THE MANUFACTURE ECOSYSTEM TOWARDS GREEN ECONOMIC GROWTH: A PER CAPITA INCOME PERSPECTIVE IN VIETNAM

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Appendix 1. Overview of the manufacturing ecosystem, green growth, and per capita income

The manufacturing ecosystem

Nowadays, customers' expectations for the manufacturing industry are getting higher, they demand better services than products. Manufacturing companies provide exceptional services that can improve business efficiency, customer experience and internal operations (Cenamor, 2017). Many manufacturers are looking for new business models to compete in the digital age. Manufacturing ecosystems help expand the scope of the supply chain and develop the industry (Rong, 2023), helping businesses meet customer needs and increase competitiveness. In the manufacturing ecosystem, there are many components such as suppliers, distributors, technology providers, etc. They play an important role in the production process: product innovation, design, production, and distribution (Helo, 2021).

Green growth

The idea of green growth production has developed concerns from the chemical issues of nutrients such as world goods, Global Green Growth Institute (GGGI), Organization for Economic Cooperation and Development (OECD), ... Green growth refers to the strength of population, increasing demand for goods and services, the need to reduce poverty.

According to OECD, Green Growth is a source of economic growth and development but still ensures resources. Green growth policy aims to bring economic and improve human life by conserving and using natural capital efficiently (OECD, 2014).

Per capita income

Per capita income is a measure of the income of people in a country or a geographical area. This index determines the average income per capita and assesses the standard of living of that country. However, it does not take into account income distribution, economic inequality, quality of life, education, or health care (Mankiw, 2020).

Appendix 2. Data processing and analysis methods

Step 1: Data on GDP per capita (GDP), agricultural production value (AGR) and CO_2 emissions (CO2) were collected from reliable sources such as the World Bank for the period 2000 to 2022 in Vietnam. To ensure that the input data are normally distributed, the study conducted a logarithm of the input research data.

Step 2: Descriptive statistics were computed to analyze the basic features of the data, i.e., mean, variance, standard deviation, maximum, and minimum values attained by each variable. Scatter plots were also used as a pictorial representation of AGR, GDP, and CO2 to view which variables are correlated. A trend analysis of CO_2 emissions over the years was also done to see how much strength per capita income and agricultural activities have in explaining variations in emission levels.

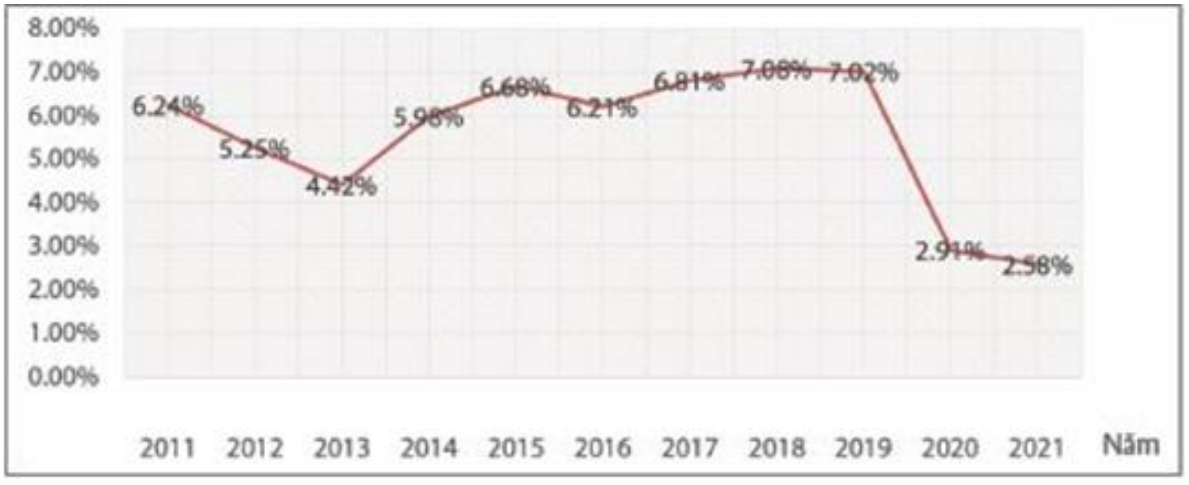
Step 3: The R-based Quantile-on-Quantile Regression (QQR) approach was thus developed to estimate the influence of AGR and GDP on CO_2 emissions at different quantile levels. What accrues is not a simple mean

