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Regional, Provincial and Municipality-Level Analysis of the Impact of Brexit on Belgium

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Executive Summary

This report presents an **impact analysis of Brexit** on Belgium and on Flanders in particular. We study the impact at the level of the **Regions**, the **Provinces** of Belgium and at the level of the **municipalities** for Flanders. By using the results of a newly developed Global Network Model (CEPR, 2017)[1], we **dig deeper** than most existing studies on brexit and consider the **local employment** effects in every **Region**, **Province and Municipality.**

The findings in this report clearly show that there are **important differences** in how Brexit affects employment across Regions, Provinces and Municipalities, which are mainly due to **sectoral composition** within a Province and within a Municipality. Different sectors are integrated differently within Global value chains and hence are more or less subject to trade shocks. Depending on which sector is present in a Municipality, the job losses will be more severe.

The losses that Belgium as a whole faces under a **no deal Brexit** are serious and grave. The aggregate short-term impact of a no deal Brexit (hard Brexit) for **Belgium** would be a loss of **2,35%** of its GDP. This would correspond to **42 000 jobs** lost for Belgium. This means that Belgium is among the **most badly affected countries in the EU-27 relative to its size.** The results show that a no deal Brexit, with WTO tariffs in place and corresponding non-tariff measures, would be far worse than a Brexit with an agreement (soft Brexit). A soft brexit with a deal on a future partnership would most likely avoid tariffs, but non-tariff barriers (border controls, divergence of product and environmental standards, etc.) would still exist and create a serious hurdle for many companies. This would be a serious stepdown of current arrangements within the European single market.

Belgian goods' sectors which are badly affected under Brexit include Food & Beverages, Textiles and Pharmaceuticals, Chemical and Petroleum products. Not just goods sectors, but also **services sectors** would be badly affected. Even though WTO tariffs on services are zero, trade barriers on goods would negatively impact the services embedded in them. This study predicts a substantial loss in employment in the following Belgian service sectors: Administrative & support activities, Legal & Accounting services and Retail activities.

The region of **Flanders** is more affected by Brexit than the region of Wallonia. Of the 42 000 jobs lost in Belgium, **28 000** would be lost in **Flanders** (corresponds to 1,06% of number of jobs in Flanders). In the case of a soft brexit, job losses would be smaller at 6500 – far from insignificant.

[1] Vandenbussche, Connell and Simons (2017), Global Value Chains, Trade shocks and Jobs: An application to Brexit", Centre for Economic Policy Research- working paper.

On a **provincial level** in Flanders, the Brexit impact will be the largest in the **Province of Antwerp** in absolute figures with an estimated job loss of 7900. In terms of relative job losses (i.e. expressed as a share of the total employment of a province) the **provinces of West-Flanders and East-Flanders** are most affected. Relative job losses for West-Flanders under a "no deal" scenario would amount to 1,28% of total employment in the province, for East Flanders this would be 1,15%.

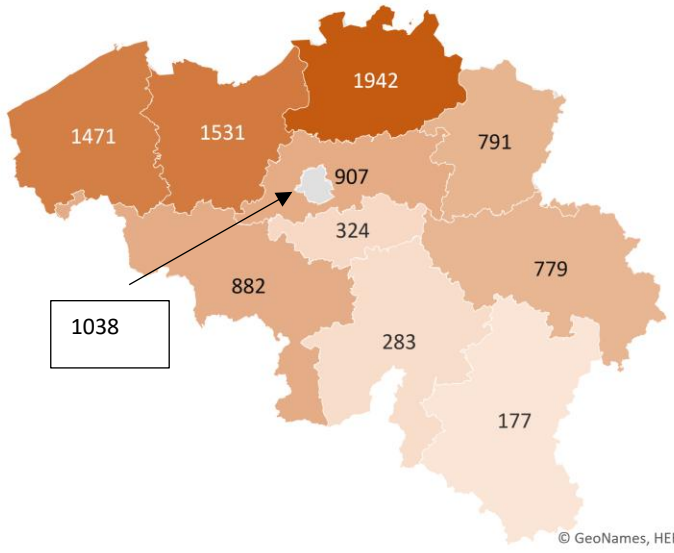
The impact of Brexit on local employment at the **level of municipalities** is very heterogeneous across Flanders. It depends on the sectoral composition within the municipalities. Notwithstanding the methodological difficulties in applying trade exposure to the results on a local level, we assume that most of the job losses will occur around the Bruges-Kortrijk axis and the cities of Antwerp and Ghent. The relative local employment losses in West-Flanders vary greatly from one municipality to another as a result of the sectoral trade exposure with the UK.

In the **Global Network Model**, the EU is modelled as a network economy to trace the global value chains between countries. The model considers **both direct trade** to the UK as well as **indirect trade** via third countries and sectors shipped to the UK. It provides a more complete impact analysis than the traditional gravitas models. It also offers a more complete set of network linkages in view of other network models around. After all, the model allows for network **connections between every country-sector** in the world. This makes it the only model that can quantify the indirect trade effects. The focus is on the trade impact of Brexit and the **network tissue** that is **lost** under Brexit. This makes the model inherently a **short-term one**. It predicts the trade destruction effects of Brexit by sector, before trade diversion takes place.

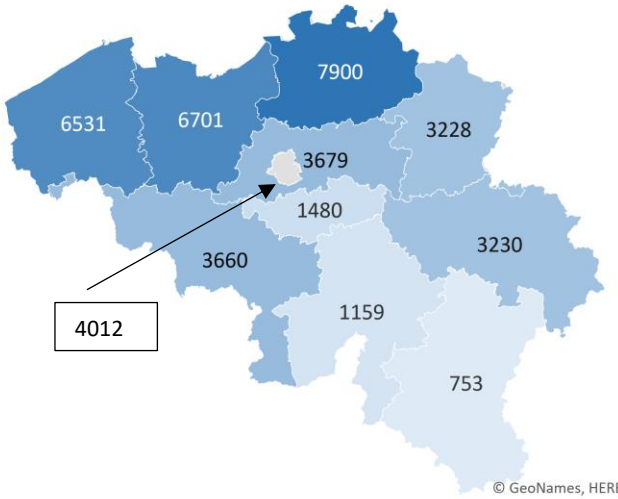
The findings in the report for the **job losses at a lower level of aggregation** were **faced with a data limitation**. Seeing as there are no regional Input-output tables at sector level with an international dimension, we had to take an alternative approach using Eurostat and Social Security Records data. Naturally the results are an approximation of the employment losses which may be an underestimation of the true Brexit impact for those municipalities that have a strong export orientation towards the UK such as in the Provinces closest to the UK.

Province	Absolute Job Losses (numbers) Soft Brexit	Relative Job Losses (%) Soft Brexit	Absolute Job Losses (numbers) No deal Brexit	Relative Job Losses (%) No deal Brexit	Total Employment in the Province
Antwerp	-1942	-0.25	-7 900	-1.0	788 900
East-Flanders	-1531	-0.26	-6 701	-1.15	581662
West-Flanders	-1471	-0.29	-6 531	-1.28	508 635
Brussels Capital Region	-1038	-0.15	-4 012	-0.58	688 420
Flemish Brabant	-907	-0.20	-3 679	-0.83	443 376
Hainaut	-882	-0.21	-3 660	-0.86	422 921
Limburg	-791	-0.24	-3 281	-0.98	333 354
Liège	-779	-0.21	-3 230	-0.86	374 248
Brabant-Wallon	-384	-0.24	-1 480	-0.93	157 660
Namur	-283	-0.17	-1 159	-0.71	162 910
Luxemburg	-177	-0.19	-753	-0.81	92 334

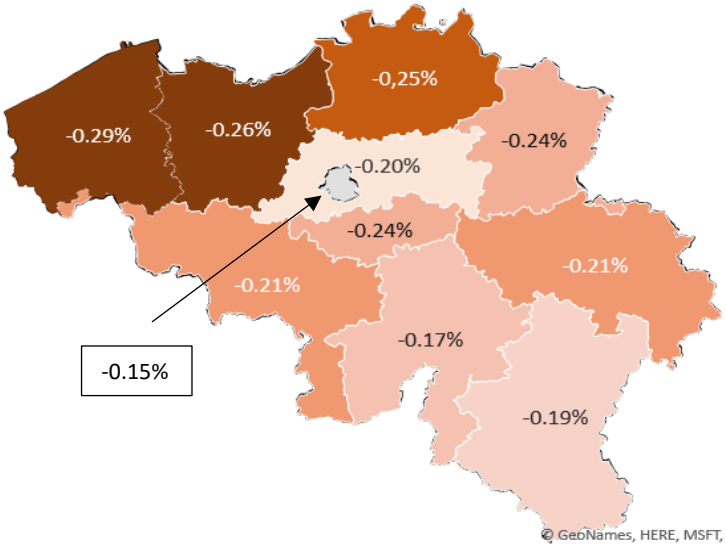
Map 5: Absolute Job Losses Soft Brexit, by Province



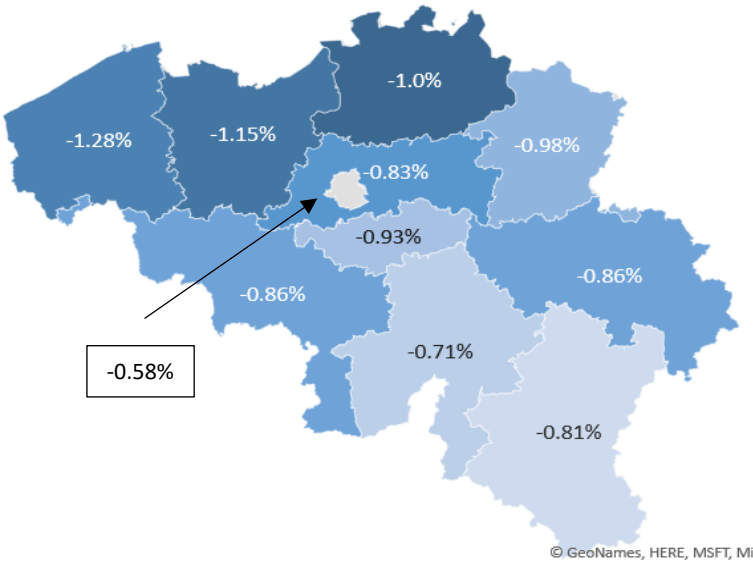
Map 6: Absolute Job Losses No deal Brexit, by Province



Map 7: Relative Job Losses Soft Brexit, by Province



Map 8: Relative Job Losses with No Deal Brexit, by Province



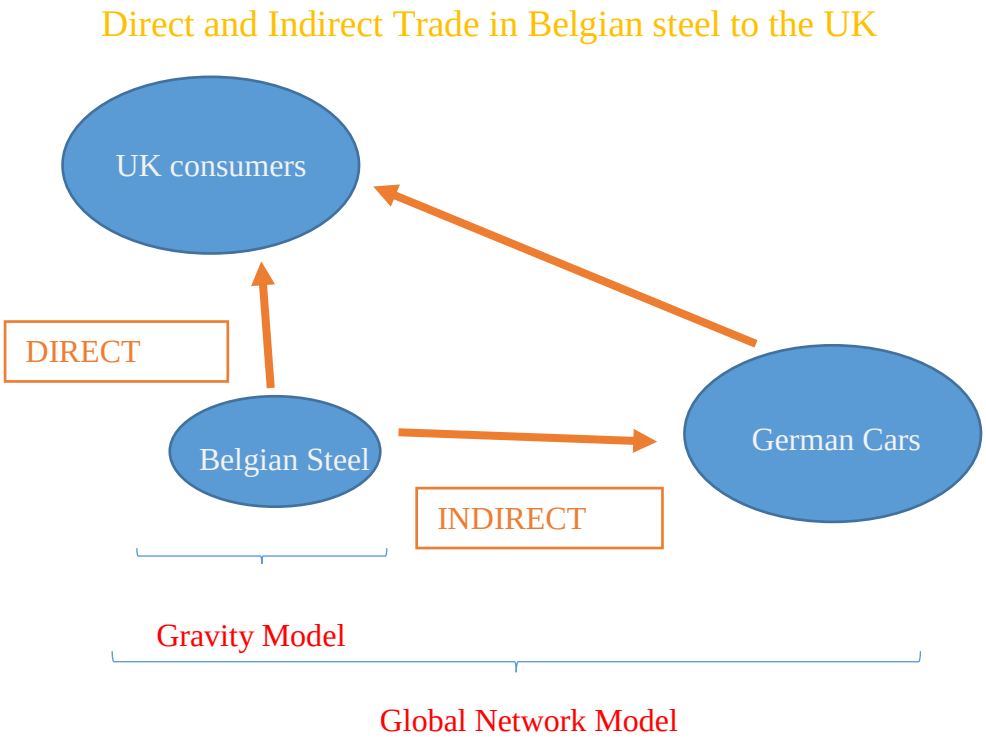
I. Global Network Model

In this paper we present results of the Global Network Model (GNM), developed at the KU Leuven (henceforth KUL, 2017). This model is well-suited to estimate the impact of trade shocks but has a number of specific characteristics that are important to point out. We start by explaining some of the most important assumptions of the theory model and continue with details on the empirical implementation. Important to know is that the model was designed to capture job losses at country-sector level. In the data section I.3., we further explain how we arrive at results at lower level of spatial aggregation (region, province, municipality).

