Estimating Demand Spillovers of EU Cohesion Policy Using European Regional Input-Output Tables

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Abstract

This paper develops a simple method to consistently break down world input-output tables to regional input-output tables. They are used to estimate Cohesion Policy-induced demand spillovers in the EU, covering the years 2007-2018. Results indicate that Cohesion spillovers from less developed regions to other regions exceed 40% of their initial EU support in some cases. In addition, spillovers from the more developed regions are equivalent to 24% of their initial EU support. This shows that the existing trade and investment linkages across the EU regions are strong and not only run from less developed to more developed regions but also vice versa. Our results are good news for the net paying regions in the EU. Taking into account capacity growth effects, Cohesion Policy spillovers might well be a multiple of the pure demand spillovers estimated in this paper. Thus, for net paying regions, Cohesion Policy is not only an act of European solidarity but also a rational long-run economic growth policy.

Keywords: Cohesion Policy, Input-Output Analysis, EU Regions, Regional Development

JEL classification: C67, D57, R11, R15, R58

CONTENTS

TABLES AND FIGURES

1. Introduction

In the last 30 years, EU Cohesion Policy has been the fundamental instrument to keep the EU's territorial, economic and social disparities within a reasonable and sustainable range. In this way, Cohesion Policy has supported the creation of the common market and EU enlargement, ensuring that EU basic notions concerning social and solidarity principles have not been overcome by market forces. During the past decade, in which the economic crisis and the tightening of public budgets have led to a drastic fall in private and public investment, Cohesion Policy has become one of the main supporting instruments for public investment. In small countries – in particular the Central and East European EU Member States – EU funds now cover more than 50% of the public resources for investment.

The foundation of the EU Cohesion Policy is formulated in the EU Treaty (Article 174), in which economic, social and territorial cohesion are recognised as pivotal objectives. This statement has been constantly reinforced by the European Commission and the Member States, which, until 2000, promoted an increase of the resources for Cohesion Policy in the EU budget and subsequently confirmed Cohesion Policy as one of the main EU priorities.

From an economic point of view, EU Cohesion Policy is a redistribution of public resources from the richer to the poorer areas of the EU to stimulate investment, productivity and competitiveness in the latter. In this way, Cohesion Policy seeks to promote convergence across EU countries and regions. As an outcome, the increase in economic development in the poorer regions is expected not only progressively to reduce the need for financial transfers within the EU, but also to provide increasing economic benefits to the more developed regions, such as in the form of higher import demand, lower pressures on the labour market etc. The introduction of the euro made this mechanism even more urgent, as adjustments among Member States can no longer use exchange rates to counteract disparities undermining the monetary union; in this respect, Cohesion Policy plays an important role also in buffering asymmetric shocks and supporting monetary stability, even though it was not initially designed for this purpose.

However, economic and social convergence needs time. It has to counteract cumulative processes that persistently benefit richer areas, and it requires successful investment strategies. There has been a continuous debate on these issues, casting doubts on the Cohesion Policy rationale (in richer areas, investments would be more efficient and would produce more growth) or demanding a stronger orientation towards results (quicker expenditure, greater concentration on a limited number of objectives, and better planning and governance).

Although theoretically there are arguments both in favour and against Cohesion Policy, it is mostly political principles that determine many of the reasons for Cohesion Policy and shape its implementation. Solidarity from richer towards poorer areas, as is the case between different regions of a single state, is an additional and crucial motivation for EU financial transfers. Solidarity implies some political commitments of the poorer areas: ownership of a common EU project, sharing of principles and acceptance of the acquis communautaire, commitment to promote structural adjustments, and visibility of the EU role in the national policies. The political significance of Cohesion Policy was evident and determinant during the creation of the common market, the progressive enlargement of the EU and the creation of the single currency.

The economic and political motivations, together with the complexity of Cohesion Policy, which requires structural changes and a long-term horizon, make it difficult to estimate its costs and benefits. In turn, this handicaps: a) the EU in its promotion of Cohesion Policy as an adequate tool to reduce disparities; b) the net payer Member States in understanding their own (indirect) benefits from Cohesion Policy; and c) the net receiving Member States in their attempts to show a purposeful use of Cohesion Policy funds.

Acquiring additional knowledge and the tools for this is fundamental, especially as available resources have diminished as a result of both Brexit and the emergence of Covid-19 and its economic and social fallout. In this framework, the debate on the spillovers of Cohesion Policy is a fundamental element. Their quantitative estimation permits a more balanced assessment of the cost of Cohesion Policy for net payer Member States and a broader view of Cohesion Policy support to EU development and cohesion.

The analysis of those spillovers has a long history in the economic literature, potentially going back to the work of Metzler (1942, 1950 and 1951). From a theoretical point of view, he analysed the effects of transfers, such as Cohesion Policy expenditures, between two countries on each country's foreign trade and current-account balance, as well as on its income levels. More recently, Martin (1998, 1999 and 2005) analysed, also from a theoretical point of view, the effects of different types of EU Cohesion Policy expenditures on the economic growth of EU regions.

However, the two most important recent studies regarding Cohesion Policy spillovers are Bartkiewicz et al. (2016) and Naldini et al. (2018). Bartkiewicz et al. focus on the benefits of Cohesion Policy spillovers to the net payer countries. Thereby, they concentrate on the spillovers from the Visegrád Four (V4) countries. Using, *inter alia*, a macroeconomic approach, they first estimate the growth effects of Cohesion Policy on the V4 countries. They then derive the additional demand for imports from the EU15 countries generated by these Cohesion Policy growth effects. Although it is not clear whether Bartkiewicz et al. take into account second-round (and subsequent) effects of this additional demand, they conclude that these 'export' benefits to the EU15 sum to 80% of the Cohesion Policy expenditures in the V4 countries.

By contrast, in parts of their study, Naldini et al. focus explicitly on short-run demand-side effects of Cohesion Policy that can be reliably estimated, including second- and third-round and other such effects, using world input-output tables. In their country level analysis, Naldini et al. find that Cohesion Policy demand spillovers from net receiving to net paying countries are only around 9% of the original Cohesion Policy expenditures in the net receiving countries.

This paper links up with this literature and aims to extend it by including the regional dimension as, after all, Cohesion Policy focuses on this. In doing so, the paper will, like Naldini et al., concentrate on pure short-term demand spillovers. Growth effects of Cohesion Policy have been explored intensively in other studies, such as DG Regio and Joint Research Centre (2016), Dall'erba and Le Gallo (2008), Esposti and Bussoletti (2008), Becker et al. (2018), and Mohl and Hagen (2010). These studies are far from clear regarding whether and to what extent Cohesion Policy stimulates regional growth.