effect but rather an understanding of how different quantiles of AGR and GDP affect different quantiles of CO_2 emissions (for instance, 0.25, 0.5, 0.75). The analysis reflects in more detail the relations between variables under various states of the economy as per the comprehensive understanding that emerged regarding how income per capita and production in agriculture, forestry, and fisheries influence CO_2 emissions.

Step 4: The model was estimated, and an analysis of the significance of the regression coefficients was carried out. With statistical significance, those regression coefficients that were evaluated describe to which independent variable has an effect on CO_2 emissions. Results across different quantiles were finally compared to see how AGR and GDP effects vary with CO_2 emissions at different quantiles of distribution - i.e., at different stages of economic development.

Step 5: When necessary, different methods can be compared to evaluate accuracy and effectiveness. Based on the analysis results, the impact of AGR and GDP on CO_2 emissions is examined to propose appropriate policies aimed at reducing greenhouse gas emissions while fostering societal development, increasing people's income, and promoting sustainable agriculture.

Appendix 3. Vietnam's economic growth rate in the period 2011 – 2021

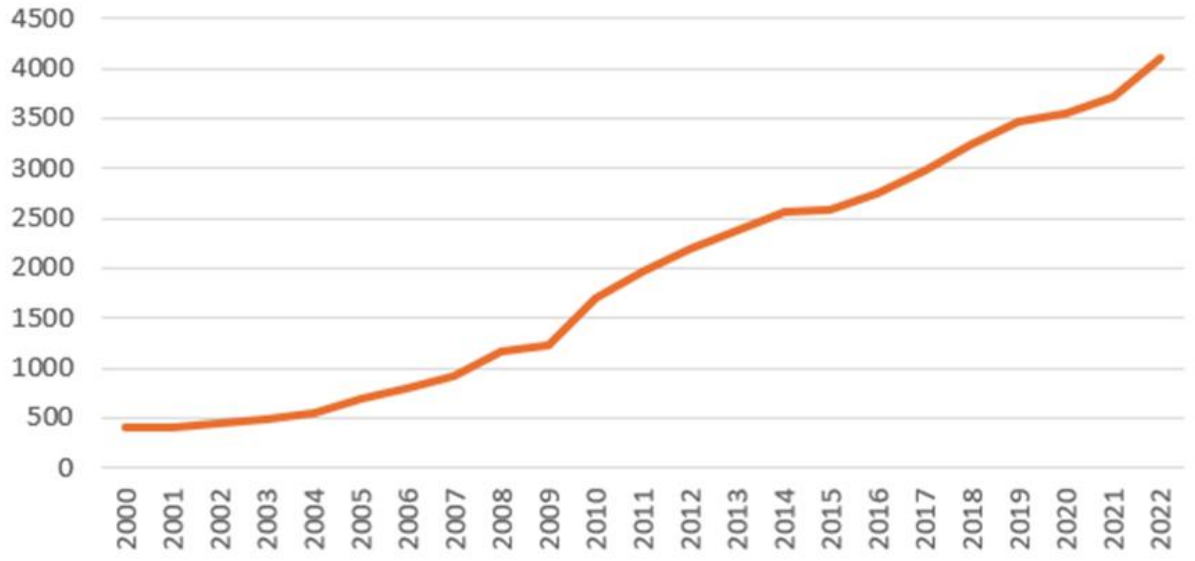


Source: National Statistics Office of Vietnam

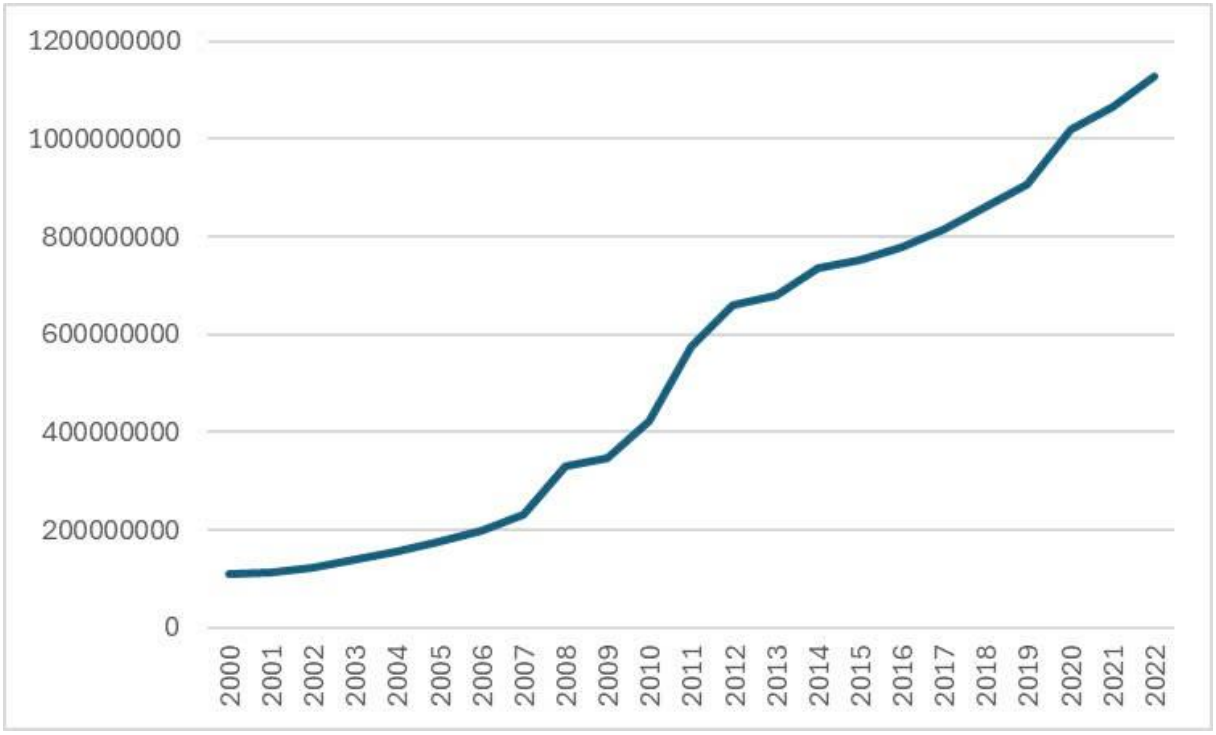
Appendix 4. Statistical table describing 3 variables of GDP, Agriculture, and CO2

	GDP	AGRICULTURE	CO_2
Mean	1927.018	535772724.3	173323981.2
Median	1958.063	575554560	155522800
Maximum	4110.219	1129908120	355323100
Minimum	401.5494	108356000	51207700
Std. Dev.	1230.753	345915729.4	98698466.13
Skewness	0.196561	0.161825233	0.629423101
Kurtosis	1.647229	1.60430044	2.139949645
Jarque-Bera	1.901845	1.9671966	2.227531193
Probability	0.386384	0.373963044	0.328320309
Sum	44321.42	12322772659600000	3986451567
Sum Sq. Dev.	33324544	263246921995453300000	214310518779799000

Appendix 5. Gross domestic product per capita from 2000 – 2022 (USD)



Appendix 6. Output value of Agriculture, forestry, and fishing at current prices (million VND)



Appendix 7. CO2 emissions from 2000 – 2022 (metric tons)