I.1. Assumptions of the Model

1) The model is a **global input-output model** at sector level. For example, for a **sector** like Belgian steel, the model allows for the Brexit impact to come from **direct exports** of steel to the UK but also via **indirect exports** of Belgian steel to the UK. Since Belgian steel is an intermediate product, used in many other sectors such as German cars, it may end up in the UK via third countries. This means that the output of Belgian steel will not just be affected by a UK tariff on steel but also by a UK tariff on cars etc. This is illustrated in **Figure 1** below. While Figure 1 is just an illustration of a particular network linkage, the Global network model includes every input-output linkage between sectors belonging to the same or to different countries in the global production network. Similarly a sector like Belgian food or the Belgian chemical sector will also be connected to many other sectors. With a hard Brexit, tariffs could come into force for certain products that can be as high as 50% and which would impact many other connected sectors in the network.

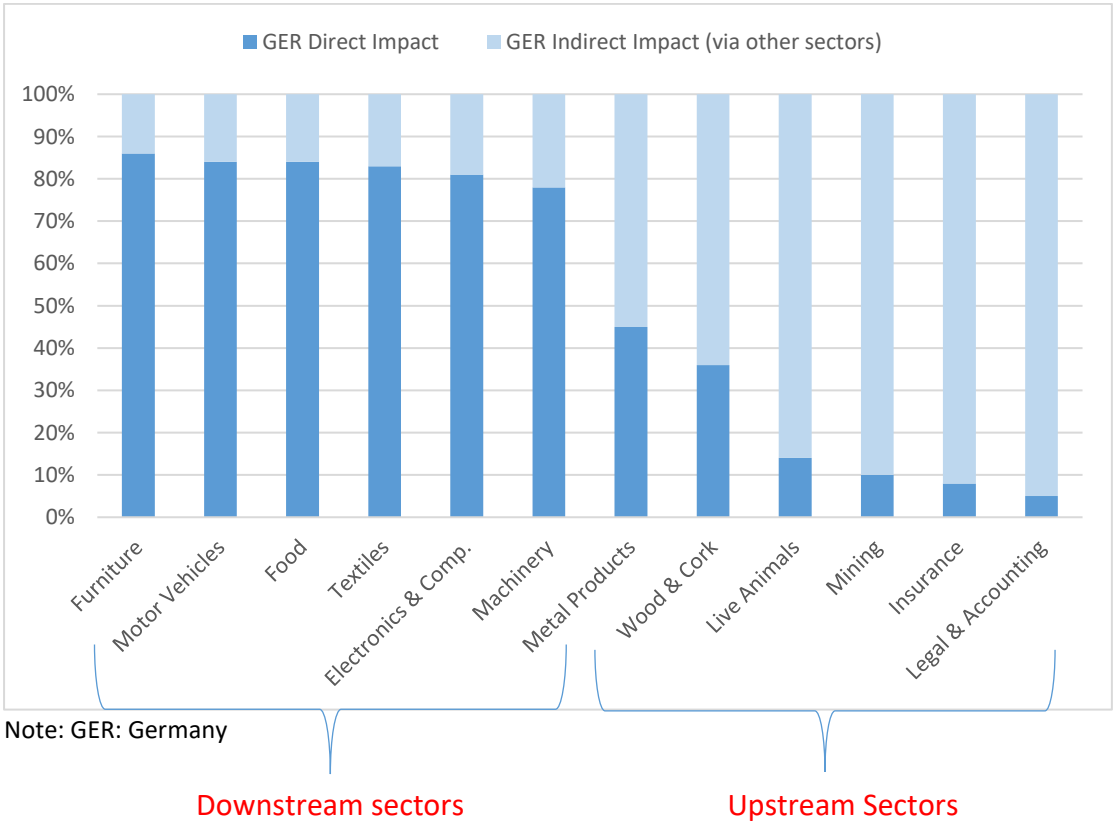
Figure 1: Global Network Model



From the network data (World Input-Output Table, WIOT) it is clear that Europe has become a network economy, where global value chains are fragmented across countries. Existing models in the literature do not sufficiently take this into account. Gravity models do not capture indirect trade effects.[2] While there are other network models around in the literature, none of them can separate the direct from the indirect effects of a trade shock. Especially a gravity type of model, which only looks at direct trade, can seriously under-estimate the impact of a trade shock such as Brexit.

The Indirect effects of Brexit on any particular sector are especially important in upstream sectors. This can be seen from Figure 2. On the left we show a number of downstream sectors which are close to the consumer, while on the far right in Figure 2, we show a number upstream sectors that produce intermediates used in other sectors before ending up with a final consumer. Figure 2 clearly shows that indirect effects of Brexit are stronger in upstream sectors such as Legal & Accounting than in downstream sectors such as Motor Vehicles. This pattern seems holds for every country in our analysis. This suggests that the more upstream and central a sector is in the European production network, the more important the indirect trade effects that come from network linkages.

Figure 2: Upstream and Downstream Indirect Effects of Brexit



Note: GER: Germany

[2] Structural gravity models with intermediate trade are already richer than traditional gravity models but cannot separate direct from indirect trade effects from a trade shock.

Therefore the mistake made by the gravity model to assess trade shocks e.g. in the absence of indirect effects, is more severe in upstream sectors.

2) The Global Network Model assumes that the output of each sector can be traded with the UK either **directly or indirectly via "third countries".** Thus, the Brexit impact can come through any of these two channels. The **direct impact of Brexit** on Belgian steel exported to the UK, comes from the UK tariff on steel. But Belgian steel is used in the production of German cars. Therefore the Brexit impact on Belgian steel can also come from the UK tariff on German cars, which is an **indirect Brexit effect**. Similarly when Belgian steel is used in French aircrafts, the Brexit effect on Belgian steel can also come via the UK tariff on French aircrafts. And when Belgian steel is used in Spanish bicycles, it is also subject to the UK tariff on bicycles. So ultimately the Brexit impact on Belgian steel is not only a function of the UK tariff rate on steel but of every UK tariff on sectors that use Belgian steel.

3) This makes the Global Network Model much more complex than a gravitas model that only considers direct trade between countries and that only considers the UK tariff rate on Belgian steel to predict the Brexit impact on Belgian steel. In the KUL (2017) we show that the **average indirect impact of Brexit e.g. via third countries** varies by country but goes up to 50% of the total Brexit impact at country level and lies around 70% of the total Brexit impact at country-sector level. In this report we always present **the sum** of the direct and the indirect Brexit impact.

4) **Tariffs (WTO**) and the tariff equivalent of **non-tariff measures (NTM)** are defined at sector level, which makes it possible to model protection per sector, which varies considerably. Sectors are defined at NACE 2 digit level (rev.2) or a slightly higher level of aggregation. Under Brexit, protection is assumed to be the same on both sides of the channel.

5) The model of KUL (2017) considers trade in **added value** rather than gross export values, because only added value in a sector also represents **domestic jobs**. By looking at added value in a sector, we retain the contribution of each sector to the value chain.

6) The Global network model (KUL, 2017), takes into account trade in both **goods and services**. While goods are subject to tariffs, **services are not subject to tariffs** within the World Trade Organization (WTO). Still service sectors are also exposed to Brexit. In the Global Network Model, we show that services are used as an input in many goods sectors. Whenever services are included in goods, services are subject to WTO tariffs. The Brexit impact is important for service sectors too.

7) Our model is a love-for-variety model where similar **inputs** in production can be **sourced from different countries** between which there is an elasticity of substitution (**Armington Assumption**). e.g. German cars can use Belgian steel as well as Mexican steel and Slovakian steel as an input. This assumption corresponds to what is observed in the data. Most other network models assume that every input can only be sourced from only one particular country (**Ricardian Assumption**) , i.e. the one with the lowest cost. A Ricardian approach results in a gravity model with Input-output linkages

between sectors, but cannot evaluate a trade shock impact on a sector like Belgian steel since steel is not differentiated by country of origin in the model.[3] The Global network model that we use in this paper, allows for steel to be differentiated by country of origin and therefore results in a network model where IO linkages give rise to indirect trade flows between country-sectors (Figure 1). We solve this network model analytically and obtain **closed-form solutions** that allow for comparative statics on tariff changes in different sectors. Other assumptions that we make are similar to other network models.

8) The Global Network Model is designed to capture the **short-term impact of trade** shocks. It highlights the network tissue that is destroyed under Brexit and how many job losses this involves. Tariffs imposed by the UK, will make European products more expensive, so there will be less demand for them and less exports from the EU-27 and vice versa. A reduction in EU-27 exports will result in production losses and job losses in the network of EU-27 sectors and similarly for the UK. We assume **equal tariff rates in each sector on both sides** of the channel.[4]

9) The Global Network Model does **not speculate about new network fabric** that can be created after Brexit. If EU-27 companies lose UK customers in certain sectors, new customers will have to be found, which always takes some time. And the same for finding new suppliers. New customers and suppliers can come from the companies' own country or from other countries (**trade diversion**). The negative economic impact will decrease over time, but it would be highly speculative to predict how long that would take. Because we do not know which new network linkages will be developed and how long this process takes, the Global Network Model predicts the short-term Brexit impact of the lost network fabric. It does **not take into account migration of people, investment and capital mobility**, the evolution of the **exchange rate** or the **mitigating policies** that governments can pursue in the face of Brexit.

10) The prediction of the Global Network Model is a **loss-loss situation** for both the UK and the EU-27. It predicts an **economic contraction as shown in Figure 3**. Brexit will decrease the overall output of a country (GDP) which boils down to a shrinking of the economy (dotted line) compared to a counterfactual situation without Brexit (full GDP trend line). How much and how quickly the economy will recover from the

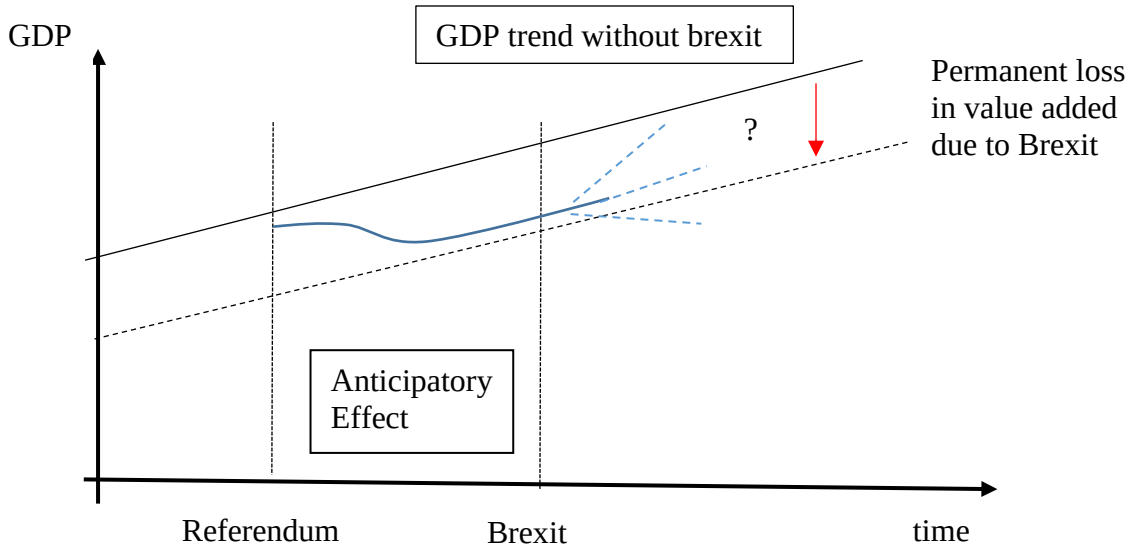
[3] Vandenbussche, Connell and Simons (CES-IFO, 2019), offers a more detailed discussion of other network models and the differences with the Global Network Model.

[4] The United Kingdom has put forward a temporary tariff regime that would apply in the event of a 'no deal'. This regime would apply for up to 12 months. Under the temporary tariff regime, 87% of total imports to the UK by value would be eligible for tariff free access. Given the Most-favored Nation (MFN) principle of the WTO, this tariff regime would equally have to apply to both the European Union as to other third country trading partners of the UK such as the United States and China. The EU has always maintained that it will not change its tariff regime. The introduction of the UK temporary tariff regime will inevitably result in the destruction of network tissue between the EU27 and the UK, but might also create new network tissue for the UK with other trading partners. The trade shock would no longer be bilateral. As the Global Network Model is especially designed to capture the network destruction in the event of a bilateral trade shock - even though it can calculate what happens in "outside" countries as a result of the bilateral trade policy – it is less well-equipped to study multi-lateral trade shocks. The latter would entail making predictions about the formation of new network tissue over time which is highly speculative.

impact, will depend on many factors including those outside the model. In the run up to actual Brexit, there may be anticipatory effects where the economy already shrinks even though no tariffs are put into place. This is due to **uncertainty** about what is going to happen which may result in postponing of investment which already lowers GDP in anticipation of Brexit. While the UK economy is still doing well at the moment, there are signs of a cooling down effect on the economy even when today it is uncertain whether Brexit will happen or not. Our model is not a dynamic model and does not predict year by year effects. Instead it predicts the drop in GDP that will occur under Brexit compared to a counterfactual without Brexit.

Example: Belgian value added will drop by 2,35% as a result of Brexit. This can be interpreted as a shrinking of the Belgian GDP with 2,35%. It is as if Belgium would start on a GDP growth path that is 2,35% lower than without Brexit. The economy will grow again afterwards, but how much time is needed to overcome the shrinking of the pie is unclear and will depend on the mitigating factors such as the extent of migration, the foreign direct investment flows, the migration, the exchange rate response, government tax policies etc. But these mitigating factors lie outside the Global Network Model and will not be taken into account here.