Concentrating on regional demand spillovers from Cohesion Policy requires the use of regional input-output tables, at least for all European countries. Although regional input-output tables have been recently developed by the Joint Research Centre (Ivanova et al., 2019), this paper proposes an alternative method for consistent estimation of regional input-output relations at the European level. Also, our method is less demanding in data requirements than that of Ivanova et al., and hence much easier to replicate and reproduce, which might appeal to researchers who want to tailor regional input-output tables to their needs. Therefore, the paper not only aims to contribute to the ongoing discussion about EU Cohesion Policy but also to facilitate empirical work at the regional level.

The remainder of the paper is organised as follows. Chapter 2 outlines the methodology to estimate regional input-output tables and to derive regional spillovers from EU Cohesion Policy. Chapter 3 describes the data used for the analysis, Chapter 4 presents the results and Chapter 5 provides conclusions.

2. Methodology

This section outlines how we constructed the regional input-output tables and estimated regional spillovers of EU Cohesion Policy.

2.1. CONSTRUCTION OF THE REGIONAL INPUT-OUTPUT TABLES

Our regional input-output tables are based on existing industry by industry world input-output tables (WIOT) from the World Input-Output Database (WIOD).[1] These tables cover the 27 EU countries, 16 non-EU countries (including the UK) and a rest of the world (RoW) model. The WIOT also include 56 industries, classified according to the International Standard Industrial Classification, Revision 4.

The WIOT were regionalised for the EU countries and the UK, using data at the NUTS-2 level of regions (see Section 3). The process comprised seven steps.

Schematically, the WIOT is organised as in Figure 1.

Figure 1 / Schematic example of the WIOT, three countries

	Country A Intermediate use 56 industries	**Country B Intermediate use 56 industries**	**RoW Intermediate use 56 industries**	**Country A Final use 5 categories**	**Country B Final use 5 categories**	**RoW Final use 5 categories**	**Total**
Country A 56 industries	Intermediate use of domestic output	Intermediate use by B of exports from A	Intermediate use by RoW of exports from A	Final use of domestic output	Final use by B of exports from A	Final use by RoW of exports from A	Output country A
Country B 56 industries	Intermediate use by A of exports from B	Intermediate use of domestic output	Intermediate use by Row of exports from B	Final use by A of exports from B	Final use of domestic output	Final use by RoW of exports from B	Output country B
RoW 56 industries	Intermediate use by A of exports from RoW	Intermediate use by B of exports from RoW	Intermediate use of domestic output	Final use by A of exports from RoW	Final use by B of exports from RoW	Final use of domestic output	Output RoW
	Value added country A	Value added country B	Value added RoW				
	Output country A	Output country B	Output RoW				

Source: Author's elaboration, based on Timmer et al., 2012.

In the first step, we aggregated for each country both the 56 industries of the intermediate use matrix and the five categories of the final use matrix from the WIOT to a smaller number of categories. This was done to make it easier to link the NUTS-2 regional data, which usually are less detailed, to the WIOD data. As a by-product, the aggregation also kept the estimation and analysis of the regionalised WIOT (RWIOT) quick and manageable. For future research, this aggregation can be changed easily or abandoned altogether, provided that more detailed regional data are available.

1 www.wiod.org

Accordingly, the 56 industries were aggregated (for both input and output data) into four sectors: agriculture, manufacturing industry, construction and services (see Table 2 in the Appendix). The five final use categories of the WIOT were aggregated into two: consumption and investment. The output and value-added data were changed accordingly.

In the second step, we took NUTS-2 regional data for the four industries and the two final use categories and calculated the regions' shares in the total country industries and final use. For example, for the industries we calculated p_{cir}, i.e. region's r share p in industry i in country c:

$$p_{cir} = rgva_{cir}/cgva_{ci}$$

where $rgva_{cir}$ represents the gross value added of region r in industry i and country c, and $cgva_{ci}$ the corresponding country total gross value added in industry i. By definition, the following condition holds:

$$\sum_{r=1}^{R} p_{cir} = 1$$

Similar calculations were done for regional consumption and investment shares.

For the remainder of the regionalisation process, it is important to understand that each element of the intermediates matrix B and the final use matrix F need to split across regions. To illustrate, Figure 2 shows the elements (z) of a two-country, two-industry intermediates matrix B.

Figure 2 / Intermediates matrix B, example for two countries and industries

	Country A Intermediate use industry 1	Country A Intermediate use industry 2	Country B Intermediate use industry 1	Country A Intermediate use industry 2
Country A industry 1	$b_{A1\,A1}$	$b_{A1\,A2}$	$b_{A1\,B1}$	$b_{A1\,B2}$
Country A industry 2	$b_{A2\,A1}$	$b_{A2\,A2}$	$b_{A2\,B1}$	$b_{A1\,B2}$
Country B industry 1	$b_{B1\,A1}$	$b_{B1\,A2}$	$b_{B1\,B1}$	$b_{B1\,B2}$
Country B industry 2	$b_{B2\,A1}$	$b_{B2\,A2}$	$b_{B2\,B1}$	$b_{B2\,B2}$

Source: Author's elaboration.

Hence, each element b needs to be regionalised, as do the corresponding elements from the final use matrix. Basically, this is done using the regional shares p_{cir}. To illustrate, consider the highlighted element $b_{A2\,B1}$ in matrix B in Figure 2, which will be split across the regions of country A and B. If, by assumption, country A consists of five regions and country B of eight regions, the regionalisation would blow up the single cell $b_{A2\,B1}$ to a 5×8 matrix, i.e. connecting all regions of country A and B with each other. The elements of the 5×8 matrix are given by:

$$b_{A2r\,B1s} = p_{A2r} * p_{B1s} * b_{A2\,B1};\ \forall\, r, s$$

where r denotes the regions of country A and s the regions of country B.

Given the definition of the regional shares above, the following condition holds:

$$\sum_{r=1}^{R}\sum_{s=1}^{S} p_{Air} \times p_{Bis} = 1;\ \forall\, i, r, s$$

This means that each element of the intermediate matrix B and the final use matrix F is consistently broken down across the regions between countries (or within a single country). Consistency here is referred to as the property that, if the regional matrices are aggregated back to the country level, the original country level input-output tables are retrieved.

