

The macroeconomics of Energy Transitions

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Hybrid modeling of transition pathways at CIRED

- Suite of hybrid **IMACLIM** models reconciling BU and TD approaches
Hourcade et al., The Energy Journal, 2006
- Running
 - Global IMACLIM-R (EMF, IAMC)
 - France
 - Brazil with COPPE-UFRJ
 - South Africa with ERC-CTU
- Developing
 - Saudi Arabia with KAPSARC
 - India with PSG-IIMA
 - China with EEE-Tsinghua
- Starting
 - Russia with CENRE-NRU HSE Moscow
 - Argentina with Bariloche F.

10 minutes at a glance

- Closed economy impacts, all other things equal
- Open economy impacts, all other things equal
- All other things... changing, in China
- Dynamics matter
- Feedbacks from macro-economy to E systems

Closed economy impacts

Energy systems embedded in economic systems

- E transition triggers **structural change**
 - E expenses \Rightarrow Investment & non-E consumption under adjusted budget constraint
 - Feedback loops of displaced output *via* the Input-Output structure
- E transition impacts on **relative prices**
 - Relative E-intensity and E-flexibility of activities rank cost impacts
 - ...Under public policy constraints... including price administration
 - IO structure propagates direct effects including *via* primary factor markets
- E transition modifies **investment structure** and +/- **crowds out** other I
- 3 effects loop to convergence through **general equilibrium effects**

Positive 'co-benefits'

- Improvement of local environment
 - Reduced private and public health expenses (macro gain?)
 - Increased Labor supply and productivity
 - Reduced agricultural losses
 - ...
- Reduced congestion losses
- Improved Energy security & price stability
- Reduced pressure on biodiversity
- Reduced adverse impacts of fuel mining activities
- ...

...of macro size?

Impacts on distribution of income

- Unclear impact on relative primary factor payments
... except shrinking fossil rent
 - Structural change induces factor demand shifts that retroact on factor prices... under constraint of labor market policies
- Impact on secondary distribution of income via public policies
 - E transition policies are balance of market incentives, pricing policies and regulations
 - Indirect effects on fiscal resource via structural change and relative price shifts
 - Distribution of aggregate gains or losses hanging on budget closure rule
- Impact on public involvement in economic activity?

...induce shifts of aggregate Investment and Savings behavior

Open economy issues

Economies embedded in globalized markets

- At all levels of domestic consumption potential trade-off between domestic and imported goods with varying degrees of exposition
- Direct impacts of relative price shifts on **competitiveness** mitigated by
 - Energy transitions of trading partners and competitors
 - Influence on international E markets **China fully price-taker?**
- Indirect impacts via nominal exchange rate shifts
 - Considering trade balance dynamics
 - Under constraint of currency **exchange** policy
- Domestic structural change can position on
 - Global **E-transition technology markets** with high opportunities
 - Global markets of the untapped fossil resources (!)

Induced financial flows

- Long term balance of payment equilibrium means that trade surplus prompts capital outflows i.e. foreign assets purchases
 - Foreign Direct Investment
 - Foreign equities and bonds
- For net E importers, E transition implies increased E autonomy hence increased foreign assets investment
 - Increasing part of growth depending on foreign economic performance
 - Geopolitical consequences

All other things... changing in China

Chinese economy rapidly transforming

- Changing lifestyles i.e. saving and consumption patterns
 - Rising living standards, further urbanization, ageing
- Economic activity climbing up the value-chain
 - Higher VA intensity of domestic activity and relocation of lower VA activity in neighboring emerging economies via FDI
 - \Rightarrow End of export-oriented economy
- Rebalancing of investment and private consumption GDP shares
 - From $I = 45\%$ and $C = 38\%$ to...? Stranded assets? Savings glut?
- The Belt and Road Initiative
 - Massive public guarantee of private investment & public investment
 - Chinese FDI outflows superseded FDI inflows in 2017 (UNCTAD)

Dynamics matter

Short term “sort of ‘Keynesian’”

Solow, 2000

- Imperfect factor mobility
 - E transition has specific Labor skills requirements
 - E transition faces K inertia up to urban form timescales
induces inertia of consumption and input structure / risk of stranded assets
- Regulated markets
 - Labor market strongly regulated in many economies
 - Administered prices of basic commodities including E (electricity)
 - Exchange markets still regulated in LDCs and emerging economies
- ‘Second best’ economic setting if only for distorting tax systems
 - 1st best options not necessarily... 1st best (Lipsey and Lancaster, 1956)

Macroeconomics feed back on E systems

- Energy demand, aggregate and mix
- Aggregate Energy system costs
- Relative prices of E system inputs
i.e. merit order of tech. options

To sum things up

Macroeconomics to keep in mind

- E transition prompts **structural change** of economic activity via Input-Output relationships
- ...Mitigated by direct & indirect, price & non-price **public policies**
- ...Under constraint of **inertia** of consumption and production structures
- **Exchange rate adjustments** should compensate trade balance impacts if RMB internationalization process continues
- Distributional impacts retroact on aggregate **savings and investment** behavior
- Macroeconomics impact **E mix, E costs and merit order** of tech options
- All of this happening in a **rapidly moving** macroeconomic context