LUISS

Institute for European
Analysis and Policy

Jean Monnet Centre of Excellence
on EU Inclusive Open Strategic Autonomy

Quantitative Scenario Analysis for a World Economy Dominated by GVCs

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GI-NI

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Input-Output Analysis

Main contributions in recent times:

1. Provision of new data as a public good
2. Quantification of stylized facts (new indicators)
3. Accounting for stylized facts

So: focus on (recent) history

But: Leontief was always active doing scenario studies, can IO still play a role regarding studies into the future?

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From the Past to the Future: Scenarios (I)

Three major ‘transformations’ happening simultaneously:

1. Technological change: automation/robotization/AI
2. Globalization: increased opportunities for continuation, but… geopolitical issues
3. Demographic change/migration

Could IO-based scenario analysis provide meaningful assessments of potential implications of these for labor market inequalities, globally?

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From the Past to the Future: Scenarios (II)

Problem:
Demographic change and migration cause changes on the supply-side, while traditional IO models are demand-driven.

Potential approaches:

- Large general equilibrium models. Downside: lots of parameters/elasticities to be fixed; ‘black box’ nature of outcomes.
- Small general equilibrium models. Downside: little attention to sector-specific characteristics.
- Linear programming models.

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From the Past to the Future: Scenarios (II)

Linear programming (LP) approach provides options to model changes in global trade according to changes in comparative advantage due to changes in technology and changes in availability of production factors.

Problem:
In times of GVCs, trade in intermediate inputs also endogenous… Changing intermediate trade coefficients cause non-linearities in $(I\text{-}A)^{-1}$ (the Leontief inverse) and LP is not feasible…

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From the Past to the Future: Scenarios (III)

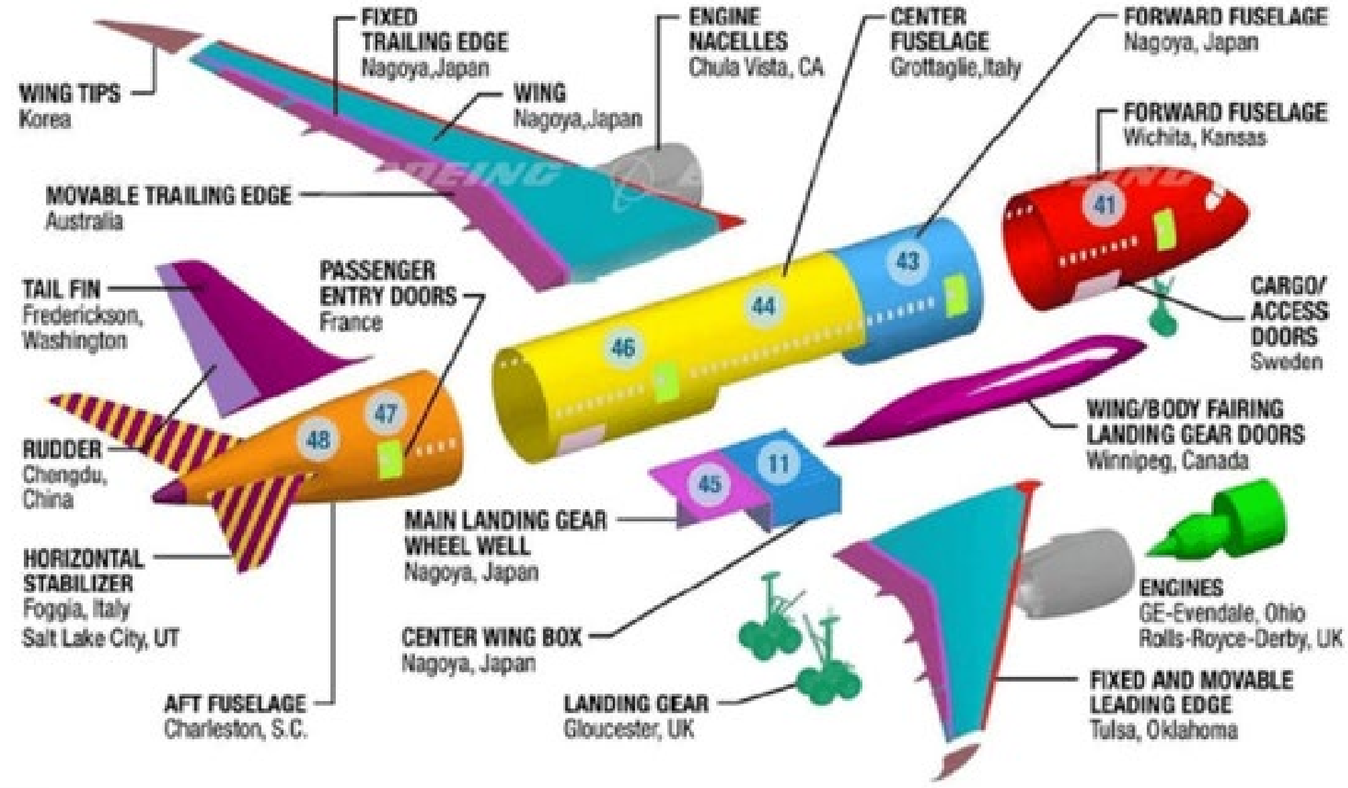
‘Global Value Chain tables’ to the rescue!!(?)

