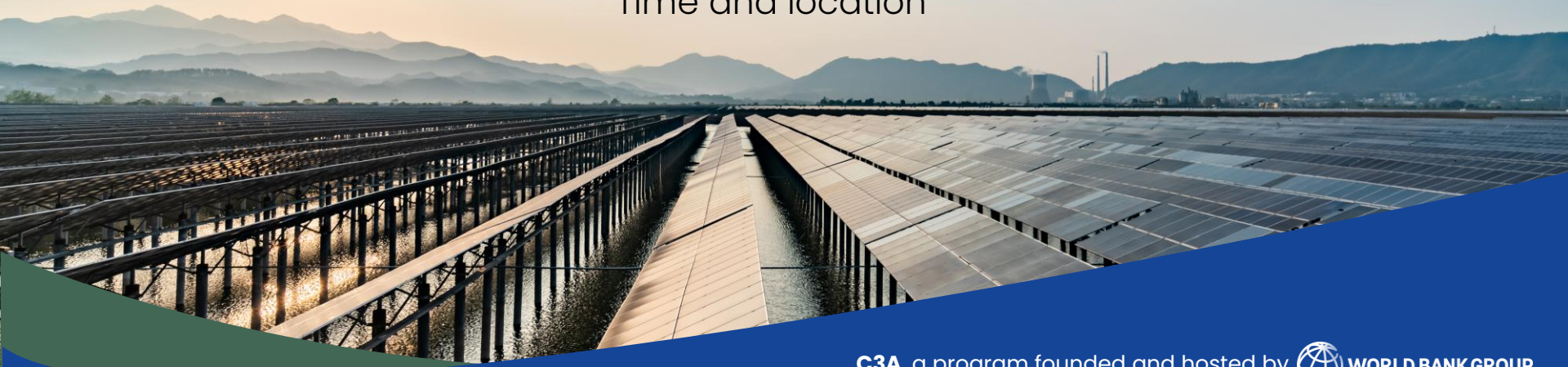
C3A Annual Symposium
December 2-6, 2024
World Bank Paris

Research Segment

Session 5: Green industrial policy

Chair of session

Time and location



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National industrial policy and the North-South convergence: state-owned enterprises as agents of change

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Motivation and research question
Understanding the role of state-owned enterprises

Industrial policy opportunities
SOEs as policy instruments: the last taboo?

Is **industrial policy** an effective instrument to foster economic convergence for a developing country? Are **state-owned enterprises** (SOEs) an adequate tool for industrial policy?

The case of **China** is a representative example of the capacity of policies to reorient the country's development trajectory while leveraging on the **energy-transition** opportunities (Dosi et al., 2015).

More recently, even the **European Union** is considering the importance of coordinated investment plans, as demonstrated by the **Green New Deal** and the **clean hydrogen** strategy (Wolf et al.,2021).

Particularly, industrial policies supporting the transition from **GHG-emitting technologies** (Rodrik, 2014) might represent an important instrument for developing countries to catch-up with developed ones.

SOEs have been playing a **significant role** in many developing countries, as key actors for targeted **industrial policy**, as in the case of Asian Tigers (Di Maio, 2009), China (Cimoli et al., 2020), Brazil (Suzigan, 1996), and Italy (Gasperin, 2022).

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Model description and validation
A comprehensive multi-country model

Research questions & objectives
The role of SOE in high-level industrial policy

Research questions:

- Which industrial policy instruments one could envision **beyond trade** or **taxation** interventions?
- How can we model and study the **real agents** of such industrial policies, like SOEs?
- How can we model SOE main **attributes** and **deployment** strategies?

