What Drives Commodity Price Booms and Busts?

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August 10, 2017

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Paper on one page

Question: What drives commodity prices in the long run?

Data: 1870-2013; 12 commodities.

Method: Structural VAR; historical decomposition.

Main Results:

- Common pattern of aggregate commodity demand shocks appears across commodities.
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- Understanding the causes of global commodity price fluctuations is important for business strategies and macroeconomic policy. ▸ Map
- Most evidence based on global market for crude oil and data starting in 1973 (e.g. Kilian, 2009, Kilian and Murphy, 2014, Baumeister and Hamilton, 2015). ▸ Literature
- Is the evidence specific to the crude oil market and/or the time period since 1973?
- Are commodity booms and busts driven by aggregate demand shocks a new phenomenon?

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Contribution

- First to provide evidence on drivers of prices:
  - Over a broad spectrum of commodities.
  - Over a broad period of time.
- New data set on prices and production.
- Punchline: Aggregate commodity demand shocks are more important than commodity supply shocks for a broad variety of commodities.

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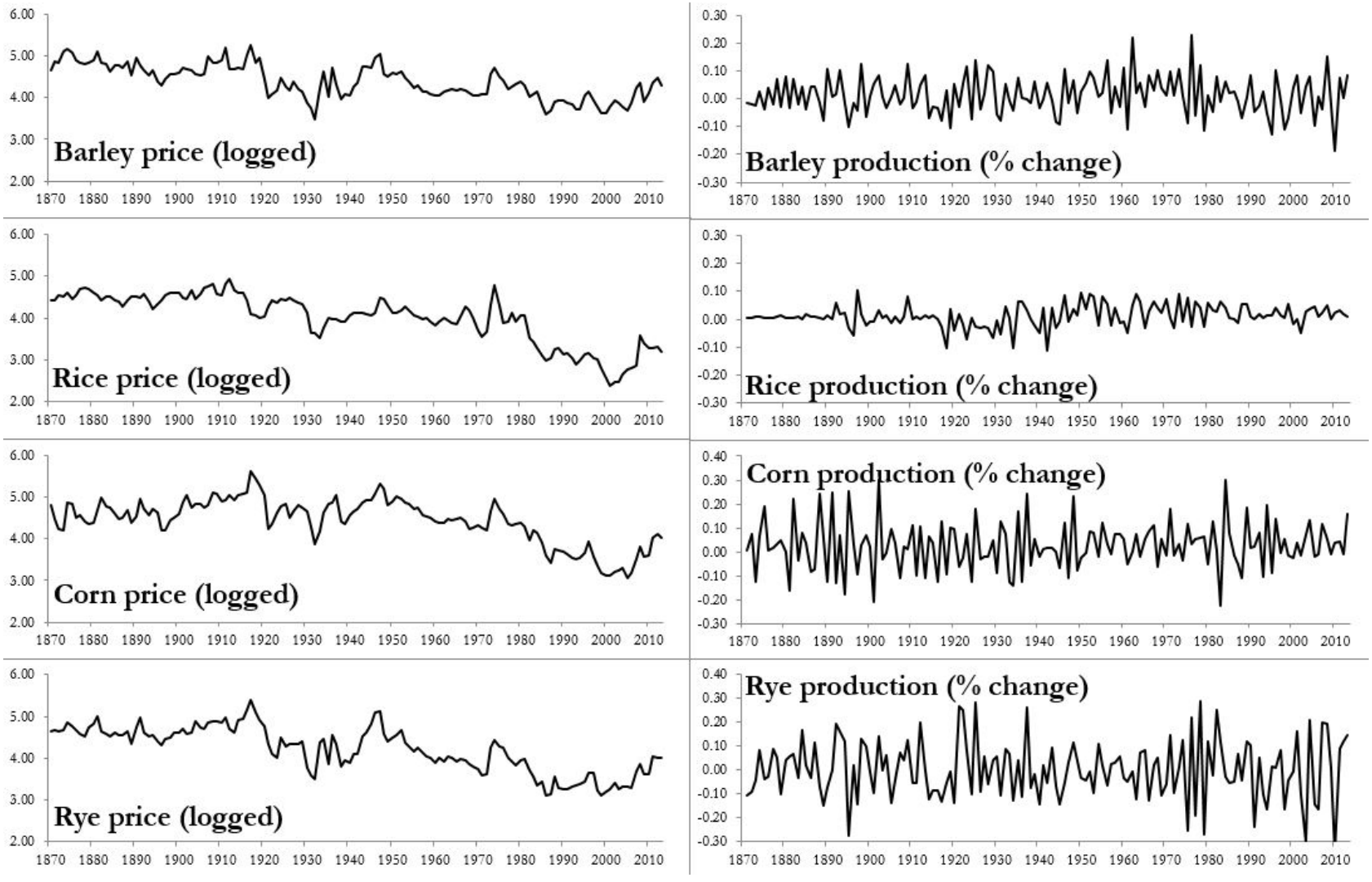
Data

- 12 commodities. ▸ List ▸ Selection Criteria
- Annual, 1870 to 2013.
- Prices: mostly U.S. and U.K., deflated with US-CPI.
- World production: different data sources.
- World GDP: Maddison (2010), The Conference Board (2014).

Data: Evolution of Agricultural Prices and Output

▸ Others



Identification

- Previous work (Kilian, 2009, and others):
  - Monthly data, short time horizon.
  - Short-run and sign restrictions.
  - Major assumption: inelastic supply in the short run.
- This paper follows Stuermer (forthcoming):
  - Annual data, long time horizon
  - Long-run restrictions
- Increases in real commodity prices set in motion investment and innovation (Anderson et al, 2014; Stuermer and Schwerhoff, 2015).

Start-off with a VAR model

$$\begin{aligned} z_t &= (\Delta Y_t, \Delta Q_t, P_t)' \\ &= \alpha_1 z_{t-1} + ... + \alpha_p z_{t-p} + \beta D_t + u_t \end{aligned} \tag{1}$$

- Three endogenous variables:
  ΔY = world GDP (%),
  ΔQ = world commodity production (%),
  P = world commodity price (log).
- Deterministic terms (denoted D): constant, linear trends, dummies for World War periods.

Assumptions: Possible Effects of Shocks

- Decomposition of reduced form residuals u_t into three structural shocks using long-run restrictions. ▸ Equations

	World GDP	Comm. Prod.	Price
Agg. Comm. Demand Shock	Yes	Yes	Yes
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Table: Assumptions on Potential Long-Run Effects of Shocks on Endogenous Variables.

▸ Assumptions: Contemporaneous Relationships

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Result 1: Common Aggregate Demand Patterns

