THE IMPACT OF COVID-19 ON EXPORTS RELATED JOBS

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ABSTRACT

The current COVID-19 pandemic has had drastic and unprecedented impacts on trade, and GDP worldwide and in the EU. We assess in the paper the potential export related jobs losses that would have affected European workers had not governments and the EU implemented large exceptional support packages to prevent real job losses. To this end, we use a global multi-region input output model and build a counterfactual analysis based on trade flows projections made before the COVID-19 pandemic broke out. Our results show that in the absence of jobs and enterprise retention measures, more than 6 million exports dependent jobs would have been at risk. Therefore, it is urgent for trade to recover quickly since millions of jobs are at stake.
1. INTRODUCTION

The COVID-19 pandemic has unleashed unprecedented economic and social crisis not experienced in that magnitude and nature by humankind. The COVID-19 related slowdown in demand for goods and services lead to a drastic decrease in real world GDP of 3.3% and a reduction in global world trade volumes of 8.5% (IMF 2021a, section 2). In comparison, the financial crises of 2009 led to a decline in real world GDP of only 0.1% however a decline in global trade volumes of 10% (IMF 2021b, section 1). In the EU, real economic activity declined by more than 6% and exports of goods and services collapsed by 22% in 2020 (EUROSTAT 2021, section 2.2).

Furthermore, the pandemic affected and in many cases disrupted the sourcing of foreign value-added along global supply chains and altered companies’ decisions in respect to their preferred choices of optimal intermediate inputs mix. Export restrictions, and in some cases export bans, led to disruptions in productions patterns and exposed the vulnerability of global supply chains interdependencies in several sectors. On the final demand side, COVID related curfews and closures of several businesses led to a significant decline in households’ expenditures on foreign and domestic goods and services.

At the same time governments throughout the world and in the European Union (EU) implemented vast exceptional support packages to alleviate the social impact of the pandemic and prevent significant employment losses. At the EU level, these measures included: (i) the suspension of state aid and fiscal rules, (ii) a new instrument to address sudden increases in public expenditure for the preservation of employment (SURE), (iii) a major Recovery plan of EUR 1.6 trillion, and (iv) the European Central Bank’s Pandemic Emergency Purchase Programme in the magnitude of EUR 1.8 trillion (see section 2.2).

At Member State level, a recently published dataset provides an indication of the size of the fiscal burden linked to payments to keep workers in active employment and to support SMEs to remain viable to amount to 8.3% in Germany, 5.1% in France, 5.5% in Denmark until November 2020 (Bruegel datasets, 2020).

These measures at EU and Member States level have proven to be highly effective to prevent real jobs losses, as employment declined by merely 1.5% in the EU compared to a decline in real economic activity of more than 6%.

Against this background, the purpose of the current paper is to assess the impact of the pandemic on exports related jobs in the EU in the absence of exceptional support measures by using a multi-region input output (MRIO) tables modelling framework. More specifically, the authors will base their calculations on the World Input-Output Database (Timmer et al, 2015, 2016).
To this end and in a first step we estimate the number of exports dependent jobs in the EU in the year 2020 based on the creation of a counterfactual trade volume that would have been realised had the pandemic not hit the world economy. For that purpose, the authors make use of global projections to extrapolate hypothetical trade volumes for the year 2020.

The estimation of the exports dependent jobs will be based on the methodology in Kutlina-Dimitrova, Rueda-Cantuche, Amores and Román (2018). By following this approach, one arrives at the number of jobs dependent on extra-EU exports in the absence of COVID-19 related trade shocks.

In a second step, the authors calculate the number of jobs related to extra-EU exports in the year 2020 by using the most recent actual 2020 trade data affected by the pandemic. The difference between scenarios 1 and 2 yields the net impact of the COVID-19 pandemic on exports dependent jobs in the EU. To the knowledge of the authors, this is a first attempt to estimate the likely impact of the pandemic on exports related jobs in the absence of vast exceptional support measures aimed at preventing real job losses.

