Patterns of Regional and Global Value Chain Participation in the EAC

Sebastian Krantz

Kiel Institute for the World Economy

17th November 2022

Table of Contents

Introduction

Using global Multi-Region Input-Output (MRIO) data from 2005-2015, I empirically investigate the extent and patterns by which EAC countries have integrated into Global Value Chains (GVCs) and Regional Value Chains (RVCs).

Prior **Africa-wide analysis** by Foster-McGregor et al. (2015) using the EORA 25 sector database over the periods from 2000-2011:

- Much of the GVC involvement of Africa is in upstream production, and involves the supply of primary goods
- Downstream involvement in GVCs is relatively small, and shows little improvement in the 1995-2011 period
- Heterogeneity in GVC involvement across African countries, with North Africa heavily involved in GVCs with the EU
- Manufacturing and high-tech sectors not very important
- Inner-African GVCs not important (except southern Africa). EU biggest GVC partner. South+East Asian shares increasing.

Determinants of GVC Participation: Broad analysis of GVC participation focusing on Africa, the Middle East and Asia by Kowalski et al. (2015), using OECD, WIOD and EORA, 1990-2011:

1. Structural factors, especially geographic proximity to manufacturing hubs in Europe, North America and East Asia, size of domestic market and the level of development
2. Trade and investment policy (low import tariffs, FDI openness), improvements of logistics and customs, intellectual property protection, infrastructure and institutions

$\Rightarrow$ Very favourable policy environments in low-income countries can substitute for suboptimal structural factors

Benefits of GVC Perticipation: enhanced productivity, sophistication and diversification of exports. Furthermore:

- SSA & MENA competitive in agriculture & food processing
- Survival of export relationships in Asia $\approx 2\times$ Africa $\rightarrow$ stronger regional integration and learning by doing in Asia.

Why the EAC is Interesting for GVCs

- Robust growth and macroeconomic stability
- Innovation friendly policies (Rwanda [2] and Kenya [4] in top 5 Doing Business in Africa 2020)
- Improvements in infrastructure (Tanzania [4], Rwanda [5], and Kenya [7] in top 10 African Logistics Performers in 2018)
- Regional integration (common market with free movement of goods and people)
- Planned monetary union (2024/25)

Data

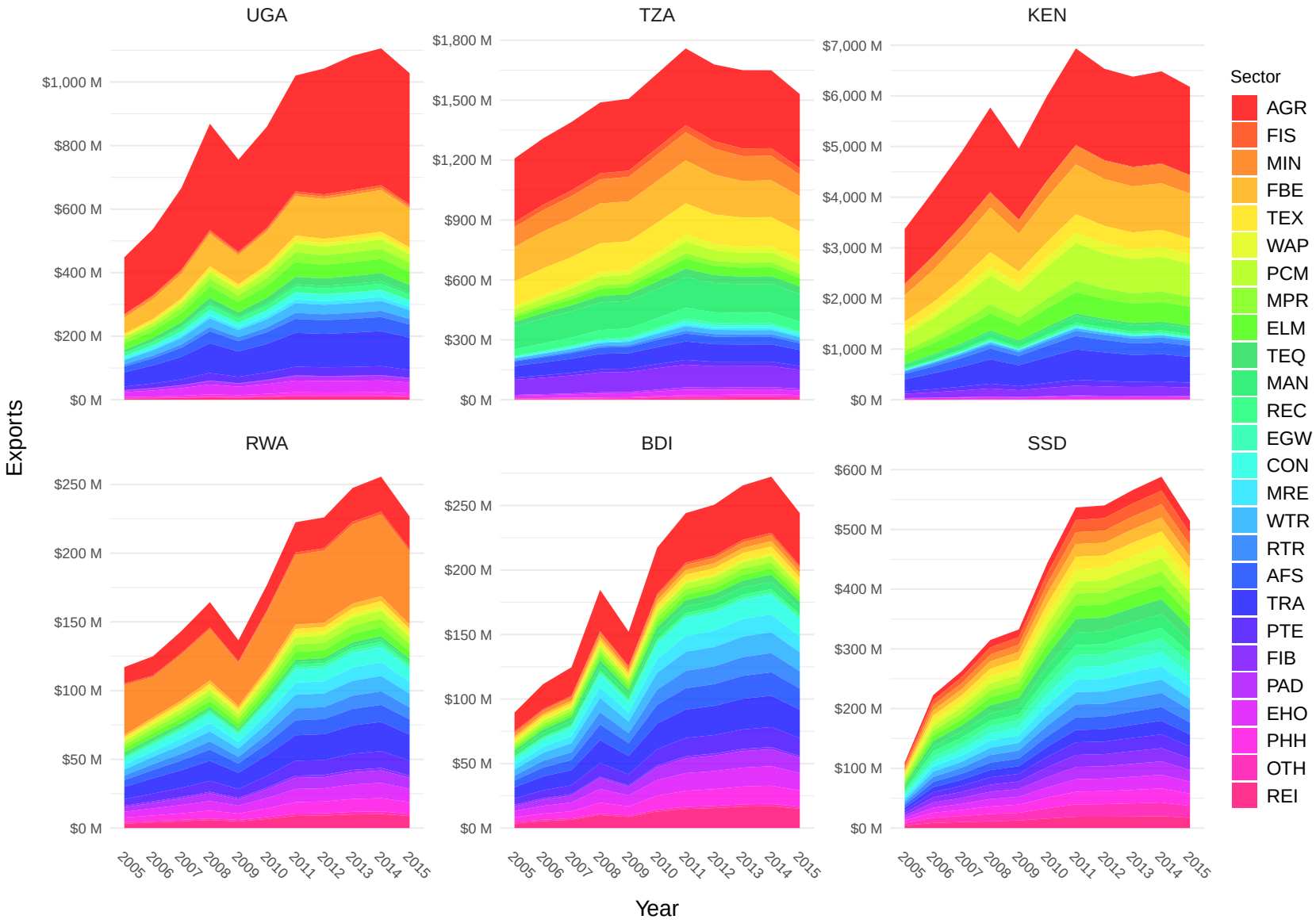
EORA 26 Global ICIO tables for 26 sectors Lenzen et al. (2012, 2013), aggregated to different regions for the years 2005-2015:

Region	*Description*	*Countries*
EAC	East African Community	6
SSA	Sub-Saharan Africa (Excluding EAC)	42
EUU	European Union + UK	28
ECA	Europe and Central Asia (Non-EU)	31
MEA	Middle East and North Africa	20
NAC	North America and Canada	3
LAC	Latin America and Carribean	42
ASE	ASEAN	10
SAS	South Asia	8
CHN	China	3
ROA	Rest of Asia	11
OCE	Oceania	14

Sectors

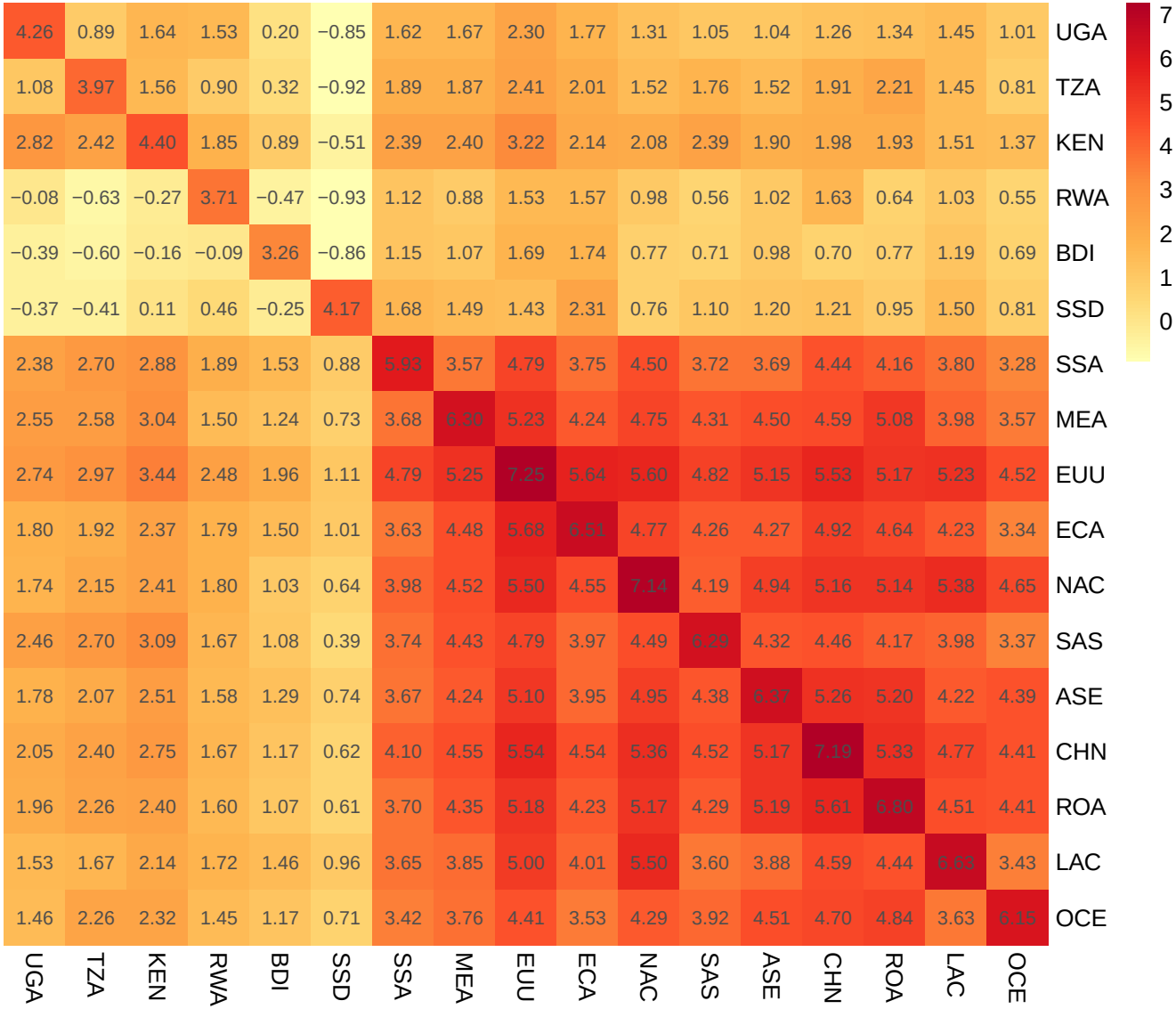
Sector Code	*Description*
AGR	Agriculture
FIS	Fishing
MIN	Mining and Quarrying
FBE	Food & Beverages
TEX	Textiles and Wearing Apparel
WAP	Wood and Paper
PCM	Petroleum, Chemical and Non-Metallic Mineral Products
MPR	Metal Products
ELM	Electrical and Machinery
TEQ	Transport Equipment
MAN	Other Manufacturing
REC	Recycling
EGW	Electricity, Gas and Water
CON	Construction
MRE	Maintenance and Repair
WTR	Wholesale Trade
RTR	Retail Trade
AFS	Hotels and Restraurants
TRA	Transport
PTE	Post and Telecommunications
FIB	Finacial Intermediation and Business Activities
PAD	Public Administration
EHO	Education, Health and Other Services
PHH	Private Households
OTH	Others
REI	Re-export & Re-import