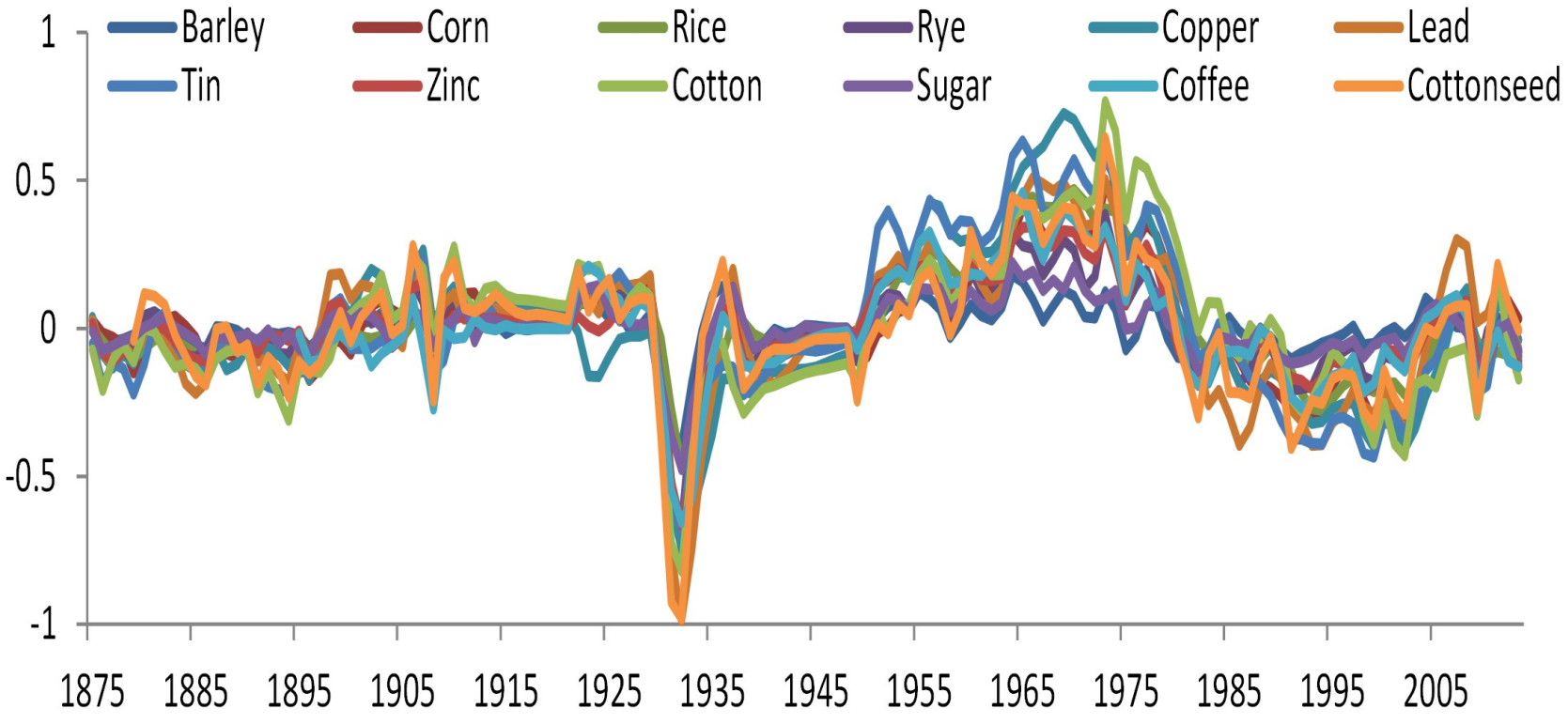

Figure: Cumulative Effects of Aggregate Commodity Demand Shocks on Real Commodity Prices.

Result 2: Demand Dominates Supply

	Agg. Commodity Demand Shock	Commodity Supply Shock	Commodity-specific Demand Shock
Grains	32%	18%	50%
Metals	38%	20%	42%
Softs	34%	20%	44%
Average	35%	20%	46%

Table: Commodity Price Booms and Busts Explained by Type of Shock.

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Result 3: Importance of Demand Shocks Increases over time, Supply Shocks Decreases

	Agg. Commodity Demand Shock	Commodity Supply Shock	Commodity-specific Demand Shock
1871-2013	35%	20%	46%
1871-1913	29%	24%	47%
1919-1939	34%	23%	45%
1949-2013	38%	16%	46%

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Result 4: Demand Shocks More Persistent

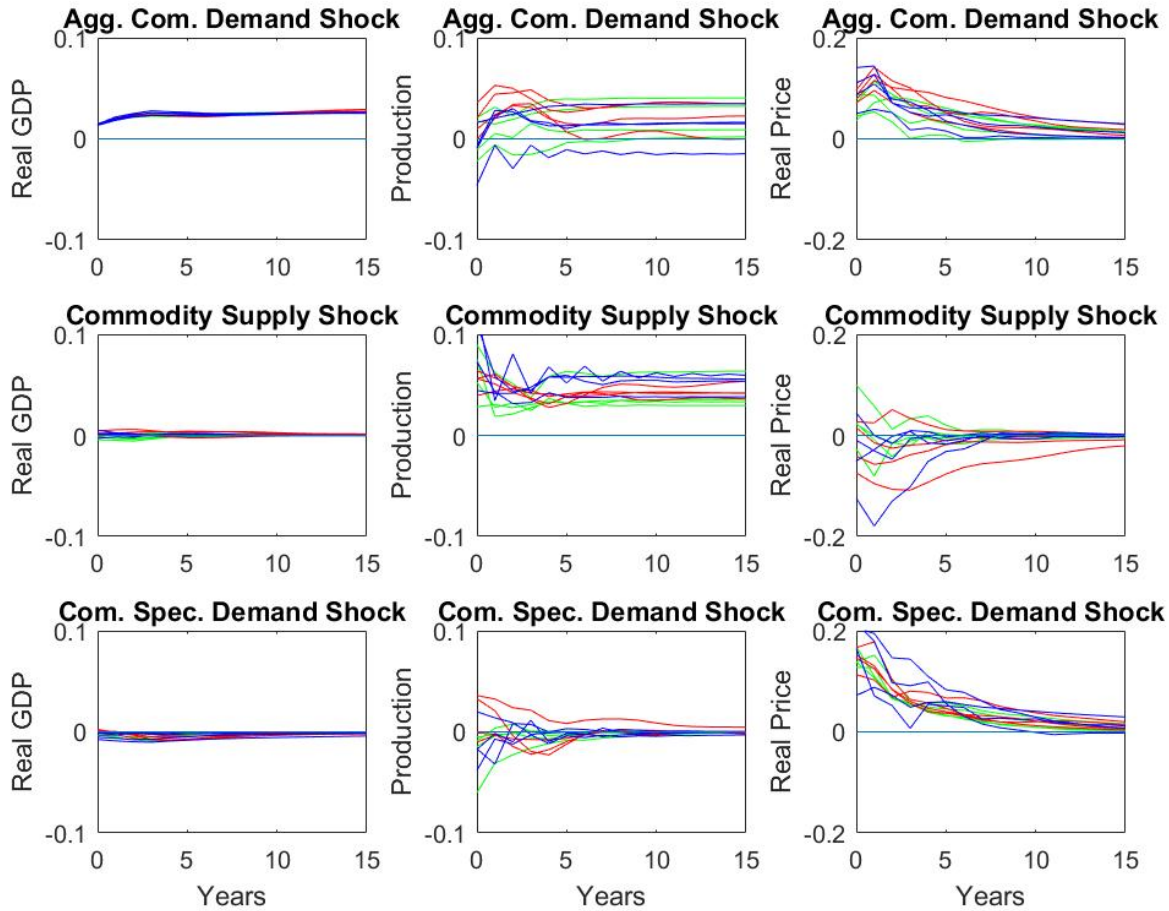


Figure: Impulse Response Functions for all 12 Commodity Markets.
Green: Agricultural Commodities, Red: Metals, Blue: Soft Commodities

