

A multi-layer framework for studying Italian regional food systems: *An application on wheat-based value chains*

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Motivations - 1

- Food security through a food systems lens → Food must be available, affordable, healthy, and sustainably produced
- The frequency and intensity of supply shocks (climatic, geopolitical, policy-based) are increasing, threatening the stability of the food supply.
- This makes it urgent to assess the vulnerability on the supply side of regional food systems (RFSs), especially as international value chains lengthen.

⇒ A value-chain approach that traces food production processes - from activities serving the final demand of the household to those that supply basic raw materials - is well suited to diagnose exposure and vulnerability to supply shocks.

Motivations - 2

However, currently available toolkits are not enough to fully capture the complexity of shocks. In particular, heterogeneity is overlooked over several dimensions:

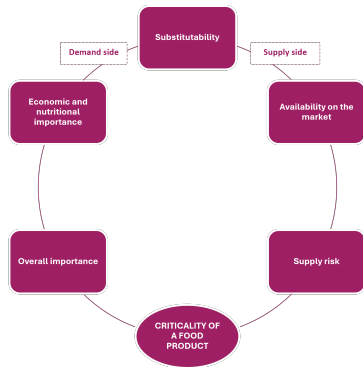
- Products and sectors: agricultural and industrially processed products are not all alike and often heterogeneously subject to different kinds of shocks
- Geography and space: not only regions, but also space in regions, matter
- Farms and firms: farm (firm) heterogeneity in terms of specializations, size, balance sheet characteristics

⇒ A framework which encompasses such different sources of heterogeneity is then needed so as to fully understand how different kinds of shocks propagate through the economy and affect food systems.

Our project

- A theoretical framework to evaluate critical food products starting from the final items in the consumption basket and moving backward towards the critical raw materials
- A multi-layer framework underpinnings both data and models which embeds in a SUT-based environment sector, product, space and firm heterogeneity
- Case studies about the impact of heterogeneous sources of shocks on food production (e.g., impact of flood in Emilia-Romagna, impact of drought on wine producers in Tuscany, price effect of wheat-based inflation on final wheat-based products)

Critical food products



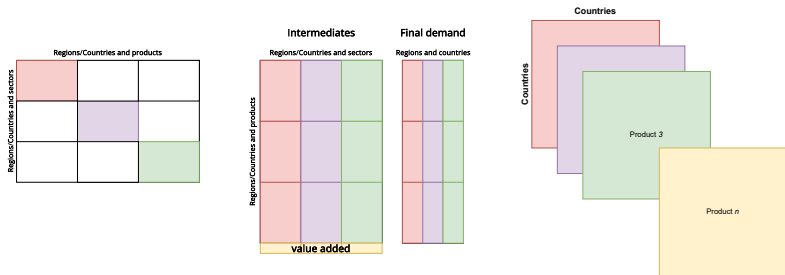
1. **Overall importance of a food product:** To what extent the food product is economically and nutritionally relevant and substitutable?
2. **Risk of food supply chain disruption:** Substitutability on the supply side
3. **Consumer preferences:** Substitutability on the demand side

Via a multi-layer approach



1. An international interregional framework based on trade data and SUTs
2. An interregional food satellite account based on disaggregated SUTs
3. A spatial disaggregation of agricultural production
4. Firm level data on productions and balance sheets

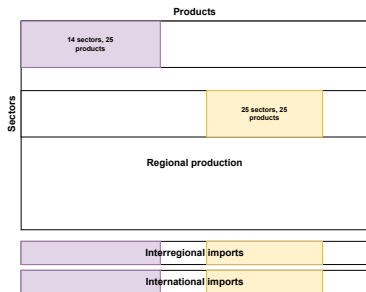
The starting point



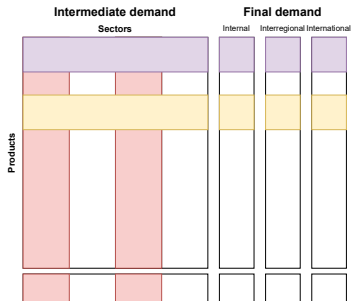
Our starting point is an interregional-international SUT with 43 sectors, 54 products, 66 geographical areas (21 Italian regions, 44 countries, Rest of the World) + CEPII BACI international trade database based on UN COMTRADE

⇒ Level of aggregation of product and sectors too high

The food satellite account by NUTS2 region



Supply Matrix



Use Matrix

⇒ First a disaggregated SUT for each region is built. Then disaggregated interregional trade is reconstructed using aggregated IRPET interSUT table as a constraint.