EAC Gross Exports



Gross IO Linkages

Millions of 2015 USD at Basic Prices on a Log10 Scale



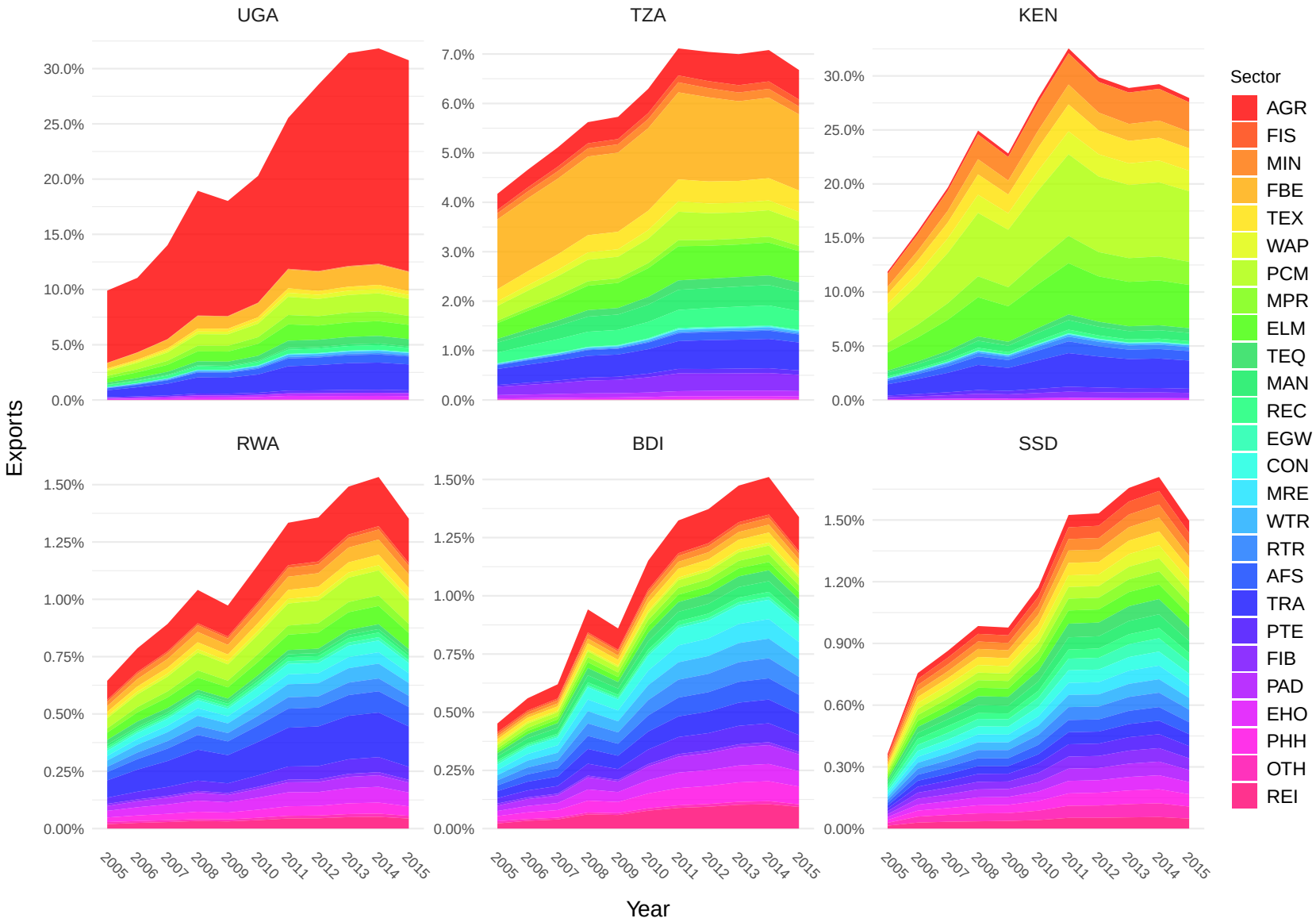
Gross IO Linkages

Table: Largest Intermediates Flows Between the EAC and the World

Millions of 2015 USD at Basic Prices

#	Flow	Value	Non-Kenya Flow	Value
1	KEN.AGR → EUU.FBE	459.214	EUU.ELM → TZA.ELM	128.665
2	KEN.AGR → EUU.REI	271.547	EUU.ELM → UGA.ELM	86.675
3	MEA.TRA → KEN.TRA	186.499	SAS.PCM → TZA.PCM	73.558
4	EUU.TRA → KEN.TRA	178.775	TZA.AGR → ROA.FBE	66.674
5	EUU.ELM → KEN.CON	165.829	EUU.PCM → TZA.PCM	62.432
6	EUU.PCM → KEN.PCM	142.660	MEA.ELM → UGA.ELM	62.200
7	KEN.FBE → EUU.FBE	137.057	SAS.ELM → TZA.ELM	49.312
8	EUU.ELM → TZA.ELM	128.665	UGA.AGR → EUU.FBE	48.568
9	OCE.AGR → KEN.FBE	128.317	SSA.ELM → TZA.ELM	44.663
10	EUU.PCM → KEN.AGR	118.039	SSA.PCM → TZA.PCM	43.131
11	EUU.PCM → KEN.CON	103.888	ROA.WTR → TZA.WTR	41.891
12	EUU.REI → KEN.CON	95.865	MEA.ELM → TZA.ELM	41.537
13	MEA.PCM → KEN.CON	95.677	TZA.AGR → EUU.FBE	39.506
14	EUU.ELM → KEN.ELM	93.319	SAS.ELM → UGA.ELM	37.466
15	SAS.PCM → KEN.PCM	90.327	EUU.ELM → TZA.TEQ	35.433
16	EUU.FBE → KEN.FBE	88.536	EUU.ELM → RWA.ELM	33.555
17	KEN.FBE → EUU.REI	88.051	CHN.ELM → TZA.ELM	31.674
18	EUU.ELM → UGA.ELM	86.675	OCE.ELM → TZA.ELM	31.160
19	SAS.ELM → KEN.CON	82.360	SAS.PCM → UGA.PCM	30.212
20	EUU.PCM → KEN.FBE	77.832	EUU.PCM → UGA.PCM	29.267

Percentage of Gross Exports Going to EAC Members



Gross IO Linkages in the EAC

Millions of 2015 USD at Basic Prices on a Log10 Scale

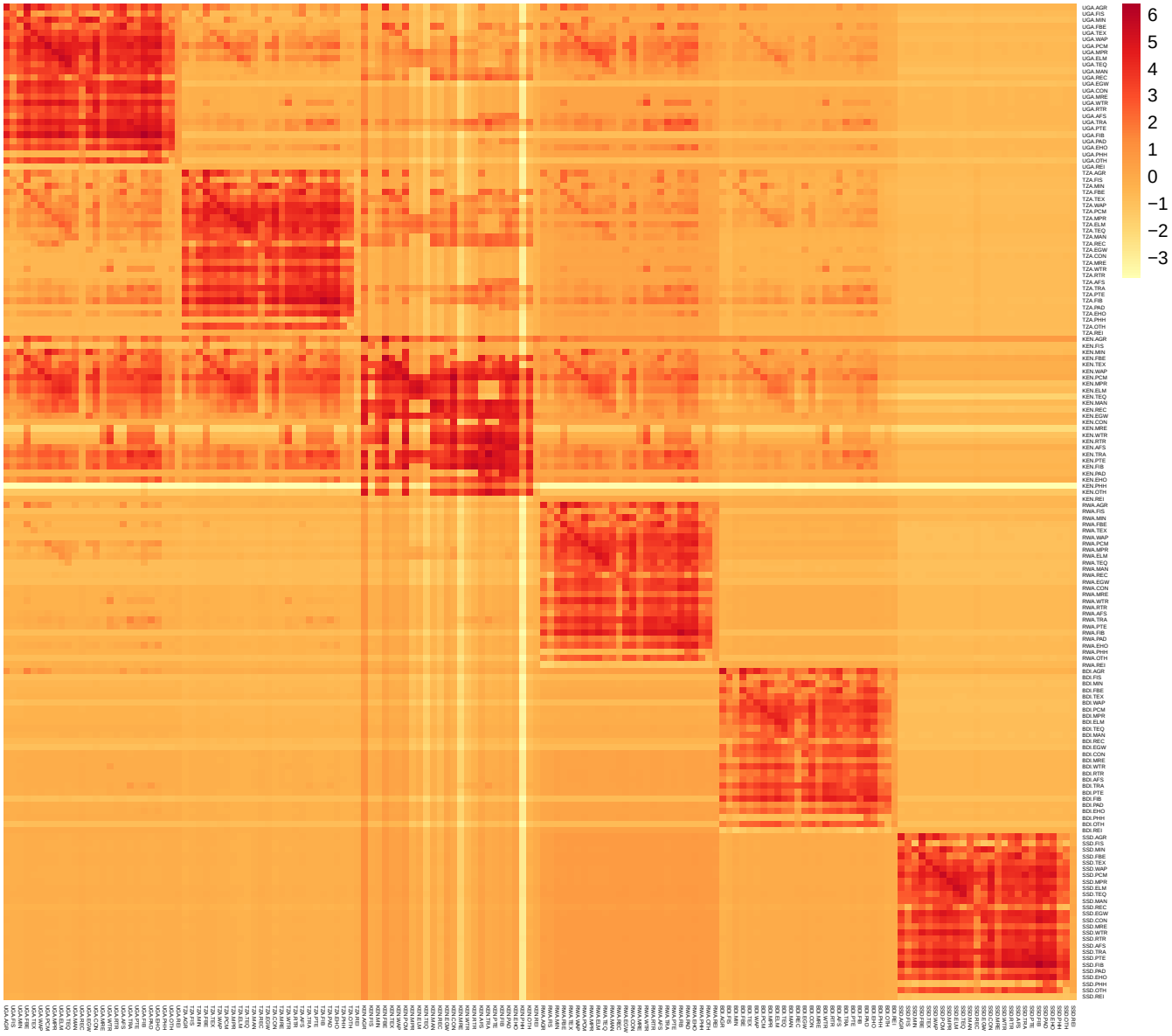


Table: Largest Inter-Country Intermediate Flows within the EAC

Millions of 2015 USD at Basic Prices

#	Flow	Value	Non-Kenya Flow	Value
1	KEN.MIN → UGA.PCM	95.270	UGA.PCM → RWA.PCM	2.539
2	KEN.PCM → UGA.PCM	63.854	UGA.TRA → RWA.PAD	2.497
3	KEN.PCM → TZA.PCM	37.412	UGA.MPR → RWA.MPR	2.091
4	KEN.WAP → UGA.WAP	29.109	UGA.TRA → RWA.TRA	2.003
5	KEN.ELM → UGA.ELM	25.912	UGA.FBE → RWA.FBE	1.958
6	UGA.AGR → KEN.FBE	24.319	UGA.MPR → RWA.ELM	1.443
7	KEN.TRA → UGA.PAD	23.140	UGA.ELM → RWA.ELM	1.346
8	KEN.PCM → UGA.EHO	20.892	UGA.FBE → RWA.AFS	1.175
9	KEN.TRA → UGA.TRA	20.085	UGA.WTR → RWA.WTR	1.124
10	KEN.MIN → UGA.EGW	18.863	UGA.PCM → TZA.PCM	1.088
11	KEN.MIN → TZA.PCM	18.044	TZA.MIN → UGA.PCM	0.992
12	KEN.WAP → TZA.WAP	15.156	UGA.AGR → RWA.FBE	0.824
13	KEN.FBE → UGA.FBE	14.913	UGA.PCM → RWA.EHO	0.817
14	KEN.WAP → UGA.CON	14.288	UGA.WAP → RWA.WAP	0.813
15	KEN.MPR → UGA.ELM	13.857	TZA.FBE → UGA.FBE	0.742
16	KEN.PCM → TZA.EHO	11.961	UGA.ELM → TZA.ELM	0.631
17	KEN.ELM → UGA.MPR	11.708	UGA.MPR → RWA.CON	0.535
18	KEN.ELM → TZA.ELM	11.688	UGA.MPR → RWA.TEQ	0.479
19	KEN.ELM → UGA.TEQ	11.555	TZA.FBE → UGA.AFS	0.471
20	KEN.PCM → UGA.PAD	11.140	UGA.PCM → RWA.PAD	0.453

Figure: Gross Flows Ratios: ROW/EAC Inflows and Outflows

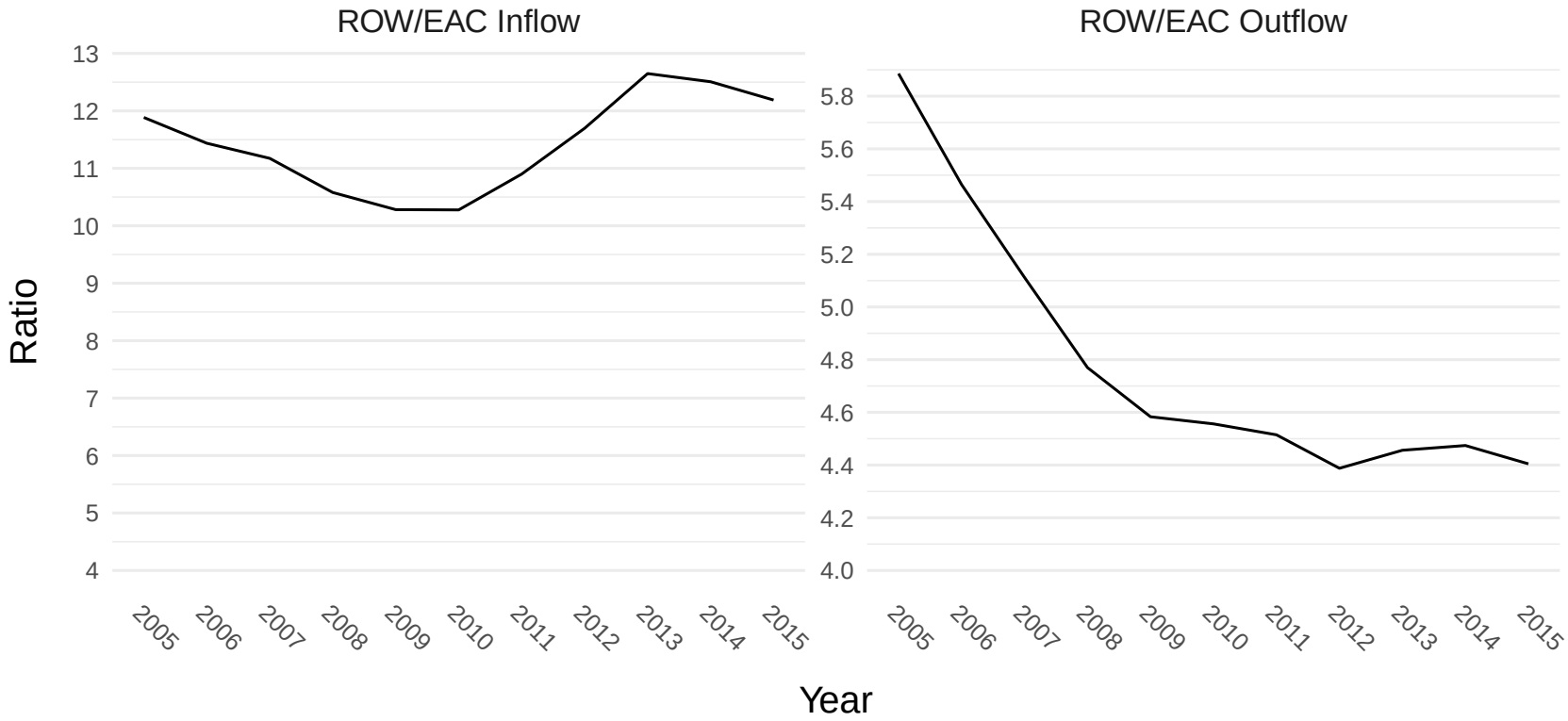
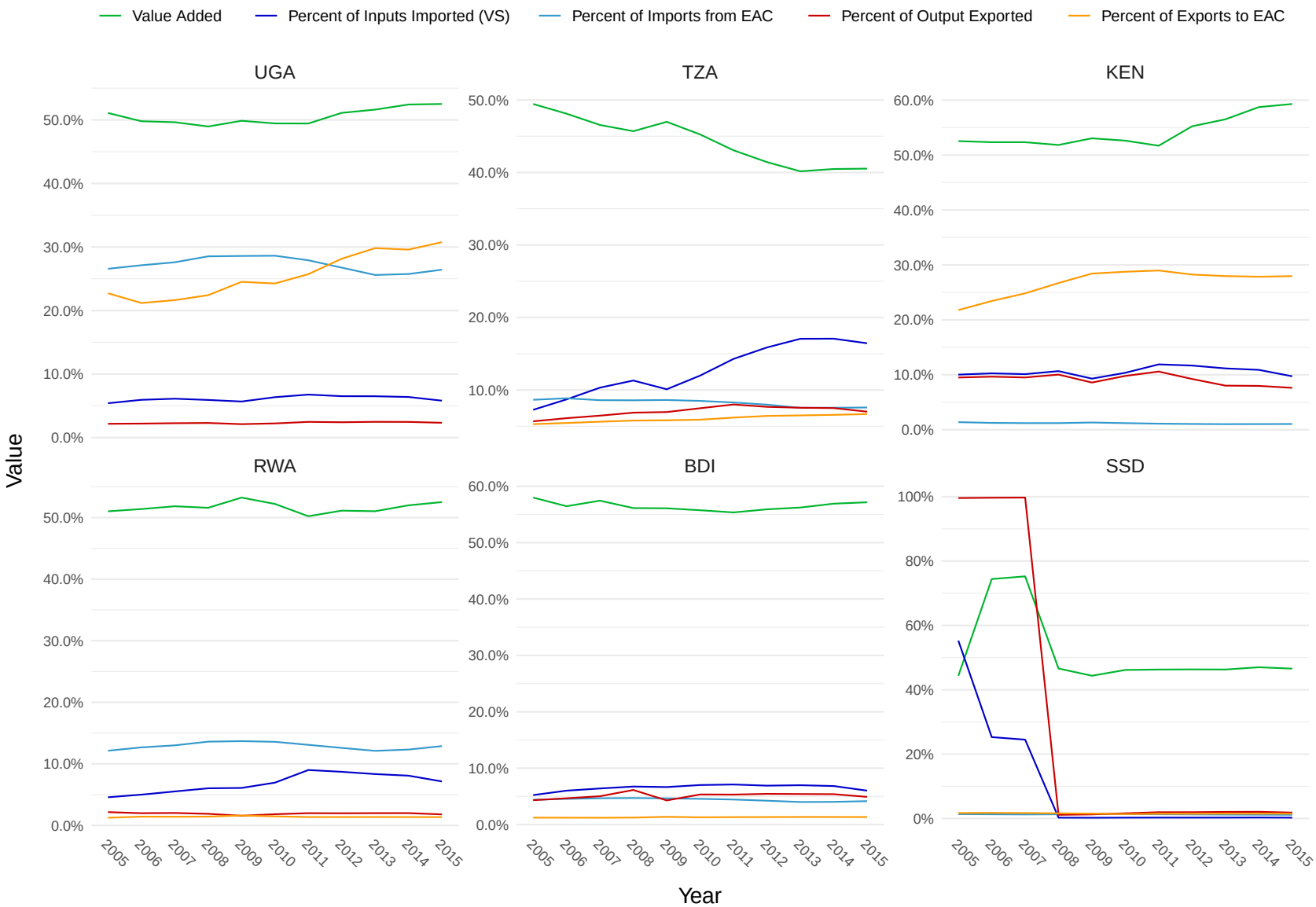