What is a Global Value Chain? (I)

BUSINESS

Boeing 737 MAX Grounding Ripples Through Supply Chain

Trade tensions, lower airline profits and now MAX uncertainty threaten historic jetliner boom



About 600 suppliers of components all over the world suffer as well.

Source: econlife.com

What is a Global Value Chain? (II)

Value Chain: “All activities required to produce a final product” (these includes services activities)

(cf. Pasinetti, 1981, “vertically integrated sectors”)

An aside:
In what cases is a value chain a *Global* Value Chain?
No strict criteria… In my view: production process is dispersed across two or more continents. Manufactured products! Here: all value chains, also for services

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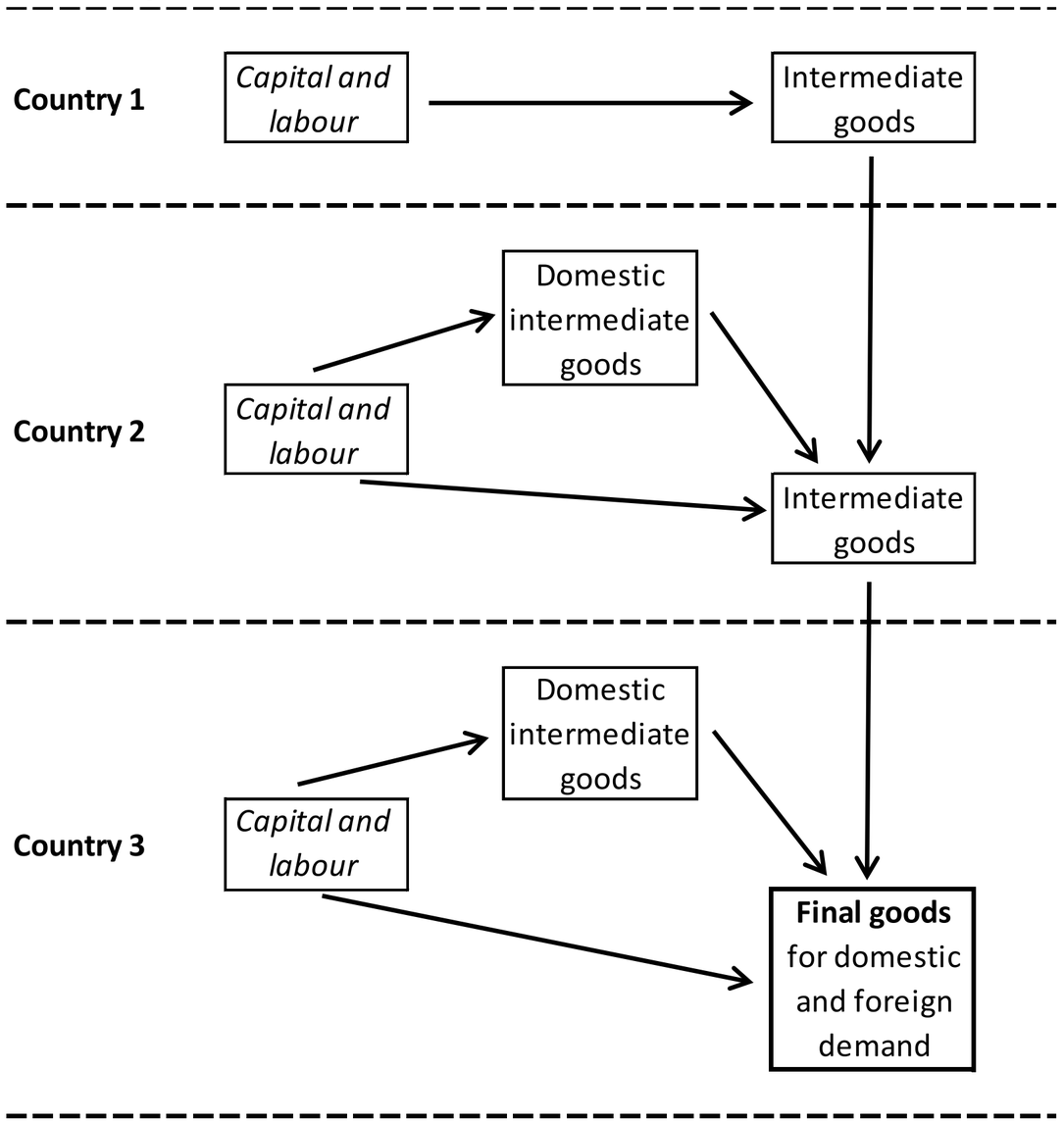
Stylized Graphical Representation of a GVC



