Participation and positioning of Greek sectors in Global Value Chains and evolution of their trade patterns

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Introduction

- **Outsourcing** and **offshoring** disperse firm's activities to **different locations** based on efficiency/cost-minimization criteria (Ambos et al., 2021; Antràs, 2020), creating **complex production networks** (Xiao et al., 2017).

- A formal definition for a global value chain (GVC) by Antràs, (2020):
  *"A set of **production** activities **fragmented across the world** that add value to the development of a good or a service, and each of the firms participating in the production network are engaged in **at least one stage**"*

- And by Timmer (2013): *"all activities **directly** and **indirectly** required to produce a final manufactured product"*

- Firms, sectors, and at the aggregate level countries participate in GVCs based on their perceived comparative advantages to maximize their value-added (VA) gains

- Trade in GVCs is <u>different</u> from traditional trade: It relates **to trade in intermediates** while traditional trade focuses on final products

- Successive rounds of trade liberalization and rapid ICT advancements have paved the way for a deepening in GVC activities in the late 1990's and early 2000's (Antràs, 2020; World Bank, 2020) → account for ½ of all trade activities (World Bank, 2020).

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GVCs as production networks

- The **bidirectional flows** of **intermediate products and their VA content** that are the focus of I-O based GVC studies (e.g. Borin & Mancini, 2023; Johnson & Noguera, 2012; Koopman et al., 2014) **constitute a production network** between all involved sectors and countries across time.

- The appeal of using network analysis (NA): **it considers the whole structure** of interactions and explores the entire pattern of connections, **instead of focusing on the isolated characteristics** of each individual element (Amador and Cabral, 2015).

- The fundamental elements of NA can be applied to study structure and unveil trade patterns that other empirical metrics may miss;
  - powerful analytical tool to study **collective interactions** among **heterogeneous agents** in **complex systems** with limited resources, acting at all (global, regional and national) geographical scales and participating in diverse organizational structures (Boccaletti et al., 2014; Varela et al., 2015).

- Over the last decade, numerous studies have employed network analysis to visualise, map, and conceptualize GVC activities [among others, (Amador et al., 2018; Cerina et al., 2015; Criscuolo & Timmis, 2018; Ferrantino & Taglioni, 2014; Ferrarini, 2013; Tsekeris, 2017; Xiao et al., 2017; Zhou et al., 2016)].

Motivation & aim for this study

This working paper aims to map Greece's participation in Global Value Chain (GVCs) at the country and sector level

- GVCs lead to a **finer international division** of labour/production across countries/sectors → **opportunities for greater specialization gains**.
  - Each country must identify and understand its **structural weaknesses** and **comparative advantages** and leverage them to secure **maximum gains from GVC participation** (World Bank, 2020).

- GVC participation can enhance productivity through access to foreign inputs, knowledge spillovers, competition effects, and learning opportunities (Criscuolo and Timmis, 2017).

- **GVC positioning** and **participation** patterns have been extensively considered for the comparative assessment of national **economic performance** (Gereffi, 1999).

Methodology

- We develop a **4-stage** empirical strategy that combines elements from IO (Leontief,1936) and network analysis (Wasserman & Faust, 1994).

- Highly complementary approach: standard IO GVC metrics capture the **intensity of involvement** in GVCs, while network metrics are more nuanced in **capturing the positioning within** GVCs (Amador et al., 2015; Tsekeris, 2017).
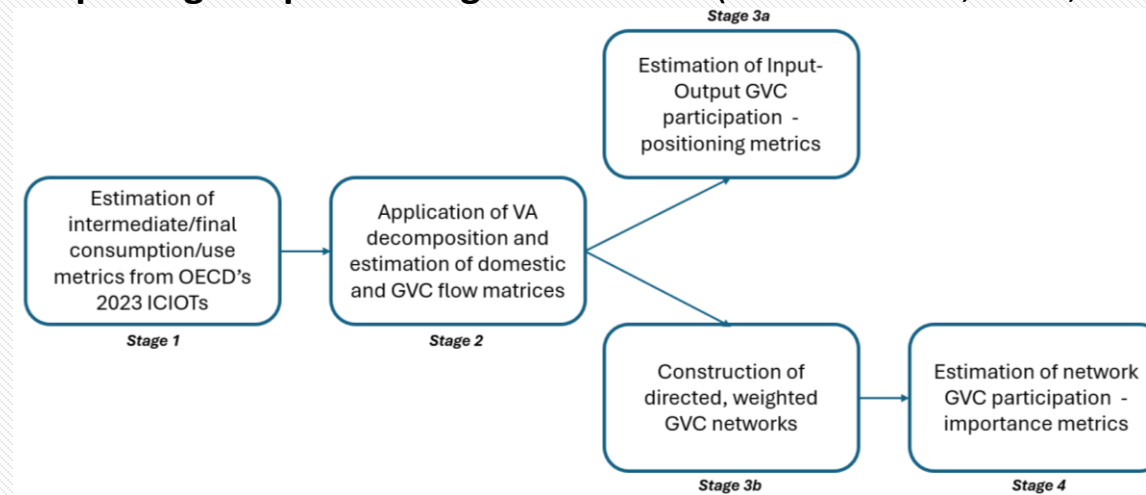

- **IO Data source**: OECD's Inter-Country Input-Output Tables (ICIOTs) (OECD 2023)

- The resulting dataset describes GVC participation and VA flows for **45 NACE rev.2 sectors for 76 countries** (includes all 27 EU members) **from 1995 to 2020.**

- This extensive period **contains rapid shifts** in world trade and the **rapid expansion of GVCs**, (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