Figure 3: GDP evolution with and without Brexit



11) In the Global Network Model there are **no winners from Brexit,** at least not in the short-run. But the model does not exclude that there can be winners in the longer term. The reason is that trade flows will shift which may benefit either domestic suppliers or suppliers outside the EU. For example, if before Brexit, fish is imported from the UK, after Brexit, fish may well come from Vietnam instead. This makes Vietnam a winner of Brexit. Another example is the import of financial services. Before Brexit, the EU-27 mainly imported financial services from London, but after Brexit, this could shift to Frankfurt and Paris instead. This trade diversion would benefit Germany

and France. However, in this study we focus on the short-term impact of Brexit, e.g. before trade diversion has taken place.[5]

12) The Global Network Model assumes **complete pass-through of tariffs into domestic prices**. We point out that our results vary linearly with the trade elasticity i.e. doubling the trade elasticity in every sector doubles the value added losses from Brexit. As such, the results depend monotonically on the value of the trade elasticity.

13) The Global Network Model starts from a **number of standard assumptions** that are generally accepted in the academic literature on trade models. It models a **Demand side** of the model summarized and visualized in Appendix A.1. It also models a **Supply side** of the model, which is summarized and visualized in Appendix A.2. By bringing together the demand side of the model, the supply side of the model and market clearing conditions, a market equilibrium can be derived. The model thus generates an analytical solution with an algorithm that predicts what the losses in added value will be if a trade partner introduces WTO tariff rates at its external border. The analytical solution of the model, given in Appendix A.3. provides us with an algorithm in which the empirical WIOT data can be used to make predictions on the Brexit impact.

14) The Global Network Model takes into account **all upstream input-output** relationships when calculating the Brexit impact. The information of upstream inputs is summarized in the **Leontief coefficients**, which are available in the Input-output Tables. As a result, the estimates of the KUL (2017) study can be regarded as more accurate than estimates in other studies that only use technical coefficients, which also capture inputs but only from the previous production stage. This is also confirmed by a study of the National Bank that made a comparison of Brexit studies (Bisciari, 2019).

The **distinction between Leontief and technical coefficients** can be made on the basis of an example.

Example: Suppose the German steel sector uses Belgian aluminum rims. Assume that the aluminum for the production of the rims comes from the UK. A technical coefficient analysis only takes into account the use of Belgian steel in German cars, while a Leontief coefficient takes into account all upstream steps in the value chain, including the fact that English aluminum is used in German cars. By only considering technical coefficients, one does not take into account all effects of Brexit, since the reduction in exports of rims from the UK will add to the UK losses from Brexit.
Modelling and using Leontief coefficients makes our analysis of Brexit more accurate than models that only consider first round inputs.

[5] Most existing studies on trade policy find trade diversion effects to be relatively small compared to trade destruction effects. Using different gravity specifications, Magee (2008) finds estimates of the trade diversion effects of regional agreements to be small and their significance to depend on the specification used. Similarly, Soloaga and Wintersb (2001) find evidence of export diversion in a minority of FTAs, as only 2 out of the 9 FTAs analyzed had substantial trade diversion. Therefore, the trade diversion effects of trade policy are likely to be relatively small.

I.2. Empirical Implementation

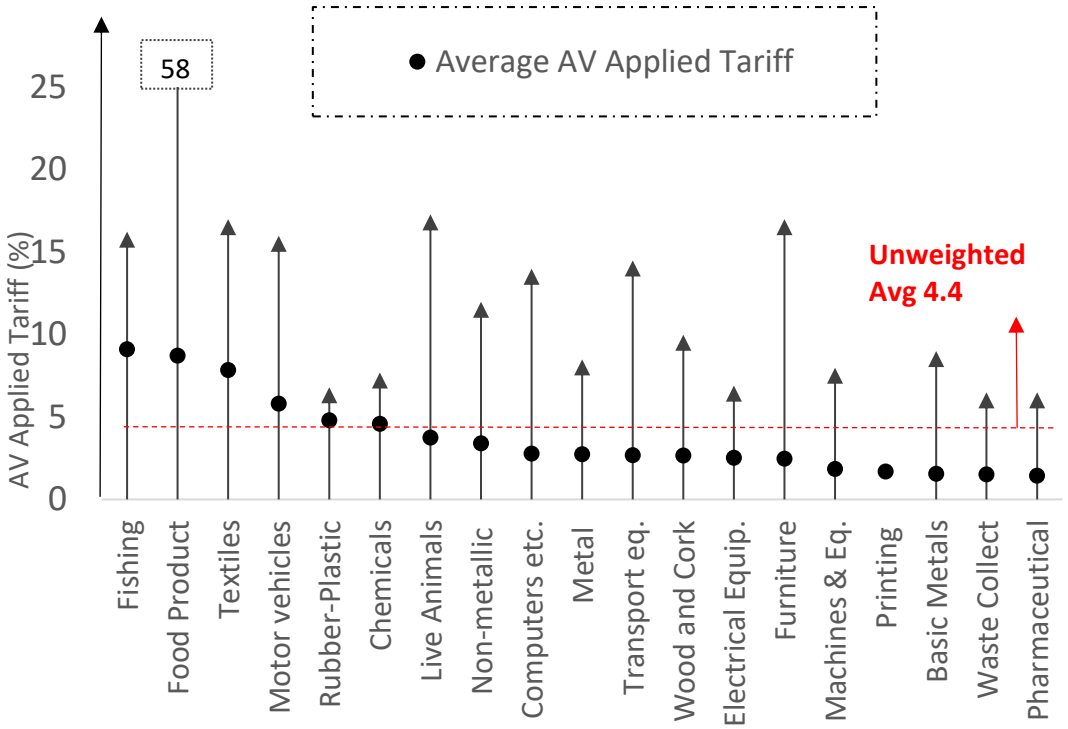
When applying our model to the data to obtain the impact of brexit for each of the EU-28 member states, we use the most recent public data on input-output relationships between sectors. We use the **World Input-Output Tables (WIOT, 2016)** where the most recent release dates from 2016. These data consist of **43 countries and 56 sectors**, with each EU member state being included separately in the database. There is currently no indication that a newer version is coming soon. While there are other input-output data sets than WIOT around, such as GTAP or EORA-MRIO, each of them has its advantages and disadvantages. For example, GTAP has been developed historically to monitor trade in agriculture and still provides great detail on agricultural sectors but less detail is provided on industrial sectors and services than in WIOT. The data available in the EORA input-output tables is available for several countries, but the latest data is from 2012, while WIOT is more recent. Also EORA features only 26 sectors, while WIOT has 56 sectors and is more detailed.
It is important to point out that the WIOT data link sectors of countries to other sectors in Europe and beyond. Therefore the input-output structure that we have allows us to calculate job losses at the level of individual member states. In the subsequent section (I.3) we will explain how we get from country-level job losses to regional, provincial and municipality job losses.

For now, we focus on the **set of parameters** that is required to estimate the algorithm that can be derived from our theory model as given in Appendix A.3. This algorithm allows us to calculate the reduction of value added resulting from tariffs:

i) The magnitude of **WTO tariffs** in every sector which we obtain from the WTO website and which are the same tariffs that apply to the US trade with the EU[6]. The graph below gives an overview of average applied tariffs by sector, where the bands around the averages given by the line segments, show the ranges of tariffs that apply to individual products in that sector. These **MFN tariffs** are the tariffs that are currently imposed on goods traded between the United States and the EU, for instance. **Figure 4** presents the unweighted current MFN tariffs according to WTO rules in the sectors contained in the WIOT database. These are the MFN tariffs from the EU perspective, i.e. those that the EU imposes on imports from abroad. In the No deal (“hard") Brexit scenario, we assume EU-UK and UK-EU trade to be subject to an increase in the trade tariffs on goods from 0% to the unweighted average MFN tariff which ranges from 0% in some sectors (Mining and quarrying, Forestry and Electricity and Gas) to 9.1% in the case of Fishing products.

[6] The WTO website on tariffs is https://www.wto.org/english/tratop_e/tariffs_e/tariff_data_e.htm.

Figure 4: World Trade Organization (WTO) Tariffs[7]



ii) Brexit may also give rise to **Non-tariff barriers** e.g. border controls, product and other standard divergences that may arise. A no deal Brexit scenario[8] corresponds to a no-deal scenario in which tariffs will apply on both sides ànd border controls and other delays and divergences (non-tariff barriers) may kick in. The tariffs we assume to apply in this case are the MFN (WTO) tariffs and the non-tariff barriers (NTB) are based on an existing study in the literature and are shown in Table 1.

[7] The upper (lower) level of the line segments corresponds to the highest (lowest) tariff imposed within the HS6 classified in a Nace rev. 2 sector. The red dotted line marks the unweighted average tariff of all the HS6 products when the European Union reports a tariff under the Most-Favoured nations (MFNs). Tariffs are collected using the Integrated Data Base (IDB). This database contains information on the applied tariffs at the Harmonized System (HS) level for all the WTO members. We use the RAMON correspondence tables to classify the equivalent Combined Nomenclature (CN) to the respective CPA 2008 codes which are then corresponded into the NAC rev 2 sectors of WIOT.

[8] For the Soft Brexit Scenario results, please see the report Vandenbussche (June 2019) that was done earlier.

Table 1: Tariffs and Non-Tariff Barriers under Brexit Scenarios.

	Soft Brexit	No deal Brexit
Tariffs	Unchanged	MFN Tariff
Non-tariff barriers	2.77%	8.31%

Note: Berden et al. (2009).

The magnitude of **NTBs** that we assume, comes from a study by the EU Commission (Berden et al., 2009) where the current NTBs on EU-US trade, are assumed at 20.4%. But for the UK, we assume these NTBs to be substantially lower since currently the UK is inside the single market. Once outside the single market without a deal, border checks, administrative procedures, delays in transport etc. are likely to arise in trade between the UK and the continent. This is what we summarize as NTBs which include both "border measures" (such as customs procedures) and "behind-the-border measures" that result from domestic regulations and standards. We put these NTBs at 8,31% (for more details on how we obtain this number we refer to Vandenbussche et al. (CES-IFO, 2019)).

Allowing for sector heterogeneity in non-tariff barriers (NTB) as in Berden et al. (2009) indicates that **NTBs in some sectors** are lower than what we assumed but in some sectors they are higher. We will discuss this based on **Table 2** below. Note that tariffs and NTBs only apply to goods trade **not to trade in services**. But whenever services are embedded as an input in goods trade, they will also be affected by tariffs and NTBs that apply in the sector in which they are used.

iii) Every sector is characterized by **trade elasticities** e.g. how sensitive EU-27 exports to the UK are to a price increase resulting from UK tariffs. The trade elasticities that we use in the Global Network Model were obtained from Imbs and Méjean (2017) and are listed in Table 2. Whenever we face a missing value in Imbs and Méjean (2017), we impute the average trade elasticities across countries for which we do observe values at a sectoral level. We thus obtain trade elasticities for sixteen different manufacturing sectors, which together with the WTO tariffs are reported in **Table 2.** For sectors where all information is missing, we simply turn to the most common value for the trade elasticity used in the literature which is -4. This value is at the lower end of all estimates that circulate in the literature. But given that we analyze trade in value added rather than gross flows and that our data are at sector-level and not at product-level, we prefer to use this **lower-end estimate** of the trade elasticity for sectors where no trade elasticity is available. This renders our results into lower bound estimates.

The first column of Table 2 lists the sectors of the WIOT database. These sectors correspond to NACE 2 (rev2) digit sectors, but are slightly more aggregated. In Appendix C, we list a complete sector level correspondence between the WIOT sector codes and the NACE 2 sector codes, together with their description.

Column (2) in Table 2 lists the average **applied WTO tariff per** WIOT **sector** where tariffs are averaged over all products belonging to that sector and which are used in our simulations.
Column (3) gives the maximum tariff in that sector, while column (4) gives the minimum tariff in that sector, usually zero.
Column (5) gives the **trade elasticity per sector** and columns (6) and (7) give the **NTB**s in a no deal Brexit case that we used to simulate the outcomes of our model. We do not distinguish between sectors, but have used the average NTB that applies across all sectors. The main reason is that data on NTBs are difficult to obtain and are missing in some sectors. This can be seen in column (8) and (9) in Table 2. There we report what is available for NTBs in terms of sector heterogeneity for a no deal Brexit scenario. But there are many sectors for which data cannot be found. The data that we retrieved are from a study by Berden et al. (2009). Due to the scarcity of data on NTBs at sector-level, we decided to take an average that is set equal across all sectors.

But it is clear from Table 2 columns (8), (9), that in some sectors the NTBs can be different than what we have used in the simulations. Especially in **Food and Beverages**, **NTBs** can be expected to be **higher than the average** that we have used in our simulations, which is why we indicate these NTBs in red in Table 2.

Based on this we conclude that for the sector Food and Beverages, the Brexit impact that we present is likely to be a lower bound of the true effect which may be larger. But for other sectors **NTBs can be substantially lower** than what we have assumed. These sectors are indicated in green. These sectors are Wood (C16), Paper (C17), Pharma (C21), Computers (C26) and Electrical equipment (C27).[9]

iv) From the WIOT data we also obtain the **Leontief coefficients** that capture all upstream input-output linkages for every sector. This information is needed to calculate **how much of the added value each sector in every EU-27 country will lose when the UK introduces WTO rates**. It is important that this also captures how much the UK loses due to its own rates.
Example: If the UK produces aluminum for Belgian car rims, a UK tariff on the export of Belgian car rims to the UK, will lead to a fall in Belgian demand for English aluminum and hurt the UK. Due to the **global value chains** that run across different European countries, **UK import rates against EU-27 exports will also damage UK sectors.** This adds to the damage that UK sectors suffer from Brexit and will be added to our calculations. And vice versa for the EU-27.

