SIRIUS

Skills and Integration of Migrants, Refugees and Asylum Applicants in European Labour Markets

# Employability of MRAs in the SIRIUS countries

## WP1: Greece/Research report

**WP Leader: NTUA**

**stelioss@central.ntua.gr**

## February 2019– Deliverable 1.4

Horizon 2020
SIRIUS (770515)

Co-funded by the Horizon 2020 programme of the European Union

**Reference:** SIRIUS Delivert D1.4

This research was conducted under the Horizon 2020 project ‘SIRIUS’ (770515).



Any enquiries regarding this publication should be sent to us at: stelioss@central.ntua.gr

This document is available for download at https://www.sirius-project.eu/publications/wp-reports-results

SIRIUS

Skills and Integration of Migrants, Refugees and Asylum Applicants in European Labour Markets

# Contents

# List of figures

# List of tables

# Acknowledgements

We are grateful to Professor Simone Baglioni and the rest of our partners for helpful comments and discussions.

# About the project

Despite the polarisation in public and policy debates generated by the post-2014 influx of refugees, asylum applicants and migrants, European countries need to work out an evidence-based way to deal with migration and asylum rather than a prejudice-based one. The project, SIRIUS, builds on a multi-dimensional conceptual framework in which host country or political-institutional, societal and individual-related conditions function either as enablers or as barriers to migrants', refugees' and asylum seekers' integration via the labour market.

SIRIUS has three main objectives:

To provide systematic evidence on post-2014 migrants, refugees and asylum applicants especially women and young people and their potential for labour market employment and, more broadly, social integration.

To advance knowledge on the complexity of labour market integration for post-2014 migrants, refugees and asylum applicants, and to explore their integration potential by looking into their spatial distribution (in relation to the distribution of labour demand across the labour market), while taking into account labour market characteristics and needs in different country and socio-economic contexts.

To advance a theoretical framework for an inclusive integration agenda, outlining an optimal mix of policy pathways for labour market integration including concrete steps that Member States and other European countries along with the EU can take to ensure that migrant-integration policies and the broader system of workforce-development, training, and employment programmes support new arrivals' access to decent work opportunities and working conditions.

SIRIUS has a mixed methods approach and innovative dissemination plan involving online priority action networks, film essays, festival, job fair and an applied game along with scientific and policy dialogue workshops and conferences.

# Executive summary/Abstract

Over the last years, Europe has become the basic recipient of large migration flows primarily from the Middle-East countries due to the continuation of war, as well as due to the dictatorship regimes that prevail in these areas. The migration flows have affect the labour structure of many EU economies, which still struggle with the smooth integration and employability of migrants into their labour markets.

In this context, the first part of this report aims at identifying the SIRIUS economies and the sectors of economic activity that could be considered as being “labour absorbing”, using aggregate national data for the time period 2008-2016.

Econometrically, in order to take into consideration the complex labour dynamics among the various SIRIUS economies as well as the potential spillover effects among the various countries, this report employed a GVAR model for all the economies. In this context, using the GVAR framework, the dynamic interlinkages and the potential spillover effects among the various SIRIUS economies will be uncovered. The implicit assumption, in this framework, is that there is labour mobility among the various economies. Therefore, the results of the GVAR estimation will pinpoint the labour absorbing economies in the dataset. At the second step, this report analysed the labour absorbing sectors in the SIRIUS economies. A labour absorbing sector, identified in the second step, implies that this specific sector could attract, independently, more labour from the rest of the sectors in order to increase its production. The fundamental difference in the second step is that the labour attracted by a sector comes directly from the labour force of the respective economy, whereas in the first step the labour attracted by an economy comes both from the rest of the economies, as well as from the respective economy.

The estimation of the sectoral VAR/VEC models in the second step is conducted using sectoral data for the economies of Switzerland (CH), the Czech Republic (CZ), Finland (FI) and the United Kingdom (UK), Greece (GR), Denmark (DK) and Italy (IT), that cover the four main sectors of economic activity, i.e. Primary sector (A, Nace Rev.2), Secondary sector (B-F, Nace Rev.2), Manufacturing sector (C, Nace Rev.2), and tertiary sector (G-U, Nace Rev.2), that capture each sector’s output (Y) and Labour (L), were employed.

A main finding is that the aggregate output of the UK has a statistically significant effect on the aggregate labour dynamics of the Czech Republic, Finland and Switzerland. This could be attributed to the strong interconnection between the UK and these economies mainly in terms of trade and financial relations. Another interesting finding is that the economies of the UK, Switzerland, Finland and the Czech Republic could be considered as being “labour absorbing”. In other words, based on our econometric analysis these economies can attract extra labourers from the other SIRIUS economies. In this context, in these economies any potential future migration flows have increased potential of being integrated into their labour markets.

Next, at a sectoral level, another main finding is that the economies of Switzerland and Greece have the highest “labour absorbing” capability for MRAs in the sense that all their sectors are characterized as being “labour absorbing”. Then, the economies of Finland and the Czech Republic have three labour absorbing sectors namely Primary, Secondary and Manufacturing for Finalnd and Primary Secondary and Tertiary for Czech Republic, whereas Denmark presents two i.e. Primary and Secondary sectors and the UK only one labour absorbing sector i.e. Primary Sector, respectively. It should be noted that, with the exception of Italy, the primary sector[1] in all the economies could be considered as being “labour

[1] Note that the present report utilizes official data on migration and labour without taking under consideration any irregular migration flows or irregular employment that could be present in the various economies.

absorbing". This fact implies that in most economies there is a dire need for labourers in the Agriculture, Forestry, Fishing and other related activities sector. Finally, another interesting finding is the fact that the secondary sector is considered to be "labour absorbing" for all the SIRIUS economies with the exception of Italy and the UK, whereas the manufacturing and tertiary sectors are considered to be "labour absorbing" for three out of seven SIRIUS economies i.e. Switzerland, Czech Republic and Greece .In other words, the econometric investigation undertaken at the sectoral level, with the results presented previously, showed that the the SIRIUS economies have the capacity to reallocate their labour force between the various economic sectors in a way that would lead an increase to their industrial production. Therefore, the MRAs that are integrated in the labour force of each economy have increased potential of being emplyoyed to the specific sectors described above.

Now, as far as the second part of the report is concerned, significant diversity among the sectors and the occupations of the examined countries that boost economic growth was evident. This diversity is driven by the countries' different specialization patterns and structural characteristics, which are present in the labour market features.

Furthermore, the employability potential for MRAs was identified in a wide range of sectors and occupations among the examined countries. The employability potential for MRAs is determined at the country level, for all the examined countries, despited their "labour absorbing" characteristics. For each SIRIUS country the most dynamic sectors and occupations are determined and the MRAs integration potential is approached based on the similarity of their educational attainment level with the educational attainment level's demand, at the sectoral and occupational levels, respectively. The analysis is carried out at the 2-digit sectoral (NACE Rev.2) and 2-digit occupational (ISCED) classification.

Based on our findings, in the Czech Republic the occupations with high employability potential are in the categories of elementary occupations, craft and related trades workers and clerical support workers. In Denmark the occupations with high employability potential can be found in a wide range of occupations. such as craft and related trades workers, clerical support workers, service and sales workers. In Greece, the occupations with high employability potential are in the categories of skilled agricultural workers, plant and machine operators and assemblers and elementary occupations. In Switzerland, the occupations with high employability potential are in the categories Clerical support workers, Plant and machine operators and assemblers and Elementary occupations. In the United Kingdom, the occupations with high employability potential are in the categories of professionals, technicians and associate professionals and clerical support workers. In Finland, MRAs integration potential is found in the services sectors and in the occupational categories of Craft and related trades workers, Skilled agricultural, forestry and fishery workers and Professionals. In Italy, MRAs integration potential is found in manufacturing, services and primary sectors and in the occupational categories of Clerical support workers, Service and sales workers and Professionals. All things considered, the uneven structure of each economy's labour market dictates the use of tailor made policy actions that would differ considerably from country to country, dependening on the inherent characteristics of each economy.

# Introduction

Nowadays, in the turbulent international markets, migration in its various forms has become a hot issue for nearly every country in the world. Over the past decades, the number of international migrants worldwide has continued to grow, reaching 258 million in 2017, up from 73 million in 2000 (UN, International Migration Report 2017, p. 4), with almost half of migrant workers concentrated in two broad regions: Northern America, and Europe, (ILO, 2015; UN News, 2017)

After the recent sharp increase of migrants, refugees and asylum seekers (MRAs) arriving in Europe, the issue of migration is forefront in the policy agenda of all European countries. Based on the "Facts and Figures" on the EU migration crisis, pubilished by the EU parliament on 30/6/2017, there were 728,470 applications for international protection in the EU in 2017. This figure represents a decrease of 44% compared to 2016, when there were almost 1.3 million applications. Additionally, in 2017, EU countries granted protection to more than 538,000 people, down by almost 25% on 2016. Almost one in three of these were from Syria, while Afghanistan and Iraq rounded up the top three. The current refugee crisis occurred a few years after the beginning of the economic crisis and at a juncture where a number of European countries have not fully recovered. The heterogeneity of the social and economic situations in the different European countries intensified after the crisis, with important impact in their labour market: rise in unemployment and precarious jobs difficulties in preserving social security policies and increased risk of social exclusion and poverty (Carmo, Rio, & Medgyesi, 2018, p. 11).

Moreover, besides the impact of the economic crisis on the labour market of all European countries, a number of labour market's challenges arise from changes in the demographic composition of the labour force and from the shifting of production to more complex processes (Cedefop, 2016, pp. 6, 18, 29). In the future, Europe is expected to face a significant decline in working age population, accompanied by an increase in old age dependency ratio (old age dependency ratio is the ratio between the number of persons aged 65 and over and the number of persons aged between 15 and 64). The decline of the working age population will result, in some countries, in the reduction of labour force, putting downward-pressure on labour supply with possible negative impact on economic growth potential (Bredtmann, 2014, p. 36; Peschner & Fotakis, 2013, p. 23). Moreover, the production of products and services of increased complexity will, also, rise the complexity of work and create the need for employment of more qualified and better skills (Pikos & Thomsen, 2016, p. 12).

The future role of MRAs in the labour market of the host countries is difficult to predict. According to Peschner and Fotakis (2013, p. 39) the impact of migration on economic growth and employment of the receiving country is connected with MRAs skills and with their compatibility and/or complementarity in the domestic labour market (for the demand side). Within the next few years, the dynamic labour markets of European countries will be found confronting significant changes in occupations' and skills' demand. At the same time, constrains in economic growth could appear due to labour supply bottlenecks. Issues of skills shortages and skills mismatches will be crucial for the economies and the adopted policies to confront the MRAs integration should take full account (OECD, 2016, p. 24).

Migrants, refugees and asylum applicants (MRAs) often face discrimination, abuse and even violence. Especially women and children may face various forms of exploitation such as "trafficking". A way of facing all the aforementioned situations is their integration in each economy's formal labour market. Such a policy will promote labour for MRAs and will eventually eliminate trafficking. After all, the population of international migrants comprises large proportions of working-age persons compared to the overall population as we discuss in the Sirius WP1 comparative report and as pointed out by other studies (UN, International Migration Report 2017, p. 19).

In this context, MRAs are seeking employment for themselves and their families away from their home countries. Of course, MRAs remain among the most vulnerable groups worldwide and are those who need jobs in troubled times. For instance, MRAs are often unemployed or underemployed and usually live in worse conditions than native-born laborers. In the words of Chiswick and Hatton (2003, p. 65), “International migration alters the labour supply and the demographic characteristics of both the sending and the receiving countries. Moreover, it influences economic growth, patterns of trade, income distribution, and the distribution of political power within and between countries”. Through employment they can contribute to the development of their home and host country, as well.

Against the background of these labour market’s features, the MRAs integration into the host countries’ labour markets is a critical policy goal. A crucial factor towards MRAs integration is the enhancement of their employability in order to access employment opportunities. Based on the research of RISE (2013, p. 36) for the situation of asylum seekers and refugees in three European countries, important barriers for their labour market integration are, among others: (i) The lack of knowledge of the host-country’s language, especially of “vocational language”, (ii) the lack of qualifications’ and skills’ recognition, (iii) the lack of host-country references or experience recognition, and (iv) the lack of appropriate training courses.

The knowledge of the host country’s language is a necessary precondition for accessing employment and successful overall integration. But language-learning programs for MRAs are rarely linked to employment, while integration programs should provide the opportunity to build both language and vocational skills (Benton & Diegert, 2018, p. 22). It is important to note that a major prerequisite towards this direction is the recording and recognition of MRAs skills and qualifications, in order to construct the suitable educational and training programs plan. The integration process should start with a comprehensive skills’ assessment, accompanied with the recognition of occupational skills and qualifications. Additionally, gaining vocational skills and work experience in the host country’s labour market should be an important policy measure for MRAs. But as we discuss in the Sirius WP2 comparative report, only in few countries are such opportunities offered to MRAs.

Thus, relevant policies should be developed to enable MRAs to contribute to the sustainable economic development of both their host and home countries. On the one hand, for the home country, MRAs contribute their remittances which, in turn, improve the home country’s economic situation. On the other hand, MRAs fill potential labour gaps, develop entrepreneurial activities and, if properly registered, they pay income and social security taxes in their host countries. Needless to say, they also offer to the host country cultural diversity and enrichment, which is of high importance in troubled times.

Hence, consistent and timely data on the integration capabilities of the MRAs by the host country is essential for assessing future trends and for setting new policy targets. After all, in recent years, research in the integration of MRAs into the labour market has focused, among other things, on the integration of MRAs in the host country’s labour market (e.g. Konle-Seidl, 2018, p .10). A number of very recent studies (see, among others, Zimmermann, 2016; Junge and Patuzzi, 2016; Karlsdóttir et. al., 2017; Konle-Seidl, 2018) have been conducted that estimate the impact of migration on the countries and magnitudes such as wages and employment/unemployment effects as well as changes in the structure of demand or supply.

Thus, in technical terms, the research question to be investigated is the following: do the SIRIUS countries’ labour markets are capable of absorbing/integrating more labourers? (e.g. Kirkwood et al., 2016).

In this report, we analyze the integration capabilities of the MRAs in the countries of interest. In order to tackle these issues, a number of relevant econometric and quantitative techniques have been employed. To do so, we proceed at multiple levels. Specifically, two (2) complementary methodological frameworks have been used in order to investigate the aforementioned topic. On the one hand, the econometric investigation of this report is twofold.

Firstly, using the GVAR framework, the dynamic interlinkages and the potential spillover effects among the various SIRIUS economies will be uncovered. The implicit assumption, in this framework, is that there is labour mobility among the various economies. In this context, the results of the GVAR estimation will pinpoint the labour absorbing economies in the dataset. Next, using the VAR/VEC framework, we will investigate if there are any specific labour absorbing sectors for all the SIRIUS economies. The implicit assumption here is that there is labour mobility across the various sectors, but not necessarily across the various economies. Note, that the results of the two methodologies employed are not mutually exculsive. In other words, based on our two step approach, the first step provides evidence for the total economy, whereas the second step provides evidence for the sectoral dimesion of the economy. Therefore, a labour absorbing economy identified in the first step, implies that the economy in total could attract more labour from the rest of the economies in order to increase its production. On the other hand, a labour absorbing sector, identified in the second step, implies that this specific sector could attract, independently, more labour from the rest of the sectors in order to increase its production. The fundamental difference in the second step is that the labour attracted by a sector comes directly from the labour force of the respective economy, whereas in the first step the labour attracted by an economy comes both from the rest of the economies, as well form the respective economy.

On the other hand, a quantitative analysis is also presented based on two composite indicators, i.e. SIRIUS 1 and SIRIUS 2. SIRIUS 1 and SIRUS 2 are used to identify the sectors and the occupations, respectively, of an economy which have simultaneously high growth potential and required educational attainment level compatible to the MRAs educational attainment level. For the construction of both indicators input-output analysis is used, which constitutes a widely used methodology appropriate for this type of investigation. The estimates are disaggregated by sector of economic activity and by occupation for each country and analytical presentations will be offered to assess the current state of integration of international MRAs in the countries under investigation.

The report is structured as follows: the first part presents the econometric analysis (VAR/GVAR), and the second part sets out the quantitative analysis for each economy investigated. The next part summarizes and concludes.

# Part A: Econometric Analysis

The aim of this part is to identify the SIRIUS economies and the sectors of economic activity that could be considered as being “labour absorbing”. In this context, throughout our analysis we make the implicit assumption that the labour markets do not discriminate against race, ethnicity or sex. In other words, we assume that all employees have equal opportunities of being integrated into the labour markets and the fact that they are either natives or MRAs plays no role at all. Therefore, in order to identify the “labour absorbing” economies and the “labour absorbing” sectors among the SIRIUS economies we will make use of a two-step approach. In the first step, we will identify which SIRIUS economies could be considered as being labour absorbing. In this context, in order to take into consideration the complex labour dynamics and the spillover effects among the various SIRIUS economies, we will make use of Global Vector Autoregressive (GVAR) modelling that will incorporate all the economies of interest. The implicit assumption made in the first step that there is labour mobility among the various economies, Therefore, a labour absorbing economy could employ extra labourers not only by realocating its own labour force but also by attracting labourers from the other economies. In the second step, we will identify the “labour absorbing” sectors in the SIRIUS economies. To do so, we will employ sectoral Vector Autoregressive (VAR) models for each economy.The implicit assumption made in the second step is that a labour absorbing sector attracts labourers only from the rest of the sectors of this specific economy.

The GVAR/VAR models are capable of assessing the dynamic relationships between the key variables of output and labour, both at the national (aggregate) as well as at the sectoral level. Based on modern econometric literature (Wooldridge, 2013; Lutkepohl, 2005; Hamilton,1994), the use of such models for uncovering the dynamic interdependencies among economic entities, i.e. economies, sectors etc provides the researcher with the modelling advantage of unspecified *a priori* assumptions regarding the relationship among the various entities. In other words, both methods are purely data-driven. Nonetheless, at the same time, the absence of an *a priori* economic hypothesis between the various entities could also be viewed as a weakness of these models. However, due to the fact that the recent global financial crisis has severely distorted traditional economic relationships, (Konstantakis et al., 2015; Benetrix et al., 2016), these models act as the main methodological tool for the study of these distortions.

## 1.1. GVAR modelling

The Global VAR model (GVAR), introduced by Pesaran at al. (2004), is suitable for assessing relationships between economic entities, while its methodology provides a general, yet practical, global modeling framework for the quantitative analysis of the relative importance of different shocks and channels of transmission mechanisms[2]. In fact, it comprises a compact econometric model of the world economy, which is designed to explicitly model the economic and financial interdependencies at both the national and the international level.

More specifically, the GVAR combines individual country/regional vector error-correcting models, where the domestic variables are related to corresponding foreign variables that are constructed exclusively to match the international trade, financial or other, desired patterns of the economic entities under consideration. Then, the individual country models are linked through a consistent econometric approach so that the GVAR model is applied to the world as a whole. Therefore, it can then be used to investigate the degree of regional interdependencies via impulse response analysis[3].

The GVAR framework is structured upon observables, which typically include macroeconomic aggregates and financial variables, with the country-specific foreign variables serving as a proxy for common unobserved factors and thus it is capable of overcoming the major problem of dimensionality[4] In this context, we will make use of the Gross Domestic Product (GDP) and Labour of each SIRIUS economy so as to investigate how an unexpected/unanticipated shock in the GDP of one economy influences labour in the rest of the SIRIUS economies.

In this work, the Global VAR model consists of seven (7) economic entities, namely the Czech Republic, Denmark, Finland, Switzerland, the UK, Greece and Italy that constitute the SIRIUS economies. Each country *i,* $i = 1, \dots, 7$ follows a VAR model, augmented by the exogenous variables of global trade (T), expressing the respective transmission channel. The endogenous variables $x_{it}$ denote a 2×1 vector of macroeconomic variables belonging to each country *i,* consisting of Gross Domestic Product (GDP) and Labour (L). The foreign variables $x^*_{i,t}$ represent a weighted average of the other country's variables that are regarded to be weakly exogenous in each country's model, whose weights are pre-determined. In order to sufficiently capture all the interconnections among the various economies we make use of Input-Output weights based on Konstantakis et al. (2016). Mathematically, the VAR model for each country is:

$$\Phi_i(L, p_i)x_{it} = a_{i0} + \Lambda_i(L, q_i)x*_{it} + a_{i1}G_t + u_{it} \quad [1]$$

For $i = 1, \dots, 7$ $and$ $t = 1 \dots T$ where $x_{it}$ is the set of country domestic variables and $\Phi_i(L, p_i)$ is the matrix of lag polynomial of the associated coefficients; $a_{i0}$ is a vector of fixed intercept; $G_t$ is a set of the Global Variables and $a_{i1}$ is a vector of their respective coefficients $x*_{it} = Wx_{it}$ is the set of weighted foreign variables and $\Lambda_i(L, q_i)$ is the matrix of lag polynomial of the associated coefficients. In this work, matrix $W_i$ is a 7 × 7 dimensional matrix of weights that defines $k_i$=7 country-specific cross section averages of foreign

[2] In general, there are two primary channels for the transmission of shocks among the various economies: the financial and the trade channel. For a comprehensive analysis of the transmission of shocks among countries see, for example, Artis et *al.* (1997) Canova and Marrinan (1998), and Pesaran et al. (2004).

[3] The impulse response analysis conducted in VAR/ GVAR models presents a variable's of interest response in time when an unanticipated unit shock, equal to one standard deviation, is experienced by another variable in the system of equations. See, among others, Koop et al. (1996) and Pesran and Shin (1998) and Lutkepohl (2005).

[4] That is: the number of estimated parameters have to be considerable less than the number of observations in order to have unbiased estimates that will belong to the class of estimates with the minimum variance

variables. Finally, $u_{it}$ is a vector of idiosyncratic, serially uncorrelated country-specific shocks with mean zero and the variance-covariance matrix Σi, $u_{it} \sim i.i.d(0, \sigma^2)$.

The implementation of the GVAR methodology has two steps. Firstly, each country's VARX model is estimated treating the Global Variables as exogenous. After the estimation of each VARX model, we relate their corresponding estimates through link matrices and then we stack them together to obtain our GVAR model. In particular, we consider the following model for country i:

$$x_{it} = a_{i0} + \Phi_{ip} x_{it-p} + \Lambda_{i0} x*_{it} + \Lambda_{iq} x*_{it-q} + a_{i1} G_t + u_{it} \quad [2]$$

To begin with, we group all foreign and domestic variables together as: $z_{it} = \begin{pmatrix} x_{it} \\ x*_{it} \end{pmatrix}$

Therefore, for each country i the respective model becomes :

$$A_i z_{it} = a_{i0} + B_{i.\max\{p.q\}} z_{it} + + a_{i1} G_t + u_{it} \quad [3]$$

where: $A_i = (I, -\Lambda_{i0})$ $and$ $B_{i,\max\{p,q\}} = \left(\Phi_{ip}, \Lambda_{iq}\right)$ .

Next, by gathering all the domestic endogenous variables together, we define the following global vector $x_t = \begin{pmatrix} x_{1t} \\ x_{2t} \end{pmatrix}$ and we obtain the identity: $z_{it} = W x_t \ \forall\, i = 1, 2$ where W is the trade matrix. Then, by using the former identity in the i-th country specific model, we get:

$$A_i W_i z_{it} = a_{i0} + B_{i,\max\{p,q\}} W_i z_{it-\max\{q,p\}} + a_{i1} G_t + u_{it} \quad [4]$$

At the second stage, by combining each country model with the later equation we to obtain the GVAR:

$$M x_t = a_{i0} + H_{i,\max\{p,q\}} x_{t-\max\{t,q\}} + + a_{i1} G_t + u_{it} \ [5]$$

where $M = (A_i W_i)$ $and$ $H_i = \left(B_{i,\max\{p,q\}} W_i\right)$.

If the M matrix is non-singular, then we obtain the reduced form of the GVAR model:

$$x_t = b_0 + F_{\max\{p,q\}} x_{t-\max\{p,q\}} + b_1 G_t + v_t \quad [6]$$

where $b_i = M^{-1} a_i$ . $F_i = M^{-1} H_i$ and $v_t = M^{-1} u_t$

We examine the dynamic characteristic of the GVAR model through the so-called Generalized Impulse Response Functions (GIRFs)[5] following Koop et *al.* (1996) and Pesaran and Shin (1998). Analytically, a positive standard error unit shock is examined on every variable in the universe of our model aiming at determining the extent to which each economy, responds to a shock. Also, we study the way these shocks can have persistent effects. A basic advantage of this approach is that the GIRFs are invariant to the ordering of the equations.

$$I_{j\,(n)} = {\sigma_{jj}}^{-1/2} + B_n \Sigma e_j \forall n = 1, 2, \ldots [7]$$

[5] In general, a GIRF is a simulated response over a time horizon of a variable to a unit shock equal to one standard deviation to another variable in the model. For an extensive discussion on the GIRFs see among others Koop et al. (1996), Pesaran and Shin (1998), and Lutkepohl (2005).

where $I_{j\,(n)}$ is the Impulse Response Function *n* periods after a positive standard error unit shock; $\sigma_{jj}$ is the *j*th row and *j*th column element of the variance–covariance matrix Σ of the lower Cholesky decomposition matrix of the error term which is assumed to be normally distributed; B is the coefficients' matrix when inversely expressing the VAR model as an equivalent MA process and $e_j$ is the column vector of a unity matrix. See Koop et *al.* (1996) and Pesaran and Shin (1998).

### 1.1.1. Weight Matrix Construction

The Input – Output (IO) model describes the economic system based on the following equation for the various (*n*) economic entities:

$$X_i = x_{i1} + x_{i2} + \ldots + x_{in} + y_i,\ i = 1, 2, \ldots, n \quad [8]$$

where: $X_i \geq 0$ is the output of economy *i*, $y_i$ is the final demand for the product of economy *i*, $x_{ij}$ is the product of economy *i* used by economy *j*. Equation (8) can be written as follows, in matrix form:

$$X = AX + Y \quad [9]$$

where: X is the vector of outputs, Y is the vector of final demand, and *A* is the so-called input or technical coefficients matrix whose typical element is equal to:

$$(a_{ij})_{nxn} = \frac{x_{ij}}{X_j} \quad [10]$$

where: $a_{ij} \geq 0$ is the quantity of output from economy *i* required to produce one unit of output in economy *j*.[6] Solving the balance equation **[9]** for X, we obtain:

$$X = (I_n - A)^{-1}Y \quad [11]$$

in which $I_n$is the*n* × *n* identity matrix, $(I_n - A)^{-1}$ is the so-called Leontief inverse and Y is the column vector of final demand. In the IO approach, the main tools of analysis are the technical coefficients matrix *A* and the Leontief inverse matrix $(I_n - A)^{-1}$, namely the matrix of input-output multipliers of changes in final demand into levels of outputs.

Now, based on the fundamental IO matrix of technical coefficients *A,* we construct matrix $Q$, which has the following form:

$$Q \equiv \begin{pmatrix} x_{11} & \ldots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{n1} & \ldots & x_{nn} \end{pmatrix}$$

where each element of $Q$ is given by the expression:

$$x_{ij} \equiv a_{ij}X_j \quad [12]$$

and the $x_{ij}$ element of matrix $Q$ expresses the product of economy i that is used from economy j, $X_j$ is the total output of the j-th economy and $a_{ij}$is interpreted as the quantity of output from economy i required to produce one unit of output in economy j, as we have seen earlier. Notice that, in general, $x_{ij} \neq x_{ji}, \forall i, j \in \{1, \ldots, n\}$.

In the IO matrix $Q$, the row elements express the quantities of goods and services, in value terms, supplied by one economy to itself and all others. Similarly, column elements

[6] For an in-depth discussion of the technical coefficients and their use see among others ten Raa (2007).

express quantities obtained by an economy from itself and all others. In general, matrix *Q* expresses an (intermediate) inter-country flow matrix.

Next, we construct the transpose of matrix *Q*, i.e. $Q^T$. In matrix $Q^T$, the row elements express quantities obtained by an economy from itself and all other economies, whereas the column elements express quantities supplied by an economy to itself and all others.

Now, let matrix P be defined as the difference between matrix *Q* and its transpose, $Q^T$, or in matrix notation:

$$P \equiv Q - Q^T$$

Thus, the typical element, $p_{ij}$, of matrix P is equal to :

$$p_{ij} \equiv x_{ij} - x_{ji}$$

Each element, $p_{ij}$, measures the net amount of goods and services of an economy, in value terms, that flows between itself and each other economy, in a given year.

Obviously, *P* is a matrix with zeros in the main diagonal. In matrix form:

$$P \equiv \begin{pmatrix} 0 & \dots & p_{1n} \\ \vdots & \ddots & \vdots \\ p_{1n} & \dots & 0 \end{pmatrix}$$

since, by definition, every element of its main diagonal indicates the quantities that each economy obtains and supplies to itself, which, in a general equilibrium framework, are equal to each other. Hence, $p_{ii} = 0, and\ p_{ij} = -p_{ji}, \forall i,j \in \{1, \dots, n\}$. Apparently, *P* represents a net (intermediate) inter-country flow matrix.

Since we are interested in constructing the so-called weight matrix, according to the spirit of the GVAR model at the international level (Pesaran et *al.* 2004), we proceed as follows: Let NQ, be the IO matrix whose typical element, $nq_{ij}$, is given by the following expression:

$$nq_{ij} \equiv \left|p_{ij}\right| = \left|x_{ij} - x_{ji}\right| \text{ [13]}$$

A net inter-country flow weight is defined as the ratio of flows of goods and services between economy *i* and economy *j*, over the total absolute flows of goods and services realized by economy *i*. Or, in mathematical terms:

$$w_{ij} \equiv \frac{nq_{ij}}{\sum_{i=1}^{n} nq_{ij}} \text{[14]}$$

Obviously, W is a matrix with zeros in the main diagonal. Or, in matrix form:

$$W \equiv \begin{pmatrix} 0 & \dots & w_{1n} \\ \vdots & \ddots & \vdots \\ w_{n1} & \dots & 0 \end{pmatrix}$$

since $nq_{ii} = 0$ as discussed above, and, in general, $w_{ij} \neq w_{ji}, \forall i \neq j$.

For instance, the element $w_{12}$ indicates the flows of goods and services, between economy 1 and economy 2 as a proportion of the total flows of sector 1, see Michaelides et *al.* (2018), Konstantakis et *al.* (2017), Tsionas et *al.* (2016), Konstantakis et *al.* (2016).

Hence, *W* represents an intermediate net inter-country flow weight matrix.

## 1.2. VAR modelling

Having used the GVAR model presented in the previous section to identify the "labour absorbing" economies among the SIRIUS ***countries***, we continue our analysis with the investigation of the "labour absorbing" ***sectors*** in these economies using VAR modelling. In this context, in our analysis, every economy is decomposed into four (4) sectors i.e. Primary, Secondary, Manufacturing and Tertiary sector, respectively.

The Vector Autoregressive (VAR) model is a technique that can be used to characterize the joint dynamic behaviour of a set of variables without imposing restrictions of the kind needed to identify underlying structural parameters.

In mathematical terms, any $nx1$ vector of stochastic process $x_t$ can be decomposed into two (2) orthogonal components, namely one linearly predictable and one linearly regular (Wold 1954). More specifically, if we let $\mathcal{M}_t$ be the time information set, then according to Wold's Theorem (1954), the following decomposition holds:

$$\mathcal{M}_t = \mathcal{M}_{t-1} \oplus \varepsilon_t \text{ [15]}$$

where: $\mathcal{M}_{t-1}$ contains the time information at time $t-1$, and $\varepsilon_t$ is the information at time $t$. The implicit assumption made is that $\mathcal{M}_{t-1}$ is orthogonal to $\varepsilon_t$, while $\oplus$ indicates direct summation, i.e. $\mathcal{M}_t = \{\mathcal{M}_{t-1} + \varepsilon_t, \mathcal{M}_{t-1} \in \mathcal{M}_{t-1}, \varepsilon_t \in \mathcal{E}_t\}$.

Based on the above representation, it is easy to check that since $\varepsilon_t \perp \mathcal{M}_{t-1}$, then $\varepsilon_t \perp \varepsilon_{t-1}$ which, in turn, implies that $\varepsilon_{t-j} \perp \varepsilon_{t-j'} \forall j' < j$.

Now, since the decomposition on $\mathcal{M}_t$ could be repeated iteratively backwards for each time $t$, then the following equality holds:

$$\mathcal{M}_t = \mathcal{M}_{t-1} \oplus \varepsilon_t = \cdots = \mathcal{M}_{-\infty} \oplus \sum_{k=1}^{\infty} \varepsilon_{t-k} \text{ [16]}$$

where $\mathcal{M}_{-\infty} = \cap_j \mathcal{M}_{t-j}$. Since $x_t$ is known at time $t$, then without loss of generality we can write $x_t = E(x_t/\mathcal{M}_t)$ using the conditional expectation. This, combined with the orthogonality of $\varepsilon_t$, implies that the following equation holds:

$$x_t = E(x_t/\mathcal{M}_t) = E(x_t/(\mathcal{M}_{-\infty} \oplus \sum_{k=1}^{\infty} \varepsilon_{t-k})) = E(x_t/(\mathcal{M}_{-\infty}) + \sum_{k=1}^{\infty} E(x_t/\varepsilon_{t-k}) \text{ [17]}$$

If we make the assumption that we consider linear representations, which in turn implies that we substitute the expectations operator with a linear projection operator, the above equations can be written as follows:

$$x_t = a_t x_{-\infty} + \sum_{k=1}^{\infty} D_{k,t} \varepsilon_{t-k} \text{ [18]}$$

Where $x_{-\infty} \in \mathcal{M}_{-\infty}$ and $\varepsilon_{t-k} \in \mathcal{E}_{t-k}$. Then, the sequence $\{\varepsilon_t\}_{t=0}^{\infty}$, which is defined as $\varepsilon_t = x_t - E(x_{t-1}/M_{t-1})$, is a white noise process, i.e. $E(\varepsilon_t) = 0$, $E(\varepsilon_t \varepsilon_{t-k}') = \Sigma_t$ if $k = 0$ and zero otherwise.

Finally, if we assume that $a_t = a$ and $D_{k,t} = D_k \forall t$, then we get the Vector Autoregressive Representation (VAR) for any nx1 vector of stochastic processes.

$$x_t = a x_{-\infty} + \sum_{k=1}^{\infty} D_k \varepsilon_{t-k} \text{ [19]}$$

(a) Econometric Representation

The VAR model also lends itself to empirical estimation, based on some assumptions, see Konstantakis et *al.* (2015).

*Assumption 1*: The history of each variable affects its own and the other variables' current state.

*Assumption 2*: No variable simultaneously affects any other variable.

*Assumption 3:*The dynamic evolution among the variables in the model is linear.

A model that takes into account Assumptions 1-3 is a VAR, and can be written as follows to ease estimation:

$$X_t = \begin{pmatrix} x_{1,t} \\ \vdots \\ x_{n,t} \end{pmatrix}, c = \begin{pmatrix} c_1 \\ \vdots \\ c_n \end{pmatrix}, A_i = \begin{pmatrix} a_{11,i} & \dots & a_{1n,i} \\ \vdots & \ddots & \vdots \\ a_{n1,i} & \dots & a_{nn,i} \end{pmatrix}, \varepsilon_t = \begin{pmatrix} \varepsilon_{1,t} \\ \vdots \\ \varepsilon_{n,t} \end{pmatrix} \text{ [20]}$$

or:

$$X_t = c + A_1 X_{t-1} + \cdots + A_p X_{t-p} + \varepsilon_t \text{ [21]}$$

where: $c_i$ are constants, $x_{i,t}$ are the so-called endogenous variables $i$, $a_{ij,k}$ indicates the effect of variable $j$ on variable $i$ with a lag of $k$, and $\varepsilon_{i,t}$ is the residual time series of variable $i$. Now, the order $p$ of the VAR model shows how long we are going back in time.

The residual's vector $\varepsilon_t$, is assumed to be white noise, meaning that each vector element has a zero mean and a time invariant positive definite covariance matrix. Also, there is no correlation across time, and no autocorrelation in each of the individual error terms. In matrix form, we have:

$$\widetilde{X_t} = \begin{pmatrix} X_t \\ X_{t-1} \\ \vdots \\ X_{t-p+1} \end{pmatrix}_{pnx1}, \tilde{C} = \begin{pmatrix} C \\ 0_{nx1} \\ \vdots \\ 0_{nx1} \end{pmatrix}_{pnx1}, \tilde{A} = \begin{pmatrix} A_1 & \dots & A_{p-1} & A_p \\ I_{nxn} & \dots & 0_{nxn} & 0_{nxn} \\ \vdots & \ddots & \vdots & \\ 0_{nxn} & \dots & I_{nxn} & 0_{nxn} \end{pmatrix}_{pnxpn}, \tilde{\varepsilon}_t = \begin{pmatrix} \varepsilon_t \\ 0_{nxn} \\ \vdots \\ 0_{nxn} \end{pmatrix}_{pnx1} \text{ [22]}$$

Where: $0_{nx1}$ and $0_{nxn}$ are an *n*-dimensional zero vector and an *n*×*n* zero matrix, respectively. In this way, we obtain a compact representation of the VAR model:

$$\widetilde{X_t} = \tilde{C} + \tilde{A}\widetilde{X_t} + \tilde{\varepsilon_t} \text{ [23]}$$

Actually, we can express the VAR (*p*) model compactly as follows:

$$Y = A^* Z + U \text{ [24]}$$

where: $Y = [X_{p+1}, X_{p+2}, \dots, X_N]$, $A^* = [\boldsymbol{C}, A_1, A_2, \dots, A_p]$, or:

$$Z = \begin{pmatrix} 1 & 1 & \dots & 1 \\ X_p & X_{p+1} & \dots & X_{N-1} \\ \vdots & \vdots & & \vdots \\ X_1 & X_2 & \dots & X_{N-p} \end{pmatrix}, U = \left(\varepsilon_{p+1}, \varepsilon_{p+2}, \dots, \varepsilon_N\right) \text{ [25]}$$

This format is compact and also lends itself to an Ordinary Least Squares (OLS) estimation, with a straightforward form for the numerical solution:

$$A^* = YZ^T(ZZ^T)^{-1} \text{[26]}$$

In case we need to model effects which are exogenous to the system, this can be done by incorporating *q>0* exogenous variables, $z_1(t)$, ..., $z_q(t)$, into the model as follows:

$$X_t = A_1X_{t-1} + \cdots + A_pX_{t-p} + \boldsymbol{c}_1z_{1,t} + \cdots + \boldsymbol{c}_qz_{q,t} + \varepsilon_t \text{ [27]}$$

where: $\boldsymbol{c}_j$is the vector of size *n*×1 $(j = 1, \ldots, q)$.