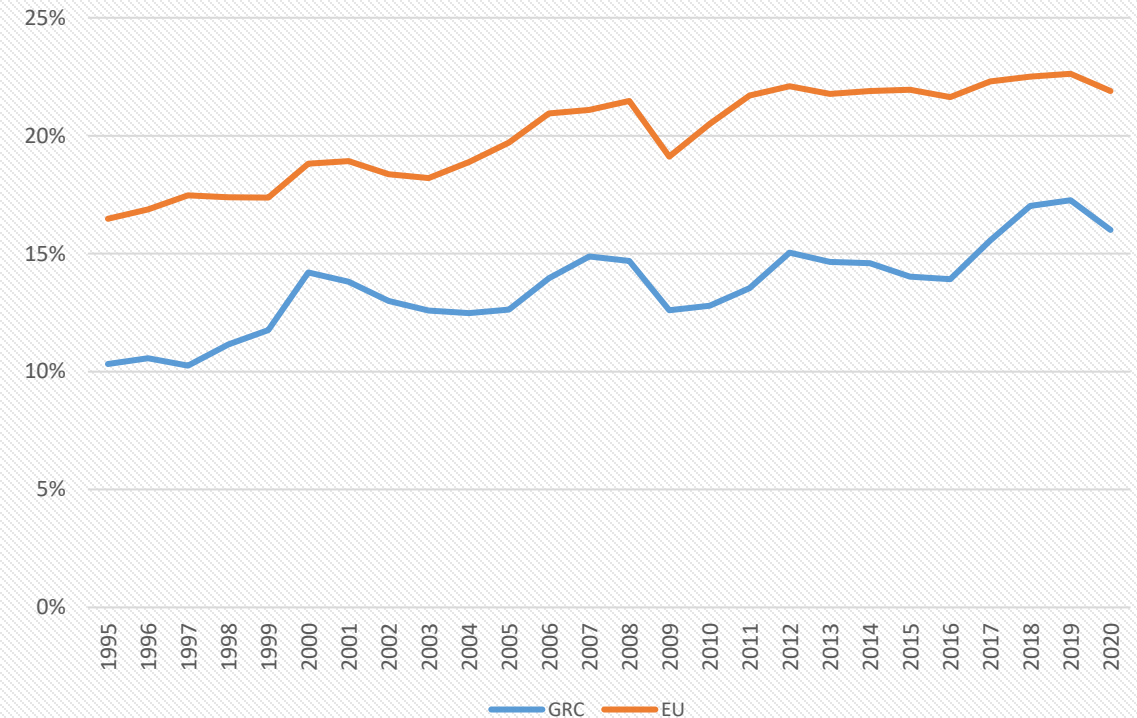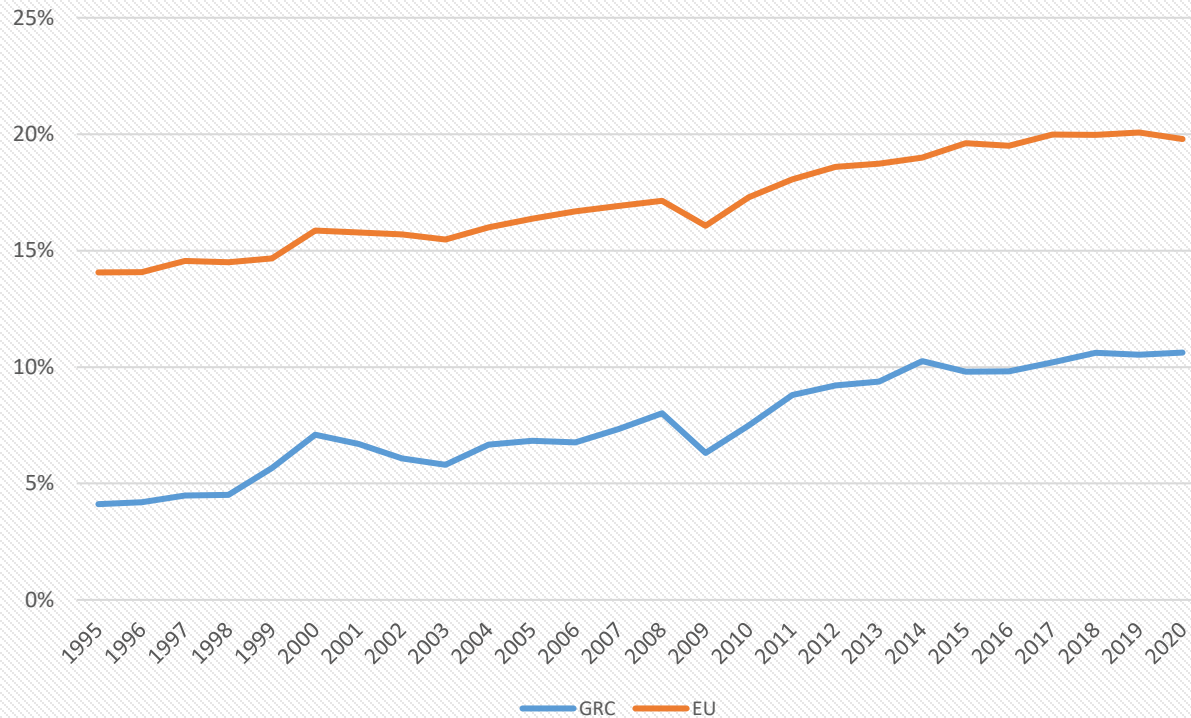**Metrics based on VA content of exports** (Koopman et al. 2014)
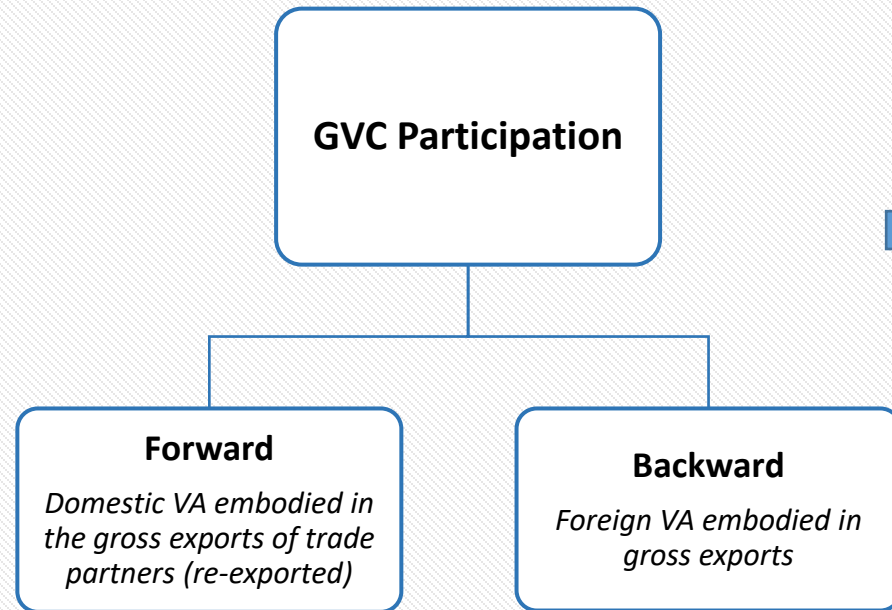
New production-based decomposition framework (Wang et al. 2022)
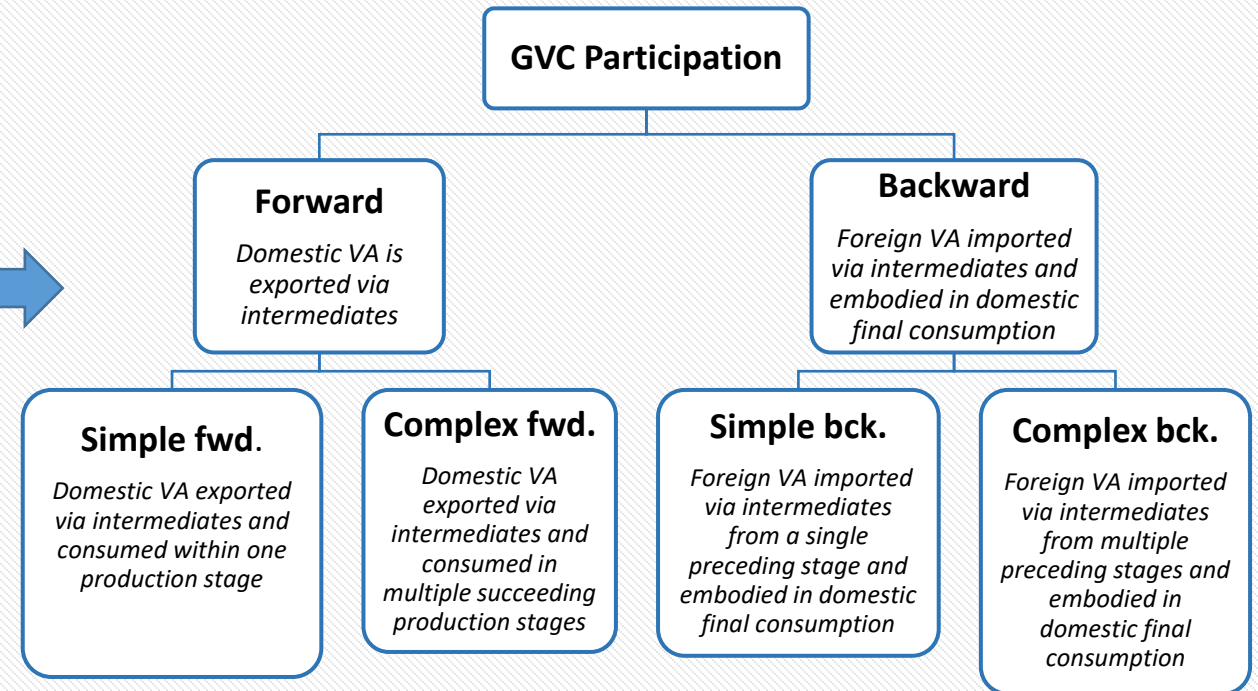
# Results part 1: Input-Output Analysis

Results and discussion –1a: Evolution in each GVC participation direction for the total available timeframe

Forward (a) and backward GVC participation for Greece (GRC) and the EU from 1995 to 2020.

- Participation pattern across the examined period **mirrors that of the EU**, but at a lower magnitude
- **GVC deepening from 1995 to 2008**, ("*era of GVCs*" (World Bank, 2020)).
- Steep decline in participation in 2009-2010, caused by the financial crisis
- Resurgence in GVC activities in a new steady state from approximately 2012 onwards
- More **profound deepening for backward** rather than forward participation in GVCs.

