

ΜΕΤΡΗΣΗ ΤΗΣ ΠΕΡΙΦΕΡΕΙΑΚΗΣ ΣΥΜΜΕΤΟΧΗΣ ΣΕ ΠΑΓΚΟΣΜΙΕΣ ΑΛΥΣΙΔΕΣ ΑΞΙΑΣ ΜΕΣΩ ΜΕΘΟΔΟΥ ΔΟΜΙΚΗΣ ΑΠΟΣΥΝΘΕΣΗΣ ΤΗΣ ΕΝΣΩΜΑΤΩΜΕΝΗΣ ΠΡΟΣΤΙΘΕΜΕΝΗΣ ΑΞΙΑΣ

Δημήτρης Σταμόπουλος, Πέτρος Δήμας, Άγγελος Τσακανίκας

Laboratory of Industrial and Energy Economics (LIEE), National Technical University of Athens (NTUA), Greece



Background & motivation for this study

- To this point, the **focus** of the empirical literature on GVCs is on the many **different approaches** for the mapping of participation in GVCs and the related gains for **firms/countries**.
- **GVC positioning** and **participation** patterns have been extensively considered for the comparative assessment of national **economic performance** (Gereffi, 1999).
- Most metrics identify **some proportion of value-added (VA)** that is **embodied in the exported** goods and services that are then **used as intermediate** inputs for production abroad.
 - Early work of Hummels et al. (2001) for **vertical specialization**, Johson and Noguera's (2012) **VAX-ratio** and the more recent and detailed frameworks of Koopman et al. (2014) and Borin and Mancini (2023)
- However, the sub-national dimension of GVC participation and positioning has been comparatively underexplored (some interesting exceptions, among others: Colozza et al. (2021), and Bolea et al. (2022)).
 - This can partly be explained by the **chronic and persistent lack of reliable regional data** (Miller and Blair (2009))
 - The **countries** that join GVCs and pursue an optimal positioning along each value chain are **not homogenous entities**.

Regional-level value chain analysis is particularly important for Europe

- In Europe, **centuries of socio-political turmoil** and many **successive industrialization waves** have formed a **highly diverse economic landscape** of dense centers of economic and innovation activity and of stagnant peripheral regions.
- **Studying and tackling these regional inequalities** has been solidly placed in **EU development agendas**, as *“strengthening social, economic and territorial cohesion, and reducing regional disparities is the main goal of EU cohesion policy”* (EC, 2019).
- In the heart of the **trade and economic dimensions** of these regional disparities lie **two opposing forces** for firms and sectors that wish to expand the scope of their activities:
 - the desire to **embed themselves in highly sophisticated production chains**, often found in **specialized clusters abroad**,
 - and the **relative attractiveness of local production partners** that is favored by **spatial supplier-buyer proximities**.

Aim

- This working paper attempts to tackle certain international trade-related extensions of this missing dimension by:
 - **A. developing a framework** that:
 1. measures sub-national regional participation in GVCs
 2. differentiates between the VA that is domestically absorbed in other regions of the same country from its own region of origin
 3. allows for the simultaneous estimation of both regional and international GVC components

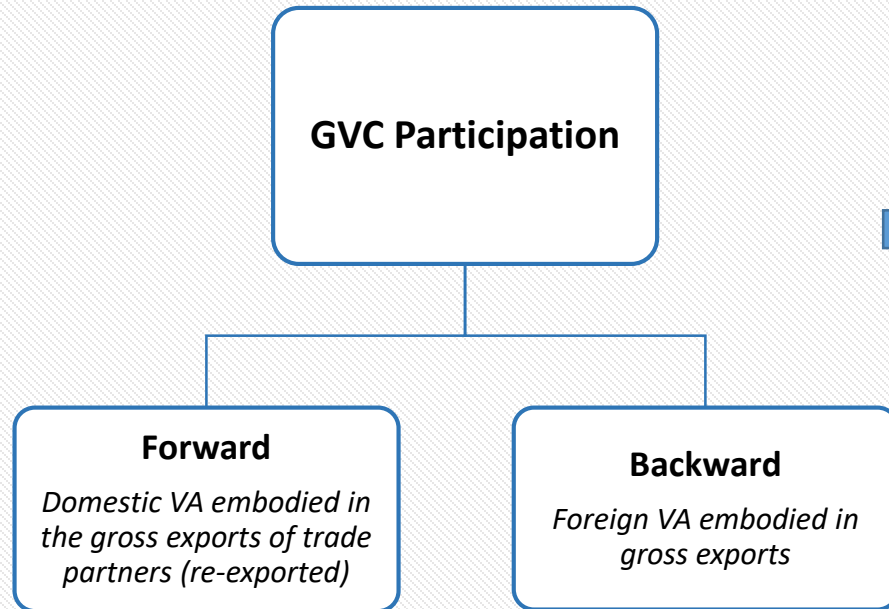
(It must also have some other desirable properties: (exactness, applicability, base-data and symmetry invariance))
 - **B. mapping and investigating** the regional **trends** and **patterns** of **GVC participation**

Methodology

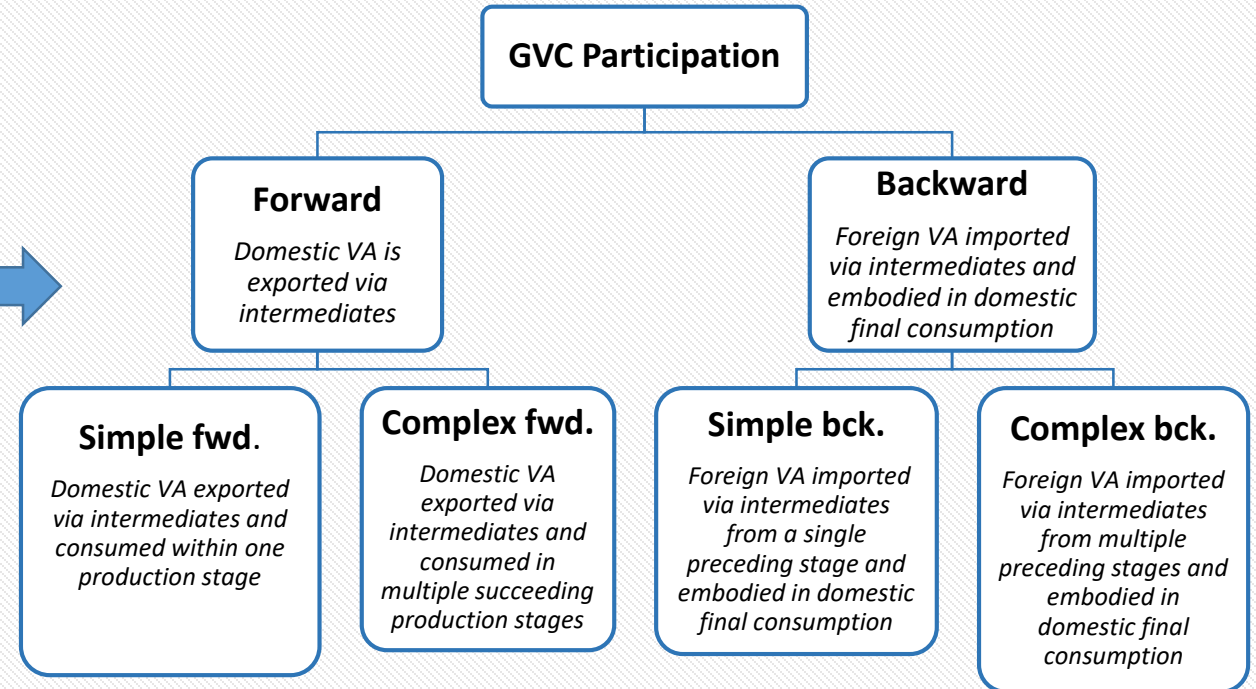
- We develop a **three-stage** empirical strategy:
 - a) Development of a **modified VA decomposition framework**
 - b) **Application in regional I-O data and formulation of DVC and GVC indicators**
 - c) Using the resulting data to **study regional GVC patterns and trends**
- **IO Data source**: 2021 edition of EUREGIO Inter-Country Inter-Regional Input-Output Tables (ICIR-IOTs)
- The resulting dataset describes GVC participation and VA flows for **14 industries in 246 EU-25 NUTS-2 regions**, plus country-level data for Bulgaria, Romania and other key extra-EU trading partners (total of **41** countries) for **2000-2010**
- The covered period **coincides with rapid shifts** in world trade and the **emergence of GVCs**, both as a production paradigm and a research direction (WTO, 2013).
 - It also allows the study of **disruptions of global production activity** due to the 2008 economic crisis and the propagation of adverse shocks through borders, as GVCs can act as channels for transmitting economic downturns (Baldwin, 2009).

