Global Wheat Price Shocks and Firm-Level Export Price Setting

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Outline

Motivation

Data

Empirical framework

Results

Summary

Why this matters

- Recent shocks (e.g., Covid, Conflicts, Climate perturbations) exposed the fragility of our food systems
- Compromise consumer and producer welfare, and raise food security concerns
- How do firms that use agricultural products as intermediate inputs respond to shocks?
- Case study: Wheat markets
  - Cereal prices, including wheat, are key agricultural prices
  - Russia–Ukraine war intensified already high post-COVID food prices.
  - FAO Food Price Index peaked at 160% in March 2022.
  - Wheat prices exceeded 500 USD/mt in May 2022.
  - Wheat prices have shown repeated volatility (2007/08, 2010/11, 2012/13, 2022).
- Key question: **How resilient are wheat-using firms to global price shocks?**
  - Firms may adjust via output reduction, wage cuts, or labour reductions.
  - We study how processing firms adjust export prices to global grain market shocks.

Contributions

- **Price transmission**
  - Commodity price shocks are incompletely passed through the value chain (Nakamura and Zerom, 2010; Richards and Hamilton, 2015)
  - We focus on export prices (not retail) and on determinants of global wheat markets, not simple price pass-through.
- **Export price-setting & PTM**
  - How firms adjust export prices in response to trade costs (Atkeson and Burstein, 2008), based on imperfect competition and variable markups (Melitz–Ottaviano framework).
  - We link the macro with the micro
- **Commodity price dynamics**
  - SVAR-based analyses of supply and demand shocks for wheat, coffee, corn.
  - Our model incorporates production and stocks, improving on sign-restricted VARs.

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Data: 1. Aggregate annual time-series data

Period: 1970–2021 (annual data)

Endogenous variable vector:

$$\mathbf{y}_t = [\Delta q_t,\ y_t,\ \Delta i_t,\ \Delta p_t]$$

- Δq_t: Growth rate of global wheat production
- y_t: Growth rate of world industrial production
- Δi_t: Inventory changes
- Δp_t: Growth rate of real wheat spot price (deflated by U.S. CPI)

Data source: USDA NASS, Agricultural Prices database.

Price reference: Hard Red Winter (HRW) wheat (Kansas City).

Data: 2. Firm-Level Customs Transaction Data

Source: ISTAT (Italian National Institute of Statistics)

Coverage:

- Period: 2004–2021
- Italian firms exporting pasta and wheat derivatives
- Product resolution: 8-digit CN level
- Destination-specific export records over time

Outline

A Bayesian Structural VAR Model of the Global Wheat Market

Structural VAR specification:

$$\mathbf{A}\mathbf{y}_t = \mathbf{b}_0 + \sum_{l=1}^{2} \mathbf{B}_l \mathbf{y}_{t-l} + \mathbf{u}_t$$

Structural shocks:

$$\mathbf{v}_t = [v_{1t}, v_{2t}, v_{3t}, v_{4t}]' \quad \text{with} \quad E[\mathbf{v}_t \mathbf{v}_t'] = \mathbf{D}$$

System of structural equations:

$$\begin{aligned}
\Delta q_t &= a_{qp}^s \Delta p_t + \mathbf{b}_1' x_{t-1} + v_{1t} \\
y_t &= a_{yp} \Delta p_t + \mathbf{b}_2' x_{t-1} + v_{2t} \\
\Delta q_t &= a_{qy}^d y_t + a_{qp}^d \Delta p_t + \Delta i_t + \mathbf{b}_3' x_{t-1} + v_{3t} \\
\Delta i_t &= a_{iq} q_t + a_{ip} \Delta p_t + \mathbf{b}_4' x_{t-1} + v_{4t}
\end{aligned}$$