Results and discussion –1b: Evolution of both types of forward and backward regional GVC participation

FWD -simple

FWD - complex

BCK simple

BCK complex

GRC EU
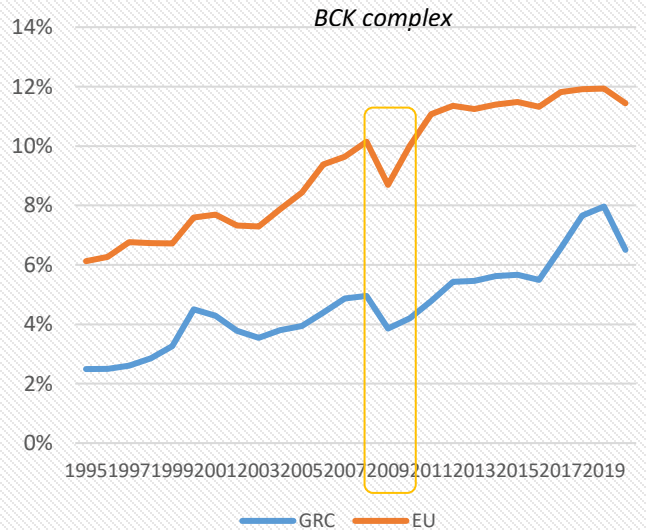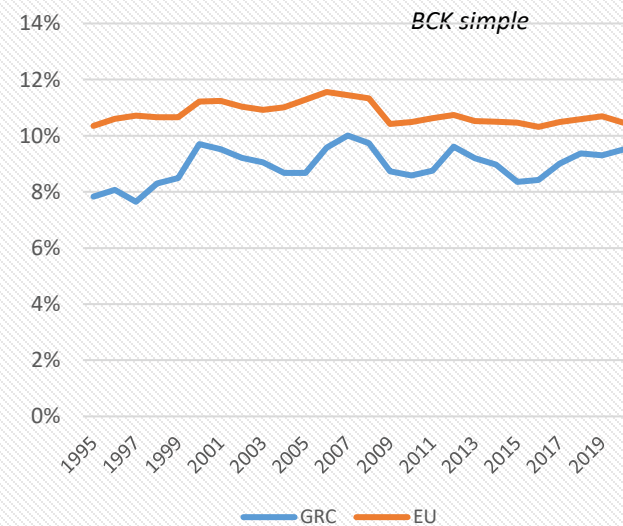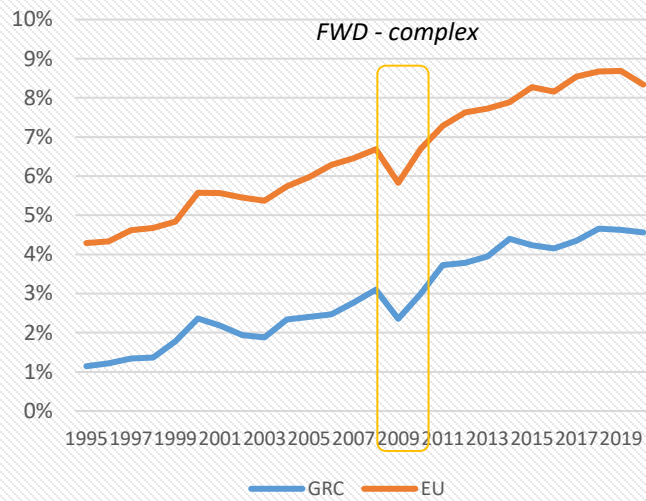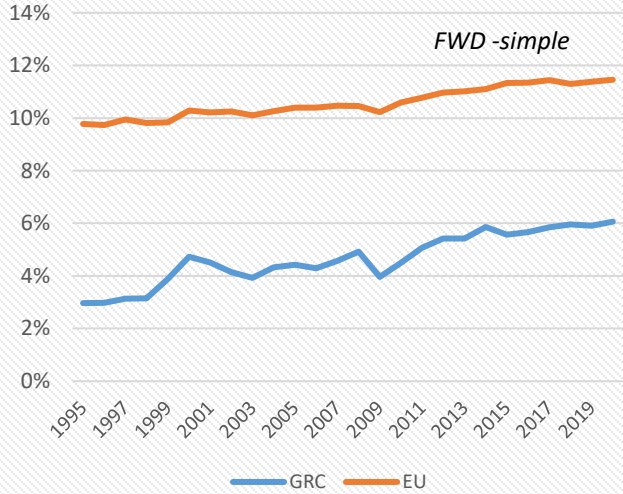
- Simple and complex forward participation patterns between Greece and the EU are quite similar, but again at a different scale (**EU participation is nearly twice as high as Greece**).

- Simple backward participation for Greece and the EU is approximately at the same level for the examined period

- Complex backward participation for the EU is significantly higher (but again the trend is similar).

- **Complex GVC activities appear to be the most affected by the financial crisis effects in 2009**.

Results and discussion – Case study 1c: Evolution of sectoral GVC participation (for Greece)

1995	2010	2020
C24 (36.9%)	H50 (59.9%)	**C24 (84.7%)**
C19 (21.6%)	**C24 (50.1%)**	**B07_08 (73.2%)**
H50 (21.4%)	**B09 (31.7%)**	**B09 (61.4%)**
B07_08 (18.4%)	**B07_08 (30.1%)**	H50 (56.9%)
C20 (17.9%)	H52 (28.5%)	H51 (42.5%)
C22 (16.6%)	H51 (28.1%)	**C19 (42.3%)**
A03 (16.2%)	**C20 (24.0%)**	**C20 (34.4%)**
B09 (16.0%)	**C19 (23.4%)**	H52 (34.4%)
H52 (10.9%)	**C22 (21.5%)**	**B05_06 (31.8%)**
C27 (9.84%)	A03 (17.6%)	**C22 (31.0%)**

Top performing sectors (NACE Rev. 2 classification) in forward GVC participation (%) for 1995, 2010, and 2020. Bold = industry

- Top performing sectors retaining status: basic metals (C24), water transports (H50), mining supporting activities (B09), and mining of metals and mines and quarries (B07_08).

- Other notable sectors: petrochemicals (C19), chemicals (C20), and rubbers and plastic products (C22).

- The latter three manufacturing sectors have significantly increased their participation since 1995, with petrochemicals (C19) in particular emerging as a top exporter of Greek intermediates from 2010 onwards.