The third step involved the inclusion of bilateral regional distance data in the regionalisation of the WIOT. This is done to add a geographic space component into the input-output table construction. It assumes that regions close to each other have stronger trade links than regions further apart.[2]

The basis for the distance component was a distance matrix D connecting all NUTS-2 regions in our analysis. The distance is measured 'as the crow flies' (the shortest distance) between any two regions, in kilometres. Schematically, D looks like this for two regions of country A and B.[3] Again, regions of country A are denoted by r and regions of B by s.

Figure 3 / Schematic example of the regional distance matrix D, three regions

		Country A		Country B	
		r1	**r2**	**s1**	**s2**
Country A	**r1**	0	$dist_{r1r2}$	$dist_{r1s1}$	$dist_{r1s2}$
	r2	$dist_{r2r1}$	0	$dist_{r2s1}$	$dist_{r2s2}$
Country B	**s1**	$dist_{s1r1}$	$dist_{s1r2}$	0	$dist_{s1s2}$
	s2	$dist_{s2r1}$	$dist_{s2r2}$	$dist_{s2s1}$	0

Source: Author's elaboration.

Matrix D is symmetric around the main diagonal, so that the distance from region 1 to region 2 ($dist_{r1r2}$) is identical to the distance of regions 2 to region 1 ($dist_{r2r1}$). The diagonal elements, i.e. the distance to the own region, are zero.

These distances are used to calculate a distance weight (dw) that shifts the regionalisation of the data in favour of regions close to each other, while the trade between regions that are further away is reduced. The distance weight dw is calculated in two steps. First, we calculate:

$$d_{r,s} = \left(\overline{dist}_{r,s} - dist_{r,s}\right) / \overline{dist}_{r,s}$$

2 The method presented here is a methodological shortcut, facilitating the inclusion of a distance element. The basic principles of the method can be applied to other, more sophisticated distance data with only small modifications.

3 Because of the regionalisation approach adopted, it is not necessary to take into account border effects etc. This is because we assume that border effects apply at the country level, not at the regional level. In other words, border effects for the regions of a country A in trading with regions of country B are the same for all regions of A.

for all regions a of country A and regions b of country B, where $\overline{dist}_{r,s}$ is the mean of all bilateral distances of the regions in both countries. We use this to calculate the distance weight $dw_{r,s}$ as:

$$dw_{r,s} = 1 + \left(T \times d_{r,s}\right)/100$$

where T is a parameter indicating the importance of distance in bilateral regional trade. For our estimations, we chose T = 10. This means that for regions with zero distance (i.e. the own region), $dw_{r,r}$ equals 1.10. The larger the distance, the smaller this value gets, and hence it is higher than 1 for all region pairs that have a bilateral distance smaller than the average distance $\overline{dist}_{r,s}$. For region pairs with a distance greater than the average, the distance weight dw is below 1. Technically, dw can also be negative; in this case, it is set to zero.

In the fourth step, all elements are put together – i.e. the distance weight, the regional share and the intermediates and final use matrix – to estimate the interim regional matrix. This is illustrated by Figure 4, which refers to the regionalisation of our example element $b_{A2\,B1}$ of matrix B (Figure 2). Because in the example, the regionalisation focuses on this element only, we denote $b_{A2\,B1}$ by simply b.

Figure 4 / Example: regionalisation of the element bA2 B1 of the intermediates matrix B

			Country B		
			Industry 1		
		Regions	**s1**	**s2**	**s3**
Country A	Industry 2	**r1**	$dw_{r1,s1} * p_{r1} * p_{s1} * b$	$dw_{r1,s2} * p_{r1} * p_{s2} * b$	$dw_{r1,s3} * p_{r1} * p_{s3} * b$
		r2	$dw_{r2,s1} * p_{r2} * p_{s1} * b$	$dw_{r2,s2} * p_{r2} * p_{s2} * b$	$dw_{r2,s3} * p_{r2} * p_{s3} * b$
		r3	$dw_{r3,s1} * p_{r3} * p_{s1} * b$	$dw_{r3,s2} * p_{r3} * p_{s2} * b$	$dw_{r3,s3} * p_{r3} * p_{s3} * b$
		r4	$dw_{r4,s1} * p_{r4} * p_{s1} * b$	$dw_{r4,s2} * p_{r4} * p_{s2} * b$	$dw_{r4,s3} * p_{r4} * p_{s3} * b$

Source: Author's elaboration.

To be consistent, the regionalised elements need to be normalised to the original value of $b_{A2\,B1}$. This is done for each cell in the WIOT and results in an interim version of the RWIOT.

In the fifth step, we calculated the total output and value added for each region and industry. This is simply done by using each region's share of the respective country's gross value added for the respective industry.

In the sixth step, we added the input-output data for non-EU countries. Any relation between non-EU and EU countries is estimated as in the procedure above, without adjusting for distances. Non-EU countries are treated as a single-region country.

Finally, in a seventh step, the elements of the preliminary RWIOT need to be made consistent, so that for each region and industry the row elements and the respective column elements add up to the same output of the region in the specific industry. For this, we use a country-constrained RAS method, as we not only have to make sure that the row and column totals are identical, but also that the regional values for each country/industry pairing add up to the original country/industry value of the WIOT intermediate or final use matrix. Each element of the initial country WIOT intermediate use and final use matrix needs to stay constant, so that the RWIOT is consistent with the WIOT.

Therefore, our RAS procedure is as follows: 1) adjustment according to row total; 2) adjustment according to country/industry value; 3) adjustment according to column total; 4) adjustment according to country/industry value; 5) like 1) and so on until convergence is achieved. This results in the final version of the RWIOT.

2.2. ESTIMATION OF COHESION POLICY SPILLOVERS

In our model, Cohesion Policy spillovers arise because of the consumption and investment demand effects Cohesion Policy expenditures have in the receiving regions. The assumption is that this increase in demand is covered like any other part of the regions' demand by their existing trade and production network.

Therefore, regions can benefit from Cohesion Policy expenditures in other regions in two ways. Region A might benefit directly from the additional demand created for its products in region B because of the EU support in the latter. Also, region A might benefit indirectly, as Cohesion Policy expenditures in region B create demand in region C, which in turn needs intermediate inputs from region A.

The strength of the RWIOT is that it can consistently measure such direct and indirect relation across regions. Correspondingly, Cohesion Policy demand spillover effects can be estimated via a straightforward Leontief demand-driven input-output model. Such a model not only takes into account that region A can, as described, benefit directly and indirectly from Cohesion Policy expenditures in other regions, but the model also takes into account third- and fourth-round effects and the like, for example as the indirect demand for region A's goods and services created by region C triggers additional demand for other regions' inputs, which in turn triggers additional demand and so on.