In order to estimate the extended VAR (*p*) model, we need to augment the definition of *A** by including $\boldsymbol{c}_1$, ...,$\boldsymbol{c}_q$ to obtain the OLS estimates of *Ai* and $\boldsymbol{c}_j$.

Finally, when the variables of a VAR are cointegrated, we use a Vector Error-Correction (VEC) model, by incorporating the error correction terms in the VAR model. More precisely, a vector error correction (VEC) model is a restricted VAR that has cointegration restrictions built into the specification, so that it is designed for use with non-stationary series that are known to be cointegrated[7]. The VEC specification restricts the long-run behavior of the endogenous variables to converge to their cointegrating relationships while allowing a wide range of short-run dynamics. In other words, in the presence of a cointegrating relationship among the variables that enter the model implies that there is a long-run equilibrium relationship among these variables in time that needs to be incorporated into the model. The cointegration term is known as the error correction term (ECM) since the deviation from long-run equilibrium is corrected through a series of partial short-run adjustments.

Following the literature (Pesaran and Shin, 1998; Koop et al., 1996), we assess the results of the proposed VAR estimation using the so-called Generalized Impulse Response Functions (GIRFs), presented in the previous section, which provide results that are invariant to the ordering of the equations The GIRFs present how an unanticipated/unexpected shock in one of the variables affects the dynamic behaviour of the rest of the variables in the VAR-VEC system.

### 1.2.1. Relevant Tests

In order to have valid statistical inference using the proposed GVAR/VAR models a number of relevant test need to be carried out.

*Stationarity*

There are several formal tests for unit roots. Here, we apply the Phillips-Perron (PP) test, which can be viewed as a Dickey–Fuller (DF) test that has been made robust to serial correlation by using the Newey–West (1987) heteroskedasticity and autocorrelation consistent covariance matrix estimator. The main advantage of the PP tests over the DF tests is that the PP tests are robust to general forms of heteroskedasticity in the error term $u_t$. Another advantage is that no a-priori specification of the lag length for the test regression is required. The popular Phillips–Perron (1988) test involves fitting the model:

[7] For a detailed analysis on cointegration and time series properties see, among others, Lutkepohl 2005.

$$Y_t = a + \rho Y_{t-1} + \varepsilon_t \text{ [28]}$$

where we may exclude the constant or include a trend term. There are two statistics, $Z_\rho$and $Z_\tau$, calculated as:

$$Z_\rho = T(\widehat{\rho_T} - 1) - \frac{1}{2}\frac{n^2\widehat{\sigma^2}}{s_T^2}(\widehat{\lambda_T^2} - \widehat{\gamma_{0,T}}) \text{ [29]}$$

$$Z_\tau = \sqrt{\frac{\widehat{\gamma_{0,T}}}{\widehat{\lambda_T^2}}}\frac{\widehat{\rho_T}-1}{\hat{\sigma}} - \frac{1}{2}(\widehat{\lambda_T^2} - \widehat{\gamma_{0,T}})\frac{1}{\widehat{\lambda_T^2}}\frac{T\hat{\sigma}}{s_T} \text{ [30]}$$

where, $\gamma_{j,T} = \frac{1}{T}\sum_{t=j+1}^{T}\widehat{u_t}\widehat{u_{t-j}}$, $\widehat{\lambda_T^2} = \widehat{\gamma_{0,T}} + 2\sum_{j=1}^{q}(1 - \frac{j}{q+1})\gamma_{j,T}$ and $s_T^2 = \frac{1}{T-k}\sum_{t=1}^{T}\widehat{u_t^2}$

where: $u_t$ is the OLS residual, k is the number of covariates in the regression, q is the number of Newey–West lags to use in calculating $\lambda_T^2$, and $\hat{\sigma}$ is the OLS s.e. error of $\hat{\rho}$.

Under the null hypothesis that $\rho = 0$, the PP statistics, $Z_\rho$and $Z_\tau$, have the same asymptotic distributions as the Augmented Dickey–Fuller (ADF) t-statistic and normalized bias statistics.

*Optimum Lag Length*

In this work, we make use of the so-called Schwartz-Bayes Information criterion (SBIC) introduced by Schwartz (1978), where the optimum lag length is given by the following objective function:

$$\hat{k} = argmin_{k\leq n}\{-2\frac{\ln(LL(k))}{n} + k\frac{\ln(n)}{n}\} \text{ [31]}$$

where LL(k) is the log-likelihood function of a VAR(k) model, n is the number of observations and k is the number of lags and $\hat{k}$ is the optimum lag length selected. As the works of Breiman and Freedman (1983) and Speed and Yu (1992) have shown, SBIC is an optimal selection criterion when used in finite samples.

*Cointegration*

In case the variables that enter the model are I(1) we have to check for cointegration between them, since if cointegrating relationships are present then the Error Correction Terms have to be employed in the estimation of the GVAR model. We employ the popular Johansen (1988) methodology that allows for more than one cointegrating relationship, in contrast to other tests. The methodology is based on the following equation:

$$\Delta y_t = m + \Pi y_{t-1} + \sum_{i=1}^{p-1}\Gamma_i\Delta y_{t-i} + e_p \text{ [32]}$$

$$\text{where: } \Pi = \sum_{i=1}^{p}A_i - I \; and \Gamma_i = -\sum_{j=i+1}^{p}A_p \text{ [33]}$$

The existence of cointegration depends upon the rank of the coefficient matrix Π which is tested through the likelihood ratio, namely the trace test described by the following formulas:

$$J_{trace} = -T\sum_{i=r+1}^{k}\log(1 - \lambda_i) \text{ [34]}$$

where: T is the sample size and $\lambda_i$ is the largest canonical correlation.

The trace test tests the null hypothesis of *r<n* cointegrating vectors and the critical values are found in Johansen and Juselius (1990). Also, having stationary variables in the

system is not an issue according to Johansen (1995) as long as all the time series are integrated of the same order.

*Asymptotic Properties*

For the purpose of estimation and inference in stationary models, Chudik and Pesaran (2011) showed that the relevant asymptotics are:

$$\frac{T}{N} \to k < \infty \text{ [35]}$$

*Stability Conditions*

Also, to determine whether the model is stable, we check the stability of the country-by-country models, separately. However, following Pesaran et *al.* (2004) and Mutl (2009) it is not sufficient to examine the country-by-country stability, ignoring the endogeneity of the other variables $x^*_{i,t}$. Hence, it does not suffice to require that $\rho(\Phi_i) < 1$ for stability, where $\rho(\Phi_i)$ is the spectral radius of the matrix $\Phi_i, i = \{US, EU15\}$. Instead, Mutl (2009, p. 9) derived a sufficient condition for the model to be stable, namely that the maximum absolute row sums of W are less or equal to $k_w$, that is:

$$\|W\|_1 \leq k_w \text{[36]}$$

where $k_w$ is the uniform bound of absolute row and column sums of the weight matrix W:

$$\sum_{j=1}^{1} \sum_{m=1}^{k} \left|w_{ij,qm}\right|_1 \leq k_w < \infty \text{ [37]}$$

where $k_w$ does not depend on T or N and the choice of indexes *i* and *q*, but can potentially depend on other parameters of the model; and $w_{ij,qm}$ denotes the (q,m)-th element of $W_{ij}$.

Finally, note that if r is the maximum number of eigenvalues of Φ, then according to the fundamental algebraic theorem, r≤ $rank(\Phi)$. See, among others, Stewart and Ji-Guang (1990).

## 1.3. Empirical Results

### 1.3.1. Data and Variables

In this report we employ both aggregate and sectoral data on Output (Y) and Labour (L) for all the SIRIUS economies. More precisely, for the GVAR analysis that will identify the "labour absorbing" economies we employ monthly time series data on aggregate output in millions of euros and aggregate number of employees in thousands for the time period 2008-2016, that come directly from Eurostat[8]. We assessed the gaps in the time series using relevant extra/intrapolation techniques following Pesaran et *al.* (2004). For the construction of the Trade weight matrix we make use of the World Input Output Tables (WIOT) that are freely available[9]. Next, for the VAR models employed for the "labour absorbing" economies we make use of sectoral data on output in millions of euros and labour in thousands of employees for the four (4) main sectors of economic activity, i.e. primary sector, secondary sector, manufacturing sector and tertiary sector that correspond to the NACE rev. 2 classification A, B-F, C, and G-U, respectively. The time series data cover the period 2008-2016 in monthly frequency. The data come directly from Eurostat.

### 1.3.2. GVAR Analysis

Before turning to the results of the GVAR model employed a number of time series tests have to take place. As a first step, we investigated for the existence of unit roots in the various time series, using the Phillips-Perron unit root test. In case the time series exhibited unit root behaviour, we transformed the data using the first difference operator, which is standard practise[10]. The results of the unit root tests for the various time series employed both in level as well as in first differences are presented in Table 0.1.

[8] All the relevant data could be downloaded directly from this link https://ec.europa.eu/eurostat/data/database?node_code=proj

[9] http://www.wiod.org/database/wiots16

[10] A unit root is a higly technical feature of some stochastic processes that causes problems in estimating time series models. In the presence of a unit root, the behaviour of a time series is explosive and its relationship with other variables might lead to spurious regression. This is the reason why we use a transformation of the data so as to avoid having unit roots in the dataset. For an analysis on unit roots see, among others, Lutkepohl, 2005.

*Table 0.1: Phillips-Perron Unit Root tests*

| Variable | Economy | Variables in Levels | Variables in First Differences | Level of Integration |
|---|---|---|---|---|
| | | p-value | | |
| L | CHE | 0.06 | 0 | I(1) |
| | CZE | 0.95 | 0 | I(1) |
| | DNK | 0.94 | 0 | I(1) |
| | FIN | 0.52 | 0 | I(1) |
| | UK | 0.86 | 0 | I(1) |
| | GRE | 0.94 | 0 | I(1) |
| | ITA | 0.96 | 0 | I(1) |
| Y | CHE | 0.00 | 0 | I(0) |
| | CZE | 0.14 | 0 | I(1) |
| | DNK | 0.00 | 0 | I(0) |
| | FIN | 0.09 | 0 | I(1) |
| | UK | 0.04 | 0 | I(0) |
| | GRE | 0.00 | 0 | I(0) |
| | ITA | 0.03 | 0 | I(0) |

Based on our findings, all the labour time series variables are found to exhibit a unit root in levels, whereas in first differences we reject the null hypothesis of a unit root. Therefore, all labour variables are integrated of degree one i.e. I(1). Turning to the aggregate output, with the exceptions of Czech Republic and Finland, the rest of the time series variables were found to be stationary in levels i.e. I(0).

In the presence of I(1) variables we have to check for the potential existence of long-run relationships among the variables of aggregate output and aggregate labour in each economy. In this context, we employ the Johansen cointegration test for all the economies in the universe of the GVAR model. Table 0.2 presents the results of Johansen test.

*Table 0.2: Johansen Cointegration Test*

| Economies | Maximum rank | Parameters | Log-Likelihood | Eigenvalue | Trace Statistic | 5% Critical Value | Cointegration |
|---|---|---|---|---|---|---|---|
| CH | 0 | 6 | -1527.10 | 0.21 | 33.26 | 15.41 | No |
| | 1 | 9 | -1514.39 | 0.07 | 7.82 | 3.76 | |
| CZ | 0 | 6 | -1034.15 | 0.08 | 10.94 | 15.41 | No |
| | 1 | 9 | -1029.61 | 0.02 | 1.85 | 3.76 | |
| DK | 0 | 6 | -1147.84 | 0.23 | 32.40 | 15.41 | No |
| | 1 | 9 | -1133.86 | 0.04 | 4.42 | 3.76 | |
| FI | 0 | 6 | -1076.02 | 0.35 | 51.85 | 15.41 | No |
| | 1 | 9 | -1053.20 | 0.06 | 6.20 | 3.76 | |
| UK | 0 | 6 | -1770.62 | 0.13 | 18.90 | 15.41 | No |
| | 1 | 9 | -1763.23 | 0.04 | 4.12 | 3.76 | |
| GR | 0 | 6 | -1085.34 | 0.25 | 34.71 | 15.41 | No |
| | 1 | 9 | -1070.25 | 0.04 | 4.51 | 3.76 | |
| IT | 0 | 6 | -1473.27 | 0.20 | 30.21 | 15.41 | No |
| | 1 | 9 | -1461.55 | 0.06 | 6.78 | 3.76 | |

Based on our findings, in all the economies, cointegration among the time series variables is not present. In this context, we continue by employing the VARX models for each economy, using two (2) lags, following Pesaran et *al.* (2004).

We will base our detailed analysis of Generalized Impulse Response Function (GIRFs) on the robust confidence bands[11] rather than the point estimates in order to avoid any possible structural instability. We focus on the impact of a unit shock in the Aggregate Output in the economies of our model in order to assess the response of Aggregate Labour for an horizon of twenty four (24) steps, i.e. two (2) years. Note, that in this setting, statistically significant deviations, which signify labour absorbing economies, are considered those where the zero line is not included in the confidence interval.

We begin our analysis with the response of Switzerland's labour in unit shocks on the rest of the economies' output (Figure 0.1). Based on our findings, Switzerland's labour is significantly affected only by a unit shock in the output of UK. This, in turn, implies that Switzerland could be considered as being a "labour absorbing" economy. This is depicted by the respective GIRFs, which deviate significantly from the initial equilibrium position when a unit shock is in force.

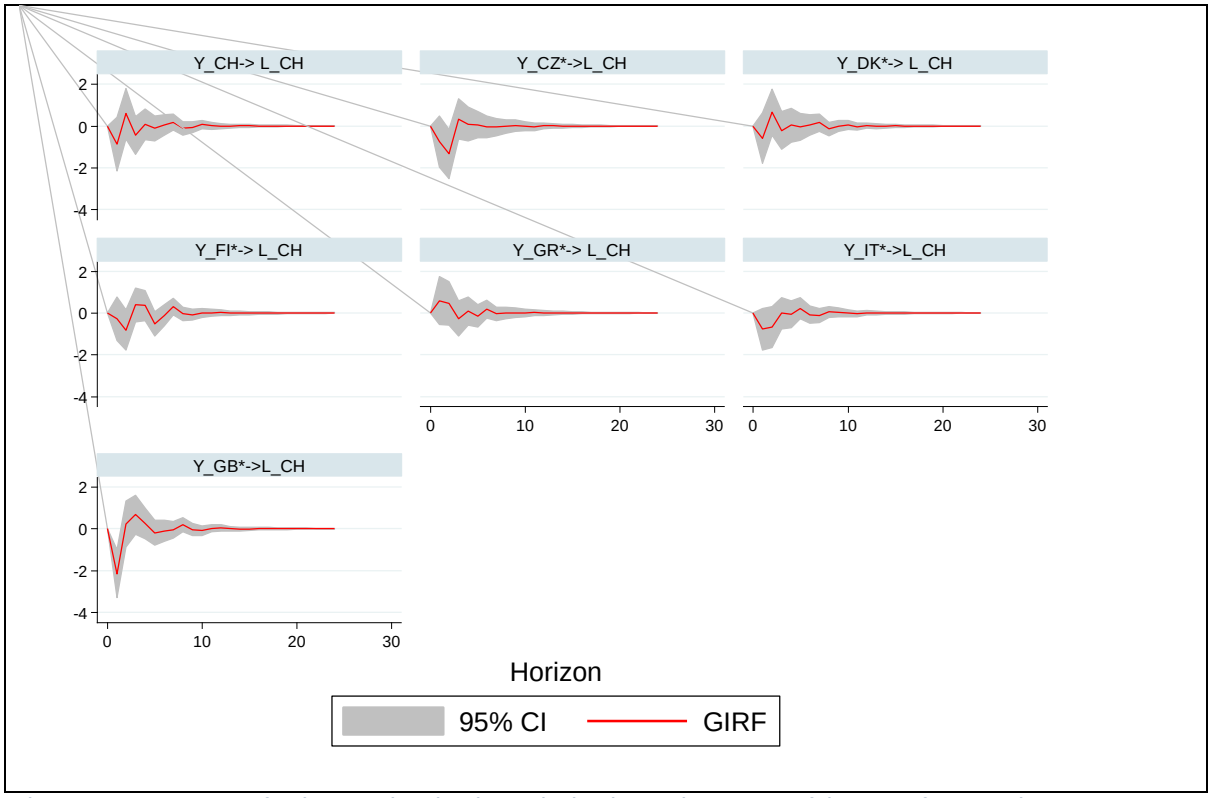



*Figure 0.1: Response of Labour Switzerland to unit shocks on the Output of the rest of economies*

We continue with the response of Denmark's labour in unit shocks on the rest of the economies' output, see Figure 0.2. Based on our findings, Denmark is unaffected by all unit shocks, since its labour remains at the equilibrium position, irrespectively of the unit shock

[11] The confidence intervals are computed using 1.000 bootstrapped iterations

imposed in the rest of the economies' output. This is depicted by the GIRFs, which do not deviate significantly from the initial equilibrium position when a unit shock is in force.

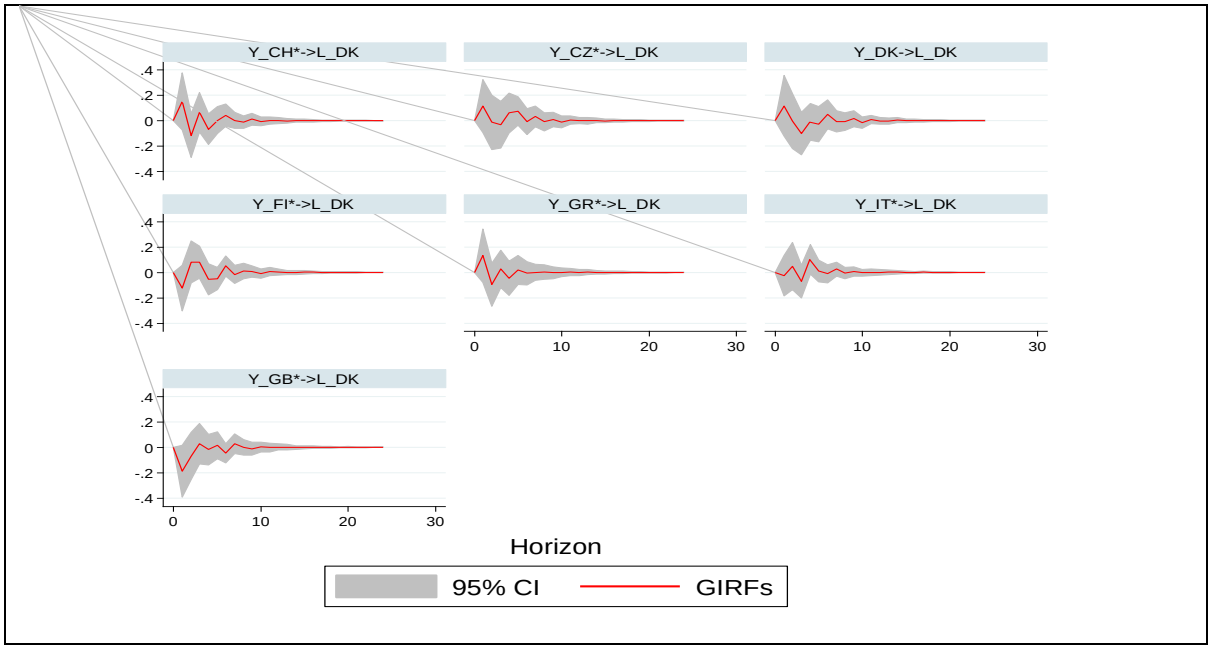



*Figure 0.2: Response of Labour Denmark to unit shocks on the Output of the rest of economies*

The response of Finland's labour in unit shocks on the rest of the economies output is presented in Figure 0.3. Based on the GIRFs, the labour of Finland is significantly affected, in the medium run, by a unit shock in the total output of UK. This, in turn, implies that the Finish economy could be considered as being a "labour absorbing" economy in the GVAR model employed.

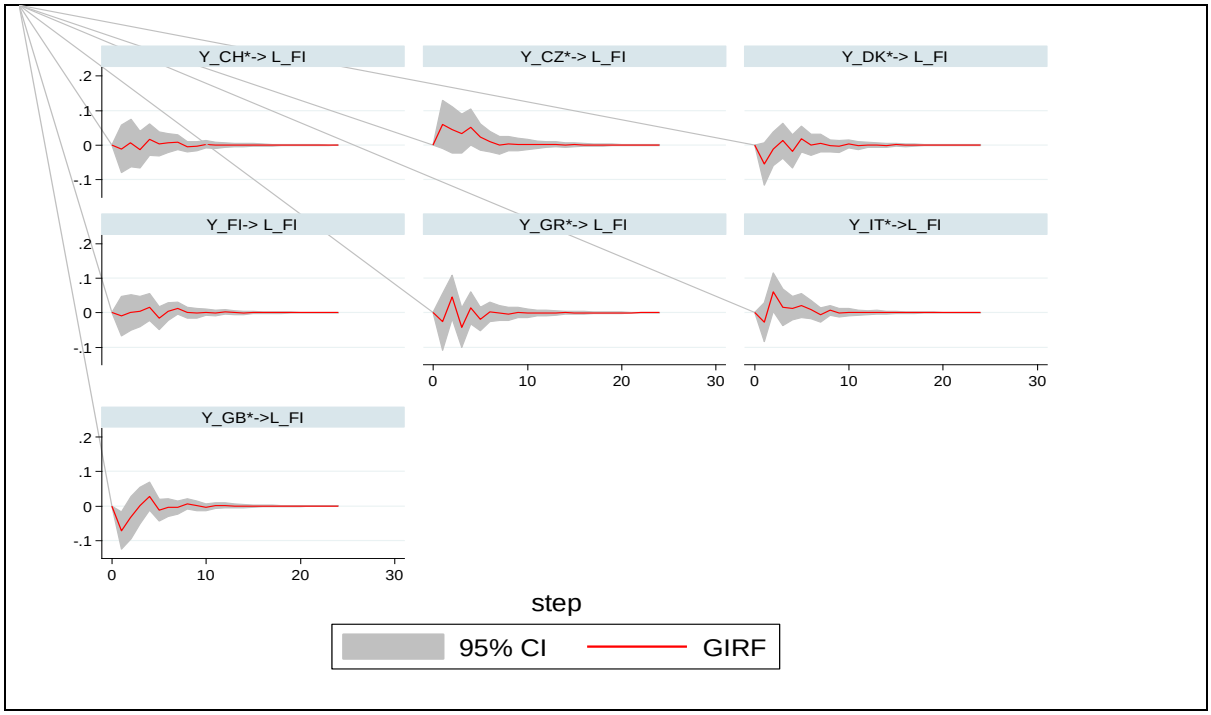


*Figure 0.3: Response of Labour Finland to unit shocks on the Output of the rest of economies*

Next, turning to the economy of Czech Republic, Figure 0.4 presents the response of labour to unit shocks in the rest of the economies' output. Based on the GIRFs, Czech Republic's labour is statistically significantly affected in the medium run by unit shocks on the aggregate output of the home economy as well as of the economy of UK. This is depicted by the respective GIRFs which deviate significantly from the initial equilibrium position when a unit shock is in force. This, in turn, implies that Czech Republic could be considered as being a "labour absorbing" economy in our modelling framework.

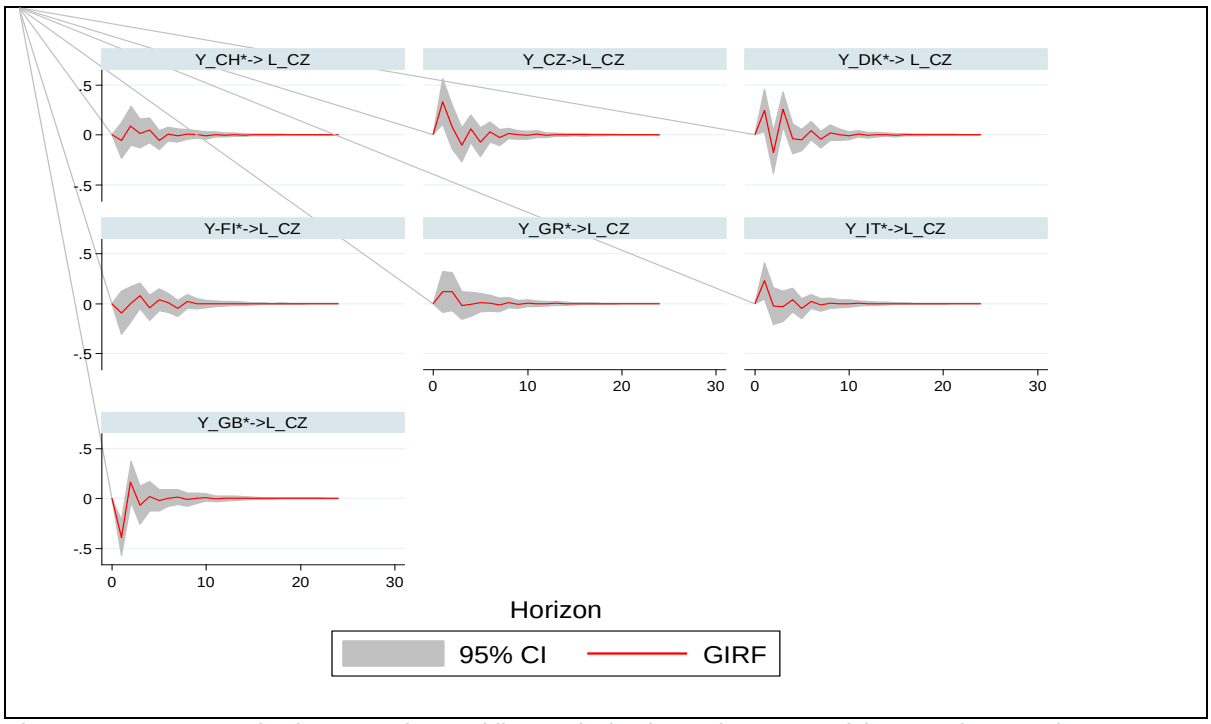



*Figure 0.4: Response of Labour Czech Republic to unit shocks on the Output of the rest of economies*

Turning to the economy of Italy, Figure 0.5, presents the response of labour to unit shocks on the rest of the economies' aggregate output. Based on the GIRFs, there is no statistically significant deviation from the initial equilibrium position, since the zero line belongs to the 95% confidence interval computed. Therefore, Italy does not belong to the "labour absorbing" economies of our model.

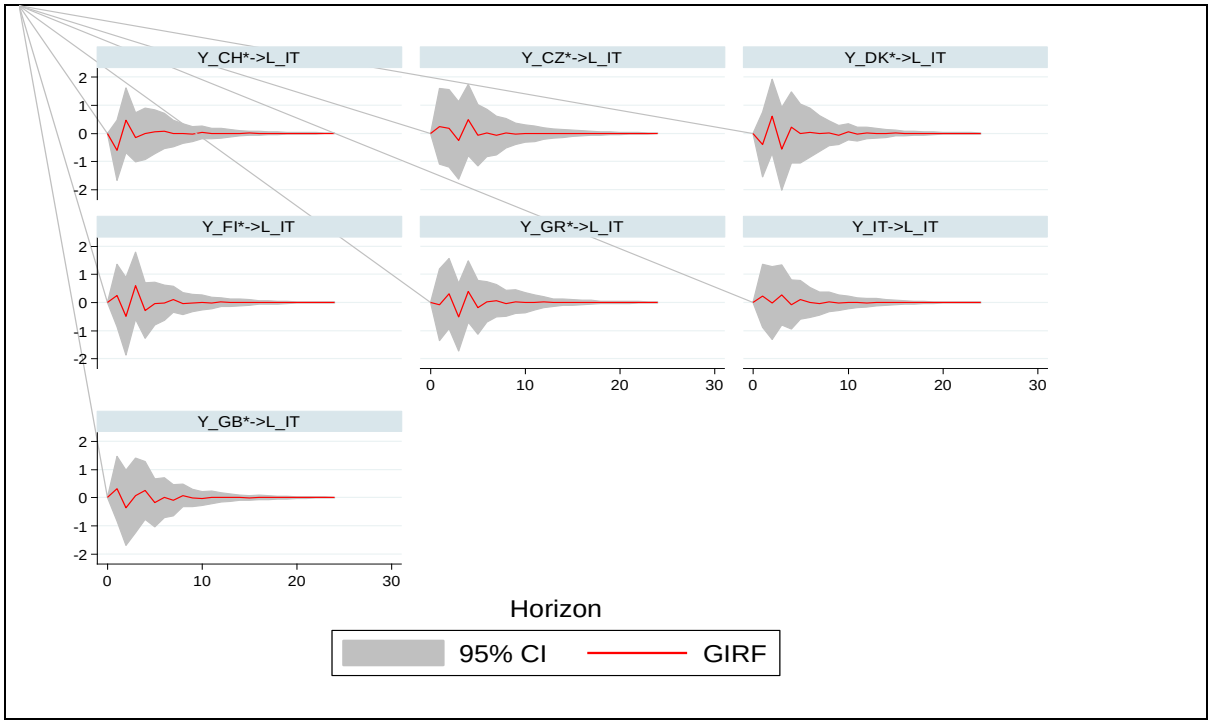



*Figure 0.5: Response of Labour Italy to unit shocks on the Output of the rest of economies*

Next, Figure 0.6 presents the response of Greek labour to unit shocks on the rest of the economies' output. Based on the GIRFs, there is no significant deviation from equilibrium. This, in turn, implies that Greece could not be considered as a "labour absorbing" economy in our modelling framework.

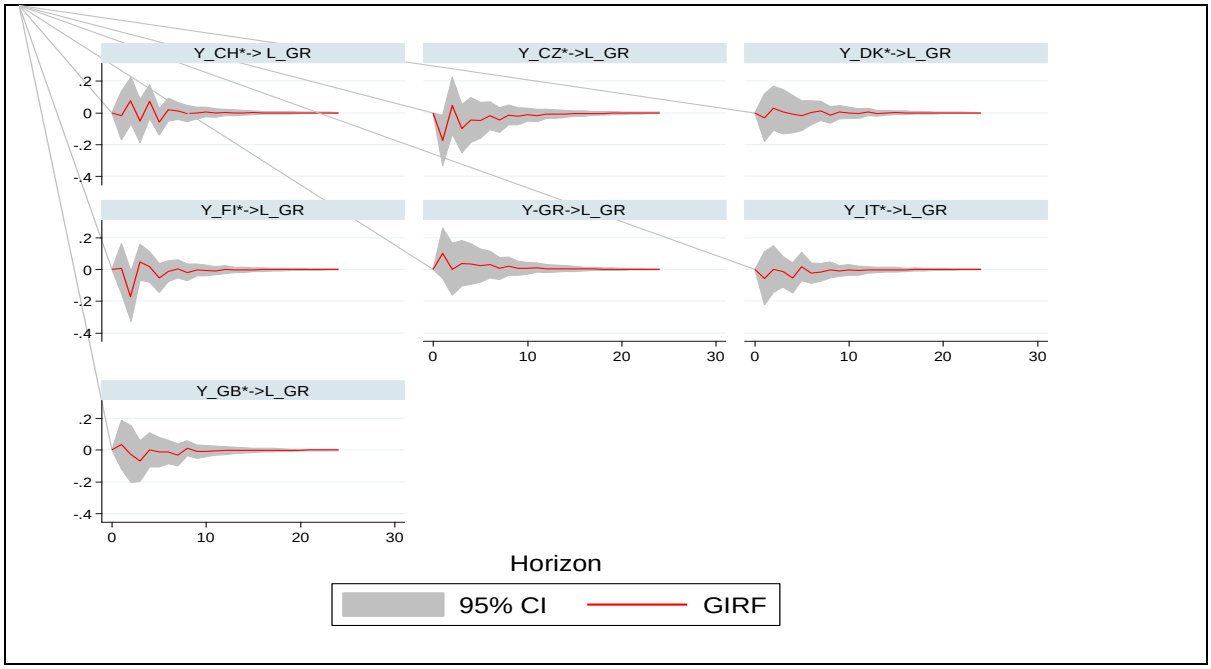



*Figure 0.6: Response of Labour Greece to unit shocks on the Output of the rest of economies*

Finally, Figure 0.7 presents the response of UK's labour to unit shocks on the aggregate output of the rest of the economies.

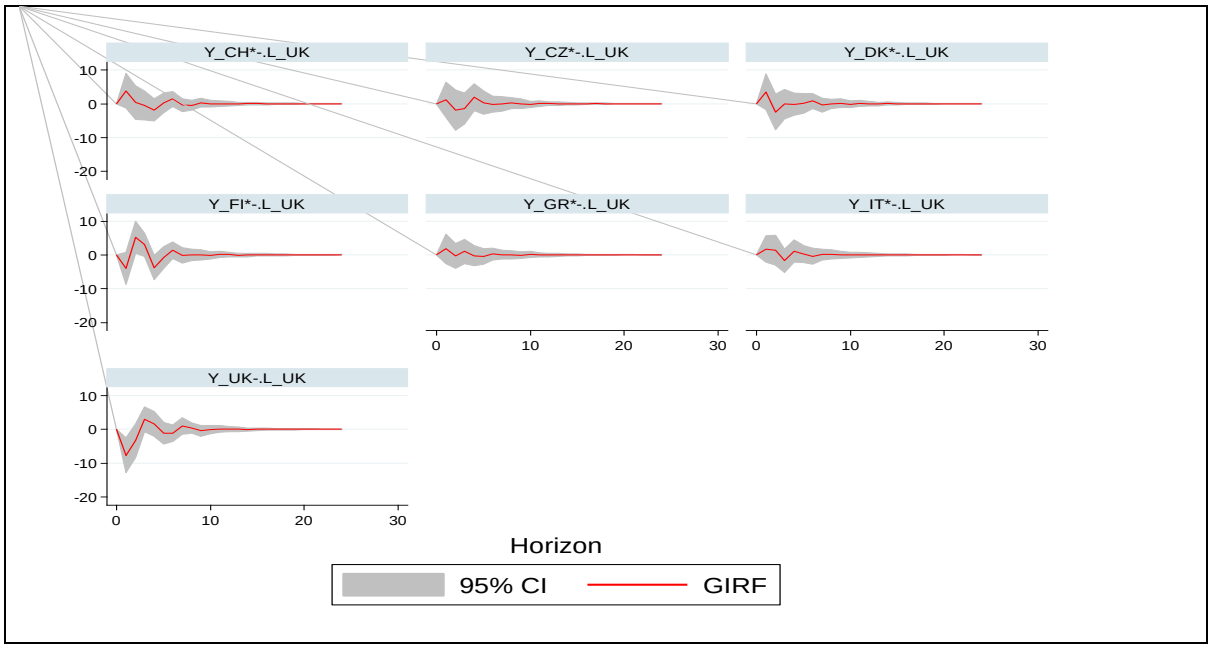



*Figure 0.7: Response of Labour UK to unit shocks on the Output of the rest of economies*

Based on the GIRFs, UK's labour deviates significantly from its initial equilibrium position when unit shock in the output of the home economy is in force. This, in turn, implies that based on our modelling framework, UK could be considered as being a "labour absorbing" economy.

Overall, our findings are robust, since all VARX models are found to be stable due to the fact that their eigenvalues lie inside the unit circle, Figure 0.8 to Figure 0.13.

*Figure 0.8: Stability VARX Switzerland*

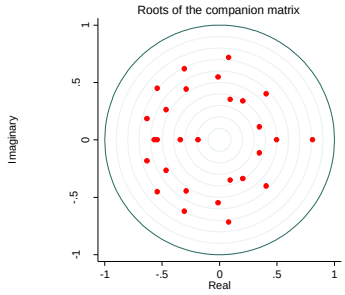



*Figure 0.9: Stability VARX Denmark*

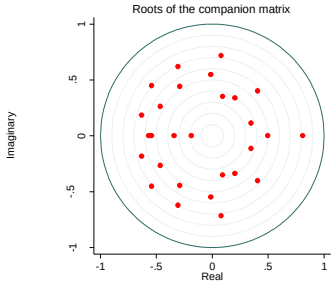



*Figure 0.10: Stability VARX Finland*

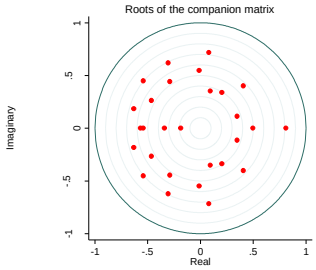



*Figure 0.11: Stability VARX Italy*

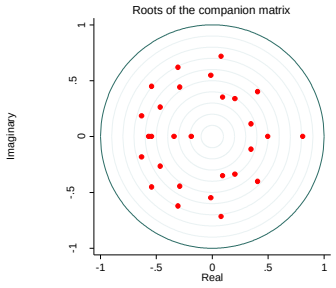



*Figure 0.12: Stability VARX Czech Republic*

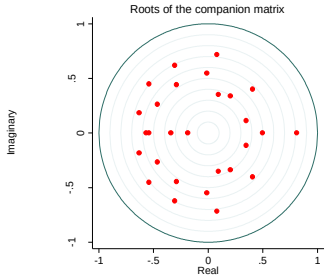
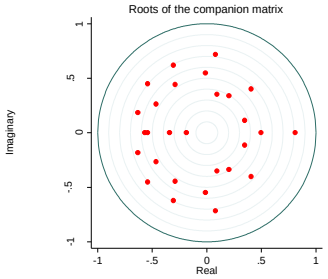
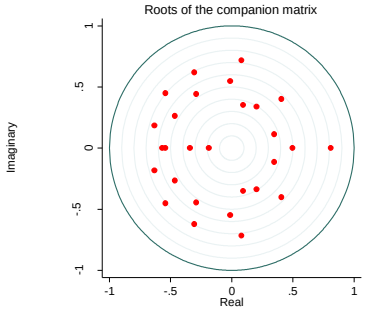



*Figure 0.13: Stability VARX Greece*




### 1.3.3. VAR/VEC Analysis

Having modelled - though GVAR - in the first step, the spillovers among the various SIRIUS economies, we unveiled the labour absorbing economies, in total. We continue our analysis with the investigation of the labour absorbing sectors for all the economies in SIRIUS. In this context, we employ sectoral data for the economies of Switzerland (CH), Czech Republic (CZ), Finland (FI) and, United Kingdom (UK), Greece (GR), Denmark (DK) and Italy (IT), that cover the four main sectors of economic activity, i.e. Primary sector (A, Nace Rev.2), Secondary sector (B-F, Nace Rev.2), Manufacturing sector (C, Nace Rev.2), and tertiary sector (G-U, Nace Rev.2), that capture each sector's output (Y) and Labour (L). Note, that despite the fact

that, in the first step, an economy is not labour absorbing, in total, it could be found to be labour absorbing in terms of its sectors, impying that this economy absorbs labour thorugh a realocation of its labour force since it could operate at a low level of employement, i.e. is characterised by high unemployment.