Figure: Decomposition of Output and Exports



From Gross Flows to Value Added

Let $\mathbf{x}$ be a vector of country-sector gross output, $\mathbf{A}$ and input shares matrix where each column was divided by output, and $\mathbf{d}$ a vector of final demand, then

$$\mathbf{x} = \mathbf{A}\mathbf{x} + \mathbf{d} \tag{1}$$

$$\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{d} = \mathbf{B}\mathbf{d}, \tag{2}$$

where $\mathbf{Bd}$ is called the total requirement matrix. Let $\mathbf{v}$ be the (own) value added share of each country-sector, defined as

$$\mathbf{v} = \mathbf{1} - \mathbf{A}'\mathbf{1}. \tag{3}$$

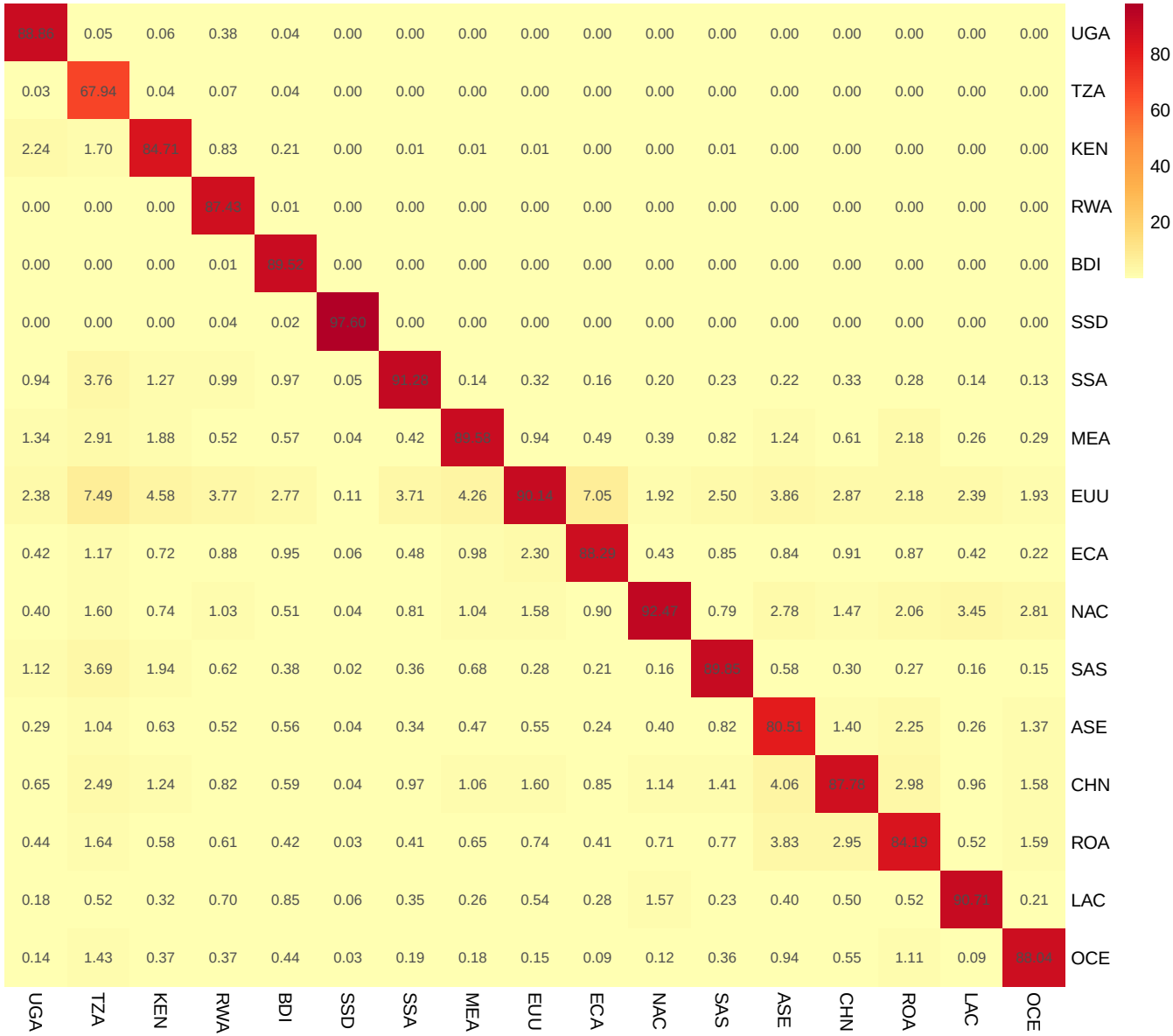
Now let $\mathbf{V} = diag(\mathbf{v})$, then from (2)

$$\mathbf{V}\mathbf{x} = \mathbf{V}(\mathbf{I} - \mathbf{A})^{-1}\mathbf{d} = \mathbf{V}\mathbf{B}\mathbf{d}. \tag{4}$$

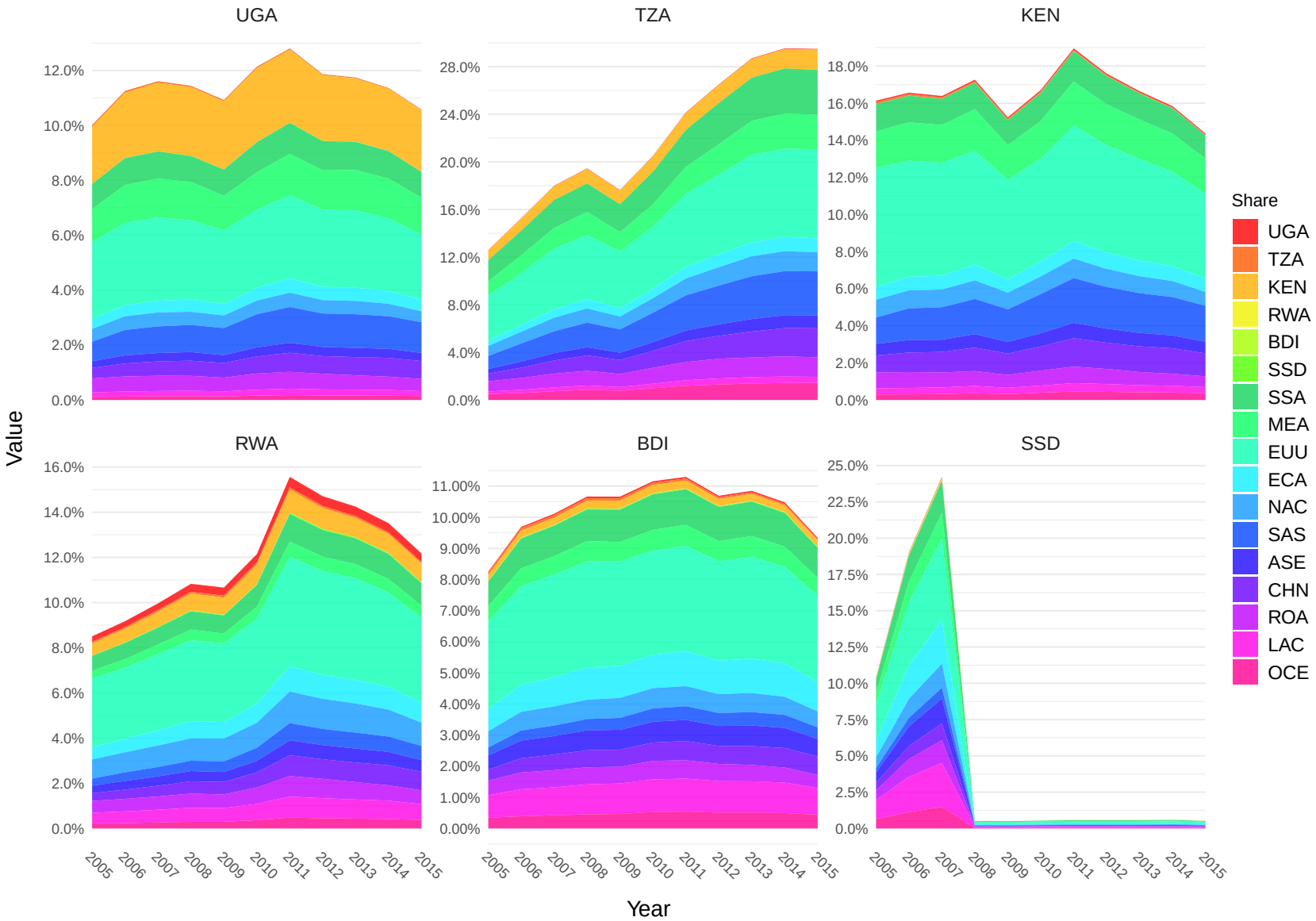
$\mathbf{VB} = \mathbf{V}(\mathbf{I} - \mathbf{A})^{-1}$ is the matrix of value added added shares, such that $\mathbf{1}'\mathbf{VB} = \mathbf{1}$ (each column gives VA from all country-sectors).

Aggregated Value Added Share Matrix (**VB**) in 2015

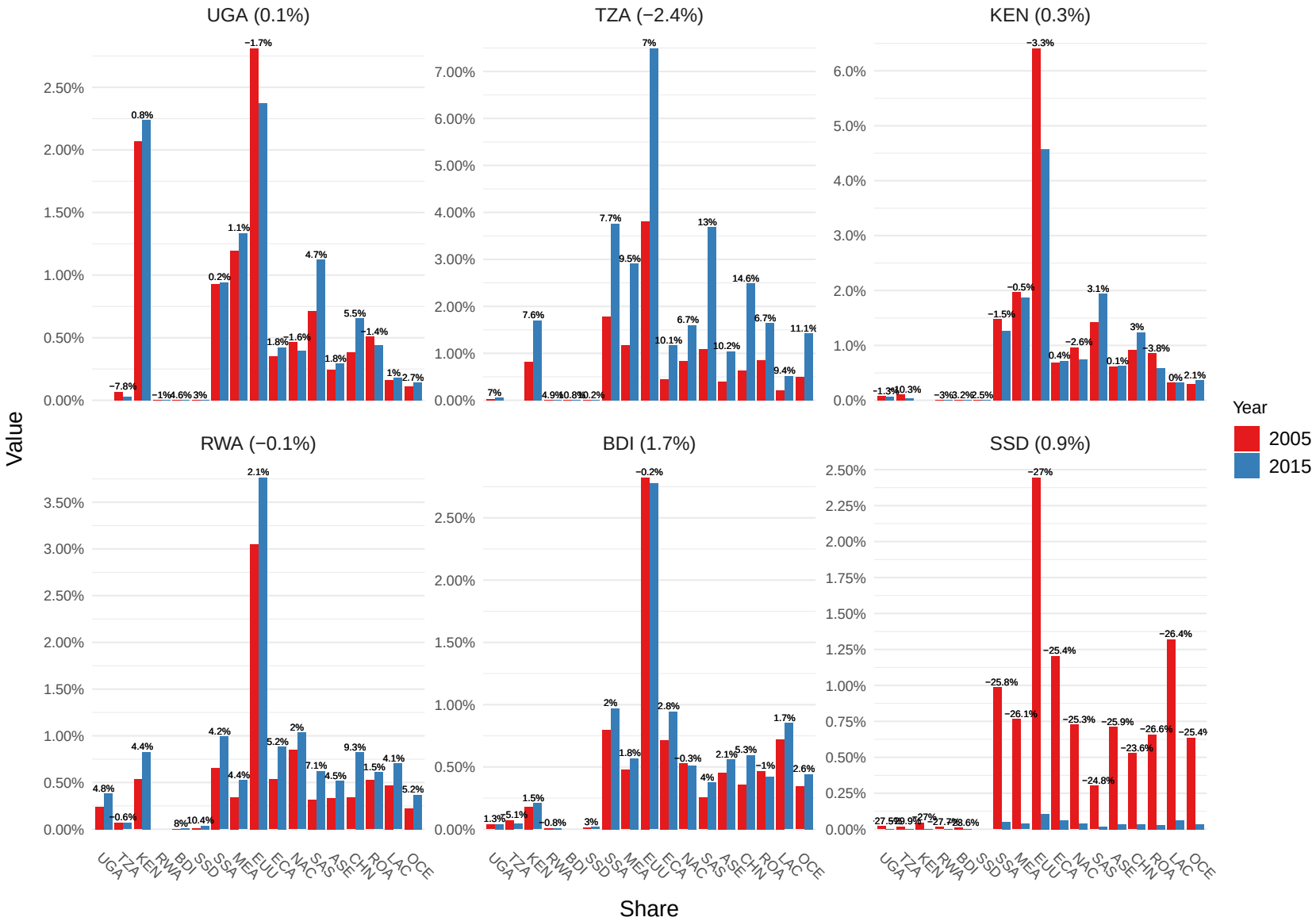
Shares in Percentage Terms, Columns Sum to 100 Percent



Foreign Value Added Shares in EAC Production (VS)



Change in Foreign Value Added Shares in EAC Production



GVC Integration of EAC Members: Aggregate

We can also consider the share of gross exports being re-exported:

$$\text{E2R}_{oi} = \frac{1}{E_{oi}} \sum_{uj, u \neq o} \text{vbe}_{oi,uj} \quad \forall\ oi. \tag{5}$$

