept can be thought as the combination of economic – social – environmental results in each development stage.

While the sustainable development is well recorded in the literature, the concept of fast development is mainly referred on the public policy discussion. In particular, an economy achieving the fast development when its economic growth rate is higher than its average growth rate in the past, or higher than the average of world economies. The first case is the time-series fast development while the second case is the cross-section fast development (Hung, 2022). Recently, the long-term development strategy of Vietnam economy follows the first concept, in which, the fast development can be thought as the combination of economic growth rate being higher than 6.4%, the average growth rate over 1990-2020, with the stability of income distribution.

## **2.2.Data**

The data is one cross-section sample of 122 economies over 1990-2021. Each variable is averaged over time period so that the analysis can focus on the long-run role of digital revolution on the fast and sustainable development.

First, the economic growth rate, denoted by (*aGDPpcgrowth*), is measured by the growth rate of output per capita at constant 2015 USD price. The output, in turn, is the gross domestic product (GDP). This variable captures the growth rate of living standard, which is consistent with the concept of economic development. Moreover, it also reflects the technological progress since at the long run equilibrium, the output per capita grows with the total factor productivity progress rate. The data covers the 1990-2020 period, and is from the world development indicators, constructed by the World Bank (2022).

Second, the income inequality, denoted by (*aGini*), is measured by the gini index. This index covers the distribution of income across population, with a higher index reflecting more inequality. The data covers the 1990-2020 period, and is from the world development indicators by World Bank (2022).

Third, the environmental protection is measured by the genuine savings per GDP on percentage, denoted by (*aGenSav*), that is the gross savings subtracting by the environmental damage. A higher genuine savings per GDP means that an economy is more efficient on its economic activities. The data covers the 1990-2020 period, and is from the world development indicators by World Bank (2022).

Fourth, and also the focal variable, is the digital revolution, which is measured by the financial services coverage, denoted by (*LnFinance*). This variable is the ratio of adults having the financial services over the whole population, on percentage. The data is extracted from the world financial index (World FinDex) constructed by the World Bank (2022) by 3-year survey from 2011 to 2021.

### 2.3. Model

The empirical model is specified as one cross-section ordinary least squares (OLS), with the following form:

$$Y_j = \alpha^Y + \beta_{Finance}^Y LnFinance_j + \beta_{Finance,2}^Y LnFinance_j^2 + \varepsilon_j$$

Whereby for each dependence variable,  $Y_j = (aGDPpcgrowth_j, aGini_j, aGenSav_j)$ , the regression equation finds out quadratic terms, including  $(\beta_{Finance}^Y)$  and  $(\beta_{Finance,2}^Y)$ . These terms presents an inverted-U shaped curve for the dependence pattern of dependence variable on the technology revolution.

The specification of one quadratic function is inspired by the Kuznets curve, introduced in the seminal paper by Kuznets (1955), and is also intensively analyzed by recent authors such as Piketty (1996) on various aspects from the social to environmental achievements. Accordingly, the income inequality follows one quadratic fuction of income growth rate. For low income growth, a higher growth

rate is associated with more income inequality. But for high enough income growth, a higher growth rate is associated with less income inequality. The turning point of these two patterns is the also maximum value of the quadratic function.

### 3. EMPIRICAL EVIDENCE

Table I presents the regression results of three dependent variables, including the economic growth, income inequality and environmental protection on the technology revolution. In column (1), the economic growth follows a quadratic function of financial coverage. The regression coefficients can be imagined as one inverted-U shaped curve for which an increase of financial coverage is first associated with higher economic growth rate then goes along with less economic growth rate.

