



EU EXPORTS TO THE WORLD: OVERVIEW OF EFFECTS ON EMPLOYMENT AND INCOME¹

Issue 1

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KEY FINDINGS

- As trade agreements create the conditions for an increase in EU exports they also foster more and better job opportunities for European citizens. From 1995 to 2011 the number of jobs in the EU that were supported by exports of goods and services to the rest of the world increased by 67% to reach around 31 million. These represented 1 in 7 jobs across the 27 EU Member States (up from 1 in 11 jobs in 1995). They tended to be high-skilled and were on average better paid.
- In order to remain competitive EU exporters increasingly rely also on foreign inputs. This means that the employment they support progressively spans beyond the EU's borders. In 2011 about 19 million jobs outside the EU depended on EU exports. This means that in 2011 a total of 50 million people around the world had jobs thanks to the EU exporting industries.
- Exports are important for employment in all Member States. In 2011 only in Greece (7%), Portugal (8%) and Spain (9%) did the EU exports to the rest of the world support less than 10% of total employment. In Luxembourg they supported a third of all jobs; in Ireland 25%.
- Increasingly the jobs supported by EU exports are related to services. Services exports are growing fast but that is not the whole story. The importance of services sectors as suppliers of inputs to the production of the goods for export (“mode 5 services” exports) also stands out from the data. In 2011, 40% of the employment supported by the exports of the primary and manufacturing sectors was in fact in services.
- The sales of goods and services to the US market were responsible for 15% of the EU employment supported by EU exports; other key markets to sustaining export-related jobs in the EU were China (10%), Russia (6%) and Turkey (4%).

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¹ The views expressed herein are those of the authors and do not necessarily reflect an official position of the European Commission.



1. INTRODUCTION

Faced with high levels of unemployment, policymakers across Europe are under pressure to better identify the drivers of new job opportunities. Trade is naturally called to the forefront of this reflection. The ever more complex production and investment networks that underpin commercial relations these days however make the relationship between openness and labour markets increasingly difficult to map out.

To accurately quantify the number of jobs (and associated income) that are supported by the exports from a given country requires going beyond identifying the employment in the exporting firms to also take into account jobs in the multiple upstream activities, which in turn also increasingly span across borders. Likewise from a bilateral trade perspective, in order to fully establish the contribution of a partner to sustain export-related employment and income one must take into account not only the size and dynamism of its demand but also its role in supplying inputs. Using the information contained in the latest release of the World Input-Output Database², the European Commission's Joint Research Centre (DG JRC) and DG TRADE have recently published a comprehensive set of indicators that shed light on these issues³. This extensive new body of evidence puts forward a good case for the importance of exporting to create good employment opportunities for EU citizens. This note aims to present some of the main findings in this regard.

2. DATA AND METHODOLOGICAL APPROACH

The key objective of this analysis is the identification of the employment supported by EU exports (and by the exports from each individual Member State) to the rest of the world⁴. The methodological approach is presented in detail in Arto et al. (2015) and follows closely that used in Sousa et al. (2012) and in Rueda-Cantuche et al. (2013). It draws on a decomposition of trade flows into the factors of production (and their returns)

² For more information on the WIOD database see: www.wiod.org.

³ The full report "EU Exports to the World: Effects on Employment and Income" and related information can be found at: <http://ec.europa.eu/trade/policy/in-focus/trade-and-jobs/>.

⁴ Given that this is an ex-post analysis built on the decomposition of trade flows based on a national accounting framework it does not offer suitable grounds for drawing robust insights into the wider implications of trade on labour markets, notably with respect to job creation and/or destruction. With these data and using this methodology it is possible to quantify how many jobs were supported by the exports of a certain country in a certain year but it is not possible to identify net job creation effects as there is no means to account for the underlying recomposition effects of production that are triggered by trade openness. Likewise, with this methodology it is not possible to shed light on the implications of imports for employment as there is no way of knowing to what extent imports displaced domestic production or complemented it.



they embody, accounting for all the contributions from the upstream sectors of the economy (see Box 1 and Annex 1)^{5,6}.

Underpinning this analysis are some key concepts closely related to the literature on global value chains and the international fragmentation of production, which call for some clarifications. Firstly, when we quantify the employment supported by EU exports to the rest of the world in a given EU Member State we take into account that production is often organised along intra-EU value chains. We therefore compute for each Member State: (i) a “domestic effect” that captures the local employment that is supported by its direct exports of goods and services to the rest of the world, and ii) a “spillover effect” or “indirect effect” that captures the local employment that is engaged in the production of intermediate inputs to be used in other Member States’ exports to the rest of the world. Secondly, this analysis also accounts for the fact that EU production chains often extend well beyond EU borders. We use a concept of “foreign employment” to capture the jobs in upstream activities located outside the EU which feed inputs into the production of extra-EU exports.

This analysis benefits from the latest update of the WIOD database (2014) and covers the period between 1995 and 2011 (although due to data constraints some indicators are only available up to 2009). This allows the gauging for the first time of the evolution of the employment supported by EU exports past the outbreak of the global financial crisis⁷. Another important contribution of the current analysis is that it offers more specific insights into some key EU bilateral trade relationships in terms of the jobs they support.

⁵ Although this note focuses exclusively on employment the analysis was also done for value added (measured as the income earned by individuals and firms from the production of goods and services). Value added (income)-based indicators are shown in Arto et al. (2015).

⁶ This analytical approach is thus based on the concept of “employment in trade” as it is grounded on the full decomposition of trade flows in terms of value added as well as on the factors of production they embody. This is akin to the “value added in trade” methodological approach that can be found in the literature on global value chains.

⁷ The pronounced variations in global trade flows observed between 2008 and 2010 (notably the sharp slump in 2008 and 2009 followed by the strong rebound in 2010) must be borne in mind when analysing the yearly evolution of these indicators in order to focus on the more structural insights from the exports and jobs relationship.

**Box 1. Short overview of the methodology**

We use a Multi-Regional Input-Output (MRIO) model to compute the EU and foreign employment supported by EU exports to the rest of the world. This type of model has been widely used to analyse different aspects of the economic and environmental impacts of trade (see Miller and Blair (2009) and Murray and Lenzen (2013)). Full details on the methodology are provided in Annex 1 as well as in Arto et al. (2015).

On the basis of Arto et al. (2015) we offer an extensive set of indicators to shed light on the complex relationship between exports, employment, and income across the EU. These indicators are characterised by two main novel features:

1) They are fully grounded in the new European Commission-funded World Input-Output Database (WIOD), which provides for the first time a set of harmonised and consistent worldwide Supply-Use and Input-Output (IO) tables benchmarked to National Accounts, featuring 35 industries and covering the period 1995-2011. The WIOD also includes data on international trade as well as satellite accounts with environmental and socio-economic data. The latter allow computing indicators that provide further insights into the characteristics of the jobs supported by exports⁸.

2) They account for intra-EU feedback effects to accurately capture the increasing complexity of production sharing across the Internal Market. For example, when quantifying the employment supported in Germany by the exports of cars to Japan the adopted methodology picks up not only the jobs that are directly supported in Germany (including those in upstream industries) but also the jobs supported by the production of inputs (say steel) in Germany that will be used by downstream intermediary producers in other Member States (say a Czech producer of car parts), which will ultimately supply the car exporters in Germany. All these jobs are included in the indicators that quantify the “domestic employment” in Germany that is supported by the EU exports to the rest of the world. This is not the case for indicators based on the OECD/WTO TiVA database.

⁸ The WIOD dataset was not available when the analyses published in the previous Chief Economist Note (Sousa et al., 2012) and in Rueda-Cantuche et al. (2013) were conducted.



3. THE EVOLUTION OF EU EMPLOYMENT SUPPORTED BY EXPORTS TO THE REST OF THE WORLD

3.1. Exports are increasingly important for employment in Europe

One in seven jobs in the EU was supported either directly or indirectly by exports to the rest of the world.

The EU employment supported by EU exports to the rest of the world reached 31.2 million jobs in 2011, having increased by 67% since 1995⁹. These jobs are not limited to the firms that are engaged directly in selling goods and services beyond the EU. They are also to be found in their many suppliers of inputs. In total, in 2011 on average each billion euros of extra-EU exports supported around 14,000 jobs across the 27 Member States. Moreover, as shown in Figure 1, the contribution of exports to employment opportunities in the EU has been increasing over time. The exports of goods and services to the rest of the world supported 14% of total employment in the EU in 2011 (up from 9% in 1995).

