NZIPL Research Proposal

Modeling Multi-Regional Macroeconomic Dynamics of Industrial and Trade Policy

Oriol Vallès Codina

20 March, 2025

Prompt

Energy, trade, and macroeconomics: *What are the sectoral, industrial, and political economy implications associated with tariffs or other restrictions placed on low-carbon product imports? What are the macroeconomic and broader GDP implications of an accelerated or stalled transition to a low-carbon economy? How are industries accounting for and assessing different approaches to decarbonize energy use?*

Please plan to write 1-2 pages with your proposed modelling approach answering the following questions:

- What is the core research question(s) and why is it important?
- What are the current knowledge gaps that this research will address?
- What are the proposed research methodologies, and what is the workplan?

Introduction

Facing a worldwide climate crisis driven by the unabated exponential growth in anthropogenic carbon emissions, the low-carbon transition is one of the grand challenges that society faces today (Mazzucato, 2018). A landmark 2016 IPCC report alerted that carbon emissions should be curbed by 50% to bring the rise in temperature below 2°C. In 2021, the International Energy Agency sternly declared that no new carbon energy projects could be approved for development in order to follow the emissions pathway of 1.5°C. "Climate change is a global emergency" for nearly two-thirds of the 1.2 million respondents to the largest public opinion survey on climate change ever conducted (United Nations Development Programme, 2021). While the UN IPCC warns that ambitious large-scale structural change of our economies is required in the coming years to avoid the looming tipping points of 1.5°C and 2°C warming, the current trajectory of carbon emissions in fact sets the course for 3.2°C, in which ecological and economic catastrophe will almost certainly ensue. While policies of carbon pricing, the flagship proposal agreed by economists to mitigate climate change, are already being implemented by policy-makers worldwide to many degrees, recent empirical research shows their actual effectiveness is actually very limited, considering the sheer urgency of the climate crisis (Ball, 2018; Lilliestam et al., 2021; Rosenbloom et al., 2020): the growth of carbon emissions has simply kept apace, as these remain tightly coupled to economic activity. To mitigate and adapt to climate change, many voices are calling for a more diversified and ambitious policy portfolio such as regulations, R&D subsidies, central-bank financial support, finance instruments like green bonds, and public investments (Semmler et al., 2021; Stern, 2022).

However, rather than cooperating in the face of such a global crisis, the world is gearing up towards a new cold war, marred by increasing geopolitical rivalries among great powers under inflationary trade wars, sanctions, tariffs, and even actual wars, as well as a heightened competition for both high-carbon and natural resources that are critical for the low-carbon transition (e.g. lithium, cobalt, nickel, graphite, rare earth elements, or copper). The low-carbon transition is not exempt of certain financial risks, as stranded carbon assets threaten the profitability of many investment portfolios (A. Jackson, 2019; Semieniuk et al., 2022) and climate change damages impact on the price of financial assets and the financial position of firms and banks (Bovari et al., 2018; Dafermos et al., 2018). Yet the speed of the low-carbon transition is critical: a stalled or incomplete process generates energy and input price volatility, energy insecurity, supply-chain bottle-necks, financial instability, reliance on outdated infrastructure, loss of employment in transition industries, regulatory uncertainty, and overall public resistance under rising

uncertainty and climate collapse. In this complex context, trade policy is crucial: tariffs, import quotas, product standards, or local content requirements may well protect and promote infant green industries from international competition, but can also be inflationary and result in a stalled transition if not accompanied by proper industrial policy, just like export controls on critical minerals, embargoes and sanctions, and restrictions on intellectual property and foreign direct investment driven by trade wars. Last but not least, the Global South can either benefit or suffer from great power competition: it can secure more generous contracts for its rich natural resources, as well as cheaper foreign investment and technological transfers, or instead face a loss of revenues from its carbon sources, employment, growth, and financial stability as other countries, the Global North in particular, transition to cleaner energy and become more self-sufficient. Large-scale migration and a debt crisis may certainly ensue if the Global North succeeds but the Global South fails at the low-carbon transition, thus exacerbating social instability worldwide.