[9] Please turn to the Sector Legend Appendix C at the end of document to see the full name of the sectors.

Finally, we arrive at a total Brexit effect per sector in the EU-28. We then aggregate all sector losses to the level of each EU-28 country to arrive at a loss of added value per EU member state.

Table 2: Parameters used to simulate the Global Network Model (KUL, 2017)

	WTO Tariffs			Imbs and Méjean	Berden et al. (2009)		Konings and Murphy
WIOT sector	Average Applied MFN Tariff (%)	Max Applied MFN Tariff (%)	Min Applied MFN Tariff (%)	Trade Elasticity	NTM no deal Brexit (%)	NTM no deal Brexit (%)	Employm. Elasticity
(1)	(2)	(3)	(4)	(5)	(7)	(9)	(10)
A01	3.75	17.30	0	-4.0	8.31		0.57
A02	0.00	0.00	0	-4.0	8.31	.	0.57
A03	9.11	16.25	0	-4.0	8.31	.	0.57
B	0.02	0.85	0	-4.0	8.31	.	0.57
C10-C12	8.73	57.60	0	-6.3	8.31	24.4	0.57
C13-C15	7.86	17.00	0	-11.9	8.31	6.7	0.57
C16	2.67	10.00	0	-5.0	8.31	3.6	0.57
C17	0.15	6.36	0	-4.9	8.31	3.6	0.57
C18	1.70	1.70	1.7	-5.1	8.31	.	0.57
C19	0.38	1.97	0	-7.8	8.31	.	0.57
C20	4.60	7.70	0	-5.7	8.31	8.4	0.57
C21	1.45	6.50	0	-5.7	8.31	4.7	0.57
C22	4.81	6.80	0	-5.1	8.31	8.4	0.57
C23	3.41	12.00	0	-4.9	8.31	8.4	0.57
C24	1.56	9.00	0	-6.1	8.31	5.4	0.57
C25	2.75	8.50	0	-8.1	8.31	5.4	0.57
C26	2.79	14.00	0	-11.3	8.31	2.4	0.57
C27	2.54	6.90	0	-4.0	8.31	2.4	0.57
C28	1.85	8.00	0	-9.9	8.31	.	0.57
C29	5.82	16.00	0	-4.0	8.31	9.8	0.57
C30	2.69	14.50	0	-4.0	8.31	9.8	0.57
C31_C32	2.48	17.00	0	-7.4	8.31	.	0.57
D35	0.00	0.00	0	-4.0	8.31	.	0.57
E37-E39	1.53	6.50	0	-4.0	8.31	.	0.57

Notes: 1) These values were used in the simulations of the model; 2)To obtain average tariffs per sector, we corresponded HS6 product codes to CPA product codes and then we corresponded CPA codes to NACE 2 codes; 3) see Sector _legend Table at the back for Nace correspondence of WIOT sectors; 4) Service sectors are not listed but have a trade elasticity of -4, tariffs and NTBs do not apply; 5) The Employment elasticity used for the service sectors is 0.33.

v) To make our estimations we also need **Employment elasticities** e.g. this will tell us how much of the value added in each sector that is lost due to Brexit, represents job losses. This elasticity measures the proportionate drop in employment after a 1% decrease in value added production. In theory, Hamermesh (1986) argued that a production function characterized by constant returns to scale, like ours, has an employment elasticity of 1. If this was true, than it would suggest that job losses are proportional to production losses e.g. a 2% loss in value added would also imply a 2% loss of jobs.

However, this seems refuted by existing empirical evidence in the literature. Konings and Murphy (2006) using European firm level data, estimate employment elasticities with respect to value added for manufacturing and non-manufacturing sectors. They find **employment elasticities** to range between 0.57 and 0.72 in manufacturing sectors and find the average employment elasticity in non-manufacturing sectors to be 0.33. Given our focus on European data, we use the lower bound of these sectoral estimates. This implies that for every 1% drop in domestically produced value added as a result of Brexit, we assume employment to go down by **0.57 % in manufacturing and 0.33% in non-manufacturing sectors**. The values of these employment elasticities are shown in the last column of **Table 2**. The Brexit results on employment depend linearly on the choice of the employment elasticity. Thus, once we have obtained the relative drop in employment from the decrease in production, we compute the **absolute number of jobs lost** by multiplying by the country-sector's total employment base.

I.3. Regional, Provincial and Municipality-Level Approach

The above analysis gives us an indication of the job losses for each EU-28 country. In order to obtain job losses at a lower level of aggregation, we would ideally need regional Input-output tables at sector level with an international dimension e.g. with value chain production linkages for every Belgian region. That would allow us to study the production structure of the regions, taking into consideration how regions and the sectors they host are connected via other EU regions/countries to satisfy the UK final demand in every sector. This information however is not available to us.

To overcome this data limitation we take an alternative approach. To calculate the proportionate job loss in every sector in the region of Flanders, we use the estimated total Belgian loss in that sector, weighted by the share of Flemish employees within the total Belgian employment in that sector. We obtain this data from EUROSTAT (2016). For example, in the food sector, the Flemish region accounts for about 70% of the total Belgian employees. Thus, to obtain the job losses in the Flemish food sector, we multiply the Belgian job losses in food that we obtain from the international Input-Output data as described in section I.2., with 70%, to obtain a measure of job losses in the Flemish food sector. What has to be kept in mind is that our alternative approach is an **approximation** of the true employment in a region that works for the

UK market. This does not fully take into account the real trade exposure of Flanders to Brexit since our data does not provide details about the export orientation of the sector-level activity at the regional level.

At **provincial level** we face a similar data limitation. Data on the export orientation of a Province is missing. Thus, we turn to an approximation to arrive at job losses at Province level e.g. we take the Belgian losses in a sector and weight them by the share of Province employees in total Belgian employment in that sector which we obtain from **EUROSTAT** (2016). This approach may result in an under-estimation of the Brexit effect in the Belgian provinces closest to the UK and an over-estimation in other provinces. The reason is that provinces closer to the UK, may have a stronger export orientation towards the UK.

For the calculation of job losses at the level of the **municipalities**, we use **Social Security Records (RSZ) data** (2015) on employment at sector-level. Given that we know for each municipality (308 in total) the number of people that work in a particular sector, we use that to calculate the job losses in every sector.[10] Our approach then consist in multiplying Belgian job losses in a sector by the share of the municipality employment in total Belgian employment in that sector.

Caveat 1: Our data on Brexit job losses are cleanest at the level of the country Belgium as a whole. When we break down the job losses by Region, Province and Municipality we face a data limitation e.g. we do not know the export orientation of the Region, Province, Municipality and do not know where exports are shipped to. This should be kept in mind when interpreting the results. Our results could entail an under-estimation of the job losses resulting from Brexit for those Flemish municipalities that are strongly export oriented to the UK. Also, in the event that a Brexit would deter future access to UK fishing zones, job losses in coastal areas could be substantially larger than what we currently predict.

Caveat 2: Our RSZ employment data per municipality indicate where the jobs are located but do not provide information on where job holders live. Therefore we may be under-estimating the impact of Brexit in some municipalities where a lot of job commuters live.

Caveat 3: Job losses at municipality level only include salaried jobs and do not include self-employed independent persons.

[10] The RSZ data give us the number of salary jobs, so not the number of self-employed persons.

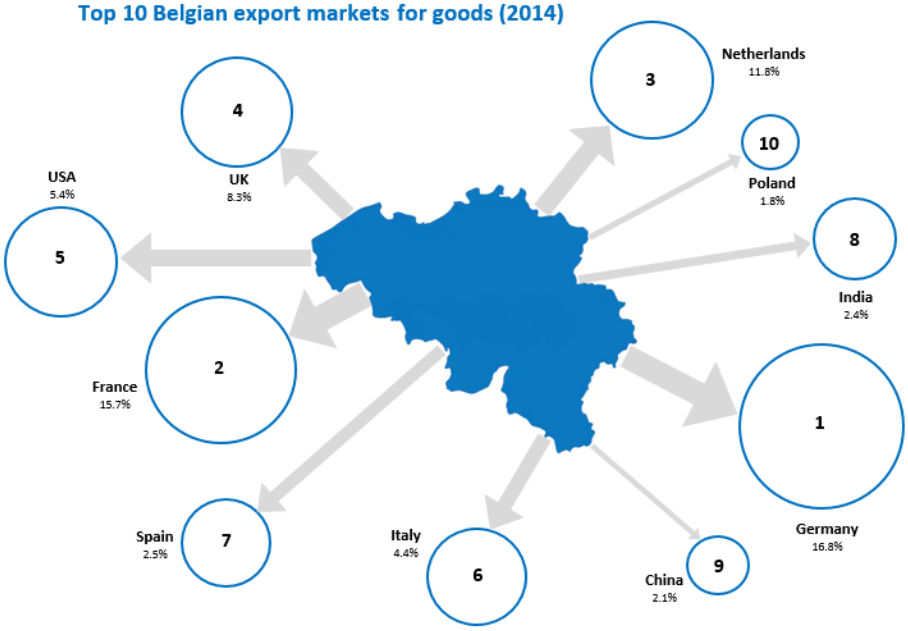
II. Belgian Gross Trade Partners

Exports

We start by documenting gross exports for Belgium. This data comes from EUROSTAT (2016). We clearly see that the UK is the fourth most important export market for Belgium, accounting for around 8,3% of exports in goods (Map 1). In terms of Imports, the UK comes in position five and accounts for 4,9% of total Belgian imports in goods (Map 2).

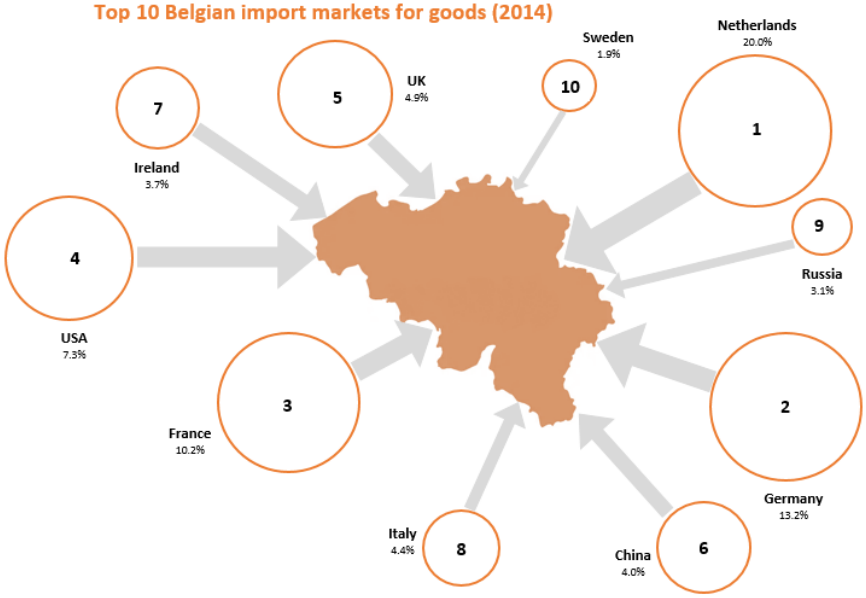
Map 1:

Top 10 Belgian export markets for goods (2014)



Map 2:

Top 10 Belgian import markets for goods (2014)



Note: *The percentage shares represent how much Belgium trades with each of its partners in terms of overall Belgian imports. The original data report import values in US $ for all goods imported in 2014 (source: UN Comtrade).*

III. Brexit Impact Results

To calculate the **aggregate impact of Brexit** we simulate the Global Network Model and study its results for Belgium, the EU-27 and the UK. We focus on the worst case scenario of a no deal Brexit, but the corresponding numbers for the soft Brexit case can be found in the Tables below. These numbers have already been reported elsewhere (KUL, 2017) but we include them here to start with results on the aggregate picture.

III.1. Brexit Impact at Country-Level

In terms of output losses, **Belgium** loses about **2,35%** of its **value added** in production, while the **EU-27** as a whole loses about **1,54%** of its **GDP** due to a no deal Brexit. The loss for the **UK** under a no deal Brexit would be **4,47%** of its **GDP**. For **Belgium** this corresponds to absolute job losses of **42 000 jobs**, while for the **EU-27** as a whole the job loss would amount to **1 200 000 jobs** lost and for the **UK** at worst **500 000 job** losses would result from a no deal Brexit.