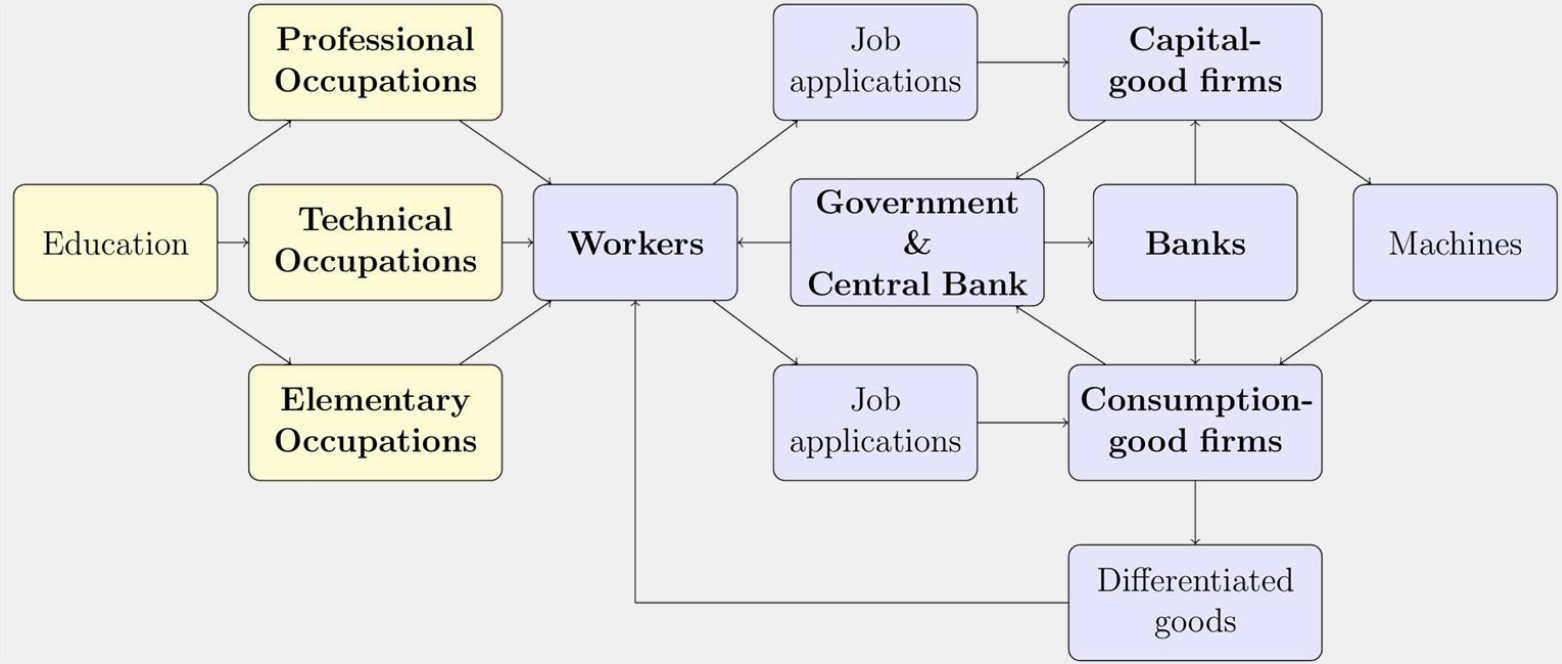
Our objective is not simply to study the ex post outcomes of industrial policy, but rather to **model** SOEs as **explicit agents** potentially capable to drive industrial dynamics, institutional build-up, and growth.

We propose a North-South ABM wherein two countries are initially **differentiated** just in term of **education** expenditure (Fanti et al., 2023) and compare the asymmetric macroeconomic performance.

We explicitly model SOEs in the South as **top-technology**, but failing, private firms **rescued** by the government to assess their role on macroeconomic performance. Focus on:

- Leader-laggard dynamics emerging from **different education** set-ups;
- International **trade** (machine and consumption-goods) and **competitiveness** (exchange rate);
- The role of SOEs on the **convergence** pattern of the laggard country.

Model structure
Two full countries with advanced labor market



Education and productivity dynamics
Countries calibrated to real N-S pattern

Individuals may have **primary**, **secondary** or **tertiary** education attainments.