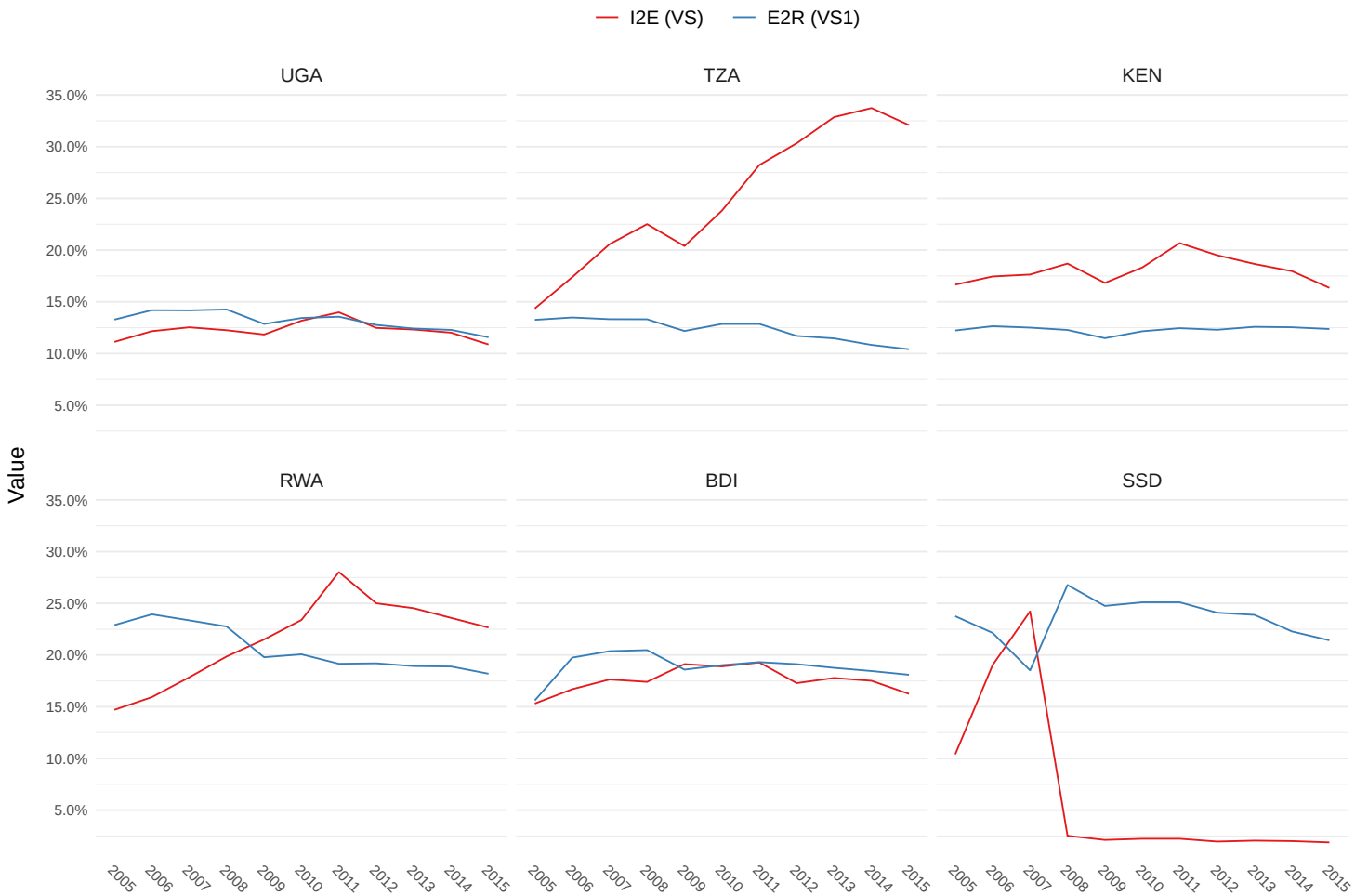


Figure: GVC Integration of EAC Members: Sector Level: 2015

Figure: EAC Trade Balance in Intermediate Goods in Gross and VA Terms

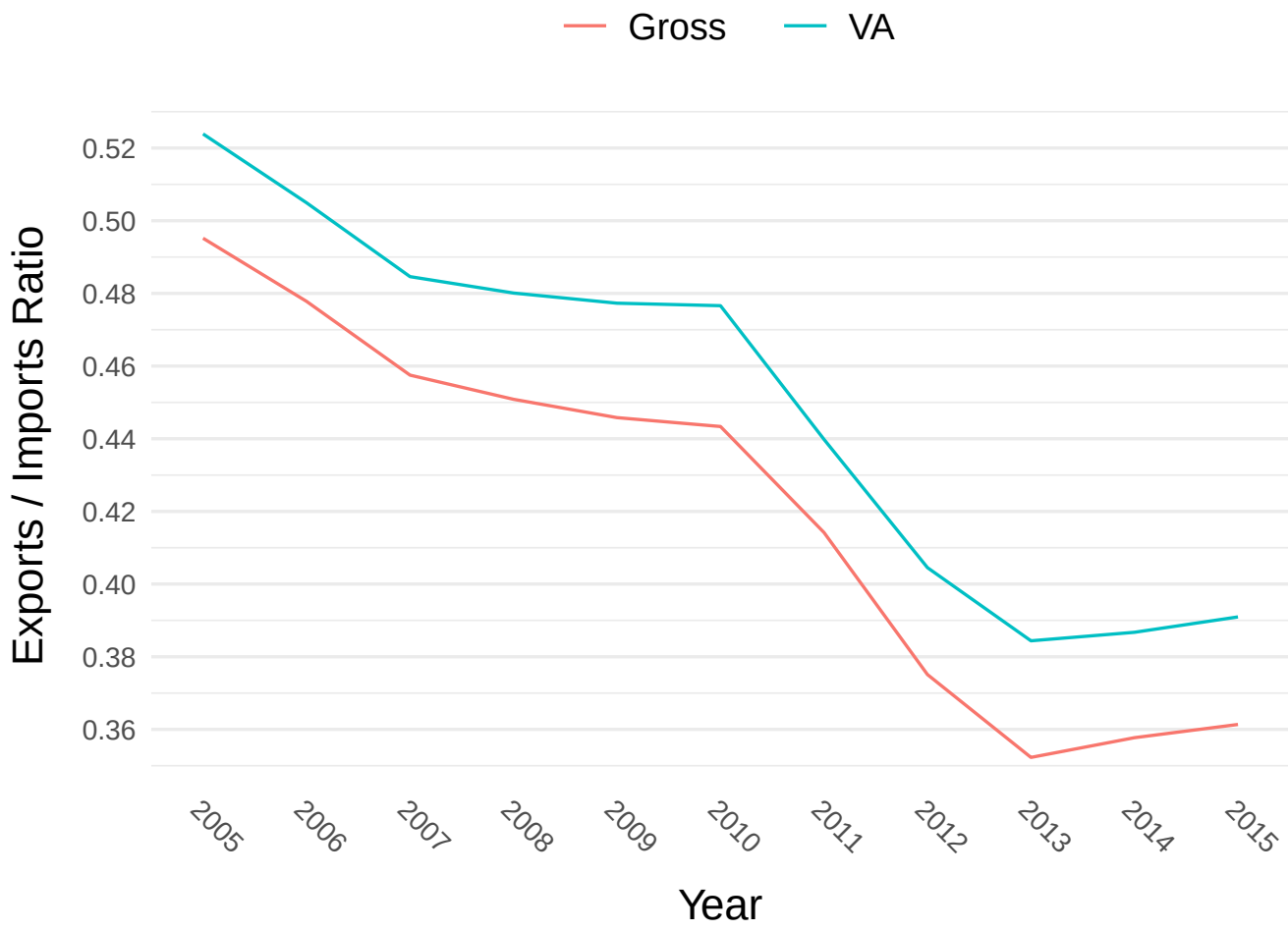
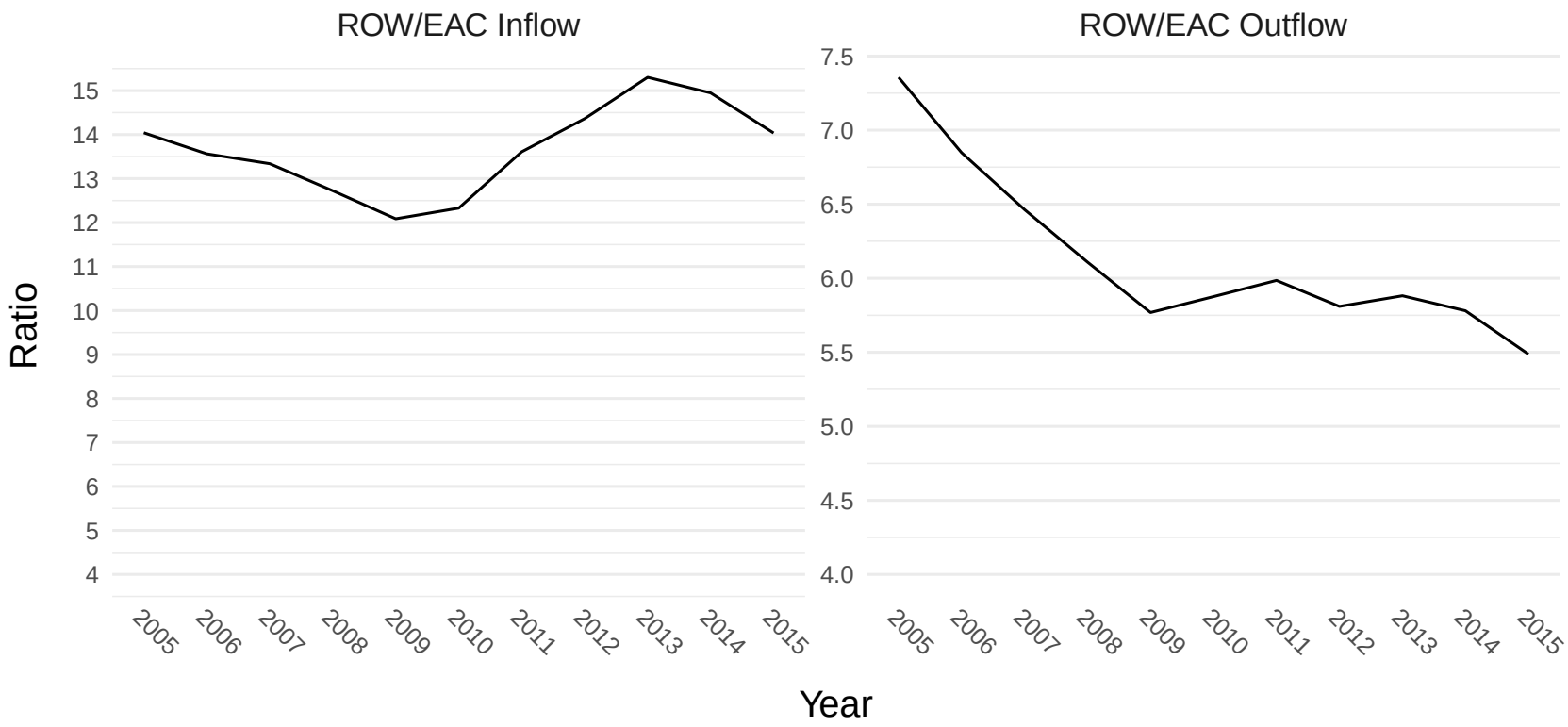
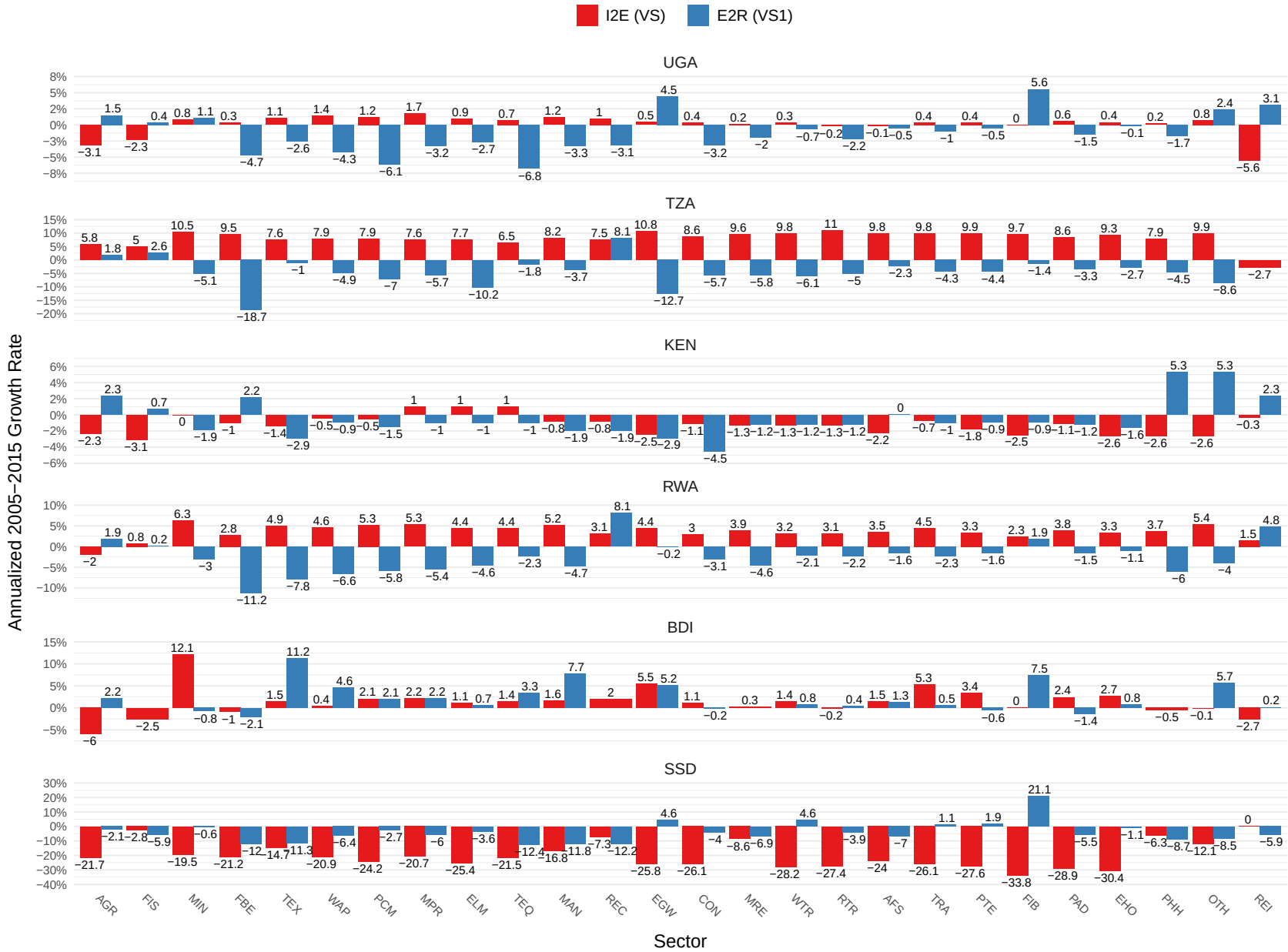