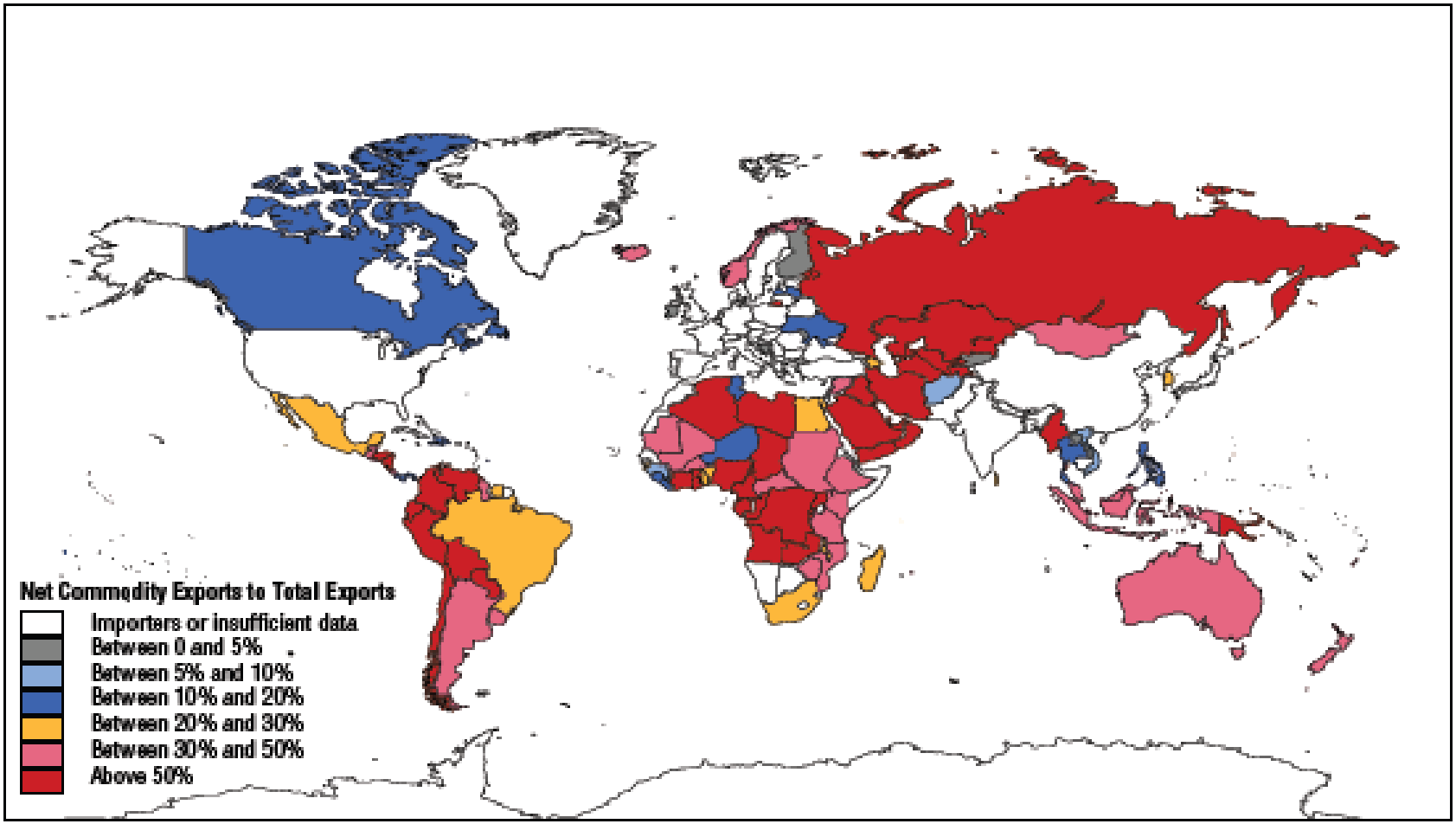
▸ Individual Impulse Response Functions ▸ Robustness Checks

Conclusions

- The same pattern of aggregate commodity demand shocks appears across commodities.
- Aggregate commodity demand shocks and commodity-specific demand shocks are most important.
- Importance of aggregate commodity demand shocks increases over time.
- Aggregate commodity demand shocks affect prices up to 10 years; commodity supply shocks up to 5 years.

Thank you for your attention and your comments!

Share of Net Commodity Exports in Total Exports



(Source: IMF, 2012)

Return

Literature

- Literature remains divided on the importance of forces determining prices.
- Some point to supply shocks as chief source for oil price fluctuation (e.g. Hamilton, 2008; Caldara et al, 2016).
- Other point to shocks on the demand side (e.g. Kilian, 2009).

Return

Literature

- Discontinuous exploration of new deposits (Arrow and Chang, 1982; Fourgeaud et al., 1982; Cairns and Lasserre, 1986).
- Storage models leave the ultimate sources of shocks open (Gustafson, 1958; Deaton and Laroque, 1992, 1996; Cafiero et al., 2011).
- Interaction between persistent demand shocks and supply restrictions (Dvir and Rogoff, 2009).
- Evidence from oil market: rather demand shocks than supply shocks (Kilian, 2009; Kilian and Murphy, 2012).

Return

List of Commodities

Grains: Corn, Rice, Barley, Rye.

Soft commodities Coffee, Cotton, Cottonseed, Sugar.

Metals: Copper, Tin, Lead, Zinc.

Return

Selection Criteria

1. Evidence of an integrated world market.
2. No evidence of dramatic structural changes in marketing or use over time.
3. High degree of homogeneity in the traded product.