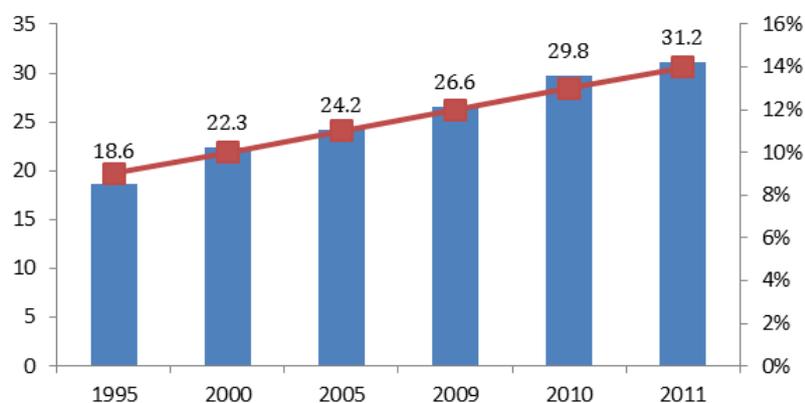


Figure 1: EU employment supported by extra-EU exports: number of jobs in millions (left axis) and in % of total employment (right axis)

Source: Based on Arto et al. (2015)

⁹ Employment is measured as number of people engaged in production activities, including employees and self-employed, see Arto et al. (2015).



The exports of the manufacturing sector continue to be the ultimate driver of export-supported employment...

In 2011, the extra-EU sales of the manufacturing sectors were responsible for around 60% of the export-supported jobs across the EU (down from 70% in 1995). In 2011, out of the 14,000 jobs supported by each 1 billion euros of EU exports around 8,500 were associated to the exports of the manufacturing sectors.

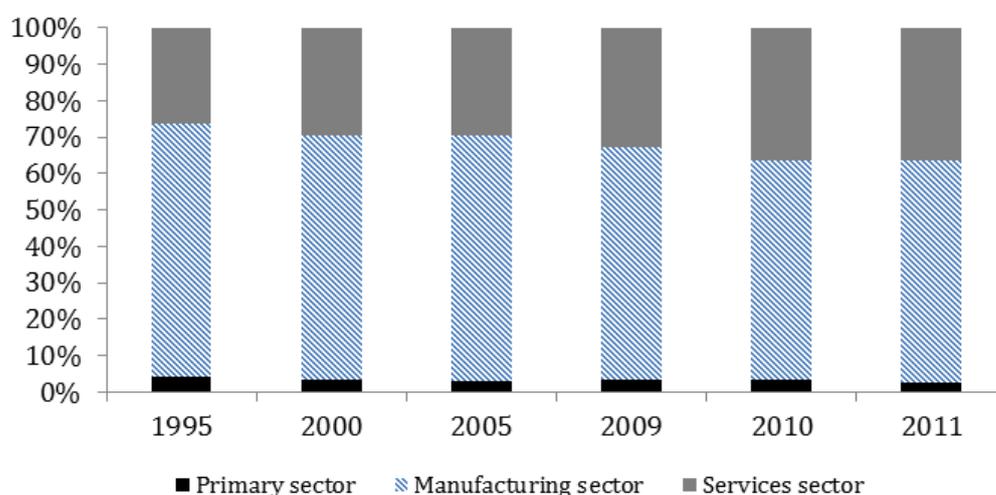


Figure 2: EU employment supported by extra-EU exports by broad exporting sector (%)

Source: Based on Arto et al. (2015)

However, the contribution of the exports of the services sectors has been increasing considerably, reaching 36% in 2011 (up from 26% in 1995). In absolute terms, the number of jobs supported by services sectors exports to the rest of the world more than doubled since 1995 across the EU to reach 11 million in 2011.

At a more detailed and industry-specific level, Table 1 shows that in 2011 the extra-EU exports of two industries were responsible for more than 63% of total exports-supported employment in the EU: “transport, trade and business services” (S1) and “machinery, transport equipment” (M7). Also worth noting was the contribution of the exports of manufacturing industries like “other non-metallic and basic metals” (M6) and “chemicals” (M5) with 9.3% and 6.7% respectively.



Table 1: EU employment supported by extra-EU exports: industry interlinkages, 1995 and 2011 (in thousand jobs)

		Exports by (1995)										
		P	M1	M2	M3	M4	M5	M6	M7	S1	S2	Total
Employment in	P	597	472	50	74	23	48	69	107	104	13	1,558
	M1	9	407	9	3	1	12	5	17	18	4	486
	M2	2	6	748	3	1	11	11	40	19	2	843
	M3	6	24	13	396	3	35	32	140	61	8	717
	M4	6	12	9	7	45	28	31	51	33	3	224
	M5	5	9	15	8	3	502	29	55	12	2	639
	M6	17	33	23	15	7	65	1,072	672	67	15	1,986
	M7	14	21	18	14	6	37	76	3,182	92	10	3,469
	S1	126	333	255	168	60	494	461	1,737	3,656	81	7,371
	S2	33	56	41	37	14	94	90	303	263	397	1,327
	Total	815	1,372	1,181	724	162	1,326	1,877	6,302	4,325	535	18,620

		Exports by (2011)										
		P	M1	M2	M3	M4	M5	M6	M7	S1	S2	Total
Employment in	P	660	416	35	89	26	40	58	103	117	34	1,578
	M1	11	539	8	3	2	16	7	22	28	17	652
	M2	1	3	847	3	1	7	10	37	14	2	925
	M3	4	23	11	473	4	36	35	132	89	14	820
	M4	5	12	8	8	89	31	33	65	49	7	307
	M5	3	7	9	6	6	604	28	47	15	3	727
	M6	12	38	23	19	15	80	1,566	973	101	32	2,859
	M7	8	21	16	16	11	46	98	4,328	108	14	4,666
	S1	137	556	335	307	207	1,050	894	3,368	8,693	236	15,783
	S2	28	87	53	68	40	178	158	530	640	1,062	2,845
	Total	870	1,702	1,344	993	401	2,088	2,885	9,605	9,854	1,421	31,163

Note: P: primary; M1: food, beverages, tobacco; M2: textile; M3: wood, paper, printing; M4: energy; M5: chemical; M6: other non-metallic and basic metals; M7: machinery and transport equipment; S1: transport, trade and business services; S2: other services.

Source: Based on Arto et al. (2015)

When moving to a perspective based on the importance of exports to employment in each industry, and taking the sectoral interlinkages that underpin the production of the exported goods and services into account, one can see wide cross-industry variation. In 2011, exports were clearly more important to support jobs in the “textile” (M2), “chemicals” (M5), “other non-metallic and basic metals” (M6) and “machinery and transport equipment” (M7) industries than in the primary (P), “food, beverages and tobacco” (M1) and “energy” (M4) industries, see Figure 3.

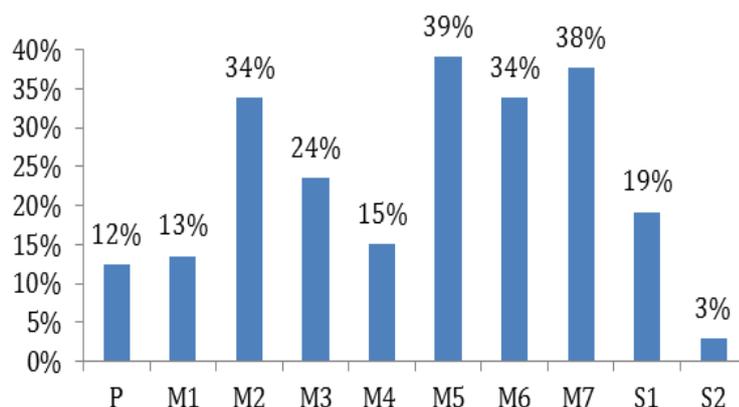


Figure 3: Share of employment supported by extra-EU exports in 2011 by industry (%)

Note: P: primary; M1: food, beverages, tobacco; M2: textile; M3: wood, paper, printing; M4: energy; M5: chemical; M6: other non-metallic and basic metals; M7: machinery and transport equipment; S1: transport, trade and business services; S2: other services.

Source: Based on Arto et al. (2015)

...but more and more of the export-dependent jobs in the EU are in services.

When industry interlinkages are accounted for the importance of the services industries as direct exporters as well as providers of (employment-intensive) inputs also comes to light. In particular the supporting role of the “transport, trade and business services” (S1) industry stands out: in 2011 it featured almost 16 million jobs dependent on exports. This means that this industry alone hosted half of the employment supported by EU exports to the rest of the world in 2011 (up from 40% in 1995).

This calls attention to the growing importance of “mode 5 services” exports¹⁰ (i.e. services inputs embodied in exports of the primary and manufacturing sectors)¹¹. In 2011 they made up 40% of the total employment supported by the exports of the primary and manufacturing sectors from the EU to the rest of the world (up from 31% in 1995), which amounted to 8 million jobs.

¹⁰ For more on the concept of “mode 5 services” exports, see L. Cernat and Z. Kutlina-Dimitrova (2014).

¹¹ See also L. Cernat and N. Sousa (2016).



This “servicification” of exports-supported employment in manufacturing ranged from 29% in textiles to around 60% in the energy and chemical industries. Only in the exports from primary industries did “mode 5 services” jobs represent less than 20% of the associated employment.