Table 3: Output losses under Brexit for EU-27, Belgium and UK

Brexit scenario	Output loss (in % of GDP)		
	Belgium	EU-27	UK
Soft Brexit	0.58%	0.38%	1.21%
No deal Brexit	2.35%	1.54%	4.47%

Table 4.a.: Job Losses under Brexit for EU-27, Belgium and UK (absolute numbers)

Brexit scenario	Job Losses (absolute numbers)		
	Belgium	EU-27	UK
Soft Brexit	10 000	284 000	140 000
No deal Brexit	42 000	1 200 000	526 000

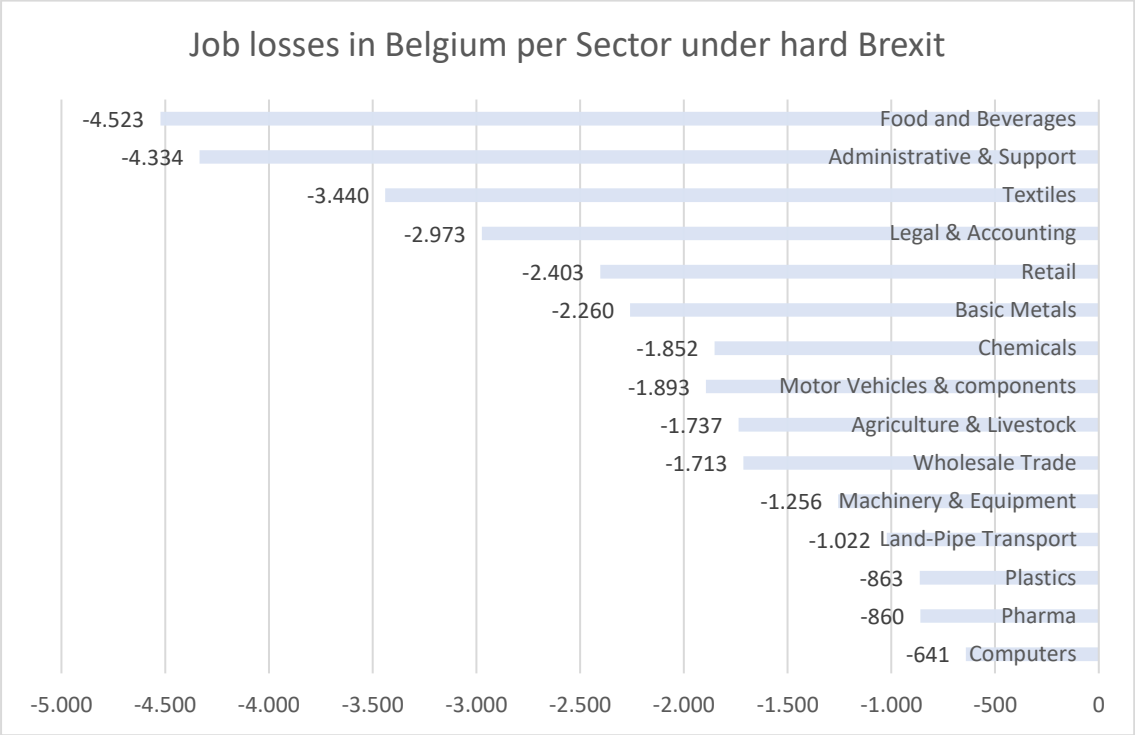
Table 4.b.: Job Losses under Brexit for EU-27, Belgium and UK (relative numbers)

Brexit scenario	Job Losses (in % country employment)		
	Belgium	EU-27	UK
Soft Brexit	-0.22%	-0.15%	-0.45%
No deal Brexit	-0.93%	-0.62%	-1.71%

III.2. Brexit Impact at Sector-Level

We rank **Belgian job losses** for the fifteen **most affected sectors** under **a no deal Brexit**. This gives a better overview of the losses for each sector and how they can be ranked.

Figure 5 : Ranking of Sectors in Belgium – Job Losses No deal Brexit



Source: Vandenbussche, Connell and Simons (2017), Vives-KU Leuven discussion paper.

III.3. Brexit Impact at Regional Level

Next, we also break down the job losses for Belgium to the level of the **regions**. The job losses for regions in Belgium are shown in Table 5 below. Not surprisingly, the **largest** share of the Belgian **job losses** takes place in **Flanders**. Of the 42 000 Belgian job losses under no deal Brexit, about 28 000 jobs will be lost in Flanders. Wallonia comes second with 10 000 job losses under hard Brexit and the remaining 4 000 jobs will be lost in Brussels.

Absolute Job Losses by Region

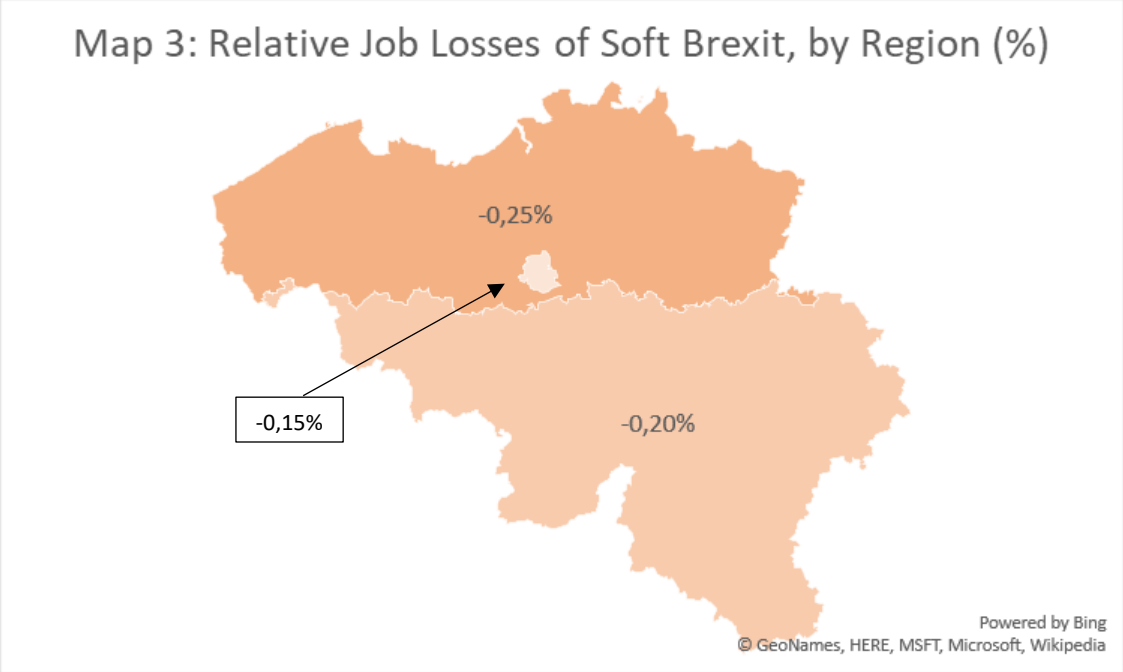
Table 5: Job losses by Region under Brexit

	Job Losses at Regional Level			
	Soft Brexit		No deal Brexit	
	jobs	(% of total jobs)	jobs	(% of total jobs)
Brussels	-1 000	-0,15%	-4 000	-0,58%
Flanders	-6 500	-0,25%	-28 000	-1,06%
Wallonia	-2 500	-0,20%	-10 000	-0,82%
Belgium	**-10 000**	**-0,22%**	**-42 000**	**-0,92%**

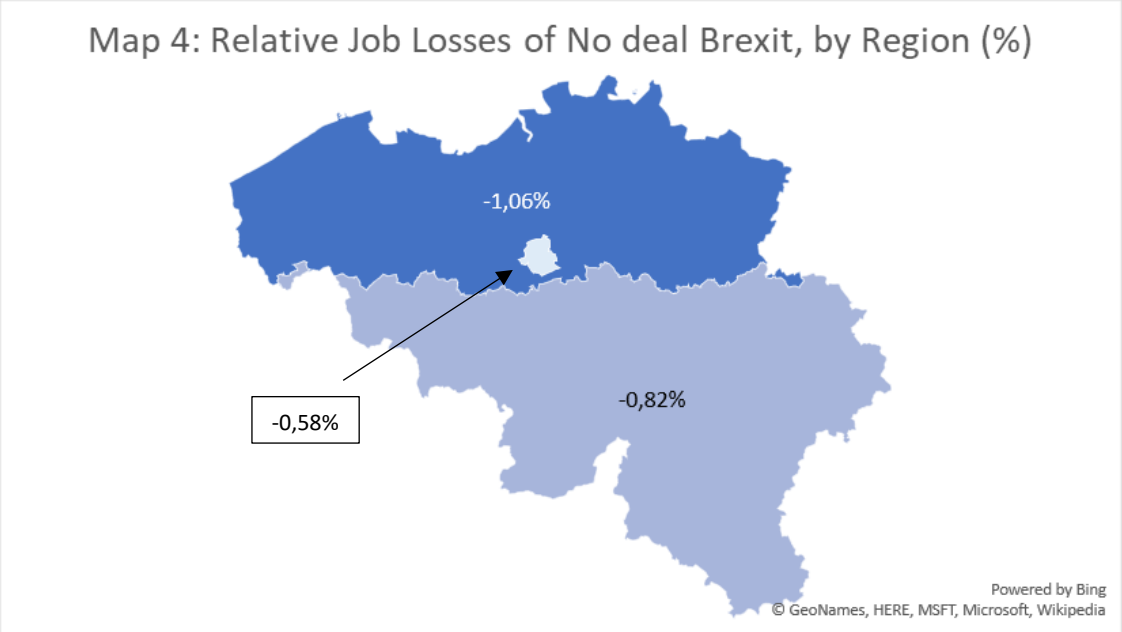
Source: Vandenbussche et al. (2017), VIVES discussion paper. KU Leuven. Numbers are rounded.

Relative job losses by Region

In Map 3 below we visualize the relative job losses under a soft Brexit for each region and in Map 4 we do the same but in the case of a No deal Brexit. To get relative employment losses, we relate the job losses to the employment level of the specific region in question.



Note : Employment numbers in the Region comes from “Steunpunt Werk (2015)”.



III.4. Brexit Impact at Provincial Level

We now **break down job losses** for Belgium by Province.

Table 6: Job Losses at Provincial Level under Brexit

Province	Absolute Job Losses (numbers) Soft Brexit	Relative Job Losses (%) Soft Brexit	Absolute Job Losses (numbers) No deal Brexit	Relative Job Losses (%) No deal Brexit	Total Employment in the Province
Antwerp	-1942	-0.25	-7 900	-1.0	788 900
East-Flanders	-1531	-0.26	-6 701	-1.15	581662
West-Flanders	-1471	-0.29	-6 531	-1.28	508 635
Brussels Capital Region	-1038	-0.15	-4 012	-0.58	688 420
Flemish Brabant	-907	-0.20	-3 679	-0.83	443 376
Hainaut	-882	-0.21	-3 660	-0.86	422 921
Limburg	-791	-0.24	-3 281	-0.98	333 354
Liège	-779	-0.21	-3 230	-0.86	374 248
Brabant-Wallon	-384	-0.24	-1 480	-0.93	157 660
Namur	-283	-0.17	-1 159	-0.71	162 910
Luxemburg	-177	-0.19	-753	-0.81	92 334

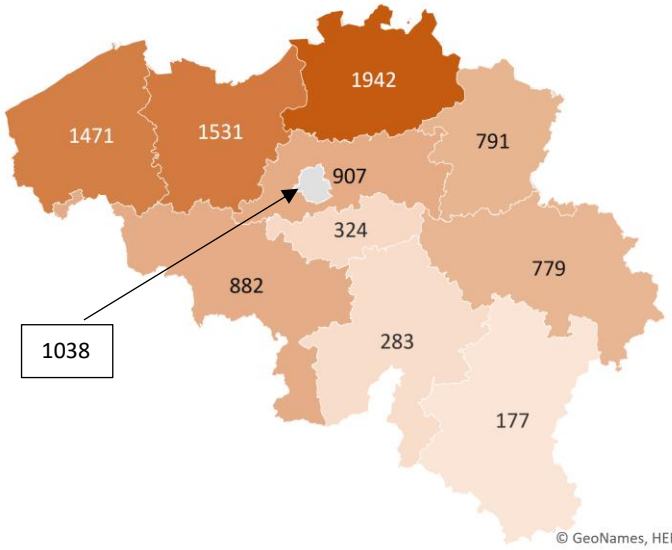
Note: Employment Losses are calculated based on data of 2014 which is the latest year available in the World Input-Output Tables (WIOT). Employment levels come from “Steunpunt Werk (2015)”.

Absolute Job Losses by Province

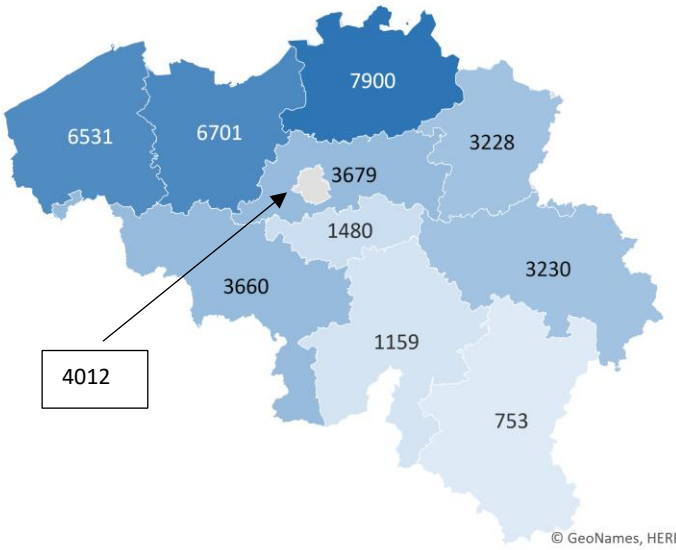
In absolute numbers, we find that the Province of Antwerp would lose most jobs. However, the difference with East-and West-Flanders job losses is not very big in absolute terms, which can be seen in the Table below.

The absolute job losses are illustrated in the following Maps. In Map 5, we show the absolute job losses by Province under a Soft Brexit and in Map 6 we do the same but for the case of a No deal Brexit.