Formally, these can be estimated using the RWIOT in the following way. To begin, we use the final version of the RWIOT to define a number of vectors and matrices needed for the estimation of spillovers. Thus, we define:

› a matrix Fc, which is the final demand matrix of the RWIOT

› a matrix B, containing the intermediate use matrix of the RWIOT

› a vector w with the total value added by industry of the regions

› a vector g with the total output by industry of the regions

From these we derive:

first, a value-added coefficients vector v:

$$v = w * inv\left(diag(g^T)\right)$$

secondly, the intermediate input coefficients matrix A:

$$A = B * inv\left(diag(g^T)\right)$$

and thirdly, from this, the Leontief inverse L:

$$L = inv(I - A)$$

with I being the identity matrix.

From this, we can re-estimate the regions' gross value added VA vector as:

$$VA = diag(v) * L * Fc * J$$

where J is a n×1 vector of ones (n being the number of regions).

To estimate the Cohesion Policy spillover effects on the regions' gross value added, we assume that the Cohesion Policy expenditures CP are a shock to final demand, increasing Fc. Thus, we define $\widehat{Fc} = Fc + CP$ as the shock of Cohesion Policy to final demand. Using this in the above equation, we can derive the gross value added after the demand shock by:

$$\widehat{VA} = diag(v) * L * \widehat{Fc} * J$$

Finally, spillovers SP are calculated as the difference between the baseline and shocked gross value added:

$$SP = \widehat{VA} - VA$$

3. Data

For our estimation of Cohesion Policy spillovers we use the following data sources.

The basis for the RWIOT is the WIOTs from the 2016 release of the World Input-Output Database.[4] This is an open-source platform, with WIOTs for the years 2000 to 2014. Each WIOT has 44 countries (inclusive of a rest of the world model) and 56 industries. The values in the WIOTs are in current prices and million US dollars. This required some transformations of the regional data, which are in euros. These transformations mostly used shares (e.g. regional share in total country gross value added by industry) instead of exchange rates to consistently match EU data with the WIOTs.

Cohesion Policy data is derived from the dataset ‘Historic EU payments – regionalised and modelled’.[5] It has yearly expenditure data for the ERDF, Cohesion Fund, EAFRD/EAGGF and ESF. It covers four programming periods, starting with 1989-1993 and ending with the 2007-2013 programme. Because some Cohesion Policy funds are spent after the programme end date, the database covers the years until 2018. For the analysis, we use the years 2007-2018.

For the estimation of regional Cohesion Policy spillovers, we use the expenditures for the ERDF, ESF and the Cohesion Fund. Original expenditures in the database are in current euros. For the estimation, these were converted into 2016 constant euros, using national price deflators.

Regional data to break down the WIOT were taken from Eurostat and included: data on gross value added by industries; data on regional household consumption to proxy consumption demand; and data on regional gross capital formation to proxy regional investment demand.

Our analysis uses EU NUTS-2 regions defined according to the 2016 NUTS breakdown. This means we have 276 EU regions (including UK regions, but excluding the five French DOMs, or overseas departments). Combined with non-EU countries, the RWIOT covers in total 297 regions/countries. For the analysis, EU regions were defined in three EU policy-related groups:[6]

› Less developed regions, where GDP per inhabitant was less than 75% of the EU average

› Transition regions, where GDP per inhabitant was between 75% and 90% of the EU average

› More developed regions, where GDP per inhabitant was more than 90% of the EU average

This grouping is based on the EU 2014-2020 programme’s division of regions. It is thus not fully consistent with the use of data pertaining to 2007-2013. However, to be more relevant for the present discussion, this

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4 www.wiod.org

5 https://cohesiondata.ec.europa.eu/Other/Historic-EU-payments-regionalised-and-modelled/tc55-7ysv

6 Basically, the grouping follows the 2014/99/EU: Commission Implementing Decision of 18 February 2014, setting out the list of regions eligible for funding from the European Regional Development Fund and the European Social Fund and of Member States eligible for funding from the Cohesion Fund for the period 2014-2020.

compromise has been made (changes from the 2007-2013 to the 2014-2020 programme were not especially large in the group of the less developed regions that are the main recipients of funding).

In total, our sample of EU regions has 68 less developed regions, 50 transition regions and 158 more developed regions. Their distribution across EU countries is illustrated in Table 1.

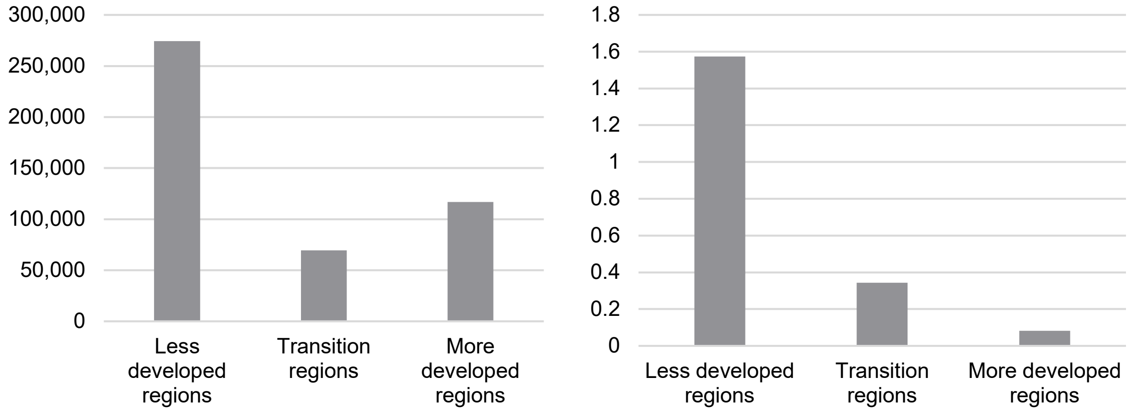
Table 1 / Types of regions by country

COUNTRY	LESS DEVELOPED	TRANSITION	MORE DEVELOPED
AT		1	8
BE		4	7
BG	6		
CY			1
CZ	7		1
DE		7	31
DK		1	4
EE	1		
EL	5	6	2
ES	1	5	13
FI			5
FR		10	12
HR	2		
HU	6		2
IE			3
IT	5	3	13
LT	2		
LU			1
LV	1		
MT		1	
NL			12
PL	15		2
PT	4	1	2
RO	7		1
SE			8
SI	1		1
SK	3		1
UK	2	11	28
TOTAL	**68**	**50**	**158**

4. Results

Turning to the results, we start by illustrating the initial distribution of Structural Funds support. Hence, the total amount of ERDF, CF and ESF support in the period 2007 to 2016 was around EUR 460 billion (in constant 2016) prices. Of this, around EUR 274 billion (some 60% of the total) was distributed to the less developed regions; EUR 70 billion (about 15% of the total) to the transition regions; and EUR 117 billion (about 25%) to the more developed regions (see Figure 5).