Education is **publicly** provided by government as a share of nominal GDP:

$$G_t^{ed} = \epsilon_{ed}\, Y_{t-1}$$

$\epsilon_{ed} \in [0, 1]$ is the only differential parameter among countries (5% in the North and 4% in the South)

Individual education level is obtained from a **calibrated Beta** distribution:

$$ed_\ell \sim 16\ \mathrm{Beta}(g\ \alpha_{ed}, \beta_{ed}/g), \qquad g = (\epsilon_{ed}/\epsilon_{ad})^{\vartheta_{ed}},$$

$(\alpha_{ed}, \beta_{ed}) \in \mathbb{R}_+^2$ define the Beta PDF proxy to the education attainment of the leading country $(g = 1)$.

Education levels affect the probability of a capital-good firm to access **innovation** and **imitation**, impacting on **productivity dynamics** in both sectors.

Worker individual education **attainment** together with current (learning-by-doing) **skill** level defines individual labor **productivity**, driving firm-level consumption-good costs and prices.

Exchange rate & international trade
Countries calibrated to real N-S pattern

The North-South **trade** includes both **capital** and **consumption** goods, and currencies are fully **convertible**, supported by central banks unlimited support.

The exchange rates determine the **domestic prices** $p^m_{i|j,t}$ of imported goods. Gross prices paid by firms/consumers to buy an imported machine/final good from a capital/consumption-good firm from the other country (inclusive of duties and transaction costs), is:

$$p^m_{j|\ell,t} = \frac{e_{y,t}\, p_{i|j,t}}{e_{w,t}\left(1 - tr_y^{mk|mc}\right)\left(1 - tr_w^{x_1|x_2}\right)},$$

$tr_y^{mk}, tr_y^{mc} \in [0,1[$ are the country-specific duties imposed on imports, and $tr_w^{x_1}, tr_w^{x_2} \in [0,1[$ are the corresponding export duties and costs associated to exports.

The **nominal** exchange rate evolves according to the **current account** conditions:

$$e_{y,t} = e_{y,t-1}\left(1 - \gamma_y^e \frac{TB_{y,t-1}}{e_{y,t-1}\, Y_{t-1}}\right), \qquad Y_t = \sum_w \frac{Y_{w,t}}{e_{w,t}},$$

$\gamma_e \in \mathbb{R}$ a country-specific exchange-rate sensitivity to trade (un)balance $TB_{y,t}$ to the countries GDP $Y_{y,t}$.

State-owned enterprises
Supporting capital-good top-tech firms

Under usual conditions, firms in both sectors are **private**

Under a specific policy setting, the **government may intervene** when capital firms producing advanced machinery are **exiting** the market because of financial (bankruptcy) or market (sales) **troubles**.

The intervention may be applied only to firms that satisfy a minimum **technological threshold**:

$$A_{i,t}^{\tau} > \gamma_g^1 \, \bar{A}_t^{\tau}$$

$\gamma_g^1 \in \mathbb{R}_+$ is a parameter, $\bar{A}_t^{\tau}$ is the average productivity of current machines in the market, and $A_{i,t}^{\tau}$ is the productivity of the troubled capital-good firm.

The government rescues only the **best eligible firm** in each period the policy is applied.

After statization, government-owned capital-good firms are endowed with a new **technological set**:

$$A_{i,t+1}^{\tau} = (1 - x_6) \max_z A_z^{\tau},$$
$$B_{i,t+1}^{\tau} = (1 - x_6) \max_z B_z^{\tau},$$

$x_6 \in [0, 1]$ is a parameter defining the firm initial distance from the technological frontier.

3

Model results
The effects of industrial policy

Model validation
New stylized-facts matched

The Labor-augmented K+S model currently matches **over 20** stylized facts (SFs).

Based on the proposed "bare-bones" SOE-based industrial policy, K+S adds **new SFs** to the list:

- **SF1**: a more productive economy, and enhanced growth over the long run;
- **SF2**: improved and less uncertain aggregate innovation dynamics;
- **SF3**: positive contribution to the export of capital-goods;
- **SF4**: positive correlation with aggregate real wage dynamics and wage share.