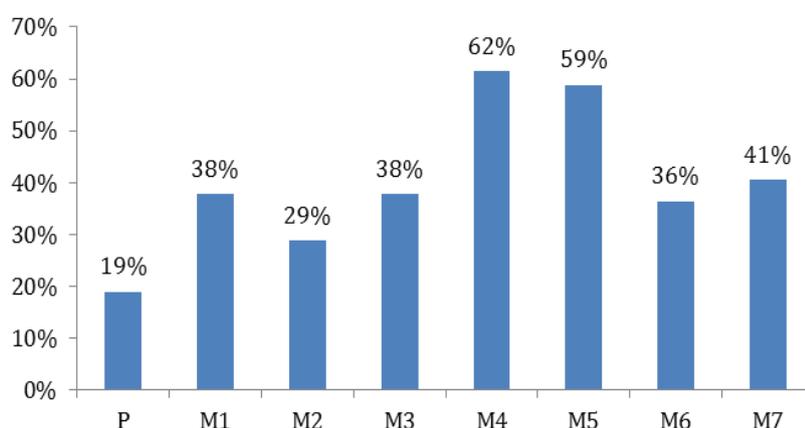


Figure 4: “Mode 5” services as a share of total employment supported by extra-EU exports in 2011, per exporting industry (%)

Note: P: primary; M1: food, beverages, tobacco; M2: textile; M3: wood, paper, printing; M4: energy; M5: chemical; M6: other non-metallic and basic metals; M7: machinery and transport equipment; S1: transport, trade and business services; S2: other services.

Source: Based on Arto et al. (2015)

Interestingly, the contribution of “mode 5 services” exports to employment also varies considerably across Member States, being particularly high in the Netherlands, Belgium, Luxembourg, France, Spain, Germany, Sweden, the United Kingdom, Slovakia and Denmark.

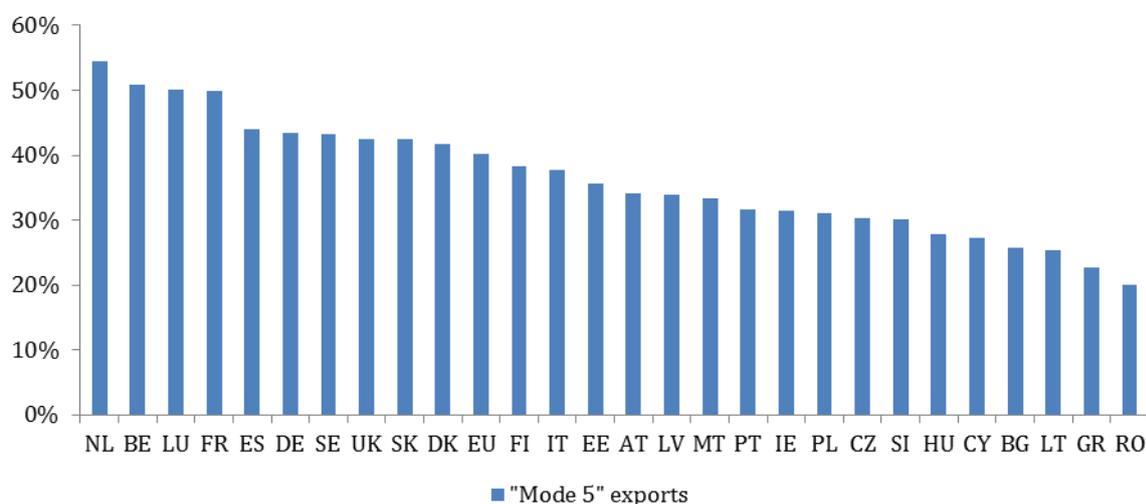


Figure 5: “Mode 5” services exports supported by primary and manufacturing extra-EU exports as a share of total employment per Member State in 2011 (%)

Source: Based on Arto et al. (2015)

The jobs supported by exports tend to be qualified and better paid than the average.

The skill composition of the employment supported by extra-EU exports is also changing, mirroring closely the structural shift of EU employment towards higher-skilled jobs. In 2009, each million EUR worth of extra-EU exports supported 2.8 high-skilled jobs, 6.1 medium-skilled jobs, and 3 low-skilled jobs¹². While the relative importance of medium-skilled jobs has been fairly constant since 1995 the share of high-skilled jobs has increased 10 percentage points to 24%. In the same period the share of low-skilled jobs fell from 38% in 1995 to 25% in 2009¹³.

The decomposition of the EU value added embodied in the exports to the rest of the world also reflects the increasing importance of labour skills: the compensation of medium- and high-skilled labour accounted for 55% of total in 2009 (up from 47% in 1995). The share of compensation to low-skilled labour was 12% in 2009 (down from 19% in 1995) while the share of returns on capital stayed constant (at around 32%).

It is worth noting that on average the EU jobs that are supported by exports to the rest of the world are better paid than the jobs in the rest of the economy. The data for 2009 showed that this compensation premium benefits workers across the full spectrum of

¹² Note that WIOD data on factor compensation is only available for period 1995-2009.

¹³ See Table 4 below.



skills: 5% for low-skilled jobs, 9% for medium-skilled jobs and 16% for high-skilled jobs. This suggests a productivity edge in export activities over the activities focused on the supply of the domestic market.

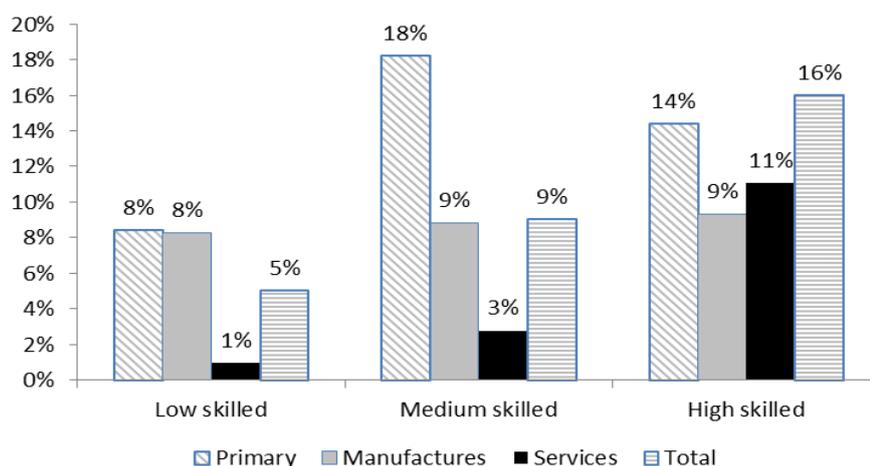


Figure 6: Export labour compensation premium in the EU in 2009, by skill level (%)¹⁴

Source: Based on Arto et al. (2015)

We also find that the compensation premium for export-supported jobs is apparent across all sectors. Interestingly, it is highest in the primary sector for all skill levels, reaching 18% in the case of medium-skilled workers. It is around 9% for all skill levels in the manufacturing sector. In services it is clearly higher for the skilled workers, who benefit from a compensation premium of 11% compared to those whose jobs are not dependent on exports.

3.2. The number of jobs supported by exports has increased in all Member States

The ever more integrated Single Market continues to go hand in hand with openness to the rest of the world.

The analysis at the level of Member States follows two complementary perspectives in order to fully capture the role of intra-EU value chains, which underpin the competitiveness of EU exporters.

¹⁴ The labour compensation premium is computed as the ratio of export-supported labour compensation per worker with respect to the same but for the whole economy. This was computed by skill levels and sectors.



We first delve into how much employment the extra-EU exports from each Member State support across *the whole EU* (see Table 2): part of this employment will be located in other Member States from where inputs are sourced. This approach ultimately allows us to show for example that in 2011 the exports from Germany to the rest of the world supported the largest number of jobs across the EU (including Germany): 7.5 million (or 24% of the total). The other large contributors to export-supported EU employment were the United Kingdom (whose exports supported a total of 3.6 million jobs across the EU), Italy (3.1 million) and France (2.7 million). Over the 1995-2011 period the strongest increases in the contribution to EU export-supported employment were in Luxembourg (750%), Ireland (265%), Malta (148%), Greece (142%), Austria (131%) and Spain (121%).