Figure 5 / Structural Funds expenditures 2007-2018, by type of regions, in 2016 constant euros (million; left graph) and as per cent of GDP (annual averages; right graph)



Source: wiiw.

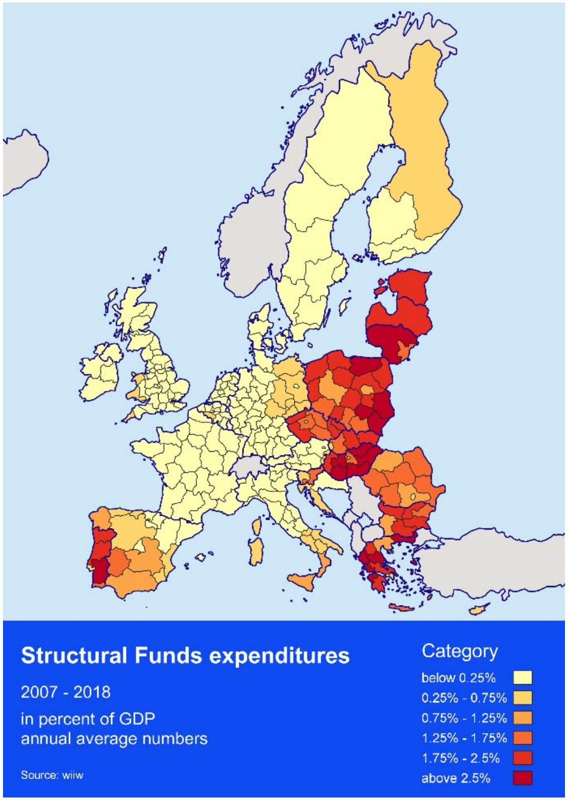
As a proportion of GDP, the Structural Funds support varies greatly, not only across the regions of the different groups (see Figure 5, right graph), but also within the groups, especially in the group of less developed regions (see Figure 6; also Appendix, Figure 12). Structural Funds expenditures amount to more than 2.5% of annual GDP in most Hungarian regions, a number of eastern Polish regions, and in some Greek regions, as well as in the central and western Lithuanian region and the Alentejo region in Portugal. In some of the regions, such as the Hungarian Észak-Alföld and Dél-Alföld regions, Structural Funds support exceeds, on average, 4% of annual GDP.

Structural Funds support is also high (between 1.25% and 2.5% of annual GDP) in the other less developed regions in Central and Eastern Europe, as well as in Greece and Portugal. By contrast, in the less developed regions in Spain and Italy, support is generally lower than 1.25% of annual GDP.

In the transition regions, Structural Funds support reaches up to 0.75% of GDP per year, on average, for example in the eastern German regions. In the more developed regions, Structural Funds support does not surpass 0.25% of annual GDP anywhere.

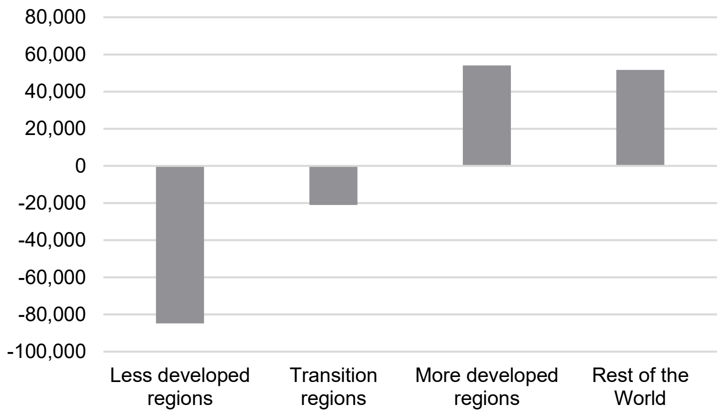
Turning to the Cohesion Policy spillovers, we show their size and direction by calculating the difference between the amount of Structural Funds in the regions before and after spillovers. A positive difference indicates that Cohesion Policy spillovers to a region were higher than the spillovers from this region. A negative difference suggests that spillovers from the region to other regions were higher than the spillover flowing into this region.

Figure 6 / Structural Funds expenditures 2007-2018, NUTS-2 regions



Source: wiiw.

Figure 7 / Structural Funds expenditure spillovers 2007-2018, by type of region, in 2016 constant euros (millions)



Source: wiiw.

Regarding the results, we first look at the absolute numbers by regional groups. These show that in the less developed regions, outflows of Cohesion Policy spillovers were much higher than inflows. Correspondingly, the difference between the amount of Structural Funds before and after spillover, i.e. the net negative spillovers, was around EUR 85 billion (see Figure 7). Net negative spillovers are also shown for the transition regions, where the net outflows were around EUR 20 billion in the period 2007-2018. Net positive spillovers are reported for the more developed regions (around EUR 54 billion). Some EUR 52 billion leaked to countries outside the EU.

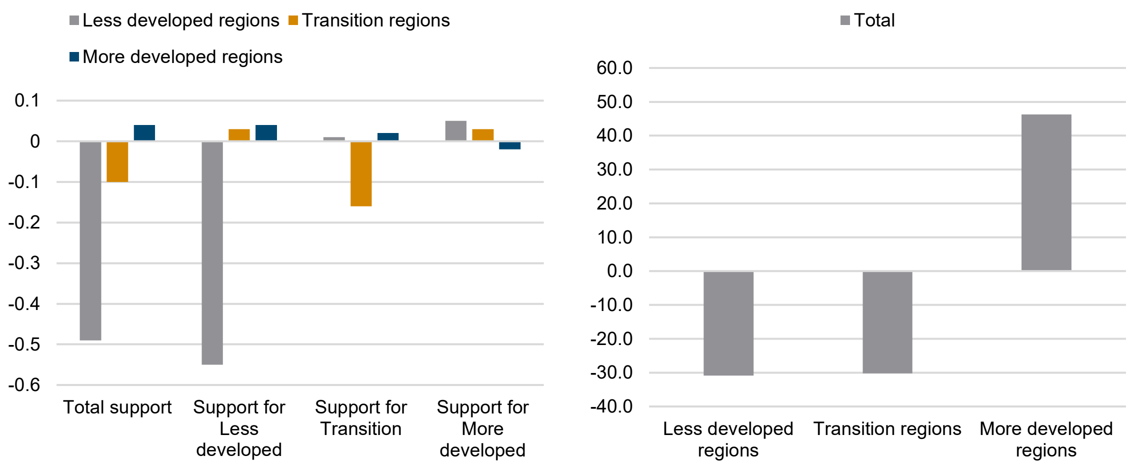
In terms of GDP, total spillovers from Structural Funds support are around -0.5% of GDP per year for the less developed regions, -0.1% for the transition regions and +0.04% for the more developed regions (see Figure 8, left graph, category 'Total support').