What is a Global Value Chain Table?

			Final products of a global value chain, identified by country-industry of completion							Value added
			Country 1			…	Country M			
			Industry 1	…	Industry N		Industry 1	…	Industry N	
Value added from country-industries participating in global value chains	Country 1	Industry 1								
		…								
		Industry N								
	…	…								
	Country M	Industry 1								
		…								
		Industry N								
Total final output value										**World GDP**

Timmer et al. (2015, Rev. Int. Ec.)

Has also been used for employment, emissions, etc.

How to Obtain GVC Tables? (I)

$g_{ri,sj}$ stands for the employment in industry *i* in country *r*, needed for the production of final product *j* completed in country *s*.

So far: global input-output tables needed
Eora/Gloria, EXIOBASE, WIOD, Figaro, OECD-ICIO, LR-WIOD

Basic idea behind derivation of a GVC table:

1. Obtain global demand for each of the *NM* products
2. Multiply these one-by-one by the global Leontief inverse to obtain output levels attributable to them
3. Multiply these output levels by labor required per unit of output

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How to Obtain GVC Tables? (II)

In the future:

Due to societal pressures (often related to CSR), increasing numbers of producers dig deeper into their supply chains (‘corporate social responsibility’, etc.) and have to report on these.

Integration of reports of large firms in crucial industries and countries with first guesses obtained from global IO tables.

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From the Past to the Future: Scenarios (IV)

No nonlinearities if coefficients in GVC tables are considered exogenous (no inverse needed). LP feasible

Application:

- 8 ‘macro-regions’: Old-EU, New-EU, Other Europe, North America, East Asia, China, Russia, Rest of the World
- 2 production factors: HQ workers and fabrication workers

Benchmark: two GVC tables for 2014, computed from WIOD (for HQ workers and for fabrication workers)

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Linear Programming Problem (I)

Maximize global consumption in 2030, subject to constraints:

1. HQ and fabrication labor demand in each country do not exceed HQ and fabrication supply

2. The ratios between HQ and fabrication workers in the non-migrated population in 2030 are identical to those in 2014

3. … (see next slide)

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Linear Programming Problem (II)

3. The changes in the activity shares within each GVC are not larger or smaller than stipulated in the globalization scenario

4. Investment to GDP ratios remain at their 2014 levels in all macro-regions, and the composition of the investment bundles remain unchanged