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Results and discussion – Case study 1d: Contrasting directions of GVC participation
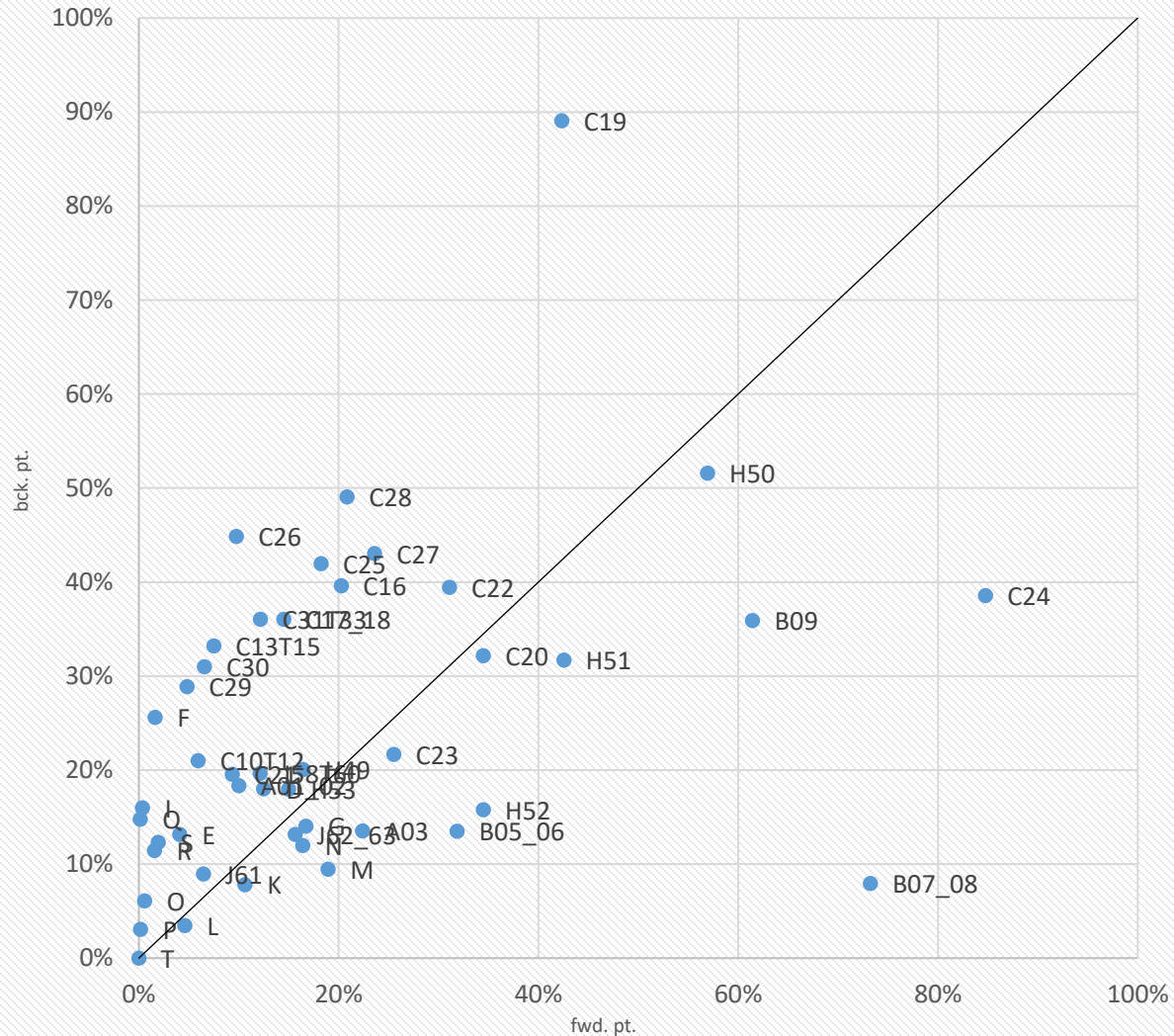
Snapshot of backward and forward GVC participation of Greek sectors (NACE Rev.2 classification) in 2020

- Contrast sectoral embedment in forward and backward production linkages for 2020

- **Electronics and opticals** (C26), **machinery and equipment** (C28), **electrical equipment** (C27), **fabricated metals** (C25), and **petroleum products** (C19) are **heavily orientated towards backward participation**

- Sectors such as **water transports** (H50), **rubbers and plastics** (C22), **non-metallic mineral products** (C23), and **software and computer services** (J62-J63) present a more balanced orientation pattern

- **Most of the Greek manufacturing sectors are in fact backward orientated**, → high dependency in critical inputs from abroad.

- On the other hand, mining, and quarrying activities (B sectors) along with basic metals (C24) dominate the landscape of forward participation.

Results and discussion – Case study 1e: Breakdown of available time series in periods
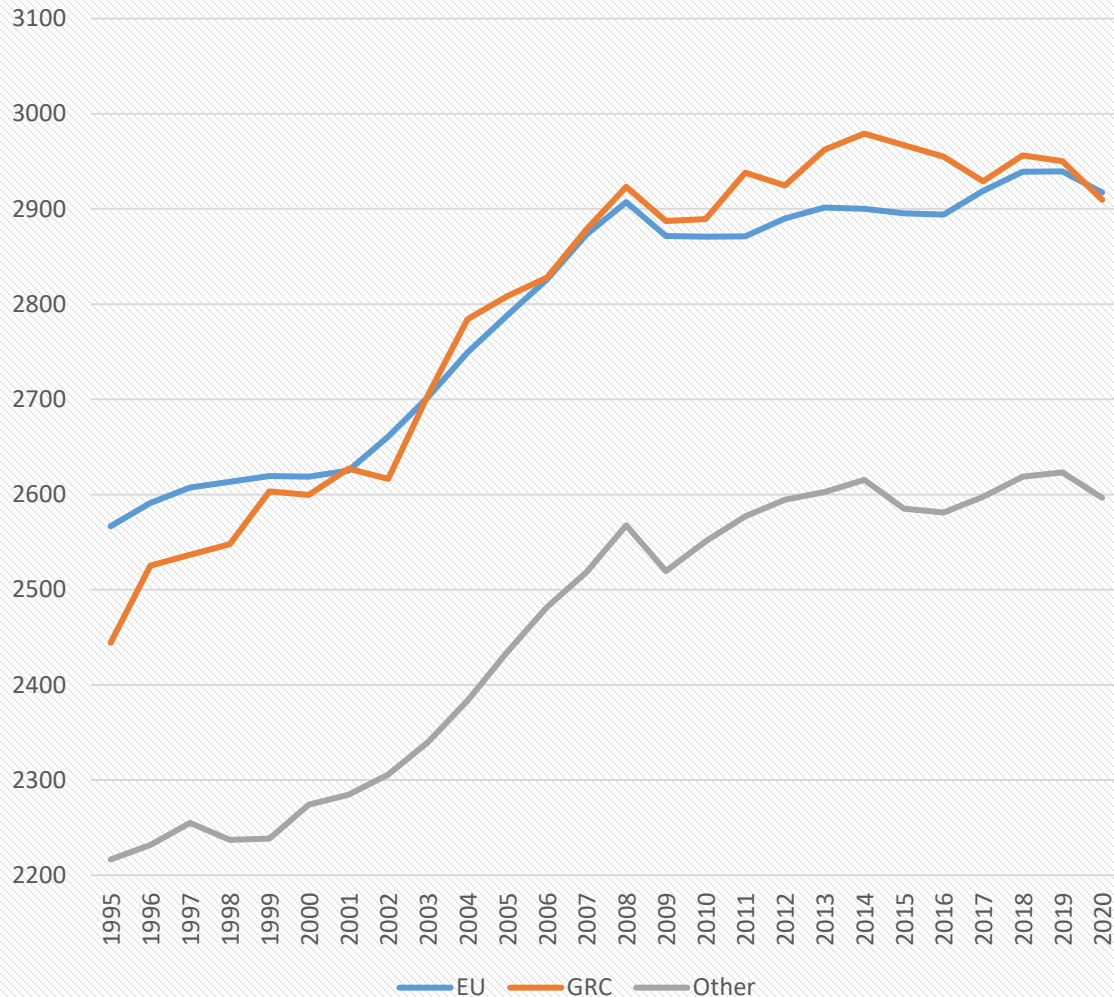
1995-2007	2008-2014	2015-2020
C21 (195%)	C30 (267%)	B07_08 (50.4%)
C31T33 (125%)	C23 (164%)	B05_06 (33.6%)
D (117%)	B07_08 (124%)	C19 (31.1%)
C25 (98.2%)	C16 (122%)	C21 (22.6%)
C28 (59.9%)	C19 (87.2%)	C24 (18.2%)
C27 (57.1%)	C26 (79.1%)	C20 (16.9%)
C22 (56.7%)	D (71.6%)	C28 (12.5%)
C16 (53.4%)	C31T33 (65.1%)	C17_18 (11.7%)
E (51.6%)	C25 (64.6%)	C27 (11.7%)
C13T15 (50.6%)	C29 (62.5%)	C13T15 (11.0%)

Relative changes of forward GVC participation for top performing industrial sectors (NACE Rev. 2 classification) in forward GVC participation (%) for 1995-2007, 2008-2014, and 2015-2020.

- 1995-2007: **global GVC deepening and national economic prosperity** for Greece, 2008-2014: **economic crisis**, the disruptions caused in global supply chains and the stagnation/recovery years, 2015-2020, **entailed the new steady-state** in global markets and value chain trade right **before the COVID-19** pandemic.