Table 2: EU employment supported by the extra-EU exports of each Member State, 1995-2011 (in thousand jobs)

	1995	2000	2005	2009	2010	2011	2011 - 1995	2011 / 1995
AT	359	473	600	644	763	832	473	131%
BE	417	579	595	668	807	812	396	95%
BG	541	561	451	582	617	586	45	8%
CY	34	40	50	43	49	46	12	35%
CZ	469	472	531	581	712	763	294	63%
DE	3,477	4,755	5,741	6,400	6,999	7,478	4,001	115%
DK	389	488	498	583	577	578	189	49%
EE	71	41	72	79	82	83	13	18%
EL	151	266	272	361	376	366	215	142%
ES	683	1,024	1,171	1,239	1,411	1,508	825	121%
FI	304	338	365	413	456	455	151	50%
FR	2,079	2,391	2,324	2,445	2,717	2,736	656	32%
HU	457	556	605	600	767	793	336	74%
IE	200	422	517	583	725	732	531	265%
IT	2,141	2,364	2,501	2,619	2,881	3,099	958	45%
LT	222	183	206	247	245	245	23	11%
LU	44	75	232	322	355	373	329	753%
LV	151	138	150	162	152	132	-19	-13%
MT	16	29	26	32	39	40	24	148%
NL	954	1,136	1,022	1,110	1,264	1,306	352	37%
PL	767	659	1,054	1,263	1,488	1,622	855	112%
PT	220	317	314	335	382	369	149	68%
RO	794	926	844	900	1,173	1,279	485	61%
SE	673	824	867	941	941	969	296	44%
SI	120	113	148	147	142	138	18	15%
SK	137	156	210	230	228	239	102	74%
UK	2,749	3,019	2,785	3,030	3,412	3,583	834	30%
EU-27	18,620	22,345	24,151	26,560	29,760	31,163	12,542	67%

Source: Based on Arto et al. (2015)

We then focus on the *location* (per Member State) of the employment that is supported by aggregate EU exports to the rest of world. This allows the mapping out of the intra-EU value chains from an input supply perspective. The data for 2011 showed that Germany



hosted the highest number of jobs supported by EU exports (7.1 million), followed by the United Kingdom (3.9 million), Italy (3.1 million), and France (2.6 million). Since 1995 the growth of export-supported employment has been particularly noteworthy in some Member States. In Germany it more than doubled by 2011 (adding almost 4 million jobs) but other Member States showed even more impressive increases in relative terms, namely Luxembourg (296%), Ireland (187%), Malta (147%), Greece (126%), Spain (126%) and Austria (121%).

Table 3: Employment per Member State supported by EU exports to the rest of the world, 1995-2011 (in thousand jobs)

	1995	2000	2005	2009	2010	2011	2011 - 1995	2011 / 1995
AT	345	456	551	602	714	761	416	121%
BE	404	547	566	638	766	767	363	90%
BG	564	589	500	648	674	643	79	14%
CY	32	37	50	41	45	44	12	39%
CZ	578	607	667	693	824	886	307	53%
DE	3,325	4,531	5,417	6,136	6,714	7,060	3,735	112%
DK	318	375	380	442	441	445	127	40%
EE	97	74	91	99	98	102	5	5%
EL	154	250	254	335	352	347	193	126%
ES	707	1,081	1,258	1,306	1,495	1,597	890	126%
FI	279	324	340	386	434	427	149	53%
FR	2,003	2,304	2,251	2,283	2,539	2,583	579	29%
HU	495	604	656	667	821	852	357	72%
IE	172	302	339	382	498	494	322	187%
IT	2,070	2,327	2,498	2,637	2,900	3,134	1,064	51%
LT	241	195	217	259	254	254	13	5%
LU	29	39	77	100	112	115	86	296%
LV	165	150	161	171	162	140	-25	-15%
MT	15	23	24	31	36	37	22	147%
NL	904	1,138	1,078	1,155	1,319	1,375	471	52%
PL	956	918	1,337	1,601	1,826	1,970	1,014	106%
PT	242	348	347	372	421	413	170	70%
RO	866	1,033	952	1,024	1,288	1,415	549	63%
SE	582	715	758	834	852	872	290	50%
SI	124	120	150	154	155	151	28	22%
SK	185	210	265	287	291	309	125	68%
UK	2,768	3,047	2,970	3,279	3,728	3,970	1,202	43%
EU-27	18,620	22,345	24,151	26,560	29,760	31,163	12,542	67%

Source: Based on Arto et al. (2015)



This analysis also allows for a better insight into the importance of extra-EU exports in the economy of each Member State, notably in terms of employment opportunities. Only in Greece (7%), Portugal (8%) and Spain (9%) did EU exports to the rest of the world support less than 10% of total employment. In contrast, the EU sales of goods and services to the rest of the world supported one in every three jobs in Luxembourg, one in every four jobs in Ireland, and one fifth of all jobs in Malta and in Hungary.

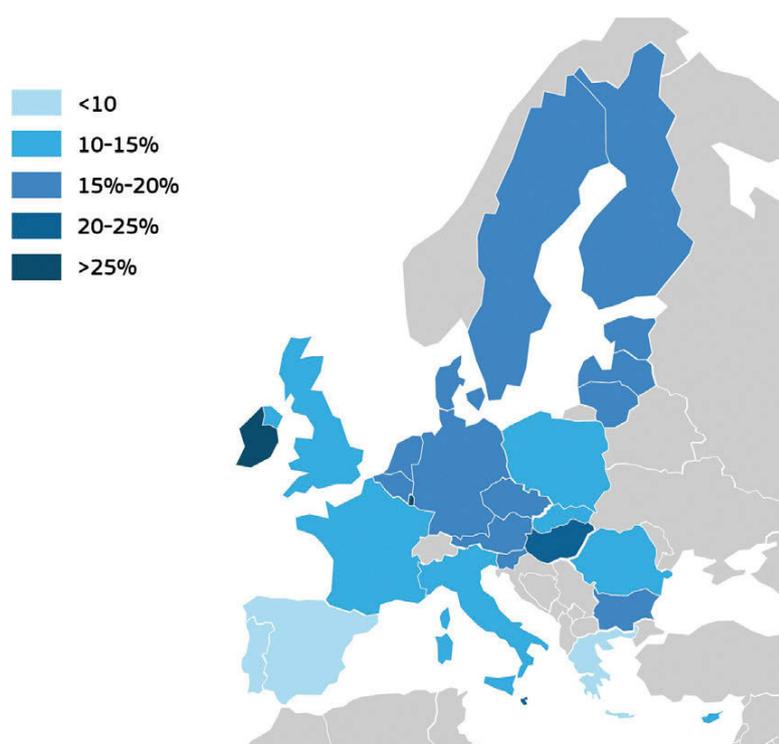


Figure 7: Share of employment supported by EU exports to the rest of the world by Member State, 2011 (%)

Source: Based on Arto et al. (2015)



Table 4: Employment supported by EU exports to the rest of the world per Member State, by skill category, 1995 and 2009 (% and thousand jobs)

	1995				2009			
	Low	Medium	High	Total	Low	Medium	High	Total
AT	23%	68%	9%	345	16%	67%	17%	602
BE	41%	46%	13%	404	21%	57%	22%	638
BG	85%	12%	4%	564	75%	18%	8%	648
CY	32%	39%	30%	32	25%	46%	29%	41
CZ	9%	81%	10%	578	6%	81%	13%	693
DE	18%	63%	19%	3,325	15%	60%	25%	6,136
DK	28%	56%	16%	318	30%	45%	25%	442
EE	12%	62%	26%	97	10%	59%	31%	99
EL	53%	34%	13%	154	36%	44%	20%	335
ES	67%	16%	17%	707	43%	24%	33%	1,306
FI	30%	44%	26%	279	17%	48%	35%	386
FR	37%	43%	19%	2,003	23%	44%	33%	2,283
HU	20%	69%	11%	495	12%	70%	18%	667
IE	38%	43%	19%	172	19%	38%	42%	382
IT	59%	35%	6%	2,070	40%	47%	13%	2,637
LT	11%	67%	22%	241	6%	64%	29%	259
LU	41%	37%	22%	29	20%	42%	38%	100
LV	15%	65%	20%	165	11%	65%	25%	171
MT	79%	15%	6%	15	63%	23%	13%	31
NL	36%	46%	18%	904	28%	41%	31%	1,155
PL	16%	76%	7%	956	9%	74%	17%	1,601
PT	80%	14%	6%	242	70%	19%	10%	372
RO	84%	12%	4%	866	74%	18%	8%	1,024
SE	29%	59%	12%	582	19%	56%	25%	834
SI	24%	65%	11%	124	16%	65%	19%	154
SK	10%	81%	9%	185	4%	83%	14%	287
UK	37%	44%	19%	2,768	22%	47%	32%	3,279
EU-27	38%	48%	14%	18,620	25%	51%	24%	26,560

Source: Based on Arto et al. (2015)

3.3. The exports of each Member State build on the competitiveness of the others

The deep economic integration that characterises the Single Market underpins the EU export competitiveness.

The growing importance of intra-EU production chains for the competitiveness of exporters based in the EU is apparent when mapping out the employment supported by extra-EU exports. This shows that many of those jobs were in Member States other than the one from where the goods and services were ultimately exported to outside the EU. This draws attention to how intricate the relationship between the Member States' labour markets and exporting activities across the EU has become.



3.3.1. Domestic vs spillover effects

Following Arto et al. (2015), for a given Member State we define “domestic” employment effects as the jobs supported by its own direct exports to the rest of the world and “spillover” employment effects as the jobs that are ultimately driven by the extra-EU exports of the other Member States. The latter captures the number of jobs associated to intra-EU exchanges of inputs that are eventually used in the production of EU exports. These two concepts help us to gauge the employment implications of the intra-EU production networks that underpin extra-EU exports.