Following standard econometric practice, we begin by investigating the stationarity characteristics of our time series variables, using the Phillips-Perron unit root test. Table 0.3 presents the level of integration regarding the sectoral output for the SIRIUS economies.

*Table 0.3: Unit Root Testing of Sectoral Output*

| Variable | Economy | Sector | Variables in Levels | Variables in First Differences | Level of Integration |
|---|---|---|---|---|---|
| | | | p-value | | |
| Y | CHE | Primary | 0.066 | 0.000 | I(1) |
| | | Secondary | 0.003 | 0.000 | I(0) |
| | | Manufacturing | 0.015 | 0.000 | I(0) |
| | | Tertiary | 0.000 | 0.000 | I(0) |
| | CZE | Primary | 0.778 | 0.000 | I(1) |
| | | Secondary | 0.014 | 0.000 | I(0) |
| | | Manufacturing | 0.192 | 0.000 | I(1) |
| | | Tertiary | 0.063 | 0.000 | I(1) |
| | DNK | Primary | 0.002 | 0.000 | I(0) |
| | | Secondary | 0.234 | 0.000 | I(1) |
| | | Manufacturing | 0.011 | 0.000 | I(0) |
| | | Tertiary | 0.000 | 0.000 | I(0) |
| | FIN | Primary | 0.183 | 0.000 | I(1) |
| | | Secondary | 0.006 | 0.000 | I(0) |
| | | Manufacturing | 0.296 | 0.000 | I(1) |
| | | Tertiary | 0.000 | 0.000 | I(0) |
| | UK | Primary | 0.112 | 0.000 | I(1) |
| | | Secondary | 0.051 | 0.000 | I(1) |
| | | Manufacturing | 0.044 | 0.000 | I(0) |
| | | Tertiary | 0.041 | 0.000 | I(0) |
| | GRE | Primary | 0.009 | 0.000 | I(0) |
| | | Secondary | 0.261 | 0.000 | I(1) |
| | | Manufacturing | 0.201 | 0.000 | I(1) |
| | | Tertiary | 0.000 | 0.000 | I(0) |
| | ITA | Primary | 0.057 | 0.000 | I(1) |
| | | Secondary | 0.005 | 0.000 | I(0) |
| | | Manufacturing | 0.071 | 0.000 | I(1) |
| | | Tertiary | 0.012 | 0.000 | I(0) |

Based on our findings, all the economies' sectoral output is either integrated of degree one, i.e. I(1), or stationary in levels, i.e. I(0). Next, we turn to the unit root test results regarding the sectoral labour of the SIRIUS economies, Table 0.4.

*Table 0.4: Unit Root test of Sectoral labour*

| Variable | Economy | Sector | Variables in Levels | Variables in First Differences | Level of Integration |
|---|---|---|---|---|---|
| | | | p-value | | |
| L | CHE | Primary | 0.245 | 0.000 | I(1) |
| | | Secondary | 0.001 | 0.000 | I(0) |
| | | Manufacturing | 0.425 | 0.000 | I(1) |
| | | Tertiary | 0.081 | 0.000 | I(1) |
| | CZE | Primary | 0.721 | 0.000 | I(1) |
| | | Secondary | 0.661 | 0.000 | I(1) |
| | | Manufacturing | 0.735 | 0.000 | I(1) |
| | | Tertiary | 0.194 | 0.000 | I(1) |
| | DNK | Primary | 0.640 | 0.000 | I(1) |
| | | Secondary | 0.699 | 0.000 | I(1) |
| | | Manufacturing | 0.675 | 0.000 | I(1) |
| | | Tertiary | 0.951 | 0.000 | I(1) |
| | FIN | Primary | 0.771 | 0.000 | I(1) |
| | | Secondary | 0.874 | 0.000 | I(1) |
| | | Manufacturing | 0.625 | 0.000 | I(1) |
| | | Tertiary | 0.743 | 0.000 | I(1) |
| | UK | Primary | 0.358 | 0.000 | I(1) |
| | | Secondary | 0.820 | 0.000 | I(1) |
| | | Manufacturing | 0.555 | 0.000 | I(1) |
| | | Tertiary | 0.632 | 0.000 | I(1) |
| | GRE | Primary | 0.627 | 0.000 | I(1) |
| | | Secondary | 0.969 | 0.000 | I(1) |
| | | Manufacturing | 0.961 | 0.000 | I(1) |
| | | Tertiary | 0.916 | 0.000 | I(1) |
| | ITA | Primary | 0.956 | 0.000 | I(1) |
| | | Secondary | 0.148 | 0.000 | I(1) |
| | | Manufacturing | 0.839 | 0.000 | I(1) |
| | | Tertiary | 0.882 | 0.000 | I(1) |

Based on our findings, in most countries, sectoral labour is stationary in first differences, i.e. I(1). Following standard econometric practise, in the presence of I(1) variables we check for the potential existence of long-run relationships among them using the popular Johansen cointegration test, see Table 0.5.

*Table 0.5: Johansen Cointegration test*

| Economies | Maximum rank | Parameters | Log-Likelihood | Eigenvalue | Trace Statistic | 5% Critical Value | Cointegration |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CH | 0 | 72 | -4488.554 | . | 132.857 | 156.000 | No |
| | 1 | 87 | -4469.050 | 0.337 | 93.850 | 124.240 | |
| | 2 | 100 | -4452.090 | 0.300 | 59.930 | 94.150 | |
| | 3 | 111 | -4442.745 | 0.179 | 41.239 | 68.520 | |
| | 4 | 120 | -4435.016 | 0.150 | 25.781 | 47.210 | |
| | 5 | 127 | -4428.024 | 0.137 | 11.796 | 29.680 | |
| | 6 | 132 | -4423.824 | 0.085 | 3.397 | 15.410 | |
| | 7 | 135 | -4422.399 | 0.030 | 0.548 | 3.760 | |
| | 8 | 136 | -4422.126 | 0.006 | | | |
| CZ | 0 | 72 | -4331.796 | . | 190.828 | 156.000 | No |
| | 1 | 87 | -4305.878 | 0.421 | 138.992 | 124.240 | |
| | 2 | 100 | -4286.844 | 0.330 | 100.925 | 94.150 | |
| | 3 | 111 | -4268.496 | 0.320 | 69.229 | 68.520 | |
| | 4 | 120 | -4255.327 | 0.242 | 37.890 | 47.210 | |
| | 5 | 127 | -4247.043 | 0.160 | 21.323 | 29.680 | |
| | 6 | 132 | -4239.499 | 0.147 | 6.236 | 15.410 | |
| | 7 | 135 | -4236.552 | 0.060 | 0.341 | 3.760 | |
| | 8 | 136 | -4236.382 | 0.004 | | | |
| DK | 0 | 72 | -3884.501 | . | 241.542 | 156.000 | No |
| | 1 | 87 | -3857.046 | 0.439 | 186.632 | 124.240 | |
| | 2 | 100 | -3832.314 | 0.406 | 137.168 | 94.150 | |
| | 3 | 111 | -3811.101 | 0.360 | 94.742 | 68.520 | |
| | 4 | 120 | -3794.481 | 0.295 | 61.502 | 47.210 | |
| | 5 | 127 | -3780.720 | 0.252 | 33.980 | 29.680 | |
| | 6 | 132 | -3770.927 | 0.186 | 17.392 | 15.410 | |
| | 7 | 135 | -3765.696 | 0.104 | 3.933 | 3.760 | |
| | 8 | 136 | -3763.730 | 0.041 | | | |
| GR | 0 | 72 | -4310.704 | . | 164.921 | 156.000 | No |
| | 1 | 87 | -4284.430 | 0.425 | 132.112 | 124.240 | |
| | 2 | 100 | -4268.264 | 0.288 | 95.041 | 94.150 | |
| | 3 | 111 | -4255.292 | 0.239 | 74.098 | 68.520 | |
| | 4 | 120 | -4246.303 | 0.172 | 49.195 | 47.210 | |
| | 5 | 127 | -4238.638 | 0.149 | 30.790 | 29.680 | |
| | 6 | 132 | -4231.845 | 0.133 | 16.204 | 15.410 | |
| | 7 | 135 | -4228.399 | 0.070 | 4.312 | 3.760 | |
| | 8 | 136 | -4228.243 | 0.003 | | | |
| FI | 0 | 72 | -3722.233 | . | 181.452 | 156.000 | No |
| | 1 | 87 | -3698.251 | 0.396 | 133.489 | 124.240 | |
| | 2 | 100 | -3677.021 | 0.360 | 97.029 | 94.150 | |
| | 3 | 111 | -3659.415 | 0.310 | 75.817 | 68.520 | |
| | 4 | 120 | -3647.942 | 0.215 | 52.870 | 47.210 | |
| | 5 | 127 | -3639.357 | 0.165 | 35.701 | 29.680 | |
| | 6 | 132 | -3634.637 | 0.095 | 16.261 | 15.410 | |
| | 7 | 135 | -3631.514 | 0.064 | 4.015 | 3.760 | |

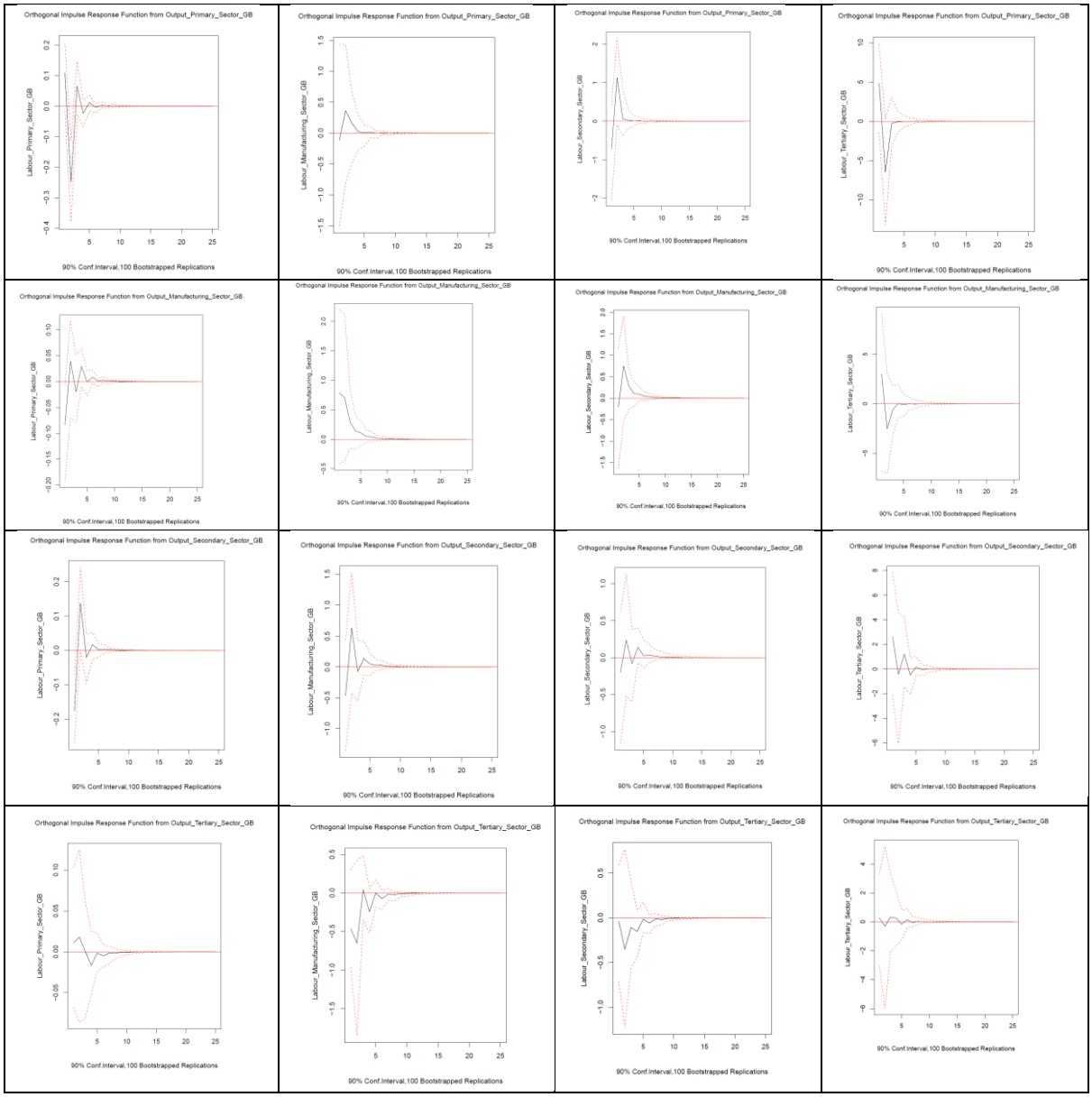
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 8 | 136 | -3631.507 | 0.000 | | | |
| IT | 0 | 72 | -5297.302 | . | 194.009 | 156.000 | No |
| | 1 | 87 | -5270.356 | 0.433 | 140.118 | 124.240 | |
| | 2 | 100 | -5245.167 | 0.412 | 99.740 | 94.150 | |
| | 3 | 111 | -5227.839 | 0.306 | 75.084 | 68.520 | |
| | 4 | 120 | -5218.222 | 0.183 | 55.850 | 47.210 | |
| | 5 | 127 | -5209.585 | 0.166 | 38.576 | 29.680 | |
| | 6 | 132 | -5204.025 | 0.110 | 17.457 | 15.410 | |
| | 7 | 135 | -5200.689 | 0.068 | 4.785 | 3.760 | |
| | 8 | 136 | -5200.297 | 0.008 | | | |
| UK | 0 | 72 | -5409.710 | . | 198.920 | 156.000 | No |
| | 1 | 87 | -5375.750 | 0.511 | 131.000 | 124.240 | |
| | 2 | 100 | -5354.280 | 0.364 | 98.0599* | 94.150 | |
| | 3 | 111 | -5338.427 | 0.284 | 76.353 | 68.520 | |
| | 4 | 120 | -5328.055 | 0.196 | 55.609 | 47.210 | |
| | 5 | 127 | -5318.358 | 0.185 | 36.215 | 29.680 | |
| | 6 | 132 | -5314.019 | 0.087 | 17.538 | 15.410 | |
| | 7 | 135 | -5310.293 | 0.075 | 4.085 | 3.760 | |
| | 8 | 136 | -5310.250 | 0.001 | | | |

Based on our findings, cointegration is not present in either of the SIRIUS economies. In this context, we will employ VAR models for all SIRIUS economies.

We continue by employing the VAR models for each economy using two (2) lags, following Pesaran et *al.* (2004). Our detailed analysis is based on the Orthogonalized Impulse Response Functions of each VAR model (OIRFs) with the use of the robust confidence bands (bootstrapped, 100 iterations) rather than the point estimates in order to avoid any possible structural instability (Lutkepohl, 2005). We focus on the impact of a unit shock in the sectoral output of one economy on the various counterparts of sectoral labour. In our analysis we make use of a twenty four (24) forecast horizon, i.e. two (2) years. Note, that in this setting, significant deviations, which imply “labour absorbing” sectors, are considered those where the zero line is not included in the confidence interval.

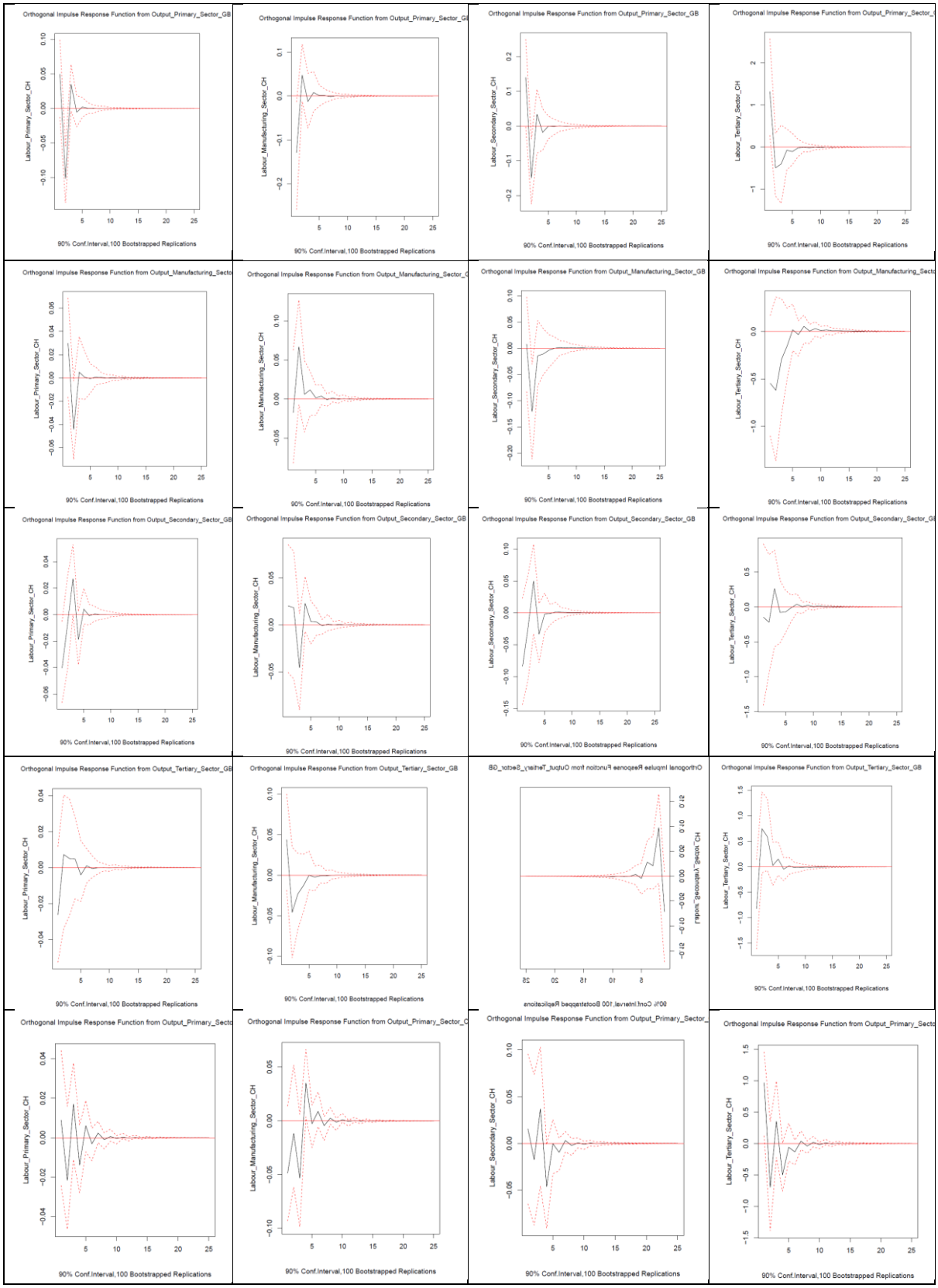
We begin with the response of sectoral UK labour to unit shocks in the sectoral output of the UK, Figure 0.14. Based on the OIRFs, a unit shock in either the output of the primary sector or the output of the secondary sector has a statistically significant effect on primary’s sector labour, since the respective OIRF deviates significantly from its initial equilibrium position and the confidence bands do not include the zero line (the initial equilibrium position). In this context, the primary sector of the UK can be regarded as being a “labour absorbing” sector in our modelling framework.

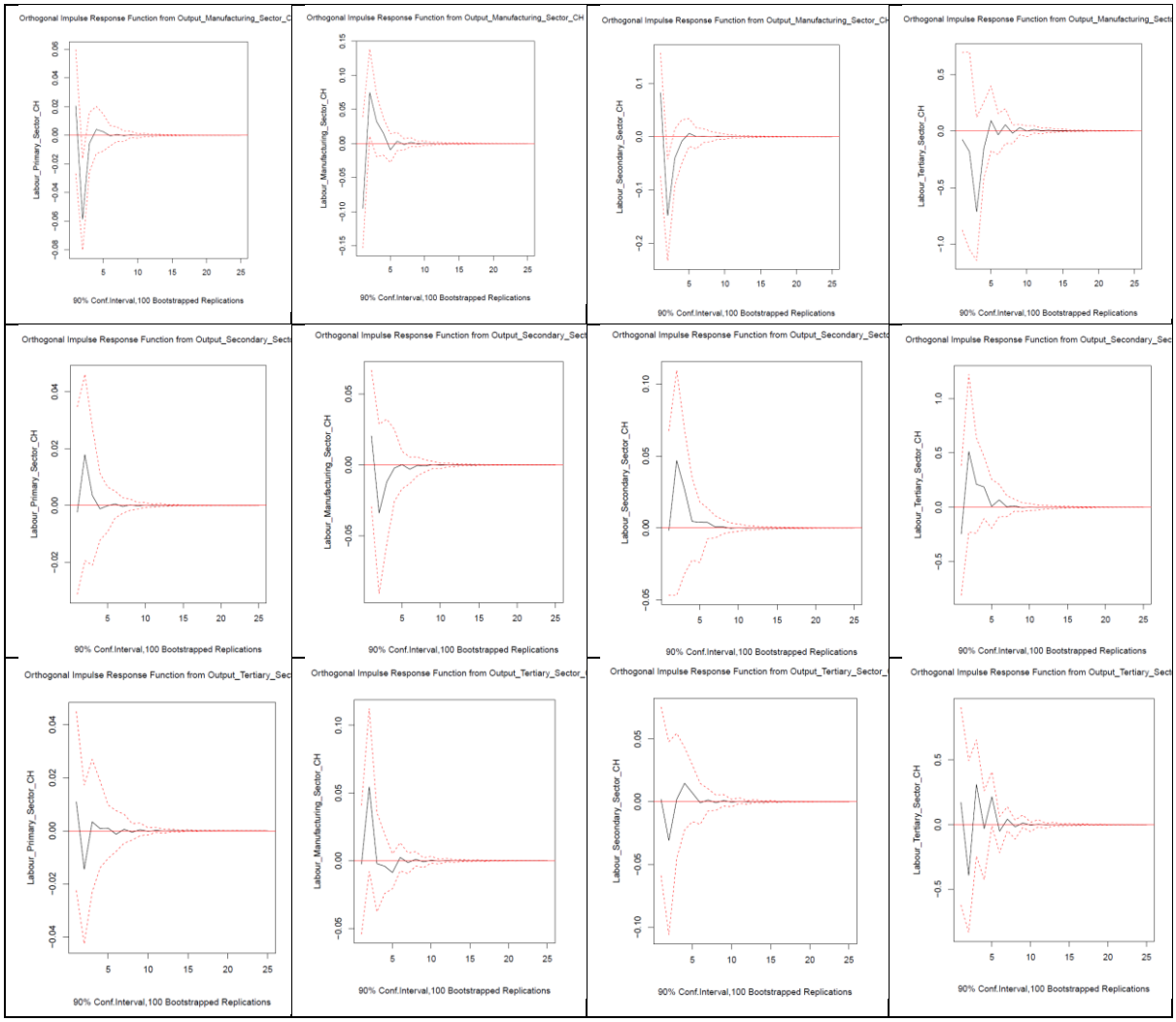
*Figure 0.14: Response of Sectoral Labour UK to unit shocks in Sectoral Output*




We continue with the sectoral responses of Switzerland's labour to unit shocks in the sectoral output of Switzerland, Figure 0.15. Note, that since in the GVAR employed in the previous section, Switzerland's labour was statistically significantly affected by the UK's aggregate output, then our modelling approach incorporated the UK sectoral dimension in the VAR model of Switzerland. Based on the OIRFs and the respective confidence bands, a unit shock in either the primary sector or the manufacturing sector of the UK has a statistically significant effect on the labour of Switzerland's primary and secondary sector. In addition, a unit shock on Switzerland's primary or manufacturing sector has a statistically significant effect on Switzerland's primary, manufacturing and secondary sector. Moreover, a unit shock in the primary sector of either Switzerland or UK has a statistically significant effect on the labour of the tertiary sector in Switzerland. In other words, based on our modelling framework, Switzerland's primary, secondary, manufacturing and tertiary sectors could be considered as being "labour absorbing" sectors.

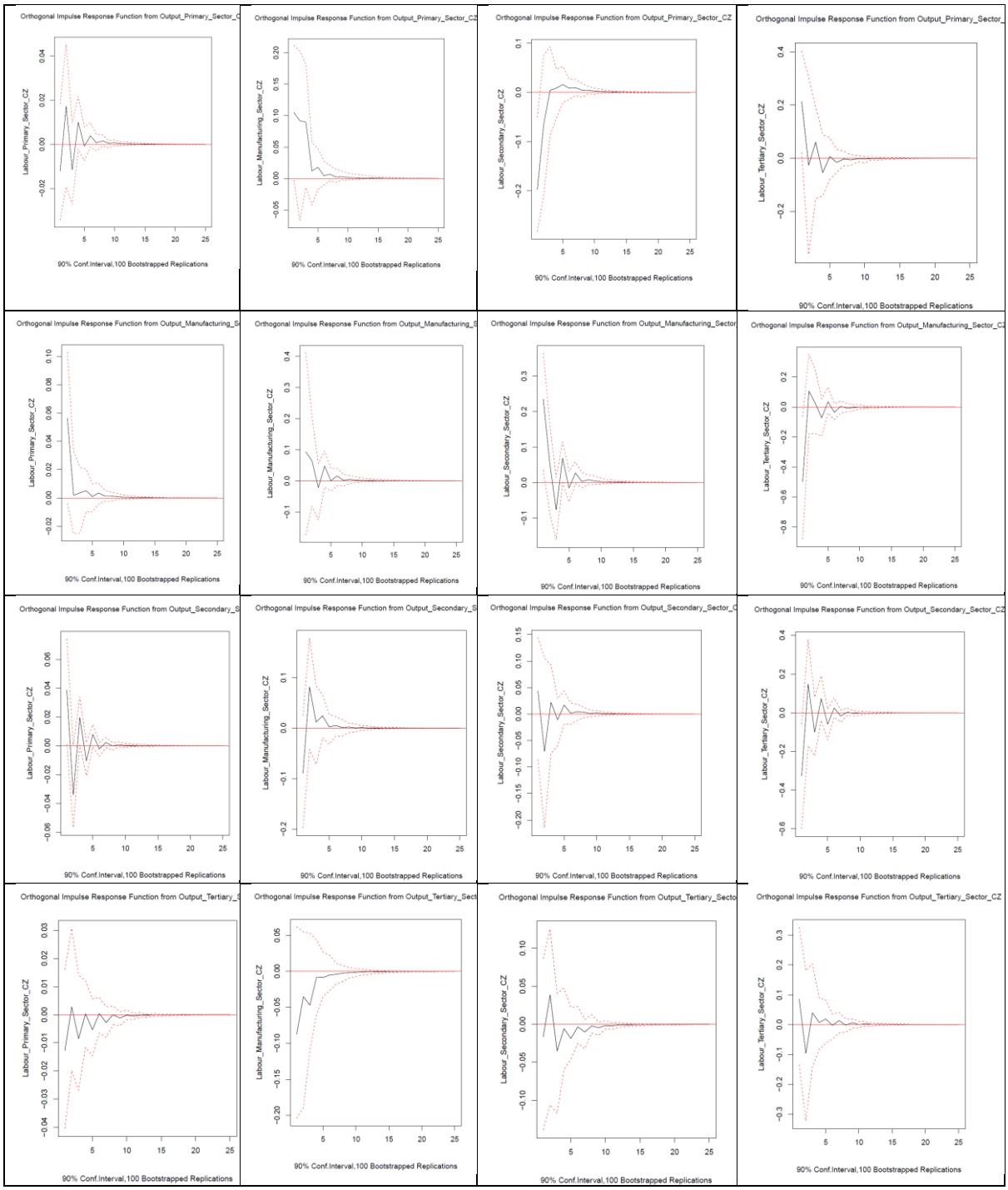
*Figure 0.15: Response of Sectoral Labour Swizerland to unit shocks on Sectoral Output Switzerland and UK*

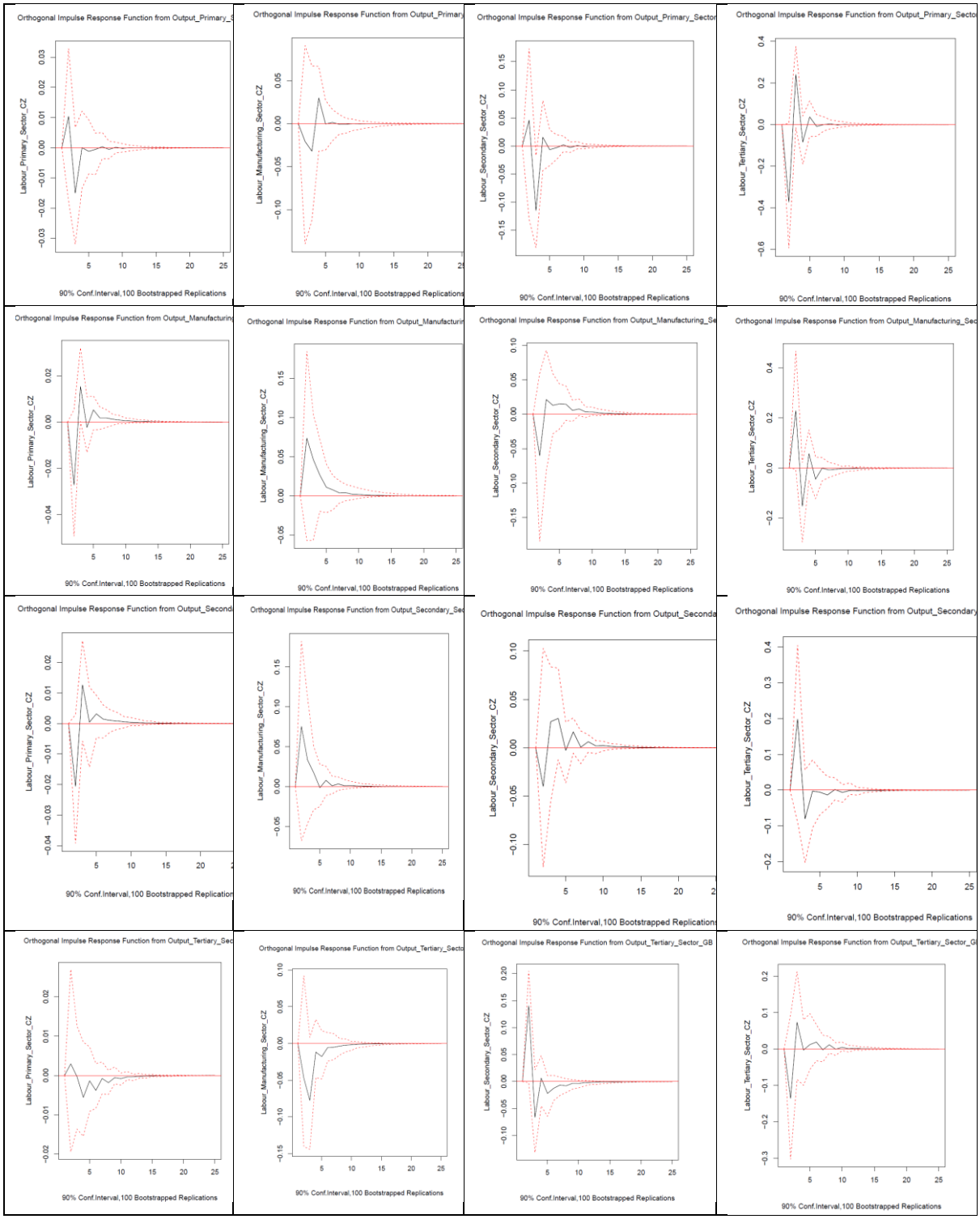





Next, we turn to the OIRFs of the Czech Republic, Figure 0.16 Note, that the sectoral VAR model of the Czech Republic also incorporates the sectoral dimension of UK, since in the GVAR framework, the aggregate output of UK affected significantly Czech Republic's labour. Based on our findings, the Czech Republic's secondary sector's labour is significantly affected by unit shocks on the output of the manufacturing sector of both the UK and the Czech Republic, as well as by unit shocks in the primary sector of the UK. In addition, the labour of the Czech Republics' primary sector is significantly affected by a unit shock in the Czech Republics' secondary sector. The same statistically significant deviation is observed for the response of labour in the tertiary sector to a unit shock in the output of all sectors of the Czech Republic and the UK with the exception of the tertiary sector. In all these cases, the OIRFs deviate statistically significantly from the initial equilibrium position and, in the same time, the respective confidence bounds do not include the zero line. In this context, based on our modelling approach, the "labour absorbing" sectors of Czech Republic are the primary, secondary and tertiary sector.

*Figure 0.16: Response of Sectoral Labour Czech republic to unit shocks on Sectoral Output Czech Republic and UK*

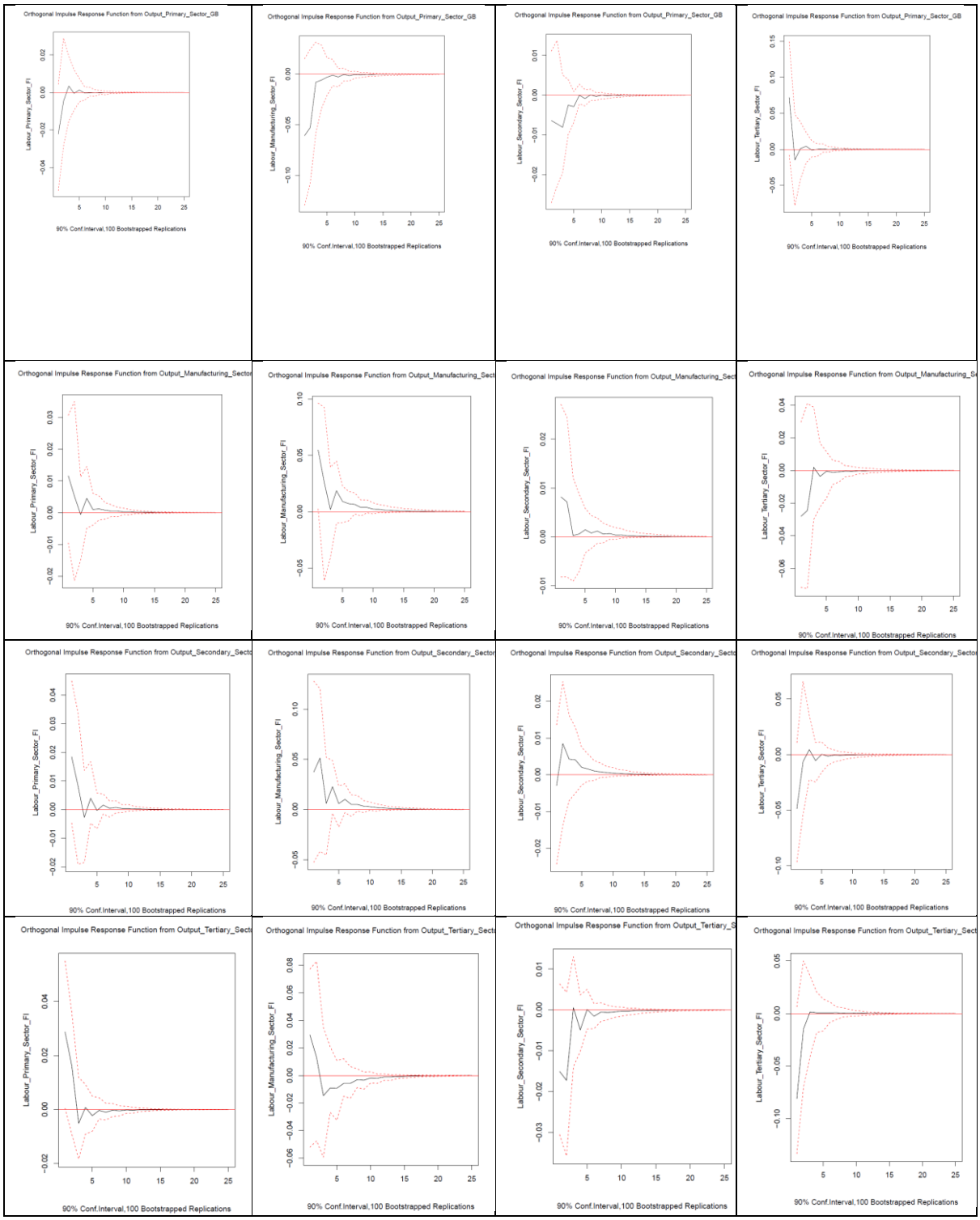


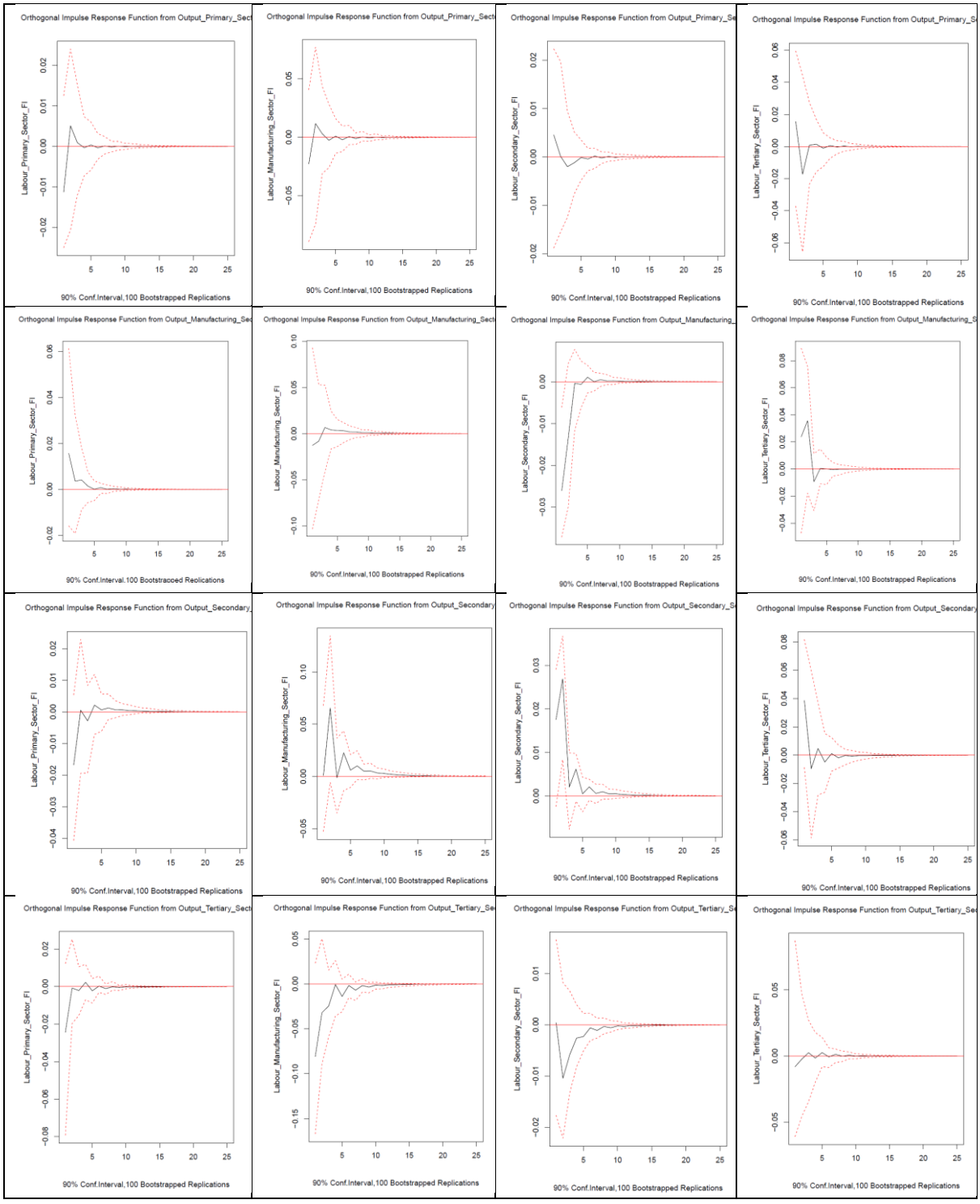



We turn to the results of the sectorial VAR model of Finland. Note, that as indicated in the GVAR section, Finland's labour was significantly affected by UK's aggregate output. As a result, the sectoral VAR model of Finland also incorporates the sectoral dimension of UK. Based on Finland's OIRFs, Figure 0.17, the labour absorbing sectors of Finland are the primary, secondary and tertiary sector. The labour of Finland's secondary sector is statistically significantly affected by a unit shock on its sectoral output counterpart. In addition, a unit shock in the output of the tertiary sectoral of Finland has a statistically significant effect on the labour

of Finland's primary sector whereas a unit shock in the aggregate output of the manufacturing sector of the UK also has a positive and statistically significant effect on the labour of Finland's manufacturing sector. As a result, based on our modelling approach, Finland's labour absorbing sectors are the primary, secondary and manufacturing sectors.