- Different leading sectors emerge in each time frame → no specific leading setor

- Significant increase of forward participation in mining and quarrying activities (B sectors) emerging in the 2015-2020 period, → emerging dimension to the country's GVC participation patterns as supplier of raw materials and energy inputs.
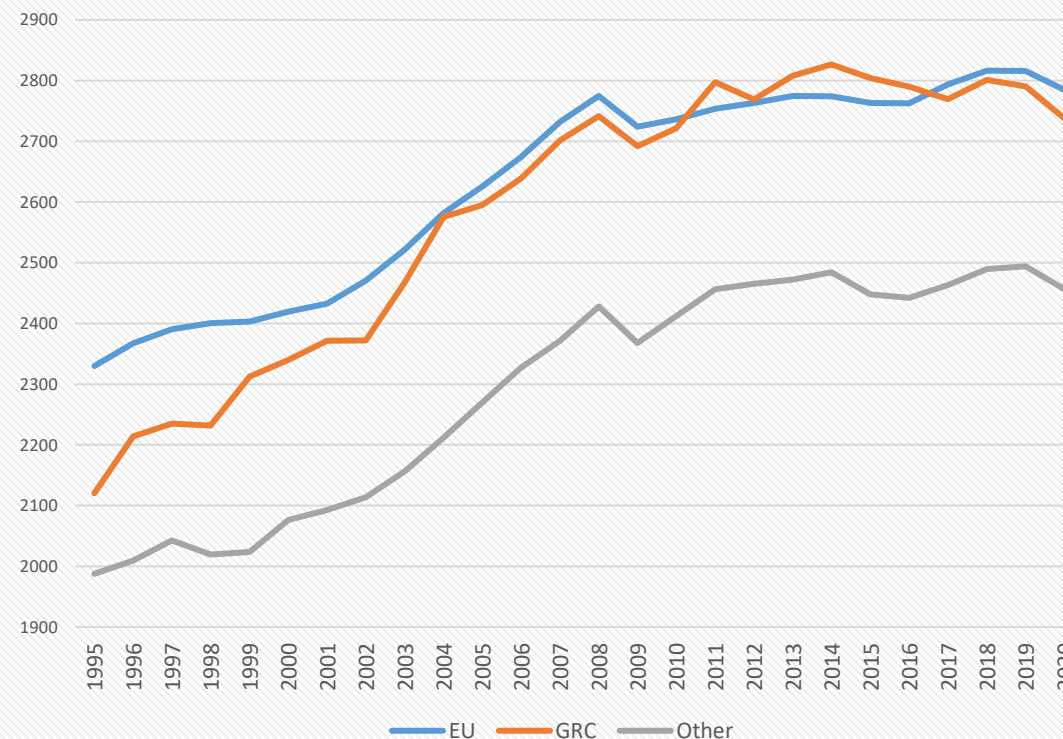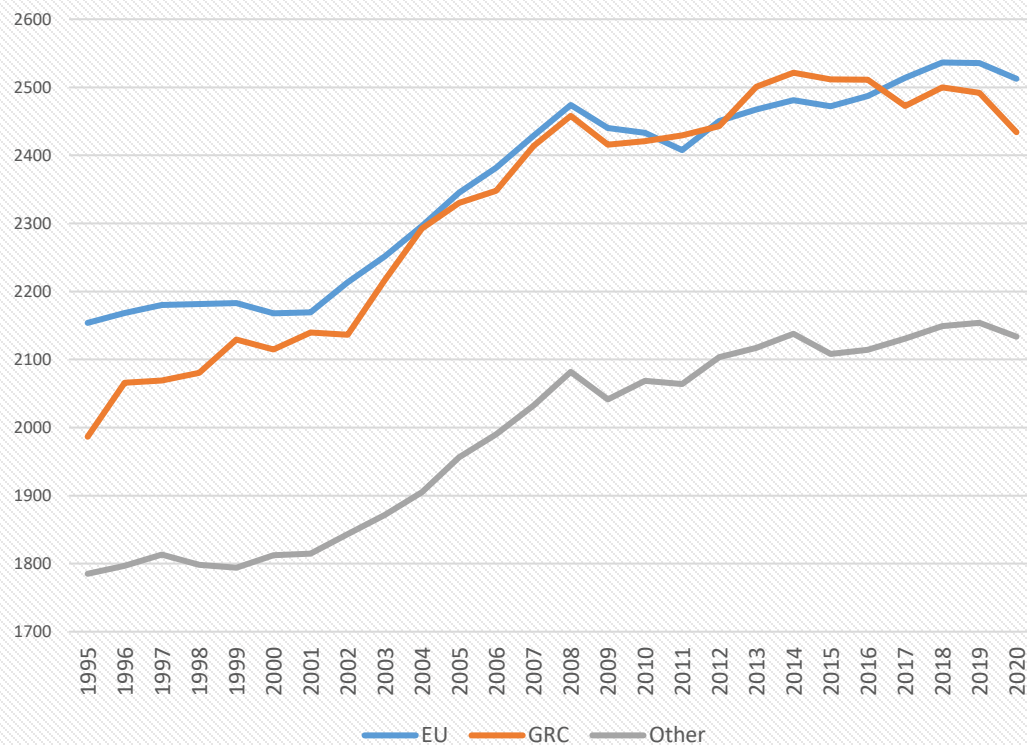
Results part B: Network Analysis

Evolution of outgoing connections (out-degree) of Greece, EU27 and the rest of the world economies between 1995 and 2020 within GVCs.

- Increase in outgoing GVC connections

- Greece is roughly **on par** with the EU average

- Its **convergence** in most cases **begins after 2004-2005**, and in recent years a downward trend in maintaining its connections is more apparent.

- After the 2008 crisis, the outgoing GVC connections **trended upwards**, surpassing the EU average for some time before converging again recently.
  - On the contrary, incoming GVC connections during the same time consistently fell and **rapidly receded below EU average →** extroversion strategy adopted by Greek industrial firms, led by forward-oriented sectors that became more

- This pattern becomes more evident in the aftermath of the economic crisis, from which arguably Greece was the most affected economy in the EU
  - on the one hand, the country appears to have adopted and exports-oriented strategy to rejuvenate its economy during a period of financial turmoil,
  - on the other, the increased number of outgoing connections could be linked to a decrease in domestic demand due to financial constraints of local industrial firms.

Results and discussion –2a: Evolution of out-going connections within the GVC network

Evolution of outgoing connections (out -degree) of Greece, EU27 and the rest of the world economies in the simple (a) and complex (b) GVC network between 1995 and 2020
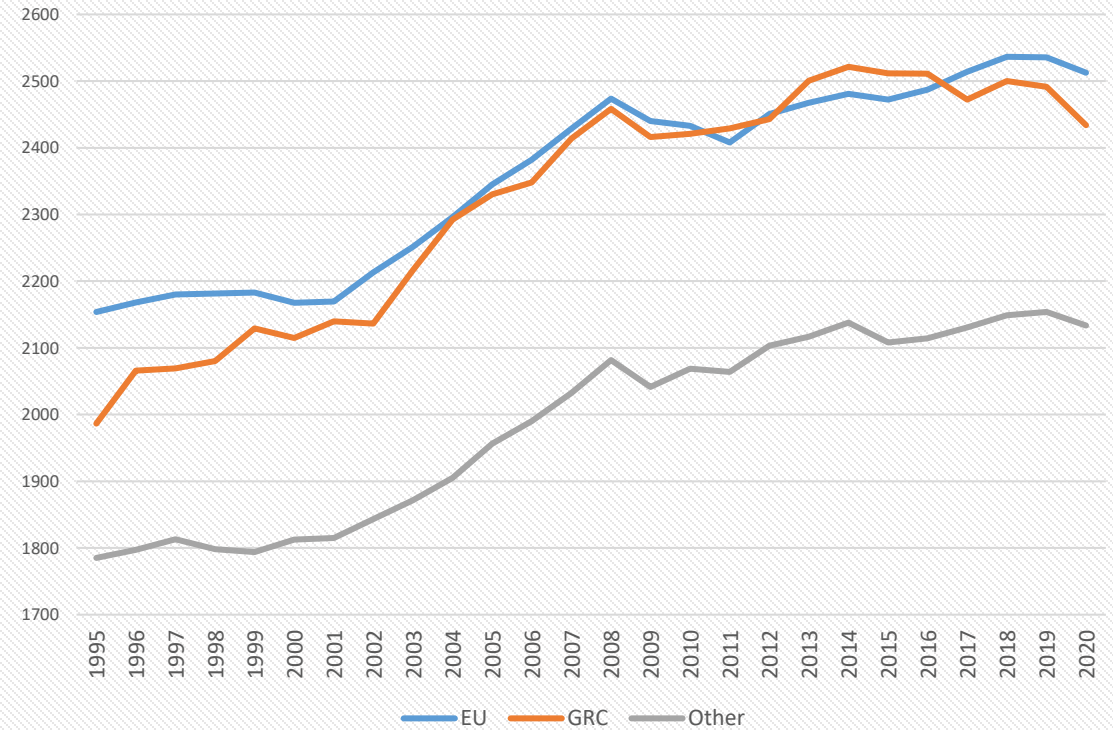
Results and discussion –2b: Evolution of incoming connections within the GVC network

