

Integrating Economic Growth and Environmental Sustainability: China's Policy Dynamics

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Abstract: This study explores the interplay between China's economic policies and climate protection measures, assessing their impacts on economic growth and CO₂ emissions. Utilizing a system dynamics model calibrated with data from 1970 to 2022, the research evaluates the effectiveness of administrative measures and investment policies in reducing CO₂ emissions and sustaining GDP growth. The findings highlight significant emission reductions per unit of GDP due to administrative measures, while investment-driven GDP growth faces challenges such as inadequate consumption, decreasing capital efficiency, and rising debt. The study suggests policy shifts towards enhancing non-investor income, increasing carbon pricing, and reallocating carbon pricing revenues to non-investors to promote sustainable development.

1. Introduction

Since economic reforms began in the late 1970s, China's GDP has grown 334 times, transforming it into the world's second-largest economy. However, this growth has been accompanied by skyrocketing debt levels. Between 1992 and 2022, while GDP saw a 44-fold increase, non-investor and corporate debt skyrocketed by 136 and 79 times, respectively. Concurrently, China became the world's largest CO₂ emitter in 2005, though emissions per unit of output have significantly decreased since 1990. This study aims to understand the interactive effects of economic and climate policies on development and emissions, employing a system dynamics model to simulate these complex interactions.

2. Literature Review and Research Questions

System dynamics have been pivotal in national economic research, offering insights into the interplay between various sectors. Previous models, such as those by Forrester and Radzicki, have highlighted the importance of integrating production, labor, finance, and other sectors. This study cites 30 literature sources and builds on such models, incorporating factors like production capacity, innovation, income distribution, purchasing power, debt, investment, and CO₂ emissions. Key research questions include the impact of income inequality on economic crises and the effectiveness of carbon taxation in emission reduction.

3. Simplified Model of Economic and Environmental Protection Policies

The model developed for this study outlines the relationships among key economic variables and CO₂ emissions, structured in four steps (Figure 1):

1. **Economic Development Drivers** (blue): Reinforcing loops show the core role of return and investment in economic growth.
2. **Non-Investor Debt** (red): The impact of debt/GDP on consumption and investment, highlighting the feedback loops that exacerbate debt levels.
3. **Green Production Capacity** (green): The introduction of green capacity to depict emission reduction efforts.
4. **Emission Reduction + Economic Policies** (yellow): Administrative measures and carbon taxes to shift investments towards green capacity as well as Strategies to boost GDP growth, reduce capital share, and enhance non-investor income.

The model's parameters, calibrated with historical data, accurately reflect China's economic and emission trends from 1970 to 2022. Sensitivity analyses demonstrate the potential of increasing carbon pricing and reducing capital share to promote GDP growth and emission reductions.