Table 1: Cross-Section Regression Results of Economic Growth, Income Inequality and Environmental Protection on Technology Revolution

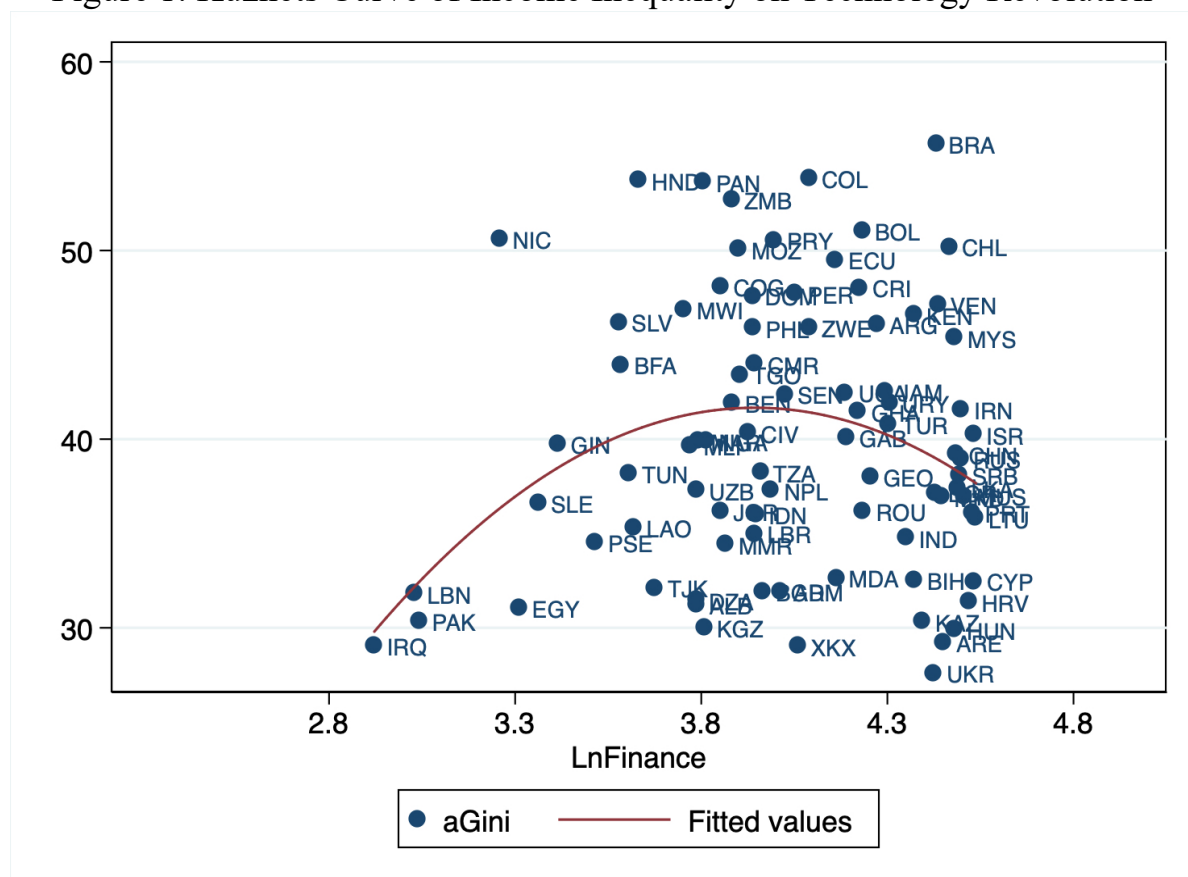
VARIABLES	(1) Economic Growth ( <i>aGDPpcgrowth</i> )	(2) Income Inequality ( <i>aGini</i> )	(3) Environmental Protection ( <i>aGenSav</i> )
Financial Coverage ( <i>LnFinance</i> )	8.698*** (2.649)	139.0*** (25.98)	4.441** (1.894)
Squared Value of <i>LnFinance</i> ( <i>LnFinance2</i> )	-1.057*** (0.354)	-17.97*** (3.248)	-0.747*** (0.243)
Constant	-15.57*** (4.925)	-226.0*** (51.53)	-4.525 (3.656)
Observations	122	110	112
R-squared	0.116	0.268	0.408

Notes: Standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1



The decreasing portion of the curve can be explained by the base effect: at a higher technology level, the contribution of technology on the economic growth can go down. Aghion and Howitt (1998) also establish that the economies with low technology level can have a high economic growth by imitating the advanced technology. But for the economies with high technology level, especially the economy at the world technology frontier, their economic growth rate would be low since they have to invent new technology, which has very low probability of success.