The rest of the paper is organised as follows: Section 2 provides an overview of the extent to which the COVID-19 crisis affected world and EU GDP, trade and employment. Section 3 presents the methodological approach and the novelty of the underlying MRIO framework. Section 4 provides results in respect to the total number of jobs losses at country and sectoral level. Finally, section 5 concludes and looks ahead.

2. GLOBAL AND EXTRA-EU TRADE, EMPLOYMENT AND GDP DURING THE COVID-19 PANDEMIC

2.1. THE IMPACT OF THE PANDEMIC ON WORLD GDP AND TRADE

The COVID-19 pandemic had severe impact on world GDP and global exports of goods and services. Figure 1 show the development of global GDP and trade in the period 2007-2020 in constant terms. Based on the data, real world GDP decreased by 3.3% in 2020 and the volume of goods and services exports by 8%. Figure 1 also allows for a comparison with the financial crises of 2009 in respect to the magnitude of the shock to the global economy.

In 2009, world economic activity declined only negligibly by merely 0.1% compared to the severe COVID-19 induced decrease in GDP of 3.3% in 2020. The impact of the financial crises in respect to global exports of goods and services is however comparable with the shock on trade flows during the pandemic although world trade declined slightly stronger by nearly 10% in 2009.
2.2. THE IMPACT OF COVID-19 ON EU EXPORTS, GDP AND EMPLOYMENT

The impact of COVID-19 on EU economies has been unprecedented in nature and magnitude. In fact, compared with the developments of the world economy presented previously, EU GDP and external trade were hit harder than the rest of the world economies. Figure 2 depicts the impact of the COVID-19 pandemic in percentage changes of EU GDP, goods and services exports as well as employment.

In 2020, EU economic activity declined by 6% in real terms which is almost double as high as the shrinking of the world economy. Furthermore, EU exports of goods decreased by 10% and EU exports of services by 22%. On average EU exports declined by 14% in 2020. Based on this data, both EU trade and GDP were significantly harder affected by COVID-19 than the global GDP and trade.

Employment, on the other side, as least measured on the base of persons employed, was not as severely impacted as economic activity and trade due to the implementation of large exceptional support measure at EU and Member States level to prevent a more pronounced drop in employment and to dampen the social impact of the crisis (see Box 1). From a theoretical perspective, it is to be expected that employment development would follow real GDP patterns, however, as mentioned previously this was prevented thanks to large employment retention measures, short and part time work schemes and the support received from EU funds notably SURE (European Commission, 2021b). The success of these measures is undeniable as the number of person employed declined by merely 1.5% corresponding to about 3 million workers at EU level.
Even compared to other developed economies such as Japan or the US, EU employment declined markedly less strongly thanks to the effectiveness of the comprehensive governmental measures in support of employment mentioned above. This led to marked differences in disruptions in labour markets as for example, employment declined by 6.3% in the US and 5% in Japan although also in these countries job retention instruments were put in place (OECD 2021).

**Box 1: An overview of exceptional support measures during COVID-19**

Exceptional measures were implemented at the level of both: the EU and at individual Member State level

Measures put in place by the EU include the following:

Temporary suspensions of fiscal and state aid rules

European Recovery Plan of up to EUR 1.8 trillion including the creation of a new recovery instrument, ‘NextGenerationEU’. This instrument has an envelope of more than EUR 800 billion to help alleviate the immediate economic and social damage brought about by the COVID-19 pandemic (European Commission, 2021a).

This instrument is in addition to the European Central Bank’s EUR 1.85 trillion Pandemic Emergency Purchase Programme counteracting the serious risks to the monetary policy transmission mechanism posed by the COVID-19 outbreak (ECB, 2021).

Employment specific exceptional measures preventing real job losses were also funded at EU level through the *temporary Support to mitigate Unemployment Risks in an Emergency* (SURE). This programme provides Member States with financial assistance in the magnitude...
of up to EUR 100 billion to address sudden increases in public expenditure for the preservation of employment. As off the latest disbursement (25 May 2021), the EU has already provided nearly EUR 90 billion to 19 EU Member States to preserve employment (European Commission, 2021b).

