The Resilience of the Indian Economy to Rising Oil Prices as a Validation Test for a Global Energy-Environment-Economy CGE Model

C. Guivarch, S. Hallegatte and R. Crassous

guivarch@centre-cired.fr
Motivations... can we trust our model?

- In our modeling results, we noticed India is highly vulnerable to oil shocks.
  - At odds, with the observed resilience of the Indian economy to rising oil prices over 2003-2006
- Twofold objective:
  - Understand the discrepancy between our model’s results and observations... and, if possible, correct this discrepancy;
  - Disentangle the mechanisms at play in India’s response to rising oil prices.
Growth in Imaclim-R model

- Exogenous potential growth engine
  - Exogenous technical progress that increases labor productivity (as Solow’s neoclassical model of economic growth)
  - Convergence assumption (Barro and Sala-i-Martin 1992):
    - For India, default assumptions for labor productivity growth lie between 5.7% and 5.3% per year over the 2003-2006 period.

- But gaps between potential growth and effective growth (endogenous to the model)
  - Interaction between growth engine and short-term constraints:
    - Available capital flows for investments
    - Not full utilization of production factors (labor and capital) due to the inadequacy between flexible relative prices (including wages) and inert capital vintages characteristics.
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Default parametrization

- GTAP 6 database (2001)
- Exogenous trends for demography and for labor productivity growth
- Gradual reduction of international capital imbalances on the long term
- Standard market-share equations depending on relative export prices for energy goods trade
The model does not reproduce observations

International oil price

GDP growth

- Oil price (US$/bbl) WRI data
- Oil price growth annual (%) (right axis)

- World Bank data
- Simulation with increasing oil prices
- Simulation with constant oil prices
Can labor productivity explain the difference?

To reproduce observed growth path, annual labor productivity gains of 14% are necessary. Realistic?

- Peak at 8.7% for the “Asian dragons” (South Korea, 1983), 9% for France in the post-war period.
In search for other mechanisms

- February 2006 IMF country report on India (Fernandez, 2006): four key mechanisms that explain the strong Indian growth despite rising oil prices:

  1. *Sectoral reallocation away from oil-intensive activities*;

  2. *Strong capital inflows and trade deficit*;

  3. *Incomplete pass-through of international petroleum prices*;

  4. *Rise of India as an exporter of refined products*
1. *Sectoral reallocation*

- Well reproduced by the default model

**Sectors contributions to Added Value growth (mean value 2003-2006)**

\[
\frac{\Delta AV_{\text{sector}}}{\Delta AV_{\text{total}}}
\]

- Imaclim-R simulation
- World Bank data
2. *Strong capital inflows and trade deficit*

- Default assumption: capital and trade imbalances are gradually reduced over time
  - Difficult to predict/model capital flows over the short-term
  - Inconsistent with observations
- Modified model: Capital inflows allow the observed increase in Indian trade deficit

![Graph showing trade deficit from 2001 to 2007](graph.png)
3. *Incomplete pass-through of international oil prices*

- Default assumption: no modification of tax and subvention structure
  - Difficulty to predict (all the more to model) political response to exogenous shocks
  - Political response observed: 40% pass-through of international oil prices to domestic consumers via cuts in government-owned petroleum company margins

- Modified model: equivalent tax reductions to represent the incomplete pass-through
4. Rise of India as an exporter of refined products

- Default assumption: Endogenous prices formation and export shares in the model doesn’t reproduce the rise of India’s exports of refined products.
  - Model: from US$2.1 billion in 2003 to 3.1 in 2006

- Modified model: volume of refined-products exports forced to follow data.
Modified model results

GDP growth

- World Bank data
- IMACLIM-R - Default parametrization
Modified model results

GDP growth

- World Bank data
- IMACLIM-R - Default parametrization
- IMACLIM-R - Exporter refined products
Modified model results

GDP growth

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- IMACLIM-R - Passthrough 40%
Modified model results

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Modified model results

GDP growth

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- IMACLIM-R - Passthrough 40%
- IMACLIM-R - Trade Balance forced
- IMACLIM-R - All three mechanisms added
Explaining the remaining difference

- Required labor productivity growth assumptions

- Other economic mechanisms neglected or imperfectly reproduced:
  - Monetary policy (Blanchard and Gali 2007)
  - Imperfection of data sources used to calibrate the model
Conclusions

- A first step toward validation of a long-term global E3 CGE model against macroeconomic data.
  - Need for similar tests with other countries, other periods, other models...

- Policy implication: highlight and assess two mechanisms that can smooth adverse effect of oil shocks over the short-term (subsidy to consumption and capital inflow or trade balance deficit).

- Methodological implication: discrepancy arises from disregarded short-term mechanisms:
  - Acceptable when analyzing long-term issues or path-dependency?
  - Anyway, a major role in the transition dynamics and policy costs.
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Thank you for your attention!

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Static equilibrium under short-term constraints

Updated parameters (tech. coef., stocks, etc.)

Static Equilibrium t

Growth engine
Electric sector
Transportation

Bottom-up sub models (reduced forms)
Macroeconomic growth engine

Price-signals, rate of return
Physical flows

Evolution of constraints