Figure 1: Kuznets Curve of Income Inequality on Technology Revolution

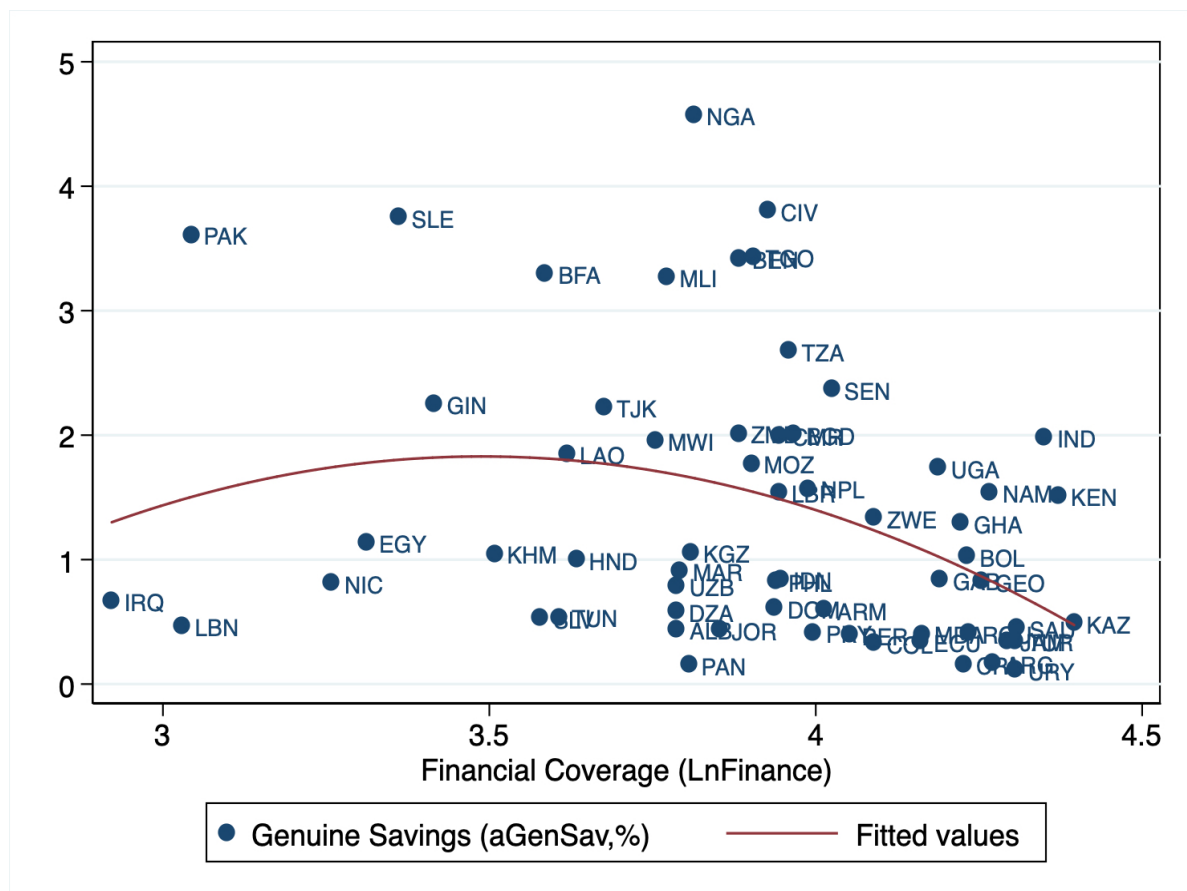


Source: Author's calculation from the data sample.