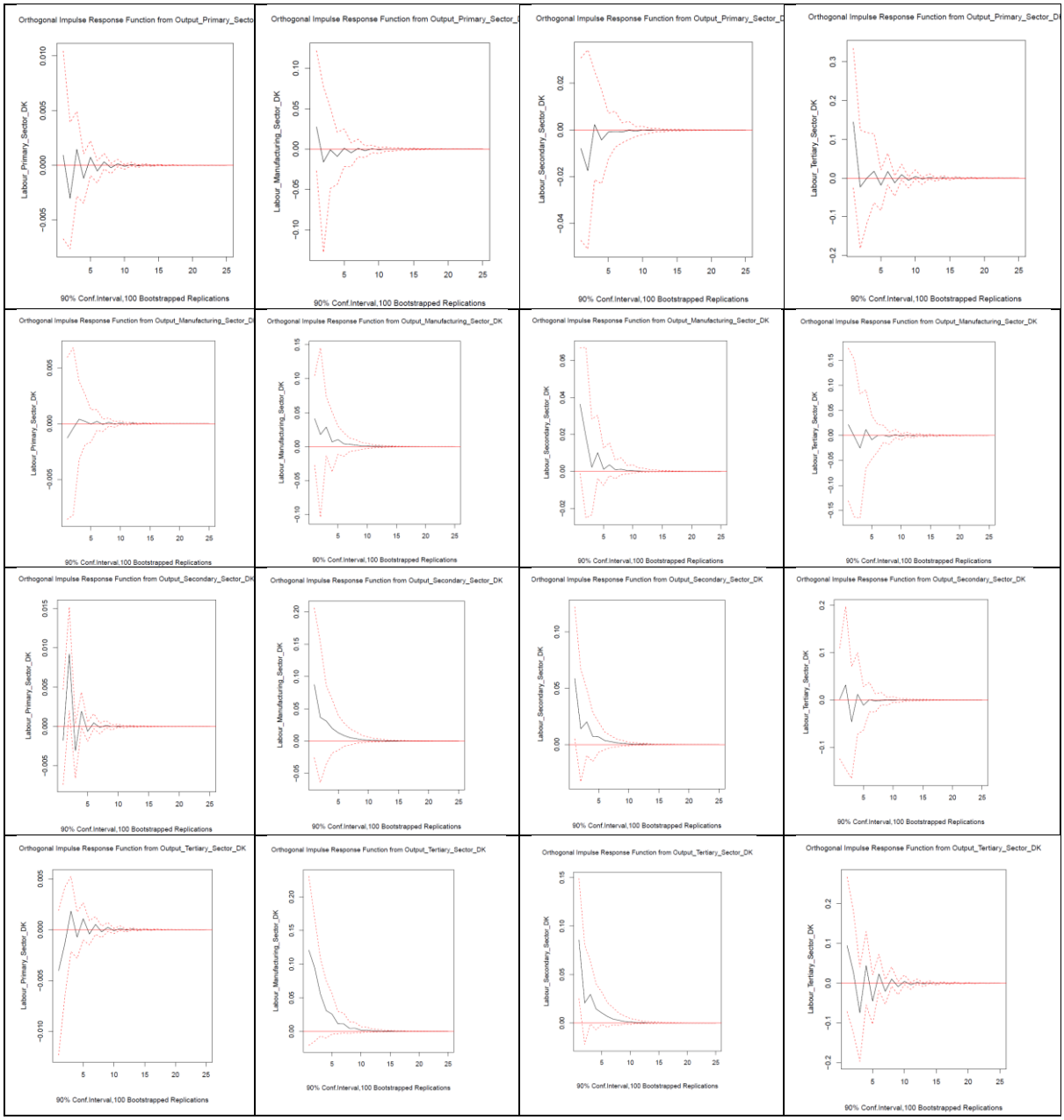
*Figure 0.17: Response of Sectoral Labour Finland to unit shocks on Sectoral Output Finland and UK*





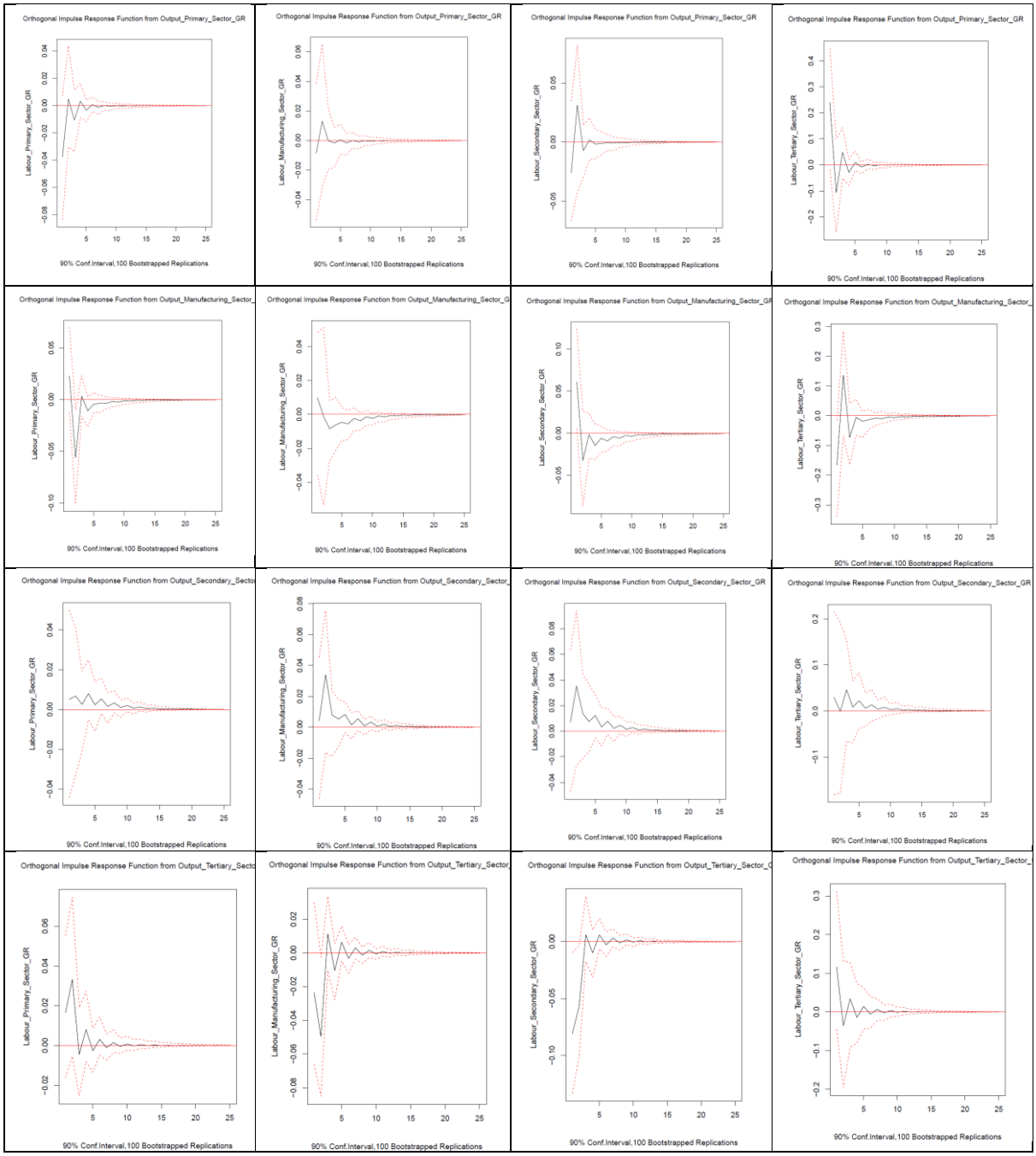

We turn to the results of the sectoral VAR model of Denmark. Based on the OIRFs presented in Figure 0.18, we witness that the only statistically significant deviations concern the labour of Denmark's primary and secondary sectors to unit shocks in the output of Denmark's secondary sector. In this case, the OIRFs deviate significantly from its initial equilibrium position, whereas the respective confidence bounds do not include the zero line. As result, the primary and secondary sector of Denmark could be considered as being "labour absorbing" sectors with respect to our modelling framework.

*Figure 0.18: Response of Sectoral Labour Denmark to unit shocks on Sectoral Output Denmark*



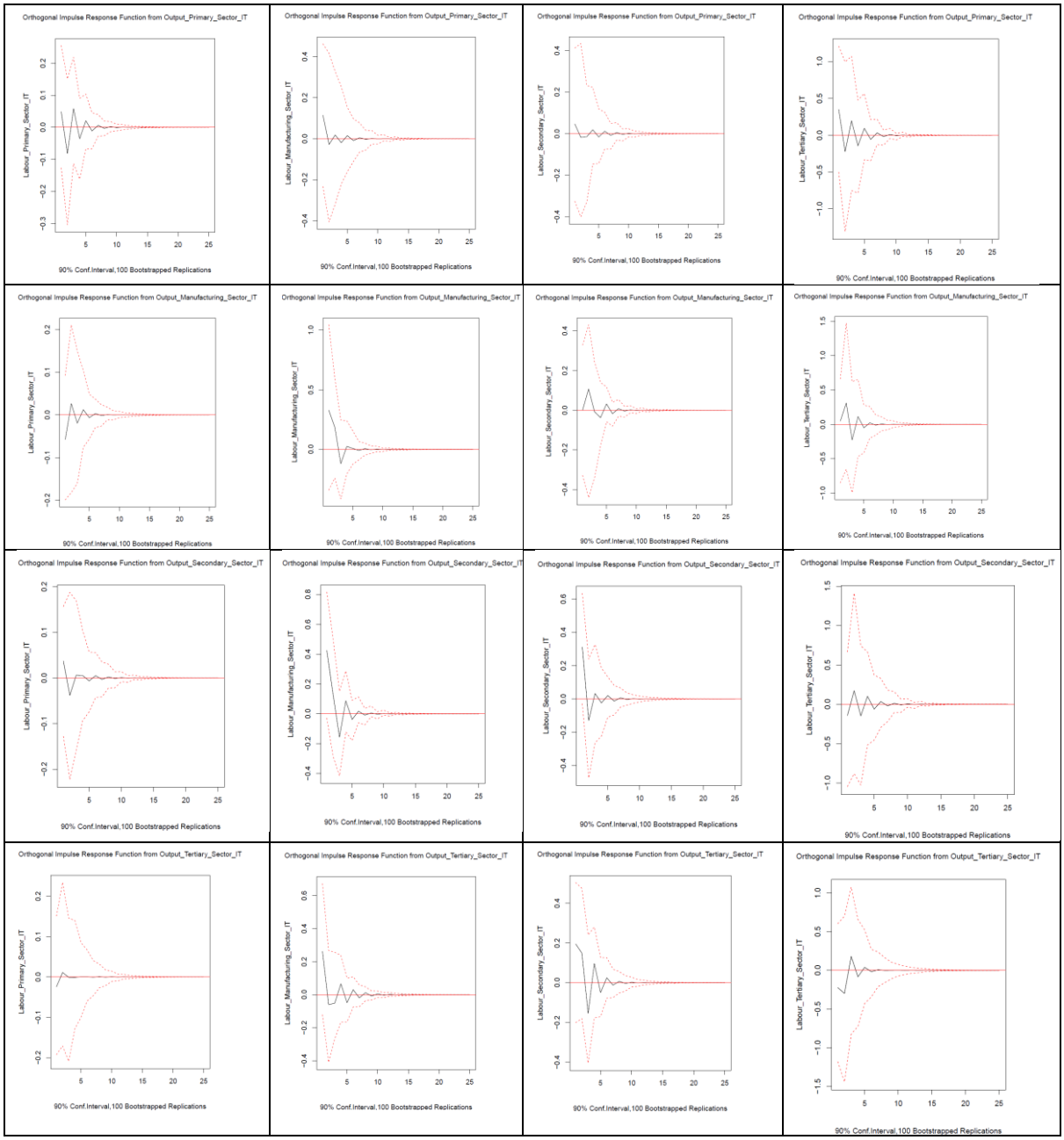

Next, we turn to the OIRF results regarding the Greek sectoral economy, Figure 0.19. Based on the relevant OIRFs, a unit shock in either the sectoral output of the manufacturing or the output of the tertiary sector, generates statistically significant deviations in the labour of the primary, secondary, manufacturing and tertiary sector of Greece. Therefore, in the context of our modelling framework the primary, secondary, manufacturing and tertiary sectors of Greece could be considered as being “labour absorbing” sectors, since their respective OIRFs deviate significantly from their initial equilibrium position.

*Figure 0.19: Response of Sectoral Labour Greece to unit shocks on Sectoral Output Greece*




Finally, Figure 0.20 presents the OIRFs of sectoral labour for the Italian economy due to unit shocks in its sectoral output. Based on the various OIRFs presented, we do not witness any statistically significant deviation from the initial equilibrium position. In other words, based on our modelling approach, the Italian economy does not have a labour absorbing sector.

*Figure 0.20: Response of Sectoral Labour Italy to unit shocks on Sectoral Output Italy*



## 1.4. MRAs Employability Opportunities for SIRIUS economies

Having identified the labour absorbing sectors in the SIRIUS economies, in this section we will deal with the employability opportunities of MRAs in the various economies. Our analysis will be based on the findings of the VAR models discussed previously, whereas on top of that we will make use of the number of vacancies for each labour absorbing sector identified previously. It is worth noticing that throughout our analysis we make the implicit assumption that the labour markets do not discriminate against race, ethnicity or sex. In other words, we assume that all employees have equal opportunities of being integrated into the labour markets and the fact that they are either natives or MRAs plays no role at all.

We summarize the labour absorbing sectors for each economy in SIRIUS,

*Table 0.6: Labour Absorbing Sectors*

| | CH | CZ | DK | FI | GR | IT | UK |
|---|---|---|---|---|---|---|---|
| **Primary Sector** | + | + | + | + | + | | + |
| **Secondary Sector** | + | + | + | + | + | | |
| **Manufacturing Sector** | + | | | + | + | | |
| **Tertiary Sector** | + | + | | | + | | |

Based on our findings, the economies of Switzerland and Greece have the highest "labour absorbing" capability for MRAs in the sense that all their sectors are characterized as being "labour absorbing". Then, the economies of Finland and the Czech Republic have three labour absorbing sectors, whereas Denmark presents two and the UK one labour absorbing sector respectively. It should be noted that with the exception of Italy, the primary sector in all economies could be considered as being labour absorbing. This fact implies that in most economies there is a dire need for labourers in the Agriculture, Forestry, Fishing and other related activities.

Another interesting finding is the fact that the secondary sector is considered to be labour absorbing for all the SIRIUS economies with the exception of Italy and the UK, whereas the manufacturing and tertiary sectors are considered to be "labour absorbing" for three out of seven economies in SIRIUS.

In order to provide a first crude matching between the MRAs and the labour absorbing sectors in the SIRIUS economies, the following table summarizes the vacancies in each economy by sector of economic activity, for **the most recent available data in Eurostat**.

*Table 0.7: Vacancies by sector of Economic activity in SIRIUS economies*

| | 2014 | 2015 | 2015 | 2014 | 2015 |
|---|---|---|---|---|---|
| **Sector** | **CH** | **CZ** | **FI** | **GR** | **UK** |
| **Primary** | | 3,427 | | | |
| **Secondary** | | 8,793 | | 293 | 33,500 |
| **Manufacturing** | 9,941 | 24,629 | 3,432 | 2,071 | 48,500 |
| **Tertiary** | 9,972 | 58,982 | 7,249 | 14,386 | 662,000 |

Combing the findings presented in Table 0.6, with the vacancies presented in Table 0.7 we have a first picture regarding the sectors and the economies that can absorb the MRAs flows. Please note that Table 1.7 provides information only on the sectors that are available.

In this context, for the cells which are empty we do not know if there are indeed vacancies or not, so we cannot come to any conclusions. Of course, in case the missing data were all zero (0), this would imply that no vacancies would be available.

However, the available vacancies published by Eurostat and the results of our analysis imply that MRAs could definitely be directed towards: (i) the manufacturing and tertiary sector of the Swiss economy, (ii) the primary, secondary and tertiary sectors of the Czech economy, (iii) the manufacturing and the tertiary sector of the Finish economy, and (iv) the secondary, manufacturing and tertiary sector of the Greek economy. For a detailed analysis, at a country-by-country level we continue with the Input-Output analysis for each one of the SIRIUS economies in Part 3.

# Part B: Employability Indicators: A Structural Analysis

## 2.1. Introduction

The aim of this part of the research is to develop a methodology to estimate the employability of migrants, refugees and asylum seekers (MRAs) for the SIRIUS economies. Specifically, it is necessary to examine the complexity of the MRAs' labour market integration (focusing on the connection of MRAs' skills –expressed by the educational attainment level, with the skills' status of the host countries), and to explore their integration potential in relation with the labour demand of the host countries. The complexity involves the process of determining their skills In the analysis, the labour market characteristics of the SIRIUS countries are taking into account in order to identify the employability potential of MRAs in the different socio-economic contexts.

It is important to point out that the skills of employees are not measured by the statistical authorities of most countries. In the majority of the studies, skills are approach based on the educational attainment level (Desjardins et al., 2013; European Commission, 2015). For example, recently, European Commission (2016), using EU Labour Force Survey data (Eurostat) proposes experimental indicators measuring the "vertical" and "horizontal" skills mismatch. These experimental indicators are based on the structure of the labour market with respect to the educational attainment levels and the occupations. Analytically, the "Vertical" measures focus on discrepancies between educational attainment levels (ISCED 2011 1-digit) and occupations (ISCO 2008 1-digit). The "Horizontal" measures focus on misalignments between the educational field of the highest level of education attained (ISCED-1999 fields of education and training) and occupations (ISCO 2008 3-digit). In the same study, European Commission (2016) defines the improvement of the matching between skills and labour market needs as well as the reduction of the gap between education and work, as a policy priority, targeting to ensure that the skills available in the European labour markets matches the the rapidly changing skills requirements of businesses and the economy. In 2017, ESCO (https://ec.europa.eu/esco/portal/home), the classification of European Skills, Competences, Qualifications and Occupations, an integrated skills, occupations and qualifications platform was launched, the objective being to aid labour mobility in Europe. ESCO, a multilingual platform, assembles disparate skills information via website-tagging technology, identifying and categorising skills, competences, qualifications and occupations relevant to the European labour market and education and training, and systematically shows the relationships between the various elements (De Smedt, le Vrang, & Papantoniou, 2015). Nevertheless, the relavant data have not reached full maturity (in terms of harmonisation among countries, coverage in analytical occupational classifications or methodology). Thus, for the need of this study, educational attainement level is adopted as the most appropriate indicator of skills.

The examination of the labour market characteristics at the country level is a crucial starting point for the integration process of MRAs. The documentation of the integration potential is highly related with the distribution of labour demand across a country's sectors of economic activities and occupations. The contemporary labour markets of SIRIUS countries show high level of heterogeneity in the productive structure, the labour force and the demographical features, creating a highly differentiated economic and social environment across countries. The drivers of the changing employment features can be found in a number of factors: technological change, capital accumulation, demographic characteristics, climate change, urbanization, government policies etc. In general, the process of labour markets' structural transformation (both regarding the sectoral structure and the distribution of employment across occupations) in developed countries, is characterized by a gradual shift from primary and traditional manufacturing sectors (agricultural production, food industries, textiles industries, etc.) to tertiary activities and/or modern (high-technology and digitalization) manufacturing sectors (Belegri-Roboli, Michaelides, Konstantakis, Marinos and Markaki, 2018). The high level of heterogeneity across the labour markets of different European countries requires the in-depth approach of their economic and social environment (structural

characteristics, sectoral composition, demographic issues and labour force structure), but also the analysis of the impact of the economic crisis on the various economies.

This part is based on Input-Output analysis (IO). The main advantage of IO analysis is the macro/micro modelling of each economy using a detailed sectoral analysis, i.e. 2-digits classification (NACE Rev. 2). In this context, the outcomes of IO analysis are targeted and sector-specific. On the other hand, the main disadvantages of IO analysis are: (a) the results are subject to the assumptions of the relevant production function that is assumed by the model; and (b) if the relevant statistical authorities do not follow the precise timetable for the construction of the technological matrices, then the researchers are obliged to assume that technology is constant for a certain time period.

In this research, a methodology of estimating the employability of migrants, refugees and asylum seekers (MRAs) for an economy is proposed. Based on the proposed methodology, an efficient model for the simulation of the labour market will be used, providing a method for the matching of educational attainment level of MRAs across the sectors and the occupations of the economy, aiming at the optimization of the integration process.

At first, the investigation of the labour market structural characteristics of the Czech Republic, Denmark, Greece, Italy, Finland, United Kingdom and Switzerland, focuses on the employment structure at the level of sectors, occupations and educational attainment level. Then, two composite indicators, focusing on the sectoral structure of employment and on the occupational structure of employment, respectively, are introduced: the Growth Indicator for Sectors (GIS) and the Growth Potential Indicator for Occupations (GIO). The estimation of the GIS and the GIO is based on important indicators. These indicators are connected, on one hand with the structure and growth of employment in sectoral and occupational level, respectively, and on the other, with the multiplying effect of sectors and occupations in the examined economy. The multiplying effect of economic sectors and occupations is estimated based on Input-Output Analysis (IOA). The theoretical and methodological framework of IOA, focusing on the IOA's extensions used in this study is analytically presented in Appendix B.

Then, for the comparison of the educational attainment level of MRAs with the educational attainment level of the employment for each country, two indicators expressing the similarity level, are introduced: the Sectoral Structure Similarity (SSS) and the Occupational Structure Similarity (OSS).

Finally, two composite indicators are used to identify the priorities, at the sectoral and occupational level, for MRAs integration in each economy: SIRIUS Indicator for Sectors (SIRIUS 1) and the SIRIUS Indicator for Occupations (SIRIUS 2). Analytically, the rank-order of SIRIUS Indicator for Sectors provides the integration priorities at the sectoral level and the rank-order of SIRIUS Indicator for Occupations provides the integration priorities at the occupational level.

The rank-order sectoral priorities are constructed combining the growth potential and the educational attainment level' level of each sector, with the educational attainment level of MRAs. It provides the high priority sectors for MRAs integration, answering to the research question: "Which sectors of an economy have simultaneously high growth potential and required educational attainment level compatible to MRAs educational attainment level?".

The rank-order occupational priorities are constructed combining the growth potential and the educational attainment level' level of each occupation, with the educational attainment level' level of MRAs. It provides the high priority occupations for MRAs integration, answering to the research question: "Which occupations of an economy have simultaneously high growth potential and required educational attainment level compatible to MRAs educational attainment level?". Analytically, the methodology for the estimation of MRAs employability potential is discussed in Section 2.2.

## 2.2. Methodology

The objective of this section is twofold: first, to propose a methodology for estimating the employability of migrants, refugees and asylum seekers (MRAs) for an economy and, second, to investigate the results of the methodology for the SIRIUS countries (Czech Republic, Denmark, Greece, Italy, Finland, Switzerland and United Kingdom). Two composite indicators are introduced, providing a method for the matching of MRAs across the sectors and the occupations of the economy, aiming at the optimization of the integration process.

The employability potential of MRAs for each economy is determined based on the employment features of the specific economy and the educational attainment level of MRAs. The methodology includes three stages:

- In the first stage, the employment features of the examined economy are approached through two composite indicators, focusing on the sectoral structure of employment and on the occupational structure of employment, respectively. These composite indicators are the Growth Indicator for Sectors (GIS) and the Growth Potential Indicator for Occupations (GIO)
- In the second stage, the educational attainment level of MRAs is compared with the educational attainment level of the employment of the examined country. The comparison is carried out by sector of economic activity and by occupation and creates two indicators the Sectoral Structure Similarity (SSS) and the Occupational Structure Similarity (OSS).
- In the third stage, two new composite indicators are employed with respect to sectors and occupations, which - combining the first two stages – allow us to identify the priorities at the sectoral and occupational level to promote MRAs employability. The priorities with respect to sectors and occupations are estimated through two composite indicators, the SIRIUS Indicator for Sectors (SIRIUS 1) and the SIRIUS Indicator for Occupations (SIRIUS 2).

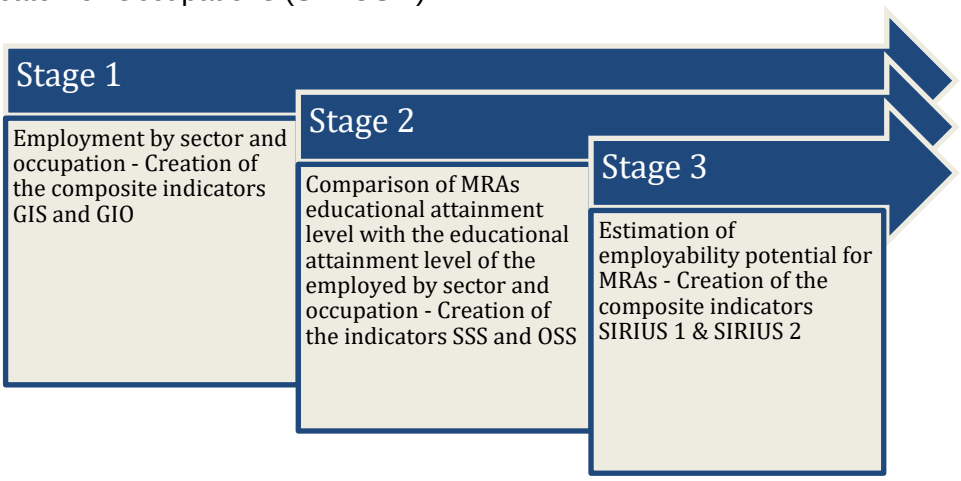



*Figure 0.1: The stages of the research on employability*

In general, composite indicators, like the proposed ones, are aggregate measures that are calculated as weighted combinations of selected sub-indicators via the underlying models of the policy domains of interest (OECD & JRS, 2008, p. 51). They are increasingly used by organisations and policy makers to compare the characteristics of different countries or regions in various policy fields.

To this end, at the first stage, the growth potential of each sector and each occupation is determined. The determination of an economic sector's or an occupation's growth potential relatively to all the other sectors and all the other occupations of an economy, respectively, is

a multidimensional concept. The aim of this section is to present a model for the measurement of growth potential, based on a set of composite indicators: The Growth Indicator for Sectors (GIS) and the Growth Potential Indicator for Occupations (GIO). The composite GIS can be used to rank the importance of the sectors of an economy to the promotion of employment and GIO can be used to rank the importance of the occupations of an economy to the promotion of employment

GIS and GIO integrate different aspects of employment characteristics. GIS contains seven (7) key performance indicators and GIO contains four (4) indicators. Both composite indicators describe briefly the complex sectoral and occupational performance of an economy, respectively. The complex assessment of the employment's growth potential with respect to sectors and occupations helps to uncover the weaknesses of an economy that could consequently affect employment and to identify strengths which the economy might pursue as an employability opportunity.

In the second stage, the indicators of Sectoral Structure Similarity (SSS) and the Occupational Structure Similarity (OSS) are created. Both indicators estimate the similarity level of the current structure with the educational attainment level of MRAs.

Finally, in the last stage, the combination of GIS and SSS and of GIO and OSS provides two new composite indicators, the SIRIUS Indicator for Sectors (SIRIUS 1) and the SIRIUS Indicator for Occupations (SIRIUS 2). SIRIUS 1 and SIRIUS 2 can be used to rank the sectors and the occupations of each country, as sectors of high and low priority for the integration of MRAs.

### 2.2.1. Growth Indicator for Sectors (GIS)

The Growth Indicator for Sectors (GIS) is a composite indicator intending to measure different aspects of the sectoral structure with respect to employment for each economy. GIS consists of seven components, namely:

- The participation rate of a sector to the total employment $(m_1)$
- The percentage change of a sector's employment $(m_2)$
- The backward multiplier of a sector $(m_3)$
- The percentage change of the backward multiplier of a sector $(m_4)$
- The forward multiplier of a sector $(m_5)$
- The percentage change of the forward multiplier of a sector $(m_6)$
- The job vacancy rate of the sector $(m_7)$

If $k$ is the number of indicators determined by the criteria defined above ($k = 1, \dots, 7$), $i$ is the number of sectors ($i = 1, \dots, 54$) and $j$ is the number of counties ($j = 1, \dots, 7$), set $s_{ij}$ the sector $i$ of the country $j$ and $m_k(s_{ij})$ the value of indicator $m_k$ for each $s_{ij}$.

In order to transform the different units and ranges of the individual indicators into comparable ones, each indicator is normalized before combining to one composite indicator. Within the normalization step, a normalization function is used to transform the indicator values $m_k(s_{ij})$ of each sector $i$ of the country $j$, $s_{ij}$, into a normalized indicator $v_k(m_k(s_{ij})$ on a scale between 0 and 1:

$$v_k \begin{cases} h \to [1,0] \\ m_k(s_{ij}) \vdash> v_k(m_k(s_{ij}) \end{cases} \qquad [0.1]$$

A value of 1 represents the highest degree of the normalized indicator and a value of 0 the lowest one. In this research, a linear normalization function is employed, which means that a linear relation between an indicator's value and its normalized value is assumed (Merz, Hiete, Comes, & Schultmann, 2013, p. 1086). The linear normalization function is defined as:

$$v_k(m_k(s_{ij}) = \frac{m_k(s_{ij}) - m_k(s_{ij})_{min}}{m_k(s_{ij})_{max} - m_k(s_{ij})_{min}} \quad [0.2]$$

, where $m_k(s_{ij})_{min}$ is the lowest and $m_k(s_{ij})_{max}$ is the highest value of indicator *k*, measured across the $i$ sectors of the $j$ economy.
The normalized indicators $v_k(m_k(s_{ij})$ are aggregated into a composite indicator, representing the overall dynamic of each sector of economic activity for the examined economy. Due to its comprehensibility, the additive aggregation rule is used:

$$GIS_{ij} = \sum_{1}^{k} w_k \cdot v_k(m_k(s_{ij})) \quad [0.3]$$

, where $w_k$ is the importance weight of indicator $k$. As discused in Janger, Schubert, Andries, Rammer, & Hoskens (2017, p. 23) the elicitation of weights for the individual indicators is especially important for the quality of the results. The weights $w_k$ express the relative importance of the individual indicators. The weight vector $W = [w_1 \quad w_2 \quad \cdots \quad w_k]$ contains the weights of all individual indicators of the composite indicator model. For $W$, it must be ensured that the following constraints are satisfied:

$$\sum_{1}^{k} w_k = 1, w_k > 0, for\ all\ k \quad [0.4]$$

The dependencies among the individual indicators $m_k(s_{ij})$ of the composite indicator $GIS_{ij}$ may lead to distorted results (Dočekalová & Kocmanova, 2016, p. 6), particularly if we consider the additive form of the aggregation. This dependencies can lead to the overestimation or to the underestimation of the growth indicator. Nevertheless, given that all secected indicators describe an aspect of employment by sector of economic activity, it is not posible to select completely independent indicators (OECD & JRS, 2008, p. 22).

### 2.2.2. Growth Indicator for Occupations (GIO)

The Growth Indicator for Occupations (GIO) is a composite indicator intending to measure different aspects of the occupational structure with respect to employment for each economy. GIS consists of four components, namely:

- The participation rate of an occupation to the total employment
- The percentage change of an occupation in employment
- The multiplier of an occupation
- The percentage change of the multiplier of an occupation

If $r$ is the number of indicators determined by the criteria defined above ($r = 1, \dots, 4$), $n$ is the number of occupations ($n = 1, \dots, 40$) and $j$ is the number of counties ($j = 1, \dots, 7$), set $s_{nj}$ the occupation $n$ of the country $j$ and $m_r(s_{nj})$ the value of indicator $m_r$ for each $s_{nj}$.

In order to transform the different units and ranges of the individual indicators into comparable ones, each indicator is normalized before combining into one composite indicator. Within the normalization step, a normalization functions is used to transform the indicator values $m_r(s_{nj})$

of each occupation $n$ of the country $j$, $s_{nj}$, into a normalized indicator $v_r(m_r(s_{nj}))$ on a scale between 0 and 1:

$$v_k \begin{cases} h \to [1,0] \\ m_r(s_{nj}) \vdash> v_r(m_r(s_{nj})) \end{cases} \quad [0.5]$$

A value of 1 represents the highest degree of the normalized indicator and a value of 0 the lowest one. In this research, a linear normalization function is employed, which means that a linear relation between an indicator's value and its normalized value is assumed. The linear normalization function is defined by:

$$v_r(m_r(s_{nj})) = \frac{m_r(s_{nj}) - m_r(s_{nj})_{min}}{m_r(s_{nj})_{max} - m_r(s_{nj})_{min}} \quad [0.6]$$

, where $m_r(s_{nj})_{min}$ is the lowest and $m_r(s_{nj})_{max}$ is the highest value of indicator *k*, measured across the $n$ occupation of the $j$ economy.
The normalized indicators $v_r(m_r(s_{nj}))$ are aggregated into a composite indicator, representing the overall dynamics of each occupation for the examined economy. Due to its comprehensibility, the additive aggregation rule is used:

$$GIO_{nj} = \sum_{1}^{r} w_r \cdot v_r(m_r(s_{nj})) \quad [0.7]$$

, where $w_k$ is the importance weight of indicator $r$. As discused in Janger et al. (2017, p. 23) the elicitation of weights for the individual indicators is especially important for the quality of the results. The weights $w_k$ express the relative importance of the individual indicators. The weight vector $W = [w_1 \quad w_2 \quad \cdots \quad w_r]$ contains the weights of all individual indicators of the composite indicator model. For $W$, it must be ensured that the following constraints are satisfied:

$$\sum_{1}^{r} w_r = 1, w_r > 0, for\ all\ r \quad [0.8]$$

The dependencies among the individual indicators $m_r(s_{nj})$ of the composite indicator $GIO_{nj}$ may lead to distorted results.

### 2.2.3. Sectoral Structure Similarity (SSS)

The indicator of Sectoral Structure Similarity (SSS) provides a method to investigate the similarity of the educational attainment level of MRAS with the educational attainment level of employment for each sector of economic activity for the examined country. SSS is constructed as follows:
If the vector $l_{ij} = [l_{1,\mathrm{ij}} \quad l_{2,\mathrm{ij}} \quad l_{3,\mathrm{ij}}]$ describes the percentage structure of employment for the sector $i$ and the country $j$ for the three educational attainment levels of Table 3.1, and the vector $l_j^{MRAs} = [l_{1,j}^{MRAs} \quad l_{2,j}^{MRAs} \quad l_{3,j}^{MRAs}]$ describes the percentage structure of MRAs educational attainment level the country $j$ for the three educational attainment levels of Table 0.1, then, the distance of the educational attainment level of MRAs from the educational attainment level of the sector $i$ of the economy $j$ is defined as:

$$D_{ij} = |l_{1,\mathrm{ij}} - l_{1,j}^{MRAs}| + |l_{2,\mathrm{ij}} - l_{2,j}^{MRAs}| + |l_{3,\mathrm{ij}} - l_{4,j}^{MRAs}| \quad [0.9]$$

And the Sectoral Structure Similarity of the sector $i$ of the economy $j$ is defined as:

$$SSS_{ij} = \frac{1}{1 + D_{ij}} \qquad [0.10]$$

$SSS_{ij}$ is transformed into a normalized indicator in order to be comparable to the indicators of the first stages and to be used in the third stage of the study. Following the methodology analytically described above, $SSS_{ij}$, is normalized as follows:

$$V(SSS_{ij}) = \frac{SSS_{ij} - SSS_{ij_{min}}}{SSS_{ij_{max}} - SSS_{ij_{min}}} \qquad [0.11]$$

, where $V(SSS_{ij})$ is the normalized indicator $SSS_{ij}$, measured in a scale between 0 and 1, $SSS_{ij_{min}}$ is the lowest and $SSS_{ij_{max}}$ is the highest value of $SSS_{ij}$, measured across the $i$ sectors of the $j$ economy.

A value of 1 represents the highest similarity degree of the normalized indicator and a value of 0 the lowest one.