Evolution of incoming connections (in-degree) of Greece, EU27 and the rest of the world economies between 1995 and 2020 within GVCs.
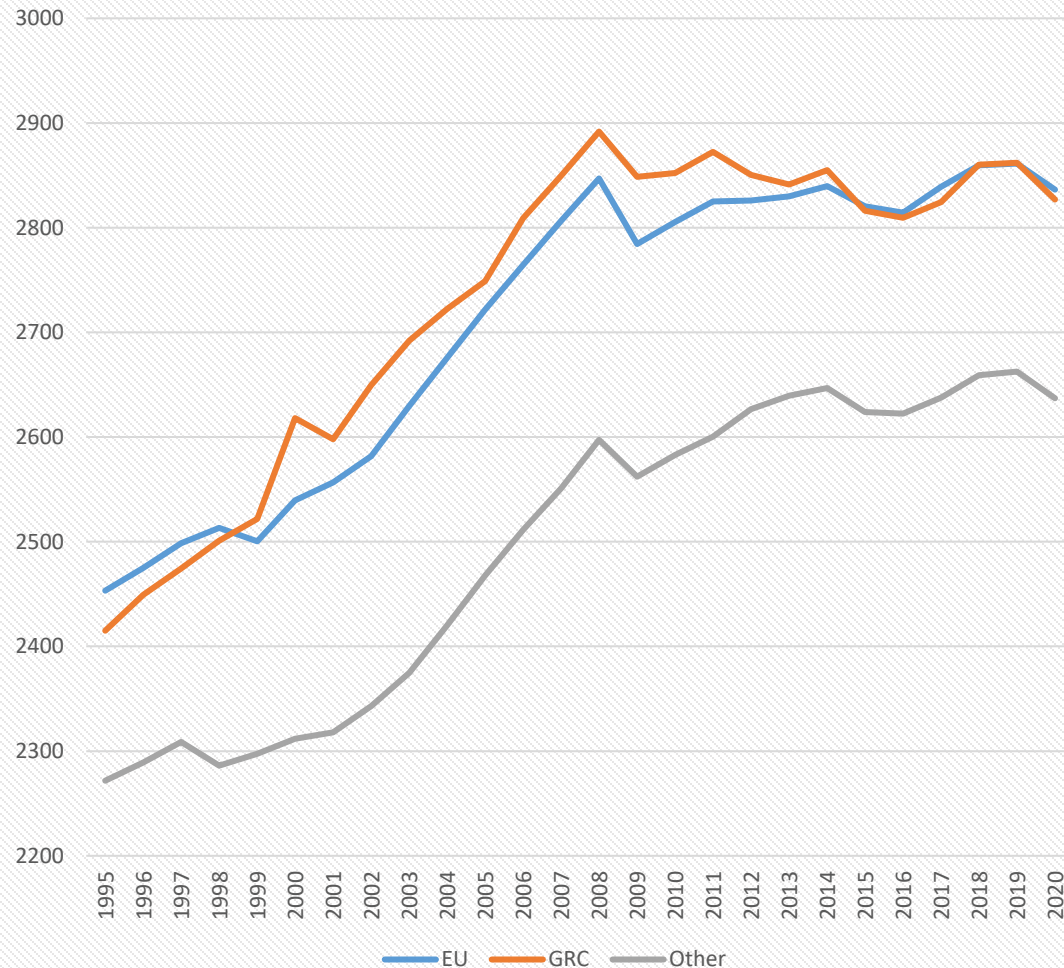
- For incoming connections, Greece follows a similar trend with the EU-average, but at a slightly higher rate between 1999 and 2013.

- Early 2000s: signi**ficant increase in the number of incoming connections -** rather expected as it signals the great deepening of GVC activities that was evident at a global scale during that period.

- Interestingly, while the EU appears to suffer a stiff decline in incoming connections in 2008, Greece's decline appears to be smoother → strong dependence on critical imported inputs and foreign suppliers.

- From 2012: declining trend in the country's incoming connections, which contradicts the rising trend in outgoing connections during the same period → shift in the balance of trade.

Results and discussion –2b: Evolution of incoming connections within the GVC network