Baseline macroeconomic performance *North (black) vs. South (blue), no policy*

No policy scenario, only difference among countries is education expenditure. MC **median** values.

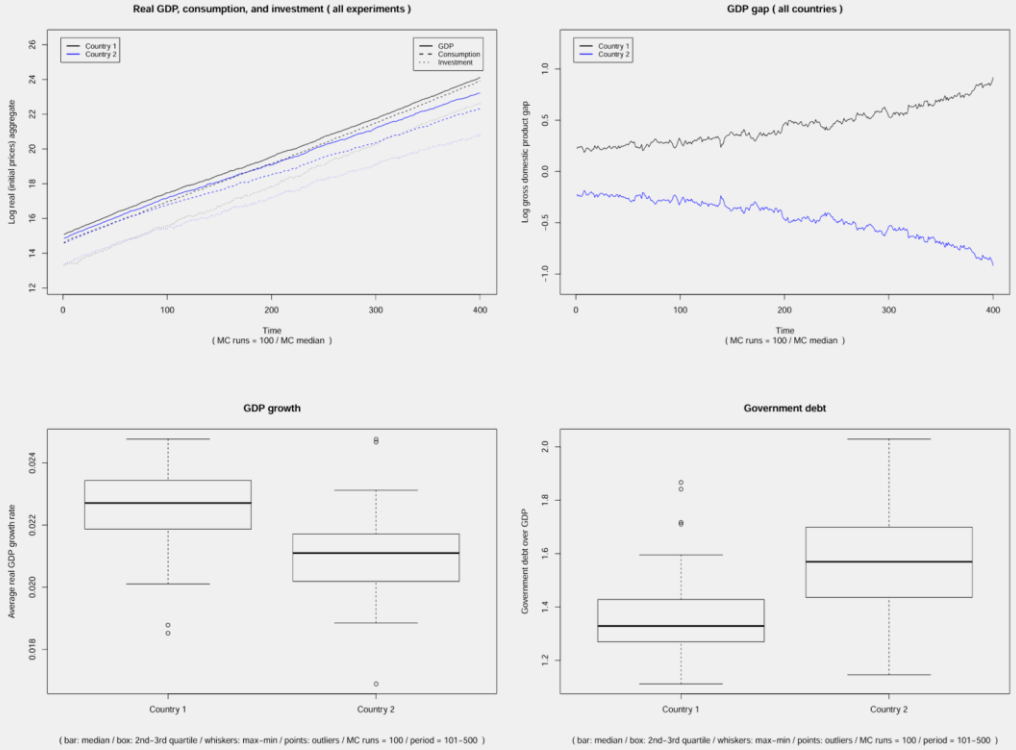
Real GDP, investment and consumption: permanent divergence