At Member State level

A recently published dataset provides an indication of the size of the fiscal burden linked to payments to keep people employed and subsidizing SMEs to amount to 8.3% in Germany, 5.1% in France, 5.5% in Denmark until November 2020 (Bruegel datasets, 2020).

The impact of these exceptional support measures becomes apparent, if one would look at the hours worked in 2020 compared to the number of person employed as depicted in Figure 3. The presented data shows clearly that the number of hours worked in the EU declined even stronger than EU GDP, by precisely 6.4% whereas the number of persons employed declined by merely 1.5%. This gives an important clue of the likely magnitude of the impact on the number of persons employed in the absence of exceptional support measures.

**Figure 3: Percentage change in the number of hours worked in the EU, based on previous year**

Source: Eurostat, data downloads on 5th June 2021.

2.3. THE IMPACT OF COVID-19 ON EXTRA-EU TRADE

As presented in Figure 1, the impact of COVID-19 on EU exports of goods and services has been severe. EU exports of goods and services to the rest of the world declined by 14% on average in 2020. Merchandise exports were less severely affected than services exports as they declined by 10% compared to a decrease of 22% of services exports. Figure 4 offers a comparison of extra-EU merchandise exports in 2020 and 2019 per HS section. The largest decline in absolute terms in exports (EUR 64 billion) has been in the transport equipment
followed by machinery products with nearly EUR 50 billion of exports losses. In relative terms, however, it is the mineral products sector losing the most with sectoral exports declining by 36%. It is important to mention that there are sectors that have expanded exports during COVID-19. These are chemicals and vegetables produced, marking an increase in exports by EUR 6 and EUR 3 billion, respectively.

Figure 4: Extra EU merchandise exports by HS section, 2019-2020, in EUR million

![Graph showing extra EU merchandise exports by HS section, 2019-2020, in EUR million]

Source: EUROSTAT, statistical regime 4

EU services sectors trade with the rest of the world has been hit the hardest during COVID-19. Figure 5 provides an overview of the most affected services sectors by balance of payments categories. The data reveals that the exports of the travel sector services have been most severely affected by the pandemic.

In 2020, the foreign demand for travel services declined in absolute terms by EUR 111 billion, corresponding to a decrease of nearly 70% on previous year basis. Furthermore, this sector accounted for nearly 60% of the total decline in extra-EU services exports.

The second most affected sector is transport followed by other businesses sector. Extra-EU exports of these sectors declined in absolute terms by EUR 36 and EUR 33 billion respectively, corresponding to a decline on a previous year basis of 19% and 11%. In terms of the importance in the total decline of services exports transport and other business services account for 1/5 and 1/10 of the total export losses.
Figure 5: Extra-EU services exports by BOP categories, 2019-2020, in EUR million

Source: EUROSTAT, BOP categories. *IPR stands for Intellectual property rights and **ICT for information and communication technologies.

3. DATA SOURCES AND METHODOLOGICAL APPROACH

We base our analysis on the latest World Input-Output Database (Timmer et al, 2015, 2016) (industry by industry) released in November 2016. These tables link National Accounts, business data, trade statistics and employment data for all EU Member States, and other non-EU countries in the world for the period from 2000 to 2014. The values in the WIOD tables are in current prices and valued at basic prices. The WIOD tables present the relationship between the EU economies, at a detailed level of 56 industries and 56 products. Employment is measured based on the number of persons engaged (hereafter, number of jobs) in each activity.