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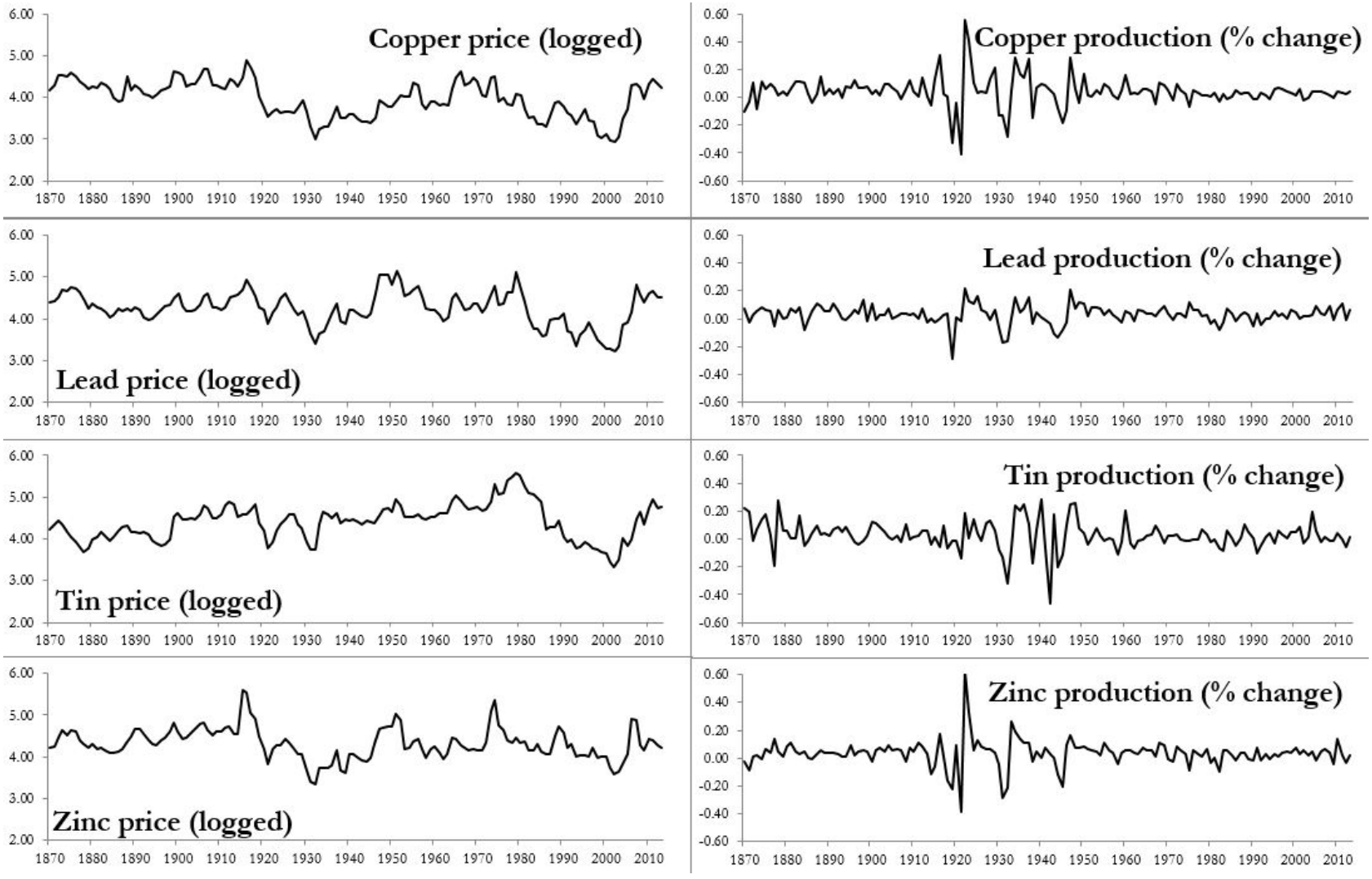
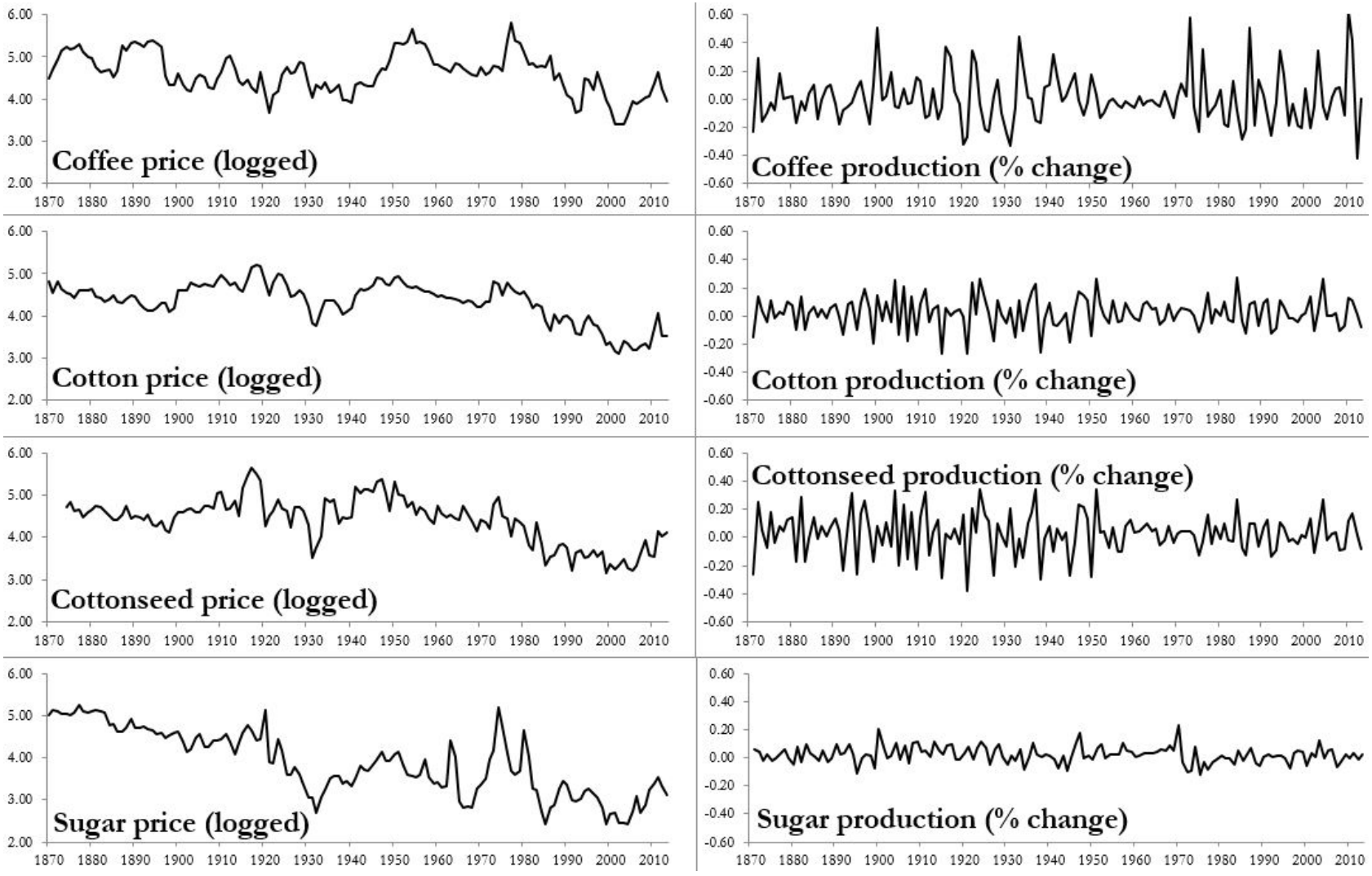
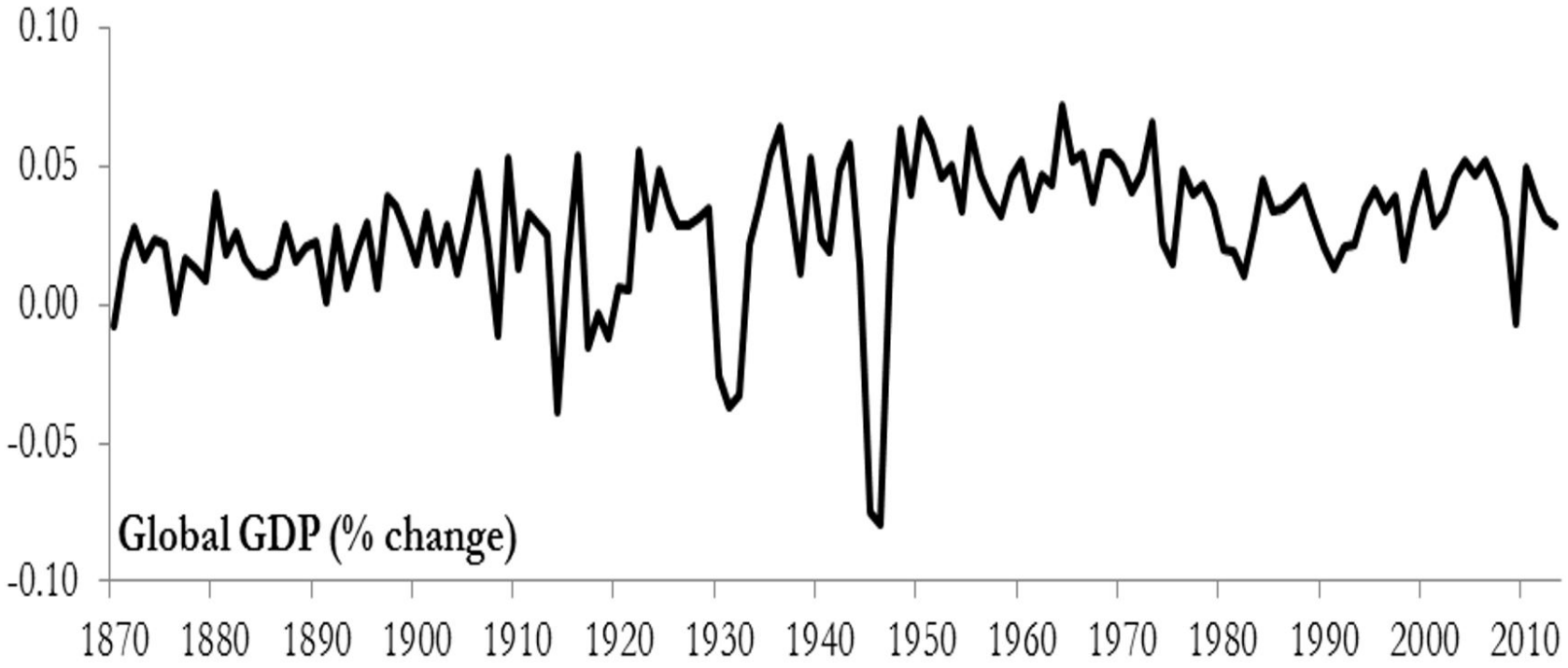
Data: Evolution of Metal Prices and Output



Data: Evolution of Soft Commodities Prices and Output



Data: Evolution of Global GDP Growth, 1870-2013



Return

Structural VAR Model

$$Ay_t = \alpha_1^* y_{t-1} + ... + \alpha_p^* y_{t-p} + \beta^* D_t + B\epsilon_t \ .$$

- α_j^*, β^* are structural form parameter matrices. They can be related to the reduced form parameter matrices by $\alpha = A^{-1}\alpha^*$.
- The reduced form coefficients are related to a vector of serially and mutually uncorrelated structural innovations by $u_t = A^{-1}B\epsilon_t = \Phi^{-1}\Psi\epsilon_t$.