Figure: VA Flows Ratios: ROW/EAC Inflows and Outflows



Average Annual Growth 2005-2015



How can we Measure Regional Integration? 4 Measures:

1. foreign VA share in production/exports accounted for by EAC

$$VS_{uj}^{EAC} = \frac{1}{VS_{uj}} \sum_{oi \in EAC,\ o \neq u} vb_{oi,uj} \quad \forall\ uj \in EAC, \tag{6}$$

2. dom. VA share in re-exported exports exported by EAC partners

$$VS1_{oi}^{EAC} = \sum_{uj \in EAC, u \neq o} vbe_{oi,uj} \Big/ \sum_{uj, u \neq o} vbe_{oi,uj} \quad \forall\ oi \in EAC. \tag{7}$$

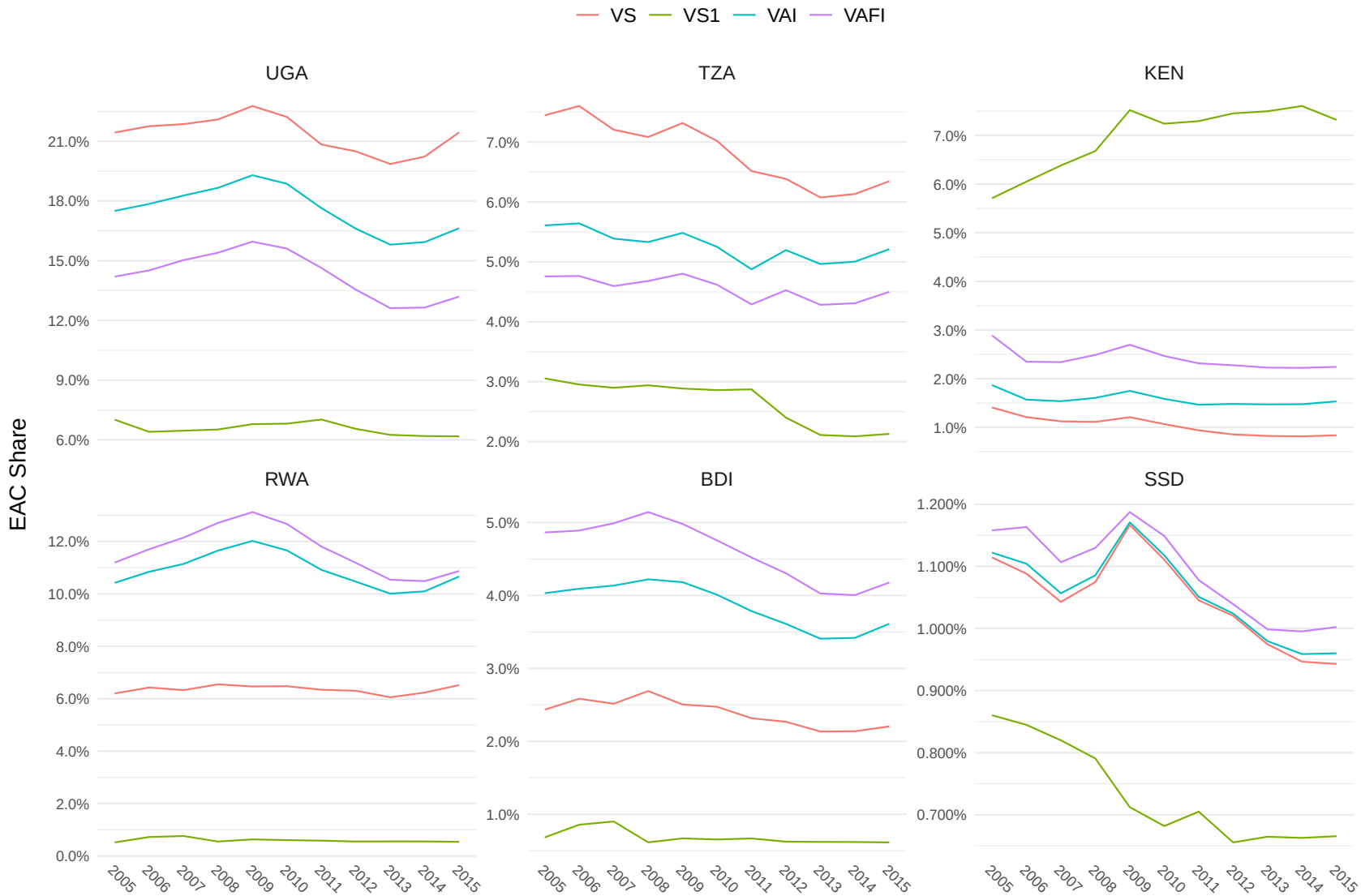
We can also compute import measures considering the EAC share in VA imports (including imported intermediate inputs)

$$VAI_{u}^{EAC} = \sum_{oi \in EAC, o \neq u} e_{oi,u}^{VA} \Big/ \sum_{oi, o \neq u} e_{oi,u}^{VA}, \tag{8}$$

or, alternatively, in final goods imports (excluding imported inputs)

$$VAFI_{u}^{EAC} = \sum_{oi \in EAC, o \neq u} fe_{oi,u}^{VA} \Big/ \sum_{oi, o \neq u} fe_{oi,u}^{VA}. \tag{9}$$

Figure: EAC VA Shares in Members VS, VS1, Imports and Final Imports



Leontief decomposition of gross exports into VA origins also captures so called pure double counted items, and provides no information where VA in exports is absorbed. Koopman et al. (2014) decompose country gross exports into 9 VA components:

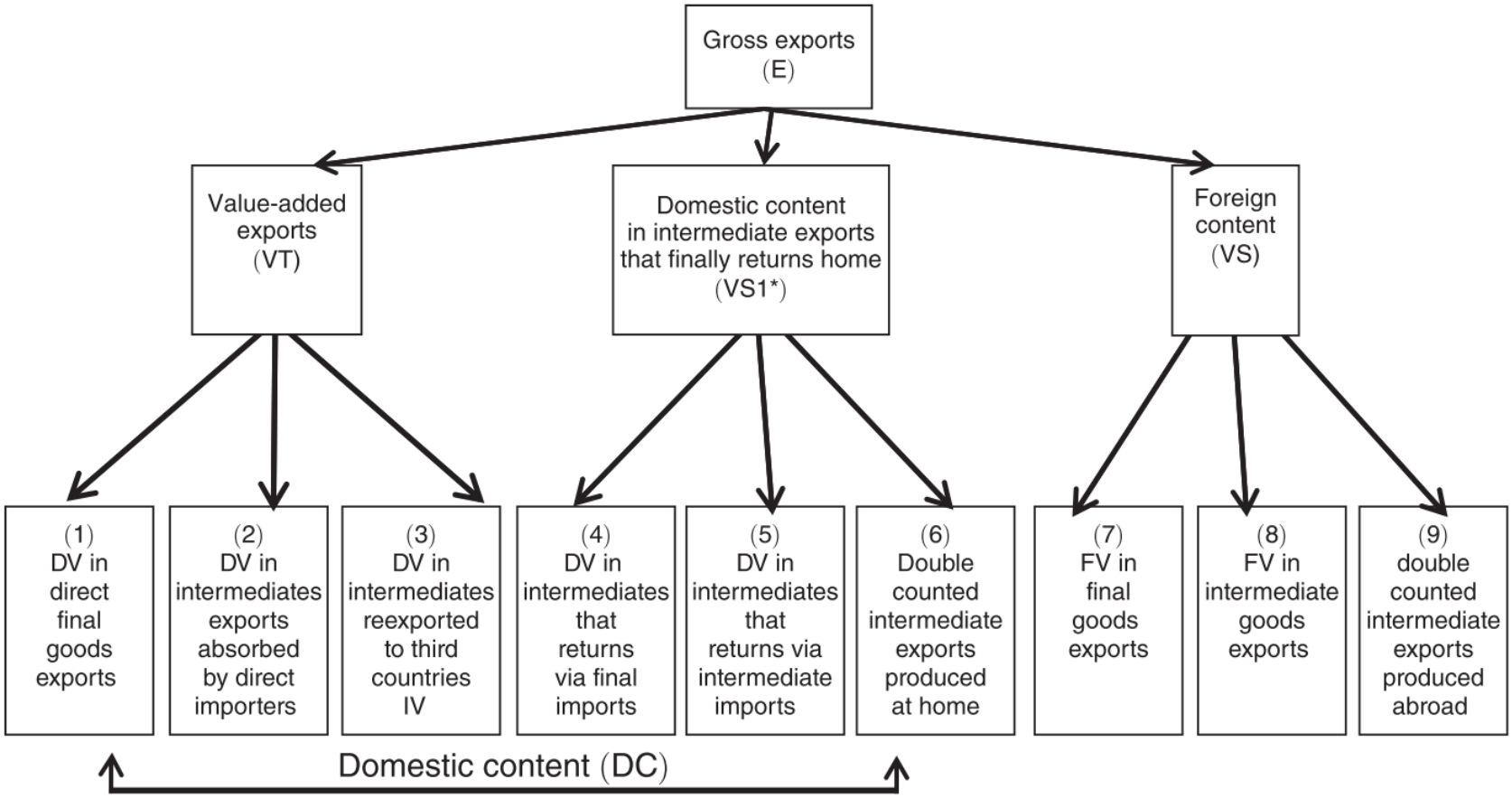
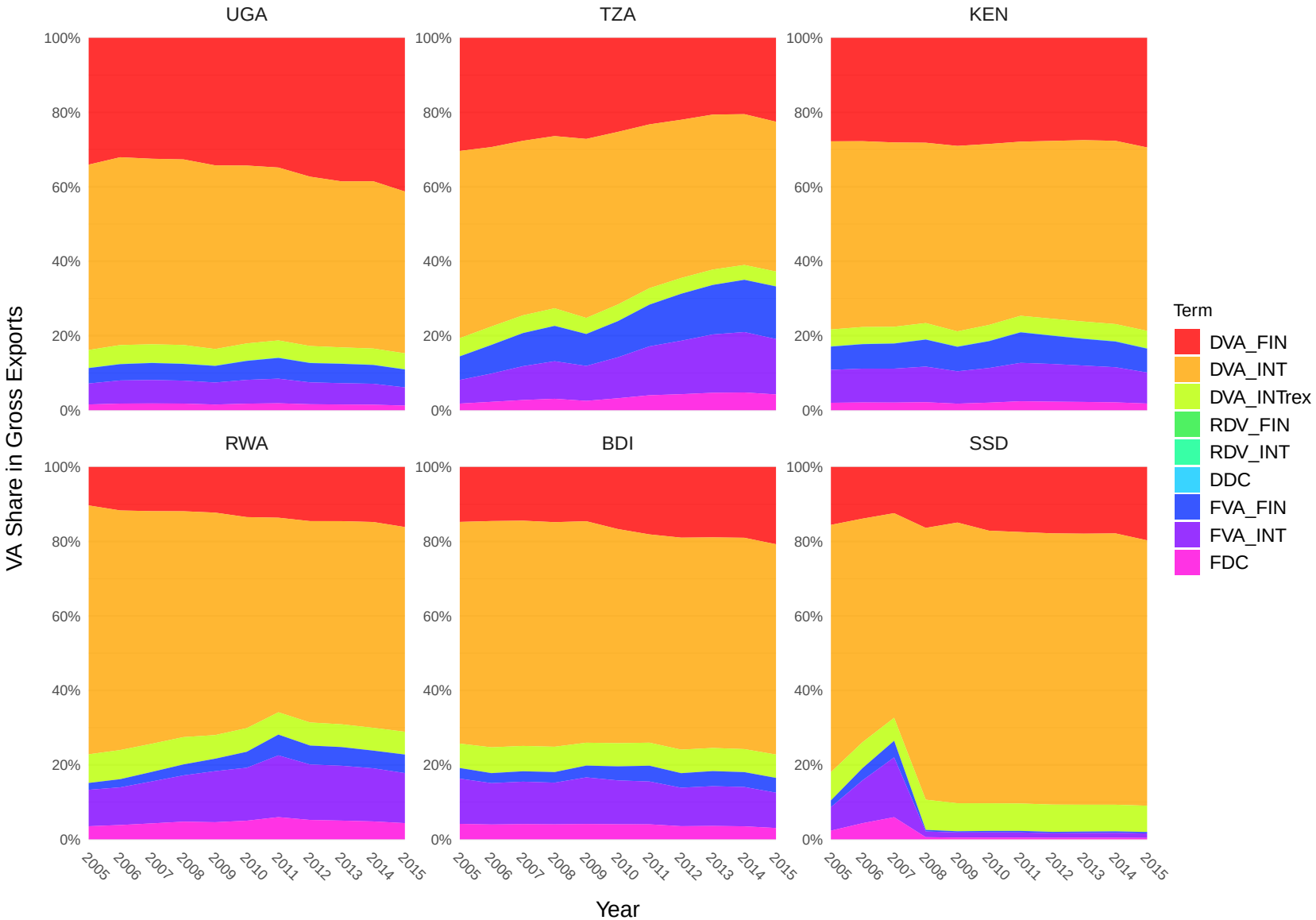


Figure: KWW Decomposition of Gross Exports



According to Kummritz & Quast (2016) and Wang et al. (2013):

- High FVA in final exports relative to total foreign content in exports indicates downstreamness (assembly tasks)
- High DVA in intermediate exports relative to total DVA in exports indicates upstreamness (specialization in tasks adding a lot of value to an unfinished product)

$$\text{Upstreamness} = \frac{\text{DVA}_{INT} + \text{DVA}_{INTrex} + \text{DDC}}{\text{DVA}_{FIN} + \text{DVA}_{INT} + \text{DVA}_{INTrex} + \text{RDV}_{FIN} + \text{RDV}_{INT} + \text{DDC}}$$

$$\text{Downstreamness} = \frac{\text{FVA}_{FIN}}{\text{FVA}_{FIN} + \text{FVA}_{INT} + \text{FDC}}$$