In order to obtain the number of jobs impacted by the COVID-19 pandemic, we estimate in a first step the number of exports dependent jobs in the EU in the year 2020 based on the creation of a counterfactual hypothetical trade volume that would have been realised had the pandemic not hit the world economy. For that purpose, the authors make use of global projections of exports in volumes published in the European Commission’s Autumn Economic Forecast 2019 for the year 2020 (European Commission, 2019). By following this approach, one arrives at the number of jobs dependent on extra-EU exports in the absence of COVID-19 related trade shocks.
In a second step, the authors calculate the number of jobs related to extra-EU exports in the year 2020 by using the most recent actual 2020 trade data affected by the pandemic. The difference between scenarios 1 and 2 yields the net impact of the COVID-19 pandemic on exports dependent jobs in the EU. To the knowledge of the authors, this is a first attempt to estimate the likely impact of the pandemic on exports related jobs in the absence of vast exceptional support measures aimed at preventing real job losses.

In formal terms and following Miller and Blair (2009) and Kutlina-Dimitrova, Rueda-Cantuche, Amores and Román (2018), among others, the calculation of the number of jobs embodied in exports for one year (i.e. 2019) is given by the Leontief model, as follows,

\[ \mathbf{v}_{\text{ex eu}}^{\text{EU}} = \mathbf{w}_{\text{EU}}^{\text{EU}} (\mathbf{x}_{\text{EU}}^{\text{EU}})^{-1} [I - \mathbf{Z}_{\text{EU}}^{\text{EU}} (\mathbf{x}_{\text{EU}}^{\text{EU}})^{-1}]^{-1} \mathbf{e}_{\text{EU}}^{\text{EU}} \]

where \( \mathbf{Z}_{\text{EU}}^{\text{EU}} \) is the intermediate matrix with industry deliveries from EU country \( r \) to EU country \( s \); \( \mathbf{e}_{\text{EU}}^{\text{EU}} \) is the column vector of exported goods produced by EU country \( r \) to non-EU countries; \( \mathbf{x}_{\text{EU}}^{\text{EU}} \) is the column vector of industry output for country \( r \); and \( \mathbf{w}_{\text{EU}}^{\text{EU}} \) is the column vector of the number of jobs in industry \( r \) of EU countries. \(^{\wedge}\) stands for a diagonal matrix with the elements of a vector placed in the main diagonal of the matrix. For \( n \) industries and \( m \) countries, the dimensions of the matrices described in the above equation are: \((n \times m)\) for exports, industry output and jobs and \((n \times m) \times (n \times m)\) for intermediate uses, the identity matrix and the result on the left hand side of the equation, namely the number of jobs in EU country \( r \) (row) supported by the EU exports of country \( s \) (column) to the rest of the world.

Moreover, \( \mathbf{Z}_{\text{EU}}^{\text{EU}} (\mathbf{x}_{\text{EU}}^{\text{EU}})^{-1} \) is the so-called matrix of technical coefficients; \( \mathbf{w}_{\text{EU}}^{\text{EU}} (\mathbf{x}_{\text{EU}}^{\text{EU}})^{-1} \) a diagonal matrix of employment coefficients, and \( [I - \mathbf{Z}_{\text{EU}}^{\text{EU}} (\mathbf{x}_{\text{EU}}^{\text{EU}})^{-1}]^{-1} \) the Leontief inverse.

Therefore, for 2019 (we drop the superscript EU to simplify notation), the equation is as follows,

\[ \mathbf{v}_{\text{ex eu}}^{2019} = \mathbf{w}_{2019} (\mathbf{x}_{2019})^{-1} [I - \mathbf{Z}_{2019} (\mathbf{x}_{2019})^{-1}]^{-1} \mathbf{e}_{2019} \]

Next, by assuming the same technical coefficients matrix as in 2019 and that employment and output grew at the same rate (as in pre-COVID19 times), we obtain the following equation (see Annex 1 for the proof).

\[ \mathbf{v}_{\text{ex eu}}^{2020} = \mathbf{w}_{2019} (\mathbf{x}_{2019})^{-1} [I - \mathbf{Z}_{2019} (\mathbf{x}_{2019})^{-1}]^{-1} \mathbf{e}_{2020} \]

We also account for the methodological differences (Lequiller and Blades, 2014, p.151) between the trade flows values in National Accounts and those in international trade in goods and services statistics (t) by applying a single correction factor (c) derived from the underlying estimation of the WIOD tables. The implicit assumption is that the underlying differences remain constant in the short run, which is a plausible assumption. Furthermore, we use \( g_m \) to represent the forecast exports growth rates in volumes that would have been realized in the absence of COVID-19 according to the Autumn Economic Forecast of 2019.

