Energy Price Shocks, Value-Added Allocation, Productivity, and Credit Risk

Frédéric VINAS [1]

[1]Banque de France

QUESTION / MOTIVATION

Question:

How do firms allocate their value-added in response to supply shocks?

Motivation:

- The firm's value added is distributed to employees and shareholders, or internally, such as to finance investments or improve liquidity ratios
- The dynamics of this allocation can undergo substantial shifts during periods of disruption: firms may face rigidities –wage rigidities or constraints on profit distribution– that limit their ability to adapt to shocks
- These constraints could affect the allocation of value added, and hence the profitability, productivity and even the survival of firms. Understanding the impacts of value-added shocks is therefore crucial.

IDENTIFICATION STRATEGY / DATA / MAIN REGRESSION

Identification Strategy:

- Intuition: I use raw material shocks as supply shocks and analyze their impact on the value added, its allocation and key financial ratios of firms
- More specifically, I use a ***Bartik instrument*** (see Eq. 1) which is based on:

1. Supply shocks, defined as the fluctuations in ***raw material prices***
2. Exposure to shocks, quantified by the ***firm's dependence on raw materials***
3. Since the production of raw materials is highly dependent on fossil resources, I focus on raw material ***shocks originating from the oil market***

$$Z_{f,t} = \left(\frac{\text{Raw Material Costs}}{\text{Firm's Sales}}\right)_{f,t_0} \times gr\left(\text{Crude Oil Spot Price}\right)_t \quad (1)$$

Data:

- Firms' financial statements over two decades (2000-2019)
- Focus on raw-material-intensive sectors: manufacturing

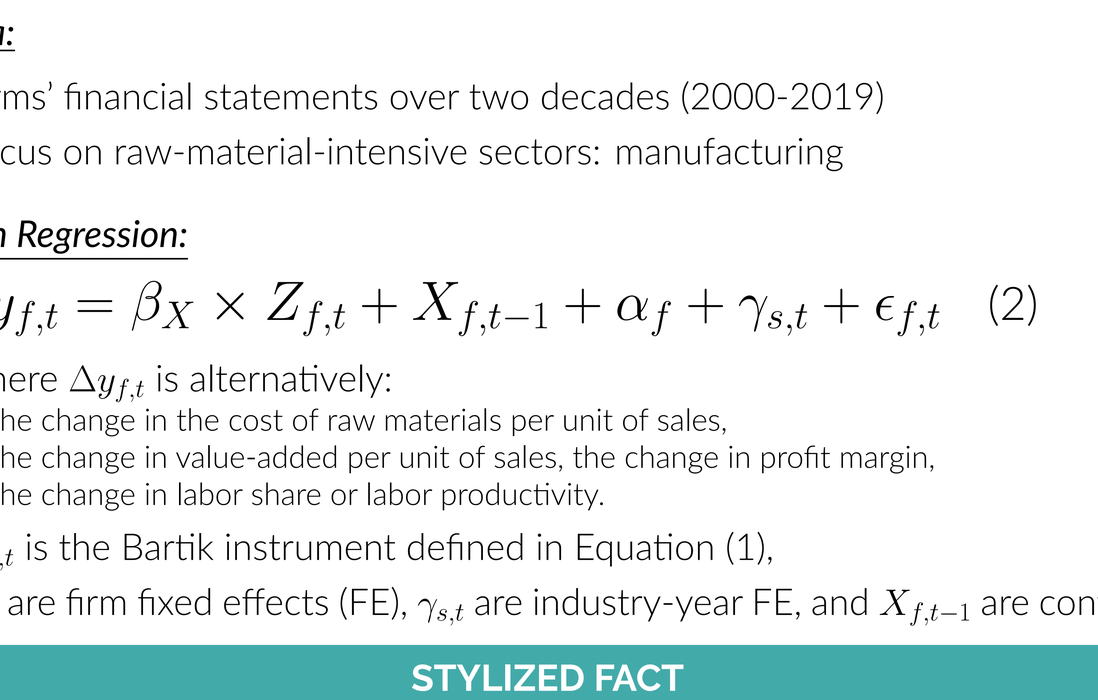
Main Regression:

$$\Delta y_{f,t} = \beta_X \times Z_{f,t} + X_{f,t-1} + \alpha_f + \gamma_{s,t} + \epsilon_{f,t} \quad (2)$$