A decomposition framework for different types and modes of GVC participation

Metrics based on VA content of exports (Koopman et al. 2014)



New production-based decomposition framework by Wang et al. 2022



Decomposition framework derivation (1)

General form of an IRIC-IOT with N countries, R regions and K economic sectors per country/region:

	Intermediate uses								Final uses			Total output
	Country/Region	C_1	C_2R_1	C_2R_2	C_3R_1	C_3R_2	[...]	C_N	C_1	[...]	C_N	
Intermediate supply	C_1	$X_{1,1}$	$X_{1,2}$	$X_{1,3}$	$X_{1,4}$	$X_{1,5}$	[...]	$X_{1,N}$	$F_{1,1}$	[...]	$F_{1,N}$	$y_{1,1}$
	C_2R_1	$X_{2,1}$	$X_{2,2}$	$X_{2,3}$	$X_{2,4}$	$X_{2,5}$	[...]	$X_{2,N}$	$F_{2,1}$	[...]	$F_{2,N}$	$y_{2,1}$
	C_2R_2	$X_{3,1}$	$X_{3,2}$	$X_{3,3}$	$X_{3,4}$	$X_{3,5}$	[...]	$X_{3,N}$	$F_{3,1}$	[...]	$F_{3,N}$	$y_{3,1}$
	C_3R_1	$X_{4,1}$	$X_{4,2}$	$X_{4,3}$	$X_{4,4}$	$X_{4,5}$	[...]	$X_{4,N}$	$F_{4,1}$	[...]	$F_{4,N}$	$y_{4,1}$
	C_3R_2	$X_{5,2}$	$X_{5,2}$	$X_{5,3}$	$X_{5,4}$	$X_{4,5}$	[...]	$X_{5,N}$	$F_{5,1}$	[...]	$F_{5,N}$	$y_{5,1}$
	[...]	[...]	[...]	[...]	[...]	[...]	[...]	[...]	[...]	[...]	[...]	[...]
	C_N	$X_{N,1}$	$X_{N,2}$	$X_{N,3}$	$X_{N,4}$	$X_{N,5}$	[...]	$X_{N,N}$	$F_{N,1}$	[...]	$F_{K,N}$	$y_{N,1}$
Value added	$va_{1,1}$	$va_{1,2}$	$va_{1,3}$	$va_{1,4}$	$va_{1,5}$	[...]	$va_{1,N}$					
Total input	$y_{1,1}$	$y_{1,2}$	$y_{1,3}$	$y_{1,4}$	$y_{1,5}$	[...]	$y_{1,N}$					

- The global matrix of direct requirements can be obtained as usual ($A = X\hat{Y}^{-1}$, where \hat{Y} is a square zero matrix with the values of Y in its diagonal)
- The global Leontief matrix (total requirements) can also directly obtained: $(I - A)^{-1} = L$ (I is a unit matrix of matching dimensions).
- The global vector of direct VA coefficients similarly is $V = VA\hat{Y}^{-1}$.

Decomposition framework derivation (2)

- In this stage, the framework of Wang et al. (2022) would isolate the **domestic** and **foreign components** of production and final demand and use them to decompose total VA by production stage and GVC activity type.
- **This is not possible in an IRIC-IOT:** each country's domestic production and final demand extends beyond the diagonal blocks; **the required symmetry is violated** for every country that the IRIC-IOT provides regional information
- The first step of our framework: create a vector of length N , with each element containing the count of sub-national regions available in each of the N countries: $\mathbf{C} = [C_1 \ C_2 \ \dots \ C_N]$.
- Its elements are used to construct the **non-symmetrical national block matrices** of domestic intermediate flows and final demand:

$$\bullet \mathbf{X}^{D,nat} = \begin{bmatrix} \mathbf{X}_{1,1} & [\mathbf{0}] & [\mathbf{0}] & \dots & [\mathbf{0}] \\ [\mathbf{0}] & \mathbf{X}_{2,2} & \mathbf{X}_{2,3} & \dots & [\mathbf{0}] \\ [\mathbf{0}] & \mathbf{X}_{3,2} & \mathbf{X}_{3,3} & \dots & [\mathbf{0}] \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ [\mathbf{0}] & [\mathbf{0}] & [\mathbf{0}] & \dots & \mathbf{X}_{N,N} \end{bmatrix} \quad \text{and} \quad \mathbf{F}^{D,nat} = \begin{bmatrix} \mathbf{F}_{1,1} & [\mathbf{0}] & [\mathbf{0}] & \dots & [\mathbf{0}] \\ \mathbf{0} & \mathbf{F}_{2,2} & \mathbf{F}_{2,3} & \dots & [\mathbf{0}] \\ \mathbf{0} & \mathbf{F}_{3,2} & \mathbf{F}_{3,3} & \dots & [\mathbf{0}] \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ [\mathbf{0}] & [\mathbf{0}] & [\mathbf{0}] & \dots & \mathbf{F}_{N,N} \end{bmatrix}$$

- The **national-domestic diagonal blocks** are **composite square matrices** of total dimensions $C_i K$ each. The dimensions of each zero sub-matrix ($[\mathbf{0}]$) are adjusted to preserve the overall KRN dimension of the entire square matrix as long as the diagonal blocks are correctly sized.