Figure: Upstreamness and Downstreamness Ratios

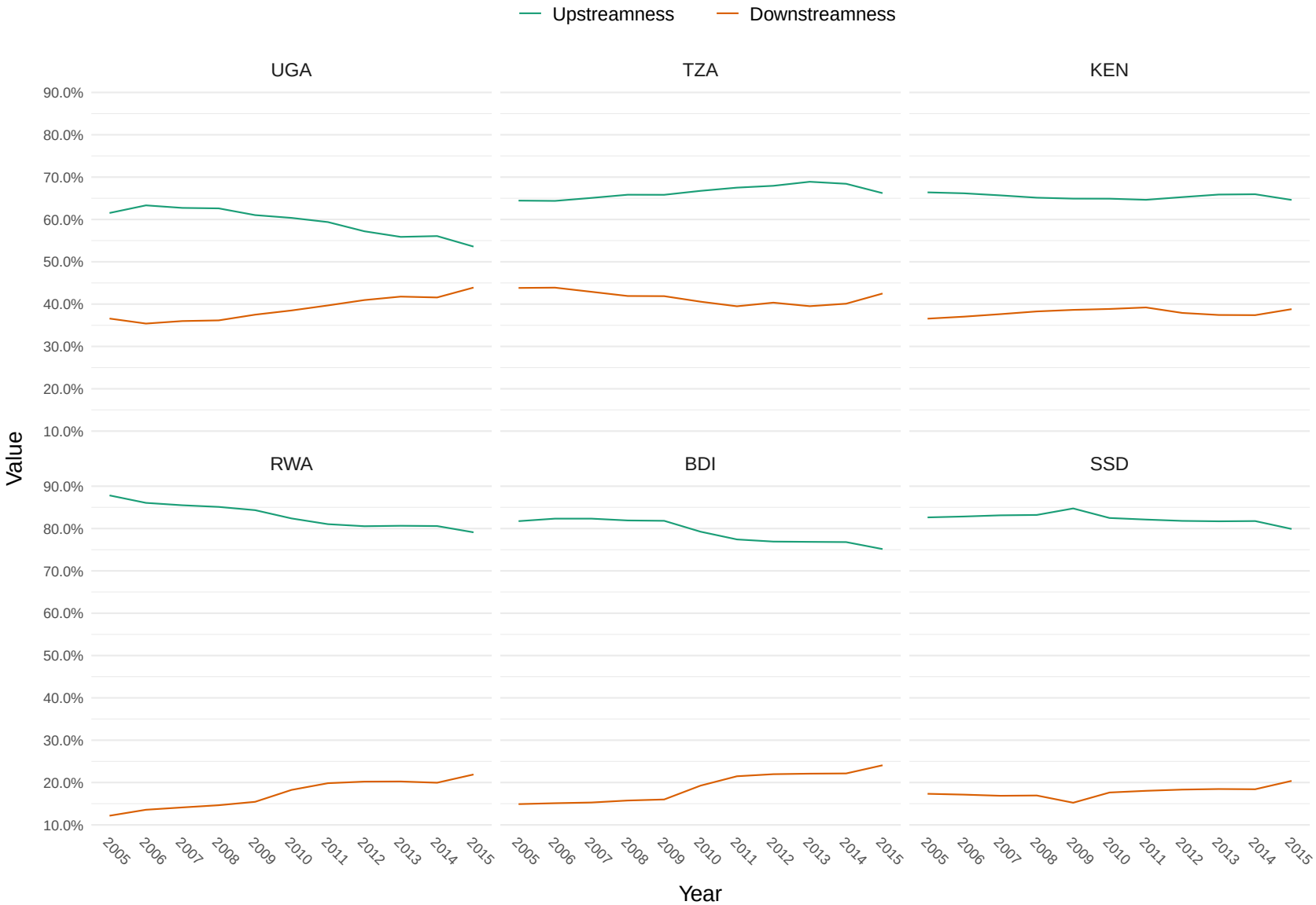


Figure: Upstreamness and Downstreamness Ratios, Difference 2005-2015

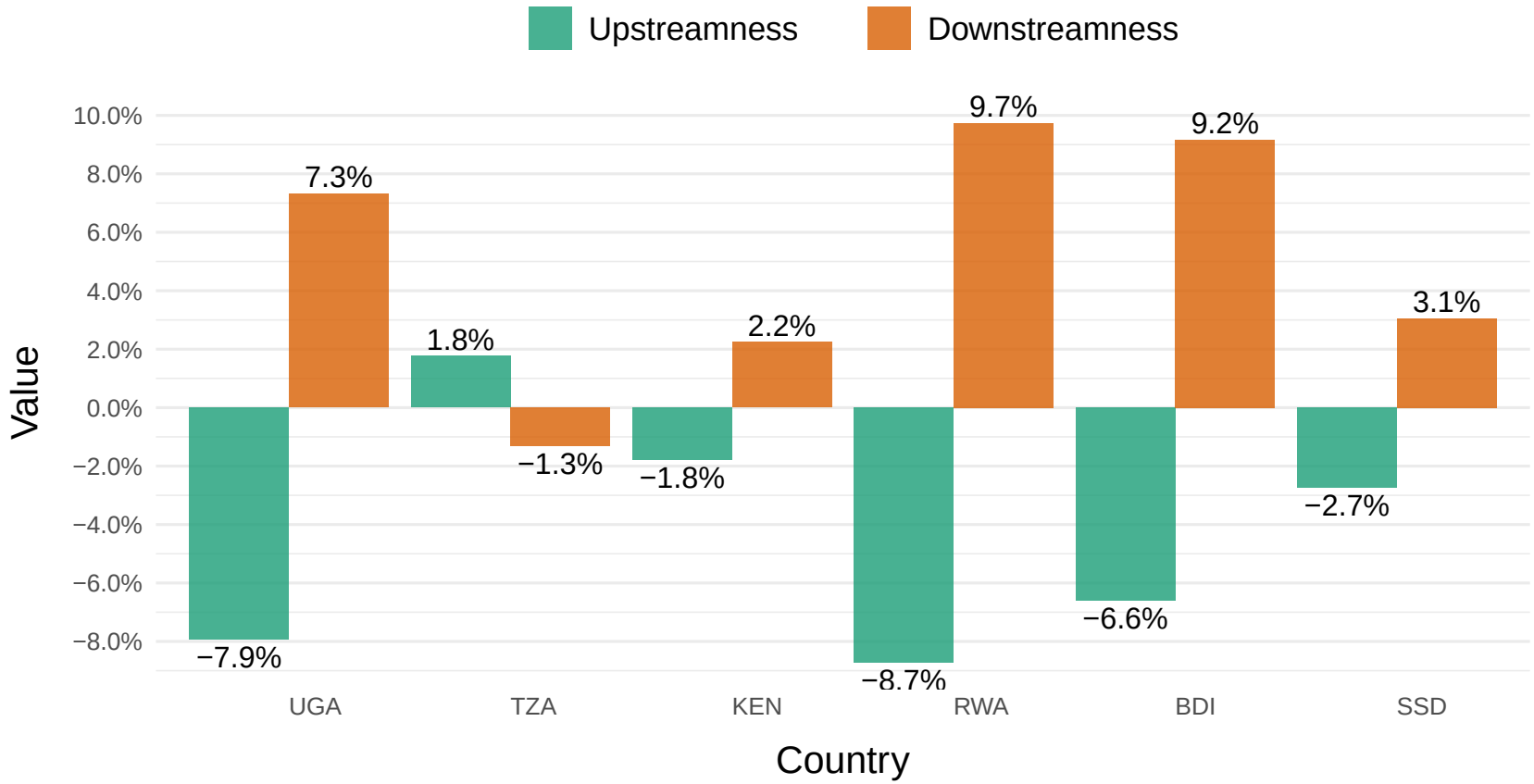


Figure: KWW Decomposition of Gross Exports to the EAC

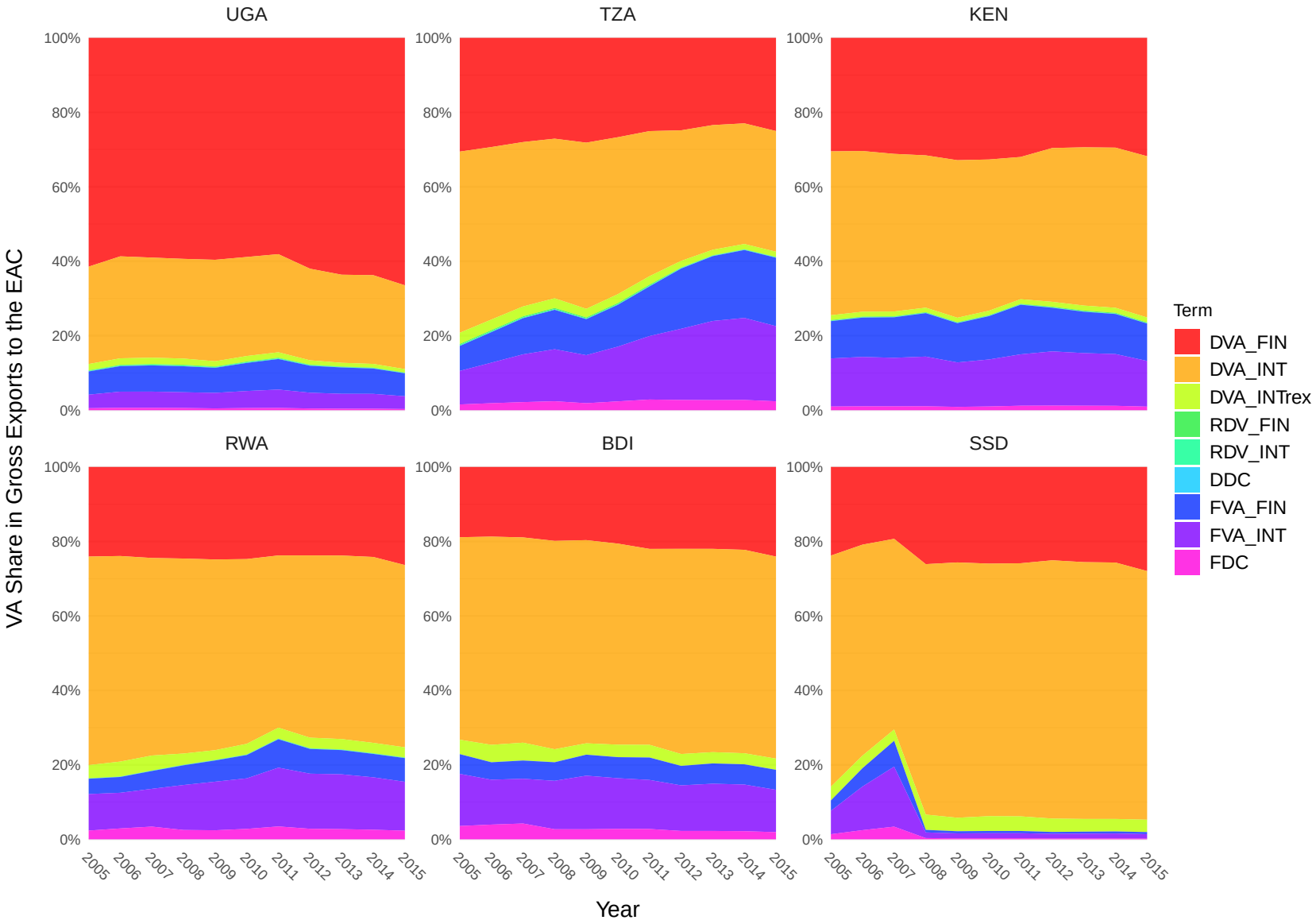
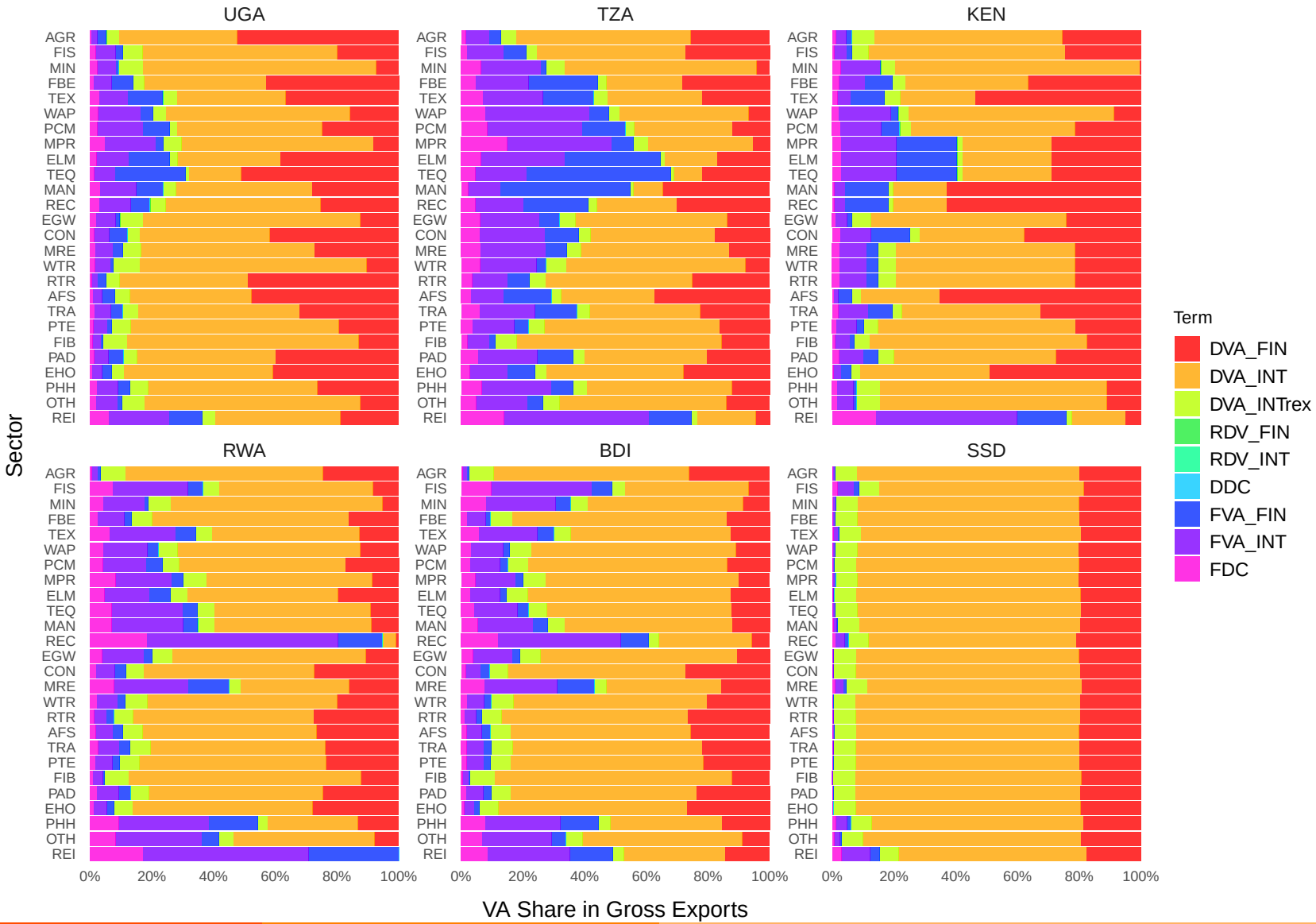


Figure: KWW Dec. of Sector-Level Gross Exports in 2015



New Revealed Comparative Advantage

- Popular measure to empirically measure Ricardo's concept of comparative advantage revealed comparative advantage proposed by Balassa (1965): Share of a sector in gross country exports, divided by the share that of that sector in gross world exports. A ratio above 1 indicates a comparative advantage of the country in this sector.