Map 5: Absolute Job Losses Soft Brexit, by Province



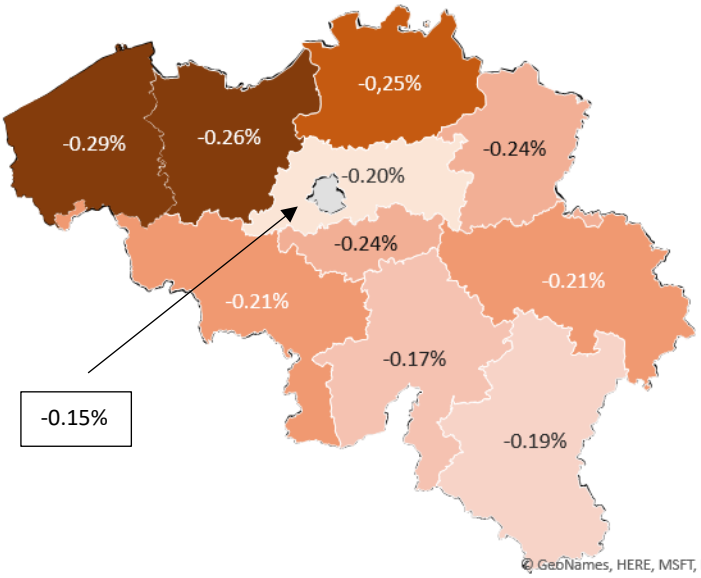
Map 6: Absolute Job Losses No deal Brexit, by Province



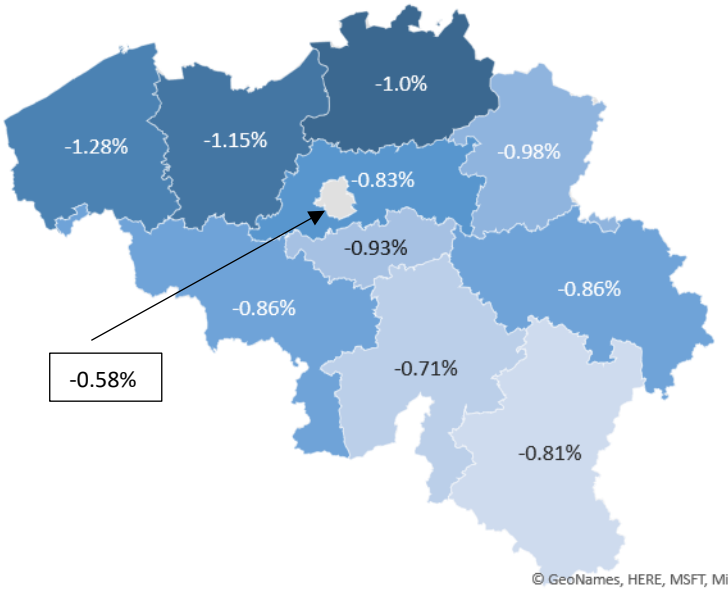
Relative Job Losses by Province

Next, we visualize the job losses in relative terms e.g. expressed in terms of the active working population of the Province. By taking the share of job losses over the active working population, we now control for the size of each Province which differs.

Map 7: Relative Job Losses Soft Brexit, by Province



Map 8: Relative Job Losses with No Deal Brexit, by Province



The Provinces hit relatively hardest under Brexit are East and West-Flanders and this holds both in the case of a soft Brexit as well as a No Deal Brexit. Average relative job loss for Belgium as a share of active working population ranges between 0.93% in the case of Soft Brexit and 0.22% in the case of No Deal Brexit.[11]

[11] Employment of active population is taken from "Steunpunt Werk (2015)".

II.5. Brexit Impact at Flemish Municipality Level

This section documents the more local employment effects of Belgium and shows job losses at the level of the municipalities based on RSZ data on employment per sector for Flanders.

Relative Job Losses

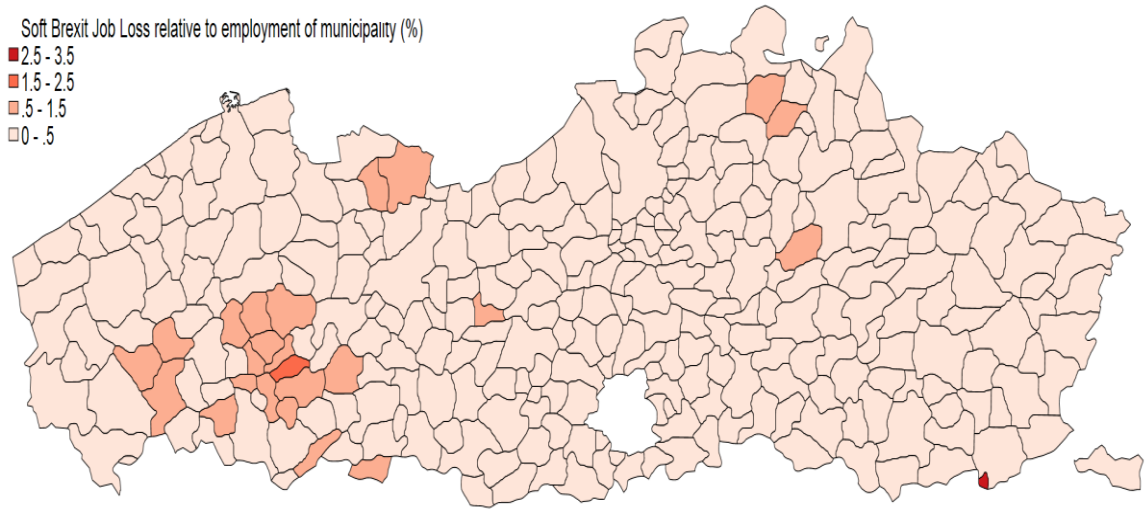
Flanders has 308 municipalities. In the maps below we show relative job losses for each municipality as a share of total employment in the municipality. We show relative job losses evolving under a soft Brexit (Map 8) and under a No deal Brexit (Map 9).

The data in the maps reflect the result of the Global Network model but broken down at the level of municipalities using the RSZ records of sector level employment per municipality.

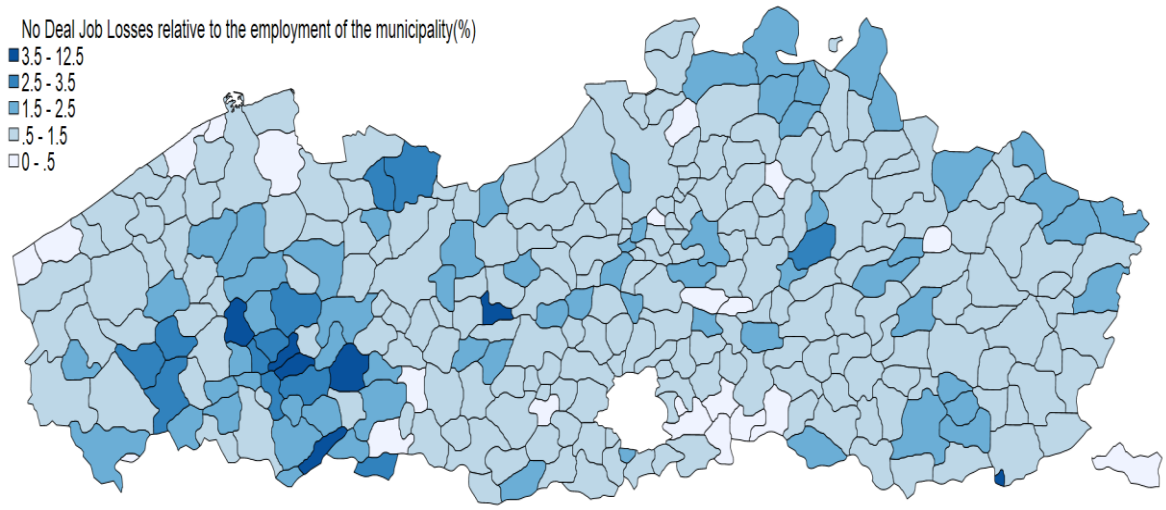
Important to note is that i) we do not know the export orientation of sectors at municipality level and ii) the RSZ data on employment per municipality only include employees but not independents. Seeing the data limitations, these results should be regarded as an approximation of the true Brexit employment losses.

The results show that especially municipalities in West-Flanders are negatively hit and suffer job losses. In the case of a No deal Brexit, job losses would also be severe in other municipalities in the region.

Map 9 : Soft Brexit Relative Job Losses in Flanders, in shares



Map 10 : No Deal Relative Job Losses in Flanders, in shares



CONCLUSION

A “no deal” brexit would have a detrimental impact on the economic tissue of the European economy with job losses of up to 1,2 million for the EU27 and 526.000 for the UK. Even though such a scenario is less probable at the time of publication, a “no deal” can still occur if there is no timely ratification of the Withdrawal Agreement or if the Withdrawal Agreement is ratified but no agreement on the EU-UK future relationship is struck before the end of the transition period. A soft brexit scenario would minimize the damage, but would still disrupt European value chains and lead to heavy job losses.

Brexit does not only affect direct trade to the UK, but also indirect trade e.g. intermediate inputs and services that are embedded in the goods of third country sectors that eventually end up in the UK. The more upstream a sector in the network, the larger the indirect network effects of a trade shock. In Belgium a lot of upstream sectors (such as Food & Beverages, Legal & Accounting Services) are exposed to a trade shock with the UK. Our results confirm that Belgium would be one of the most affected countries within the EU, both in terms of GDP as in job losses. A “no deal” brexit would lead to 42.000 job losses and an output loss of 2,35% of GDP. A soft brexit would still be significant with 10.000 jobs lost and an output loss of 0,58% of GDP.

Flanders would feel the largest impact under any Brexit scenario within Belgium. Job losses in Flanders under a “no deal” brexit would be 28.000 which is larger than those for most European countries such as Austria, Denmark, Sweden, Slovakia and similar to those of Portugal or Hungary. The impact figures are most probably an underestimation for Flanders as they do not take into account export orientation and job losses for Flemish commuters who work in Brussels.

On a provincial level in Flanders, the Brexit impact will be the largest in the Province of Antwerp in absolute figures with an estimated job loss of 7900. In terms of relative job losses (i.e. expressed as a share of the total employment of a province) the provinces of West-Flanders and East-Flanders are most affected. Relative job losses for West-Flanders under a “no deal” scenario would amount to 1,28% of total employment in the province, for East Flanders this would be 1,15%.

The impact of Brexit on local employment at the level of municipalities is very heterogeneous across Flanders. It depends on the sectoral composition within the municipalities. Notwithstanding the methodological difficulties in applying trade exposure to the results on a local level, we assume that most of the job losses will occur around the Bruges-Kortrijk axis and the cities of Antwerp and Ghent. The relative local employment losses in West-Flanders vary greatly from one municipality to another as a result of the sectoral trade exposure with the UK.

Appendix A: Global Network Model

A.1. Demand Side of the Model

Analytical

The representative consumer in country k derives utility from consuming quantities of an aggregate final good F_k:

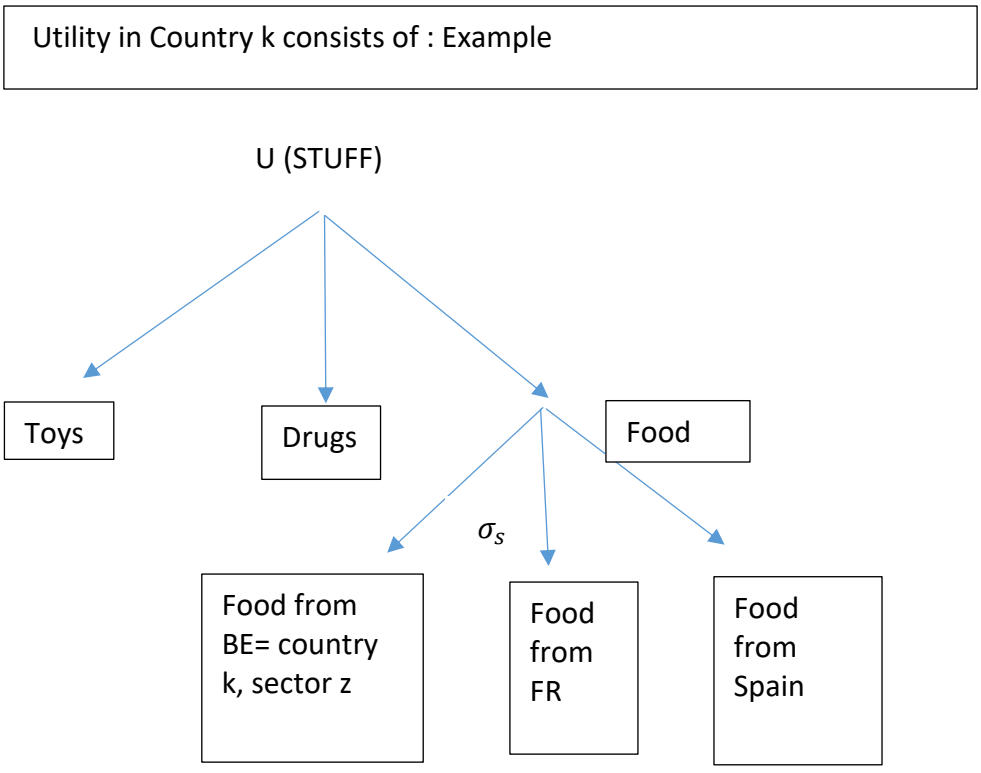
$$U_k = F_k = \prod_{s=1}^{S} [F_k^s]^{\alpha_k^s}$$

Which is a Cobb-Douglas combination of quantities F_k^s consumed of final goods from all sectors $s \in S$, with α_k^s the corresponding share in total expenditures. This sector-specific final good is a Constant Elasticity (CES) of Substitution aggregate across all countries the good can be purchased from:

$$F_k^s = \left[\sum_{i=1}^{N} (F_k^{is})^{\frac{\sigma_s - 1}{\sigma_s}}\right]^{\frac{\sigma_s}{\sigma_s - 1}}$$

Where σ_s>1 is the elasticity of substitution (for final goods) between the countries of origin N within sector s.