- where $\Delta y_{f,t}$ is alternatively:
  - the change in the cost of raw materials per unit of sales,
  - the change in value-added per unit of sales, the change in profit margin,
  - the change in labor share or labor productivity.
- $Z_{f,t}$ is the Bartik instrument defined in Equation (1),
- α_f are firm fixed effects (FE), $\gamma_{s,t}$ are industry-year FE, and $X_{f,t-1}$ are controls

STYLIZED FACT

Figure 1. **The Figure 1 shows the negative correlation btw. the weighted changes in the oil price and the changes in the value added of firms**



MAIN RESULTS

In the short run, over 2000-2019, rising oil prices lead to (see Table 1):

- no full pass-through, in the sense that raw material costs rise faster than sales
- a decline in value added (column (2) of the Table 1)
- a decrease in the profit margin (column (3))
- an increase in the labor share (column (4))
- a decline in productivity (column (5))

Table 1. **Impact of rising oil prices on key financial ratios in the year of the shock**

Change in ...	Raw material c./SA (1)	Value Added/SA (2)	Profit margin (3)	Labor share (4)	Productivity (5)
Weighted oil price rises	0.058***	-0.029***	-0.032***	0.078***	-4.065***
	(0.005)	(0.006)	(0.006)	(0.022)	(1.442)
Constant	Yes	Yes	Yes	Yes	Yes
Observations	122,944	122,944	122,944	122,944	122,944
R-squared	0.175	0.165	0.189	0.196	0.191
Ind.-year FE & Firm FE	Yes	Yes	Yes	Yes	Yes
Firm level cluster	Yes	Yes	Yes	Yes	Yes
No. firms	22,704	22,704	22,704	22,704	22,704

RESULTS BY TIME HORIZON

In the medium term, oil price rises lead to U-shaped effects:

- they peak about two years after the shock,
- they dissipate after four years
- leading to a cyclical pattern in productivity

Table 2. **Impact of rising oil prices on value added by time horizon**

Number of years after the shock ...	Zero (1)	One (2)	Two (3)	Three (4)	Four (5)
Weighted oil price rises	-0.029***	-0.038***	-0.058***	-0.036***	-0.004
	(0.006)	(0.007)	(0.008)	(0.009)	(0.009)
Constant	Yes	Yes	Yes	Yes	Yes
Observations	122,944	121,025	112,157	106,055	101,486
R-squared	0.165	0.252	0.302	0.330	0.357
Ind.-year FE & Firm FE	Yes	Yes	Yes	Yes	Yes
Firm level cluster	Yes	Yes	Yes	Yes	Yes
No. firms	22,704	22,361	20,690	19,490	18,508

ADDITIONAL RESULTS

- These effects depend on firm characteristics: firm size, energy intensity.
- Rising raw material costs ***affect firms' default risk*** over a one-year horizon.

IMPLICATIONS / CONTRIBUTIONS

1. *Energy transition:*
   - For policy makers involved in the study of energy transition scenarios, the paper provides useful information by documenting the behavior of firms in the face of rising energy prices according to their size, energy dependence and time horizon.
   - The methodology of the paper could be extended with raw material consumption data that may be made available: e.g. as part of new corporate sustainability reporting (***ESRS*** in the case of Europe).
2. *Bank stress testing:*
   - For policy makers involved in bank stress testing, the paper documents the link between energy prices and corporate failures using a more representative sample of the economy than previous literature.
3. *Literature on productivity cycle:*
   - It complements previous work on the heterogeneity of productivity dynamics depending on firm's characteristics (e.g. Giroud and Mueller,2017).

frederic.vinas@banque-france.fr

frederic.vinas@banque-france.fr