Decomposition framework derivation (3)

- Accordingly, the **regional-domestic** intermediate flows are the **fully symmetrical** versions of the above (each regional-domestic matrix placed in the diagonal of the composite matrix, equally sized zero matrices everywhere else).

$$\mathbf{X}^{D,reg} = \begin{bmatrix} \mathbf{X}_{1,1} & [\mathbf{0}] & [\mathbf{0}] & \cdots & [\mathbf{0}] \\ [\mathbf{0}] & \mathbf{X}_{2,2} & [\mathbf{0}] & \cdots & [\mathbf{0}] \\ [\mathbf{0}] & [\mathbf{0}] & \mathbf{X}_{3,3} & \cdots & [\mathbf{0}] \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ [\mathbf{0}] & [\mathbf{0}] & [\mathbf{0}] & \cdots & \mathbf{X}_{N,N} \end{bmatrix} \quad \text{and} \quad \mathbf{F}^{D,reg} = \begin{bmatrix} \mathbf{F}_{1,1} & [\mathbf{0}] & [\mathbf{0}] & \cdots & [\mathbf{0}] \\ \mathbf{0} & \mathbf{F}_{2,2} & [\mathbf{0}] & \cdots & [\mathbf{0}] \\ \mathbf{0} & [\mathbf{0}] & \mathbf{F}_{3,3} & \cdots & [\mathbf{0}] \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ [\mathbf{0}] & [\mathbf{0}] & [\mathbf{0}] & \cdots & \mathbf{F}_{N,N} \end{bmatrix} \quad (2)$$

The intermediate flows and final demand that exist **outside all regions** of each country are the differences of the domestic from the global matrices:

$$\mathbf{X}^{F,nat} = \mathbf{X} - \mathbf{X}^{D,nat}, \quad \mathbf{F}^{F,nat} = \mathbf{F} - \mathbf{F}^{D,nat} \quad (3)$$

Then, both the **regional-domestic** and the **national-domestic** matrices of direct and total requirements can be estimated:

$$\mathbf{A}^{D,reg} = \mathbf{X}^{D,reg} \hat{\mathbf{Y}}^{-1}, \quad \mathbf{L}^{D,reg} = (\mathbf{I} - \mathbf{A}^{D,reg})^{-1} \quad (4a)$$

$$\mathbf{A}^{D,nat} = \mathbf{X}^{D,nat} \hat{\mathbf{Y}}^{-1}, \quad \mathbf{L}^{D,nat} = (\mathbf{I} - \mathbf{A}^{D,nat})^{-1} \quad (4b)$$

Accordingly, the **extra-national direct requirements** are $\mathbf{A}^{F,nat} = \mathbf{A} - \mathbf{A}^{D,nat}$.

Decomposition framework derivation (3)

With the above formulation, the VA that is embodied (EVA) in intermediate flows **that originate from a specific sub-national region and is used (both directly and indirectly) to meet final demand within the same region** is contained in the matrix:

$$\hat{V}L^{D,reg}\hat{F}^{D,reg} \quad (5)$$

Similarly, the EVA in intermediate flows that **originate from all sub-national regions and is used (both directly and indirectly) to meet national final demand within all other regions of the same country** is contained in the matrix:

$$\hat{V}L^{D,nat}\hat{F}^{D,nat} \quad (6)$$

“domestic” VC (DVC) activity

Both these terms refer to **intra-national economic activity** and are derived from the intermediate and final flows that may **cross regional borders but not national borders**, i.e., they measure domestic value chains. To account for EVA in international trade in final goods (traditional trade), we need the domestic national components of production and final demand abroad:

$$\hat{V}L^{D,nat}\hat{F}^{F,nat} \quad (7)$$

Decomposition framework derivation (4)

The estimation of the EVA that is **directed outside the country** and then is **converted abroad into final products** that are **immediately used to meet local demand** involves the domestic total requirements and the direct requirements for production abroad:

$$\hat{V}L^{D,nat}A^{F,nat}L^{D,nat}\hat{F}^{D,nat} \quad (8) \quad \text{"simple" GVC activity}$$

The EVA that is **directed outside the country** and then is **converted abroad into final or intermediate products** that are **then re-exported** to meet intermediate or final demand in a third country is:

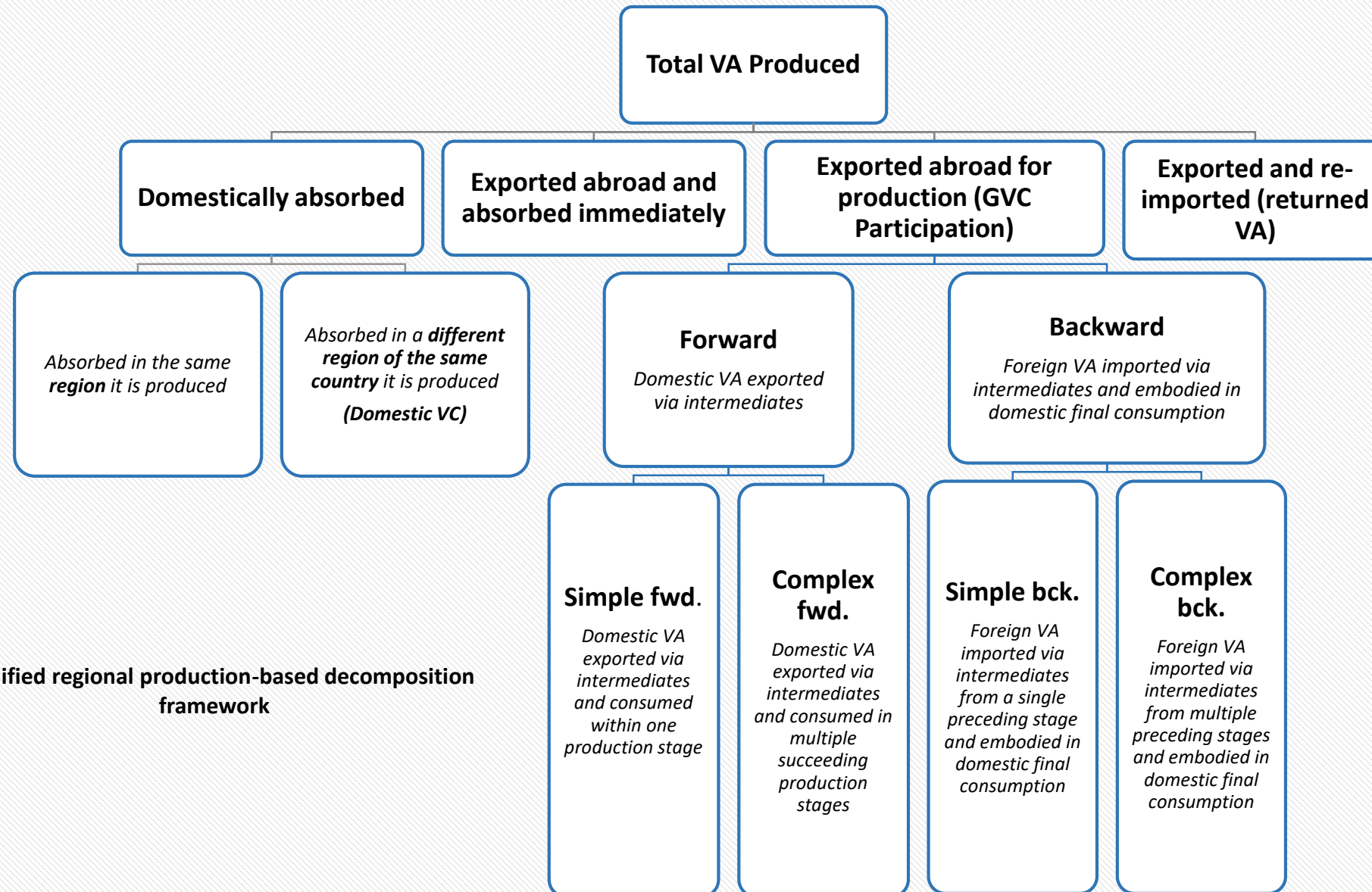
$$\hat{V}L^{D,nat}A^{F,nat}(L\hat{Y} - L^{D,nat}\hat{F}^{D,nat}) \quad (9) \quad \text{"complex" GVC activity}$$

Decomposition framework derivation (5)