*Table 0.1: Eurostat's Aggregation of Educational Attainment Level based on ISCED*

| **Description** | **Level** |
|---|---|
| Less than primary, primary and lower secondary education | Levels 0-2 |
| Upper secondary and post-secondary non-tertiary education | Levels 3-4 |
| Tertiary education | Levels 5-8 |

Source: Eurostat

### 2.2.4. Occupational Structure Similarity (OSS)

The indicator of Occupational Structure Similarity (OSS) provides a method to investigate the similarity of the educational attainment level of MRA with the educational attainment level of each occupation for the examined country. OSS is constructed as follows:
If the vector $l_{nj} = [l_{1,\mathrm{nj}} \quad l_{2,\mathrm{nj}} \quad l_{3,\mathrm{nj}}]$ describes the percentage structure of employment for the occupation $n$ and the country $j$ for the three educational attainment levels of Table 0.1, and the vector $l_j^{MRAs} = \left[l_{1,j}^{MRAs} \quad l_{2,j}^{MRAs} \quad l_{3,j}^{MRAs}\right]$ describes the percentage structure of MRAs educational attainment level the country $j$ for the three educational attainment levels then, the distance of the educational attainment level of MRAs from the educational attainment level of the occupation $j$ of the economy $j$ is defined as:

$$D_{nj} = \left|l_{1,\mathrm{nj}} - l_{1,j}^{MRAs}\right| + \left|l_{2,\mathrm{nj}} - l_{2,j}^{MRAs}\right| + \left|l_{3,\mathrm{nj}} - l_{4,j}^{MRAs}\right| \qquad [0.12]$$

And the Occupational Structure Similarity of the sector $i$ of the economy $j$is defined as:

$$OSS_{nj} = \frac{1}{1 + D_{nj}} \quad [0.13]$$

$OSS_{ij}$ is transformed into a normalized indicator in order to be comparable to the indicators of the first stages and to be used in the third stage of the study. Following the methodology analytically described above, $OSS_{ij}$ is normalized as follows:

$$V(OSS_{nj}) = \frac{OSS_{nj} - OSS_{nj_{min}}}{OSS_{nj_{max}} - OSS_{nj_{min}}} \quad [0.14]$$

, where $V(OSS_{nj})$ is the normalized indicator $OSS_{nj}$, measured in a scale between 0 and 1, $OSS_{nj_{min}}$ is the lowest and $OSS_{nj_{max}}$ is the highest value of $SSS_{ij}$,measured across the $n$ occupations of the $j$ economy.

### 2.2.5. SIRIUS Indicator for Sectors (SIRIUS 1)

The SIRIUS Indicator for Sectors (SIRIUS 1) is a composite indicator intending to express the employability potential of MRAs in the sectors of economic activity of each country. SIRIUS 1 consists of eight (8) components, the components of GIS and the indicator SSS.

The indicator $SIRIUS1_{ij}$ of the sector $i$ of the country $j$ is defined as follows:

$$SIRIUS1_{ij} = \sum_{1}^{k} w'_k \cdot v_k(m_k(s_{ij})) + w_{sss} \cdot V(SSS_{ij}) \quad [0.15]$$

, where $w'_k$ importance weight of the normalized indicator $k$ and $w_{sss}$ the weight of normalized indicator $SSS_{ij}$. The weights $w'_k$ and $w_{sss}$ express the relative importance of the individual indicators. The weight vector $W' = [w'_1 \quad w'_2 \quad ...w'_k \quad w_{sss}]$ contains the weights of all individual indicators of the composite indicator model. For $W'$, it must be ensured that the following constraints is satisfied:

$$\sum_{1}^{k} w'_k + w_{sss} = 1, w'_k > 0, for\ all\ k\ \ and\ w_{sss} > 0 \quad [0.16]$$

### 2.2.6. SIRIUS Indicator for Occupations (SIRIUS 2)

The SIRIUS Indicator for Occupations (SIRIUS 2) is a composite indicator intending to express the employability potential of MRAs in the occupations of each country. SIRIUS 2 consists of five components, the components of GIO and the indicator OSS.

The indicator $SIRIUS2_{nj}$ of the occupation $n$ of the country $j$ is defined as follows:

$$SIRIUS2_{nj} = \sum_{1}^{r} w'_r \cdot v_r(m_r(s_{nj})) + w_{oss} \cdot V(OSS_{ij}) \quad [0.17]$$

, where $w'_r$ is the importance weight of the normalized indicator $r$ and $w_{oss}$ is the weight of the normalized indicator $OSS_{ij}$. The weights $w'_r$ and $w_{oss}$ express the relative importance of the individual indicators. The weight vector $[w'_1 \quad w'_2 \quad ...w'_r \quad w_{oss}]$ contains the weights of all individual indicators of the composite indicator model. It must be ensured that the following constraints are satisfied:

$$\sum_{1}^{r} w'_r + w_{oss} = 1, w'_r > 0, for\ all\ r\ \ and\ w_{oss} > 0 \qquad [0.18]$$

### 2.2.7. Assignment of Weights

Assigning weights is a key procedure and, therefore, the it should be approached in the direction of achieving maximum level of objectivity. In general, statistical methodologies, as well as experts evaluation methodologies can be used to consider the relationship among the individual indicators and setting suitable weights (analytically in Becker, Paruolo, Saisana, & Saltelli, 2016; OECD & JRS, 2008; Tangian, 2007). Although a number of methodologies, such as Factor Analysis, Date Envelopment Analysis, Analytic hierarchy Process, etc. can be used to assign weights to individual indicators, this approach was not applied in this study. As discussed in Saisana and Tarantola (2002, p. 60) the weights assigned only on the basis of statistical analysis do not necessarily reflect the actual relationships between the indicators.

It is important to note that most composite indicators rely on equal weighting, i.e. all variables are given the same weight. Moreover, if variables are grouped into dimensions and those are further aggregated into the composite indicator, then applying equal weighting to the dimensions may imply an unequal weighting of the variables (OECD & JRS, 2008, p. 31).

In this study, the weights of the indicators $GIS_{ij}$ and $GIO_{nj}$ are determined based on the assumptions that the structure of employment and the multiplying effect that this structure creates are two dimensions of equal importance.

In the case of $GIS_{ij}$, the dimension of the economic structure is defined by the variables $v_1(m_1(s_{ij})$ and $v_2(m_2(s_{ij})$. The sum of their weight equals 0.5. The dimension of the multiplying effect is defined by the variables $v_3(m_3(s_{ij})$, $v_4(m_4(s_{ij})$, $v_5(m_5(s_{ij})$ and $v_6(m_6(s_{ij})$ according to the input-output analysis linkages. We consider the variable $v_7(m_7(s_{ij})$ also a part of the multiplying effect, since it shows the vacancies by sector of economic activity. The sum of this five variables' weights is also 0.5. For both dimensions, we also consider that the variables expressing a percentages change are less important than the variable expressing the current value of a measure. As a result, the weight of the variables $v_2(m_2(s_{ij})$, $v_4(m_4(s_{ij})$ and $v_5(m_5(s_{ij})$ is set to 0.05. We also assume that the variable $v_7(m_7(s_{ij})$ is most important than the percentage changes but not as important as the values of the variables $v_1(m_1(s_{ij})$, $v_3(m_3(s_{ij})$. The weight of $v_7(m_7(s_{ij})$ is set to 0.1. Finally, given that the weights of $v_3(m_3(s_{ij})$ and $v_4(m_4(s_{ij})$ are equal, since backward and forward multipliers are of the same importance, all the weights of the composite indicator $GIS_{ij}$ are defined.

In the case of $GIO_{nj}$ the dimension of the economic structure is defined by the variables $v_1(m_1(s_{nj})$ and $v_2(m_2(s_{nj})$. The sum of their weight equals 0.5. The dimension of the multiplying effect is defined by the variables $v_3(m_3(s_{nj})$ and $v_4(m_4(s_{ij})$ and the sum of their weights is also 0.5. For both dimensions, we also consider that the variables expressing a percentages change are less important than the variable expressing the current value of a measure. As a result, the weights of the variables $v_2(m_2(s_{ij})$ and $v_4(m_4(s_{ij})$ are set to 0.1. Then, all the weights of the composite indicator $GIO_{nj}$ are defined.

For the estimation of the weights of $\mathrm{SIRIUS}\,1_{ij}$ we consider that the importance of $GIS_{ij}$ and of $V(SSS_{ij})$ is equal, so the weight of each one of them is equal to 0.5. For the estimation of $\mathrm{SIRIUS}\,1_{ij}$ we rearrange the weights of the variables $v_1(m_1(s_{ij})$ to $v_7(m_7(s_{ij})$ in such way that they sum up to 0.5.

For the estimation of the weights of $\text{SIRIUS } 2_{nj}$ we consider that the importance of $GIO_{nj}$ and of $V(OSS_{nj})$ is equal, so the weight of each one of them is equal to 0.5. For the estimation of $\text{SIRIUS } 2_{nj}$ we rearrange the weights of the variables $v_1(m_1(s_{nj})$ to $v_4(m_4(s_{nj})$ in such way that they sum up to 0.5.

All weights used for the construction of the composite indicators of the study are presented in Table 0.2.

*Table 0.2: Assignment of weights*

| | Indicator | Symbol | $GIS_{ij}$ | $\text{SIRIUS } 1_{ij}$ |
|---|---|---|---|---|
| Composite Indicators for Sectors | Participation rate | $v_1(m_1(s_{ij})$ | 0.45 | 0.225 |
| | Percentage change of employment | $v_2(m_2(s_{ij})$ | 0.05 | 0.025 |
| | Backward multiplier | $v_3(m_3(s_{ij})$ | 0.15 | 0.075 |
| | Forward multiplier | $v_4(m_4(s_{ij})$ | 0.15 | 0.075 |
| | Percentage change of backward multiplier | $v_5(m_5(s_{ij})$ | 0.05 | 0.025 |
| | Percentage change of forward multiplier | $v_6(m_6(s_{ij})$ | 0.05 | 0.025 |
| | Job vacancy rate | $v_7(m_7(s_{ij})$ | 0.1 | 0.05 |
| | Sectoral Structure Similarity (SSS) | $V(SSS_{ij})$ | - | 0.5 |
| Composite Indicators for Occupations | Indicator | Short Name | $GIO_{nj}$ | $\text{SIRIUS } 2_{nj}$ |
| | Participation rate | $v_1(m_1(s_{nj}))$ | 0.4 | 0.25 |
| | Percentage change of employment | $v_2(m_2(s_{nj}))$ | 0.1 | 0.05 |
| | Occupational multiplier | $v_3(m_3(s_{nj}))$ | 0.4 | 0.15 |
| | Percentage change of occupational multiplier | $v_4(m_4(s_{nj}))$ | 0.1 | 0.05 |
| | Occupational Structure Similarity (OSS) | $V(OSS_{nj})$ | - | 0.5 |

Based on the above table, $\text{SIRIUS1}_{ij}$ and $\text{SIRIUS2}_{nj}$ are formulated as follows:

$$\text{SIRIUS1}_{ij} = 0.225 \cdot v_1(m_1(s_{ij}) + 0.025 \cdot v_2(m_2(s_{ij}) + 0.075 \cdot v_3(m_3(s_{ij}) + 0.075 \cdot v_4(m_4(s_{ij}) + 0.025 \cdot v_5(m_5(s_{ij}) + 0.025 \cdot v_6(m_6(s_{ij}) + 0.05 \cdot v_7(m_7(s_{ij}) + 0.5 \cdot V(SSS_{ij})$$ [2.19]

$$\text{SIRIUS2}_{ij} = 0.25 \cdot v_1(m_1(s_{nj}) + 0.05 \cdot v_2(m_2(s_{nj})) + 0.15 \cdot v_3(m_3(s_{nj})) + 0.05 \cdot v_4(m_4(s_{nj})) + 0.5 \cdot V(OSS_{nj})$$ [2.20]

## 2.3. Results

### 2.3.1. Introduction

The results of the proposed methodology are represented in the following subsections by each SIRIUS member country.

For each country, the structure of employment is analyzed, focusing on: the backward and forward employment multipliers, the key sectors of employment and the occupational multipliers. The theoretical and methodological framework of input-output analysis is analytically presented in Appendix B. Based on input-output analysis, the various measures are defined as:

- The backward employment multiplier of sector $j$ shows the employment's increase in the economy, which is required in order to satisfy a one unit increase in the final demand of sector $j$.
- The forward employment multiplier of sector $j$ shows the employment's increase in the economy, which is required in order to satisfy a one unit increase in the value added of sector $j$.
- The key sectors of an economy have both backward and forward employment multipliers above the average of all sectors. The expansion of key sectors causes significant increase in the employment of the examined economy, since the key sectors are the most interconnected ones. If a sector shows relative high backward multipliers, but the forward multipliers are lower than the average, then it is characterized as "Leontief key sector". If a sector shows relative high forward multipliers, but the backward multipliers are lower than the average, then it is characterized as "Ghosh key sector".
- The occupational multipliers of occupation $i$ show the increase of employment in occupation $i$ following a unitary increase in final demand for all the sectors of the economy.

Then, based on Section 2.2, the indicators GIS, GIO, SSS and OSS are estimated and the results are presented. Furthermore, the employability potential of MRAs is studied through SIRIUS 1 and SIRIUS 2 indicators, resulting in the priorities of each economy by sector of economic activity and occupation.

The analysis below is based on the classification of sectors of economic activity from World Input-Output Database –WIOD (Timmer, Dietzenbacher, Los, Stehrer, & Vries, 2015; Timmer, Los, Stehrer, & de Vries, 2016) and covers 54 sectors of economic activity according to ISIC Rev. 4 (or equivalently NACE Rev. 2, digit 2) listed in Table A.3 of the Appendix. For an overview of the results, we also use the NACE Rev. 2, digit 1 classification described in Table A.2 of the Appendix.

The analysis of employment by occupation is based on the ISCO 08 classification available in Table A.4 (for the 1-digit classification) and Table A.5 (for the 2-digit classification).

The analysis of the employment structure by educational attainment level is based on the ISCED aggregation of Table 0.1. Analytically, the categories of Table 0.1 are listed in Table A.1 in the Appendix.

Data on the job vacancy rate[12] are available from Eurostat by sector of economic activity (1-digit analysis in NACE Rev. 2 classification), for all SIRIUS countries except Italy. The job

[12] The official definition of a job vacancy is included in Article 2 of Regulation (EC) No 453/2008 and is used by EUROSTAT: "A job vacancy shall mean a paid post that is newly created, unoccupied, or about to become vacant: a) for which the employer is taking active steps and is prepared to take further steps to find a suitable candidate from outside the enterprise concerned, and b) which the employer intends

vacancy rate measures the proportion between the annual average number of vacancies and the total annual average number of jobs (occupied and vacancies). Note that an occupied post means a paid post within the organisation to which an employee has been assigned.

The sectoral taxonomy by R&D intensity is provided by OECD (Galindo-Rueda & Verger, 2016) and is also presented in Table A.3 of the Appendix. Note that the classification of sectors is as follows: LI: Low R&D intensity, MLI: Medium-Low R&D intensity, MHI: Medium-High R&D intensity, HI: High R&D intensity.

The data used in the research are:

- The input-output tables, that come from the WIOD.
- Data on the structure of employment by sector and occupation at the 2-digit level were provided by the SIRIUS partners of the countries Czech Republic, Greece, Denmark, Switzerland and United Kingdom. For Finland and Italy, due to the 2-digit level data unavailability, data was collected from Eurostat's Database at the 1-digit level of analysis.
- Data on job vacancy rate by sector of economic activity were collected from Eurostat's Database, at the 1-digit level for all SIRIUS countries except Italy.

The analysis covers the period 2011-2017 for all countries, with the exception of Denmark, where the last year with available data is 2016. The analytical results of the research are available in Table A.6 - Table A.33 of the Appendix.

to fill either immediately or within a specific period of time. A vacant post that is only open to internal candidates is not treated as a 'job vacancy'."

### 2.3.2. Czech Republic

#### *2.3.2.1. Sectoral Analysis*

The employment's share of the primary sector of the Czech Republic was 2.98% in 2011 and declined to 2.92% in 2017. The respective shares of employment in manufacturing sectors was 38.55 and 38.85% and in the tertiary sectors 58.46% and 58.72%.

In Figure 0.2, the employment structure of the Czech Republic for the years 2011 and 2017 is presented on a sector-by-sector basis.

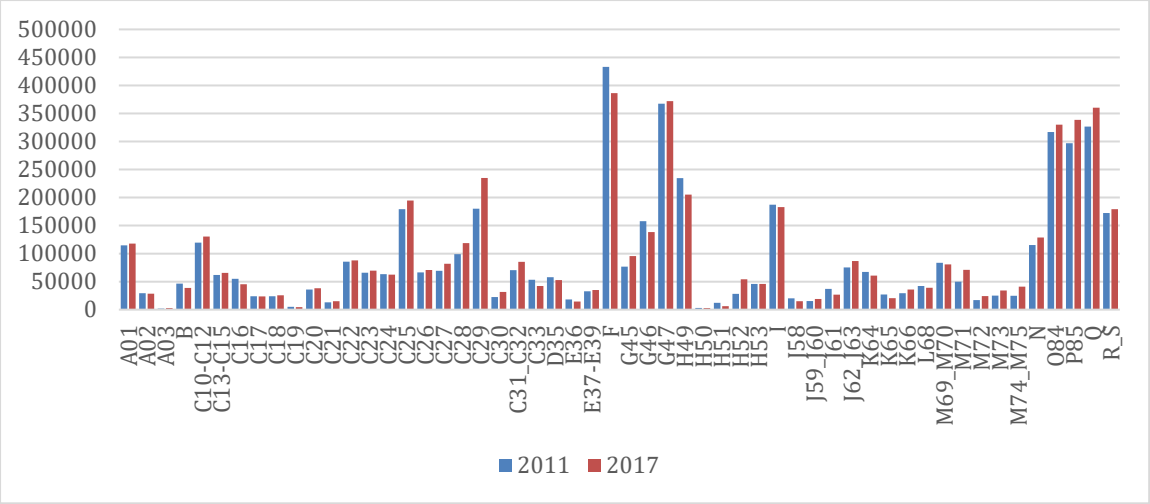



*Figure 0.2: Employment structure by sector of economic activity, Czech Republic (2011 & 2017)*

The sectors with the highest participation rate in employment are:

- F, Construction
- G47, Retail trade, except of motor vehicles and motorcycles
- Q, Human health and social work activities
- P85, Education
- O84, Public administration and defence; compulsory social security
- C29, Manufacture of motor vehicles, trailers and semi-trailers
- H49, Land transport and transport via pipelines
- C25, Manufacture of fabricated metal products, except machinery and equipment
- I, Accommodation and food service activities
- R_S, Other service activities

The sectors with the highest increase in the percentage change of employment between the years 2011 and 2017 are:

- H52, Warehousing and support activities for transportation
- M74_M75, Other professional, scientific and technical activities; veterinary activities
- M72, Scientific research and development
- M71, Architectural and engineering activities; technical testing and analysis
- C30, Manufacture of other transport equipment
- A03, Fishing and aquaculture
- M73, Advertising and market research
- C29, Manufacture of motor vehicles, trailers and semi - trailers
- G45, Wholesale and retail trade and repair of motor vehicles and motorcycles

- J59_J60, Motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activities

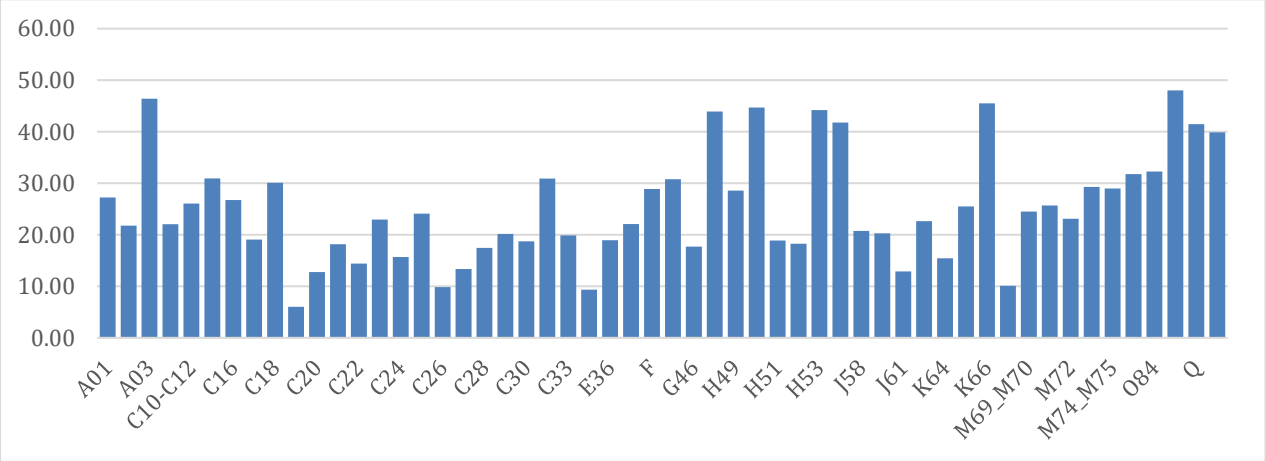



*Figure 0.3 Backward employment multipliers, Czech Republic, 2017*

In Figure 0.3 the backward employment multipliers for the Czech Republic are presented, for 2017. The sectors with the highest backward employment multipliers are:

- K66, Activities auxiliary to financial services and insurance activities
- H50, Water transport
- H53, Postal and courier activities
- G47, Retail trade, except of motor vehicles and motorcycles
- P85, Education
- C18, Printing and reproduction of recorded media
- A03, Fishing and aquaculture
- G45, Wholesale and retail trade and repair of motor vehicles and motorcycles
- M73, Advertising and market research
- M74_M75, Other professional, scientific and technical activities, veterinary activities

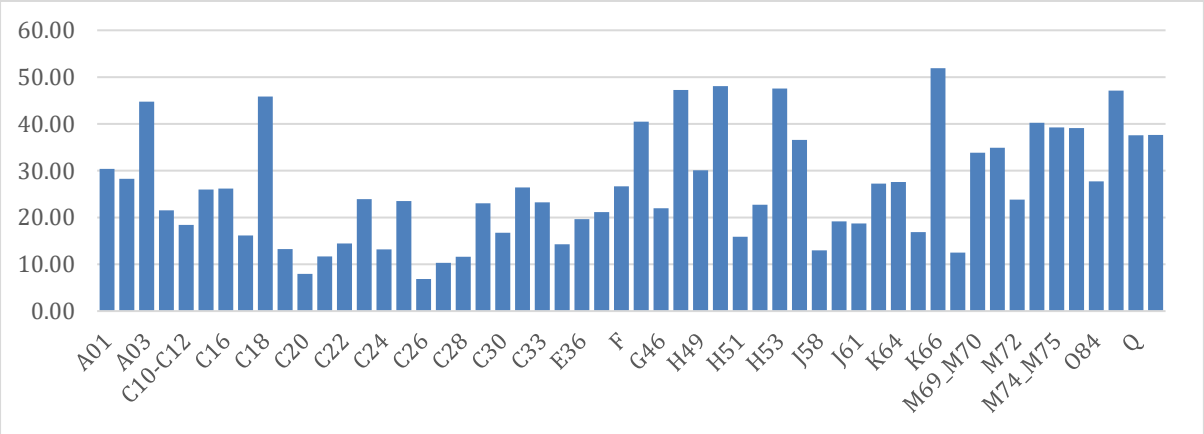



*Figure 0.4 Forward employment multipliers, Czech Republic, 2017*

In Figure 0.4, the forward employment multipliers for the Greek economy are presented, for 2017. The sectors with the highest forward employment multipliers are:

- P85, Education
- A03, Fishing and aquaculture

- K66, Activities auxiliary to financial services and insurance activities
- H50, Water transport
- H53, Postal and courier activities
- G47, Retail trade, except of motor vehicles and motorcycles
- I, Accommodation and food service activities
- Q, Human health and social work activities
- R_S, Other service activities
- O84, Public administration and defense, compulsory social security

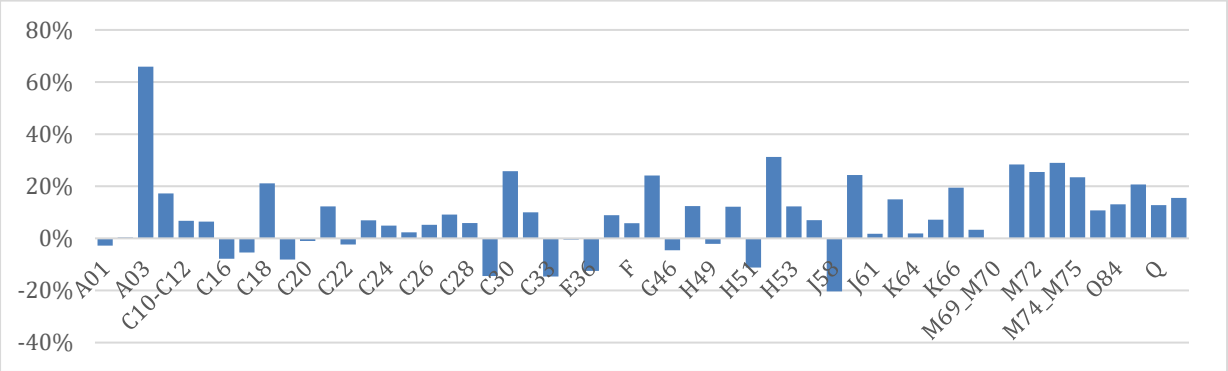



*Figure 0.5 Percentage change of the backward employment multipliers between the years 2011 and 2017, Czech Republic*

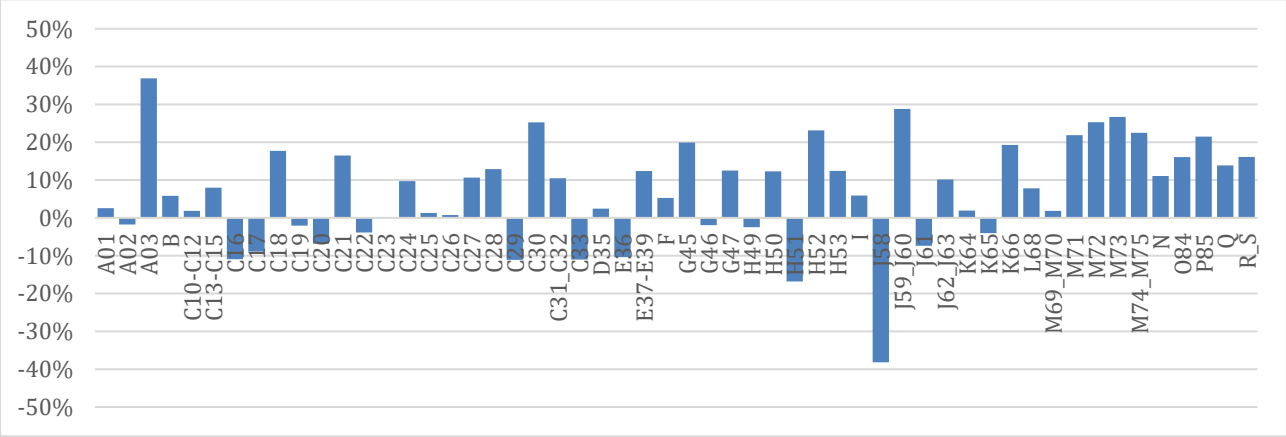



*Figure 0.6 Percentage change of the forward employment multipliers between the years 2011 and 2017, Czech Republic*

In Figure 0.5 and Figure 0.6 the percentages change of backward and forward multipliers, respectively, are presented, between the years 2011 and 2017. The sectors with the highest increase in both multipliers are:

- A03, Fishing and aquaculture
- M73, Advertising and market research
- H52, Warehousing and support activities for transportation
- J59_J60, Motion picture, video and television programme production, sound recording and music publishing activities, programming and broadcasting activities
- C30, Manufacture of other transport equipment
- M72, Scientific research and development
- M71, Architectural and engineering activities, technical testing and analysis

- M74_M75, Other professional, scientific and technical activities, veterinary activities
- G45, Wholesale and retail trade and repair of motor vehicles and motorcycles
- P85, Education

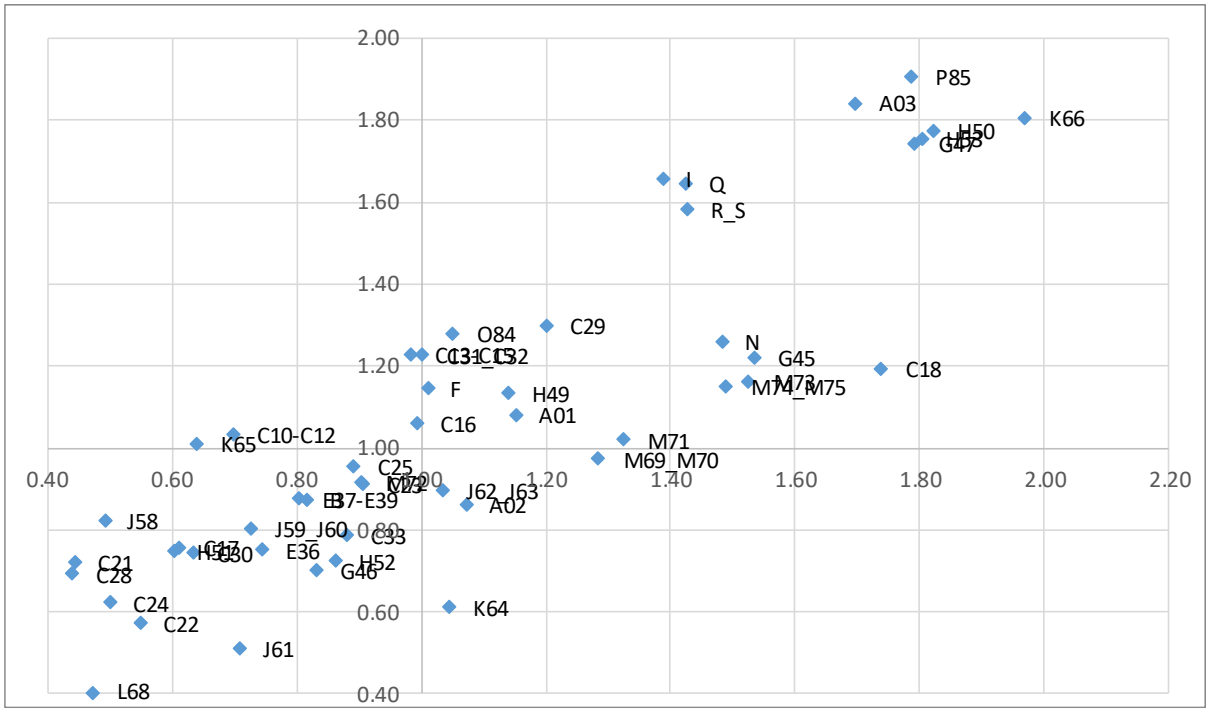



*Figure 0.7: Key sectors of employment, Czech Republic, 2017*

Figure 0.7 shows the key sectors of the Czech economy[13]. The figure is designed as follows: The horizontal axis represents the normalized forward employment multipliers and the vertical one the normalized backward employment multipliers. The two axes intersect at the point (1, 1). The particular presentation gives the ability to "map" the economy following the schema: A sector located in the first quadrant is a key sector of the economy, a sector located in the second quadrant is a Leontief key sectors , a sector located in the third quadrant is not a key sector, and, finally, a sector located in the fourth quadrant is Ghosh key sector. The key sectors (the sectors are orderd based on their NACE Rev. 2 code) of Czech Republic are:

- A01, Crop and animal production, hunting and related service activities
- A03, Fishing and aquaculture

[13] The key sectors of an economy have both backward and forward employment multipliers above the average of all sectors. The expansion of key sectors causes significant increase in the employment of the examined economy, since the key sectors are the most interconnected ones. If a sector shows relative high backward multipliers, but the forward multipliers are lower than the average, then it is characterized as "Leontief key sector". If a sector shows relative high forward multipliers, but the backward multipliers are lower than the average, then it is characterized as "Ghosh key sector".

It should be noted that for the determination of the key sectors two measures are taking into account: the direct coefficient of employment (employment per unit of output) and the importance of a sector as a producer and a consumer of intermediate products. If sector i is a key sector, then, an increase in the sector's final demand and value added by one monetary unit causes higher increase of employment in the economy than of the average of all sectors. This way, the expansion of key sectors of employment promotes the employment generation more than other sectors. In the case of Leontief key sectors the expansion of employement is more important than the average only as a result of final demand increase, while in the case of Ghosh key sectors the expansion is more important than the average only as a result of an increase in value added.

- C18, Printing and reproduction of recorded media
- C29, Manufacture of motor vehicles, trailers and semi-trailers
- C31_C32, Manufacture of furniture, other manufacturing
- F, Construction
- G45, Wholesale and retail trade and repair of motor vehicles and motorcycles
- G47, Retail trade, except of motor vehicles and motorcycles.
- H49, Land transport and transport via pipelines
- H50, Water transport
- H53, Postal and courier activities
- I, Accommodation and food service activities
- K66, Activities auxiliary to financial services and insurance activities
- M71, Architectural and engineering activities, technical testing and analysis
- 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

#### *2.3.2.2. Occupations*

In Figure 0.8 the employment structure by occupation of the Czech Republic for the years 2011 –and 2017 is presented.

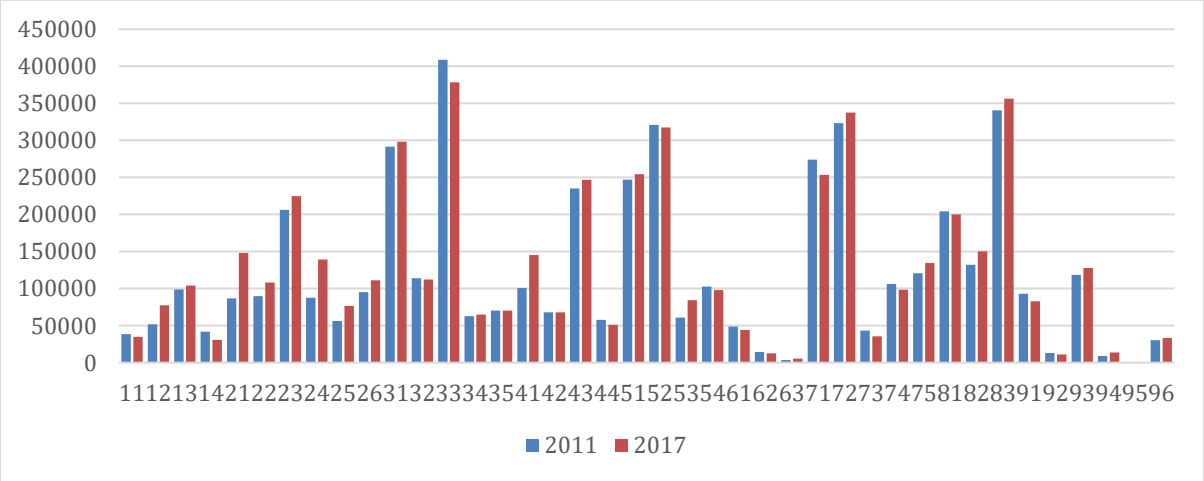



*Figure 0.8: Employment structure by occupation, Czech Republic, 2011 & 2017*

The occupations with the highest participation rate in employment for 2017 are:

- 33, Business and administration associate professionals
- 83, Drivers and mobile plant operators
- 72, Metal, machinery and related trades workers
- 52, Sales workers
- 31, Science and engineering associate professionals
- 51, Personal service workers
- 71, Building and related trades workers, excluding electricians
- 43, Numerical and material recording clerks
- 23, Teaching professionals

- 81, Stationary plant and machine operators

The occupations with the highest increase in the percentage change of employment between the years 2011 and 2017 are:

- 21, Science and engineering professionals
- 24, Business and administration professionals
- 63, Subsistence farmers, fishers, hunters and gatherers
- 94, Food preparation assistants
- 12, Administrative and commercial managers
- 41, General and keyboard clerks
- 53, Personal care workers
- 25, Information and communications technology professionals
- 22, Health professionals
- 26, Legal, social and cultural professionals

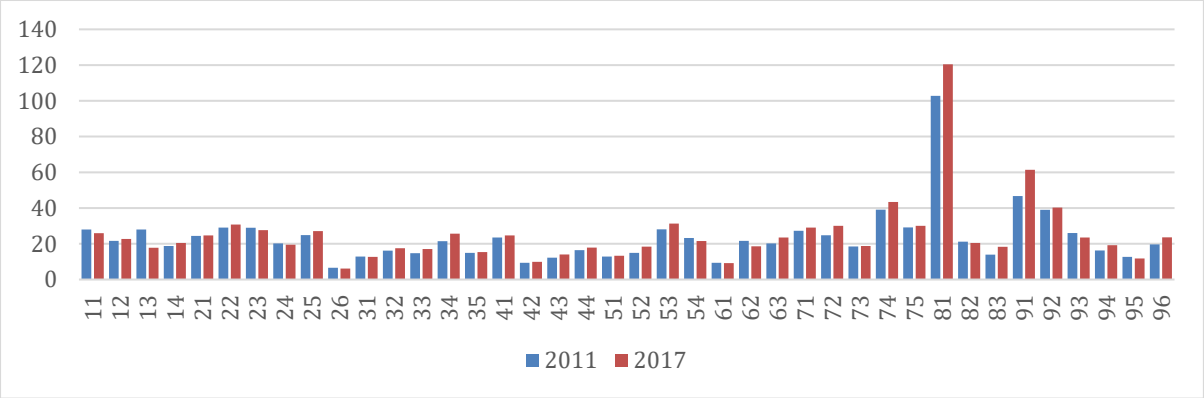



*Figure 0.9: Occupational multipliers, Czech Republic, 2017*

In Figure 0.9 the occupational multipliers for Czech Republic are represented, for the years 2011 & 2017. The occupations with the highest multipliers in 2017 are:

- 81, Stationary plant and machine operators
- 91, Cleaners and helpers
- 74, Electrical and electronic trades workers
- 92, Agricultural, forestry and fishery labourers
- 53, Personal care workers
- 22, Health professionals
- 72, Metal, machinery and related trades workers
- 75, Food processing, wood working, garment and other craft and related trades workers
- 71, Building and related trades workers, excluding electricians
- 23, Teaching professionals

The occupations with the highest increase in their multipliers between the years 2011 and 2017 are:

- 83, Drivers and mobile plant operators
- 91, Cleaners and helpers
- 52, Sales workers
- 72, Metal, machinery and related trades workers
- 96, Refuse workers and other elementary workers

- 34, Legal, social, cultural and related associate professionals
- 94, Food preparation assistants
- 81, Stationary plant and machine operators
- 63, Subsistence farmers, fishers, hunters and gatherers
- 33, Business and administration associate professionals

#### 2.3.2.3. Educational attainment level

In Figure 0.10, the employment structure by educational attainment level for the Czech Republic is presented. Level 0-2 participation rate in employment is slightly decreasing for the examined period, while the participation rate of level 3-4 showed a significant decrease and the participation rate of level 5-8 increases significantly.