Identification and Interpretation of Structural Shocks

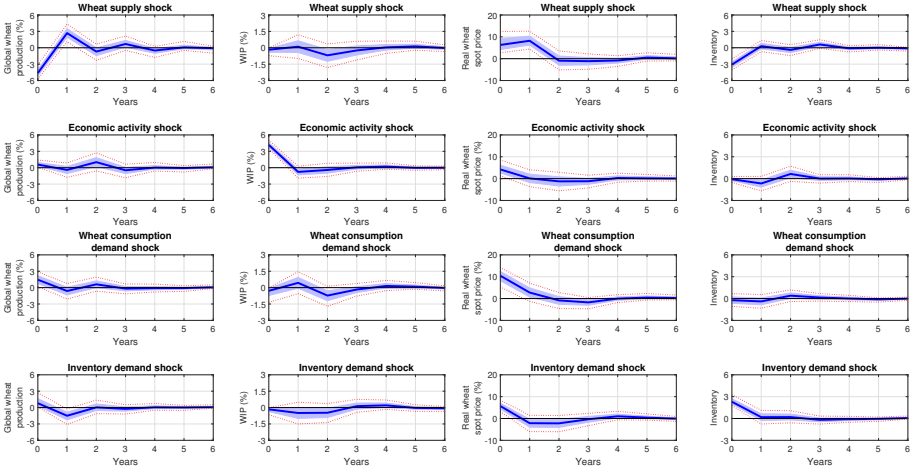
Structural shocks identified:

- **Wheat supply shock** (v_{1t}): negative shock shifts supply left (weather, disease, wars).
- **Economic activity shock** (v_{2t}): global business cycle expansion shifts demand right.
- **Consumption demand shock** (v_{3t}): shocks to food, feed, or industrial demand beyond business cycle effects.
- **Inventory demand shock** (v_{4t}): speculative/expectations-driven demand for storage.

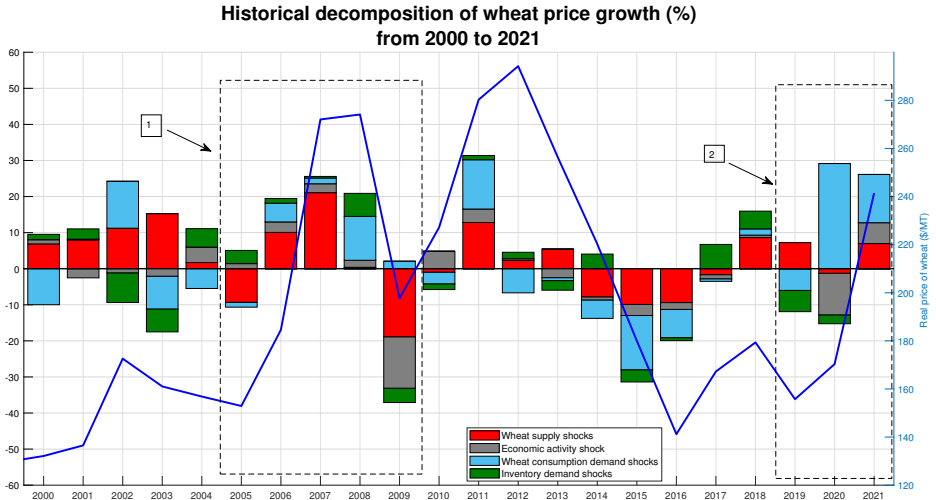
Identification:

- Structural parameters $(\mathbf{A}, \mathbf{B}, \mathbf{D})$ identified using the Baumeister–Hamilton (2015) Bayesian algorithm.
- Step 1: impose informative priors on structural parameters.
- Step 2: draw from posterior using Random-Walk Metropolis–Hastings.