Since the total VA can be expanded as $\hat{V}L\hat{F}$, the above terms provide a **simultaneous decomposition** of the total EVA in all the transactions between sectors, countries, and regions into **regional-domestic, national-domestic, traditional-trade, simple and complex GVC activities**:

$$\begin{aligned} \hat{V}L\hat{F} = & \hat{V}L^{D,reg}\hat{F}^{D,reg} + (\hat{V}L^{D,nat}\hat{F}^{D,nat} - \hat{V}L^{D,reg}\hat{F}^{D,reg}) + \hat{V}L^{D,nat}\hat{F}^{F,nat} + \\ & \hat{V}L^{D,nat}A^{F,nat}L^{D,nat}\hat{F}^{D,nat} + \hat{V}L^{D,nat}A^{F,nat}(L\hat{Y} - L^{D,nat}\hat{F}^{D,nat}) \end{aligned} \quad (10)$$

Overview: A new regional decomposition framework for different types and modes of domestic and international VC participation



Modified regional production-based decomposition framework

Formulation of GVC participation indexes

GVC participation indexes and related measures can be calculated from appropriate summation operations. More specifically, by summing each matrix-component of eq. 10 row-wise (all columns), the **distribution of the total EVA in each stage of use** in the value chain is obtained:

$$VA' = V^{D,reg} + V^{D,nat} + V^{TR} + V^{GVC_S} + V^{GVC_C} \quad (11)$$

Accordingly, by summing each matrix-components of eq. 10 column-wise (all rows), the **distribution of the EVA in each production stage** of the value chain is obtained:

$$U' = U^{D,reg} + U^{D,nat} + U^{TR} + U^{GVC_S} + U^{GVC_C} \quad (12)$$

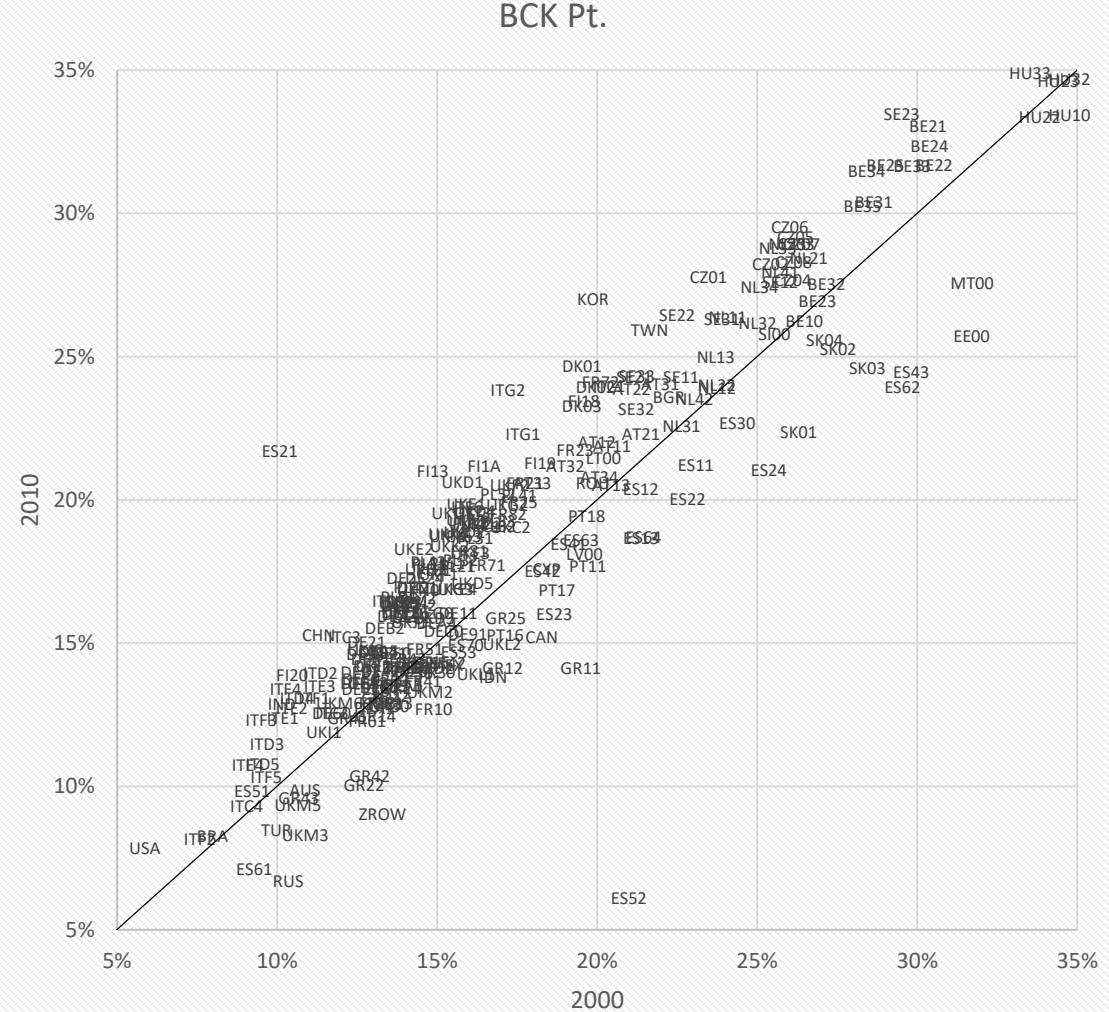
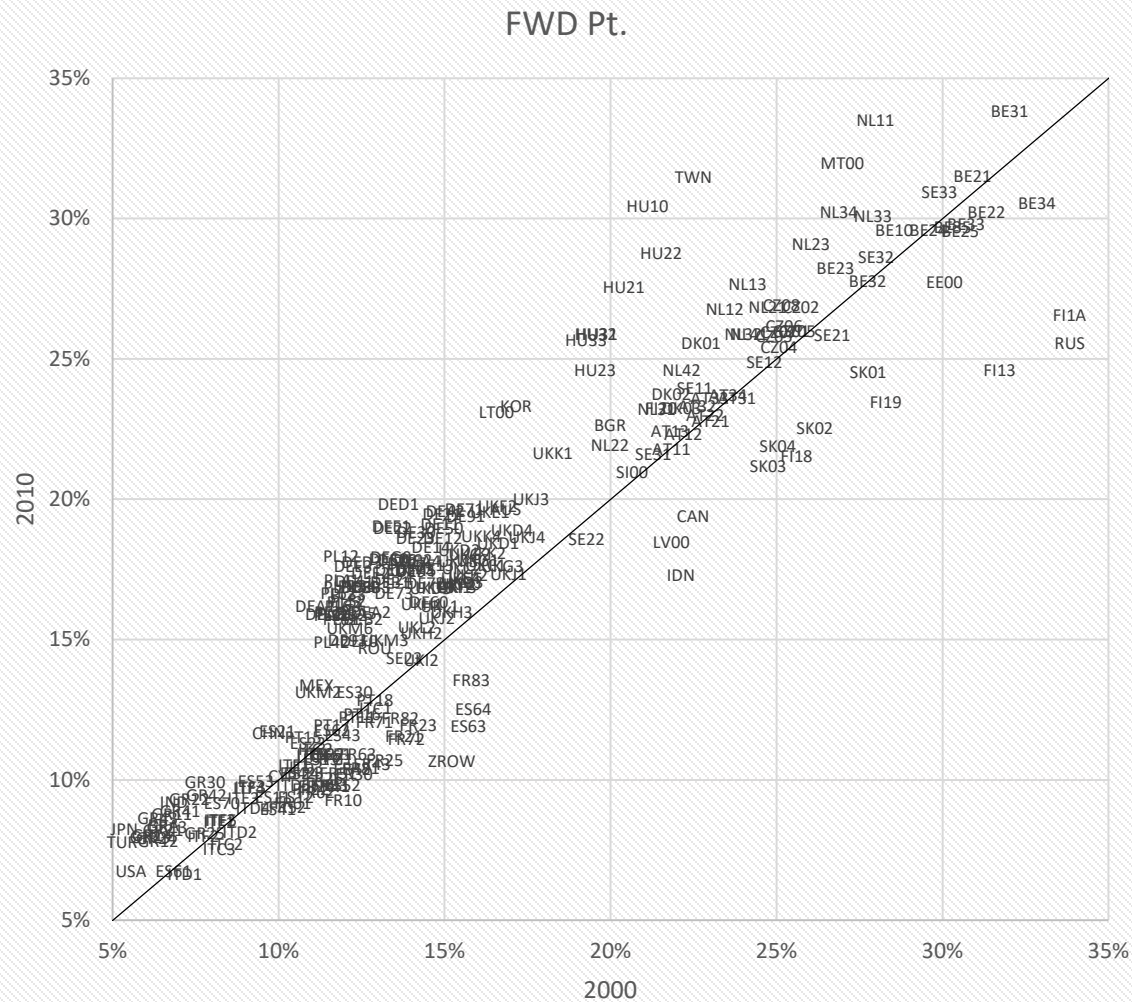
Indexes for the forward and backward participation of each region-sector in GVCs: isolating VA component and dividing with total VA to obtain Wang et al.'s user/producer GVC participation indexes. Total/individual components of forward GVC participation for the k sector of the r region of the n country are:

$$GVC_{n,k,r}^{Fw} = \frac{V_{n,k,r}^{GVC_S}}{VA_{n,k,r}} + \frac{V_{n,k,r}^{GVC_C}}{VA_{n,k,r}} = \frac{V_{n,k,r}^{GVC}}{VA_{n,k,r}} \quad (13)$$

The backward GVC participation indexes for the k sector of the r region of the n country are calculated from the VA that which is embedded in its final products and originates from all its supplier sectors/regions/countries:

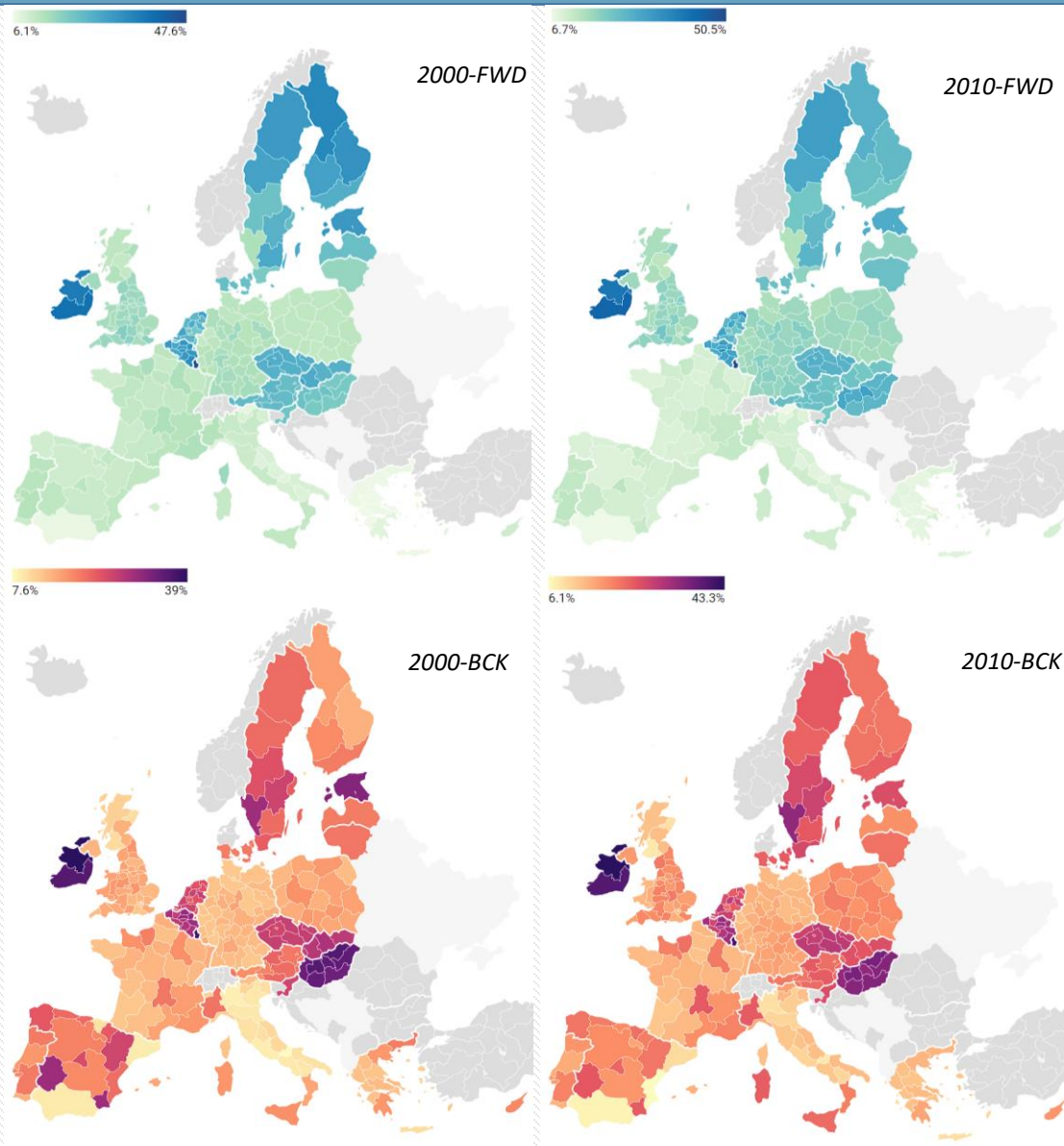
$$GVC_{n,k,r}^{Bk} = \frac{U_{n,k,r}^{GVC_S}}{U_{n,k,r}} + \frac{U_{n,k,r}^{GVC_C}}{U_{n,k,r}} = \frac{U_{n,k,r}^{GVC}}{U_{n,k,r}} \quad (14)$$

Results and discussion – Case study 1a: Relative shifts in each GVC participation type for the total available timeframe