In other terms, net negative spillovers from the less developed regions to other regions were around 31% of their initial funding. For the transition regions, this ratio was approximately the same (30%), while the more developed regions had net positive spillovers of around 46% of their initial support (see Figure 8, right graph).

Looking only at the spillovers of Structural Funds support to the less developed regions (see Figure 8, left graph, category 'Less developed regions'), the negative spillovers for this group of regions were around 0.55% of their annual GDP. This amount of funds was distributed to the transition regions, where they led to positive spillovers of 0.03% of GDP per year, to the more developed regions (positive spillovers of 0.04% of GDP per year) and to the rest of the world.

Regarding the spillovers from the support to transition regions, they themselves had negative spillovers equal to about 0.16% of their annual GDP. These funds went partly to the less developed regions, accounting for 0.01% of their annual GDP and to the more developed regions, where they increased demand by 0.02% of GDP per year. From a different perspective, these spillovers are around 47% of the initial Cohesion Policy funding received by the transition regions.

Figure 8 / SF spillovers 2007-2018, by type of region and support, as per cent of GDP and per cent of SF funds, annual averages



Source: wiiw.

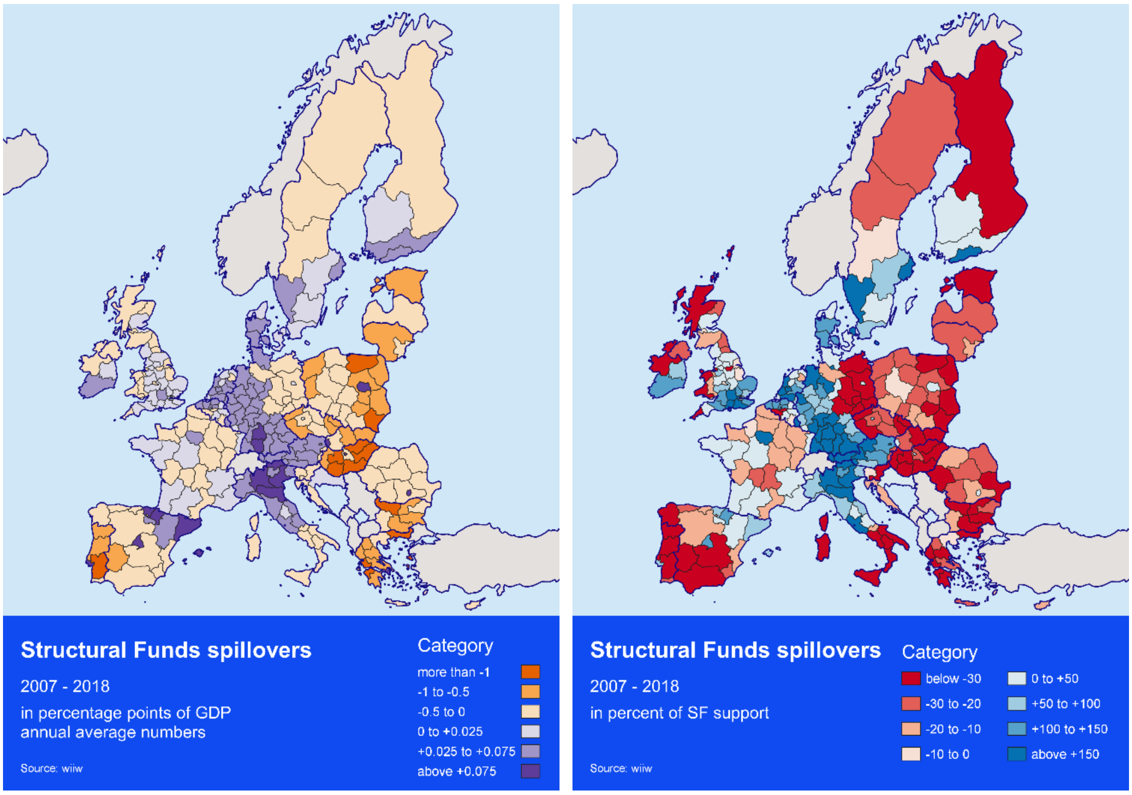
Regarding the support for the more developed regions, their initial support equalled 0.08% of their annual GDP per year (see Figure 5, right graph). Of this, around 0.02 percentage points per year spilled over to the less developed regions (positive spillovers of 0.05% of their GDP per year), the transition regions (+0.03% of GDP per year) and the rest of the world. In terms of initial Cohesion Policy funding to the more developed regions, these spillovers sum to around 24%.

At a more detailed regional level, negative spillovers in terms of GDP are largest for those regions where the initial funding was substantial in terms of GDP, e.g. the Hungarian and eastern Polish regions. In these, negative spillovers to other regions were up to 2% of those regions' annual GDP. In other less developed or transition regions, the losses were lower, mainly because the initial funding was lower (see Figure 9; left map).

In terms of initial funding, data shows that spillovers were quite significant in both directions. In many of the less developed and transition regions, more than 30% of their initial support went to other EU regions or abroad. For some regions, in Hungary, Spain and Italy, for example, these outflows exceeded 40%, reaching almost 50% of their initial Structural Funds support.

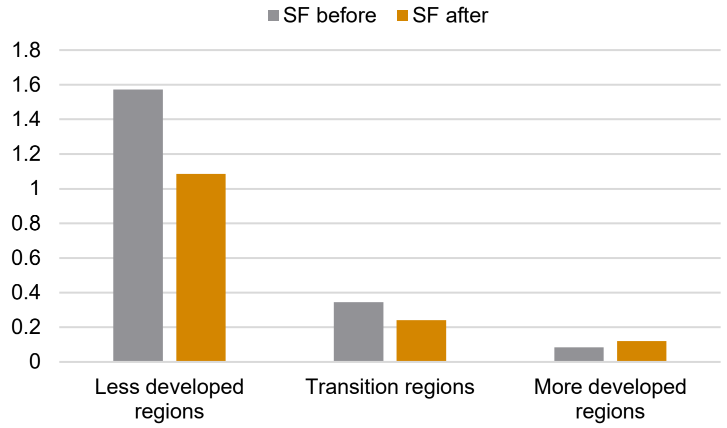
The regions benefiting from these spillovers were the more developed regions, including some of the capital cities in Central and Eastern Europe. The regions that gained most and where the positive spillovers summed to six or seven times those regions' own initial funding, were the industrially strong regions, mainly located along the 'blue banana' in the EU but also including the strong centres in the Scandinavian countries (see Figure 9).