- Traditional index based on gross flows does not take account of double counting in gross exports, and may thus be noisy and misleading. Koopman et al. (2014) therefore propose a new index based on VA flows, which considers the domestic VA in gross exports (or domestic GDP in exports, the sum of terms 1-5 of the KWW decomposition).

Figure: New Revealed Comparative Advantage in 2015

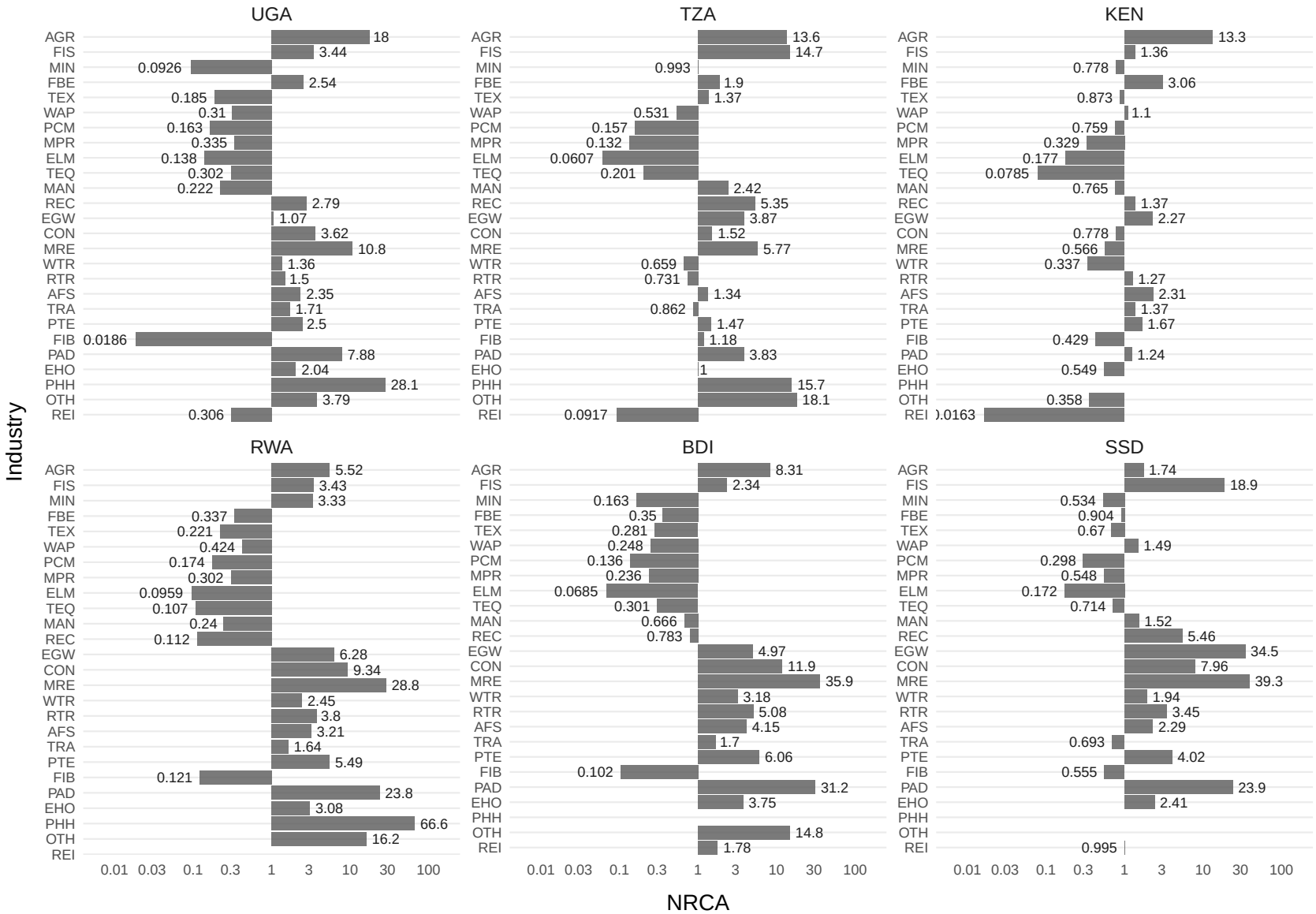


Figure: NRCA Annualized 2005-2015 Growth Rate

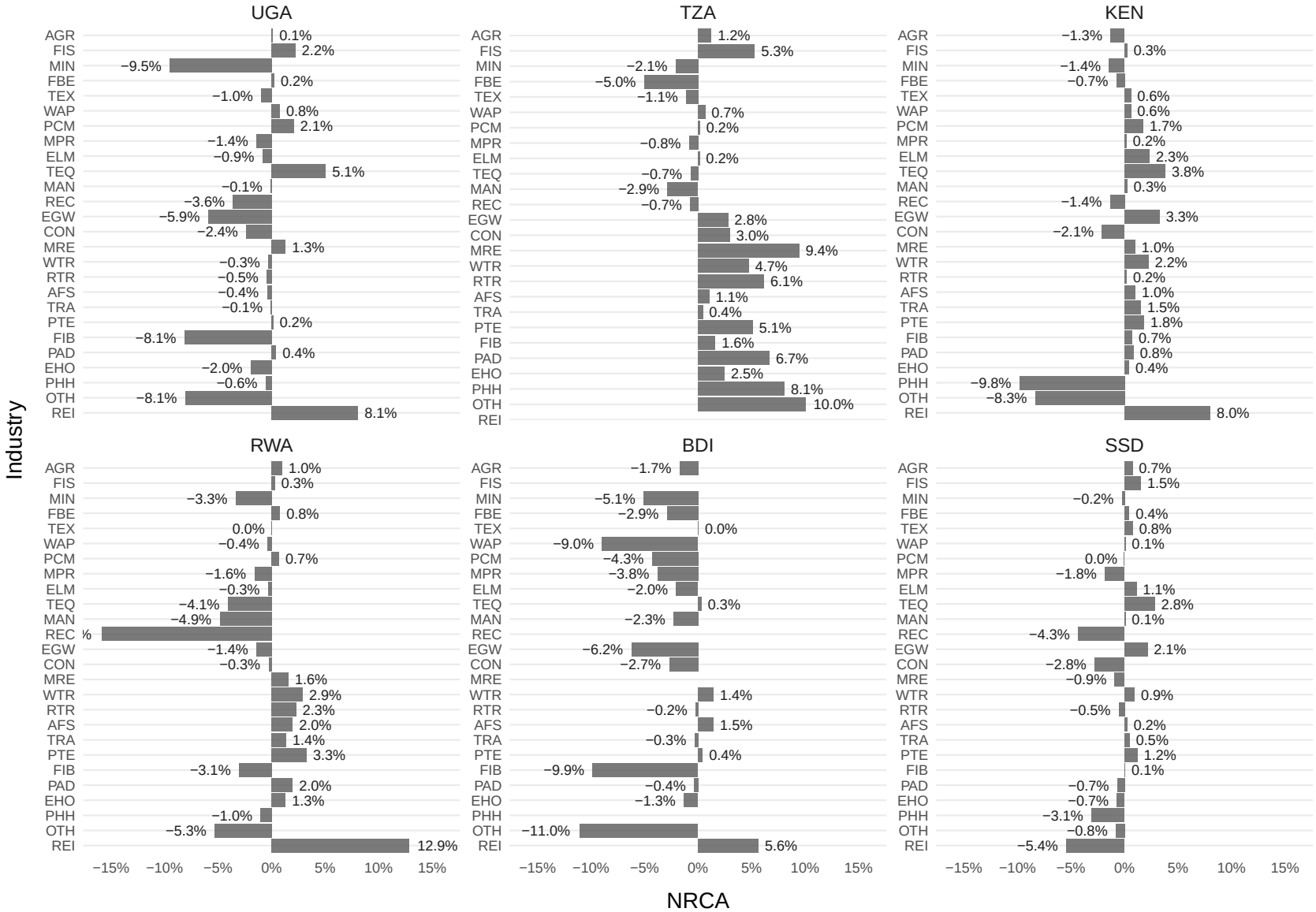


Figure: NRCA Relative to EAC

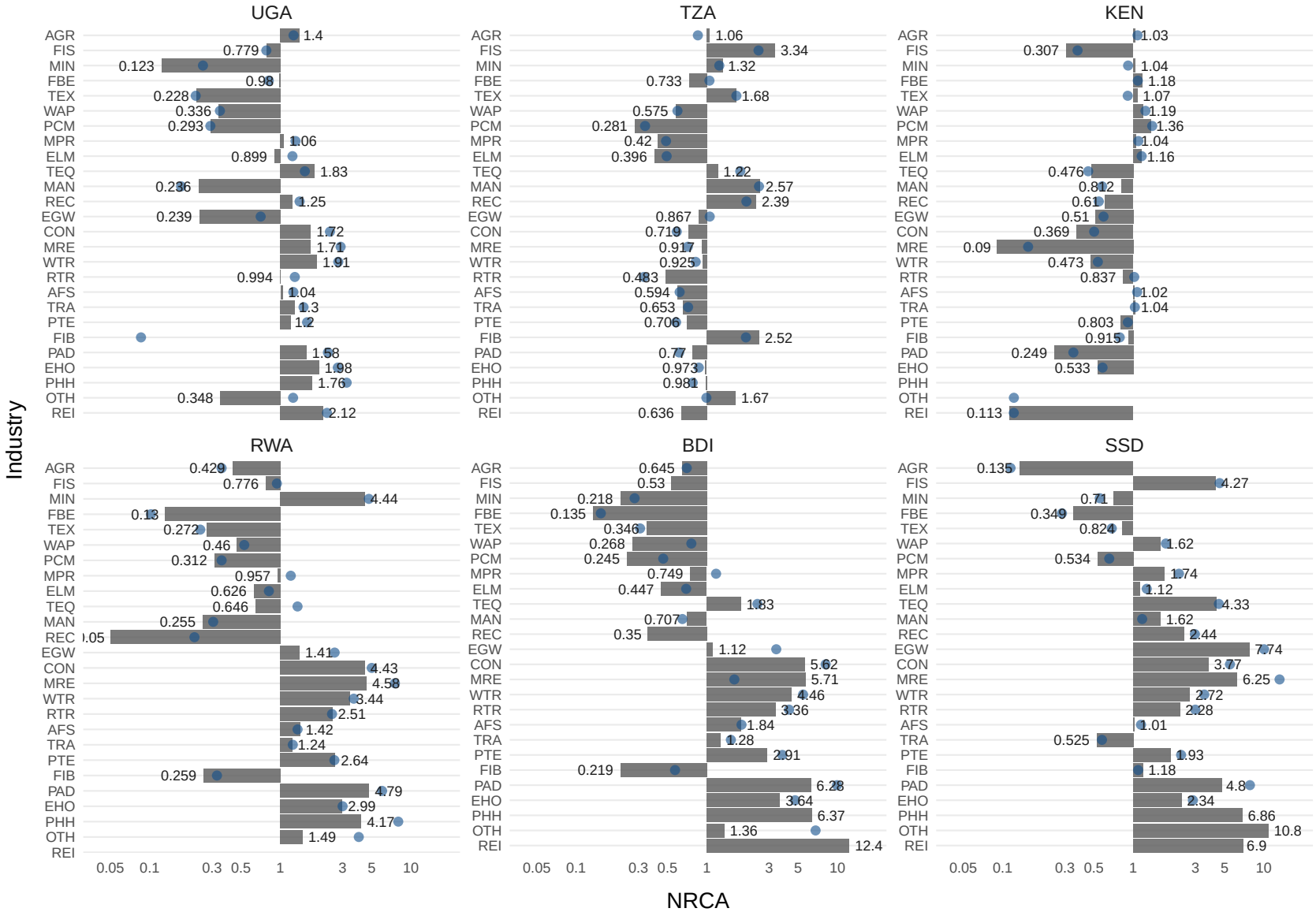
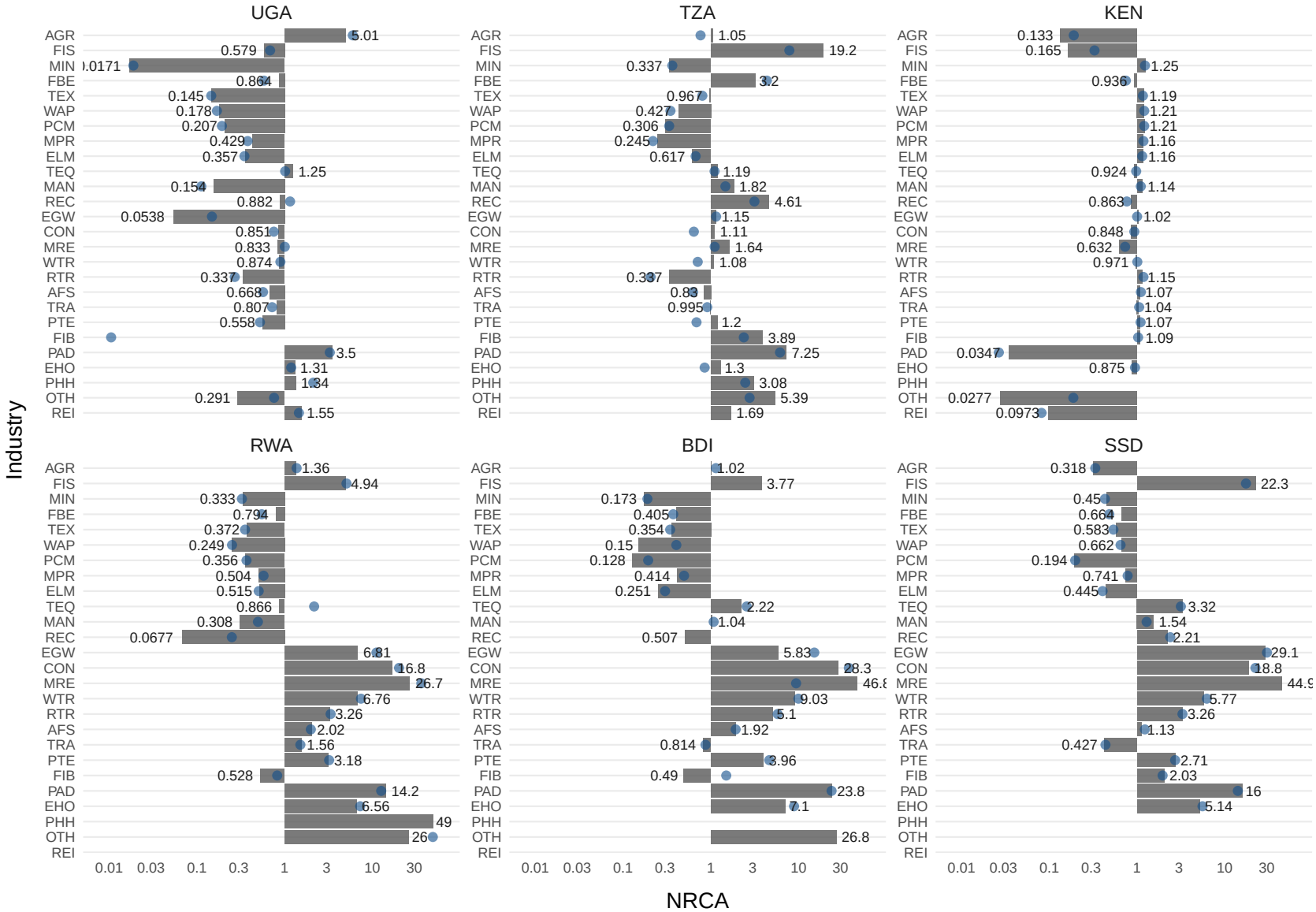


Figure: NRCA for Inner-EAC Trade



GVCs and Industrial Development

Previous empirical work generally establishes a positive relationship:

- Kummritz (2016): OECD ICIO's, 61 countries, 34 industries, 1995-2011. Novel IV for GVC participation: value added trade resistance index. 1%↑ in I2E → 0.11%↑ DVA in avg. industry. 1%↑ in E2R → 0.60%↑ DVA and 0.33%↑ labour productivity.

