Inflation in Times of Overlapping Emergencies Systemically Significant Prices from an Input-output Perspective

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Keynes Gesellschaft, February 13, 2023

Vision of price stabilization in the great moderation



Inflation as monetary phenomenon - Monetarists

"what of oil and food to which every government official has pointed? Are they not the obvious immediate cause of the price explosion? Not at all. It is essential to distinguish changes in relative prices from changes in absolute prices. The special conditions that drove up the prices of oil and food required purchasers to spend more on them, leaving less to spend on other items. Did that not force other prices to go down or to rise less rapidly than otherwise? Why should the average level of all prices be affected significantly by changes in the prices of some things relative to others?" (Friedman, 1974)

- Large relative price changes transitory as such of no macroeconomic relevance
- Relative prices only linked through the budget constraint of individuals

Inflation as macro phenomenon - New Keynesians

- Inflation takes off when aggregate demand goes beyond full capacity utilization
- Relative price changes are *transitory* adjustments without bearing on macroeconomic outcomes

Exceptions:

- special cases like the 1970s when oil, food and mortgage rates mattered (e.g. Blinder 1983)
- Stochastic analysis of distribution in changes in relative prices matters for inflation (Vining and Elwertowski 1976, Ball and Mankiw 1995)

Price stabilization in times of overlapping emergencies



Mishast Operation. 16 Jan. 45

This was a German oil plant

British people have become all too familiar with bombing pictures. But examine the two photographs below. They tell more vividly than a dozen communiques the terrible and devastating story of the Allied air attacks on German industry. The place is the synthetic oil plant at Zeitz, near Leipzig. The picture on the left was taken before January 16, 1945: that on the right a month later. The plant employed about 5,000 workers and its output was equal to that of some of the largest plants in the Ruhr. For long periods during the summer of 1944 it was kept out of action by American bombers, but it was managing to produce about half its normal



output when R.A.F. Bomber Command attacked on the night of January 16. The photograph taken on February 17 shows destruction so complete that the plant appears to have been abandoned. Normally the enemy begins repairing his damaged oil plants within a few hours of attack. But there is no sign of any attempt at repair work, or of activity of any kind. The plant is a mass of debris among a dense concentration of craters. Most of the pipelines are broken, and all the vital parts of the plant have been hit. Large numbers of storage tanks and cooling towers are destroyed or damaged. The scene is one of wholesale devastation



The economy as circular flow - Input-Output

"Input-output analysis is a method of systematically quantifying the mutual interrelationships among the various sectors of a complex economic system." (Leontief, 1985)

"The effect of an event at any one point is transmitted to the rest of the economy step by step via the chain of transactions that links the whole system together." (Leontief, 1951)

"Far from being independent of each other, the cost-price structures of all the separate industries are nothing but links in a vast network which embraces the whole national economy.

...overall dependence among wage rates, profits earned, and taxes paid per unit of output in each of the many separate industries on the one hand and the prices of all different kinds of goods and services sold by these industries on the other." (Leontief, 1947)

Inflation as a micro/sectoral phenomenon

"As a matter of fact, the problem of inflation cannot be dealt with in aggregative terms either. If you had inflation in which all prices and incomes move in parallel, nobody would care. <u>Actual inflation is a change in relative prices, not just in the average price level</u>." (Leontief, 1974)

- Change in relative prices of great relevance to macroeconomy because it has immediate redistributive implications
- Downward stickiness of prices implies that increase in some prices is not compensated by decrease in others but creates a cost-push pressure
- Higher levels of inflation can follow from shocks to important sectors (e.g. through political events like wars, climate disasters, speculative hikes, supply bottlenecks, large sector specific investment programs)

Research question

If inflation is not always and everywhere a macroeconomic phenomenon, but can be unleashed by microshocks on the supply side, we need to <u>identify which sectors present points of vulnerability</u> for monetary stability, or in other words, have the greatest potential to <u>become systemically significant</u> for inflation.