Figure 9 / SF spillovers 2007-2018, NUTS-2 regions



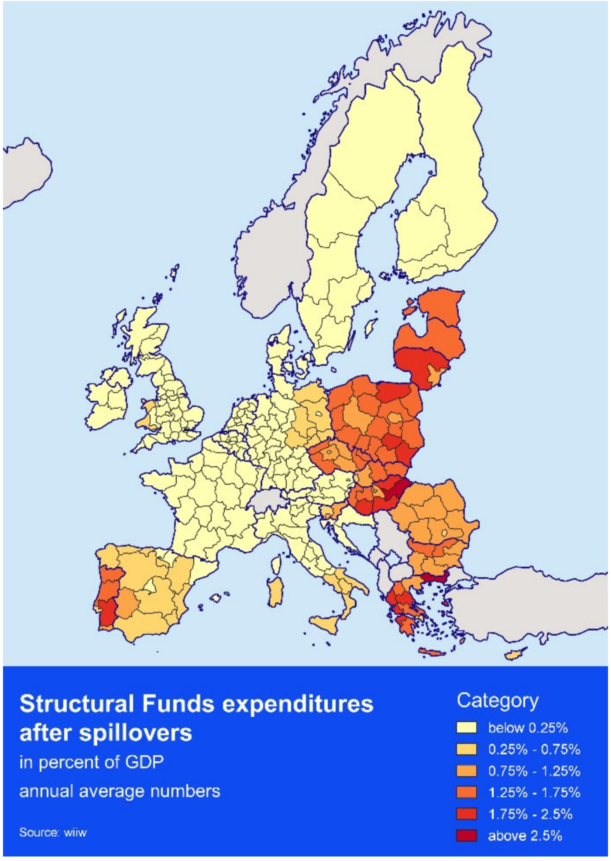
Source: wiiw.

Figure 10 / Structural funds before and after spillovers, 2007-2018, as per cent of GDP, annual averages



Source: wiiw.

Figure 11 / Structural funds after spillovers – NUTS-2 regions, 2007-2018



Source: wiiw.

To summarise, Cohesion Policy support was very strong, especially in the less developed regions, where it initially added around 1.6% per year to their GDP. Support in the transition regions and more developed regions was much lower, at around 0.34% and 0.08% of annual GDP, respectively. Simultaneously, spillovers from Cohesion Policy were also strong, so that after redistribution the actual Structural Funds support remaining in the less developed regions was around 1.1% of their annual GDP and 0.24% in the transition regions. By contrast, in the more developed regions the spillovers increased the total Structural Funds spent there to 0.12% of their GDP (see Figure 10 for the aggregate numbers and Figure 11 for the regional details).

5. Conclusions

The analysis has shown at least five points.

First, we developed a simple method to consistently break down world input-output tables to regional input-output tables. This method is not very demanding regarding data requirements and, from a conceptual standpoint, is straightforward to implement. It is flexible enough to allow for different aggregations of industry and different distance measures if data are available. Thus, it is easy to replicate and to extend, making it a useful tool for economists looking for ways to construct their own regional input-output models. Also, because it is consistent with the WIOT, it can easily be updated once new world input-output tables are released.

Secondly, the results have shown that Cohesion Policy-induced demand spillovers from less developed regions to other regions are quite high. In a few regions, these amount to over 40% of the initial EU support, with the average being 35% across all less developed regions. The main beneficiaries are the economically strong, More developed EU regions along the EU ‘blue banana’ that are the main suppliers of intermediate and final goods and services to the less developed regions.

Thirdly, EU Cohesion Policy spillovers from the more developed regions to other regions equal 24% of their initial EU support. This ratio is not too far off the average leakage of the less developed regions. It shows that the existing trade and investment linkages across the EU regions are strong in each direction, and run not only from less developed to more developed regions but also in the other direction. Certainly, the link from the less developed to the more developed regions is still weaker, but the strengthening of this is one purpose of EU Cohesion Policy.

Fourthly, the estimation of the size of Cohesion Policy-induced demand spillovers is important in estimating regional growth effects of the ERDF, ESF or the Cohesion Fund. Our analysis enables the identification of how much of the EU support stays in the regions and how much is spent on goods and services in other regions. This is a valuable input for any growth analysis that is interested in the size of the demand and the capacity growth effects of Cohesion Policy.

Finally, the results are good news for the net paying countries in the EU. Demand spillovers from the less developed and net receiving regions are already 30% of their initial support. Taking into account capacity growth effects arising from Cohesion Policy in the less developed regions, these spillovers are likely to increase strongly, not only in the short run, but in a cumulative way in the long run. Thus, for the more developed regions, Cohesion Policy is not only an act of European solidarity, but can also be a rational long-run economic growth policy.

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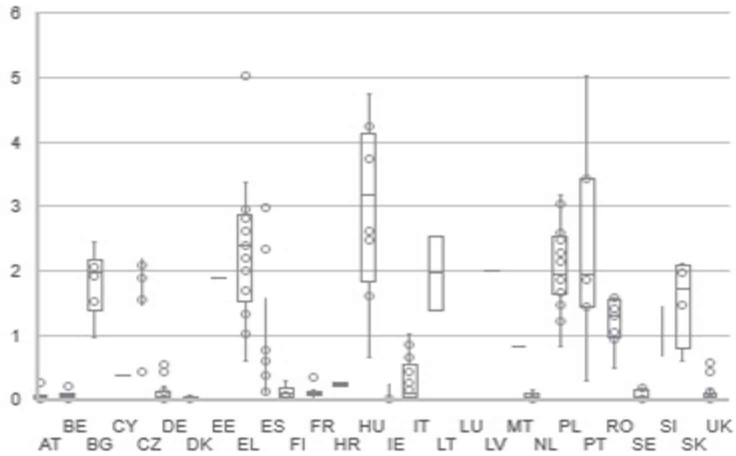
Appendix