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In short, we construct two scenarios:

Scenario 1 (without COVID19): \( \hat{e}^{2020} = \hat{t}^{2019} \times g_{m} \times \zeta \)

Scenario 2 (actual 2020 data): \( \hat{e}^{2020} = \hat{t}^{2020} \times \zeta \)

The difference between the results for the two scenarios provide the likely impacts of COVID-19 on trade related jobs in the absence of the large exceptional support measures to prevent ‘real’ job losses. These results need to be taken with caution for two reasons: first, they are a lower bound results given that the projected growth rates applied from the forecast were in volume terms and second, we assumed the same price evolution of exports in both scenarios to isolate exclusively the trade effect on jobs due to COVID-19, without any price distortion.

4. THE IMPACT OF COVID-19 ON EXPORTS SUPPORTED JOBS

4.1. THE REGIONAL IMPACT IN RESPECT TO ACTUAL LOSSES VERSUS TRADE TREND LOSSES

Following the methodological approach described previously, we were able to calculate the potential job losses due to COVID-19. Figure 6 depicts these losses per EU Member State by comparing a hypothetical no-COVID scenario and the actual situation. The potential impact of the pandemic on exports related jobs would have been severe if EU Member States and the EU have not implemented exceptional support measures to prevent significant employment decline. As shown in Figure 6, more than 6 million jobs would have been lost in the absence of supportive packages to alleviate the social and economic impact of the pandemic.

These potential job losses vary by EU Member State, with Germany being most severely affected with 1.4 million jobs at risk, followed by France 630 thousand and Italy close to 590 thousand jobs. In relative terms, German losses account for more than 1/5 of total jobs at risk followed by France and Italy with 10% each. Figure 6 also shows that there are several countries such as Luxembourg, Cyprus, Malta and Latvia that would have been only negligibly affected by the COVID-19 in respect to potential exports related jobs losses.

Finally, it is important to stress that as showed in the methodological design these potential job losses comprise two effects: (i) an impact driven by the fact that trade would have increased in 2020 in the absence of the pandemic and (ii) the real decline in trade in 2020. If we would decompose the 6 million potential job losses, we would arrive at 1.2 million potential job losses due to trade falling off its trend path and 4.8 million jobs losses related to the actual exports decline in 2020.
Figure 6: COVID-19 related potential job losses, in thousand jobs

Source: Authors’ calculations based on WIOD 2016 and Eurostat data.

4.2. ASSESSING THE SECTORAL IMPACT OF COVID-19 RELATED JOB LOSSES

The country specific differences presented in Figure 6 are driven by sector specific differences because, as shown in section 2, goods and services trade were affected differently by the pandemic. Figure 7 present the potential exports related job losses per sector based on the CPA 2.1/NACE Rev.2 sectoral classification aggregated at 10 sectors level, available in WIOD (see Annex 2 for the sectoral mapping).

The sector responsible for the largest part of the jobs at risk is ‘transport, trade and other business services’ sector accounting for close to 3 million jobs or 53% of the total\(^2\). The second and third most affected sectors are ‘machinery and transport’ and ‘other services sectors’ responsible for 16% and 9.5\(^3\)% of the total job impact, respectively. These results are in line with expectation as extra-EU services exports decreased by 22% and services sectors are responsible for 56% of exports related employment.

\(^2\) This is in line with the share of ‘transport, trade and other business services’ jobs in total export supported employment of 49.4%.
\(^3\) The impact on ‘other services sectors’ is in the order of magnitude of its share in total export supported employment of 8.7%. 
Figure 7: The potential impact of the COVID-19 on sectoral jobs distribution, in thousand number of workers

Source: Authors’ calculations based on WIOD 2016 and Eurostat data.