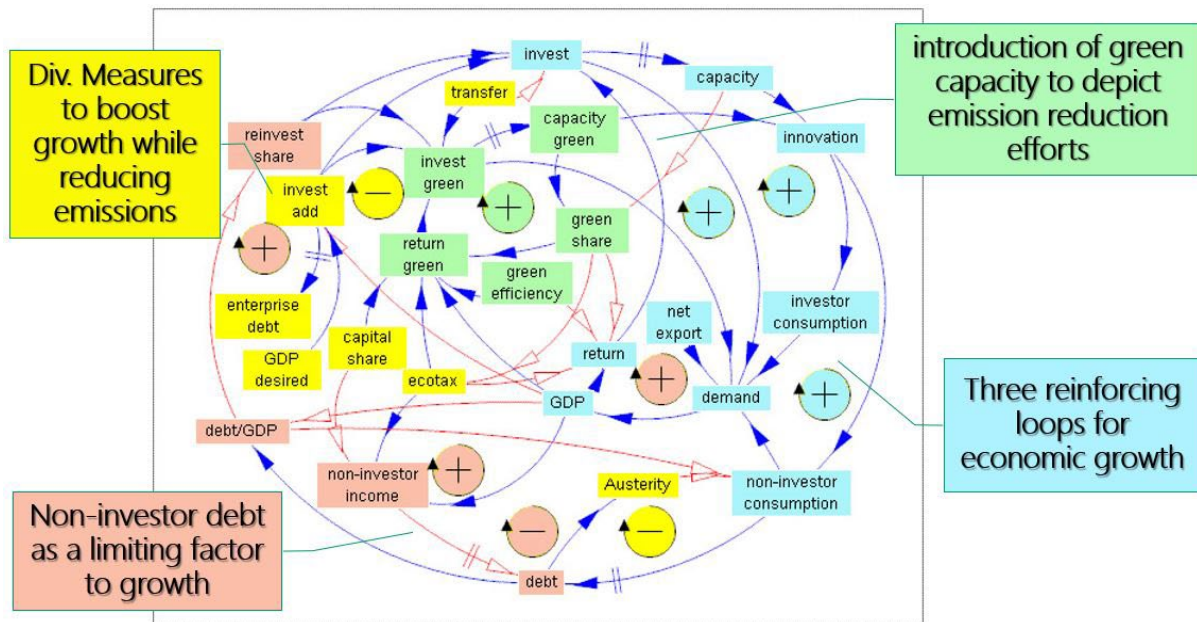


Figure 1: The model structured in four steps

4. Scenario Analysis

The study presents two policy scenarios:

1. **First Policy Scenario:** Halting administrative increases in capital formation, reducing capital share by 15 percentage points, and introducing an 11% carbon tax to increase non-investor income. This scenario significantly boosts non-investor consumption, reduces debt, and lowers CO₂ emissions.
2. **Second Policy Scenario:** Stronger measures, including a 16 percentage point reduction in capital share and a 36% carbon tax, lead to faster GDP growth, higher non-investor consumption, and more rapid CO₂ emission reductions.

Contour maps of GDP and CO₂ emissions for 2050 highlight the decision space for policymakers to balance economic and environmental goals, demonstrating that these objectives can be complementary (Figure 2).

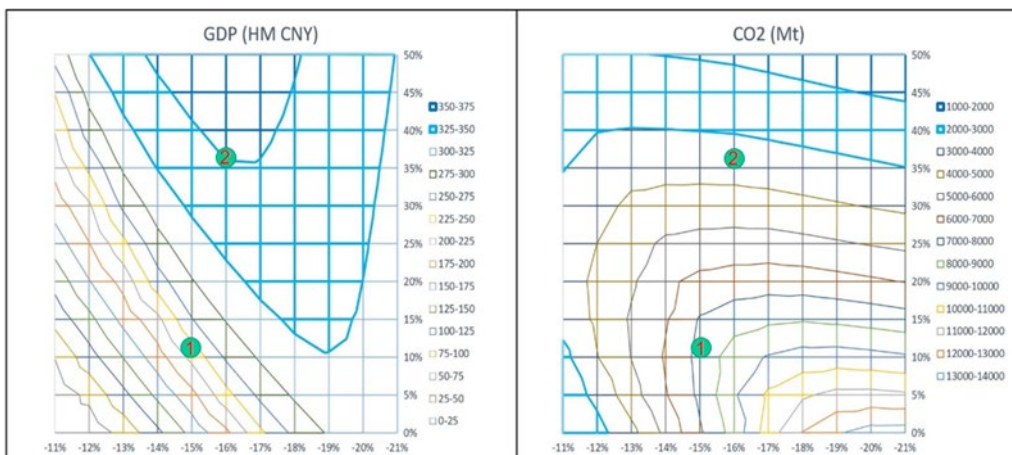


Figure 2: Contour map of GDP and CO₂ in 2050 calculated by the model with change and ecotax share as parameters. Both scenarios are depicted within the contour maps.

5. Summary

This research underscores the potential for China's economic policies to achieve sustainable growth and climate protection goals. By enhancing non-investor income, adjusting carbon pricing, and reallocating revenues, China can foster a balanced approach to economic and environmental development.