Evolution of incoming connections (in-degree) of Greece, EU27 and the rest of the world economies in the simple (a) and complex (b) GVC network between 1995 and 2020
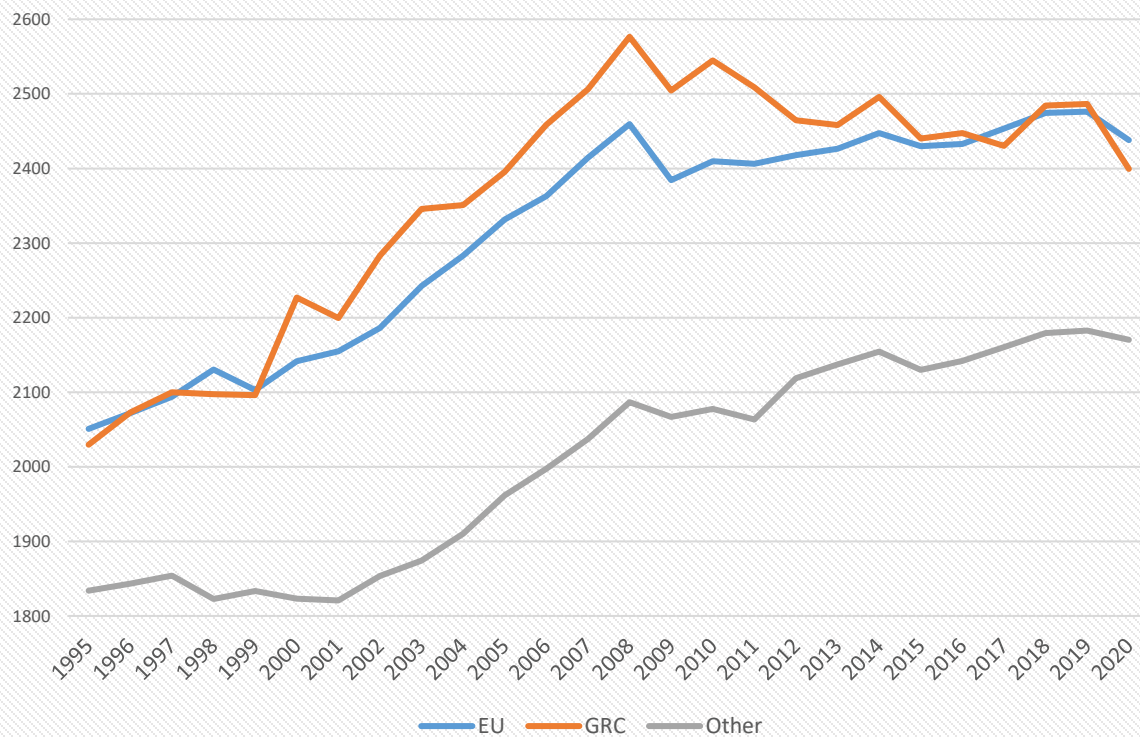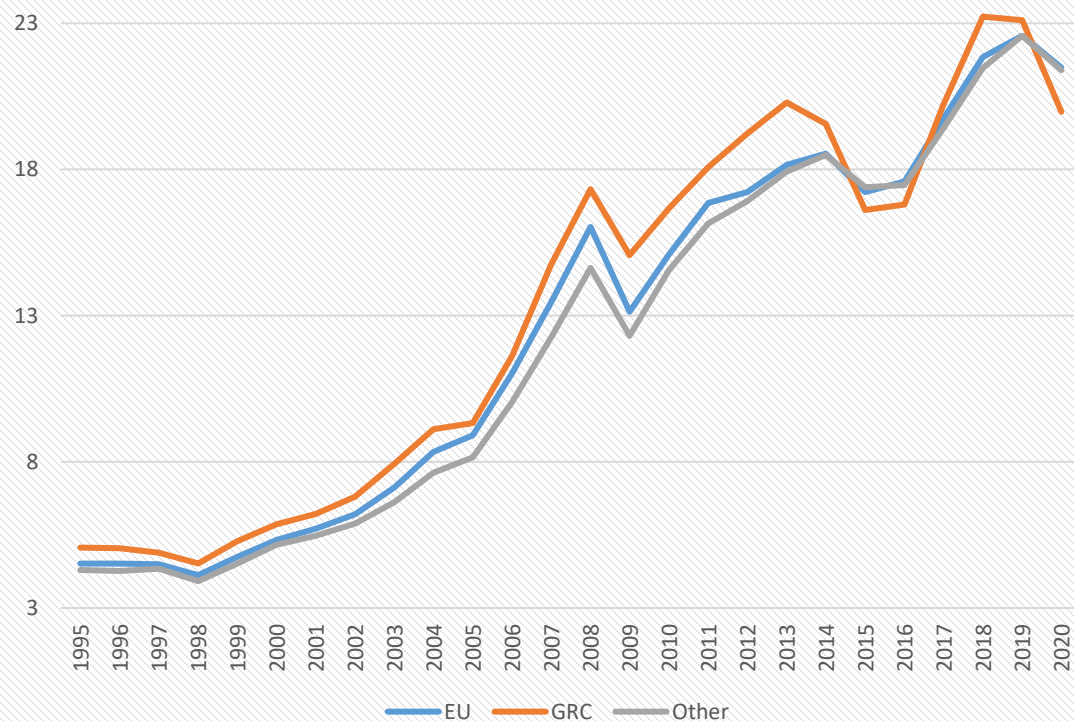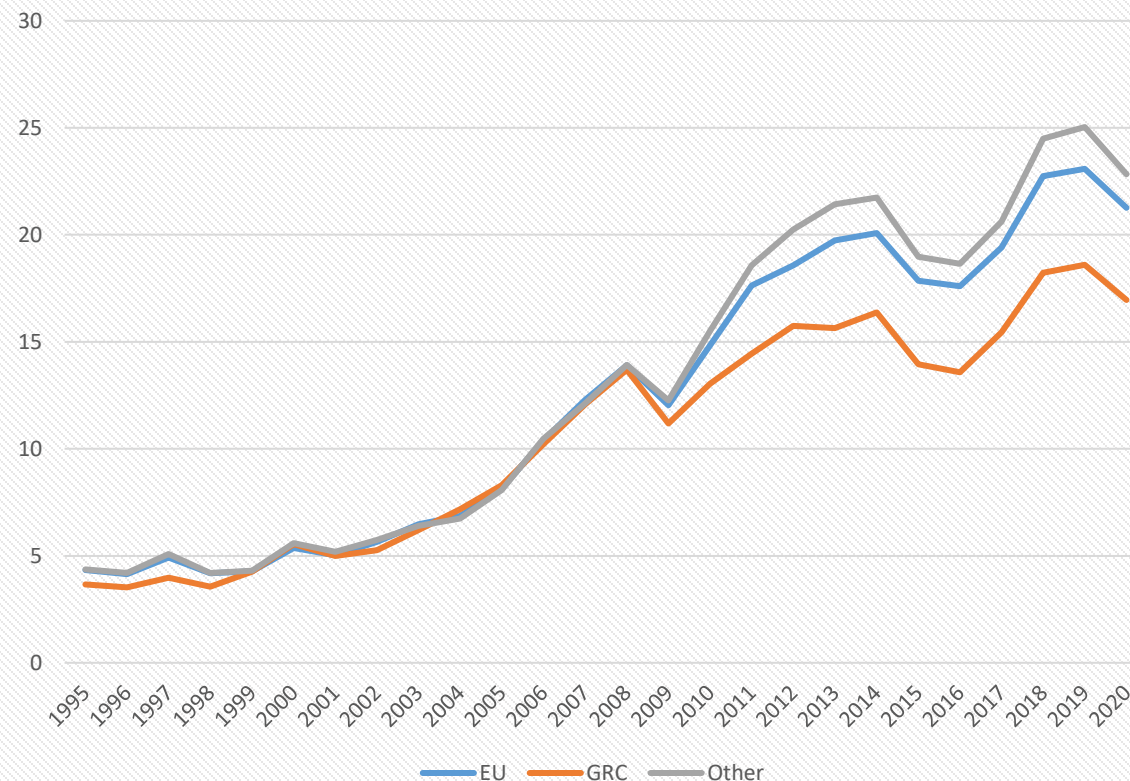
Pattern is reversed from outgoing GVC connections – simpler production sharing is favored

Results and discussion –2c: Evolution of closeness with users and suppliers in the GVC network

Evolution of in-closeness of Greece and average in-closeness of EU27 and the rest of the world economies between 1995 and 2020

Evolution of out-closeness of Greece and average out-closeness of EU27 and the rest of the world economies between 1995 and 2020

- Production proximity to its international GVC suppliers: no notable difference (other than a small overperformance of Greece for most of the time)

- In contrast, its production proximity to its downstream GVC partners follows EU and world averages until the economic crisis, where it then diverges, and while it mirrors the changes in other regions, it never again reaches their level.