Visual



Source: Vandenbussche et al. (2017), KU Leuven

A.2. Supply Side of the Model

In country k sector z, output Y^{kz} is produced with a Cobb-Douglass technology that uses as inputs labor L_{kz} and intermediate inputs X_{kz}:

$$Y^{kz} = (L_{kz})^{1-\beta^{kz}}(X_{kz})^{\beta^{kz}}$$

Where β^{kz} represents the share of intermediate expenditures in total sales of country k's sector z. The intermediate goods composite X_{kz} is a Cobb-Douglas combination of intermediate goods from all sectors $s \in S$, X_{kz}^{s}:

$$X_{kz} = \prod_{s=1}^{S} [X_{kz}^{s}]^{\gamma_{kz}^{s}}$$

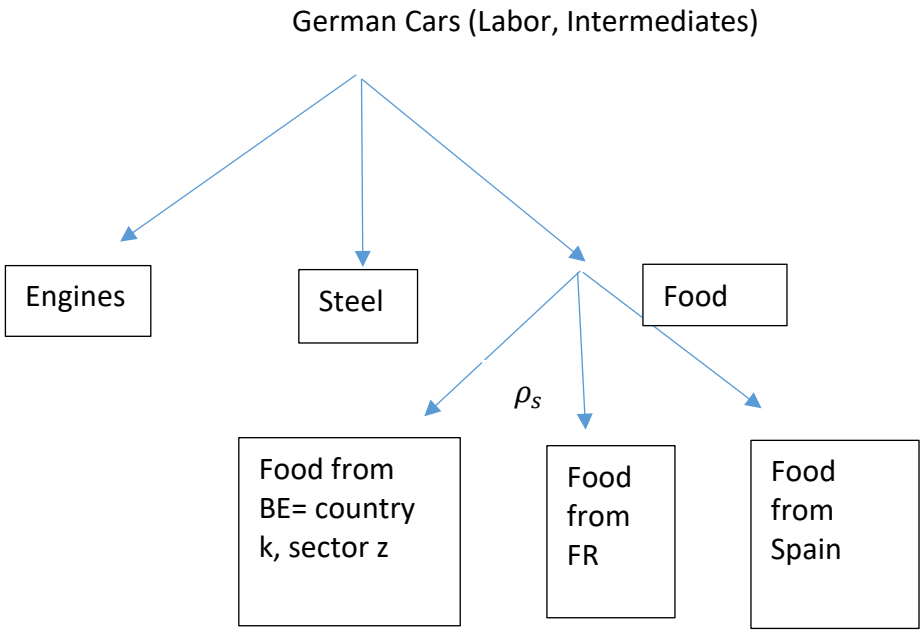
Where X_{kz}^{s} denotes the real aggregate demand of intermediates from sector s by country k's sector z, and γ_{kz}^{s} is the corresponding share in total expenditures in inputs. The sector specific intermediate good X_{kz}^{s} is a CES aggregate across all countries N the input can be purchased from:

$$X_{kz}^{s} = \left[\sum_{i=1}^{N} (X_{kz}^{is})^{\frac{\rho_s - 1}{\rho_s}}\right]^{\frac{\rho_s}{\rho_s - 1}}$$

Where ρ_s>1 is the elasticity of substitution (for intermediate goods) between the countries of origin within sector s. Note that this nested Cobb-Doubles-CES structure is similar to that of the consumer demand aggregates.

Visual

Sector Level Output and its Inputs: Example



A.3. Solution of the Model for a UK tariff on EU-27

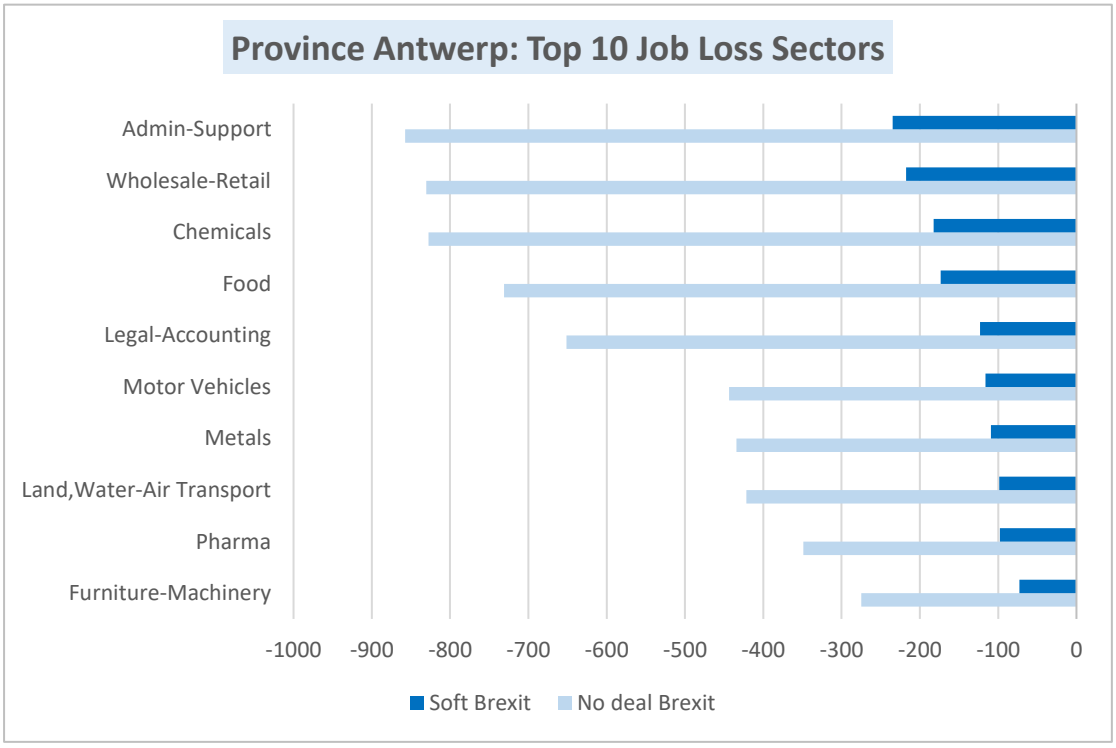
$$dva^{kz} \approx \underbrace{-v^{kz}\sum_{s=1}^{S}(\sigma_s-1)\frac{d\tau_{UK}^{EU,s}}{\tau_{UK}^{EU,s}}L_{ks}^{kz}e_{UK}^{ks}}_{\text{direct loss}} \underbrace{-v^{kz}\sum_{i\in EU\setminus\{k\}}^{N}\sum_{s=1}^{S}(\sigma_s-1)\frac{d\tau_{UK}^{EU,s}}{\tau_{UK}^{EU,s}}L_{is}^{kz}e_{UK}^{is}}_{\text{indirect loss}}$$

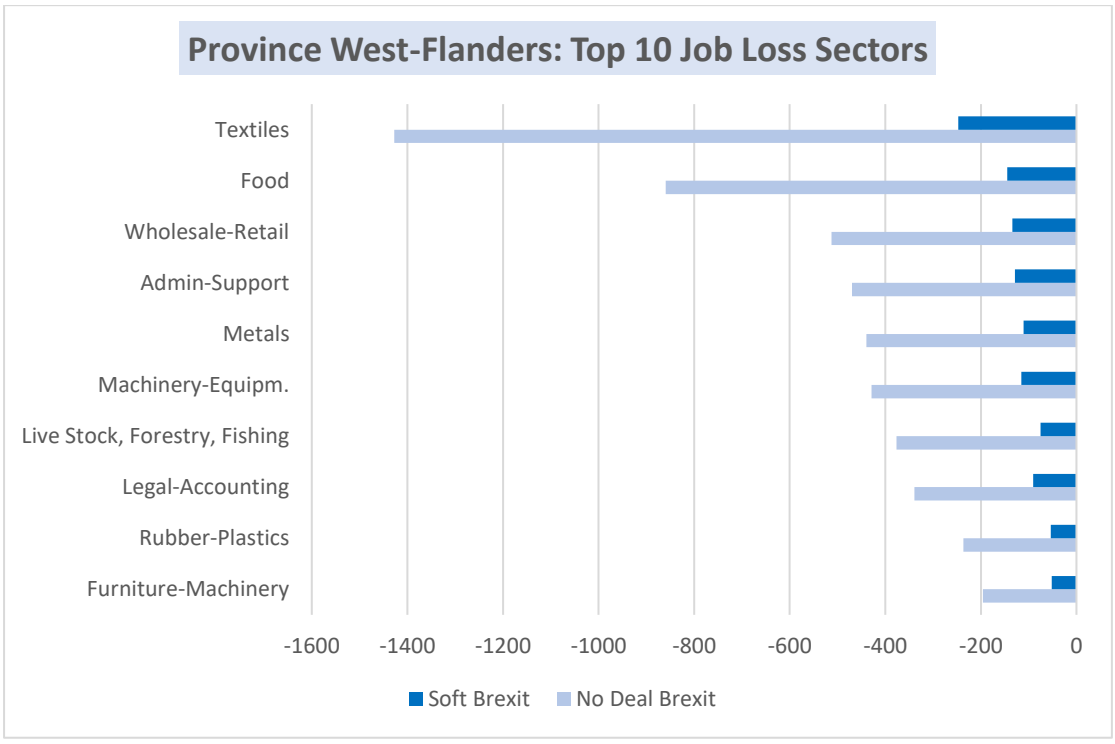
The first term on the right-hand side of the formula gives the impact of UK tariffs on the direct trade between Belgium and the UK. It states that the loss of Belgian value added (dva^{kz}) in a country(k)-sector(z) e.g. *kz* (Belgian steel) depends on the share of value added in gross output of sector Belgian steel (v^{kz}); the trade elasticity in sector s that uses Belgian steel ($\sigma_s - 1$); the change in the tariffs between the EU and the UK in sector *kz* (Belgian steel) and any domestic sector *s* that uses Belgian steel ($\frac{d\tau_{UK}^{EU,s}}{\tau_{UK}^{EU,s}}$); the Leontief coefficient between a country-sector *kz* (Belgian steel) and another sector s (Belgian cars) in the same country (L_{ks}^{kz}) which is a summary of how any sector s in country k uses input z; and the intensive margin of the direct trade flow between the country-sector *ks* that uses sector *z* (including sector *z* itself) and the UK (e_{UK}^{ks}).

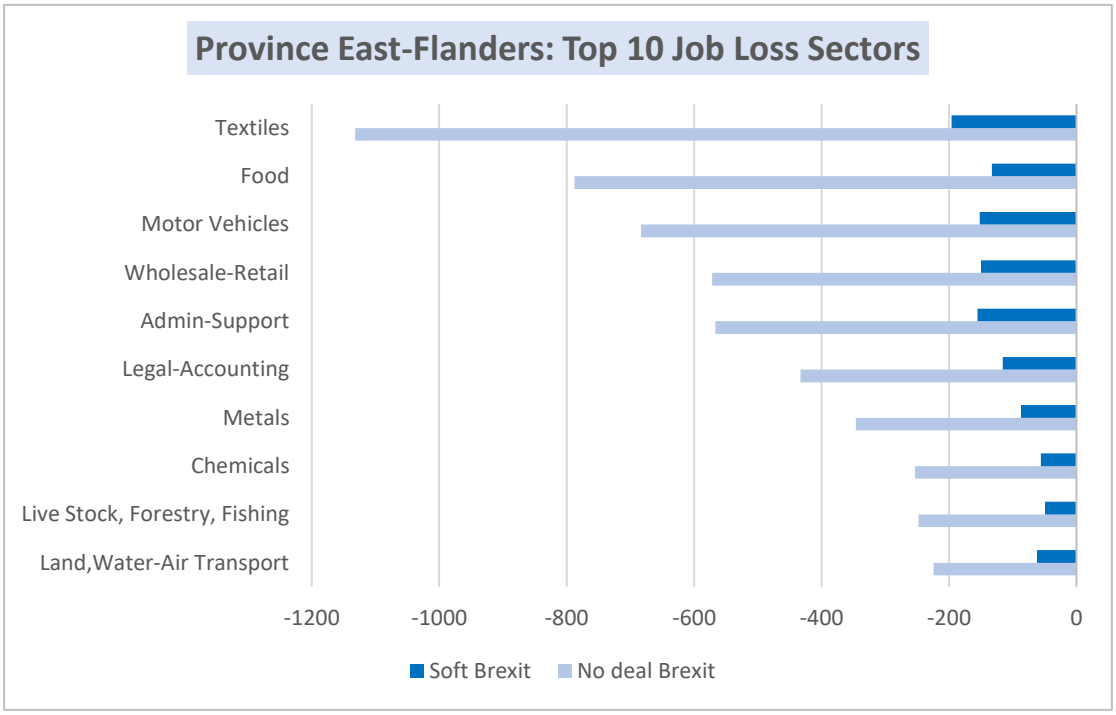
The second term on the right-hand side gives the impact of UK tariffs on trade from any EU-27 sector that travels to the UK e.g. via third countries (any of the other EU-27). This indirect loss from UK tariffs for the country(k)-sector(z) e.g. *kz* (Belgian steel) depends on the Leontief coefficient between a country-sector *kz* and any third country (i)-sector (s) e.g., *is* (German cars), which summarizes how every sector abroad uses Belgian steel (L_{is}^{kz}); the direct trade flow between country-sector abroad and the UK (e_{UK}^{is}). In our analysis we assume that only the tariffs between the EU-27 and the UK change(($\frac{d\tau_{UK}^{EU,s}}{\tau_{UK}^{EU,s}}$), but for other countries, tariffs remain the same.