Data

Production side → Make matrix + Use (production + value added + intermediate inputs):

- For agriculture the starting point is represented by Istat agricultural accounts (disaggregated products, aggregated sector with production, value added, intermediate inputs) combined with FADN accounts (much more aggregated products, disaggregated sectors) and COEWEB data
- For the food & beverages industry we use PRODCOM (5 digits sectors, 8 digits products) combined with SCI, SCI pmi (5 digits sectors), ASIA microdata and COEWEB data to disaggregate sectoral regional accounts

Consumption side (Final internal demand for food):

- Consumption survey (up to 100 items in the food basket)

Methodology

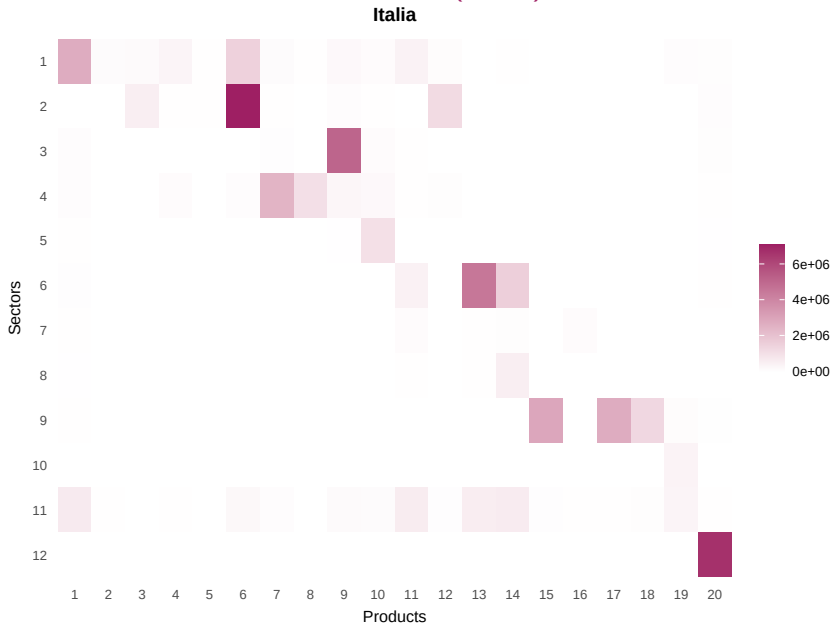
The Supply Matrix:

- Agriculture: we start from Istat accounts and split sectors using FADN and Asia agriculture; we add international imports using Coeweb and aggregated interSUT as constraint
- Food industry: we split interSUT make using PRODCOM and Asia frame data; we add international imports using Coeweb and aggregated interSUT as constraint

The Use Matrix:

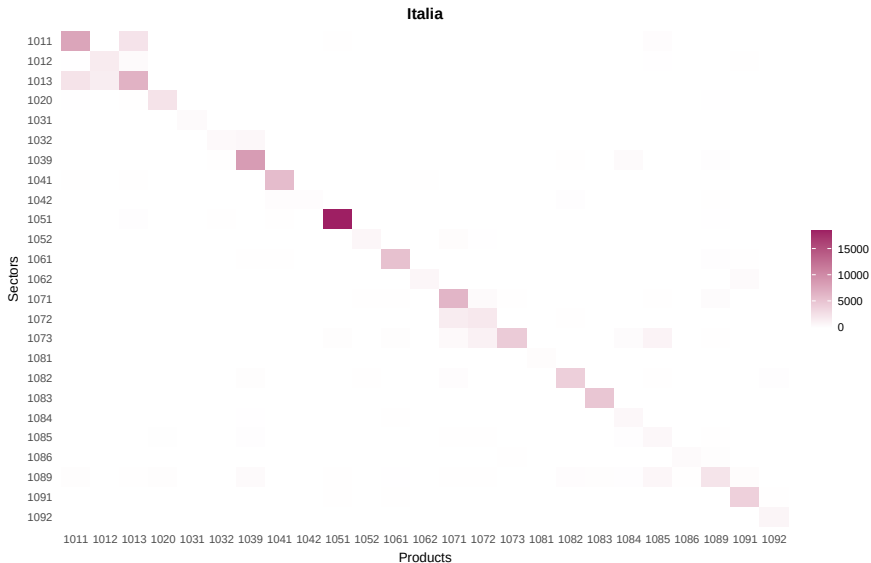
- Intermediates: FADN accounts, Istat regional accounts and SCI are used to provide a first estimate of disaggregated agricultural and food industrial sector; interSUT data as constraint
- Final goods: internal demand split using Istat consumer survey; Coeweb data for international exports; interSUT data as constraint

The Supply matrix: Agriculture (Italy)



The Supply matrix: Agriculture (regions)

The Supply matrix: Food processing industry (Italy)

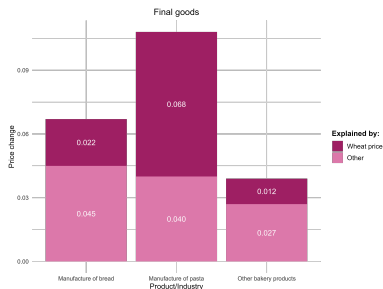
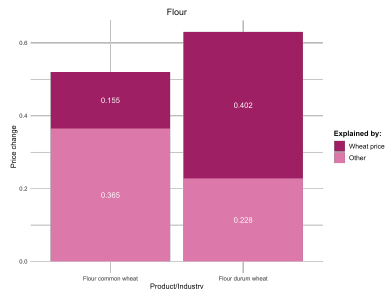
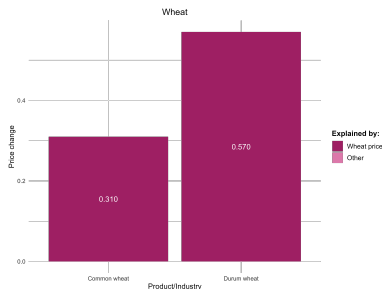


The Supply matrix: Food processing industry (regions)

An application to wheat-based value chains (Intro)

- Example of a case study based on the multi-layer framework: accounting constraints + specific information to pursue a higher level of disaggregation (e.g., data about flour production and destination; inflation for specific products)
- Why wheat? Base product of many Mediterranean diets; relevant input for Italian food industry; Italy highly dependent from abroad; abrupt recent shocks (wildfires in Canada; Ukraine war)
- Wheat based value chains based on 3 nodes: wheat production → flour production → final products (i.e., bread, other bakery products; pasta)
- Research question: how did the wheat price shocks propagated over the value chain? Answer via a Leontief price model (shock on prices; stable demand; stable value added coefficients)

An application to wheat-based value chains (Results)



- Wheat inflation has been crucial in generating inflation in wheat-based final products
- Which role for wholesale and retail?

Discussion

- The increase of the frequency and intensity of supply shocks on food makes it urgent to assess the vulnerability on the supply side of regional food systems (RFSs), especially as international value chains lengthen.
- This makes it urgent to assess the vulnerability on the supply side of regional food systems (RFSs), especially as international value chains lengthen → input-output well suited
- However: heterogeneity (products, sectors, geography and space, farms and firms) matter!
- Our multi-layer toolkit, coupled with the provided theoretical framework, aims at addressing such issues providing a toolkit to investigate how supply shocks over food value chains from different perspectives