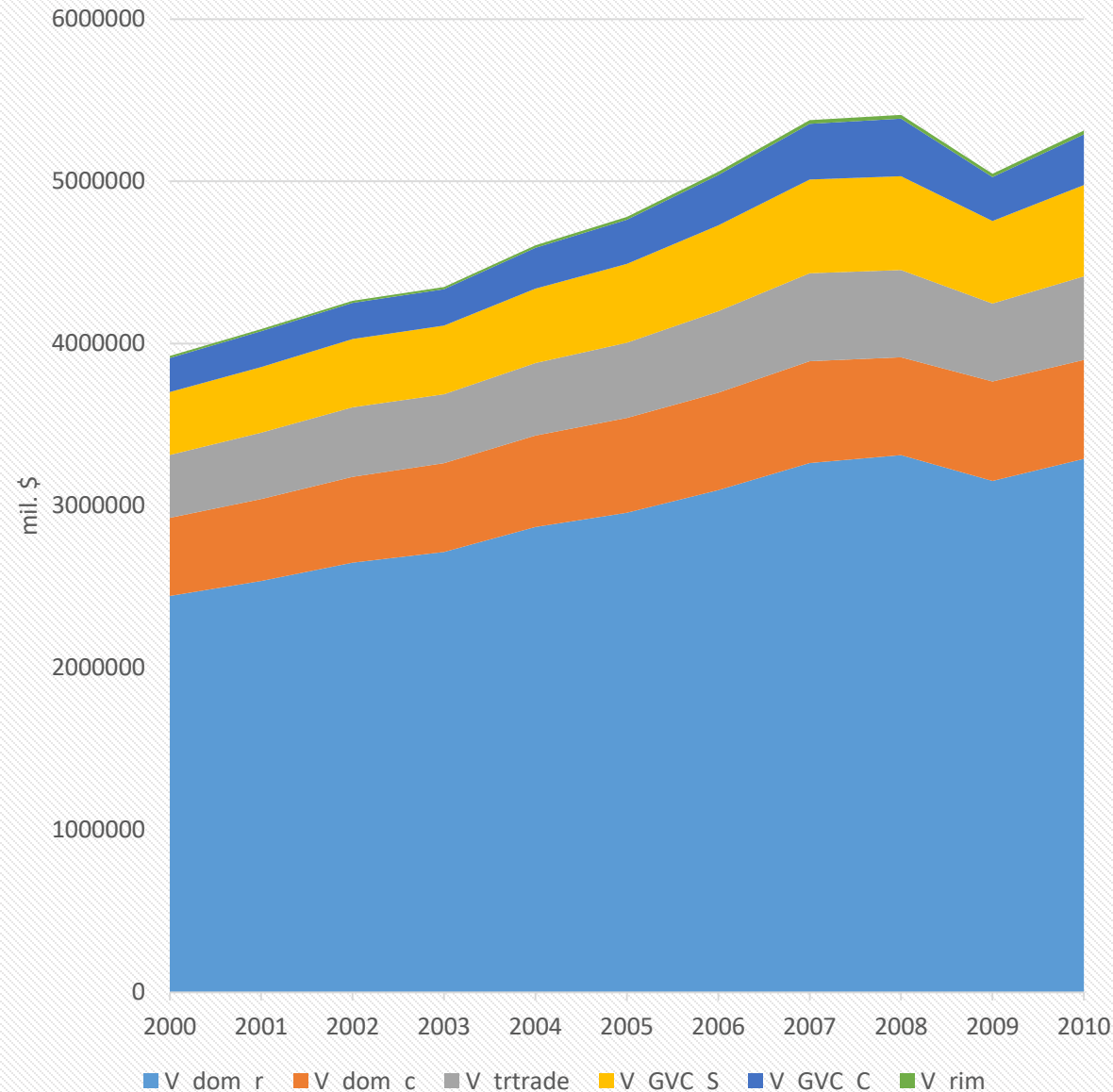
- **Upwards shift** towards more intensive GVC embedding for both types
- Most regions form **clusters of similar GVC deepening** at the +20%/+20% area.
- More **profound deepening for backward** rather than forward participation in GVCs.

Results and discussion – Case study 1b: Mapping the evolution of total forward and backward regional GVC participation



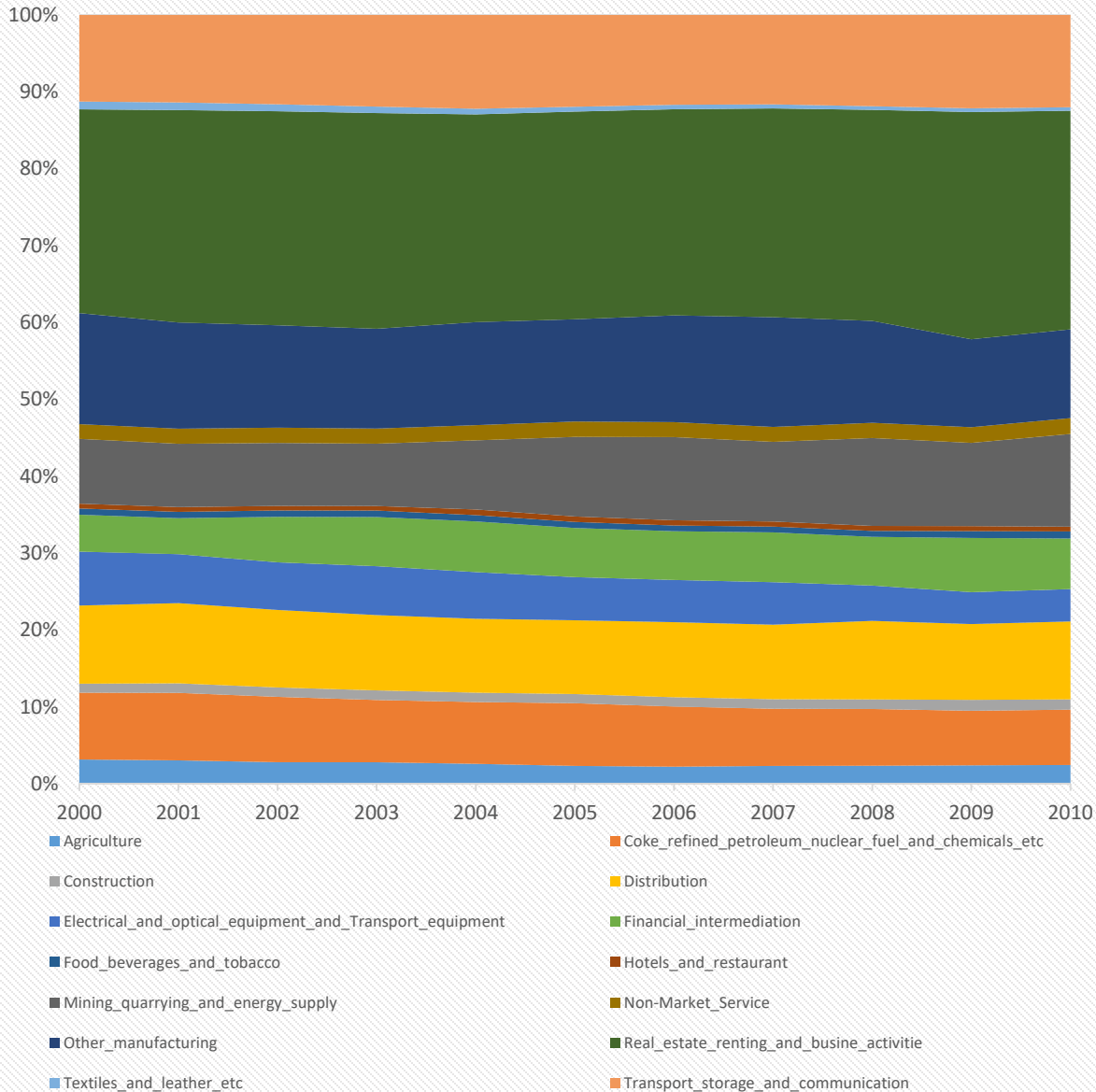
- **Changes** in forwards GVC participation are **slight** and **do not alter the overall pattern** of some key central and Scandinavian countries and of a lagging EU periphery.
- **German and Polish regions emerge** -> strengthening of economic and manufacturing ties
- **Baltics outperform expectations** -> sudden opening to world trade after their departure from the soviet union.
- **Gradual disengagement** of European south from incorporating FVA in their domestic consumption - but this is not uniform.
 - some regions exhibit **lower backward GVC shares** (mainly in Spain), some others (such as in France and central-northern Italy) **strengthen their dependance on shared manufacturing activities**.
 - At the same time, some other very different regions move in the same direction, mainly from Germany, Poland, and Scandinavia.
- Overall, many regions exhibit deepening in both types, hinting that **participation in GVCs is a two-way process**, but the fact that the backward participation is higher **shows the orientation** of this process.
- Interesting **dichotomy**: some regions with a **strong production base** and trade relations might incorporate more foreign value added due to their **embedment in highly sophisticated production chains** with many suppliers, some others might **de-industrialize** to the point that their **domestic consumption relies on foreign**, lower-complexity products and services.