Table 5: Member States’ employment supported by EU exports to the rest of the world by effect, 1995 and 2011 (% and thousand jobs)

	1995			2011		
	Direct	Spillover	Total	Direct	Spillover	Total
AT	81%	19%	345	82%	18%	761
BE	67%	33%	404	74%	26%	767
BG	94%	6%	564	87%	13%	643
CY	97%	3%	32	93%	7%	44
CZ	75%	25%	578	70%	30%	886
DE	86%	14%	3,325	86%	14%	7,060
DK	89%	11%	318	88%	12%	445
EE	68%	32%	97	74%	26%	102
EL	92%	8%	154	95%	5%	347
ES	85%	15%	707	81%	19%	1,597
FI	86%	14%	279	86%	14%	427
FR	88%	12%	2,003	86%	14%	2,583
HU	87%	13%	495	80%	20%	852
IE	86%	14%	172	92%	8%	494
IT	90%	10%	2,070	87%	13%	3,134
LT	90%	10%	241	90%	10%	254
LU	66%	34%	29	86%	14%	115
LV	88%	12%	165	87%	13%	140
MT	77%	23%	15	87%	13%	37
NL	84%	16%	904	78%	22%	1,375
PL	78%	22%	956	75%	25%	1,970
PT	83%	17%	242	81%	19%	413
RO	90%	10%	866	87%	13%	1,415
SE	88%	12%	582	87%	13%	872
SI	84%	16%	124	78%	22%	151
SK	66%	34%	185	63%	37%	309
UK	89%	11%	2,768	82%	18%	3,970
EU-27	86%	14%	18,620	83%	17%	31,163

Source: Based on Arto et al. (2015)



In 2011, on average 83.8% of the jobs supported by extra-EU exports could be found in the exporting Member State (down from 86.5% in 1995), while the remaining 16.2% were associated to spillovers (13.5% in 1995). In 2011, the latter supported a total of 5 million jobs across the EU (or 2.2% of total EU employment).

The importance of the spillover effects varies importantly across Member States. In Slovakia, the Czech Republic, Estonia, Belgium and Poland more than 25% of the employment supported by extra-EU exports was linked to spillovers. This shows how important it is for these economies to supply inputs to exporters across the rest of the EU. In contrast, in Members States like Greece, Cyprus, Ireland and Lithuania, spillovers represented less than 10% of the employment supported by EU exports.

3.3.2. The mapping of an “Internal Market” at work to export

Figure 8 provides additional insight into the complex production networks across the Single Market and related employment linkages. Interestingly, some of the most open European economies like Belgium and Austria show strong “two-way” spillovers; in other words, they host many jobs that are dependent on other Member States’ extra-EU exports while their own exports to the rest of the world also support a considerable number of jobs elsewhere in the EU. This clearly shows how these Member States have extensively integrated over time into intricate pan-European production networks, with very real implications on the employment front.

Another main insight from Figure 8 is the pivotal role of the large Members States. In 2011 the extra-EU exports from Germany supported around 1.3 million jobs across the EU via spillovers (i.e. through purchases of inputs from other EU countries to be embodied in their exports – see dark red bar in Figure 8)¹⁵. These jobs can be found all across the EU¹⁶. On the other hand, Germany also hosted the largest employment spillovers from other Member States (i.e. employment in Germany-based firms that supply inputs to exporters based elsewhere across the EU) reaching a total of 960,000 jobs in 2011 (see dark blue bar in Figure 8). The other large hosts of jobs associated with spillovers were the United Kingdom (730,000 jobs), Poland (490,000 jobs) and Italy (400,000 jobs).

¹⁵ France was the second most important generator of employment spillovers (around 500,000 jobs), followed by Italy (370,000 jobs) and the United Kingdom (340,000 jobs).

¹⁶ Notably 200,000 jobs in Poland, 140,000 in Italy, 130,000 in the United Kingdom, 120,000 in the Czech Republic and in France.

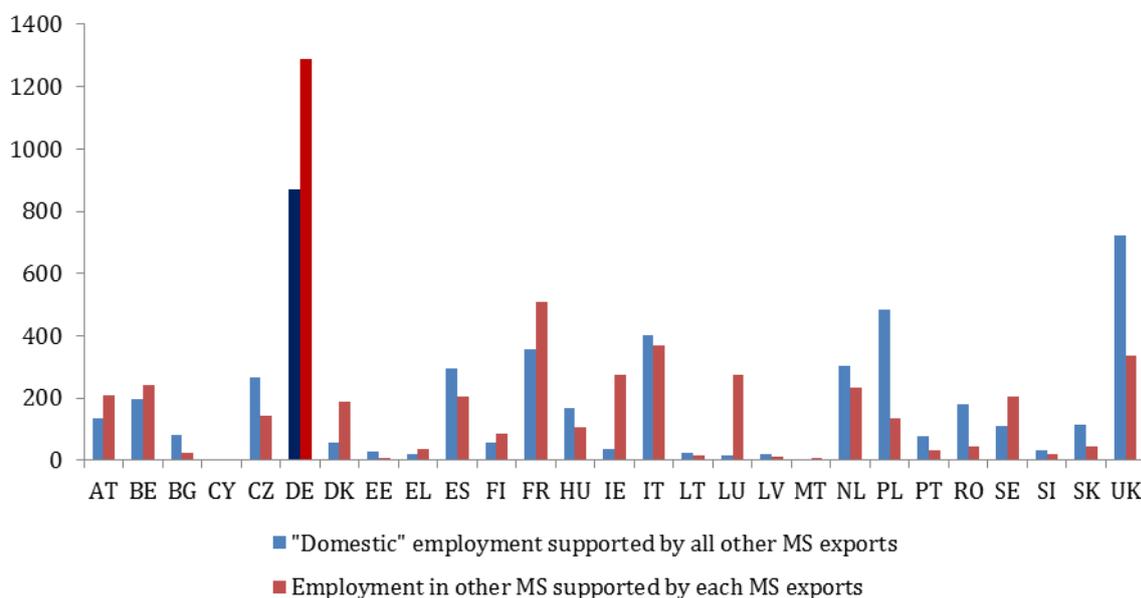


Figure 8: Employment by Member State supported by extra-EU exports of other Member States vs Employment in other Member States supported by extra-EU exports of each Member State, 2011 (in thousand jobs)

Source: Based on Arto et al. (2015)

Figure 9 reveals how these Internal Market production hubs have strengthened over time. Each line in the graphs represents the number of jobs that are supported by the exchanges of inputs between two Member States that will eventually feed into the production of goods and services to be sold outside the EU. The colour identifies the Member State that hosts the employment associated with the trade flow (e.g. dark blue for Poland).

Although the number and structure of the linkages is apparently stable (note that we have focused on the top-50 trade flows among EU Member States), Figure 9 shows that the hubs around the larger Member States like Germany, the United Kingdom and France have strengthened, leading to more and denser employment linkages. It is interesting to identify some particular employment relationships that have strengthened more recently like, for example, the increase in the number of jobs in the UK supported by Ireland’s and Luxembourg’s exports outside the EU or the increase in the number of jobs in Poland that depend on exports from Germany to the world.