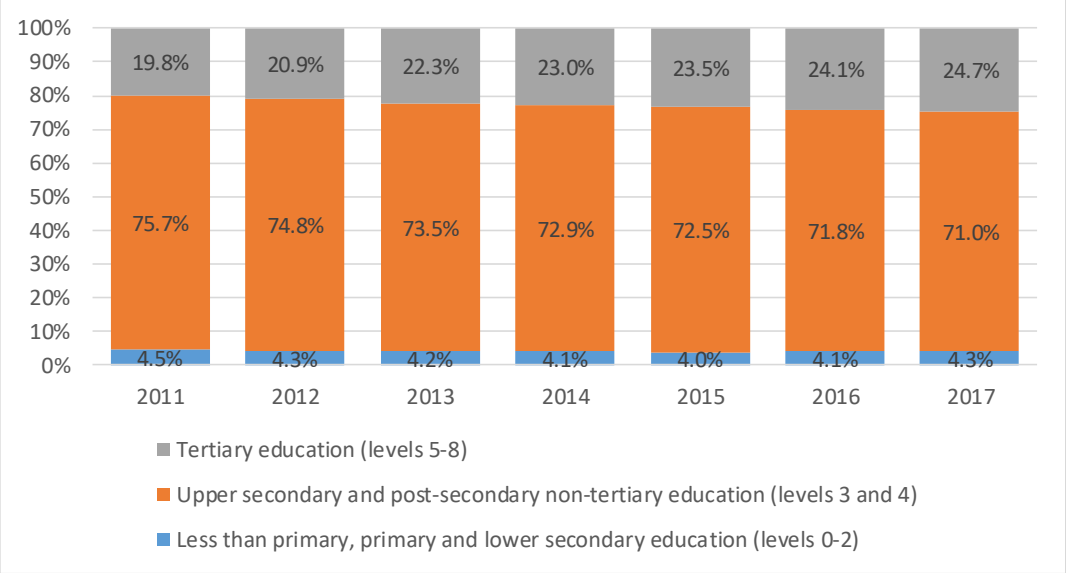



*Figure 0.10: Employment by educational attainment level, Czech Republic*

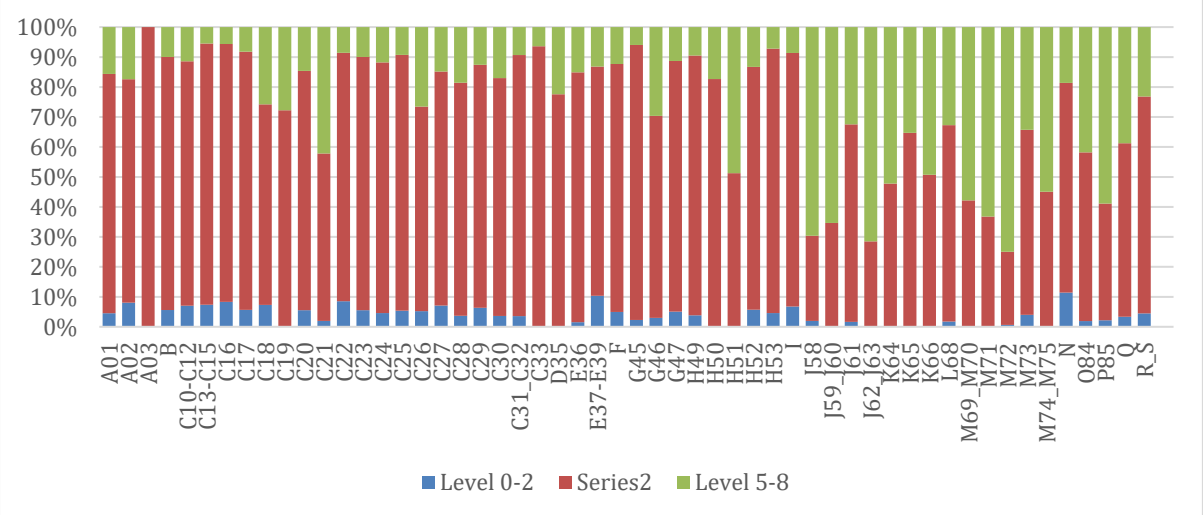



*Figure 0.11: Structure of employment by sector of economic activity and educational attainment level, Czech Republic, 2017*

The sectors with the highest participation of low-skilled employment (Level 0-2) are:

- N, Administrative and support service activities

- E37-E39, Sewerage, waste collection, treatment and disposal activities, materials recovery, remediation activities and other waste management services
- C22, Manufacture of rubber and plastic products
- C16, Manufacture of wood and of products of wood and cork, except furniture, manufacture of articles of straw and plaiting materials
- A02, Forestry and logging

The sectors with the highest participation of medium-skilled employment (Level 3-4) are:

- A03, Fishing and aquaculture
- C33, Repair and installation of machinery and equipment
- G45, Wholesale and retail trade and repair of motor vehicles and motorcycles
- H53, Postal and courier activities
- C13-C15, Manufacture of textiles, wearing apparel and leather products

The sectors with the highest participation of high-skilled employment (Level 5-8) are:

- M72, Scientific research and development
- J62_J63, Computer programming, consultancy and related activities, information service activities
- J58, Publishing activities
- J59_J60, Motion picture, video and television programme production, sound recording and music publishing activities, programming and broadcasting activities
- M71, Architectural and engineering activities, technical testing and analysis

#### 2.3.2.1. Job vacancy rate

Figure 0.12 shows the job vacancy rate for the Czech Republic in 2017. The sectors with the higher job vacancy rates are Real estate activities (L) and Administrative and support service activities (N).

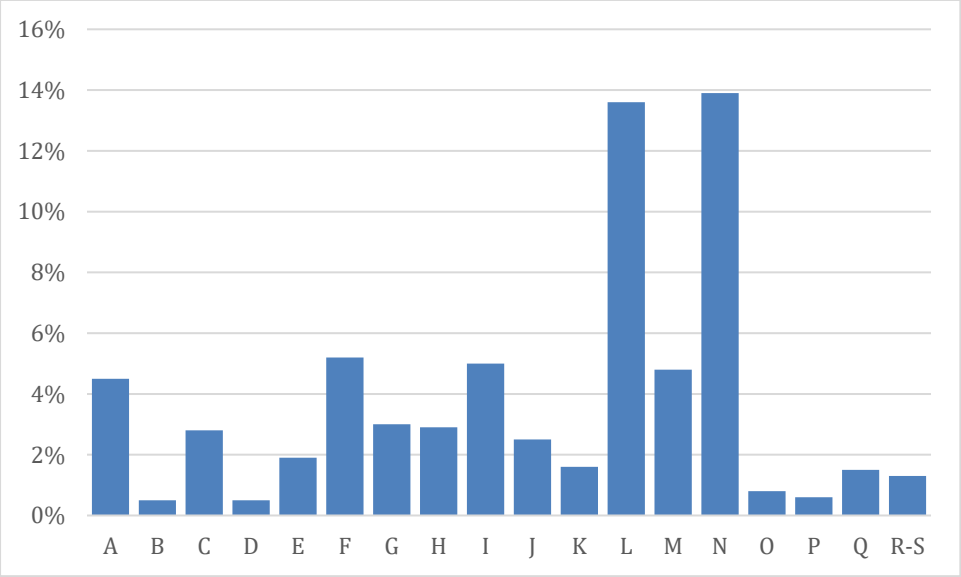



*Figure 0.12: Job vacancy rate, Czech Republic, 2017*

### 2.3.2.2. Employability opportunities for MRAS

For the determination of the employability opportunities of MRAs in the Czech Republic, two composite indicators are used, the SIRIUS Indicator for Sectors (SIRIUS 1) and the SIRIUS Indicator for Occupations (SIRIUS 2). The construction of SIRIUS 1 requires the estimation of the Growth Indicator for Sectors (GIS) and the Sectoral Structure Similarity (SSS) and the construction of SIRIUS 2 requires, at first, the estimation of the Growth Indicator for Occupations (GIO) and the Occupational Structure Similarity (OSS).

The GIS and the SSS for Czech Republic are shown in Figure 0.13.

The sectors with the higher GIS are:

- G47, Retail trade, except of motor vehicles and motorcycles
- P85, Education
- Q, Human health and social work activities
- F, Construction
- O84, Public administration and defense, compulsory social security
- I, Accommodation and food service activities
- N, Administrative and support service activities
- R_S, Arts, entertainment and recreation and other service activities
- H49, Land transport and transport via pipelines
- C29, Manufacture of motor vehicles, trailers and semi – trailers

Moreover, the sectors with the higher SSS are:

- D35, Electricity, gas, steam and air conditioning supply
- G46, Wholesale trade, except of motor vehicles and motorcycles
- H52, Warehousing and support activities for transportation
- C19, Manufacture of coke and refined petroleum products
- R_S, Arts, entertainment and recreation and other service activities
- G47, Retail trade, except of motor vehicles and motorcycles
- C18, Printing and reproduction of recorded media
- C29, Manufacture of motor vehicles, trailers and semi - trailers
- E36, Water collection, treatment and supply
- N, Administrative and support service activities

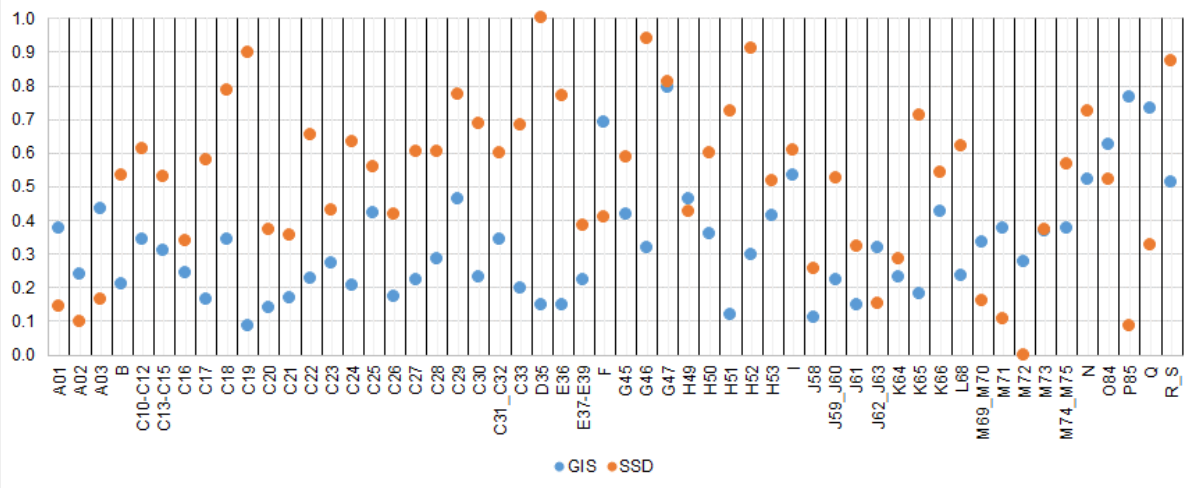



*Figure 0.13: GIS and SSS, Czech Republic*

The values of the SIRIUS Indicator for Sectors (SIRIUS 1) are used to rank the sectors and to identify the sectors of 1st priority for the integration of MRAs into the labour market of the Czech Republic. The SIRIUS 1 is represented in Figure 0.14.

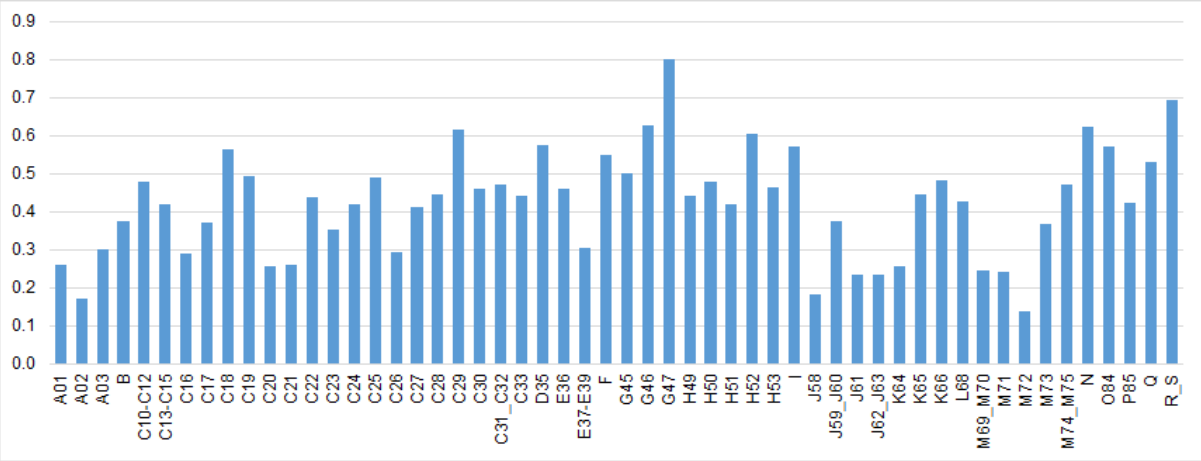



*Figure 0.14: SIRIUS 1, Czech Republic*

Based on the above figure, the sectors of the Czech Republic which are determined as 1st priority for the employability of MRAs are:

- G47, Retail trade, except of motor vehicles and motorcycles
- R_S, Arts, entertainment and recreation and other service activities
- G46, Wholesale trade, except of motor vehicles and motorcycles
- N, Administrative and support service activities
- C29, Manufacture of motor vehicles, trailers and semi - trailers
- H52, Warehousing and support activities for transportation
- D35, Electricity, gas, steam and air conditioning supply
- O84, Public administration and defense, compulsory social security
- I, Accommodation and food service activities
- C18, Printing and reproduction of recorded media

The GIO and the OSD for the Czech Republic are shown in Figure 0.15.

The occupations with higher GIO are:

- 81, Stationary plant and machine operators
- 83, Drivers and mobile plant operators
- 33, Business and administration associate professionals
- 72, Metal, machinery and related trades workers
- 52, Sales workers
- 31, Science and engineering associate professionals
- 71, Building and related trades workers, excluding electricians
- 43, Numerical and material recording clerks
- 51, Personal service workers
- 23, Teaching professionals

Moreover, the occupations with the higher OSS are:

- 44, Other clerical support workers
- 42, Customer services clerks
- 34, Legal, social, cultural and related associate professionals
- 52, Sales workers

- 94, Food preparation assistants
- 43, Numerical and material recording clerks
- 11, Chief executives, senior officials and legislators
- 73, Handicraft and printing workers
- 72, Metal, machinery and related trades workers
- 14, Hospitality, retail and other services managers

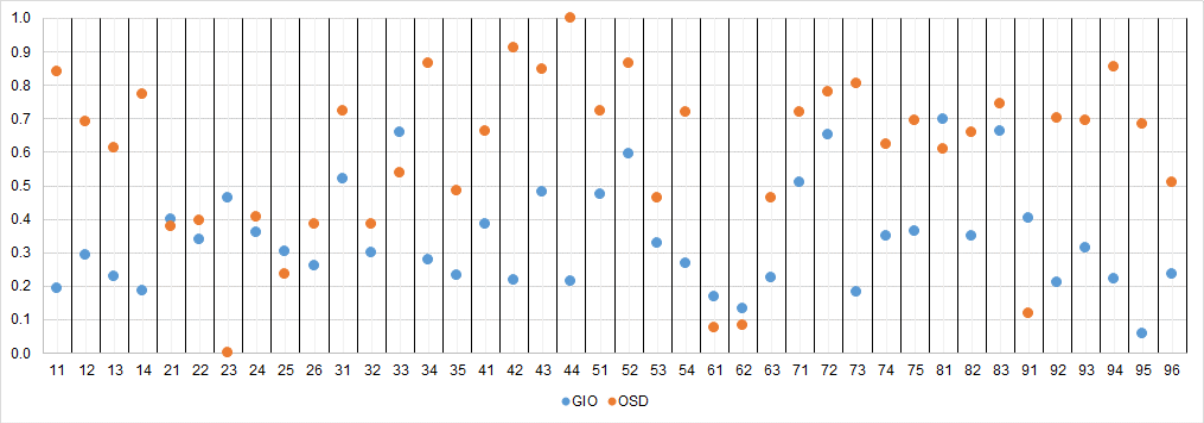



*Figure 0.15: GIO and OSS, Czech Republic*

The values of the SIRIUS Indicator for Occupations (SIRIUS 2) are used to rank the occupations and to identify the occupations of 1st priority for the integration of MRAs into the labour market of Czech Republic. The SIRIUS 2 indicator is represented in Figure 0.16.

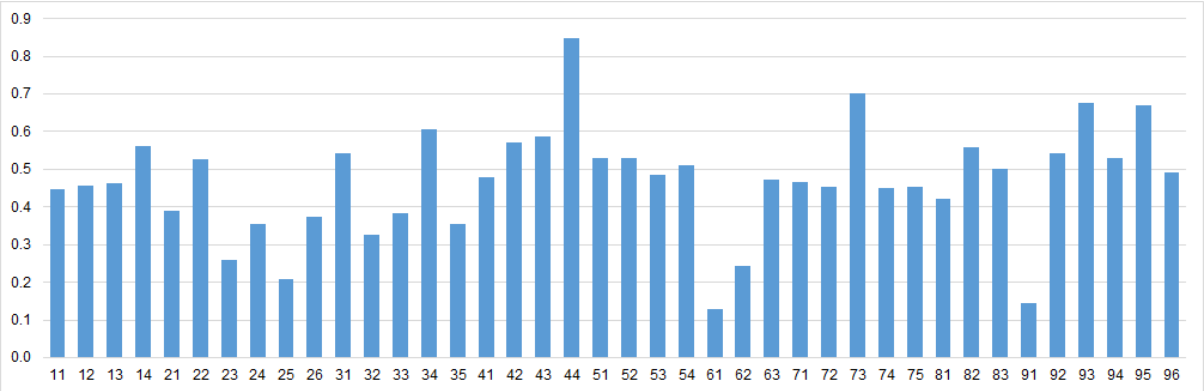



*Figure 0.16: SIRIUS 2, Czech Republic*

Based on the above figure, the occupations of the Czech Republic which are determined as 1st priority for the employability of MRAs are:

- 44, Other clerical support workers
- 73, Handicraft and printing workers
- 93, Labourers in mining, construction, manufacturing and transport
- 95, Street and related sales and service workers
- 34, Legal, social, cultural and related associate professionals
- 43, Numerical and material recording clerks
- 42, Customer services clerks
- 14, Hospitality, retail and other services managers

- 82, Assemblers
- 92, Agricultural, forestry and fishery labourers

The above analysis shows that the employability potential of MRAs in the Czech Republic are concentrated in two industrial and eight service sectors. The industrial sectors are characterised by medium-high and medium-low R&D intensity and the services sectors are characterized by low R&D intensity. Moreover, the occupations with high employability potential are in the categories of elementary occupations, craft and related trades workers and clerical support workers.

### 2.3.3. Denmark

#### *2.3.3.1. Sectoral Analysis*

The employment's share of the primary sector of Denmark was 0.65% in 2011 and declined to 0.64% in 2016[14]. The respective shares of employment in the manufacturing sectors were 18.55% and 19.25%, and in the tertiary sectors 80.80% and 80.11%, respectively.

In Figure 0.17 the employment structure of Denmark for the years 2011 and 2016 is represented on a sector-by-sector basis.

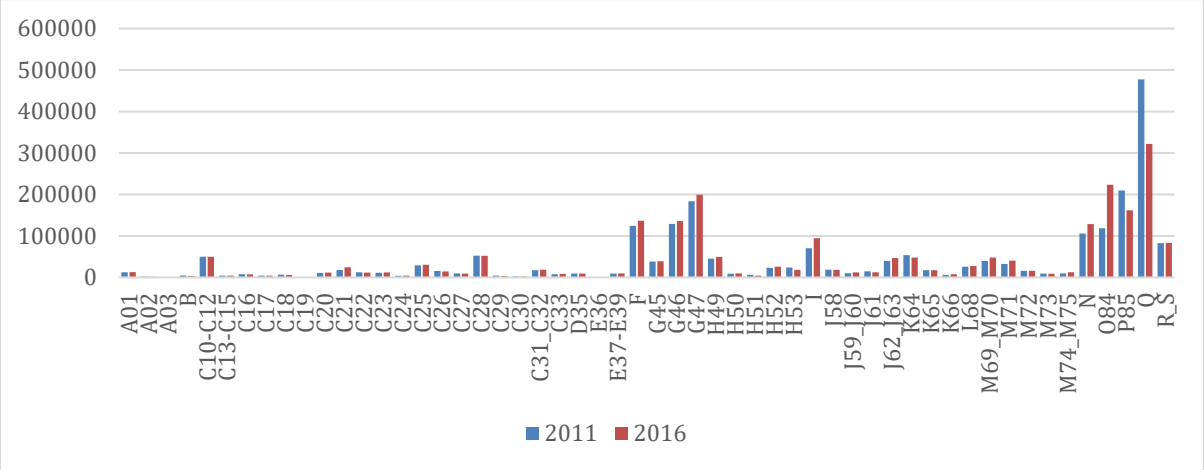



*Figure 0.17: Employment Structure by sector of economic activity, Denmark (2011 & 2016)*

The sectors with the higher participation rate in employment are:

- Q, Human health and social work activities
- O84, Public administration and defence, compulsory social security
- G47, Retail trade, except of motor vehicles and motorcycles
- P85, Education
- F, Construction
- G46, Wholesale trade, except of motor vehicles and motorcycles
- N, Administrative and support service activities
- I, Accommodation and food service activities
- R_S, Other service activities
- C28, Manufacture of machinery and equipment n.e.c.

The sectors with the higher increase in the percentage change of employment between the years 2011 and 2016 are:

- O84, Public administration and defence, compulsory social security
- C21, Manufacture of basic pharmaceutical products and pharmaceutical preparations
- I, Accommodation and food service activities
- M74_M75, Other professional, scientific and technical activities, veterinary activities
- K66, Activities auxiliary to financial services and insurance activities
- M71, Architectural and engineering activities, technical testing and analysis
- A03, Fishing and aquaculture
- N, Administrative and support service activities

[14] The latest available data for Denmark are for the year 2016.

- M69_M70, Legal and accounting activities, activities of head offices, management consultancy activities
- J62_J63, Computer programming, consultancy and related activities, information service activities

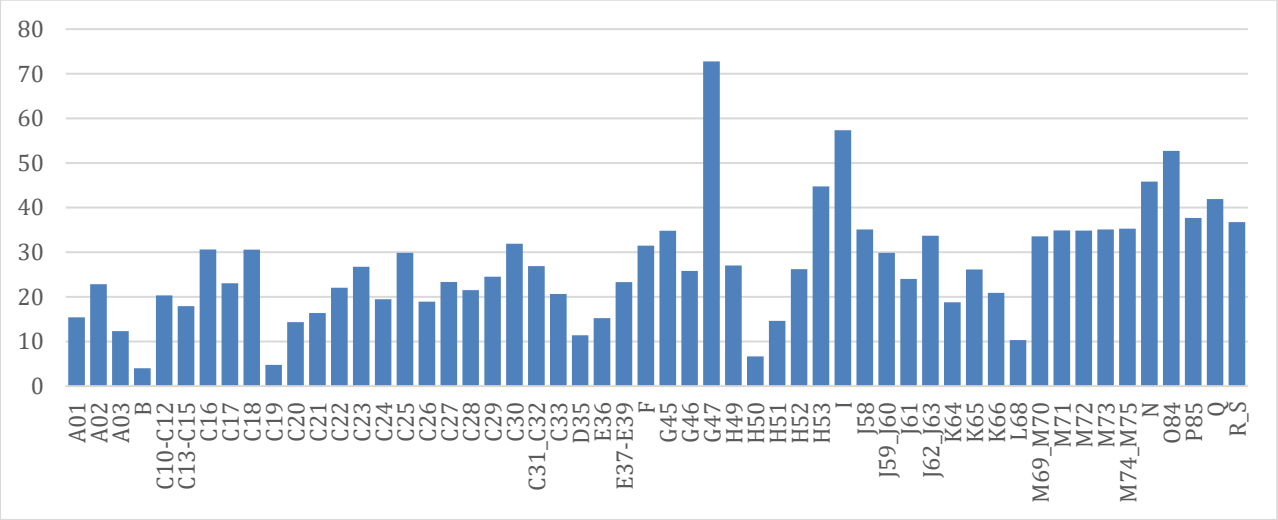



*Figure 0.18 Backward employment multipliers, Denmark, 2016*

In Figure 0.18 the backward employment multipliers for Denmark are presented, for 2016. The sectors with the higher backward employment multipliers are:

- G47, Retail trade, except of motor vehicles and motorcycles
- I, Accommodation and food service activities
- O84, Public administration and defence, compulsory social security
- N, Administrative and support service activities
- H53, Postal and courier activities
- Q, Human health and social work activities
- P85, Education
- R_S, Other service activities
- M74_M75, Other professional, scientific and technical activities, veterinary activities
- M73, Advertising and market research

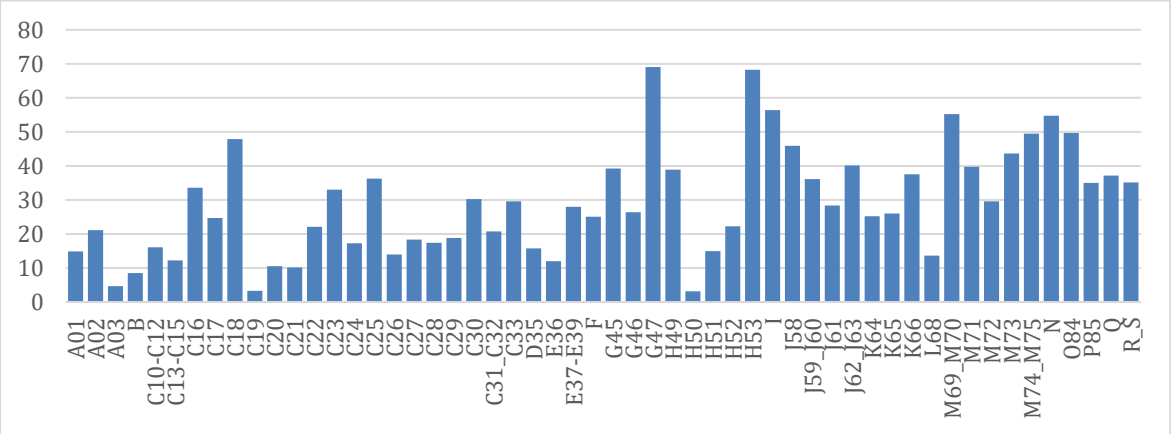



*Figure 0.19 Forward employment multipliers, Denmark, 2016*

In Figure 0.19,the forward employment multipliers for Denmark are represented, for 2016. The sectors with the higher forward employment multipliers are:

- G47, Retail trade, except of motor vehicles and motorcycles
- H53, Postal and courier activities
- I, Accommodation and food service activities
- M69_M70, Legal and accounting activities, activities of head offices, management consultancy activities
- N, Administrative and support service activities
- O84, Public administration and defence, compulsory social security
- M74_M75, Other professional, scientific and technical activities, veterinary activities
- C18, Printing and reproduction of recorded media
- J58, Publishing activities

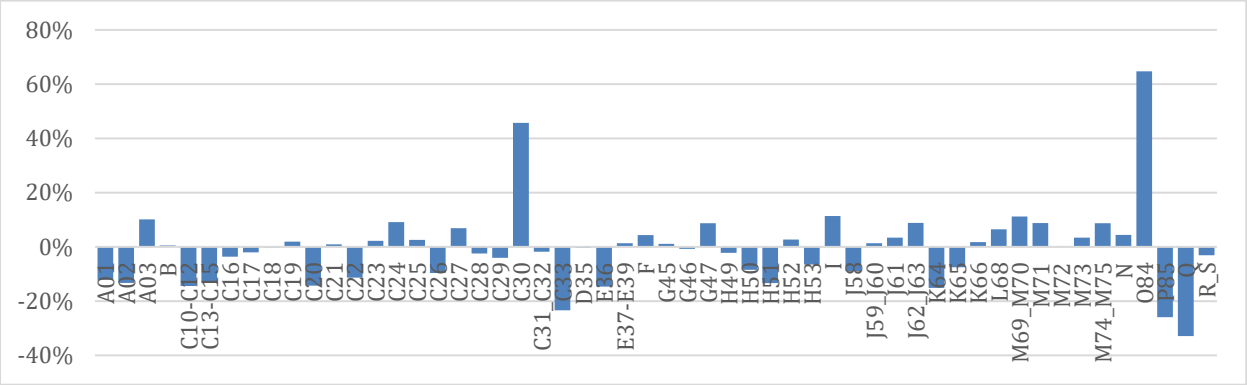



*Figure 0.20 Percentage change of the backward employment multipliers between the years 2011 and 2016, Denmark*

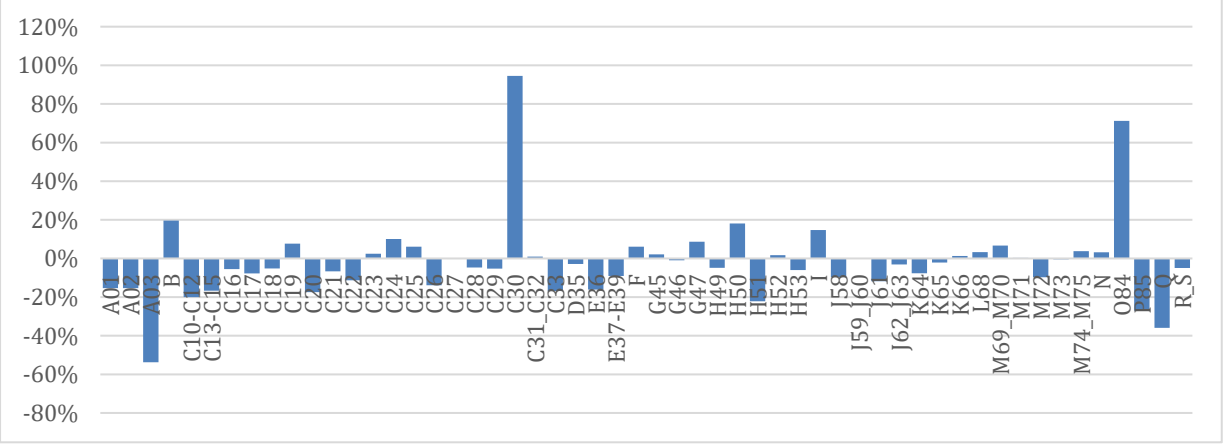



*Figure 0.21 Percentage change of the forward employment multipliers between the years 2011 and 2016, Denmark*

In Figure 0.20 and Figure 0.21 the percentages change of backward and forward multipliers, respectively, are presented, between the years 2011 and 2016. The sectors with the higher increase in both multipliers are:

- C30, Manufacture of other transport equipment
- O84, Public administration and defence, compulsory social security
- I, Accommodation and food service activities
- B, Mining and quarrying

- C24, Manufacture of basic metals
- M69_M70, Legal and accounting activities, activities of head offices, management consultancy activities
- G47, Retail trade, except of motor vehicles and motorcycles
- H53, Postal and courier activities
- H50, Water transport
- M74_M75, Other professional, scientific and technical activities, veterinary activities

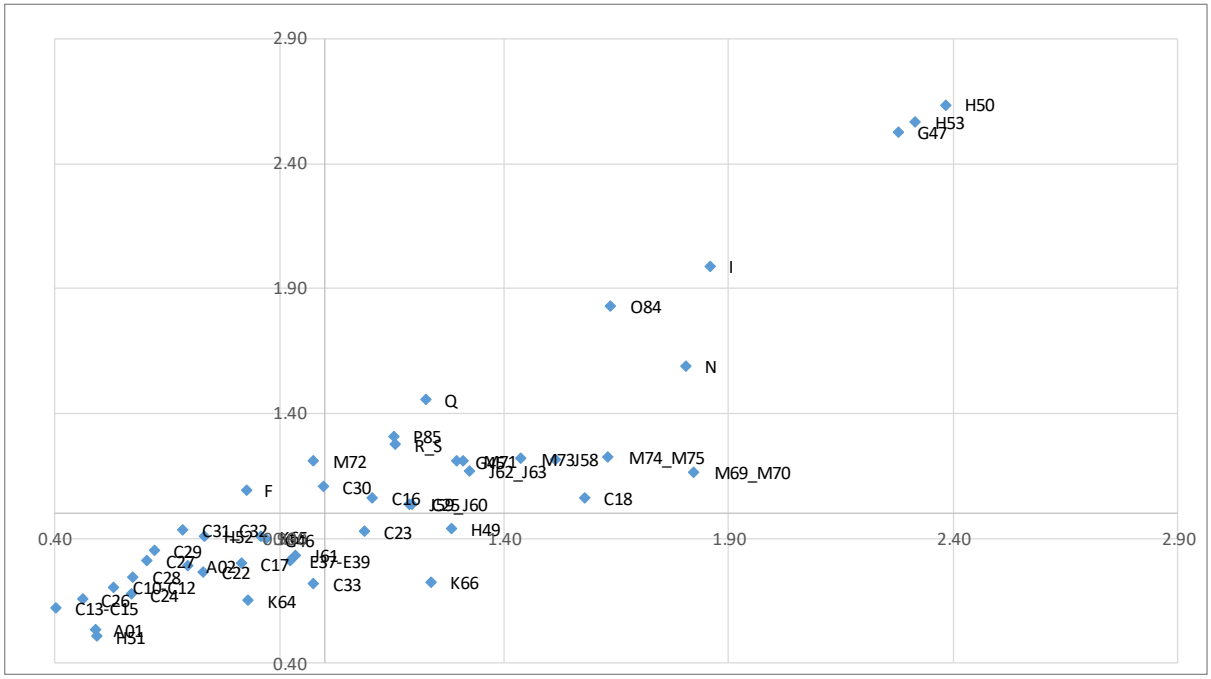



*Figure 0.22: Key sectors of employment, Denmark, 2016*

Figure 0.22 shows the key sectors of Denmark. The figure is designed as follows: The horizontal axis represents the normalized forward employment multipliers and the vertical one the normalized backward employment multipliers. The two axes intersect at the point (1, 1). The particular presentation gives the ability to "map" the economy following the schema: A sector located in the first quadrant is a key sector of the economy, a sector located in the second quadrant is a Leontief key sectors, a sector located in the third quadrant is not a key sector, and, finally, a sector located in the fourth quadrant is Ghosh key sector. The key sectors of Denmark are:

- C16, Manufacture of wood and of products of wood and cork, except furniture, manufacture of articles of straw and plaiting materials
- C18, Printing and reproduction of recorded media
- C25, Manufacture of fabricated metal products, except machinery and equipment
- G45, Wholesale and retail trade and repair of motor vehicles and motorcycles
- G47, Retail trade, except of motor vehicles and motorcycles
- H50, Water transport
- H53, Postal and courier activities
- I, Accommodation and food service activities
- J58, Publishing activities
- J59_J60, Motion picture, video and television program production, sound recording and music publishing activities, programming and broadcasting activities

- J62_J63, Computer programming, consultancy and related activities, information service activities
- M69_M70, Legal and accounting activities, activities of head offices, management consultancy activities
- M71, Architectural and engineering activities, technical testing and analysis
- 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 defense, compulsory social security
- P85, Education
- Q, Human health and social work activities
- R_S, Other service activities

#### *2.3.3.2. Occupations*

In Figure 0.23 the employment structure by occupation of Denmark for the years 2011 and 2016 is represented.