This proposal poses the following core research questions: is the low-carbon transition better driven by international cooperation or competition, in terms of the ecological, economic, and social risks involved? Can a nationalist green industrial policy driven by geopolitical rivalry ensure economic growth and employment alone, but fail at protecting the climate and thus face unsustainable social risks in the long term? In what conditions can a nationalist low-carbon transition succeed and in what conditions it will stall under sustained inflation and stagnation? Does it matter whether the Global North or the Global South unilaterally pursue such policies and, more importantly, can they afford them in terms of the risks that go with them? How do different financial and monetary regimes (e.g., public banking, green bonds, carbon pricing and tariffs, or public debt cancellation) influence the viability of nationalist versus cooperative low-carbon transitions? To what extent do sectoral dynamics —such as the role of state-owned enterprises, private capital, and labor movements—shape the success or failure of nationalist and internationalist low-carbon transitions?

Theoretical Framework and Methodology

In order to address the questions above, this proposal aims at the development of a stock-flow consistent macroeconomic model with an ecologically-extended, multi-regional input-output structure encompassing three regions (two "great powers" and the Global South) following Bimpizas-Pinis et al. (2024). Stock-flow consistent models offer a comprehensive framework for analyzing economic dynamics, ensuring that all stocks and flows are accounted for in a coherent manner (Caverzasi & Godin, 2015; Godley & Lavoie, 2006; Nikiforos & Zezza, 2017). These models are complex dynamical systems of mainly discrete-time difference equations that provide a systematic framework for the dynamical analysis of the complex institutional structure of whole socio-economic systems, using 1) careful, rigorous double-accounting of the stocks and flows through extended social accounting and flow-of-funds matrices and 2) sets of behavioral equations (Caverzasi & Godin, 2015; Nikiforos & Zezza, 2017). The careful book-keeping framework allows to capture all the relevant dynamic interdependencies among variables of the economic system that other approaches may neglect. Hence the main value-added of SFC models is their consistent and comprehensive integration of the flows and the stocks for both the real (i.e. productive) and the financial sides of the economy, which in the case of ecological SFC models allows them to investigate climate risks for the financial sector (Bovari et al., 2018; Canelli et al., 2024; Dafermos et al., 2018; Dunz et al., 2021; Magacho et al., 2023; Monasterolo & Raberto, 2018).

At this moment, most ECO-SFC models still aggregate the economy into one or very few sectors, in particular the energy sector (Berg et al., 2015; Canelli et al., 2024; Carnevali et al., 2021; Naqvi, 2014; Valdecantos & Valentini, 2017). While SFC models are increasingly including an input-output structure in order to investigate the crucial interactions between the economy and the environment such as Berg et al. (2015), who analyze the impact of energy price shocks, or Valdecantos & Valentini (2017) and Valdecantos (2022) for Argentina, only the input-output structure of Bimpizas-Pinis et al. (2024) is multi-regional. Their model only encompasses two areas (the European Union and the Rest of the World) and thus allows to investigate ecological unequal exchange, that is, the systematic flows in labor and natural resources from the South to the North (Dorninger et al., 2021; Hickel et al., 2022) that not only is the cornerstone of the unequal international division of labor, but also its importance will only increase with heightened competition for resources critical for the low-carbon transition. However, the two-region model fails to capture the important international trend of the rise of China as a great industrial power and thus the interaction between the low-carbon transition and great power competition at the heart

of this research proposal. Dunz & Naqvi (2016), Carnevali et al. (2021) and Carnevali (2021) address two-region setups, but without an input-output structure able to capture ecological unequal exchange.

