ANALYZING THE IMPACT OF CAPITAL AND LABOUR ON ECONOMIC GROWTH IN VIETNAM - COBB-DOUGLAS APPROACH

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Abstract: ***The article presents empirical evidence on the impact of capital and labour on economic growth in Vietnam during the period, using the Cobb-Douglas production function. The study uses time series data in the period 1990-2023. The ordinary least squares (OLS) method is used to estimate the model. The results show that there is a statistically significant positive impact of labour and capital on economic growth in Vietnam. The adjusted R2 value reaches 98.9%, showing that capital and labour are the main resources driving Vietnam's economic growth. In addition, the results also show that the efficiency of the economy increases with scale. From there, some recommendations are made to promote Vietnam's economic growth in the coming years.***

• Keywords: *economic growth, capital, labour, cobb-douglas production function.*

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1. Introduction

Economic growth has long been considered one of the central objectives of national development strategies, and understanding its determinants remains a pivotal concern in both theoretical and empirical economics. Since the seminal contributions of Solow (1956), Swan (1956), and Solow & Swan (1956), growth theory has emphasized the roles of capital accumulation and labour supply as the fundamental engines driving the expansion of productive capacity. Capital, by enhancing the availability of physical assets such as machinery, infrastructure, and technology, enables economies to increase output per worker and stimulate productivity. The mechanism is typically explained through capital deepening, whereby the marginal product of labour rises as workers are equipped with better tools, leading to higher aggregate output. Moreover, capital also embodies technological progress and knowledge diffusion, which further amplify its contribution to long-run growth trajectories.

Similarly, labour constitutes a critical factor of production, as the size, quality, and productivity of the workforce directly influence the capacity of an economy to generate goods and services. labour's impact on growth is not merely quantitative but also qualitative, since improvements in human capital - through education, skills, and health - enhance the efficiency with which workers utilize capital. The dynamic interplay between labour and capital is therefore crucial, as economies with abundant labour but limited capital may experience diminishing returns, whereas those with balanced accumulation of both factors can sustain higher levels of growth. In this regard, labour force expansion contributes to output growth, while human capital development ensures that labour complements rather than constrains the utilization of physical capital.

To analyze these mechanisms rigorously, economists frequently employ the Cobb-Douglas production function, which provides a parsimonious yet powerful framework for quantifying the contribution of capital and labour to economic growth. Its functional form allows for the estimation of output elasticities with respect to both inputs, offering valuable insights into the relative importance of each factor within a given economy. Furthermore, the Cobb-Douglas specification captures the principle of diminishing marginal returns while accommodating constant returns to scale, making it particularly suitable for comparative analysis across different stages of development. Numerous empirical studies have applied this model to examine the growth experiences of both developed and developing economies, yet its application to Vietnam remains

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both timely and necessary given the country's rapid structural transformation.

Vietnam's remarkable economic progress over the past three decades has been characterized by substantial capital inflows, structural shifts in labour allocation, and impressive productivity improvements. However, questions remain regarding the precise contribution of capital and labour to this growth trajectory, particularly in the context of ongoing industrialization, demographic change, and technological adoption. By applying the Cobb-Douglas approach, this study seeks to disentangle the relative roles of capital and labour, thereby offering an evidence-based assessment of the underlying growth dynamics.

The findings of this research hold significant implications for economic policy. Understanding the elasticity of output with respect to capital and labour provides policymakers with a robust basis for designing strategies that balance investment in physical infrastructure with investments in human capital formation. Such evidence-based insights are indispensable for Vietnam, where sustaining high growth rates requires careful calibration of factor accumulation and productivity enhancement. By highlighting the relative contributions of capital and labour, this study not only enriches the empirical literature on growth determinants in emerging economies but also delivers practical guidance for policy formulation aimed at fostering sustainable and inclusive economic development.

The above introduction is followed by an overview of domestic and foreign studies, then the data collection and research methods. The next part of the study is the empirical results together with discussions, and the final part proposes some implications.

2. Literature review

Swan (1956) extracted the principal component of China's expenditure per capita of local government based on the factor and cluster analysis method, to determine the structure of fiscal expenditure by category of basic services, senior services, economics, and resource protection. Then the paper analyzed the regional differences in the distribution of fiscal expenditure structure based on the systematic cluster analysis method. The conclusion was that Beijing, Tianjin, and Shanghai were the advanced service category of expenditure growth pole, which drove around cities' technology as well as education spending, and promoted regional economic growth.