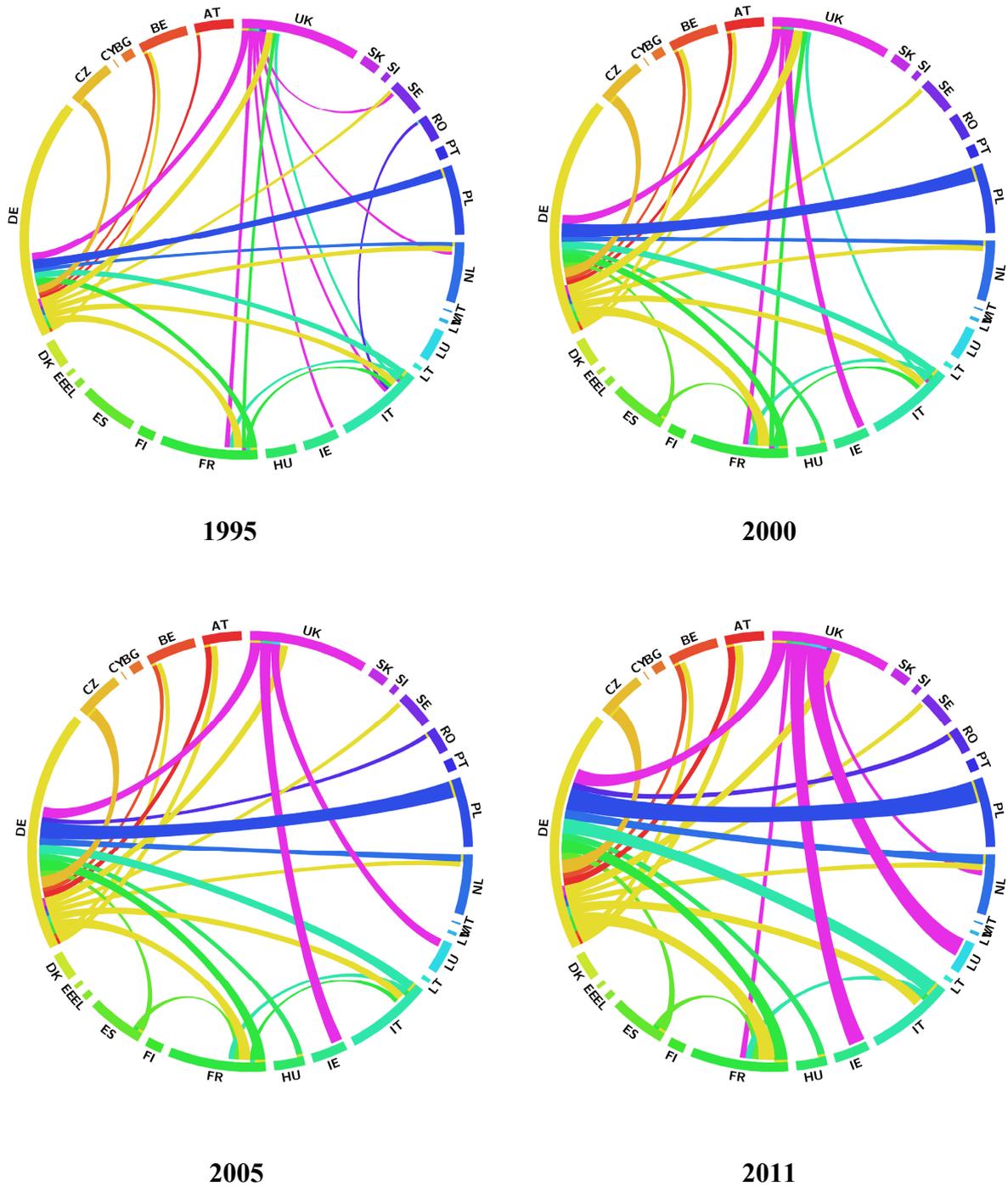


Figure 9: Map of intra-EU spillover effects underlying EU exports to the rest of the world, 2011

Source: Based on Arto et al. (2015)



4. IMPLICATIONS BEYOND THE EU'S BORDERS

The employment supported by extra-EU exports is not confined within the European borders.

Despite the increasing numbers of jobs in the EU that are dependent on exports, the involvement of European firms in global value chains also means that extra-EU exports increasingly rely on foreign inputs (including labour). Between 1995 and 2011 the “foreign” employment supported by extra-EU exports doubled to 19.2 million jobs.

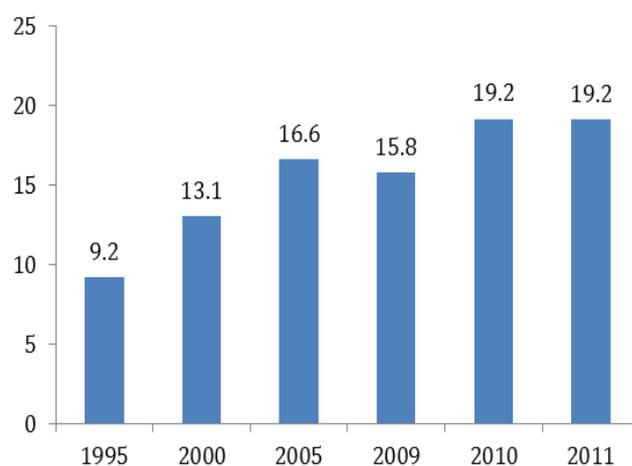


Figure 10: Number of jobs outside the EU supported by extra-EU exports (in thousand jobs)

Source: Based on Arto et al. (2015)

Germany’s imports of intermediate goods from the rest of the world to be embodied in its exports are responsible for one in four jobs outside the EU that are dependent on extra-EU exports. However, the exports of all Member States support employment outside the EU, although the intensity of the phenomenon differs greatly (due inter alia to differences in industrial specialisation and comparative advantage profiles of each Member State). In 2011 each billion euros of extra-EU exports from Belgium, Denmark, Finland, the Netherlands, Slovakia and Slovenia supported more than 15,000 jobs in the rest of the world. In contrast, each billion euros of exports to the rest of the world from Greece, Latvia, Luxembourg and Romania supported less than 6,000 jobs outside the EU.

The type of jobs that extra-EU exports support abroad also sheds some light on the nature of the parts of the production chain that tend to be offshored by EU exporters. In 2009, low-skilled jobs made up the majority (57%) of this employment (58% in 1995); medium-skilled jobs represented 34% (36% in 1995), and high-skilled jobs 9% (6% in 1995). Each million euros worth of extra-EU exports in 2009 supported around 9.5 jobs



outside the EU, of which 5.4 were low-skilled, 3.2 were medium-skilled and 0.9 were high-skilled.

Table 7: Number of jobs outside the EU supported by extra-EU exports from each Member State (in thousand jobs)

	1995	2000	2005	2009	2010	2011	2011 - 1995	2011 / 1995
AT	178	253	332	337	451	478	300	169%
BE	387	558	680	692	884	899	512	132%
BG	77	106	52	106	91	78	2	2%
CY	15	23	14	15	16	15	0	-1%
CZ	64	87	208	287	410	403	338	525%
DE	1,642	2,556	3,791	3,714	4,558	4,759	3,117	190%
DK	468	474	596	726	733	722	254	54%
EE	12	23	44	31	35	33	21	169%
EL	33	161	169	173	156	134	101	308%
ES	288	527	725	698	831	959	671	233%
FI	204	305	387	406	485	438	234	115%
FR	932	1,255	1,605	1,495	1,733	1,732	800	86%
HU	63	148	263	180	258	246	183	289%
IE	163	395	601	603	806	781	619	380%
IT	1,065	1,370	1,667	1,427	1,878	1,893	828	78%
LT	33	36	75	73	63	57	24	72%
LU	16	30	170	158	204	218	201	1238%
LV	14	17	28	25	23	22	8	59%
MT	7	28	16	19	20	19	12	164%
NL	1,877	2,389	2,183	1,878	2,227	1,956	78	4%
PL	68	100	253	295	416	469	401	590%
PT	90	121	129	116	128	112	22	24%
RO	48	68	118	88	94	93	45	93%
SE	321	518	703	638	795	788	467	146%
SI	33	39	67	73	71	65	32	99%
SK	23	53	79	119	119	113	90	395%
UK	1,119	1,422	1,692	1,435	1,698	1,675	556	50%
EU-27	9,240	13,064	16,646	15,807	19,184	19,157	9,917	107%

Source: Based on Arto et al. (2015)

5. TRADING WITH KEY PARTNERS: A TWO-WAY STREET FOR JOBS

As global value chains expand the competitiveness of EU firms (and therefore their capacity to sustain employment and generate income when they export) increasingly depends on the competitiveness of their trade partners.

The importance of the trade relationship with a given partner must be assessed not only from the perspective of the value of the sales of goods and services to such markets but also from the standpoint of the supply of inputs to EU exporters.



In 2011, 35% of the EU employment supported by extra-EU exports was driven by sales to the US (15%), China (10%), Russia (6%) and Japan (4%). This means that almost 4.7 million jobs in the EU were dependent on exports to the US market, over 3 million jobs were dependent on EU sales of goods and services to China, and almost 2 million were depend on the imports from Russia.