GDP gap: slow exponential divergence

$$\tilde{Y}_N = \frac{Y_N - Y_S}{Y_N}, \qquad \tilde{Y}_S = -\tilde{Y}_N$$

GDP growth distribution: systematic separation most cases

Government debt: significant worse profile of the South



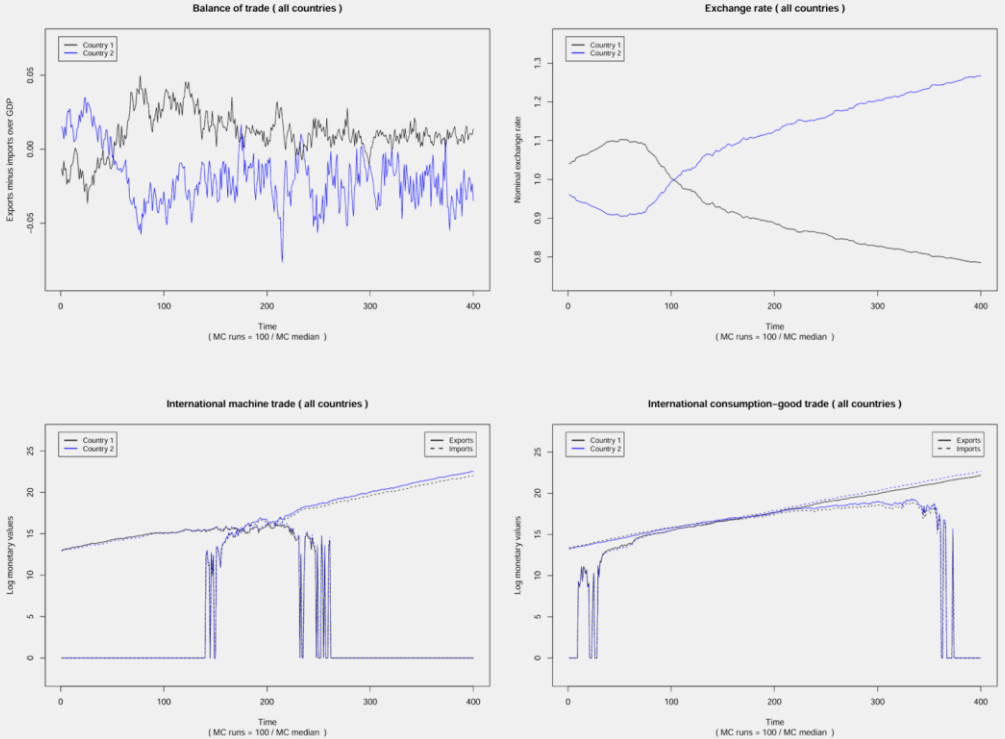
Baseline trade asymmetries
North (black) vs. South (blue), no policy

Balance of trade on GDP: persistent unbalance between countries

Exchange rate: consistent devaluation of South currency

Int'l capital-good trade: slow specialization of South, due to lower (wage) costs

Int'l consumption-good trade: fast specialization of North, due to higher productivity



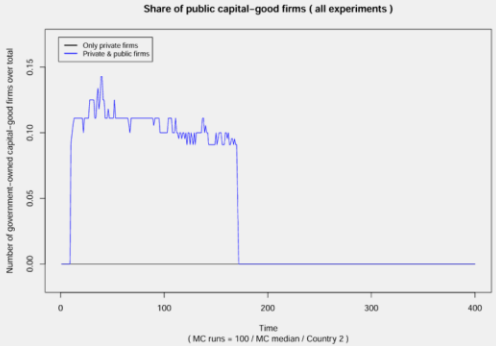
The role of SOEs (1)
No (black) vs. SOE (blue) policy

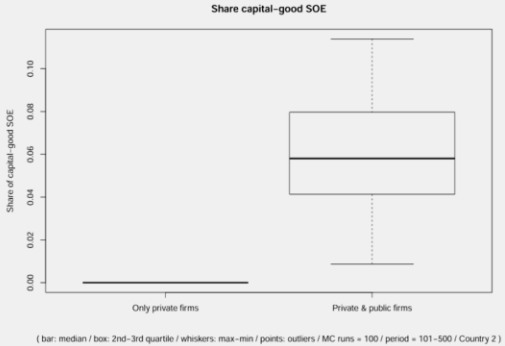
Share of SOE number of firms: SOE policy fades away endogenously.

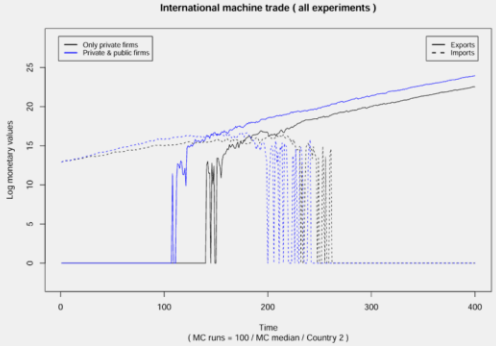
Distribution of SOE market share: share of SOEs keeps relatively small (2-10%)

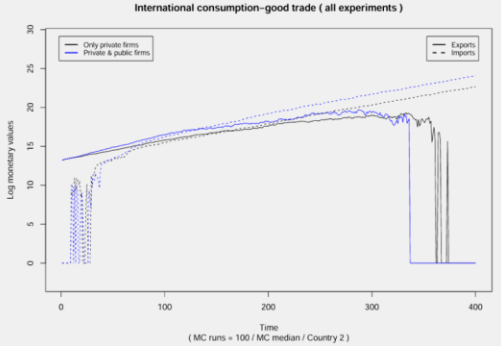
Int'l capital-good trade: SOEs significantly accelerates specialization of the int'l machine market.