Figure 7 also shows that the least affected sectoral employment is in the ‘chemicals’, ‘wood, paper and printing industries’ and energy sectors. The employment situation in the food, beverages and tobacco as well as textile sectors has been moderately affected by the COVID-19 pandemic.

4.3. ASSESSING THE SECTORAL AND REGIONAL IMPACT OF COVID-19 RELATED JOB LOSSES

Another dearth of information in respect to the impact of COVID-19 on exports related jobs is revealed by calculating the impact at sectoral and EU Member States level. Figure 8 provides insights about the potential job losses at sectoral and EU Member States level and shows that there are important differences between EU countries driven by the sectoral exports and employment intensities.

In all EU Member States, the most impacted sector is ‘transport, trade and other business services’. Furthermore, in 15 out of the 27 Member States the second most affected sector is the manufacturing industry of ‘machinery and transport’ equipment. However, in 12 Member States i.e. Belgium, Bulgaria, Cyprus, Denmark, Spain, Greece, Hungary, Ireland, Luxembourg, Malta, the Netherlands and Portugal the second most affected sector is ‘other services’.
Figure 8: The potential impact of COVID-19 at country and sectoral level

Source: Authors’ calculations based on WIOD 2016 and Eurostat data.
5. CONCLUSIONS AND POLICY IMPLICATIONS

This paper is a first attempt to assess the impact of COVID-19 on exports related jobs in the EU. This has been a challenging undertaking as EU Member States and the EU have implemented large exceptional support measures to prevent real job losses. These measures have been unprecedented in magnitude and nature, and included (i) the suspension of application of state aid and fiscal rules, (ii) a new instrument to address sudden increases in public expenditure for the preservation of employment (SURE), (iii) a major Recovery plan of EUR 1.8 trillion and (iv) the European Central Bank’s Pandemic Emergency Purchase Programme in the magnitude of EUR 1.8 trillion. These programmes were complemented by measures at individual Member State level of extraordinary magnitude corresponding to 8.3% of GDP in Germany, 8.3% in the UK, 5.1% in France and 5.5% in Denmark until November 2020 (Brugel datasets, 2020).

The employment figures presented in this paper provide evidence of the effectiveness of these measures as total employment declined by merely 1.5% in the EU compared to a real decline in EU GDP of 6.4% (similar to that of hours worked) and to the decline of employment of 6.3% in the US and 5% in Japan.

Against this background the authors analysed the impact COVID-19 would have had on exports related jobs, had not government and the EU implemented the extraordinary and exceptional support measures. The methodology, which is based on Input-Output modelling, takes into account the fall in exports to gauge the potential impact of the pandemic on exports supported jobs.

Our results show that in the absence of the exceptional support measures, more than 6 million exports dependent jobs would have been at risk. These potential jobs losses vary across sectors with ‘transport, trade and other business services’ accounting for 53% of the COVID-19 potential related losses, followed by ‘other services’ sectors (16%) and the manufacturing industry of ‘machinery and transport equipment (9%).

At country level the potential jobs losses are the highest in Germany (23%), followed by France (10%) and Italy (10%). Some countries such as Latvia, Estonia, Malta, Cyprus and Luxembourg would have experienced only negligible job losses.

Our results show that if trade is not to recover quickly, millions of jobs are at stake.
References:


Annex 1: Formalizing the methodological approach

Based on Miller and Blair (2009) and Kutlina-Dimitrova, Rueda-Cantuche, Amores and Román (2018), the equation that yields the number of export-supported jobs due to EU exports for 2019 and 2020 is as follows,

\[
V_{exeu}^{2019} = \hat{W}^{2019}(\hat{X}^{2019})^{-1}[I - Z^{2019}(\hat{X}^{2019})^{-1}]^{-1}\hat{e}^{2019}
\]

\[
V_{exeu}^{2020} = \hat{W}^{2020}(\hat{X}^{2020})^{-1}[I - Z^{2020}(\hat{X}^{2020})^{-1}]^{-1}\hat{e}^{2020}
\]