Table 8: Employment by Member State supported by EU exports to specific trading partners, 2011 (% and thousand jobs)

	BR	CN	ID	IN	JP	RU	TR	US	RW	Total
AT	4%	13%	1%	1%	2%	4%	3%	11%	61%	761
BE	5%	12%	2%	5%	3%	4%	4%	19%	48%	767
BG	1%	3%	1%	0%	1%	10%	21%	5%	59%	643
CY	0%	3%	0%	0%	1%	9%	4%	3%	79%	44
CZ	2%	8%	0%	2%	2%	11%	4%	14%	57%	886
DE	3%	14%	1%	2%	3%	5%	3%	15%	55%	7,060
DK	2%	10%	1%	1%	3%	4%	1%	14%	64%	445
EE	1%	5%	0%	1%	3%	22%	2%	10%	56%	102
EL	1%	2%	1%	0%	0%	5%	7%	7%	76%	347
ES	2%	5%	0%	1%	2%	4%	7%	21%	57%	1,597
FI	3%	19%	1%	3%	4%	8%	2%	13%	47%	427
FR	4%	11%	1%	1%	3%	4%	3%	15%	58%	2,583
HU	2%	7%	1%	1%	2%	7%	4%	8%	68%	852
IE	0%	8%	0%	0%	2%	1%	0%	24%	64%	494
IT	3%	11%	1%	2%	3%	7%	5%	14%	54%	3,134
LT	0%	2%	0%	0%	1%	19%	3%	3%	71%	254
LU	1%	4%	0%	0%	1%	1%	1%	4%	88%	115
LV	0%	4%	0%	1%	1%	13%	2%	4%	74%	140
MT	5%	11%	0%	0%	6%	2%	2%	11%	62%	37
NL	2%	16%	1%	1%	2%	4%	2%	19%	53%	1,375
PL	1%	7%	0%	1%	2%	17%	6%	10%	56%	1,970
PT	10%	5%	0%	1%	2%	5%	4%	17%	56%	413
RO	1%	3%	1%	1%	2%	7%	10%	5%	71%	1,415
SE	2%	11%	1%	1%	2%	4%	1%	14%	64%	872
SI	1%	7%	0%	1%	1%	10%	4%	8%	68%	151
SK	2%	11%	0%	1%	2%	20%	6%	10%	48%	309
UK	3%	8%	1%	2%	3%	3%	3%	21%	58%	3,970
EU-27	3%	10%	1%	1%	2%	6%	4%	15%	58%	31,163

Source: Based on Arto et al. (2015)

The employment supported by the US imports is significant across all Member States but it is especially striking in Ireland, Spain, the United Kingdom, the Netherlands, and Belgium where it represents about 20% of the export-supported jobs (in the case of Ireland it is almost 25%). The exports to the Chinese market are especially important for jobs in Finland and in the Netherlands where more than 15% of the employment supported by exports was driven by Chinese imports. Finally, the importance of the Russian market for some Member States in particular is also striking. More than 15% of



the jobs supported by extra-EU exports in Estonia, Slovakia, Lithuania and Poland were due to sales to Russia.

From the point of view of the sourcing of inputs we look at the employment in specific partners that is supported by extra-EU exports¹⁷. Table 9 shows that in 2011 extra-EU exports supported 5.1 million jobs in China (27% of the total number of jobs outside Europe supported by EU exports), 2.2 million jobs in India (12% of total), 1.1 million jobs in Russia (6% of total), 900,000 jobs in Brazil (5% of total) and 740,000 jobs in the US (4% of total). The evolution between 1995 and 2011 clearly suggests that China and India (and to a lesser extent Brazil, the US and Indonesia) have strongly reinforced their position as suppliers of intermediates to the EU economy¹⁸.

Table 9: Number of jobs per trading partner supported by extra-EU exports, 1995-2011 (in thousand jobs)

	1995	2000	2005	2009	2010	2011	2011 - 1995	2011 / 1995
AU	27	38	41	39	46	47	21	77%
BR	283	427	665	607	793	872	589	208%
CA	59	76	79	86	101	114	56	95%
CN	2,821	3,435	4,498	4,017	5,114	5,131	2,311	82%
ID	265	451	491	529	601	655	390	147%
IN	733	1,306	1,671	1,460	2,104	2,231	1,498	205%
JP	101	147	185	157	165	167	67	66%
KR	85	115	156	177	277	286	201	236%
MX	96	143	169	158	164	178	82	85%
RU	836	1,575	1,416	980	1,132	1,131	295	35%
RW	3,473	4,690	6,579	6,766	7,619	7,152	3,678	106%
TR	63	128	139	210	227	297	234	371%
TW	60	87	106	118	141	151	90	149%
US	339	445	450	501	701	744	406	120%
Non EU-27	9,240	13,064	16,646	15,807	19,184	19,157	9,917	107%

Source: Based on Arto et al. (2015)

In 2011, the services sector was responsible for 43% of the “foreign” employment supported by extra-EU exports (37% in 1995); the manufacturing and construction industries were responsible for 25% (22% in 1995), and the primary sector for 32% (41%

¹⁷ Another more commonly used metric is based on the value added, which is less driven by the labour intensity of the sourced inputs.

¹⁸ In terms of value added the US is the main supplier to EU exporters, being responsible for 20% of the foreign value added embodied in EU exports of goods and services to the world in 2011. China came second with 13% and Russia third with 11%.



in 1995). However, there are some noticeable differences across trading partners: in Turkey, Japan, and Taiwan more than 50% of the employment supported by EU exports could be found in the manufacturing and construction sectors while in the other trading partners the employment in services dominated.

Table 10: Employment by trading partner and by industry supported by extra-EU exports, 1995 and 2011 (% and thousand jobs)

	P	M1	M2	M3	M4	M5	M6	M7	S1	S2	Total
AU	12.3%	0.6%	1.0%	0.9%	1.3%	0.9%	6.9%	4.3%	58.6%	13.3%	47
BR	18.1%	1.4%	1.9%	2.0%	0.4%	0.6%	3.7%	1.4%	38.2%	32.3%	872
CA	8.7%	0.6%	0.3%	3.0%	1.7%	1.2%	8.3%	7.9%	50.2%	18.1%	114
CN	23.4%	1.1%	5.3%	3.6%	1.0%	2.5%	7.6%	12.9%	19.7%	23.0%	5,131
ID	26.1%	1.5%	3.5%	3.1%	0.4%	0.9%	8.4%	1.3%	37.5%	17.3%	655
IN	25.4%	1.1%	5.4%	2.1%	0.5%	1.6%	5.0%	6.9%	31.7%	20.4%	2,231
JP	1.8%	0.5%	2.1%	2.7%	1.1%	3.2%	15.3%	24.5%	37.2%	11.6%	167
KR	1.6%	0.2%	1.1%	1.1%	0.7%	1.5%	7.1%	15.4%	64.0%	7.3%	286
MX	6.9%	0.3%	2.1%	1.1%	0.6%	1.6%	5.9%	13.7%	65.7%	2.0%	178
RU	13.9%	0.1%	0.6%	2.0%	6.3%	2.0%	7.7%	4.3%	56.0%	7.1%	1,131
TR	7.7%	0.3%	7.4%	1.9%	1.4%	1.3%	22.1%	16.9%	34.1%	7.1%	297
TW	0.4%	0.0%	1.6%	1.2%	0.6%	2.2%	15.6%	27.5%	43.2%	7.6%	151
US	1.9%	0.3%	0.5%	1.9%	0.4%	2.0%	5.1%	8.6%	68.0%	11.4%	744
RW	53.7%	1.3%	1.4%	3.0%	1.1%	2.5%	5.2%	4.4%	17.9%	9.5%	7,152
Non EU-27	32.2%	1.1%	3.0%	2.8%	1.2%	2.1%	6.5%	7.7%	27.8%	15.5%	19,157

Note: P: primary; M1: food, beverages, tobacco; M2: textile; M3: wood, paper, printing; M4: energy; M5: chemical; M6: other non-metallic and basic metals; M7: machinery and transport equipment; S1: transport, trade and business services; S2: other services.

Source: Based on Arto et al. (2015)

6. CONCLUDING REMARKS

The comprehensive collection of facts and figures that we present in this note and that have been extensively reported in Arto et al. (2015) points to the increasing importance of extra-EU exports as a means to provide employment opportunities in Europe, which are in general associated with more qualified and better paid jobs than those in the rest of the economy.

We also show evidence that the benefits extend to citizens of all Member States who have jobs that depend directly or indirectly on external markets. These include those who work in firms that are selling directly to markets outside the EU and those who are employed by suppliers of inputs to exporters that may be located in their own Member State or



elsewhere across the EU. Underlying this is a well-functioning Single Market that is clearly an important pillar of EU competitiveness in the global marketplace.

In addition, we note that with the expansion of global value chains many jobs that are supported by EU exports are found beyond European borders. This strengthens the realisation that in a globalised world economic stakes are ever more interdependent. In a global economy based on international production networks the trade relationship with a given partner must be assessed not only from the perspective of the size and dynamism of its market but also from the standpoint of its importance as an input supplier. Both aspects of the bilateral trade relationship have implications for jobs in the EU and elsewhere.

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ANNEX 1

SUMMARY OF METHODOLOGY USED FOR CALCULATIONS

In order to obtain the EU and foreign employment embodied in the EU exports to the rest of the world, we have used a methodological approach based on a Multi-Regional Input-Output (MRIO) model together with the information provided by the World Input-Output Database (WIOD). We follow a long-standing literature that uses this type of model to explore the economic and environmental consequences of trade (for an extended overview see Miller and Blair (2009), and Murray and Lenzen (2013)).

As in Arto et al. (2015), we describe the methodology for the case of four regions (two EU countries and two non-EU countries) with n industries and one economic dimension (employment), but it can be applied to any number of regions, dimensions and industries. The MRIO tables used in the calculations are industry by industry IO tables. Accordingly, all the data reported in this note is reported by industry (e.g. we report the employment supported by the exports of the manufacturing industry and not the employment supported by the exports of manufactured products).

The starting point of the model is a MRIO table at basic prices. This table describes the flows of goods and services from all industries to all intermediate and final users, explicitly broken down by countries of origin and by countries of destination in each flow.