Int'l consumption-good trade: SOEs also stimulate the specialization of the int'l consumption-good market.









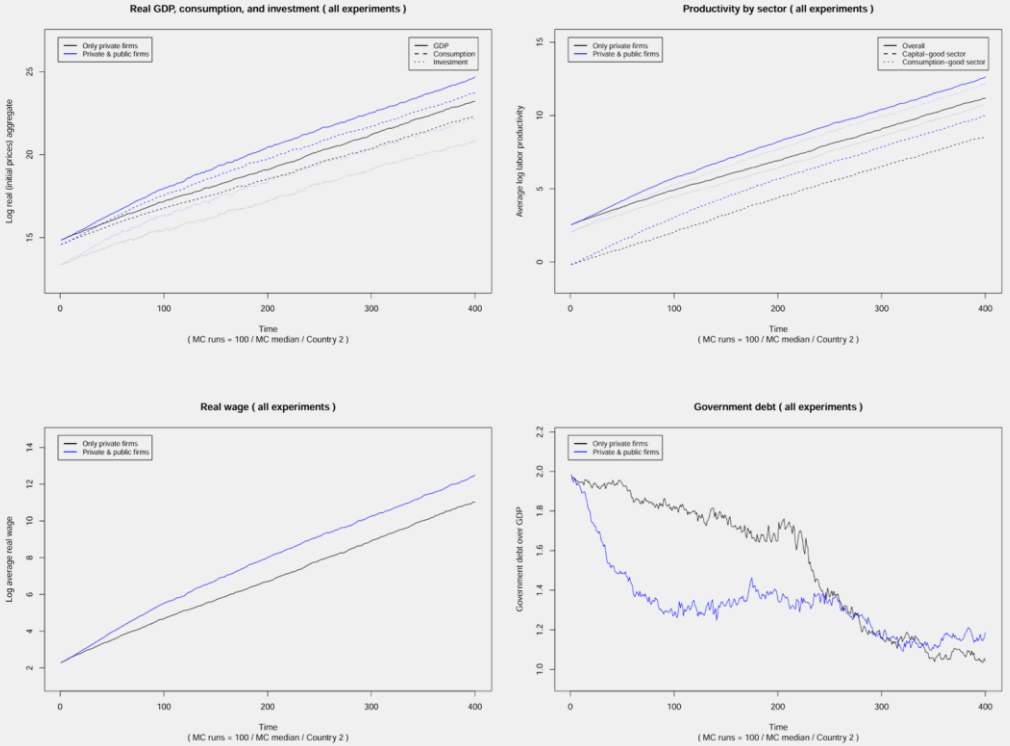
The role of SOEs (2)
No (black) vs. SOE (blue) policy

Real GDP, consumption, and investment: SOE impact in macro dynamics is very significant.

Sectoral productivity: the macro driver is diffusion of better capital-goods among the consumption-good sector improving labor productivity.

Real mean wage: increased labor productivity trickles down to wages

Gov't debt: public debt is improved because of reduced unemployment and increased tax revenues from firms