In this case, the new model explicitly includes trade barriers such as tariffs in its price determination following the classical assumption of uniform profitability across industries (instead of the conventional Kaleckian markup pricing), but not necessarily across regions, in addition to incorporating migration flows between regions. Inflation in the price of final goods has two components: one which is cost-push, depending on unitary cost of production, and a demand-pull component determined by disequilibrium in the market for final goods. Following Dafermos et al. (2017) and Jacques et al. (2023), import quotas, green regulatory standards, and exhaustible resources can also be incorporated in its output determination in order to explore other trade policies and ecological constraints in the form of limited high-carbon and low-carbon natural resources, respectively. Green industrial policy can be introduced either following the conventional approach by Dafermos et al. (2017) or Dunz & Naqvi (2016) of separating firms and their corresponding investment and loans into a green and a carbon category or the more powerful and simplified approach to directed technical change of Naqvi & Stockhammer (2018), where firms have a baseline autonomous investment allocation across the three inputs of capital, labor, and natural resources plus additional adjustments based on relative price growth signals. Changes in labor productivity can thus be driven by research and development as in Naqvi & Stockhammer (2018), by the Veldoorn law that associates it to output growth as in Carnevali (2021), or to the growth of public investment as in Yilmaz et al. (2025). While the model of Bimpizas-Pinis et al. (2024) already incorporates public investment, it does not induce a rise in labor productivity.

Cross-border financial flows and technological diffusion are incorporated following Carnevali et al. (2021), who remarkably show that, lacking a cross-area policy coordination plan, currency fluctuations may counteract green policies, as their effectiveness depends crucially on the impact of cross-border financial flows and the growth rate differentials of exchange rates. In order to assess the important distributional impacts of the success or failure of the low-carbon transition, personal income inequality across households can be incorporated following Dafermos & Papatheodorou (2015). While functional inequality among income classes (workers and employers) and its interaction with economic growth is a critical feature of post-Keynesian models (Hardt & O'Neill, 2017), it is often not underscored in the literature of ecological macroeconomics, with the exception of T. Jackson & Victor (2016) and T. Jackson (2019). Finally, potential reforms of a multi-regional financial monetary system could be addressed following Valdecantos & Mazier (2015) and Valdecantos & Zezza (2015), who do so albeit without an industrial structure.

Research Output and Timeline

By incorporating directed technical change and trade policies in a multi-regional input-output setup, this research contributes to an important gap in the literature through the modeling of multi-regional macroeconomic dynamics of industrial and trade policy under scenarios of nationalist competition and internationalist cooperation. In the current times of increased geopolitical rivalries, it is important to understand whether these different scenarios lead to a successful low-carbon transition, sustainable economic growth, and employment stability, or if instead they create macroeconomic instability, inflationary pressures, and social resistance. The findings will thus provide insights into the conditions under which nationalist industrial policies can effectively drive decarbonization without exacerbating social, economic and financial fragilities, as well as the potential advantages and drawbacks of internationalist cooperation. By doing so, this research will contribute to the understanding of how different policy frameworks shape the trajectory of the low-carbon transition, and what institutional, financial, and industrial strategies are necessary to ensure a just and sustainable transformation of the global economy.

This research will be conducted in five main phases, with the following tentative timeline:

1. **Literature Review and Theoretical Framework** (1 month)
    - Assessing in more detail the requirements of the model with stakeholders.
2. **SFC-MRIO Model Development** (3-4 months)
3. **Model Calibration and Validation** (3-4 months)
4. **Simulation and Scenario Analysis** (3-4 months)

- **Nationalist Green Industrial Policy** (e.g., tariffs, local content requirements, state-led investment).
- **Internationalist Cooperative Transition** (e.g., cross-border coordination, green financing mechanisms, public debt cancellation).
- **Stalled Transition Under Geopolitical Rivalries** (e.g., supply chain disruptions, carbon lock-in).
- **Financial Instability and Social Disruptions** (e.g., stranded assets, inflationary pressures, migration).

5. **Policy Implications and Dissemination**, writing a research paper (3-4 months)

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