Onalan & Basegmez (2018) applied the Grey Cobb-Douglas production model to predict the GDP, examine the effects of the variation rate of capital, and labour inputs to economic growth. Many factors contribute to economic growth, the capital and labour are the main elements of economic growth. Improving the capital and labour performance plays an important role in increasing the wealth of a country. Traditionally, the Cobb-Douglas (C-D) production model uses only capital stock and labour to describe economic growth. In this study, firstly C-D production function was established and confirmed that capital and labour had a positive impact on economic growth (GDP). The future GDP values were predicted by the estimated capital and labour values, putting them into the Cobb-Douglas model. The authors also obtained the production elasticities of capital and labour inputs. Findings suggested that the contribution rate of capital was 0.403 and labour was 1.094 to economic growth. The sum of the contributions of factors was 1.497 and greater than one. Findings of this empirical study showed that the percentage of the increase in GDP was greater than that of the increase in capital stock and labour.

For the case of Poland, Dritsaki & Stamatiou (2018) analyzed the relationship between international trade and economic and financial development for Poland for the period 1990-2016. For this long-run relationship, the authors applied the autoregressive distributed lag (ARDL) technique as well as the augmented Cobb-Douglas production function. The results of the ARDL test confirmed the existence of a long-run relationship between the examined variables. Capital seemed to be an impetus for economic development both in the short and long run, while labour had a negative impact on Poland's economic growth. However, trade openness and financial development were found to be insignificant on economic development, both in the short and long run. Finally, causality results showed that there was a unilateral causal relationship between financial development and labour towards economic development, and also a bilateral causal relationship between capital and trade openness with economic development.

A comparative analysis among selected Asian countries, in the case of Bangladesh, India, China, Malaysia, and Thailand, Khatun & Afroze (2016)

studied the relationship between real GDP and labour & capital by applying the Cobb-Douglas production function. The study used time-series data covering the period of 1990-2014. Ordinary Least Squares (OLS) was used to estimate the model. The results showed that there was a strong positive and significant relationship between labour and capital and real GDP in case of all the countries selected. The value of R^2 ranged between 0.930 to 0.988, indicating that most of the variations in real GDP in all these countries were explained by labour and capital alone. The results were statistically significant at the 1% and 5% levels of significance. The study also showed that there were increasing returns to scale in the production process in case of all the selected countries. It had been found that a 100% increase in labour would increase real GDP by 301% and a 100% increase in capital would increase real GDP by 40%. The contribution of both labour and capital was the highest in the case of China, followed by Bangladesh. The contribution of capital was lowest in the case of Thailand (10%) and Malaysia (15%) because they both emphasized investing in human capital by giving importance to education, health, and training of their labour force.

Another application of the Cobb-Douglas production function can be found in Dana & Jaromír (2007). The Cobb-Douglas production function is often used to analyse the supply-side performance and measurement of a country's productive potential. This functional form, however, includes the assumption of a constant share of labour in output, which may be too restrictive for a converging country. In this paper, the authors tested whether this fact renders the application of the Cobb-Douglas production function unreliable for the Czech economy. The authors applied a more general form of production function and allowed the labour share to develop according to the empirical data. For the period 1995-2005, the authors did not find a significant difference between the calculation of the supply side of the Czech economy by the Cobb-Douglas production function and a more general production function.

A comprehensive review of the existing literature unequivocally demonstrates that employing the Cobb-Douglas production function constitutes a theoretically sound and empirically validated approach to assessing the impact of capital and labour on economic growth. It has been consistently emphasized that this functional form, by capturing factor elasticities and accommodating constant returns to scale, allows growth dynamics to be disentangled with analytical precision, thereby reinforcing the appropriateness of its application in examining Vietnam's developmental trajectory.

3. Methodology and research data

The Cobb-Douglas production function is one of the most widely used production functions in economic analysis. The Cobb-Douglas production function not only reflects the basic economic law but also makes it easy to calculate and interpret the estimated parameters. The purpose of applying the Cobb-Douglas function is to estimate the coefficients of input factors affecting total output and returns to scale. The Cobb-Douglas function has the form:

$$Y = AK^{\alpha}L^{\beta}$$

where Y is total output, represented by GDP, K is total capital stock, and L is total labour.