We can distinguish three main components in the MRIO table:

$$\mathbf{Z} = \begin{bmatrix} \mathbf{Z}^{11} & \mathbf{Z}^{12} & \mathbf{Z}^{13} & \mathbf{Z}^{14} \\ \mathbf{Z}^{21} & \mathbf{Z}^{22} & \mathbf{Z}^{23} & \mathbf{Z}^{24} \\ \mathbf{Z}^{31} & \mathbf{Z}^{32} & \mathbf{Z}^{33} & \mathbf{Z}^{34} \\ \mathbf{Z}^{41} & \mathbf{Z}^{42} & \mathbf{Z}^{43} & \mathbf{Z}^{44} \end{bmatrix}, \mathbf{f} = \begin{bmatrix} \mathbf{f}^{11} + \mathbf{f}^{12} + \mathbf{f}^{13} + \mathbf{f}^{14} \\ \mathbf{f}^{21} + \mathbf{f}^{22} + \mathbf{f}^{23} + \mathbf{f}^{24} \\ \mathbf{f}^{31} + \mathbf{f}^{32} + \mathbf{f}^{33} + \mathbf{f}^{34} \\ \mathbf{f}^{41} + \mathbf{f}^{42} + \mathbf{f}^{43} + \mathbf{f}^{44} \end{bmatrix}, \mathbf{x} = \begin{bmatrix} \mathbf{x}^1 \\ \mathbf{x}^2 \\ \mathbf{x}^3 \\ \mathbf{x}^4 \end{bmatrix},$$

where \mathbf{Z}^{rs} is the intermediate matrix with industry deliveries from country r to country s ; \mathbf{f}^{rs} is the column vector of country s ' final demand (including household consumption, government consumption, and investment) for goods produced by country r ; and \mathbf{x}^r is the column vector of industry output for country r . Furthermore, let us assume that the MRIO table is extended to include a vector of employment by country and let us denote it as:



$$\mathbf{w} = \begin{bmatrix} \mathbf{w}^1 \\ \mathbf{w}^2 \\ \mathbf{w}^3 \\ \mathbf{w}^4 \end{bmatrix}$$

The relation between \mathbf{x} , \mathbf{Z} and \mathbf{f} is defined by the accounting equation $\mathbf{x} = \mathbf{Z}\mathbf{i} + \mathbf{f}$, where \mathbf{i} is the column summation vector consisting of ones.

Suppose that countries 1 and 2 represent the EU and the remaining countries (3 and 4) are non-EU countries. In such a case we can define the components of the MRIO framework of the EU as:

$$\mathbf{Z}^{\text{EU}} = \begin{bmatrix} \mathbf{Z}^{11} & \mathbf{Z}^{12} \\ \mathbf{Z}^{21} & \mathbf{Z}^{22} \end{bmatrix}, \mathbf{f}^{\text{EU}} = \begin{bmatrix} \mathbf{f}^{11} + \mathbf{f}^{12} + \mathbf{e}^{13} + \mathbf{e}^{14} \\ \mathbf{f}^{21} + \mathbf{f}^{22} + \mathbf{e}^{23} + \mathbf{e}^{24} \end{bmatrix}, \mathbf{x}^{\text{EU}} = \begin{bmatrix} \mathbf{x}^1 \\ \mathbf{x}^2 \end{bmatrix}, \mathbf{w}^{\text{EU}} = \begin{bmatrix} \mathbf{w}^1 \\ \mathbf{w}^2 \end{bmatrix}$$

where $\mathbf{e}^{ij} = \mathbf{f}^{ij} + \mathbf{Z}^{ij}\mathbf{i}$ represents the extra-EU exports from the Member State i to the non-EU country j (with $i \neq j$).

The input coefficient matrix for the EU is defined as $\mathbf{A}^{\text{EU}} = \mathbf{Z}^{\text{EU}} (\hat{\mathbf{x}}^{\text{EU}})^{-1}$, where $(\hat{\mathbf{x}}^{\text{EU}})$ is a diagonal matrix with industry outputs placed along the main diagonal and zero elsewhere. Thus, the accounting equation can now be written as the standard input-output model: $\mathbf{x}^{\text{EU}} = \mathbf{A}^{\text{EU}} \mathbf{x}^{\text{EU}} + \mathbf{f}^{\text{EU}}$. For a certain final demand vector \mathbf{f}^{EU} , the solution to the model is given by $\mathbf{x}^{\text{EU}} = \mathbf{L}^{\text{EU}} \mathbf{f}^{\text{EU}}$, where $\mathbf{L}^{\text{EU}} \equiv (\mathbf{I} - \mathbf{A}^{\text{EU}})^{-1}$ is the Leontief inverse of the EU. Thus, multiplying the Leontief inverse of the EU by the extra-EU exports we obtain the total output in the EU to produce exported goods and services:

$$\mathbf{x}_{\text{exeu}}^{\text{EU}} = \mathbf{L}^{\text{EU}} \mathbf{e}^{\text{EU}} \tag{1}$$

The employment coefficients vector, $\mathbf{v}^{\text{EU}} = (\hat{\mathbf{x}}^{\text{EU}})^{-1} \mathbf{w}^{\text{EU}}$, yields the EU employment per unit of output. Hence, the EU employment supported by the production of extra-EU exports (i.e. EU employment embodied in extra-EU exports) is given by:

$$\begin{aligned} \mathbf{w}_{\text{exeu}}^{\text{EU}} &= (\mathbf{v}^{\text{EU}})' \mathbf{L}^{\text{EU}} \mathbf{e}^{\text{EU}} = (\mathbf{v}^1)' \mathbf{L}^{11} \mathbf{e}^{13} + (\mathbf{v}^1)' \mathbf{L}^{11} \mathbf{e}^{14} \\ &+ (\mathbf{v}^1)' \mathbf{L}^{12} \mathbf{e}^{23} + (\mathbf{v}^1)' \mathbf{L}^{12} \mathbf{e}^{24} + (\mathbf{v}^2)' \mathbf{L}^{21} \mathbf{e}^{13} + (\mathbf{v}^2)' \mathbf{L}^{21} \mathbf{e}^{14} \\ &+ (\mathbf{v}^2)' \mathbf{L}^{22} \mathbf{e}^{23} + (\mathbf{v}^2)' \mathbf{L}^{22} \mathbf{e}^{24} \end{aligned} \tag{2}$$

where $(\mathbf{v}^i)' \mathbf{L}^{ij} \mathbf{e}^{jk}$ is the EU country i 's employment supported by the extra-EU exports of an EU Member State j to a non-EU country k .



From expression [1] we can also derive the foreign employment embodied in extra-EU exports. First, we define the matrix of non-EU import coefficients of the EU as:

$$\mathbf{A}^{\text{noEU,EU}} = \mathbf{Z}^{\text{noEU,EU}} (\hat{\mathbf{x}}^{\text{EU}})^{-1}, \text{ where}$$

$$\mathbf{Z}^{\text{noEU,EU}} = \begin{bmatrix} \mathbf{Z}^{31} & \mathbf{Z}^{32} \\ \mathbf{Z}^{41} & \mathbf{Z}^{42} \end{bmatrix}$$

Pre-multiplying expression [1] by the matrix of non-EU import coefficients of the EU, we obtain the vector of intermediate imports of the EU from non-EU countries or, alternatively, the exports of non-EU countries to the EU:

$$\mathbf{A}^{\text{noEU,EU}} \mathbf{L}^{\text{EU}} \mathbf{e}^{\text{EU}} \tag{3}$$

It follows that the foreign employment embodied in extra-EU exports can be calculated as:

$$\mathbf{w}_{\text{exeu}}^{\text{noEU}} = (\mathbf{v}^{\text{noEU}})' \mathbf{L}^{\text{noEU}} \mathbf{A}^{\text{noEU,EU}} \mathbf{L}^{\text{EU}} \mathbf{e}^{\text{EU}} \tag{4}$$

where $\hat{\mathbf{v}}^{\text{noEU}}$ and \mathbf{L}^{noEU} are the vector of employment coefficients and the Leontief inverse matrix of the non-EU countries, respectively.

We can expand [4] in a similar fashion to [2] to obtain the different components of the foreign employment in extra-EU exports. Thus, the element $(\mathbf{v}^{\text{m}})' \mathbf{L}^{\text{ml}} \mathbf{A}^{\text{li}} \mathbf{L}^{\text{ij}} \mathbf{e}^{\text{jk}}$ of the resulting expression would represent the employment in a non-EU country m supported by the production of intermediate exports of a non-EU country l to an EU country i that are used to produce the extra-EU exports from EU country j to non-EU country k . In other words, it would be the employment generated in Australia (m) to produce metals that would be exported to China (l) for the production of car parts. These car parts would in turn be exported to the Czech Republic (i) to be used in the production of engines for cars that would be sold to Germany (j), where the assembly would be carried out. Eventually, Germany would export cars to Japan (k).