Results and discussion – Case study 2: Evolution of the composition of the total VA from all European regions



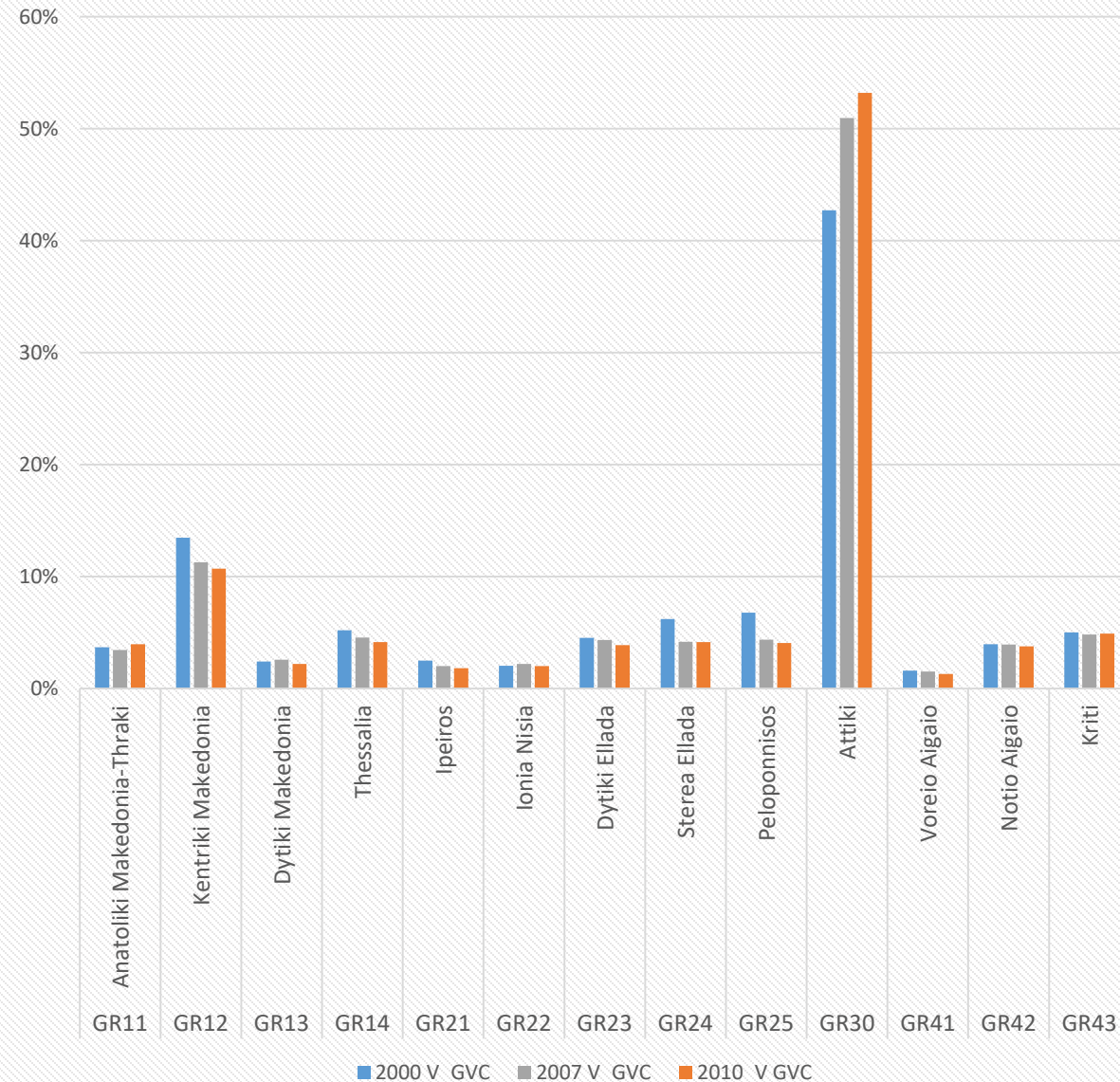
- The overall upwards trend is **slowed** and **partially reversed** by the onset of the 2008 economic crisis, but it seems to regain momentum **quickly**.
- the vastly largest share originates from production activities **within national borders** (dark blue and orange regions).
 - The largest share is **even more localized**, as it **does not cross the borders of the sub-national region where it is produced** ($V^{D,reg}$, dark blue bottom area).
 - A comparatively **small share of VA** is used by **other regions within the same country** as the originating regions ($V^{D,nat}$), hinting at the existence of strong regional industrial clusters.
- The participation in **domestic VCs** outside the producing region **is significantly less** than the combined participation in GVCs (simple and complex, V^{GVC_S} and V^{GVC_C} respectively).
 - -> apart from local clusters, there also exist significant parts of the economy that are more likely to cooperate with foreign than domestic extra-regional partners.

Results and discussion – Case study 3: Evolution of the sectoral breakdown of VA from all EU regions involved in forward GVC pt.



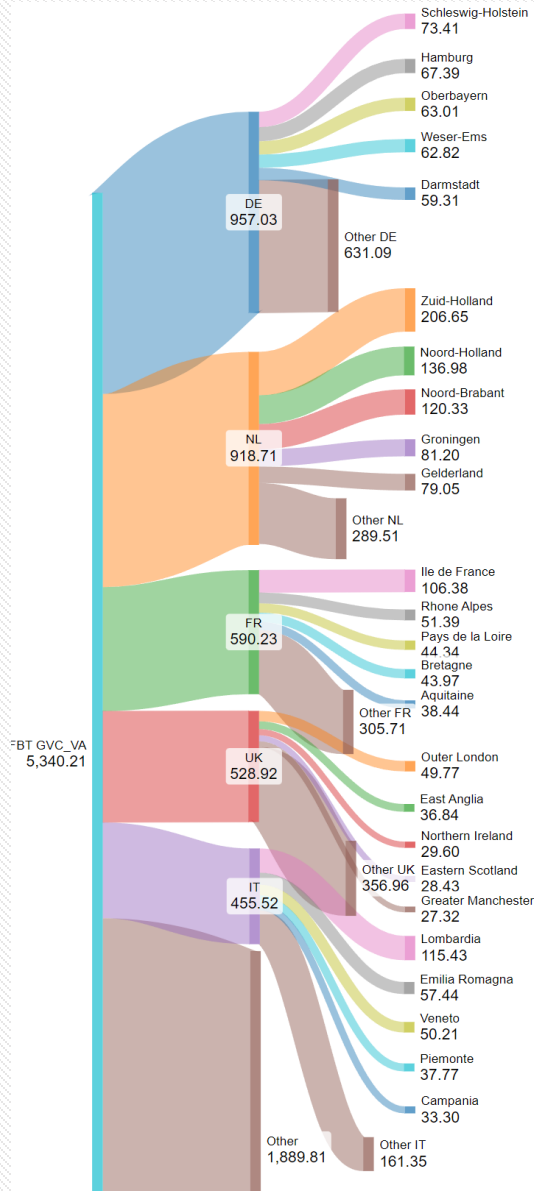
- While some sectors exhibit the expected low shares (such as the hotel and restaurant industry), **the largest share of VA sent abroad for GVC purposes mostly comes from business services.**
- Transport activities and logistics along with retail/wholesale trade and Real-estate/rest of business services account for more than a third of all VA exported for GVC activities.
 - -> increasing **servicification of manufacturing** (Miroudot and Cadestin, 2017) and boarder **de-industrialization patterns of Europe**, whose focus on services (Rodrik, 2013) has been the subject of much debate regarding its industrial policy planning.