Approach

- 1. Leontief Price Model
- 2. Simulate the inflation impact of a price shock to each sector separately based on a) average price volatilities and b) the price movements in the COVID pandemic assuming full pass-through
- 3. Rank sectors by their inflation impact to identify a) latent systemically significant prices and b) realized systemically significant prices in the COVID pandemic

The Leontief Price Model (I): The basic identity

value of output of each industry =

value of domestic inputs + value-added + value of imported inputs where the value-added is composed of wages, profits, and taxes per unit of output

$$\hat{X}P_{j} = x_{j}a_{1j}P_{1} + \dots + x_{j}a_{nj}P_{n} + V_{j} + M_{j}$$
$$\hat{X}P = \hat{X}A'P + V + M$$

The value of domestic inputs is the product of the unit-requirement of domestic inputs by each industry (A'), the output of each industry (\hat{X}) and the output price of each good (P).

The Leontief Price Model (II): Price determination

Dividing both sides by total industry output gives us the **price per unit of output**:

 $P = \underbrace{A'P}_{\text{inputs}} + \underbrace{v}_{\text{j}} + \underbrace{m}_{\text{j}}_{\text{j}}$ Share of price: Domestic Value- Imported inputs added inputs
Solving for P gives the prices of all sectors, which are endogenous and determined by the total requirements of inputs $(I - A')^{-1}$, value-added (v) and imported inputs per-unit of output (m):

$$P = (I - A')^{-1}(v + m)$$

Assuming that the prices of all domestic sectors take the same functional form, this implies that the *price formation of all industries is interdependent*.

The Leontief Price Model (III): Exogenous sectors and price shocks

To simulate the effect that price shocks have on the overall price level, we expand the price equation to set the industry that receives a shock exogenous. P_X is the vector of prices of exogenous sectors. The vector of prices of endogenous sectors is then

$$P_E = (I - A'_{EE})^{-1}A'_{XE}P_X + (I - A'_{EE})^{-1}(v_E + m_E)$$
Share of price determined by Share of price determined endogenously exogenous sectors
Assuming that value-added and imports remain constant, the percentage change in the price of the endogenous sectors caused by a price shock ΔP_X can be expressed as:

$$\Delta P_E = (I - A'_{EE})^{-1} A'_{XE} \Delta P_X$$

The Leontief Price Model (IV): Total inflation impact

In order to get a measure of the total impact of ΔP_X on the general price level (a "synthetic CPI"), we average ΔP_E using the shares of personal consumption of each industry to get:

$$IP_{tot} = IP_{dir} + IP_{ind} = c_x \Delta P_X + \sum_{i \neq x} c_i \Delta P_E^i$$

Some industries matter much more than others



Latent systemical significance



Systemical significance in the post-shutdown inflation



b) Yearly price change from 2020 Q4 to 2021 Q4

Systemical significance in the Ukraine war inflation



Pathways to systemic significance

Systematically Significant Industries
 Rest

Three groups of systemically significant sectors

1. Basic necessities

Housing, Food, Farms, Utilities, Petroleum and gas products

2. Basic production inputs

Petroleum and gas products, Oil and gas extraction, Chemical products

3. Basic circulation

Wholesale trade, (truck transportation)

Modeling conflict inflation

The model outlined above assumes that nominal wages and profits remain constant through price adjustments in response to an increase in input costs due to a sector-specific price shock.

We can extend the model to incorporate a **conflict inflation scenario** in which firms and workers respond to the price shock and subsequent price adjustments by trying to regain their initial position. We develop three models:

- (i) No profit or wage adjustment (this is the model outlined before)
- (ii) Industries adjust their prices to keep the profit share of the value of their output constant
- (iii) Wages adjust to keep real wages constant

Profit and wage adjustments to compensate for price rises

Figure 1: After-tax profit margins of non-financial corporate business

Conclusion

- If price shocks become systemic, it is not feasible to react with rate hikes and macroeconomic tightening each time a shock hits a systemically significant sector.
- Economic stabilization in the age of overlapping emergencies needs **economic policy disaster preparedness** to absorb shocks in systemically significant sectors. This requires a change in mindset and monitoring capacity as well as institutions and laws for emergency price management which can involve buffer stocks, regulation of financial speculation, minimum inventory requirements and prohibition of hoarding in emergencies, prohibition of price gouging and limits to price hikes in emergencies, investments and a standby authority for emergency price stabilization in systemically significant sectors.
- If systemically significant sectors are so important that they can unsettle the whole economy, we might need to reconsider the role of public and private stakeholders (central banks as the stabilizers of interest rates – a systemically significant price! - were once private).