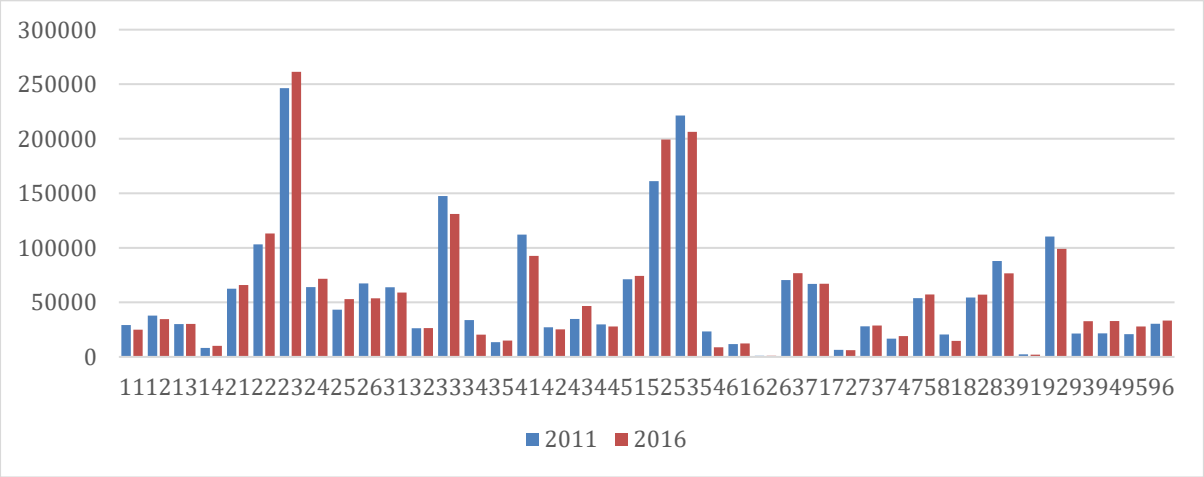



*Figure 0.23: Employment structure by occupation, Denmark, 2011 & 2016*

The occupations with the higher participation rate in employment for 2016 are:

- 23, Teaching professionals
- 53, Personal care workers
- 52, Sales workers
- 33, Business and administration associate professionals
- 22, Health professionals
- 92, Agricultural, forestry and fishery labourers
- 41, General and keyboard clerks
- 63, Subsistence farmers, fishers, hunters and gatherers
- 83, Drivers and mobile plant operators
- 51, Personal service workers

The occupations with the higher increase in the percentage change of employment between the years 2011 and 2016 are:

- 93, Labourers in mining, construction, manufacturing and transport
- 94, Food preparation assistants
- 43, Numerical and material recording clerks
- 95, Street and related sales and service workers
- 14, Hospitality, retail and other services managers
- 52, Sales workers
- 25, Information and communications technology professionals
- 74, Electrical and electronic trades workers
- 24, Business and administration professionals
- 35, Information and communications technicians

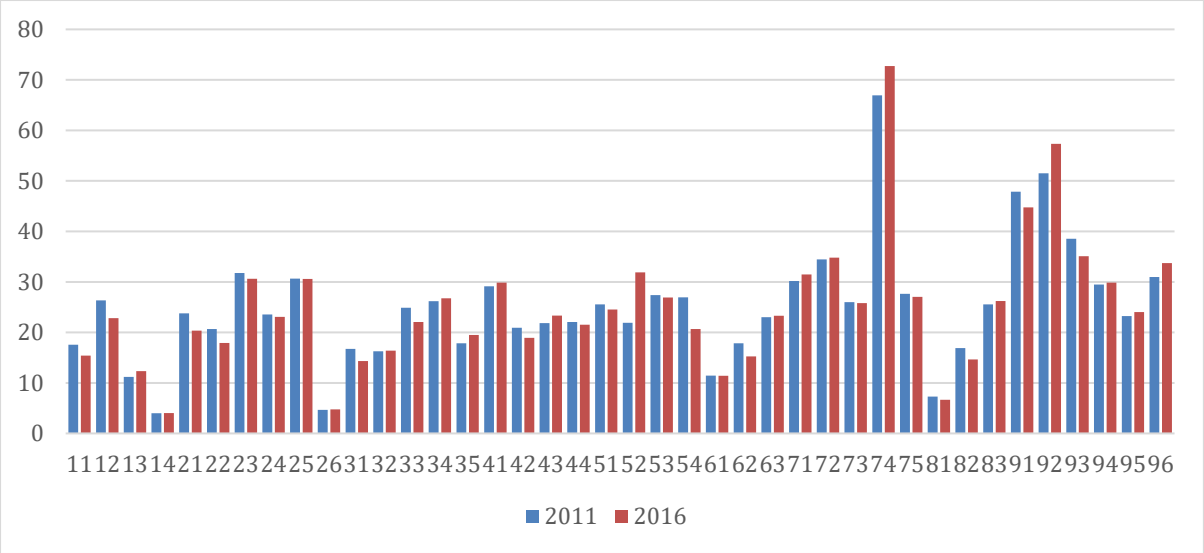



*Figure 0.24: Occupational multipliers, Denmark, 2016*

In Figure 0.24 the occupational multipliers for Denmark are represented, for the years 2011 & 2016. The occupations with the higher multipliers in 2016 are:

- 74, Electrical and electronic trades workers
- 92, Agricultural, forestry and fishery labourers
- 91, Cleaners and helpers
- 93, Labourers in mining, construction, manufacturing and transport
- 72, Metal, machinery and related trades workers
- 96, Refuse workers and other elementary workers
- 52, Sales workers
- 71, Building and related trades workers, excluding electricians
- 23, Teaching professionals
- 25, Information and communications technology professionals

The occupations with the higher increase in their multipliers between the years 2011 and 2016 are:

- 52, Sales workers
- 92, Agricultural, forestry and fishery labourers
- 13, Production and specialised services managers
- 35, Information and communications technicians
- 96, Refuse workers and other elementary workers
- 74, Electrical and electronic trades workers
- 43, Numerical and material recording clerks

- 71, Building and related trades workers, excluding electricians
- 95, Street and related sales and service workers
- 83, Drivers and mobile plant operators

#### 2.3.3.1. Educational attainment level

In Figure 0.25, the employment structure by educational attainment level of Denmark is represented. Level 0-2 participation rate in employment is significantly decreased for the examined period, while the participation rate of level 3-4 remained relatively stable and the participation rate of level 5-8 increased significantly.

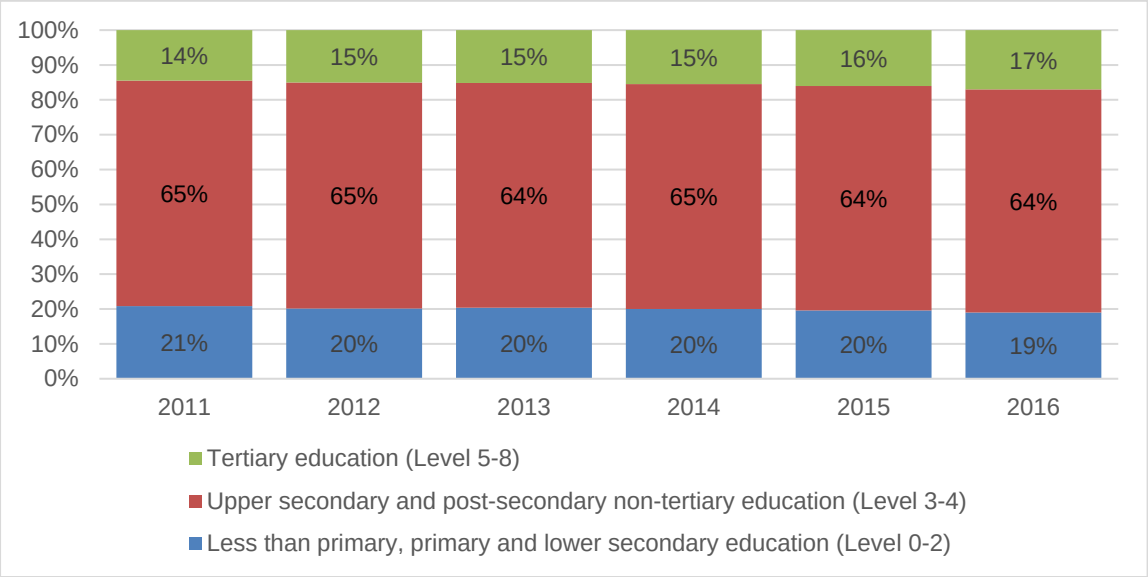



*Figure 0.25: Employment by educational attainment level, Denmark*

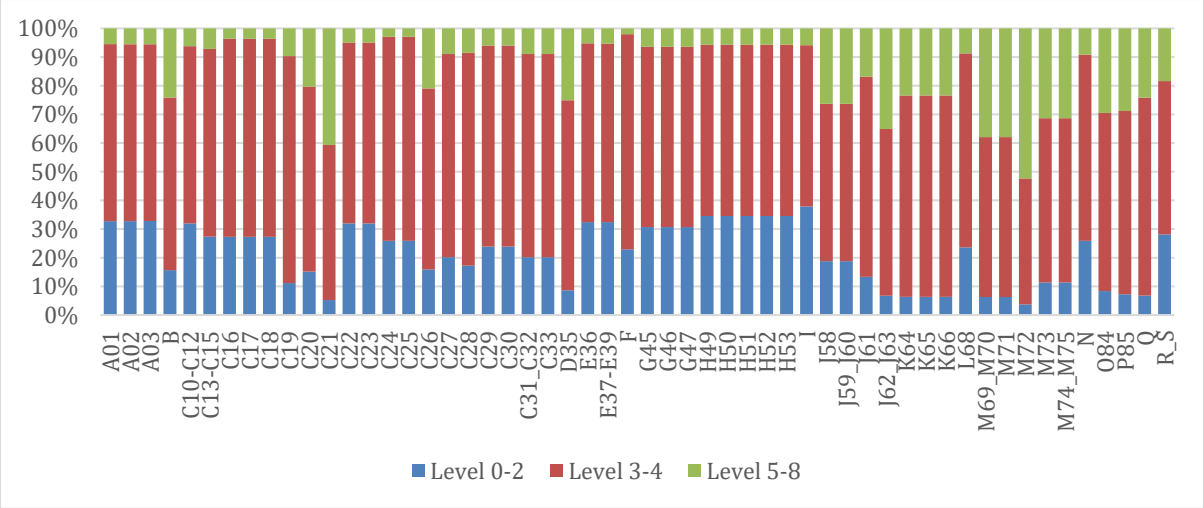



*Figure 0.26: Structure of employment by sector of economic activity and educational attainment level, Denmark, 2016*

The sectors with the highest participation of low-skilled employment (Level 0-2) are:

- I, Accommodation and food service activities
- H51, Air transport

- H49, Land transport and transport via pipelines
- H50, Water transport
- H52, Warehousing and support activities for transportation

The sectors with the highest participation of medium-skilled employment (Level 3-4) are:

- C19, Manufacture of coke and refined petroleum products
- F, Construction
- C28, Manufacture of machinery and equipment n.e.c.
- C25, Manufacture of fabricated metal products, except machinery and equipment
- C24, Manufacture of basic metals

The sectors with the highest participation of high-skilled employment (Level 5-8) are:

- M72, Scientific research and development
- C21, Manufacture of basic pharmaceutical products and pharmaceutical preparations
- M69_M70, Legal and accounting activities, activities of head offices, management consultancy activities
- M71, Architectural and engineering activities, technical testing and analysis
- J62_J63, Computer programming, consultancy and related activities, information service activities

#### 2.3.3.2. Job vacancy rate

Figure 0.27 shows the job vacancy rate for Denmark in 2017 The sectors with the higher job vacancy rate are Mining and quarrying (B) and Information and communication (J).

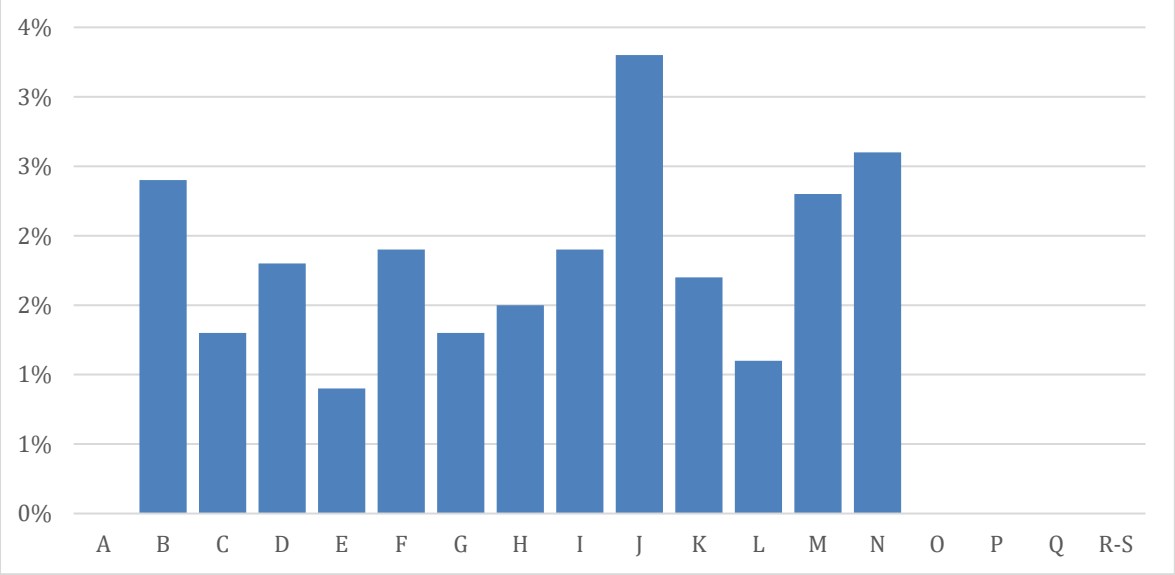



*Figure 0.27: Job vacancy rate, Denmark, 2017*

#### 2.3.3.3. Employability opportunities for MRAS

For the determination of the employability opportunities of MRAs in Denmark two composite indicators are used, the SIRIUS Indicator for Sectors (SIRIUS 1) and the SIRIUS Indicator for Occupations (SIRIUS 2). The construction of SIRIUS 1 requires the estimation of the Growth

Indicator for Sectors (GIS) and the Sectoral Structure Similarity (SSS) and the construction of SIRIUS 2 requires, at first, the estimation of the Growth Indicator for Occupations (GIO) and the Occupational Structure Similarity (OSS).

The GIS and the SSS for Denmark are shown in Figure 0.28.

The sectors with the highest GIS are:

- G47, Retail trade, except of motor vehicles and motorcycles
- O84, Public administration and defense, compulsory social security
- Q, Human health and social work activities
- N, Administrative and support service activities
- I, Accommodation and food service activities
- H50, Water transport
- F, Construction
- H53, Postal and courier activities
- P85, Education
- M69_M70, Legal and accounting activities, activities of head offices, management consultancy activities

Moreover, the sectors with the highest SSS are:

- C24, Manufacture of basic metals
- C28, Manufacture of machinery and equipment n.e.c.
- C20, Manufacture of chemicals and chemical products
- H50, Water transport
- C30, Manufacture of other transport equipment
- C21, Manufacture of basic pharmaceutical products and pharmaceutical preparations
- O84, Public administration and defense, compulsory social security
- Q, Human health and social work activities
- M73, Advertising and market research
- G46, Wholesale trade, except of motor vehicles and motorcycles

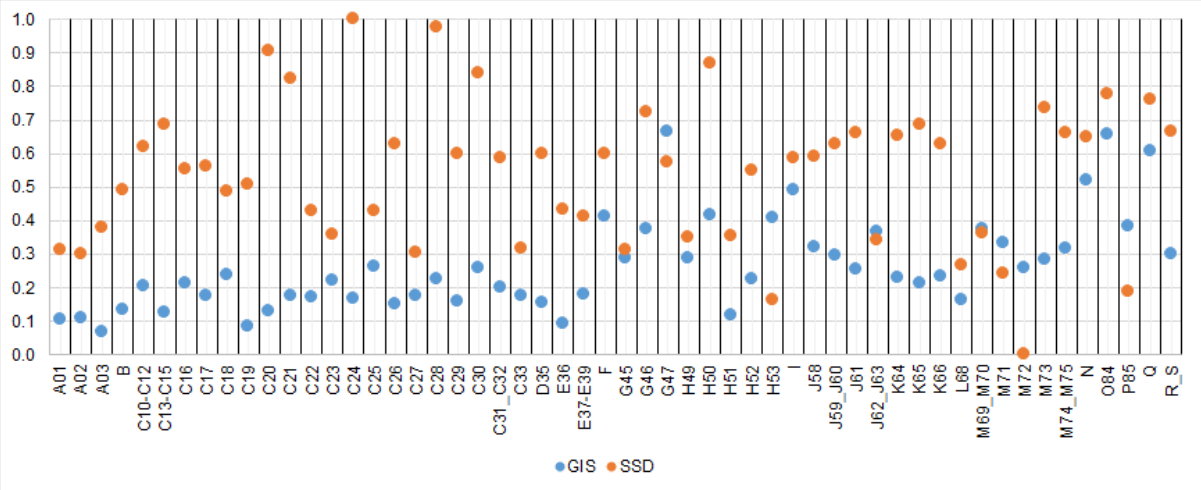



*Figure 0.28: GIS and SSS, Denmark*

The values of the SIRIUS Indicator for Sectors (SIRIUS 1) are used to rank the sectors and to identify the sectors of 1st priority for the integration of MRAs into the labour market of Denmark. The SIRIUS 1 indicator is represented in Figure 0.29.

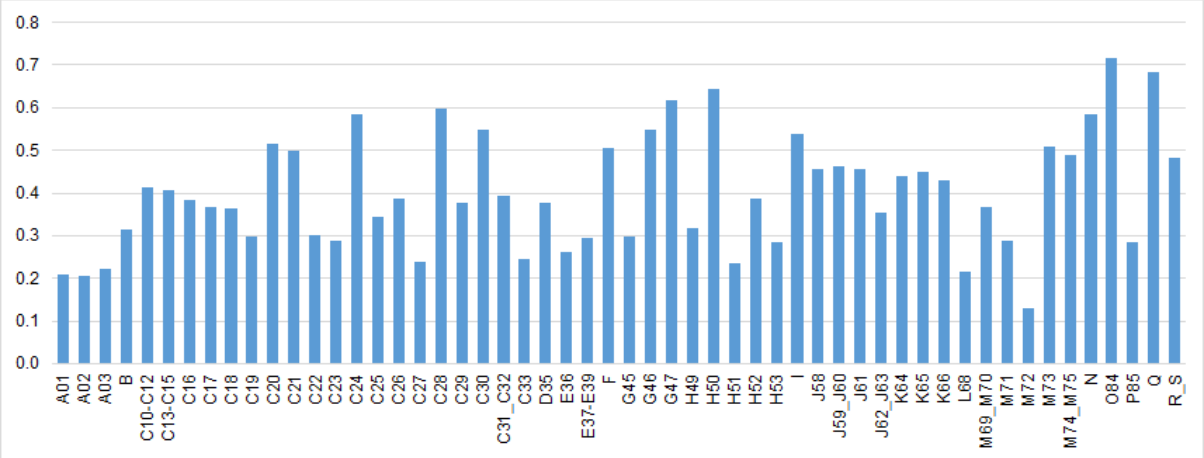



*Figure 0.29: SIRIUS 1, Denmark*

Based on the above figure the sectors of Denmark which are determined as 1st priority for the employability of MRAs are:

- O84, Public administration and defense, compulsory social security
- Q, Human health and social work activities
- H50, Water transport
- G47, Retail trade, except of motor vehicles and motorcycles
- C28, Manufacture of machinery and equipment n.e.c.
- N, Administrative and support service activities
- C24, Manufacture of basic metals
- G46, Wholesale trade, except of motor vehicles and motorcycles
- C30, Manufacture of other transport equipment
- I, Accommodation and food service activities

The GIO and the OSD for Denmark are shown in Figure 0.30.

The occupations with highest GIO are:

- 23, Teaching professionals
- 52, Sales workers
- 53, Personal care workers
- 92, Agricultural, forestry and fishery labourers
- 74, Electrical and electronic trades workers
- 33, Business and administration associate professionals
- 41, General and keyboard clerks
- 22, Health professionals
- 71, Building and related trades workers, excluding electricians
- 63, Subsistence farmers, fishers, hunters and gatherers

Moreover, the occupations with the higher OSS are:

- 13, Production and specialised services managers
- 53, Personal care workers
- 31, Science and engineering associate professionals
- 12, Administrative and commercial managers
- 54, Protective services workers
- 41, General and keyboard clerks
- 83, Drivers and mobile plant operators

- 21, Science and engineering professionals
- 11, Chief executives, senior officials and legislators
- 32, Health associate professionals

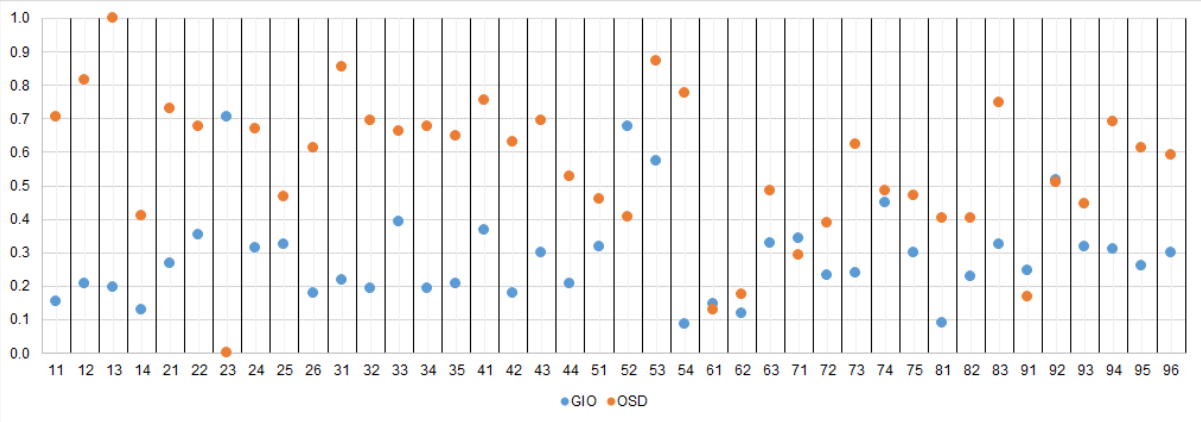



*Figure 0.30: GIO and OSS, Denmark*

The values of the SIRIUS Indicator for Occupations are used to rank the occupations and to identify the occupations of 1st priority for the integration of MRAs into the labour market of Denmark. The SIRIUS 2 indicator is presented in Figure 0.31.

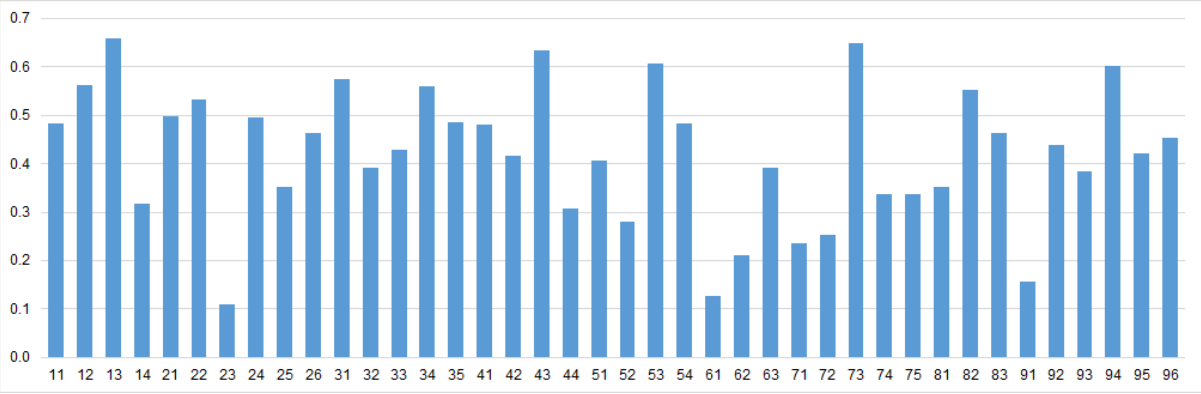



*Figure 0.31: SIRIUS 2, Denmark*

Based on the above figure the occupations of Denmark which are determined as 1st priority for the employability of MRAs are:

- 13, Production and specialised services managers
- 73, Handicraft and printing workers
- 43, Numerical and material recording clerks
- 53, Personal care workers
- 94, Food preparation assistants
- 31, Science and engineering associate professionals
- 12, Administrative and commercial managers
- 34, Legal, social, cultural and related associate professionals
- 82, Assemblers
- 22, Health professionals

The above analysis shows that the employability potential of MRAs in Denmark are concentrated in three industrial and seven service sectors. The industrial sectors are characterised by medium-high and medium R&D intensity and the service sectors are characterized by low R&D intensity. Moreover, the occupations with high employability potential can be found in a wide range of occupations.

### 2.3.4. Greece

#### *2.3.4.1. Sectoral Analysis*

The employment's share of the primary sector in Greece was 12.82% in 2011 and increased to 12.93% in 2017. The respective shares of employment in the manufacturing sector was 17.80% and 16.40% and in the tertiary sector 69.38% and 70.67%, respectively.

In Figure 0.32 the employment structure in Greece for the years 2011 and 2017 is presented on a sector-by-sector basis.

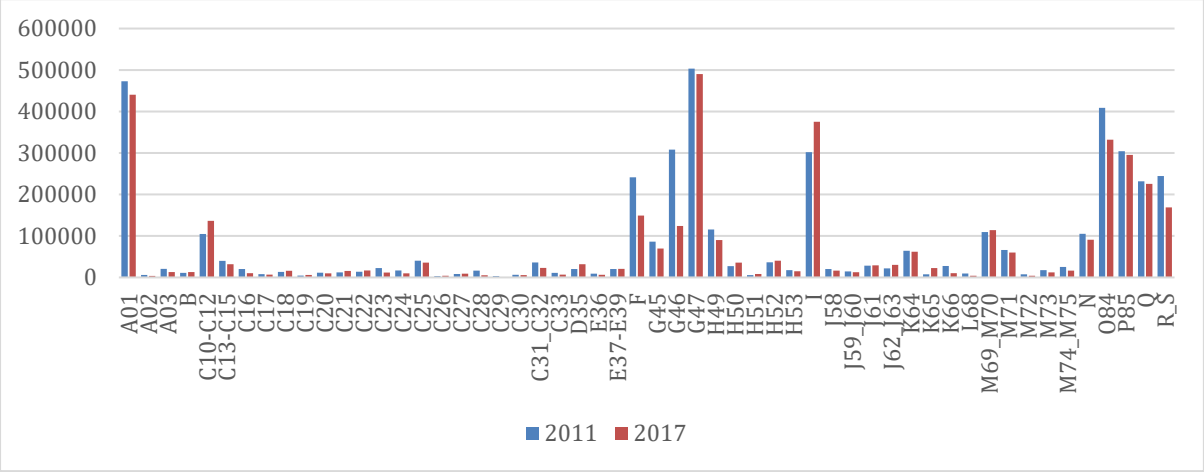



*Figure 0.32: Employment Structure by sector of economic activity, Greece (2011 & 2017)*

The sectors with the highest participation rate in employment are:

- G47, Retail trade, except of motor vehicles and motorcycles
- A01, Crop and animal production, hunting and related service activities
- I, Accommodation and food service activities
- O84, Public administration and defence, compulsory social security
- P85, Education
- Q, Human health and social work activities
- R_S, Other service activities
- F, Construction
- C10-C12, Manufacture of food products, beverages and tobacco products
- G46, Wholesale trade, except of motor vehicles and motorcycles

The sectors with the highest increase in the percentage change of employment between the years 2011 and 2017 are:

- K65, Insurance, reinsurance and pension funding, except compulsory social security
- D35, Electricity, gas, steam and air conditioning supply
- H51, Air transport
- J62_J63, Computer programming, consultancy and related activities, information service activities
- C19, Manufacture of coke and refined petroleum products

- H50, Water transport
- C10-C12, Manufacture of food products, beverages and tobacco products
- C21, Manufacture of basic pharmaceutical products and pharmaceutical preparations
- I, Accommodation and food service activities
- C22, Manufacture of rubber and plastic products

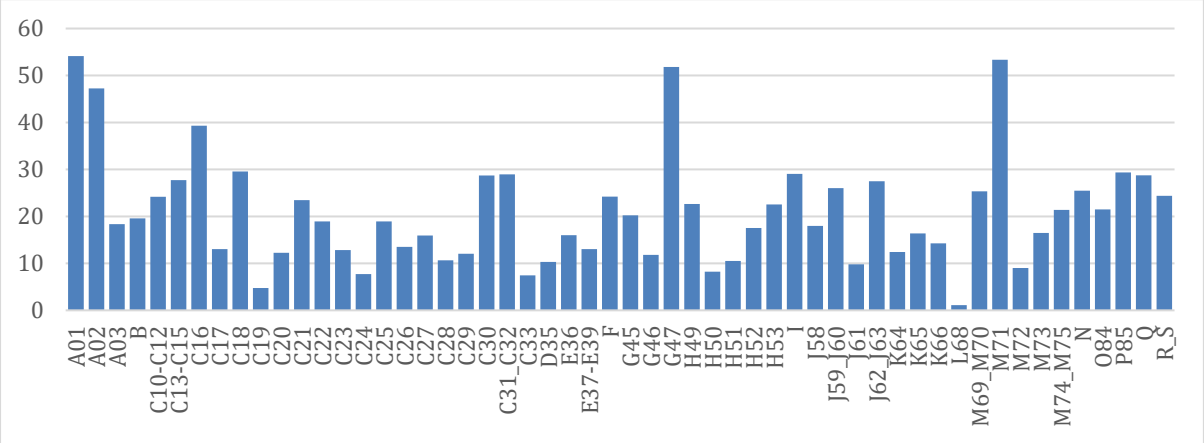



*Figure 0.33 Backward employment multipliers, Greece, 2017*

In Figure 0.33, the backward employment multipliers for the Greek economy are presented, for 2017. The sectors with the highest backward employment multipliers are:

- M71, Architectural and engineering activities, technical testing and analysis
- G47, Retail trade, except of motor vehicles and motorcycles
- A01, Crop and animal production, hunting and related service activities
- A02, Forestry and logging
- C16, Manufacture of wood and of products of wood and cork, except furniture, manufacture of articles of straw and plaiting materials
- C18, Printing and reproduction of recorded media
- M69_M70, Legal and accounting activities, activities of head offices, management consultancy activities
- H53, Postal and courier activities
- C30, Manufacture of other transport equipment
- M74_M75, Other professional, scientific and technical activities, veterinary activities

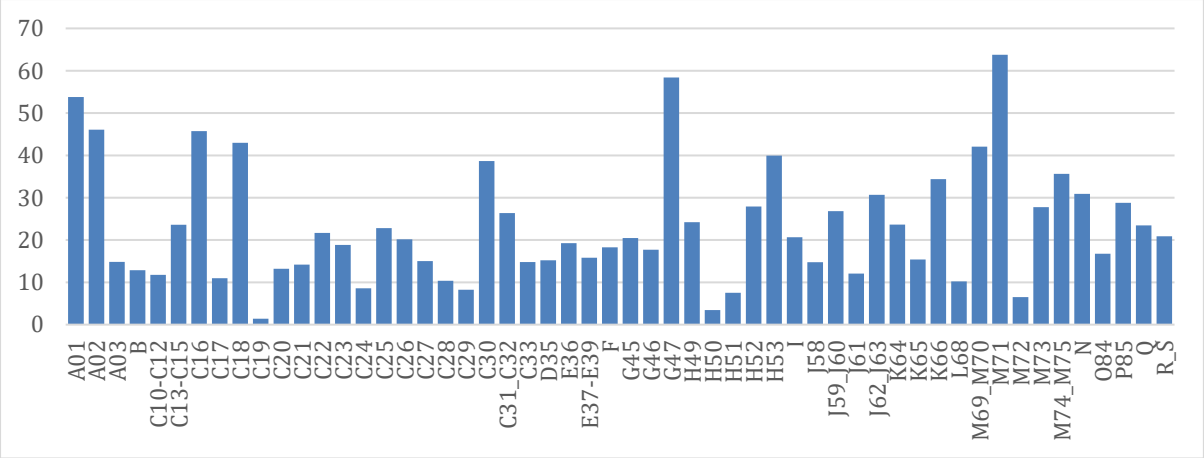



*Figure 0.34 Forward employment multipliers, Greece, 2017*

In Figure 0.34, the forward employment multipliers for the Greek economy are presented, for 2017. The sectors with the highest forward employment multipliers are:

- A01, Crop and animal production, hunting and related service activities
- M71, Architectural and engineering activities, technical testing and analysis
- G47, Retail trade, except of motor vehicles and motorcycles
- A02, Forestry and logging
- C16, Manufacture of wood and of products of wood and cork, except furniture, manufacture of articles of straw and plaiting materials
- C18, Printing and reproduction of recorded media
- P85, Education
- I, Accommodation and food service activities
- C31_C32, Manufacture of furniture, other manufacturing
- Q, Human health and social work activities

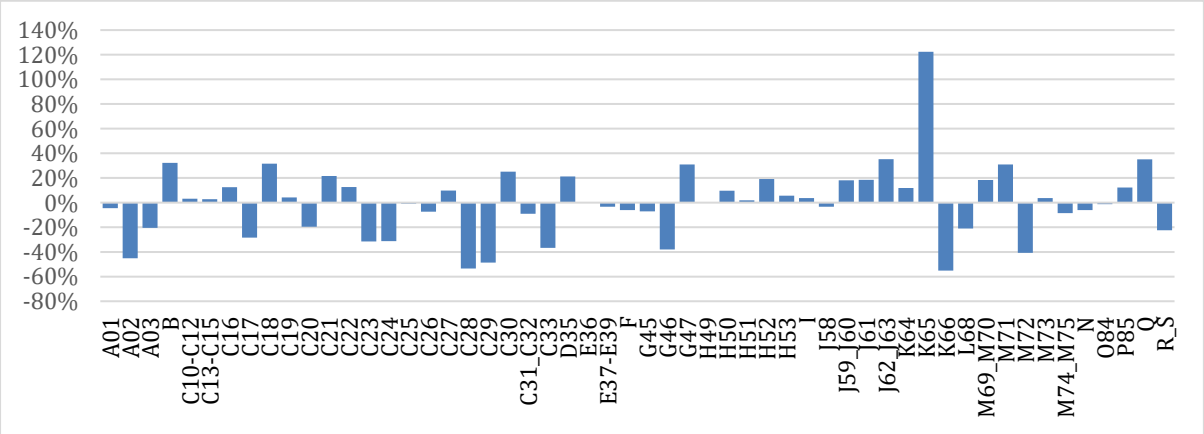



*Figure 0.35 Percentage change of the backward employment multipliers between the years 2011 and 2017, Greece*

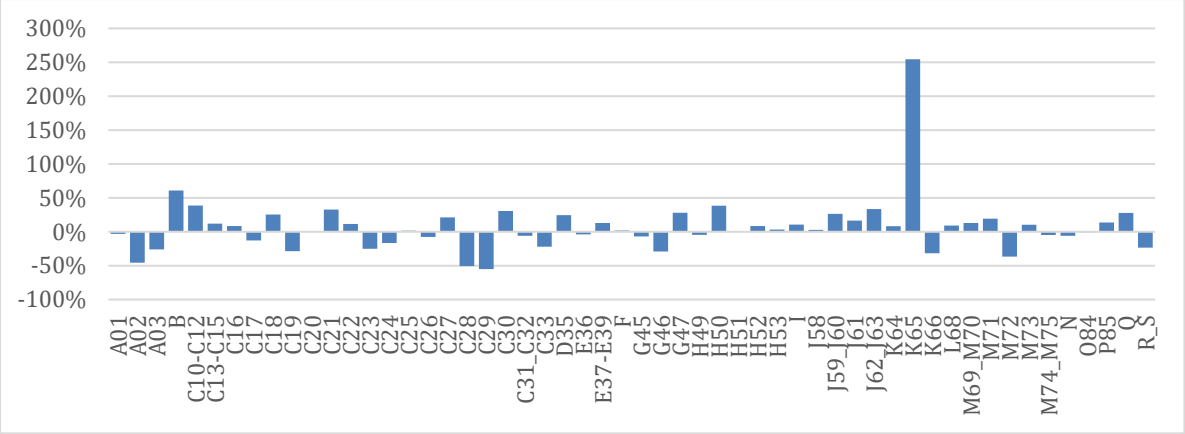



*Figure 0.36 Percentage change of the forward employment multipliers between the years 2011 and 2017, Greece*

In Figure 0.35 and Figure 0.36, the percentages change of backward and forward multipliers, respectively, are presented, for the years 2011 and 2017. The sectors with the highest increase in both multipliers are:

- K65, Insurance, reinsurance and pension funding, except compulsory social security
- B, Mining and quarrying
- J62_J63, Computer programming, consultancy and related activities, information service activities
- Q, Human health and social work activities
- G47, Retail trade, except of motor vehicles and motorcycles
- C18, Printing and reproduction of recorded media
- C30, Manufacture of other transport equipment
- C21, Manufacture of basic pharmaceutical products and pharmaceutical preparations
- M71, Architectural and engineering activities, technical testing and analysis
- H50, Water transport

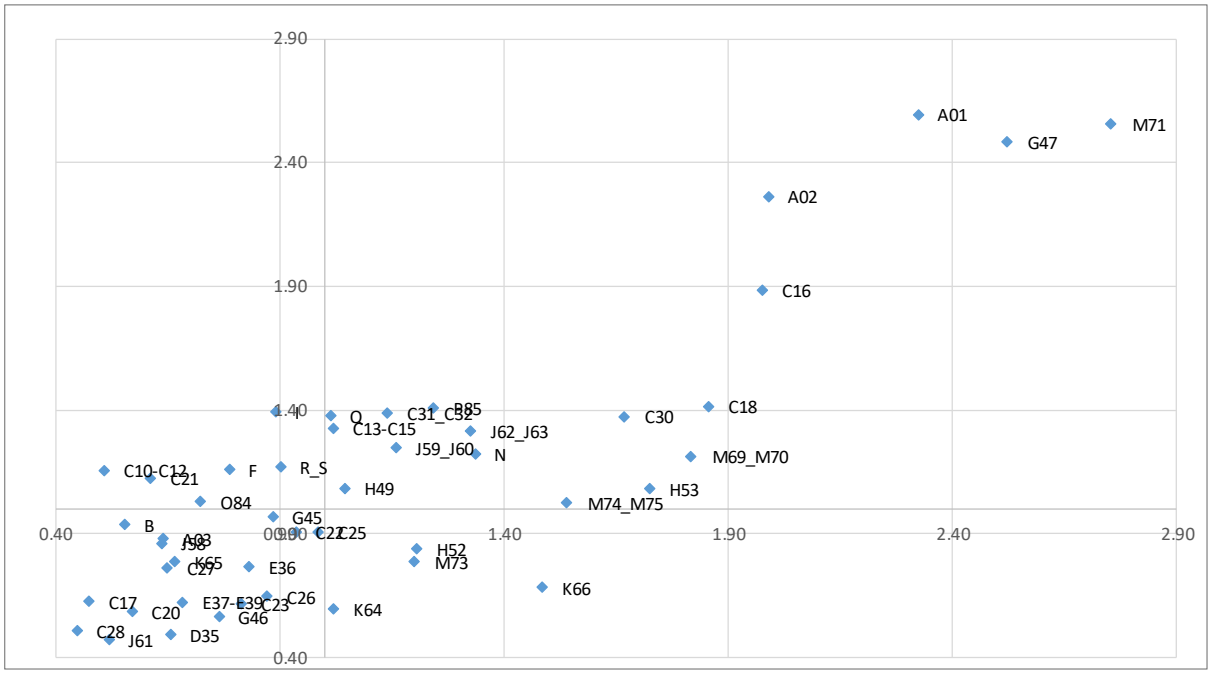



*Figure 0.37: Key sectors of employment, Greece, 2017*

Figure 0.37, shows the key sectors of Greece. The figure is designed as follows: The horizontal axis represents the normalized forward employment multipliers and the vertical one the normalized backward employment multipliers. The two axes intersect at the point (1, 1). The particular presentation gives the ability to "map" the economy following the schema: A sector located in the first quadrant is a key sector of the economy, a sector located in the second quadrant is a Leontief key sectors, a sector located in the third quadrant is not a key sector, and, finally, a sector located in the fourth quadrant is Ghosh key sector. The key sectors of Greece are:

- A01, Crop and animal production, hunting and related service activities
- A02, Forestry and logging
- 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
- C18, Printing and reproduction of recorded media
- C30, Manufacture of other transport equipment
- C31_C32, Manufacture of furniture, other manufacturing
- G47, Retail trade, except of motor vehicles and motorcycles
- H49, Land transport and transport via pipelines
- H53, Postal and courier activities
- J59_J60, Motion picture, video and television programme production, sound recording and music publishing activities, programming and broadcasting activities
- J62_J63, Computer programming, consultancy and related activities, information service activities
- M69_M70, Legal and accounting activities, activities of head offices, management consultancy activities
- M71, Architectural and engineering activities, technical testing and analysis
- M74_M75, Other professional, scientific and technical activities, veterinary activities
- N, Administrative and support service activities
- P85, Education
- Q, Human health and social work activities

#### *2.3.4.2. Occupations*

In Figure 0.38, the employment structure by occupation for Greece for the years 2011 and 2017 is presented.