- Piermartini & Rubínová (2014): industry-level R&D and patent data for 29 countries, 2000-2008: knowledge spillovers increase with GVC intensity + larger vis-a-vis traditional trade.

- Benz et al. (2015): firm-level data: offshoring leads to knowledge spillovers + stronger spillovers in forward linkages.

- Beverelli et al. (2019): 1 SD increase in domestic integration raises GVC integration through backward linkages (I2E) by 0.4% + DVC integration explains up to 30% of overall GVC integration. Why?: overcomes fixed cost of fragmentation.

Dynamic FE specification following follow Kummritz (2015) and Li & Liu (2015), where *lagged* GVC participation affects domestic VA.

$$log(VA_{cst}) = \sum_{i=0}^{2} \beta_{1i} I2E_{cs,t-i} + \sum_{i=0}^{2} \beta_{2i} E2R_{cs,t-i} + \alpha_{cs} + \beta_{ct} + \gamma_{st} + \epsilon_{cst}$$

with country-sector (α_{cs}), country-year (β_{ct}) and sector-year (γ_{st}) fixed effects. Kummritz (2016) estimates similar IV specification (no lags) and finds that OLS gives similar results. I also estimate a FD-specification: more efficient due to strong serial correlation.

$$\Delta log(VA_{cst}) = \sum_{i=0}^{2} \beta_{1i} \Delta I2E_{cs,t-i} + \sum_{i=0}^{2} \beta_{2i} \Delta E2R_{cs,t-i} + \Delta\beta_{ct} + \Delta\gamma_{st} + \Delta\epsilon_{cs}$$

GVC participation (I2E and E2R) is measured in shares, log-shares, and log-levels (different specifications). Classical and robust (MM) estimates. Excl. South Sudan and Sectors REC, REI, FIB, EGW, PHH and OTH. Also estimates for manufacturing (FBE, TEX, WAP, PCM, MPR, ELM, TEQ, MAN). Total: 36 reg., 72 lag coef.

Figure: Time Series of Variables

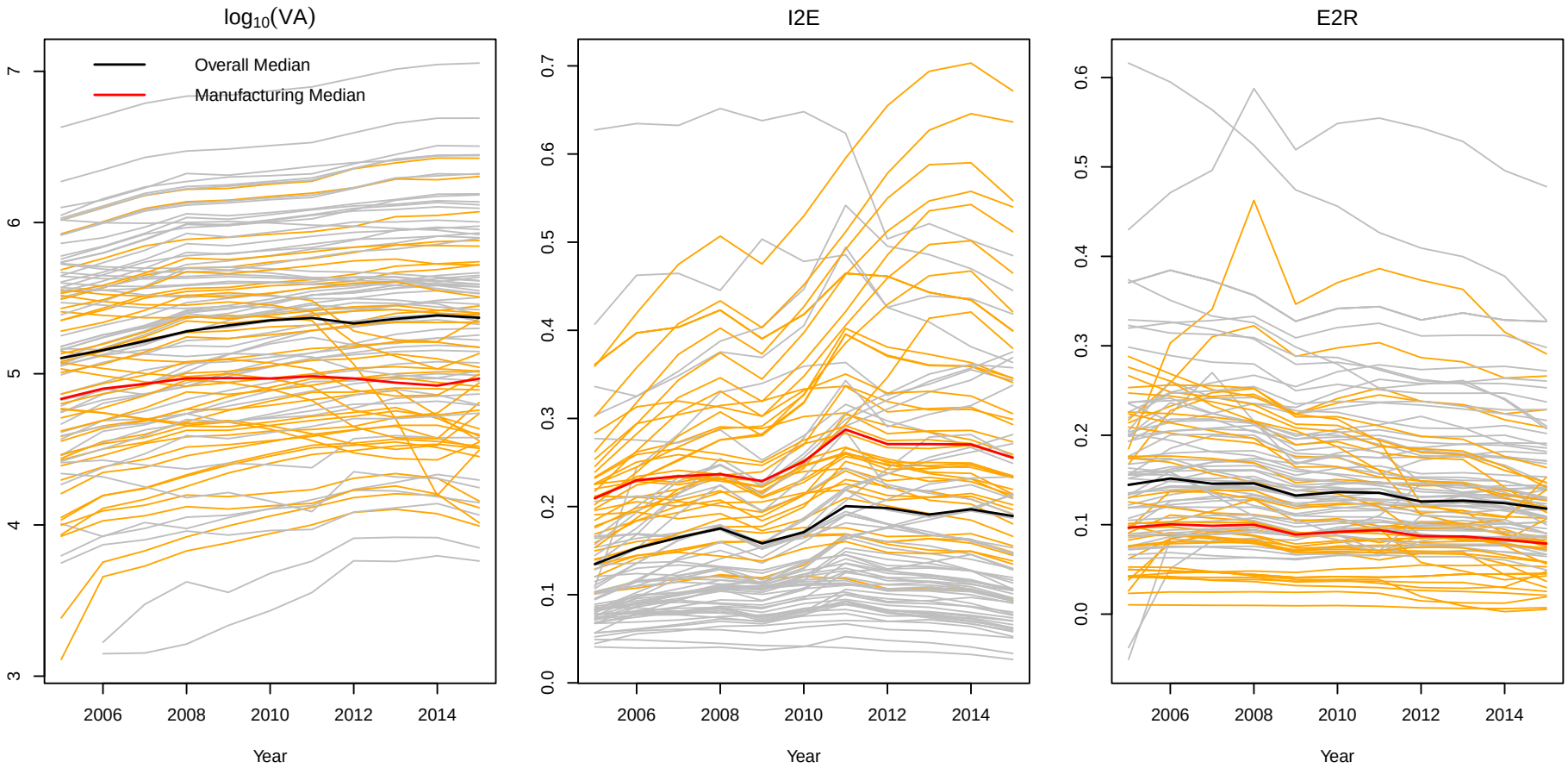
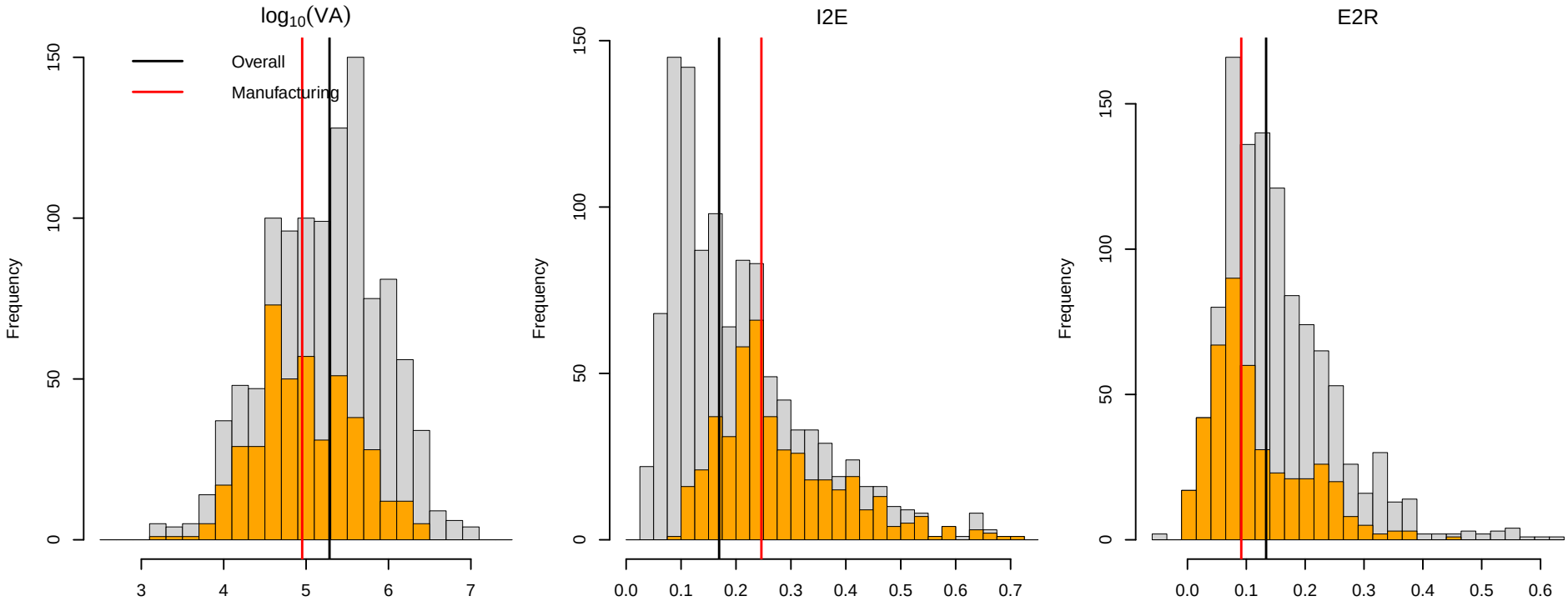


Figure: Histograms of Variables



Summary of Results

- A 0.01 unit increase in I2E / E2R ratios yields a 0.81% / 1.97% increase in overall VA and a 0.58% / 2.47% increase in manufacturing VA after 2 years.
- A 1% increase in I2E / E2R ratios yields a 0.27% / 0.21% increase in overall VA and a 0.28% / 0.31% increase in manufacturing VA after 2 years.
- A 1% increase in the values of I2E / E2R yields a 0.11% / 0.082% increase in overall VA and a 0.15% / 0.07% increase in manufacturing VA after 2 years.

Contextualizing the Results

Kummritz (2016), using OECD ICIO tables, estimates a VA elasticity of 60% w.r.t. E2R with and elasticities between 10% and 30% for I2E. Also labour productivity elasticity of 29% w.r.t. E2R.

Kummritz (2015) finds that low- and middle-income countries generally benefit less from GVC integration, but benefit relatively more from backward linkages (I2E) compared to high-income countries.

These findings appear to be broadly confirmed by the empirical results of this paper.

Conclusion

- Foreign content (I2E) and re-exported content (E2R) of exports remain at 10% - 20% in most EAC countries.
- Trade in intermediates with ROW remains 12-14 times greater in VA terms than EAC trade in intermediates.
- Kenya has become an important supplier of inputs to the EAC (higher E2R in EAC partners).
- Downstream shift across EAC countries and sectors: more VA (both domestic and foreign) is used for the production of final goods, while maintaining high levels of exports in primary agriculture and mining.
- Higher I2E and E2R shares increase VA with an average elasticity of ≥ 0.25 in the course of 2 years. Estimates for manufacturing sectors higher at elasticities ≥ 0.3 w.r.t. E2R.

$\Rightarrow$ Greater GVC integration, especially forward integration (E2R), can boost productivity and growth in the EAC.

References

Balassa, B. (1965). Trade liberalisation and "revealed" comparative advantage 1. *The manchester school*, *33*(2), 99–123.

Benz, S., Larch, M. & Zimmer, M. (2015). Trade in ideas: Outsourcing and knowledge spillovers. *International Economics and Economic Policy*, *12*(2), 221–237.

Beverelli, C., Stolzenburg, V., Koopman, R. B. & Neumueller, S. (2019). Domestic value chains as stepping stones to global value chain integration. *The World Economy*, *42*(5), 1467–1494.

Foster-McGregor, N., Kaulich, F. & Stehrer, R. (2015). Global value chains in africa.

Koopman, R., Wang, Z. & Wei, S.-J. (2014). Tracing value-added and double counting in gross exports. *American Economic Review*, *104*(2), 459–94.

Kowalski, P., Gonzalez, J. L., Ragoussis, A. & Ugarte, C. (2015). Participation of developing countries in global value chains: Implications for trade and trade-related policies.

Kummritz, V. (2015). *Global value chains: benefiting the domestic economy?* (Tech. Rep.). Graduate Institute of International and Development Studies Working Paper.

Kummritz, V. (2016). Do Global Value Chains Cause Industrial Development? *CTEI Working Paper No 2016-01*. Retrieved from http://repec.graduateinstitute.ch/pdfs/cteiwp/CTEI-2016-01.pdf doi: 10.1002/pd

Kummritz, V. & Quast, B. (2016). Global value chains in low and middle income countries. *CTEI Working Papers*(10). Retrieved from https://ideas.repec.org/p/gii/cteiwp/ctei-2016-10.html

Lenzen, M., Kanemoto, K., Moran, D. & Geschke, A. (2012). Mapping the structure of the world economy. *Environmental science & technology*, *46*(15), 8374–8381.

Lenzen, M., Moran, D., Kanemoto, K. & Geschke, A. (2013). Building eora: a global multi-region input–output database at high country and sector resolution. *Economic Systems Research*, *25*(1), 20–49.

Li, B. & Liu, Y. (2015). *Moving up the value chain* (Tech. Rep.). Mimeo, Boston University.

Piermartini, R. & Rubínová, S. (2014). *Knowledge spillovers through international supply chains* (Tech. Rep.). The Graduate Institute of International and Development Studies.

Wang, Z., Wei, S.-J. & Zhu, K. (2013). *Quantifying international production sharing at the bilateral and sector levels* (Vol. No. w19677; Tech. Rep.). National Bureau of Economic Research.