Structural VAR with long-run restrictions

- Φ is the matrix of accumulated effects of the impulses. It is given by $\Phi = \sum_{s=0}^{\infty} \Phi_s = (I_K - \alpha_1 - ... - \alpha_p)^{-1}$.
- Ψ is the long-run impact matrix of structural shocks. $\Psi = \text{chol}[\Phi \Sigma_u \Phi']$ Return to VAR model
- We need $K(K-1)/2 = 3$ restrictions to identify the structural shocks of the VAR. I assume that Ψ is lower triangular and obtain it from a Choleski decomposition.

Return to assumptions on long run restriction

Historical decomposition

Each endogenous variable in z_t can be decomposed according to :

$$\tilde{z}_t = \sum_{i=0}^{t-1} \phi_i C \epsilon_{t-i} + \sum_{i=0}^{t-1} \phi_i \beta D_{t-i} + \alpha_1^{(t)} z_0 + ... + \alpha_p^{(t)} z_{-p+1},$$

where $C = A^{-1}B = \Phi^{-1}\Psi$, $\phi_i = J\boldsymbol{\alpha}^i J'$ and
$\left[\alpha_1^{(t)}, \cdots, \alpha_p^{(t)}\right] = J\alpha^t$, with $(K \times Kp)$ matrix
$J = \left[I_K, 0_{(K\times K)}, \cdots, 0_{(K\times K)}\right]$.

Assumptions: Potentially Transitory Effects of Shocks

- This approach leaves the contemporaneous relationships completely unrestricted.

	World GDP	Comm. Prod.	Price
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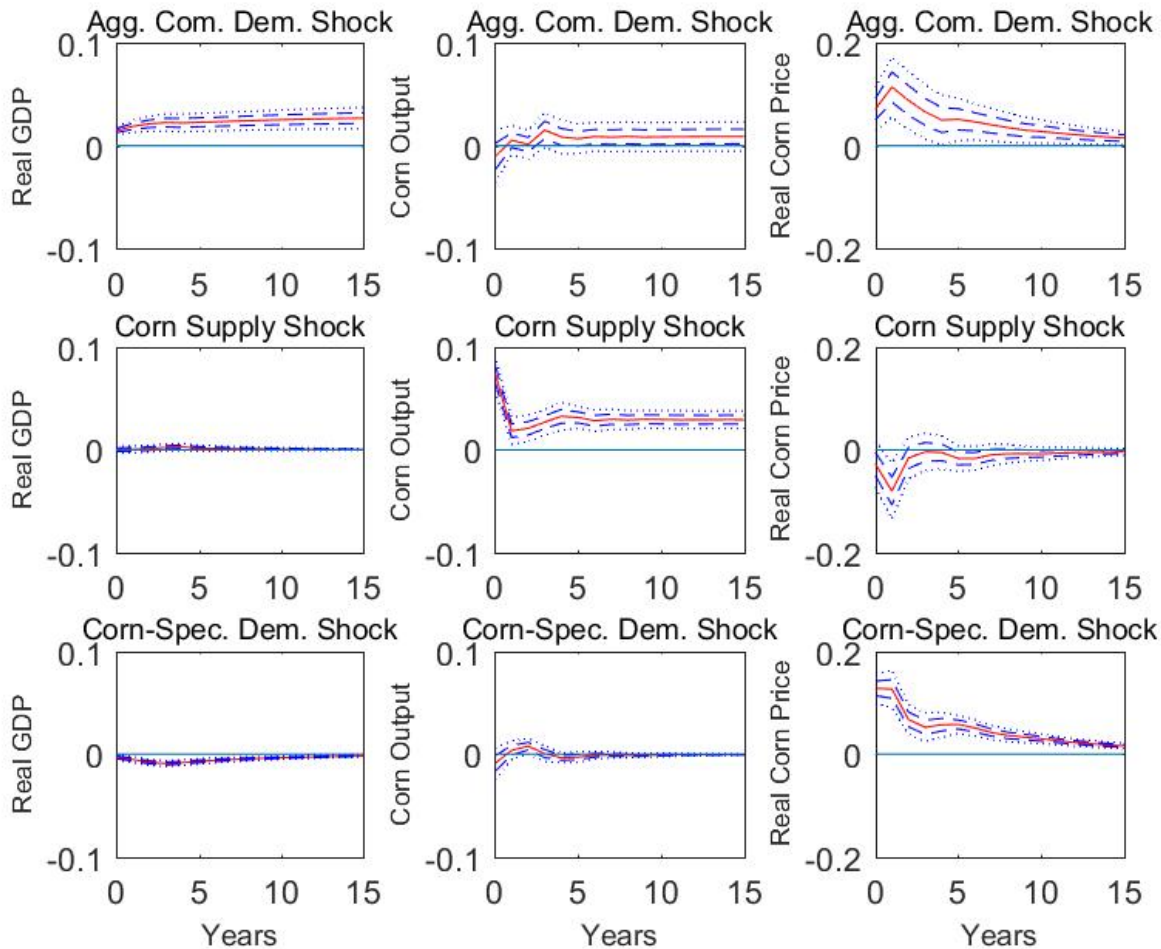
Table: Assumptions on Potential Short-Run Effects of Shocks on Endogenous Variables.

Return

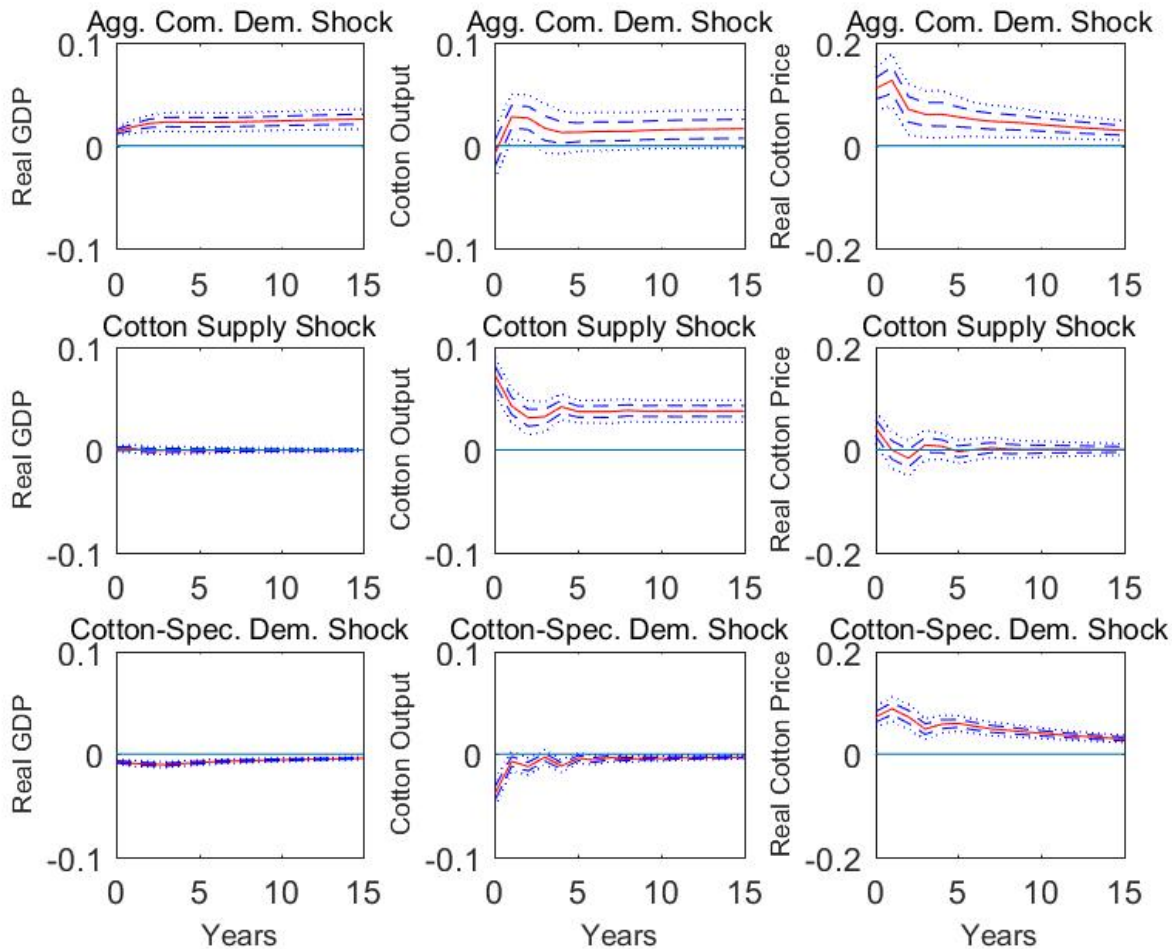
Responses to One-Standard-Deviation Structural Shock: Corn



(Point estimates with one- and two-standard error bands.)