Results and discussion – Case study 4: Regional shares of VA involved in forward GVC pt. for Greece



- Three different time periods: -start - end of coverage, and the year before the onset of the 2008 crisis.
- The regional inequalities in Greece are well-known; almost **40% of the population and 50% of the GDP are concentrated in Attica.**
- What is interesting is that this economic concentration seems to have enabled Attica not only to **increase its total GVC share more than 10% in 10 years**, but also to not be affected by the onset of the crisis.
 - All other regions either remained stagnant or gradually contributed less to the total national GVC VA exports.

Results and discussion – Case study 5: Regional components of Europe’s FBT exported VA for fwd. GVC participation



- **National and regional contribution** to European FBT sector’s **exported VA** for GVC activities shows **profound imbalances**.
- The top 5 countries (DE, NL, FR, the UK and IT) account for **64.5% of all exported VA**
- With our framework we can peer **behind national aggregation effects**: there are important **differences in regional composition** of exported VA:
 - **Germany’s top 5** regions account for about **40% of its contribution**, but the **top 5** regions of the **Netherlands** contribute **about 69%** of its total contribution.
- The homogeneity of regional production capabilities and international business horizon of their firms differs significantly between otherwise similar economies with vast expertise in FBT activities.
- Not all regions are sector-specific -> quantifying these differences sheds light on the underlying economic structures.

Key take-away points

- Overall, DVCs and GVCs participation contains **diverse trajectories, diverging sectoral dynamics**, and of course **regional disparities**.
- There is a discernible **increased engagement and embedment within GVCs** for both backward and forward participation
- Regions are moving **towards deeper integration** within these chains, with a significant clustering, particularly in terms of **backward GVC** participation
- There are differences among regions regarding the direction of their participation in GVCs, which might indicate **either strengthening participation** due to economic and manufacturing growth, or **negative shifts in domestic industrial activity**.
- Participation in **DVCs** is notably **less emergent** than involvement in **GVCs** -> strong regional industrial clusters and significant parts of the economy which are more inclined towards cooperation with foreign partners over interregional collaboration
- Many of the current perceptions around GVC activities, such as the “*head-quarters vs factories*” and the “*hub-and-spoke*” country taxonomies may not be applicable on a sub-national level -> result of the focused capacity of a **few select regions interacting with each other**.
- Manufacturing and mostly various business services constitute the main share of VA exported for GVC activities, reflecting the **increasing servicification of manufacturing** and the ongoing debate regarding Europe's industrial policy planning and de-industrialization patterns.
- While the emergence of shared manufacturing networks presents **significant economic opportunity**, its benefits may **pre-suppose certain regional economic capacities**.

Thank you for your time and attention

E-mails:

dstamopoulos@mail.ntua.gr

petrdimas@chemeng.ntua.gr

atsaka@central.ntua.gr

References

- Baldwin, R. (2009). The great trade collapse: What caused it and what does it mean. *The great trade collapse: Causes, consequences and prospects*, 100(105), 1.
- Bolea, L., Duarte, R., Hewings, G. J. D., Jiménez, S., & Sánchez-Choliz, J. (2022). The role of regions in global value chains: an analysis for the European Union. *Papers in Regional Science*, 101(4), 771–794. <https://doi.org/10.1111/pirs.12674>
- Borin, A., & Mancini, M. (2019). Measuring what matters in global value chains and value-added trade. World Bank policy research working paper, (8804). <https://www.tandfonline.com/doi/citedby/10.1080/09535314.2022.2153221?scroll=top&needAccess=true>
- BRIEFING EPRS | European Parliamentary Research Service Author: Agnieszka Widuto Members' Research Service PE 637.951 – May 2019 EN Regional inequalities in the EU. [https://www.europarl.europa.eu/RegData/etudes/BRIE/2019/637951/EPRS_BRI\(2019\)637951_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/BRIE/2019/637951/EPRS_BRI(2019)637951_EN.pdf)
- Colozza, F., Boschma, R., Morrison, A., and Pietrobelli, C. (2021). The importance of global value chains and regional capabilities for the economic complexity of EU-regions, *Papers in Evolutionary Economic Geography (PEEG)* 2139, Utrecht University, Department of Human Geography and Spatial Planning, Group Economic Geography, revised Dec 2021.
- Gereffi, G. (1999). International Trade and Industrial Upgrading in the Apparel Commodity Chain. *Journal of International Economics*, 48(1), 37–70. [https://doi.org/10.1016/S0022-1996\(98\)00075-0](https://doi.org/10.1016/S0022-1996(98)00075-0)
- Johnson, R. C., & Noguera, G. (2012). Accounting for intermediates: Production sharing and trade in value added. *Journal of International Economics*, 86(2), 224-236.
- Koopman, Robert, Zhi Wang, and Shang-Jin Wei. 2014. "Tracing Value-Added and Double Counting in Gross Exports." *American Economic Review*, 104 (2): 459-94. DOI: 10.1257/aer.104.2.459
- Miroudot, S. and C. Cadestin (2017). 'Services in Global Value Chains: From Inputs to Value-Creating Activities', OECD Trade Policy Papers, No. 197, OECD Publishing, Paris, <https://doi.org/10.1787/465f0d8b-en>.
- Rodrik, D. (2013), 'Unconditional convergence in manufacturing,' *The Quarterly Journal of Economics*, 128(1), 165–204.
- Thissen, M., Lankhuizen, M., van Oort, F., Los, B., & Diodato, D. 2018. EUREGIO: The Construction of a Global IO Database with Regional Detail for Europe for 2000–2010; Tinbergen Institute Discussion Paper; No. TI 2018–084/VI; Tinbergen Institute: Amsterdam, The Netherlands. <https://doi.org/10.2139/ssrn.3285818>
- Timmer, M., Los, B., Stehrer, R., & de Vries, G. J. (2013). Fragmentation, incomes and jobs: an analysis of European competitiveness. *Economic Policy*, 28(76), 613–661. <https://doi.org/10.1111/1468-0327.120>
- Wang, Z., Wei, S.-J., Yu, X., & Zhu, K. (2022). Global value chains over business cycles. *Journal of International Money and Finance*, 126, 102643. <https://doi.org/https://doi.org/10.1016/j.jimonfin.2022.102643>
- WORLD TRADE REPORT 2014 C. The rise of global value chains https://www.wto.org/english/res_e/booksp_e/wtr14-2c_e.pdf