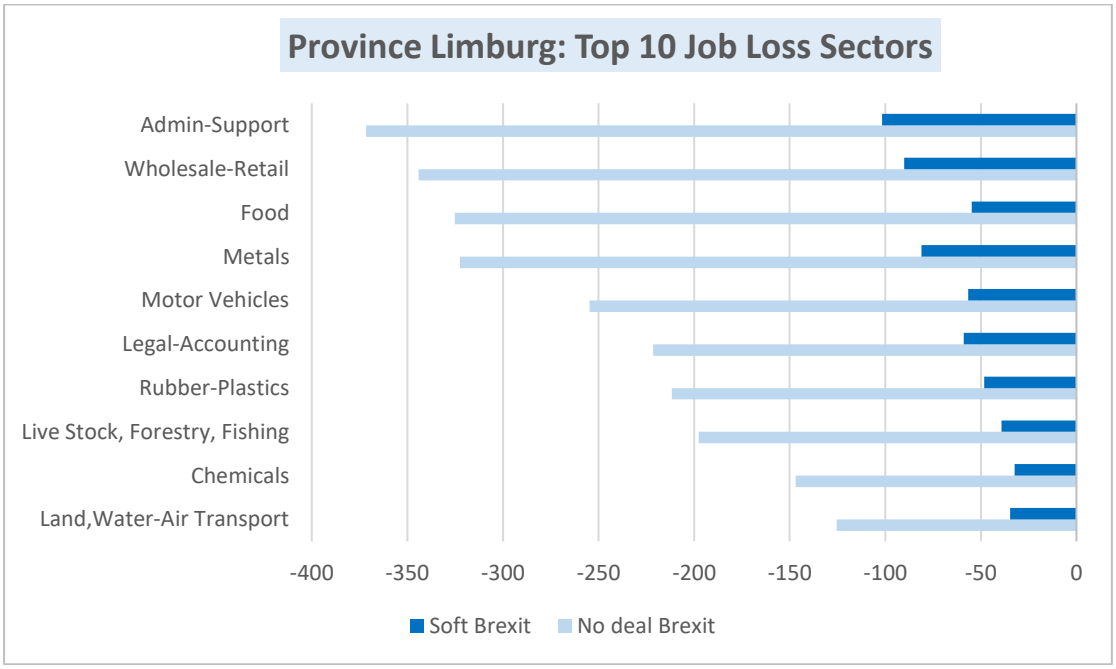
For our analysis, the formula above is applied to any sector in the EU-27 that is facing UK tariffs (1) to obtain a measure of the impact of UK tariffs.
Subsequently, we then engage in the same analysis but now assuming that the EU-27 imposes tariffs on imports from the UK (2). This results in the same formula but where UK and EU-27 now switch positions. The total Brexit effect for any country-sector is then given by the sum of (1) and (2).

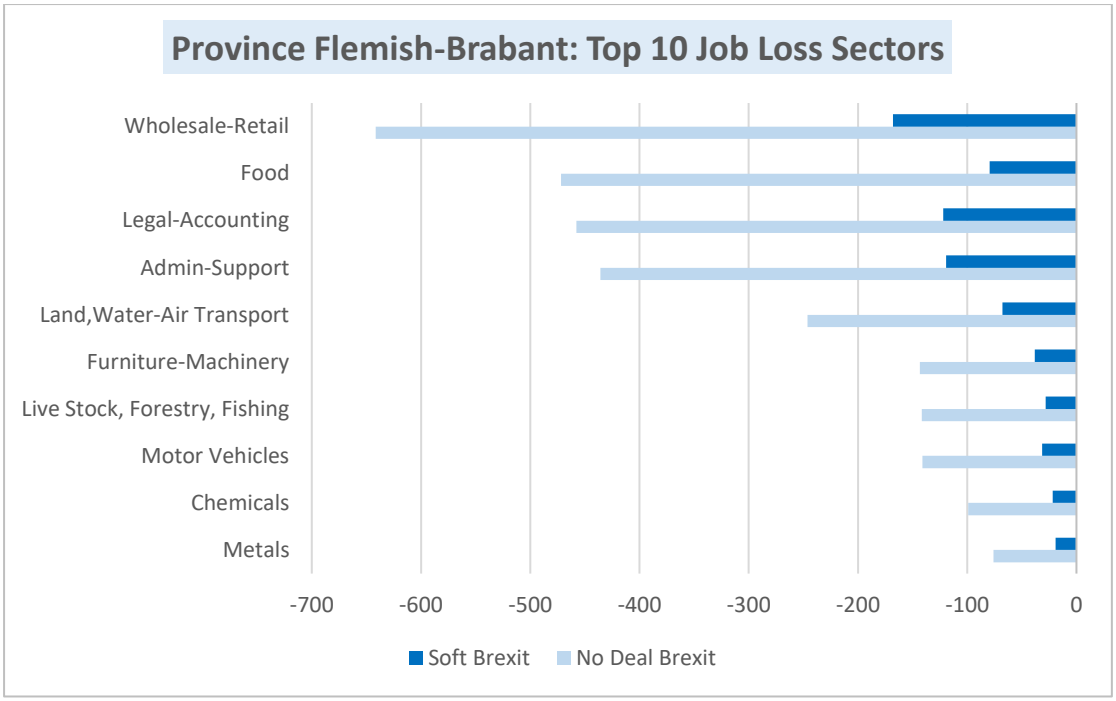
Appendix B:
By Province in Flanders: Top 10 Most Affected Sectors. Hard Brexit case






Province East-Flanders: Top 10 Job Loss Sectors
Textiles
Food
Motor Vehicles
Wholesale-Retail
Admin-Support
Legal-Accounting
Metals
Chemicals
Live Stock, Forestry, Fishing
Land,Water-Air Transport
-1200
-1000
-800
-600
-400
-200
0
Soft Brexit
No deal Brexit


Province Limburg: Top 10 Job Loss Sectors
Admin-Support
Wholesale-Retail
Food
Metals
Motor Vehicles
Legal-Accounting
Rubber-Plastics
Live Stock, Forestry, Fishing
Chemicals
Land,Water-Air Transport
-400
-350
-300
-250
-200
-150
-100
-50
0
Soft Brexit
No deal Brexit


Province Flemish-Brabant: Top 10 Job Loss Sectors
Wholesale-Retail
Food
Legal-Accounting
Admin-Support
Land,Water-Air Transport
Furniture-Machinery
Live Stock, Forestry, Fishing
Motor Vehicles
Chemicals
Metals
-700
-600
-500
-400
-300
-200
-100
0
Soft Brexit
No Deal Brexit

Appendix C: NACE-WIOT Sector Legend

Nace Rev.2	NACE	Official Description (Nace Rev.2)	WIOT	WIOT Legend Short
1	A	Crop and animal production, hunting and related service activities	A01	Agriculture and livestock farming
2	A	Forestry and logging	A02	Forestry
3	A	Fishing and aquaculture	A03	Fishing and aquaculture
5	B	Mining of coal and lignite	B	Mining and quarrying
6	B	Extraction of crude petroleum and natural gas	B	Mining and quarrying
7	B	Mining of metal ores	B	Mining and quarrying
8	B	Other mining and quarrying	B	Mining and quarrying
9	B	Mining support service activities	B	Mining and quarrying
10	C	Manufacture of food products	C10-C12	Food & Beverages
11	C	Manufacture of beverages	C10-C12	Food & Beverages
12	C	Manufacture of tobacco products	C10-C12	Food & Beverages
13	C	Manufacture of textiles	C13-C15	Textiles, clothing, footwear, leather goods
14	C	Manufacture of wearing apparel	C13-C15	Textiles, clothing, footwear, leather goods
15	C	Manufacture of leather and related products	C13-C15	Textiles, clothing, footwear, leather goods
16	C	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	C16	Wood and cork products
17	C	Manufacture of paper and paper products	C17	Paper and cardboard products
18	C	Printing and reproduction of recorded media	C18	Printing and Media
19	C	Manufacture of coke and refined petroleum products	C19	Petroleum Products
20	C	Manufacture of chemicals and chemical products	C20	Chemicals
21	C	Manufacture of basic pharmaceutical products and pharmaceutical preparations	C21	Pharmaceuticals
22	C	Manufacture of rubber and plastic products	C22	Plastics
23	C	Manufacture of other non-metallic mineral products	C23	Other non-metallic mineral products
24	C	Manufacture of basic metals	C24	Basic Metals
25	C	Manufacture of fabricated metal products, except machinery and equipment	C25	Non-machinery metal products
26	C	Manufacture of computer, electronic and optical products	C26	Electronic and computer equipment, optical and precision instruments
27	C	Manufacture of electrical equipment	C27	Electrical Equipment
28	C	Manufacture of machinery and equipment n.e.c.	C28	Machinery & Equipment
29	C	Manufacture of motor vehicles, trailers and semi-trailers	C29	Motor vehicles and automotive components
30	C	Manufacture of other transport equipment	C30	Other transport equipment (shipbuilding, railway stock, aeronautics…)
31	C	Manufacture of furniture	C31_C32	Furniture, medical supplies & miscellaneous manufacturing
32	C	Other manufacturing	C31_C32	Furniture, medical supplies & miscellaneous manufacturing
33	C	Repair and installation of machinery and equipment	C33	Installation of machinery
35	D	Electricity, gas, steam and air conditioning supply	D35	Electricity & Gas
36	E	Water collection, treatment and supply	E36	Water Collection Activities
37	E	Sewerage	E37-E39	Waste Collection Activities
38	E	Waste collection, treatment and disposal activities; materials recovery	E37-E39	Waste Collection Activities
39	E	Remediation activities and other waste management services	E37-E39	Waste Collection Activities
41	F	Construction of buildings	F	Construction
42	F	Civil engineering	F	Construction
43	F	Specialised construction activities	F	Construction
45	G	Wholesale and retail trade and repair of motor vehicles and motorcycles	G45	Wholesale and retail trade
46	G	Wholesale trade, except of motor vehicles and motorcycles	G46	Wholesale trade
47	G	Retail trade, except of motor vehicles and motorcycles	G47	Retail trade
49	H	Land transport and transport via pipelines	H49	Land & Pipeline transport

50	H	Water transport	H50	Water transport
51	H	Air transport	H51	Air transport
52	H	Warehousing and support activities for transportation	H52	Warehousing
53	H	Postal and courier activities	H53	Postal
55	I	Accommodation	I	Accommodation & Food serv.
56	I	Food and beverage service activities	I	Accommodation & Food serv.
58	J	Publishing activities	J58	Publishing Act.
59	J	Motion picture, video and television programme production, sound recording and music publishing activities	J59_J60	Media Production
60	J	Programming and broadcasting activities	J59_J60	Media Production
61	J	Telecommunications	J61	Telecom
62	J	Computer programming, consultancy and related activities	J62_J63	Computer Programming, consultancy
63	J	Information service activities	J62_J63	Computer Programming, consultancy
64	K	Financial service activities, except insurance and pension funding	K64	Financial Services
65	K	Insurance, reinsurance and pension funding, except compulsory social security	K65	Insurance
66	K	Activities auxiliary to financial services and insurance activities	K66	Auxiliary Financial Serv.
68	L	Real estate activities	L68	Real Estate
69	M	Legal and accounting activities	M69_M70	Legal and Accounting
70	M	Activities of head offices; management consultancy activities	M69_M70	Legal and Accounting
71	M	Architectural and engineering activities; technical testing and analysis	M71	Architectural and engineering act.
72	M	Scientific research and development	M72	Scientific Research
73	M	Advertising and market research	M73	Advertising and market research
74	M	Other professional, scientific and technical activities	M74_M75	Other professional activities
75	M	Veterinary activities	M74_M75	Other professional activities
77	N	Rental and leasing activities	N	Administrative and support act.
78	N	Employment activities	N	Administrative and support act.
79	N	Travel agency, tour operator and other reservation service and related activities	N	Administrative and support act.
80	N	Security and investigation activities	N	Administrative and support act.
81	N	Services to buildings and landscape activities	N	Administrative and support act.
82	N	Office administrative, office support and other business support activities	N	Administrative and support act.
84	O	Public administration and defence; compulsory social security	O84	Public admin and defence
85	P	Education	P85	Education
86	Q	Human health activities	Q	Health
87	Q	Residential care activities	Q	Health
88	Q	Social work activities without accommodation	Q	Health
90	R	Creative, arts and entertainment activities	R_S	Other services
91	R	Libraries, archives, museums and other cultural activities	R_S	Other services
92	R	Gambling and betting activities	R_S	Other services
93	R	Sports activities and amusement and recreation activities	R_S	Other services
94	S	Activities of membership organisations	R_S	Other services
95	S	Repair of computers and personal and household goods	R_S	Other services
96	S	Other personal service activities	R_S	Other services
97	T	Activities of households as employers of domestic personnel	T	N/A
98	T	Undifferentiated goods- and services-producing activities of private households for own use	T	N/A
99	U	Activities of extraterritorial organisations and bodies	U	N/A
N/A not included in the study				

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