▸ Return to Result 4

Responses to One-Standard-Deviation Structural Shock: Cotton



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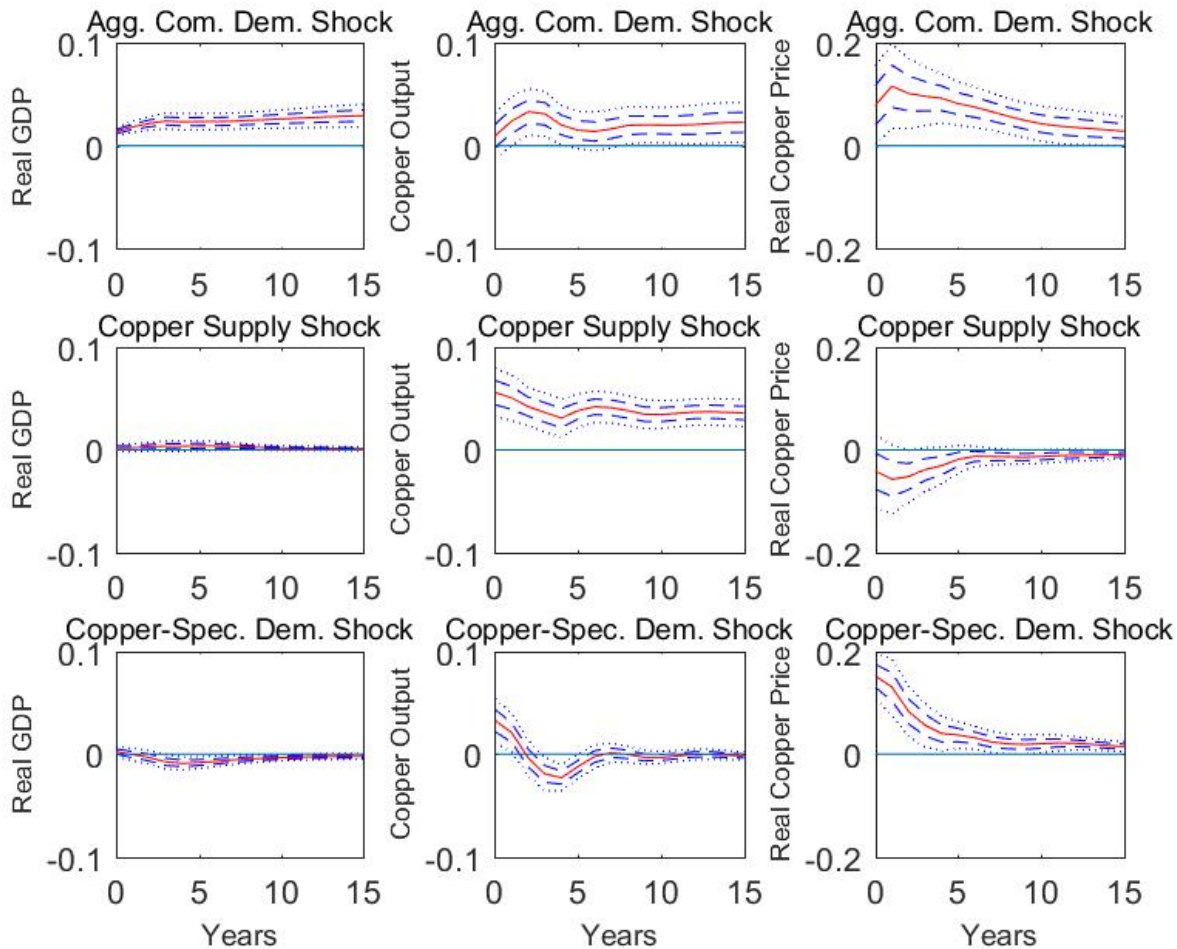
Responses to One-Standard-Deviation Structural Shock: Copper