Impulse responses of the variables to the structural shocks of model 1



Cumulative effect of each structural shock on wheat price growth (%)



A reduced form gravity model of Italian firm-level exports

Estimate how structural shocks to the global wheat price affect firm-level export prices of pasta and wheat derivatives.

$$\ln(X_{fkd,t}) = \beta_0 + \beta_1 \Delta \hat{p}_t^{V_{s,t}} + \beta_2 \ln(1 + \tau_{kd,t}) + \mathbf{b}'\mathbf{X}_{dt} + \gamma_{fkd} + \epsilon_{fkd,t}^{V_n}$$

- $\ln(X_{fkd,t})$: firm–product–destination unit values.
- $\Delta \hat{p}_t^{V_{s,t}}$: cumulative impact of structural shock s on global wheat price.
- β_1: elasticity of firm export prices to unexpected global wheat price changes.
- $\mathbf{X}$: vector of destination-time controls; $\tau_{kd,t}$: destination tariffs.

Fixed effects and identification:

- γ_{fkd}: firm–product–destination FE (absorbs distance, contiguity, firm productivity, etc.).
- Error term ($\epsilon_{fkd,t}^{V_n}$) clustered by destination and year.

A reduced form gravity model of Italian firm-level exports: Asymmetric Effects

Structural shocks s can be positive or negative ⇒ export price responses may be asymmetric.

Asymmetric model:

$$\ln(X_{fkd,t}) = \beta_0 + \beta_1 \Delta^{+} \hat{p}_t^{v_{st}} + \beta_2 \Delta^{-} \hat{p}_t^{v_{st}} + \beta_2 \ln(1 + \tau_{kd,t}) + \mathbf{b}'\mathbf{X}_{dt} + \gamma_{fkd} + \epsilon_{fkd,t}^{v_n}$$

Shock decomposition:

- $\Delta^{+} \hat{p}_t^{v_{st}} = \Delta \hat{p}_t^{v_{st}}$ if shock effect on wheat price is positive, else 0.
- $\Delta^{-} \hat{p}_t^{v_{st}} = \Delta \hat{p}_t^{v_{st}}$ if shock effect is negative, else 0.

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The effect of global wheat market shocks on firm-level export prices

Dependent variable	$\ln X_{fpdt}$	$\ln X_{fpdt}$	$\ln X_{fpdt}$	$\ln X_{fpdt}$
	(1)	(2)	(3)	(4)
Wheat Supply shocks$_t$	0.198***			
	(0.038)			
Economic activity shocks$_t$		0.639***		
		(0.081)		
Consumption demand shocks$_t$			0.044**	
			(0.022)	
Inventories demand shocks$_t$				−0.022
				(0.059)
Controls	Yes	Yes	Yes	Yes
Firm-product-destination FEs	Yes	Yes	Yes	Yes
Observations	246030	246030	246030	246030
R^2	0.138	0.142	0.134	0.134

Notes: All models are estimated using ordinary least squares. ***, ** and * denote significance at 1%, 5% and 10% respectively.

Heterogeneous effects

- Heterogeneous effects by
  1. Product (pasta and pasta derivatives)
  2. Distance to destination
  3. Firm size

The effect of global wheat market shocks on firm-level export prices

	(1)	(2)	(3)	(4)
Wheat Supply shocks$_t^+$	−0.149**			
	(0.064)			
Wheat Supply shocks$_t^-$	0.252***			
	(0.043)			
Economic activity shocks$_t^+$		1.637***		
		(0.259)		
Economic activity shocks$_t^-$		−0.203***		
		(0.063)		
Consumption demand shocks$_t^+$			0.028	
			(0.033)	
Consumption demand shocks$_t^-$			−0.216***	
			(0.042)	
Inventories demand shocks$_t^+$				−0.066
				(0.047)
Inventories demand shocks$_t^-$				−0.077
				(0.146)
Controls	Yes	Yes	Yes	Yes
Firm-product-destination FEs	Yes	Yes	Yes	Yes
N	246030	246030	246030	246030

Notes: All models are estimated using ordinary least squares. ***, ** and * denote significance at 1%, 5% and 10% re-

Looking ahead

- Clarify assymetric effects
- Does the price effects translate into volume effects?

Thank you!

Questions?

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