Results and discussion –2c: Evolution of Greece's relative importance in the GVC network
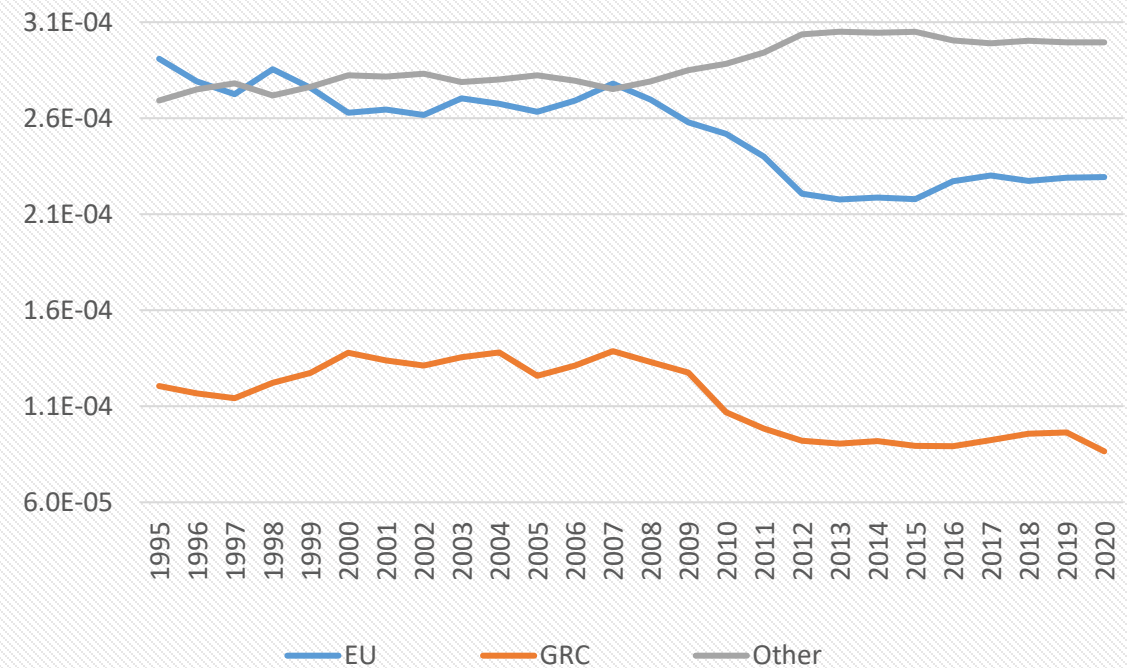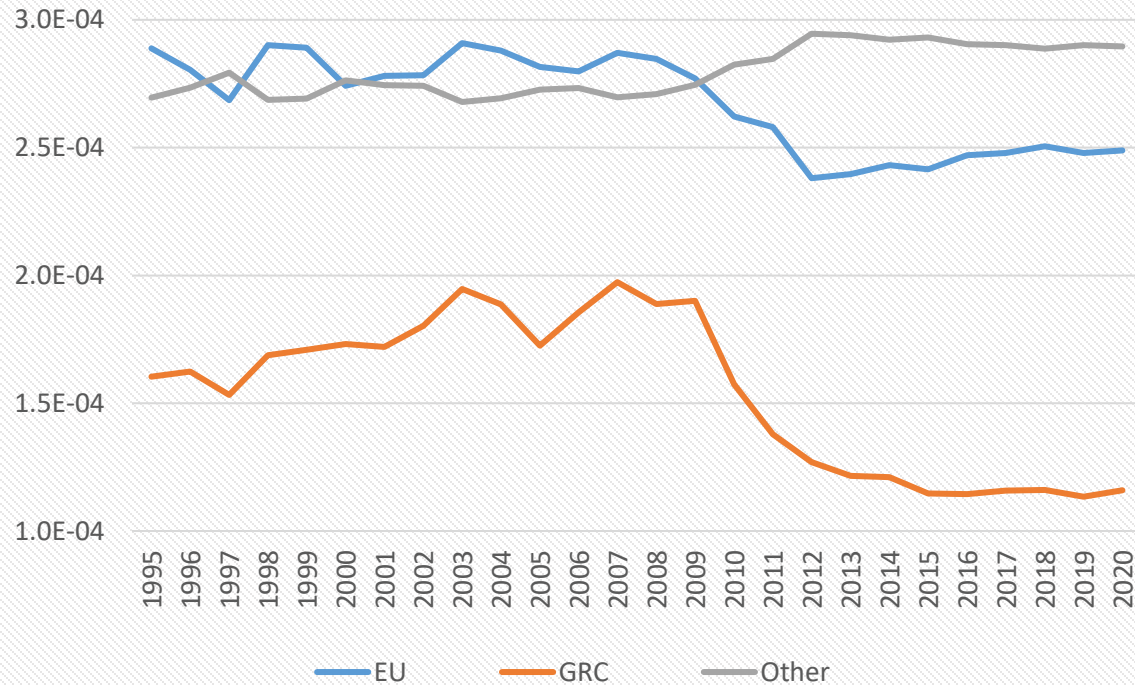
Relative importance of Greece, EU27 and the rest of the world economies in the simple (a) and complex (b) GVC network between 1995 and 2020 based on random walks (pagerank)

- Another notable trend for Greece's and the EU's VA trade evolution is the decline in their relative importance within the GVC network.

- EU: stable until 2008, especially in simple GVC activities, it recedes rapidly after 2010 and is surpassed by RoW, possibly reflecting the emergence of China, Taiwan and the broader East-Asia as dominant forces in GVCs (World Bank, 2020). This is evident for both simple and complex GVC activities.

- Greece's trend was rather "noisy" during the period of the great GVC unbundling, signaling an unstable position in international markets for the country, and was followed by a steep decline from 2010 onwards as direct consequence of the financial crisis and the corresponding losses in terms of international competitiveness.

Results and discussion –2d: Evolution of GVC embeddedness
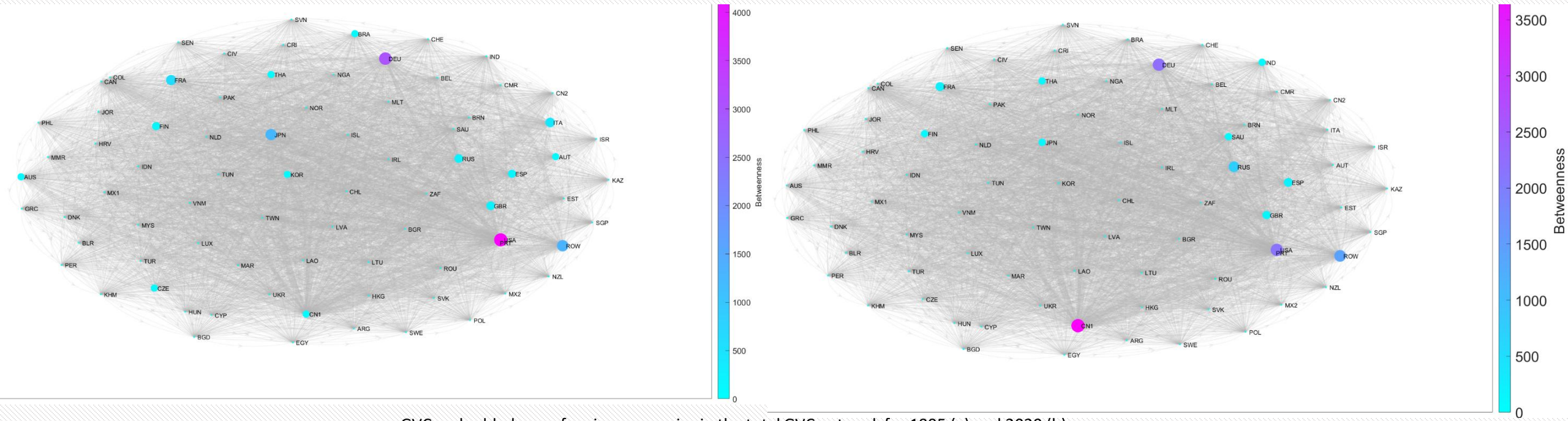
GVC embeddedness of major economies in the total GVC network for 1995 (a) and 2020 (b)

- 1995: most prominent nodes: US and Germany, with the only Asian economy close enough being Japan.

- In 2020, the picture is partially reversed; the US and Germany are still important economic nodes, but their relative importance has declined.

- China becomes the most embedded GVC economy,

  - losses of relative importance for the EU as a whole and for its prominent member-states individually.

- Greece, it remains a relatively small and peripheral production node.

Some concluding remarks

- The findings so far comprise of diverging trends and patterns (Greece's trajectory in the last 25 years was affected both by international forces (as the 2008 crisis and the post 2010 trade slowdown) and internal economic disparities and production limitations.

- Greek sectors become increasingly connected with more downstream GVC partners (out-degree deepening) BUT at the same time, these are growing "*thinner*" in terms of VA flows (out-closeness).

- Production linkages with downstream partners may be associated to simple *arms-length* trade transactions and not long-term trade relationships that could arguably include the trade of higher shares of VA.
    - Greece's export orientation has yet to be solidified by long-lasting, large scale, outward VA flows from the country
    - Hints at apparent competitiveness losses?

- Interestingly, production relations with upstream suppliers depict a certain degree of stability in the country's imports of intermediates.

- Declining importance in many aspects of the production network and reduction of the strength of its economic ties, but the picture is more complex than that.

- We aim to delve deeper into the results in upcoming and versions of this paper.

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Limitations

Next steps

- The usual i-o analysis constraints (single product per industry, no scale effects etc.)
- Hard to associate countries and sectors in two-tiered networks – but aggregation cuts ties
- Results may be sensitive to cut-off point for minimum allowed flow in the network
- 45-sector definition can be challenging for delving deep in specific economic ecosystems

- Map further sectoral patterns and dynamics
- Disaggregate RoW and EU regions to contrast country specific trends
- Isolate specific case studies in the network (e.g. the GVC network of automobiles)
- Examine the crossover with regional diversification/relatedness applications
- Examine the combines effects of GVC participation and position in econometric applications

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Thank you for your time and attention

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