Take the logarithm of both sides of the above equation to get the linear equation:

$$LnY = LnA + \alpha LnK + \beta LnL$$

The coefficient A represents the productivity of total factors, α is the coefficient of capital contribution, and β is the coefficient of labour contribution. α + β indicates the return to scale. If α + β > 1, it shows increasing return to scale, if α + β <1, it shows decreasing return to scale, and if α + β = 1, it shows constant return to scale.

Table 1 below reports the description of the variables used in the study, collected from the World Bank data source.

Table 1. Variables and Measurement

Variables name	Symbols	Variables measurement
Economic growth	GDP	Gross domestic product (at local current unit, thousand billion Dongs)
Capital	CAPITAL	Gross capital formation (at local current unit, thousand billion Dongs)
Labour	LABOUR	Labour force, total (million)

Source: Authors' summary.

4. Empirical results

First, descriptive statistics of the study variables are presented in the following Table 2:

Table 2. Descriptive statistics

	GDP	CAPITAL	LABOUR
Mean	2930.502	841.6545	45.57281
Median	1154.167	742.6952	45.54258
Maximum	10320.31	2101.984	56.79900
Minimum	41.95500	61.55807	31.53525
Std. Dev.	3225.591	631.2276	8.574476
Skewness	0.894469	0.553707	-0.122674
Kurtosis	2.424438	2.072981	1.526887
Jarque-Bera	5.003057	2.954783	3.159530

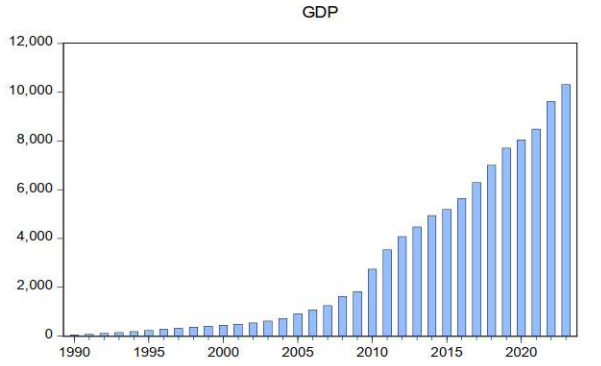
	GDP	CAPITAL	LABOUR
Probability	0.081960	0.228232	0.206024
Sum	99637.07	28616.25	1549.475
Sum Sq. Dev.	3.43E+08	13148793	2426.214
Observations	34	34	34

Source: Summarized by the author

The descriptive statistics reveal substantial heterogeneity across the three variables. GDP exhibits a relatively high mean of 2,930.50 trillion VND, though its large standard deviation (3,225.59) and maximum value (10,320.31) indicate pronounced volatility and a right-skewed distribution, reflecting periods of accelerated economic expansion. Capital displays a mean of 841.65 trillion VND, with moderate dispersion (standard deviation of 631.23) and positive skewness, suggesting that a few years experienced exceptionally high levels of investment. Labour, measured in millions of people, appears more stable, with a mean of 45.57 and relatively low variability (standard deviation of 8.57). Its distribution is slightly left-skewed, reflecting demographic consistency. The Jarque-Bera test statistics do not reject normality for all three variables at the 5% significance level, implying that the distributions approximate normality, thereby enhancing their suitability for econometric modeling.

The graph depicting Vietnam's economic growth in the period 1990-2023 is shown in Figure 1 below.

Figure 1. Vietnam's economic growth in the period 1990-2023



Source: Summarized by the author

Vietnam's economic performance over the period 1990-2023 demonstrates a remarkable and sustained growth trajectory. GDP increased from merely 41.96 trillion VND in 1990 to more than 10,320 trillion VND in 2023, representing a nearly 250-fold expansion within three decades. The data reveal an accelerating growth pattern, particularly after the early 2000s, when GDP began to rise more steeply, surpassing 1,000 trillion VND in 2005 and exceeding 5,000 trillion VND by 2015. The period after 2010 is characterized by pronounced momentum, with GDP expanding rapidly to over 10,000 trillion VND in 2023, despite global economic volatility. This consistent upward trajectory reflects Vietnam's successful structural transformation, integration into global markets, and improvements in capital accumulation, labour productivity, and institutional capacity.

