Abstract

By incorporating energy-saving through both technology-embodied investment, embodied and disembodied technical change into a dynamic stochastic general equilibrium (DSGE) model with heterogeneous investment, this paper identifies avenues through which firms adjust to rising energy prices. Using Chinese firm-level data from 1997-2004, we estimate a set of stylized facts regarding how firms of various ownership types respond to energy price changes. We then use these stylized facts to recover key parameters in the DSGE model through indirect inference. The results show that within Chinese industry, in response to rising energy prices, state-owned enterprises, domestic non-state enterprises, and foreign-funded enterprises employ significantly different means to achieve their energy efficiency. Such differences can be substantially explained by government policy affecting energy pricing and the cost of investment finance across firms of different ownership types.

Main Takeways

- Vintage capital or investment embedded with energy-efficient technology plays a crucial role in achieving energy efficiency in Chinese industrial firms.
- State-owned enterprises rely on vintage capital mostly, followed by domestic non-state-owned enterprises, and foreign-funded firms rely on vintage capital least.
- Embodied and disembodied technologies are another two critical channels through which firms achieve their energy efficiency.
- The model with both embodied and disembodied technologies fits the data best.
- State-owned enterprises rely on embodied technology more than domestic non-state-owned enterprises and foreign-funded firms.
- All three types of firms equally rely on disembodied technology.

Facts

- Regression 1: Energy intensity responding to energy prices
  \[ \ln(\text{En}) = \beta_0 + \beta_1 \ln P + \beta_2 \ln P_{t-1} + \beta_3 \ln P_{t-2} \]  
- Regression 2: Energy intensity responding to the vintage structure
  \[ \ln(\text{En}) = \gamma_0 + \gamma_1 \ln P + \gamma_2 \ln P_{t-1} + \gamma_3 \ln P_{t-2} \]  
- Regression 3: Vintage structure NVFA/OVFA responding
  \[ \ln(\text{NVFA/OVFA}) = \tau_0 + \tau_1 \text{average energy prices} + \text{controls} \]  
- NVFA: original value of fixed assets; NFVA: net value of fixed assets.
- The higher NVFA/OVFA, the younger age structure of a firm's capital stock.

Table 1: Compare model with data: SOEs

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Table 2: Compare model with data: SOEs

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Table 3: Compare model with data: FFEs

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Model and Estimation

- In a dynamic stochastic general equilibrium model, we introduce:
  - Putter's investment or vintage capital: capital's energy efficiency is optimized chosen by firms in response to energy price changes.
  - Embodied and disembodied technologies: autonomous change and energy-price induced innovation.
- Estimating parameters in the model:
  - Key structural parameters are estimated via indirect inference method.
  - The estimated model is able to replicate the stylized facts observed from the data.

In Tables 1-3, we compare the estimated structural model with data for three types of firms:

- The left panels of Tables 1-3 report the regression coefficients from the estimated model.
- The right panels of Tables 1-3 report the regression coefficients directly obtained from the firm-level data.
- Our model successfully reproduce the stylized facts for SOEs, NSOEs and FFEs.