By multiplying and dividing by \(\hat{W}^{2019}\) and \(\hat{X}^{2019}\) in the second equation, we obtain:

\[
V_{exeu}^{2020} = \hat{W}^{2020}(\hat{X}^{2020})^{-1}\hat{W}^{2019}(\hat{W}^{2019})^{-1}\hat{X}^{2019}(\hat{X}^{2019})^{-1}[I - Z^{2020}(\hat{X}^{2020})^{-1}]^{-1}\hat{e}^{2020}
\]

which can be re-ordered in this way:

\[
V_{exeu}^{2020} = \hat{X}^{2019}(\hat{X}^{2019})^{-1}\hat{W}^{2020}(\hat{W}^{2019})^{-1}\hat{W}^{2019}(\hat{X}^{2019})^{-1}[I - Z^{2020}(\hat{X}^{2020})^{-1}]^{-1}\hat{e}^{2020}
\]

Now, by assuming the same technical coefficients matrix in 2019 and 2020,

\[
Z^{2019}(\hat{X}^{2019})^{-1} = Z^{2020}(\hat{X}^{2020})^{-1},
\]

it yields:

\[
V_{exeu}^{2020} = \hat{X}^{2019}(\hat{X}^{2019})^{-1}\hat{W}^{2020}(\hat{W}^{2019})^{-1}\hat{W}^{2019}(\hat{X}^{2019})^{-1}[I - Z^{2019}(\hat{X}^{2019})^{-1}]^{-1}\hat{e}^{2020}
\]

which can be written as follows:

\[
V_{exeu}^{2020} = \frac{\hat{W}^{2020}(\hat{W}^{2019})^{-1}}{\hat{X}^{2019}(\hat{X}^{2019})^{-1}}\hat{W}^{2019}(\hat{X}^{2019})^{-1}[I - Z^{2019}(\hat{X}^{2019})^{-1}]^{-1}\hat{e}^{2020}
\]

Next, assuming the same variation rates in employment and output (as in pre-COVID19 times),

\[
\frac{\hat{W}^{2020}(\hat{W}^{2019})^{-1}}{\hat{X}^{2019}(\hat{X}^{2019})^{-1}} = 1
\]

We obtain:

\[
V_{exeu}^{2020} = \hat{W}^{2019}(\hat{X}^{2019})^{-1}[I - Z^{2019}(\hat{X}^{2019})^{-1}]^{-1}\hat{e}^{2020}
\]
## Annex 2: Sectoral mapping