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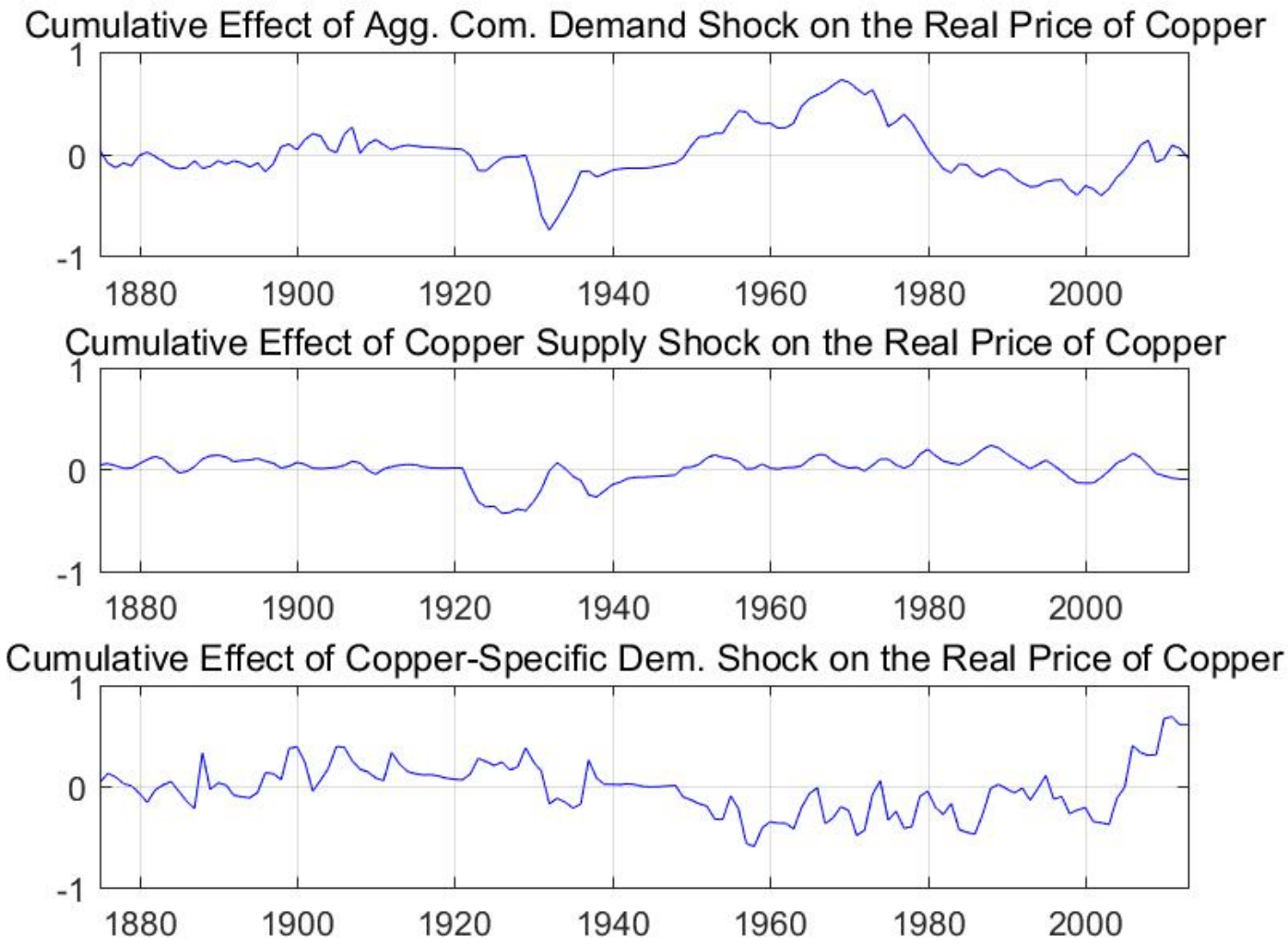
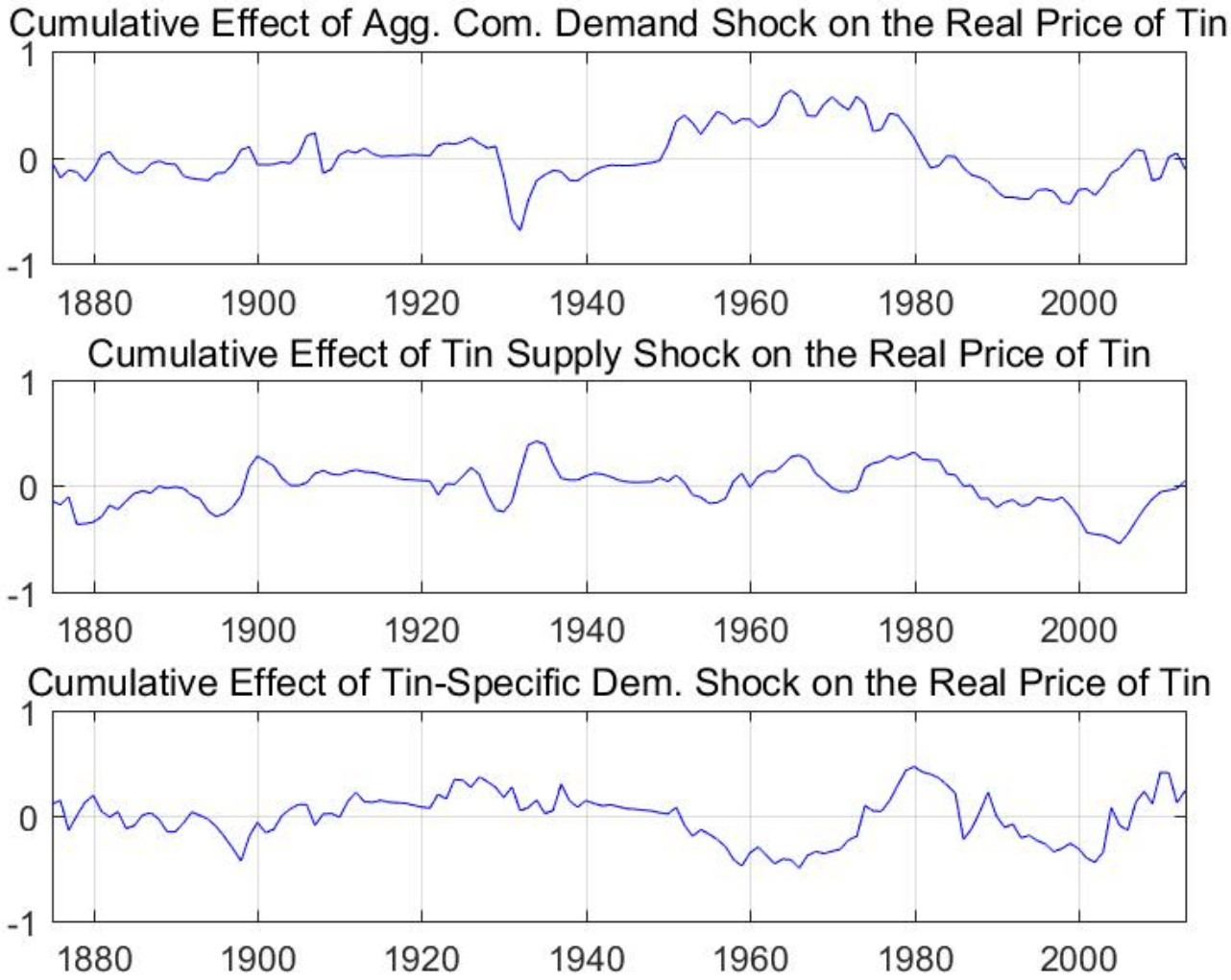
Historical Decomposition of the Real Price of Copper



▸ Return to Results

Historical Decomposition of the Real Price of Tin



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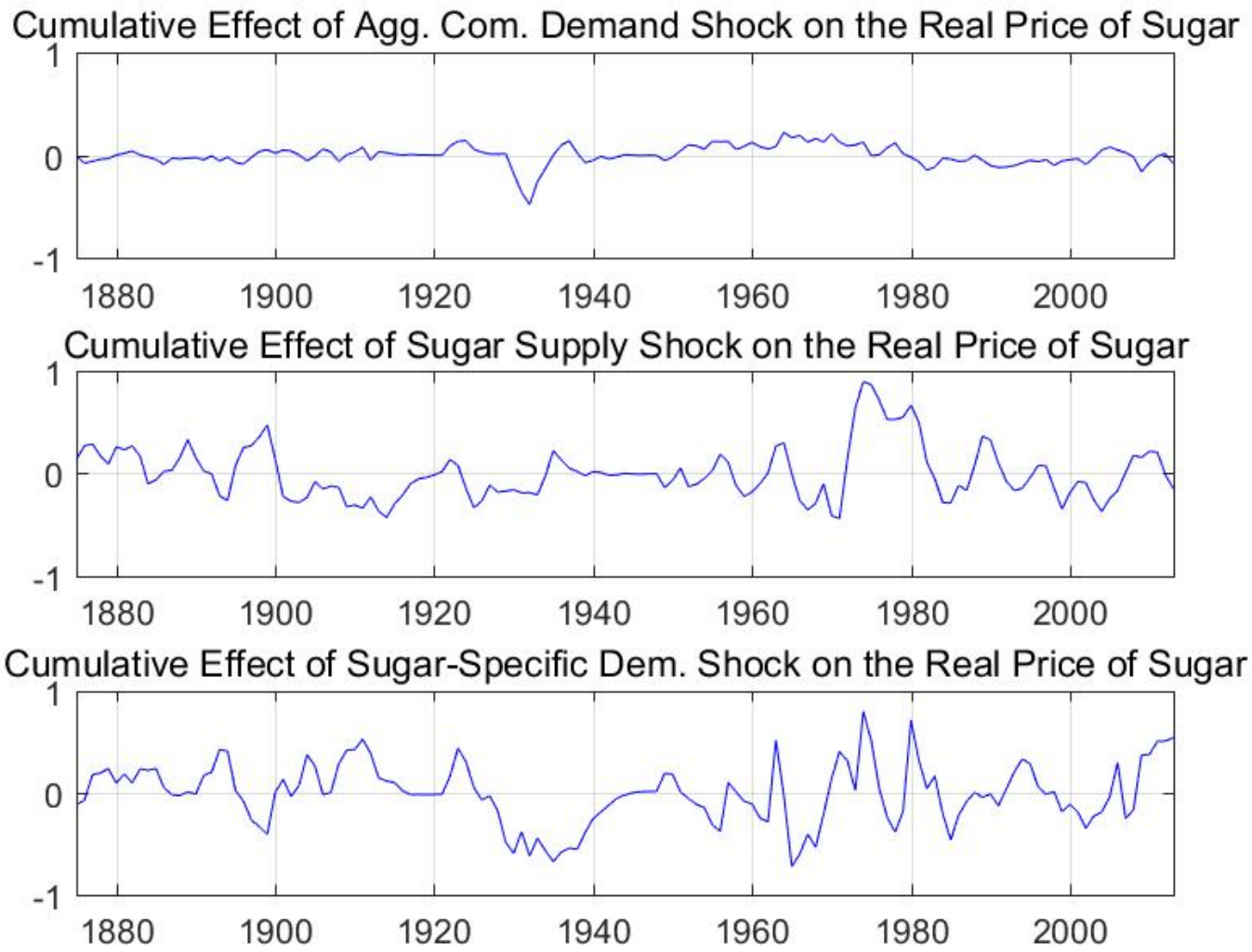
Historical Decomposition of the Real Price of Sugar