Table 2 / WIOD industries and regional aggregation scheme

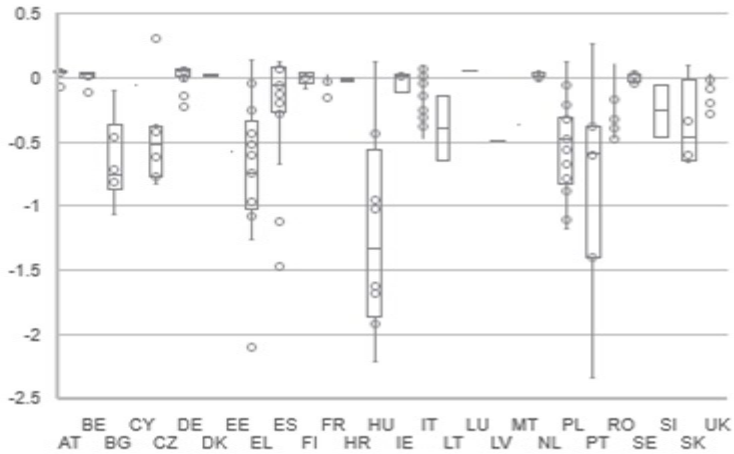
WIOD - NACE rev.2 code	WIOD - NACE rev.2 sector	Aggregated industries
A01	Crop and animal production, hunting and related service activities	Agriculture
A02	Forestry and logging	
A03	Fishing and aquaculture	
B	Mining and quarrying	Manufacturing industries
C10-C12	Manufacture of food products, beverages and tobacco products	
C13-C15	Manufacture of textiles, wearing apparel and leather products	
C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	
C17	Manufacture of paper and paper products	
C18	Printing and reproduction of recorded media	
C19	Manufacture of coke and refined petroleum products	
C20	Manufacture of chemicals and chemical products	
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	
C22	Manufacture of rubber and plastic products	
C23	Manufacture of other non-metallic mineral products	
C24	Manufacture of basic metals	
C25	Manufacture of fabricated metal products, except machinery and equipment	
C26	Manufacture of computer, electronic and optical products	
C27	Manufacture of electrical equipment	
C28	Manufacture of machinery and equipment n.e.c.	
C29	Manufacture of motor vehicles, trailers and semi-trailers	
C30	Manufacture of other transport equipment	
C31_C32	Manufacture of furniture; other manufacturing	
C33	Repair and installation of machinery and equipment	
D35	Electricity, gas, steam and air conditioning supply	
E36	Water collection, treatment and supply	
E37-E39	Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services	
F	Construction	Construction
G45	Wholesale and retail trade and repair of motor vehicles and motorcycles	Services
G46	Wholesale trade, except of motor vehicles and motorcycles	
G47	Retail trade, except of motor vehicles and motorcycles	
H49	Land transport and transport via pipelines	
H50	Water transport	
H51	Air transport	
H52	Warehousing and support activities for transportation	
H53	Postal and courier activities	
I	Accommodation and food service activities	
J58	Publishing activities	
J59_J60	Motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activities	
J61	Telecommunications	
J62_J63	Computer programming, consultancy and related activities; information service activities	
K64	Financial service activities, except insurance and pension funding	
K65	Insurance, reinsurance and pension funding, except compulsory social security	
K66	Activities auxiliary to financial services and insurance activities	
L68	Real estate activities	
M69_M70	Legal and accounting activities; activities of head offices; management consultancy activities	
M71	Architectural and engineering activities; technical testing and analysis	
M72	Scientific research and development	
M73	Advertising and market research	
M74_M75	Other professional, scientific and technical activities; veterinary activities	
N	Administrative and support service activities	
O84	Public administration and defence; compulsory social security	
P85	Education	
Q	Human health and social work activities	
R_S	Other service activities	
T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	
U	Activities of extraterritorial organisations and bodies	

Figure 12 / Structural Funds expenditures 2007-2018, NUTS-2 regions, as per cent of GDP, annual averages



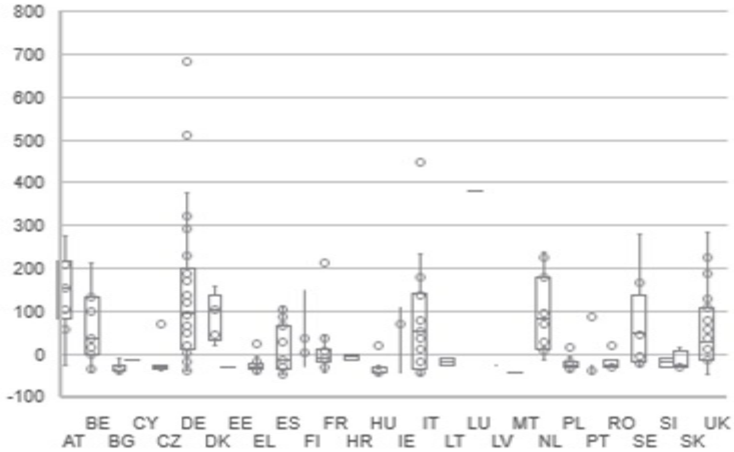
Source: wiiw.

Figure 13 / Structural Funds spillovers 2007-2018, by country, as per cent of GDP, annual averages



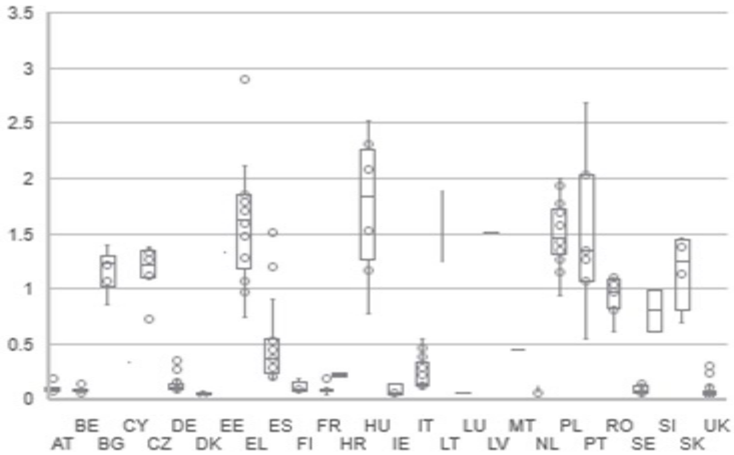
Source: wiiw.

Figure 14 / Structural Funds spillovers 2007-2018, by country, as per cent of SF expenditures



Source: wiiw.

Figure 15 / Structural Funds after spillovers 2007-2018, by country, as per cent of GDP, annual averages



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