SOE policy selectivity
Evaluating statization thresholds

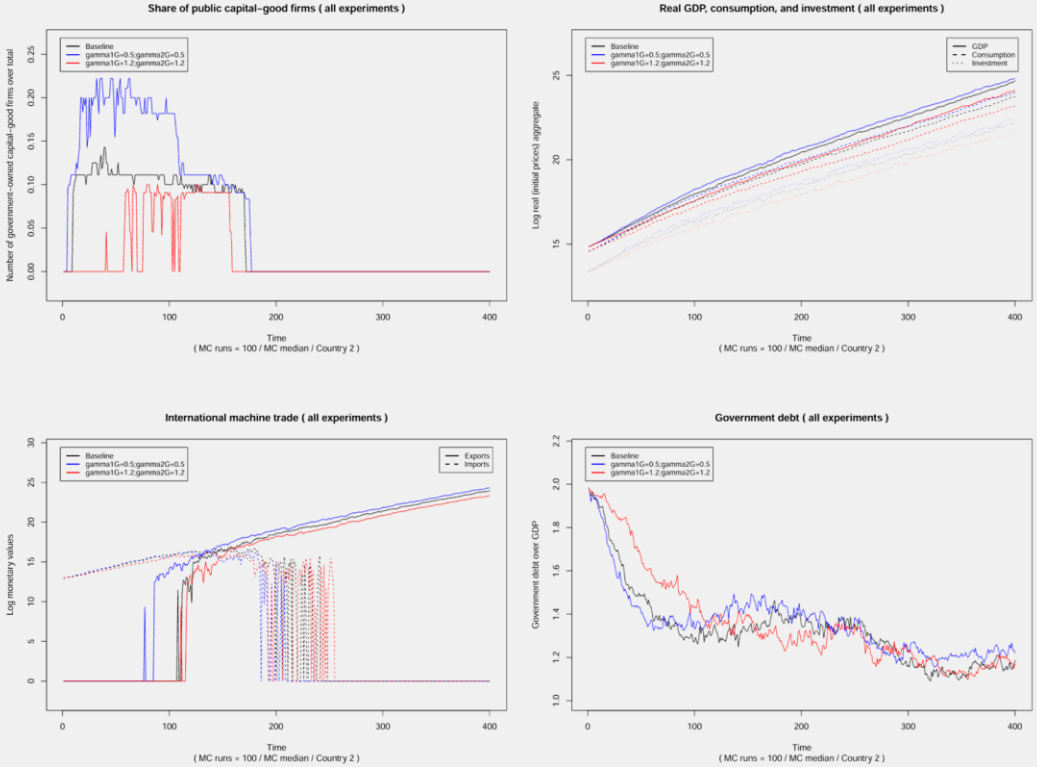
Experiment increasing the statization **technology threshold** γ_1^g from baseline 1 (black) to 0.5 (blue), and 1.2 (red).

Share of SOE number of firms: lower threshold increases number of firms but does not accelerate the process.

Real GDP, consumption, and investment: there are decreasing gains on statization strategy.

Int'l capital-good trade: lower threshold accelerates specialization.

Gov't debt: statization thresholds do not affect public debt.



4

Conclusion
Key messages & next steps

Summary of results
Positive consequences of SOE-based policy

In a (yet) theoretical ABM, we evaluate the effect of explicitly modeling **SOEs** which are responsible for operating as instruments for **industrial policymaking** in a North-South scenario.

Initial differences in **education levels** persistently affected **country performance**, trade balance and labor markets through different channels and feedback mechanisms, before industrial policy is used.

The rising of SOEs due to a rescue policy in favor of top-tech (but failing) private failing firms leaded to **better** macroeconomic and technological performance in the South, fostering **convergence**.

SOEs in capital-good market accelerated the pattern of **specialization** of international trade for **both** markets, including consumption.

SOE market share remained **small**, preserving the **competitive** and mostly **private** nature of the capital-good sector.

The **fiscal costs** of SOE-based policy tended to be **negative** (surplus!).

Next steps
Opportunities for model development

New model developments may look at specific schemes adopted by **SOEs targeting**, for example, inequality reduction, low-carbon transition, or the adoption of targeted technologies.

There are opportunities to **calibrate** and **extend** the model to explore specific, real-world scenarios, from the inclusion of **additional sectors** (e.g., green energy), to **micro-calibration** (firm and households).

History-oriented analyses, applied to **case studies** on specific country and historical periods are also a natural way forward of a the current general-oriented setting.

5

Q&A
Discussion

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Thank you

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