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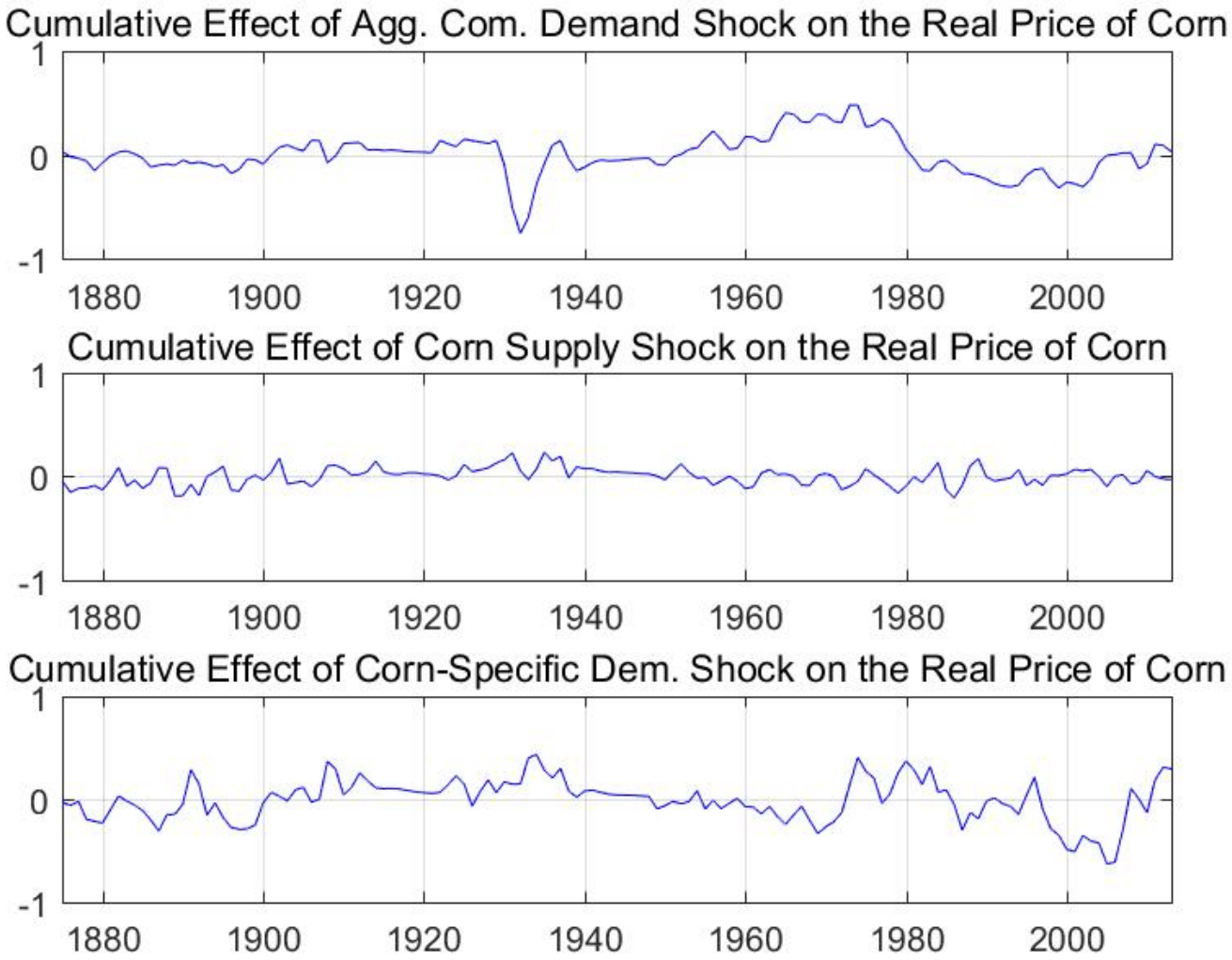
Historical Decomposition of the Real Price of Corn



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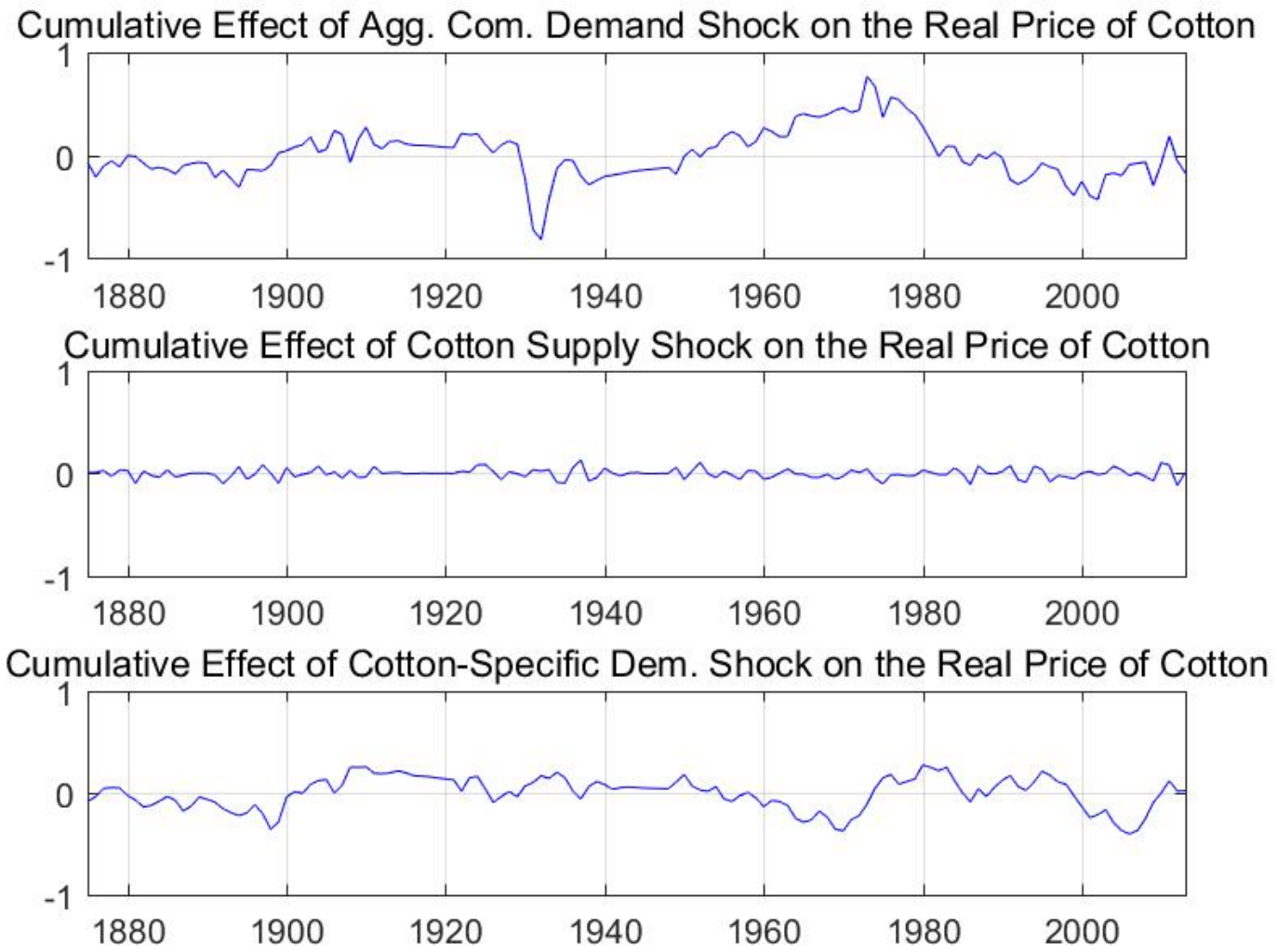
Historical Decomposition of the Real Price of Cotton



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Robustness checks

Results are robust to:

- Non-linear trends in commodity prices.
- Shorter sample
- Different sub-period samples: 1971-1938 and 1927-2013.
- Different lag length.

Return to Result 4