<table>
<thead>
<tr>
<th>NACE</th>
<th>Code</th>
<th>10 sectors level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A01</td>
<td>P</td>
<td>Primary</td>
<td>Crop and animal production, hunting and related service activities</td>
</tr>
<tr>
<td>A02</td>
<td>P</td>
<td>Primary</td>
<td>Forestry and logging</td>
</tr>
<tr>
<td>A03</td>
<td>P</td>
<td>Primary</td>
<td>Fishing and aquaculture</td>
</tr>
<tr>
<td>B</td>
<td>P</td>
<td>Primary</td>
<td>Mining and quarrying</td>
</tr>
<tr>
<td>C10-C12</td>
<td>M1</td>
<td>Food, beverage, tobacco</td>
<td>Manufacture of food products, beverages and tobacco products</td>
</tr>
<tr>
<td>C13-C15</td>
<td>M2</td>
<td>Textiles</td>
<td>Manufacture of textiles, wearing apparel and leather products</td>
</tr>
<tr>
<td>C16</td>
<td>M3</td>
<td>Wood, paper, printing</td>
<td>Manufacture of wood and of products of wood and cork</td>
</tr>
<tr>
<td>C17</td>
<td>M3</td>
<td>Wood, paper, printing</td>
<td>Manufacture of paper and paper products</td>
</tr>
<tr>
<td>C18</td>
<td>M3</td>
<td>Wood, paper, printing</td>
<td>Printing and reproduction of recorded media</td>
</tr>
<tr>
<td>C19</td>
<td>M4</td>
<td>Energy</td>
<td>Manufacture of coke and refined petroleum products</td>
</tr>
<tr>
<td>C20</td>
<td>M5</td>
<td>Chemicals</td>
<td>Manufacture of chemicals and chemical products</td>
</tr>
<tr>
<td>C21</td>
<td>M5</td>
<td>Chemicals</td>
<td>Manufacture of basic pharmaceutical products</td>
</tr>
<tr>
<td>C22</td>
<td>M6</td>
<td>Other non-metallic and basic metals</td>
<td>Manufacture of rubber and plastic products</td>
</tr>
<tr>
<td>C23</td>
<td>M6</td>
<td>Other non-metallic and basic metals</td>
<td>Manufacture of other non-metallic mineral products</td>
</tr>
<tr>
<td>C24</td>
<td>M6</td>
<td>Other non-metallic and basic metals</td>
<td>Manufacture of basic metals</td>
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<tr>
<td>C25</td>
<td>M6</td>
<td>Other non-metallic and basic metals</td>
<td>Manufacture of fabricated metal products</td>
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<tr>
<td>C26</td>
<td>M7</td>
<td>Machinery and transport equipment</td>
<td>Manufacture of computer, electronic and optical products</td>
</tr>
<tr>
<td>C27</td>
<td>M7</td>
<td>Machinery and transport equipment</td>
<td>Manufacture of electrical equipment</td>
</tr>
<tr>
<td>C28</td>
<td>M7</td>
<td>Machinery and transport equipment</td>
<td>Manufacture of machinery and equipment n.e.c.</td>
</tr>
<tr>
<td>C29</td>
<td>M7</td>
<td>Machinery and transport equipment</td>
<td>Manufacture of motor vehicles, trailers and semi-trailers</td>
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<tr>
<td>C30</td>
<td>M7</td>
<td>Machinery and transport equipment</td>
<td>Manufacture of other transport equipment</td>
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<td>C31_C32</td>
<td>M7</td>
<td>Machinery and transport equipment</td>
<td>Manufacture of furniture; other manufacturing</td>
</tr>
<tr>
<td>C33</td>
<td>M7</td>
<td>Machinery and transport equipment</td>
<td>Repair and installation of machinery and equipment</td>
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<td>D35</td>
<td>M4</td>
<td>Energy</td>
<td>Electricity, gas, steam and air conditioning supply</td>
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<td>E36</td>
<td>M4</td>
<td>Energy</td>
<td>Water collection, treatment and supply</td>
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<td>E37-E39</td>
<td>M4</td>
<td>Energy</td>
<td>Sewerage; waste collection, treatment and disposal activities;</td>
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<td>F</td>
<td>S2</td>
<td>Other services</td>
<td>Construction</td>
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<td>G45</td>
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<td>Transport, trade and business services</td>
<td>Wholesale and retail trade and repair of motor vehicles</td>
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<td>Wholesale trade, except of motor vehicles and motorcycles</td>
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<td>Retail trade, except of motor vehicles and motorcycles</td>
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<td>Warehousing and support activities for transportation</td>
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<td>S1</td>
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<td>Postal and courier activities</td>
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<td>S2</td>
<td>Other services</td>
<td>Accommodation and food service activities</td>
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<td>Motion picture, video and television programme production</td>
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<td>Computer programming, consultancy and related activities</td>
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<td>Legal and accounting activities; activities of head offices;</td>
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<td>O84</td>
<td>S2</td>
<td>Other services</td>
<td>Public administration and defence; compulsory social security</td>
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<td>S2</td>
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<td>Education</td>
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<td>Activities of households as employers;</td>
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<td>S2</td>
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<td>Activities of extraterritorial organizations and bodies</td>
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