The income inequality also follows a quadratic function of technology revolution. In column (2), the regression coefficients are all significant. This implies that the dependence pattern of income inequality on financial coverage is one inverted-U shaped curve. Accordingly, for low financial coverage, an increase

of coverage raises the income inequality, but for high financial coverage, an improvement of coverage reduces the income inequality. This inverted-U-shaped curve recall the well-known Kuznets curve. The difference is that while the original Kuznets curve concerns the income inequality and economic growth, the Kuznets curve recorded in Table (1) reveals the dependence of income inequality on the technology revolution.

Figure 2: Kuznets Curve of Environmental Protection on Technology Revolution



Source: Author's caculation from the data sample.

The environmental protection also follows one quadratic function of the financial coverage. The estimated coefficients of the quadratic function in column (3) are all significant. This result can be imagined as an inverted-U shaped curve, a type of Kuznets curve, which captures the dependence pattern of the income inequality on the financial revolution. For a low financial coverage range, an increase of coverage is associated with more environmental protection. But for a high financial coverage range, an increase of coverage is associated with less environmental protection.

The Figure (2) depicts the dependence pattern of the environmental protection on the financial coverage. The turning point of environmental protection is around the financial coverage around 3.6. And many economies have the environmental protection, measured by the genuine savings per GDP, being in the range of 0 to 2. In brief, the environmental protection follows one inverted-U shaped as an Kuznets environmental curve on the financial revolution.

#### **4. CONCLUSION**

The paper analyzes the contribution of digital revolution on the fast and sustainable development by both qualitative and quantitative analysis. The quantitative analysis covers one sample of 120 economies over 1990-2021, with the digital revolution is proxied by the financial coverage ratio. The research method is one cross-section empirical model with an emphasizes on the quadratic regression function, which can be depicted by an inverted-U shaped, a type of Kuznets curve.

The evidence records the existence of Kuznets curve on the dependence pattern of the income inequality and environmental protection on the digital revolution. These curve implies that only for a high digital revolution level, proxied by low financial coverage ratio, more financial coverage is associated with less income inequality and lower environmental protection.

The evidence suggests that the digital revolution is crucial for the fast and sustainable development cross economies around the world. Thus, one possible

policy mechanism can be the stimulation of digital revolution so that an economy can first achieve the social Kuznets curve then the environmental Kuznets curve.

## REFERENCES

Daly, H. E. (1990). Sustainable development: from concept and theory to operational principles. *Population and Development Review*, 16, 25-43.

Hartwick, J. M. (1978). Substitution among exhaustible resources and intergenerational equity. *The Review of Economic Studies*, 45(2), 347-354.

Hotelling, Harold. "The economics of exhaustible resources." *Journal of Political Economy* 39.2 (1931): 137-175.

Ly Dai Hung. "Fast and Sustainable Development Space in Vietnam by a Multi-Dimension Approach." *VNU Journal of Economics and Business* 2.5 (2022): 1-10.

Piketty, Thomas. "The Kuznets curve: Yesterday and tomorrow." *Understanding Poverty* (2006): 63-72.

Kuznets, Simon. "Economic growth and income inequality." *The gap between rich and poor*. Routledge, 2019. 25-37.

Solow, Robert. "An almost practical step toward sustainability." *An Almost Practical Step Toward Sustainability*. RFF Press, 2014. 11-28.

Schumpeter, Joseph, and Ursula Backhaus. "The theory of economic development." *Joseph Alois Schumpeter*. Springer, Boston, MA, 2003. 61-116.

Solow, Robert M. "A contribution to the theory of economic growth." *The Quarterly Journal of Economics* 70.1 (1956): 65-94.

Swan, Trevor W. "Economic growth and capital accumulation." *The Economic Record* 32.2 (1956): 334-361.

World Bank (2022). World Development Indicators. <https://databank.worldbank.org/source/world-development-indicators>.

World Bank (2022). Global Findex Database. <https://www.worldbank.org/en/publication/globalfindex>.