5. The compositions of the consumption bundles of the eight macro-regions remain as in 2014

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Constraints mainly scenario-specific

Labor-saving technological change can be “slow” or “fast”, relative to historical “business as usual” scenario

Opportunities for trade (both in activities needed to produce final products and in final products) can be “slow” or “fast”

Opportunities for migration from one macro-region to another can be “slow” or “fast”

In what follows: “slow” and “fast” symmetric across pairs of macro-regions (e.g. North America treats Old-EU and China identically, regarding trade and migration)

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Eight scenarios (“2x2x2”), for 2030

“Slow” **technological change** (in each GVC): annual reductions in fabrication labor requirements 25% less in 2014-2030 than in 2000-2014; Reductions in HQ labor requirements continue at an unchanged pace;

“Fast” technological change: Reductions in fabrication labor requirements continue at an unchanged pace; Reductions in HQ labor requirements 10% stronger than over 2000-2014;

Convergence 25% lower in “slow”, 25% higher than over 2000-14 in “fast”.

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Eight scenarios (“2x2x2”), for 2030

“Slow” **globalization**: activity shares in ‘own’ GVCs are at least as high in 2030 as in 2014;
“Fast” globalization: these ‘own’ shares can decrease by 20%;
Similar assumptions regarding trade in final goods.

“Slow” **migration**: at min 25% less net immigration of fabrication workers per region than in 2000-2014, max proportion of HQ immigration as in 2000-2014;
“Fast” migration: at most 25% more immigration, both for fabrication and HQ

Fast Globalization vs. the benchmark (2030)

Table 7: Effects of changes regarding a single transformation

Business-as-usual								
Global final output	117,739,396							
	Old-EU	New-EU	Oth Europe	N-America	East Asia	China	Russia	RoW
Consumption	12,618,583	828,554	4,618,772	20,797,103	5,078,905	10,729,475	484,192	29,198,815
Fabrication employment	34,062	12,244	7,661	32,523	21,828	278,228	18,661	1,429,678
HQ employment	113,344	20,864	32,809	150,362	68,873	414,922	37,349	1,197,443
Fab unemployment	0.9%	22.0%	-3.0%	4.9%	19.3%	32.9%	31.0%	13.7%
HQ unemployment	-6.4%	7.2%	-6.1%	-6.3%	-0.6%	0.4%	-0.3%	1.2%
Consumption/worker	85.6	25.0	114.1	113.7	56.0	15.5	8.6	11.1
Fast globalisation								
ΔGlobal final output	1.5							
	Old-EU	New-EU	Oth Europe	N-America	East Asia	China	Russia	RoW
ΔConsumption	5.0	-1.2	6.7	2.4	5.5	0.3	-3.1	-1.1
ΔFabrication employment	1.0	4.1	2.4	2.0	2.6	2.5	-4.3	-1.1
ΔHQ employment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ΔFab unemployment	-1.0%	-3.2%	-2.5%	-1.9%	-2.1%	-1.7%	3.0%	0.9%
ΔHQ unemployment	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
ΔConsumption/worker	4.8	-2.7	6.2	2.0	4.8	-0.7	-1.7	-0.6

Eight scenarios (“2x2x2”): Results

Technology	Globalization	Migration	Consumption
slow	slow	slow	-7.1
slow	slow	fast	-6.0
slow	fast	slow	-4.1
slow	fast	fast	-2.9
fast	slow	slow	14.1
fast	slow	fast	15.1
fast	fast	slow	15.0
fast	fast	fast	15.6

Global consumption, percent differences to ‘business-as-usual’ scenario

Main differences relate to the technology scenario: HQ labor turns out to be a scarce factor.

Many more results: D7.2 on https://gini-research.org/deliverables

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Other scenario studies

If data available, many more scenario studies can be performed using this (and related frameworks).

Examples:

- Given scenarios about technological progress and trade, how much consumption should advanced countries have to give up to meet the SDGs on GHG emissions and growth of poorest countries simultaneously?
- Given scenarios about technological progress and migration opportunities, what would the impacts on welfare be of the EU striving for strategic autonomy?

Thank you for your attention!

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