The results of Cobb-Douglas function estimation for Southeast Asian countries are presented in the following Table 3:

Table 3. Estimation results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-18.22779	1.915491	-9.515992	0.0000
LNCAPITAL	0.432132	0.143471	3.011985	0.0051
LNLABOUR	5.932784	0.736734	8.052818	0.0000

Source: Summarized by the author

The main objective of the study is to examine whether both labour and capital can contribute significantly to the growth of manufacturing in Vietnam, and the empirical results using the Cobb-Douglas production function have confirmed these results. The estimated equation is as follows:

$LnGDP = -18.22 + 0.432*LnCAPITAL + 5.932*LnLABOUR$

or in another form as:

$GDP = 1.2*10^{-8}*CAPITAL^{0.432}*LABOUR^{5.932}$.

Here, the adjusted R2 coefficient of determination of the Cobb-Douglas production function for Vietnam is 98.9%, indicating that the model fits very well in the case of Vietnam. From the estimation results in Table 1, the elasticity of GDP with respect to labour is 5.9 and that with respect to capital is 0.432. That is, if the labour force increases by 1%, GDP will increase by 5.9%; on the other hand, if capital increases by 1%, Vietnam's GDP will increase by 43.2%.

In terms of returns to scale, Vietnam has increasing returns to scale, as shown in the results that $\alpha + \beta = 0.432 + 5.932 = 6.364$, which is greater than 1. The estimation results reveal that Vietnam exhibits increasing returns to scale, as indicated by the sum of output elasticities ($\alpha + \beta = 6.364$), which substantially exceeds unity. This implies that a proportional increase in capital and labour inputs generates a more than proportional increase in aggregate output, suggesting that the production structure benefits from scale economies. Such a

phenomenon may reflect the combined effects of technological progress, enhanced managerial efficiency, and productivity gains derived from specialization and structural transformation. The finding underscores that Vietnam's growth trajectory is not solely reliant on factor accumulation but is also reinforced by improvements in total factor productivity, thereby highlighting the economy's potential to sustain high growth rates through both input expansion and efficiency enhancement. The empirical results in this paper are similar to those in Onalan & Basegmez (2018).

5. Conclusion

Vietnam's long-term growth prospects critically depend on its ability to mobilize and allocate resources effectively while simultaneously upgrading its institutional and technological foundations. As the economy deepens its integration into global value chains, sustaining high growth rates requires a dual strategy that leverages both capital accumulation and labour force transformation. In particular, capital investment must be oriented toward infrastructure modernization and digital adoption, while labour development strategies should prioritize human capital formation and digital workforce readiness. Together, these complementary approaches create a synergistic framework for promoting sustainable and inclusive economic growth.

Capital-based strategies

To begin with, strengthening capital accumulation through sustained infrastructure investment remains imperative. Infrastructure not only enhances productive capacity but also reduces transaction costs and fosters regional connectivity. Expanding public-private partnerships can mobilize large-scale resources for transport, energy, and digital infrastructure, thereby creating multiplier effects that reinforce industrial upgrading and long-term economic growth.

Furthermore, expanding access to finance for small and medium-sized enterprises constitutes another pivotal solution. Capital deepening at the firm level promotes innovation, productivity, and competitiveness. By improving credit markets, diversifying financial instruments, and strengthening regulatory frameworks, Vietnam can channel capital more efficiently, ensuring that private sector dynamism contributes substantially to aggregate output expansion and economic diversification.

Finally, leveraging the transformative potential of Industry 4.0 requires targeted capital investment in advanced technologies such as artificial intelligence, big data, and automation. Strategic adoption of these innovations not only enhances production efficiency but also fosters new business models and value chains, allowing Vietnam to capture higher value-added activities within global supply networks.

Labour-based strategies

Equally important, enhancing human capital formation through education reform is fundamental to aligning workforce skills with rapidly changing labour market demands. Strengthening STEM disciplines, fostering creativity, and promoting lifelong learning can cultivate a digitally competent labour force capable of supporting innovation-driven growth and sustaining productivity improvements.

In addition, expanding vocational training and reskilling programs tailored to digital competencies represents a critical pathway. By integrating digital literacy, coding, and data analytics into vocational curricula, Vietnam can transform its labour force into a more adaptive and resilient engine of growth, ensuring that technological change complements rather than displaces employment opportunities.

Finally, promoting inclusive labour market participation by empowering women and disadvantaged groups is essential for fully harnessing demographic potential. Policies that encourage flexible work arrangements, digital entrepreneurship, and remote employment can broaden workforce engagement, thereby boosting aggregate labour supply, enhancing equity, and consolidating the foundations of sustainable and inclusive growth.

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