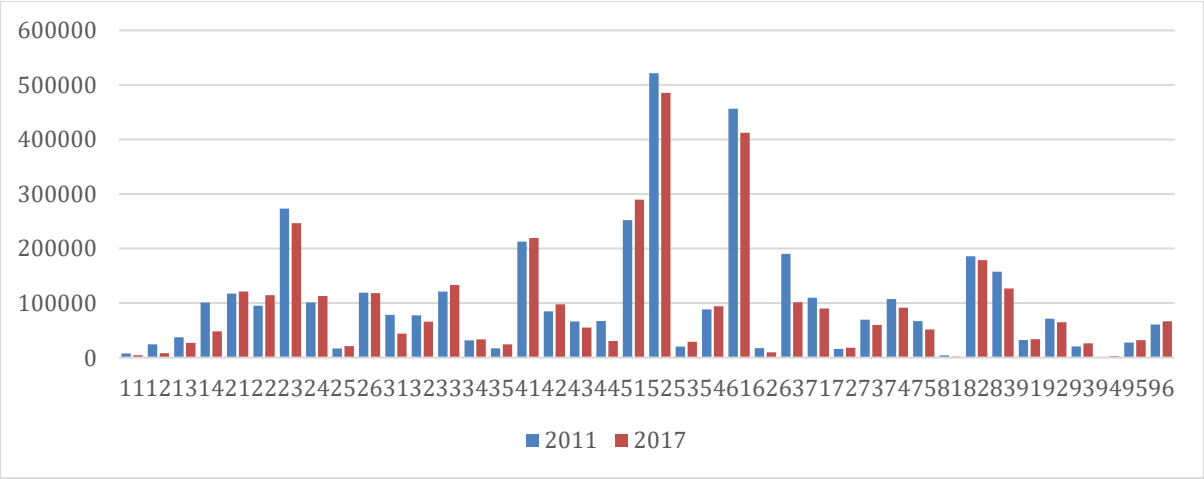



*Figure 0.38: Employment structure by occupation, Greece, 2011 & 2017*

The occupations with the highest participation rate in employment for 2017 are:

- 52, Sales workers
- 61, Market - oriented skilled agricultural workers
- 51, Personal service workers
- 23, Teaching professionals
- 41, General and keyboard clerks
- 82, Assemblers
- 33, Business and administration associate professionals
- 83, Drivers and mobile plant operators
- 21, Science and engineering professionals
- 26, Legal, social and cultural professionals

The occupations with the highest increase in the percentage change of employment between the years 2011 and 2017 are:

- 94, Food preparation assistants
- 91, Cleaners and helpers
- 54, Protective services workers
- 53, Personal care workers
- 35, Information and communications technicians
- 22, Health professionals
- 72, Metal, machinery and related trades workers
- 92, Agricultural, forestry and fishery labourers
- 25, Information and communications technology professionals
- 33, Business and administration associate professionals

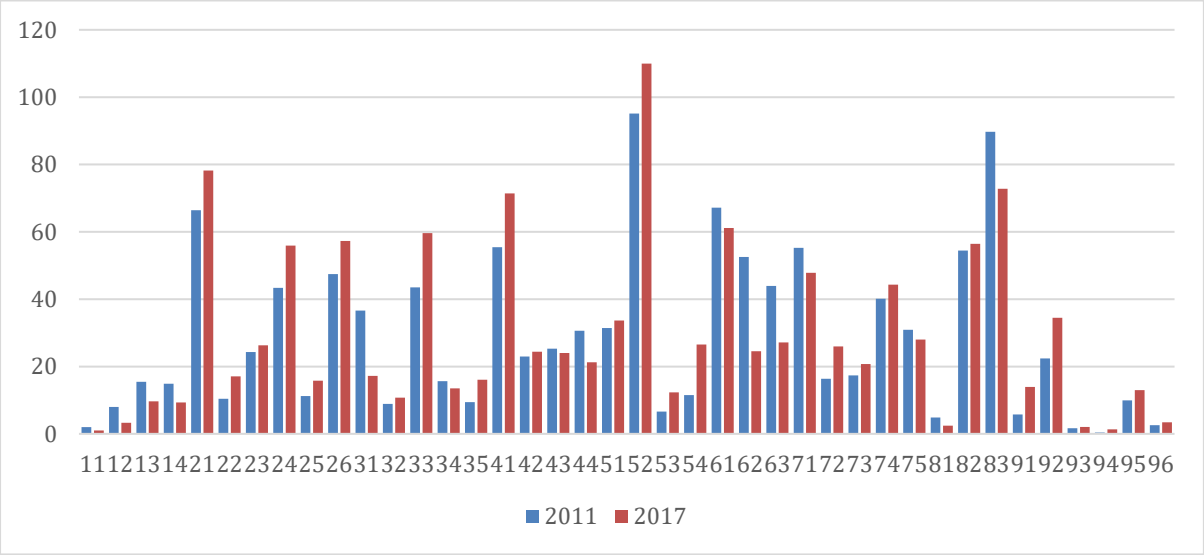



*Figure 0.39: Occupational multipliers, Greece, 2017*

In Figure 0.24, the occupational multipliers for Greece are presented, for the years 2011 and 2017. The occupations with the highest multipliers in 2017 are:

- 52, Sales workers
- 21, Science and engineering professionals
- 83, Drivers and mobile plant operators
- 41, General and keyboard clerks
- 61, Market - oriented skilled agricultural workers
- 33, Business and administration associate professionals

- 26, Legal, social and cultural professionals
- 82, Assemblers
- 24, Business and administration professionals
- 71, Building and related trades workers, excluding electricians

The occupations with the highest increase in their multipliers between the years 2011 and 2017 are:

- 94, Food preparation assistants
- 91, Cleaners and helpers
- 54, Protective services workers
- 53, Personal care workers
- 35, Information and communications technicians
- 22, Health professionals
- 72, Metal, machinery and related trades workers
- 92, Agricultural, forestry and fishery labourers
- 25, Information and communications technology professionals
- 33, Business and administration associate professionals

#### *2.3.4.1. Educational attainment level*

In Figure 0.40, the employment structure by educational attainment level for Greece is presented. Level 0-2 participation rate in employment decreases significantly in the examined period, while the participation rate of level 3-4 and level 5-8 increases significantly.

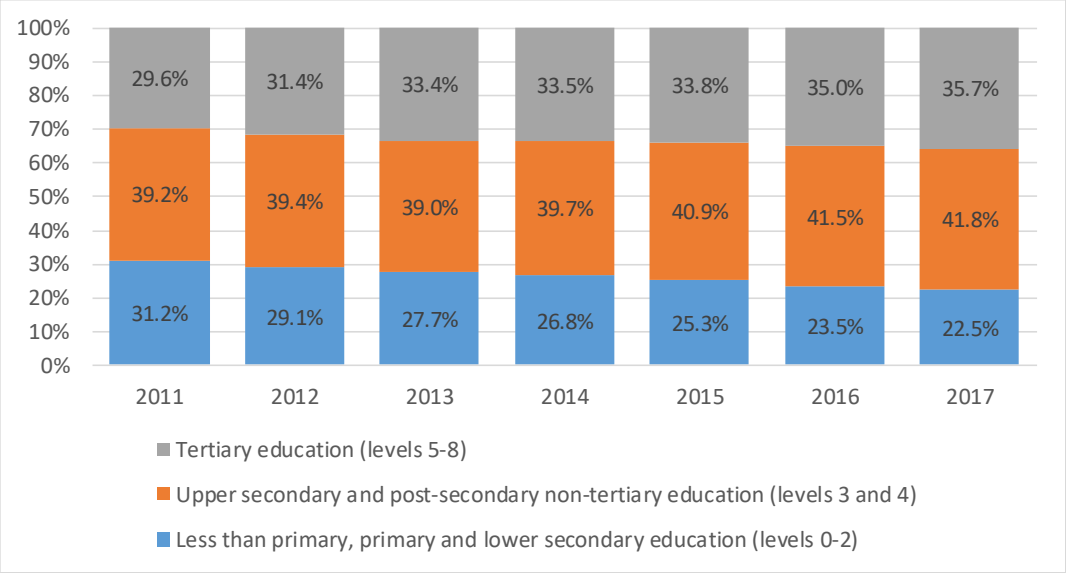



*Figure 0.40: Employment by educational attainment level, Greece*

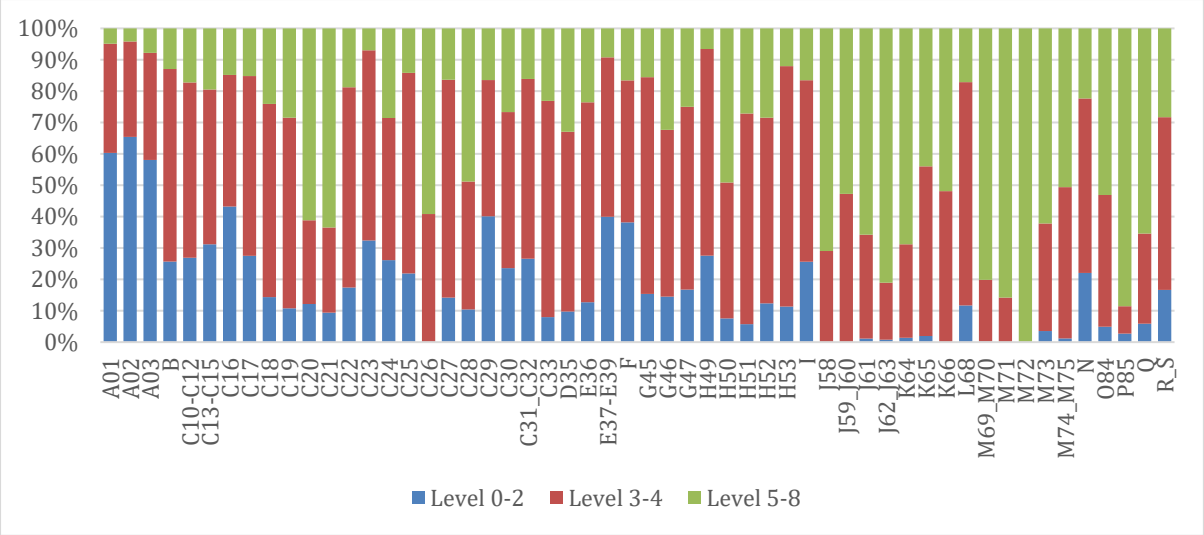



*Figure 0.41: Structure of employment by sector of economic activity and educational attainment level, Greece, 2017*

The sectors with the highest participation of low-skilled employment (Level 0-2) are:

- A02, Forestry and logging
- A01, Crop and animal production, hunting and related service activities
- A03, Fishing and aquaculture
- C16, Manufacture of wood and of products of wood and cork, except furniture, manufacture of articles of straw and plaiting materials
- C29, Manufacture of motor vehicles, trailers and semi-trailers

The sectors with the highest participation of medium-skilled employment (Level 3-4) are:

- H53, Postal and courier activities
- L68, Real estate activities
- C27, Manufacture of electrical equipment
- G45, Wholesale and retail trade and repair of motor vehicles and motorcycles
- C33, Repair and installation of machinery and equipment

The sectors with the highest participation of high-skilled employment (Level 5-8) are:

- M72, Scientific research and development
- P85, Education
- M71, Architectural and engineering activities, technical testing and analysis
- J62_J63, Computer programming, consultancy and related activities, information service activities
- M69_M70, Legal and accounting activities, activities of head offices, management consultancy activities

#### 2.3.4.2. Job vacancy rate

Figure 0.42, shows the job vacancy rate for Greece in 2017. The sectors with the highest job vacancy rates are: Accommodation and food service activities (I) and Accommodation and food service activities (L).

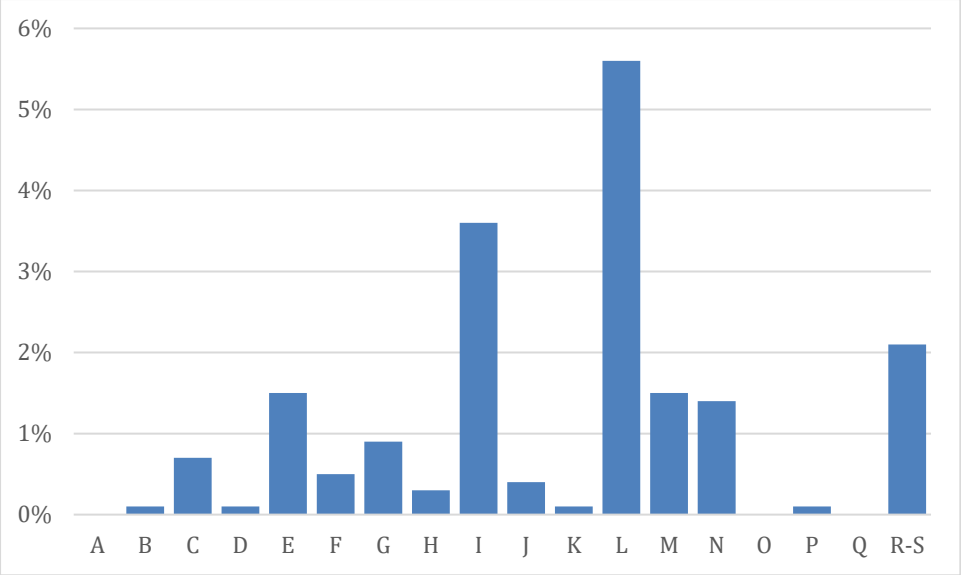



*Figure 0.42: Job vacancy rate, Greece, 2017*

### 2.3.4.3. Employability opportunities for MRAS

For the determination of the employability opportunities of MRAs in Greece two composite indicators are used, the SIRIUS Indicator for Sectors (SIRIUS 1) and the SIRIUS Indicator for Occupations (SIRIUS 2). The construction of SIRIUS 1 requires the estimation of the Growth Indicator for Sectors (GIS) and the Sectoral Structure Similarity (SSS) and the construction of SIRIUS 2 requires at first the estimation of the Growth Indicator for Occupations (GIO) and the Occupational Structure Similarity (OSS).

The GIS and the SSS for Greece are shown in Figure 0.43.

The sectors with highest GIS are:

- G47, Retail trade, except of motor vehicles and motorcycles
- A01, Crop and animal production, hunting and related service activities
- I, Accommodation and food service activities
- M71, Architectural and engineering activities, technical testing and analysis
- Q, Human health and social work activities
- O84, Public administration and defense, compulsory social security
- M69_M70, Legal and accounting activities, activities of head offices, management consultancy activities
- P85, Education
- N, Administrative and support service activities
- J62_J63, Computer programming, consultancy and related activities, information service activities

Moreover, the sectors with the highest SSS are:

- C16; Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
- C29; Manufacture of motor vehicles, trailers and semi - trailers
- A03; Fishing and aquaculture
- F; Construction

- E37-E39; Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services
- A01; Crop and animal production, hunting and related service activities
- C13-C15; Manufacture of textiles, wearing apparel and leather products
- A02; Forestry and logging
- C23; Manufacture of other non - metallic mineral products
- C17; Manufacture of paper and paper products

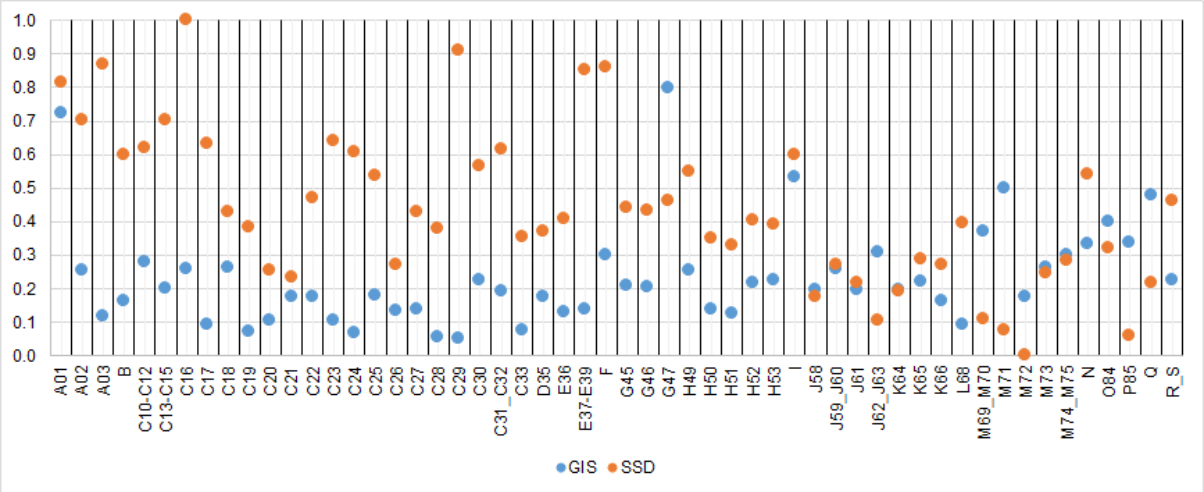



*Figure 0.43: GIS and SSS, Greece*

The values of the SIRIUS Indicator for Sectors (SIRIUS 1) are employed in order to rank the sectors and to identify the sectors of 1st priority for the integration of MRAs into the labour market of Greece. The SIRIUS 1 indicator is presented in Figure 0.44.

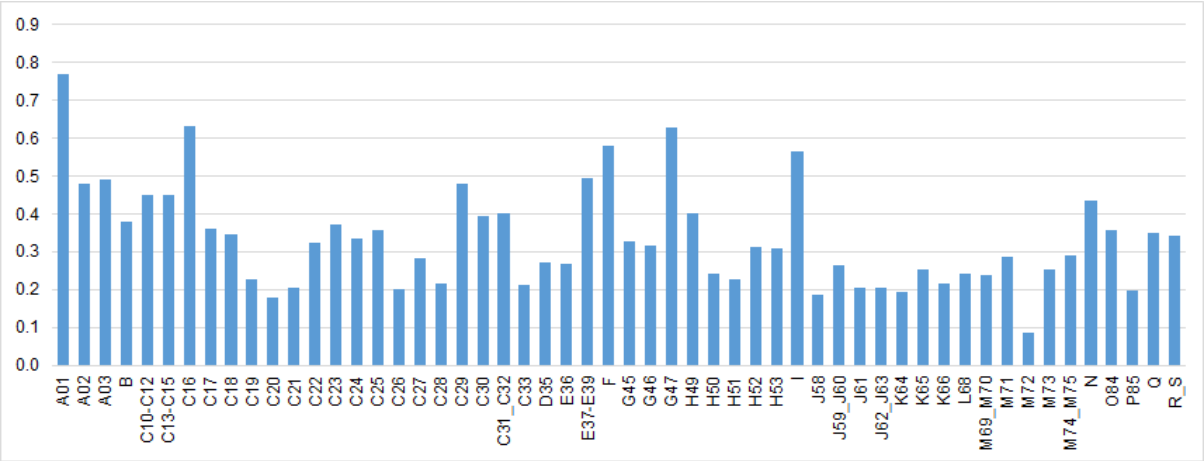



*Figure 0.44: SIRIUS 1, Greece*

Based on the above figure, the sectors of Greece which are determined as 1st priority for the employability of MRAs are:

- A01; Crop and animal production, hunting and related service activities
- C16; Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
- G47; Retail trade, except of motor vehicles and motorcycles
- F; Construction

- I; Accommodation and food service activities
- E37-E39; Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services
- A03; Fishing and aquaculture
- C29; Manufacture of motor vehicles, trailers and semi - trailers
- A02; Forestry and logging
- C13-C15; Manufacture of textiles, wearing apparel and leather products

The GIO and the OSD for Greece are shown in Figure 0.45.

The occupations with the highest GIO are:

- 52, Sales workers
- 61, Market-oriented skilled agricultural workers
- 41, General and keyboard clerks
- 51, Personal service workers
- 21, Science and engineering professionals
- 82, Assemblers
- 23, Teaching professionals
- 33, Business and administration associate professionals
- 83, Drivers and mobile plant operators
- 26, Legal, social and cultural professionals

Moreover, the occupations with the highest OSS are:

- 91, Cleaners and helpers
- 62, Market-oriented skilled forestry, fishery and hunting workers
- 61, Market-oriented skilled agricultural workers
- 63, Subsistence farmers, fishers, hunters and gatherers
- 74, Electrical and electronic trades workers
- 81, Stationary plant and machine operators
- 95, Street and related sales and service workers
- 75, Food processing, wood working, garment and other craft and related trades workers
- 93, Labourers in mining, construction, manufacturing and transport
- 82, Assemblers

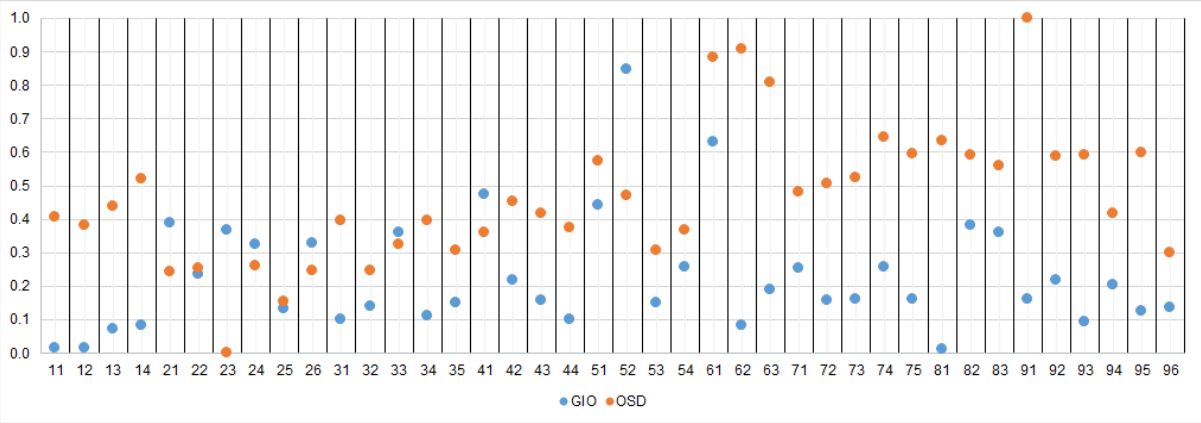



*Figure 0.45: GIO and OSS, Greece*

The values of the SIRIUS Indicator for Occupations (SIRIUS 2) are used to rank the occupations and to identify the occupations of 1st priority for the integration of MRAs into the labour market of Greece. The SIRIUS 2 indicator is presented in Figure 0.46.

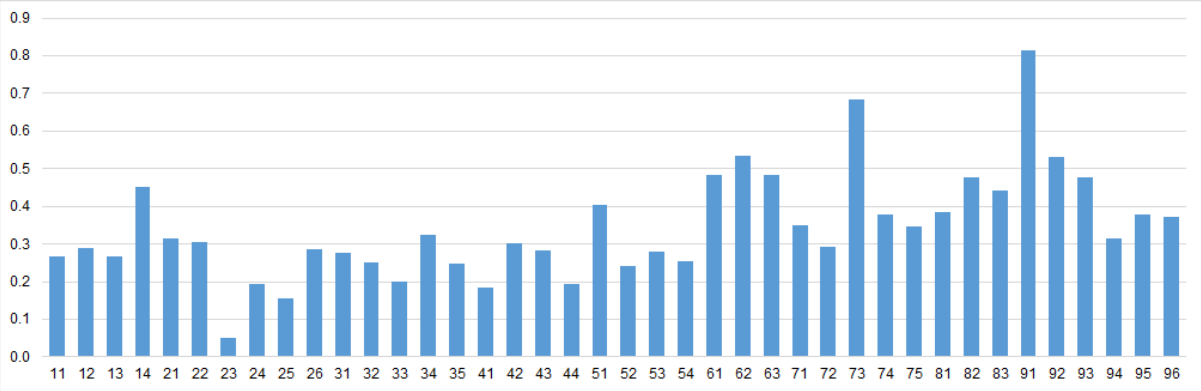



*Figure 0.46: SIRIUS 2, Greece*

Based on the above figure, the occupations of Greece which are determined as 1st priority for the employability of MRAs are:

- 91, Cleaners and helpers
- 73, Handicraft and printing workers
- 62, Market-oriented skilled forestry, fishery and hunting workers
- 92, Agricultural, forestry and fishery labourers
- 61, Market-oriented skilled agricultural workers
- 63, Subsistence farmers, fishers, hunters and gatherers
- 82, Assemblers
- 93, Labourers in mining, construction, manufacturing and transport
- 14, Hospitality, retail and other services managers
- 83, Drivers and mobile plant operators

The above analysis shows that the employability potential of MRAs in Greece is concentrated in three primary, three industrial and four service sectors. The industrial sectors are characterised by medium-high and medium-low R&D intensity and the primary and services sectors are characterized by low R&D intensity. Moreover, the occupations with high employability potential are in the categories of skilled agricultural workers, plant and machine operators and assemblers and elementary occupations.

### 2.3.5. Italy

#### *2.3.5.1. Sectoral Analysis*

The employment share of the primary sector in Italy was 3.96% in 2011 and increased to 4.06% in 2017. The respective shares of employment in the manufacturing sector was 28.95% and 26.78% and in the tertiary sector 67.09% and 69.16%, respectively.

In Figure 0.47 the employment structure of Italy for the years 2011 and 2017 is presented on a sector-by-sector basis.

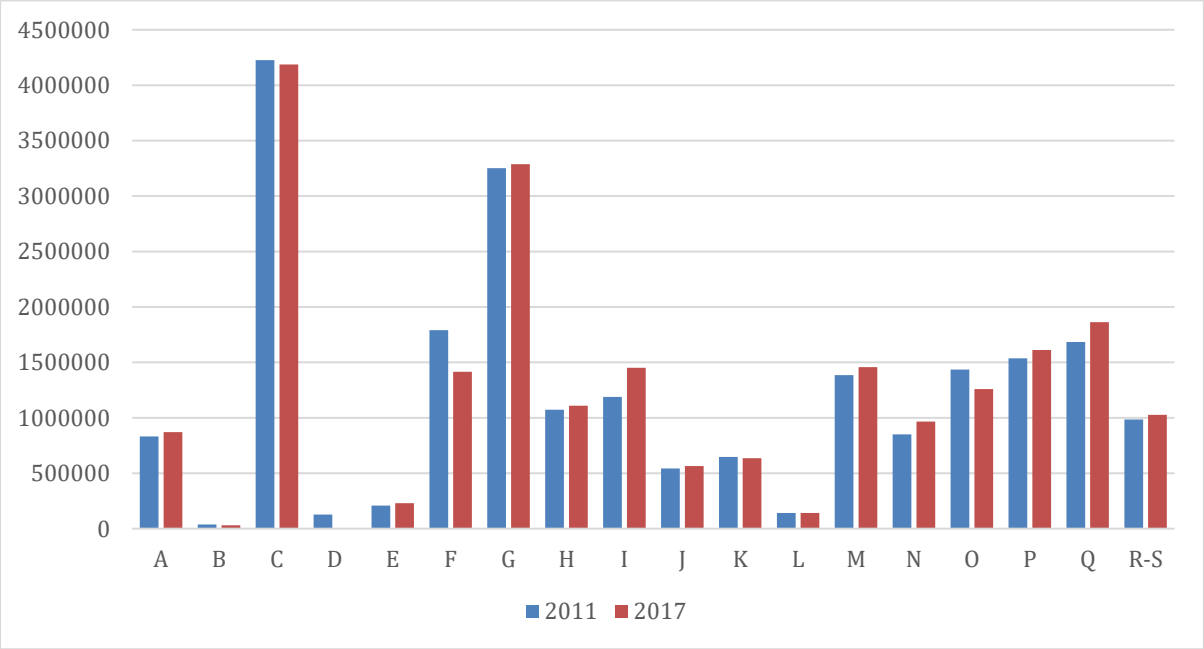



*Figure 0.47: Employment Structure by sector of economic activity, Italy (2011 & 2017)*

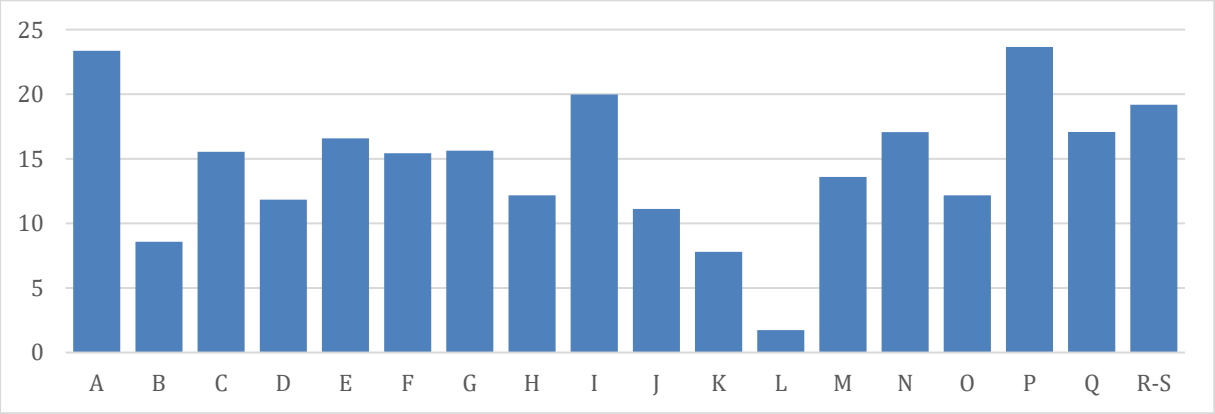



*Figure 0.48 Backward employment multipliers, Italy, 2017*

In Figure 0.48, the backward employment multipliers for Italy are represented for 2017. The sectors with the highest backward employment multipliers are:

- P, Education
- A, Agriculture, forestry and fishing
- I, Accommodation and food service activities

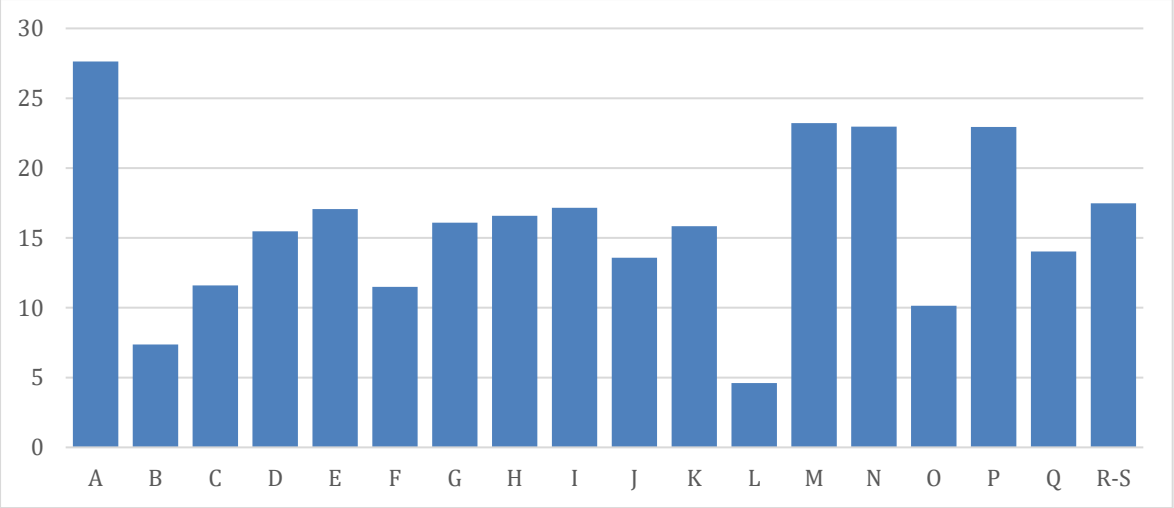



*Figure 0.49 Forward employment multipliers, Italy, 2017*

In Figure 0.49, the forward employment multipliers for Italy are presented for 2017. The sectors with the highest forward employment multipliers are:

- A, Agriculture, forestry and fishing
- M, Professional, scientific and technical activities
- N, Administrative and support service activities

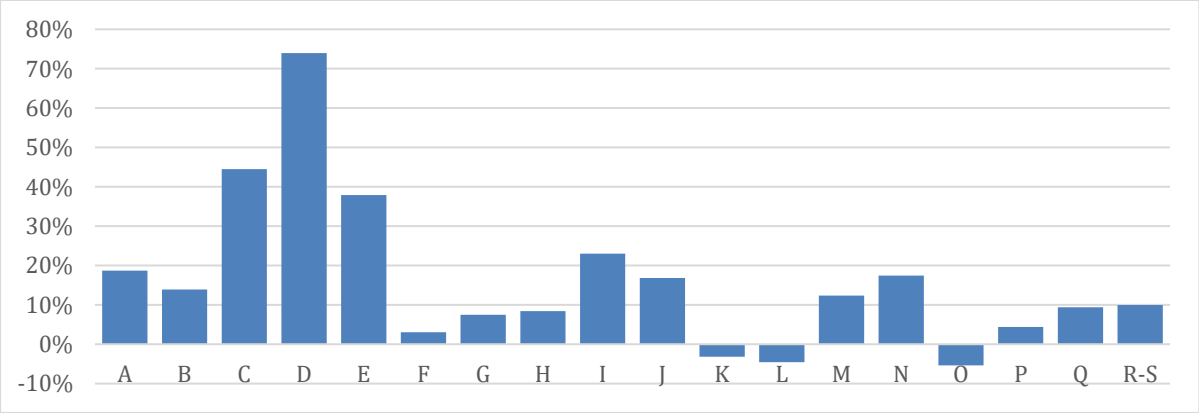



*Figure 0.50 Percentage change of the backward employment multipliers between the years 2011 and 2017, Italy*

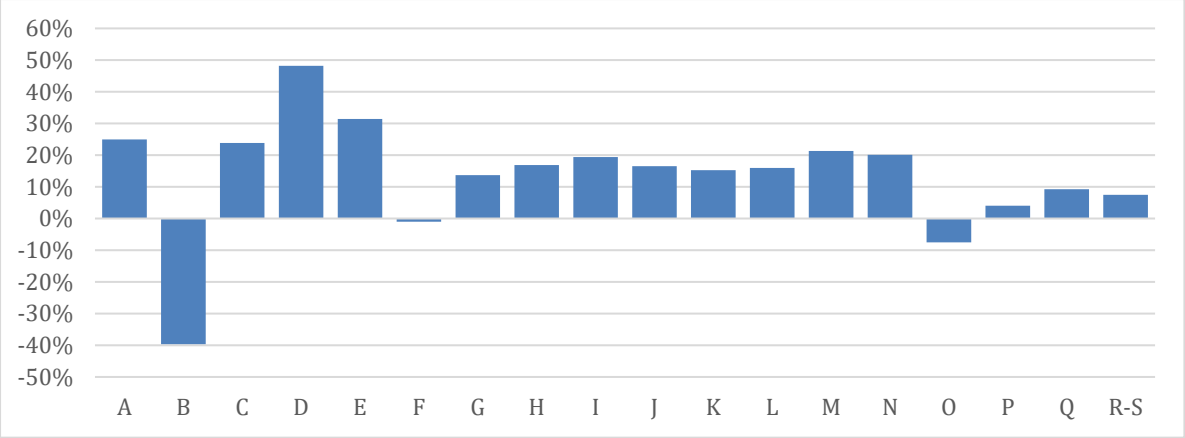



*Figure 0.51 Percentage change of the forward employment multipliers between the years 2011 and 2017, Italy*

In Figure 0.50 and Figure 0.51, the percentages change of backward and forward multipliers, respectively, are represented, between the years 2011 and 2017. The sectors with the highest increase in both multipliers are:

- B, Mining and quarrying
- D, Electricfiny, gas, steam and air conditioning supply
- K, Financial and insurance activfinies

### 2.3.5.2. Occupations

In Figure 0.52, the employment structure by occupation for Italy for the years 2011 and 2017 is presented.

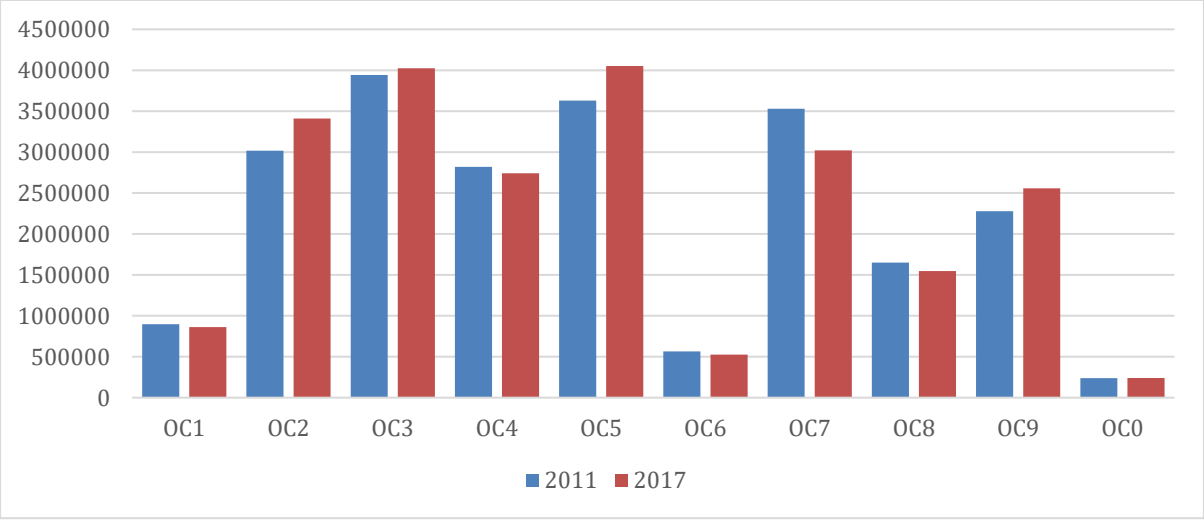



*Figure 0.52: Employment structure by occupation, Italy, 2011 & 2017*

The occupations with the highest participation rate in employment for 2017 are:

- OC5, Service and sales workers
- OC3, Technicians and associate professionals
- OC2, Professionals

The occupations with the higher increase in the percentage change of employment between the years 2011 and 2017 are:

- OC2, Professionals
- OC9, Elementary occupations

- OC5, Service and sales workers

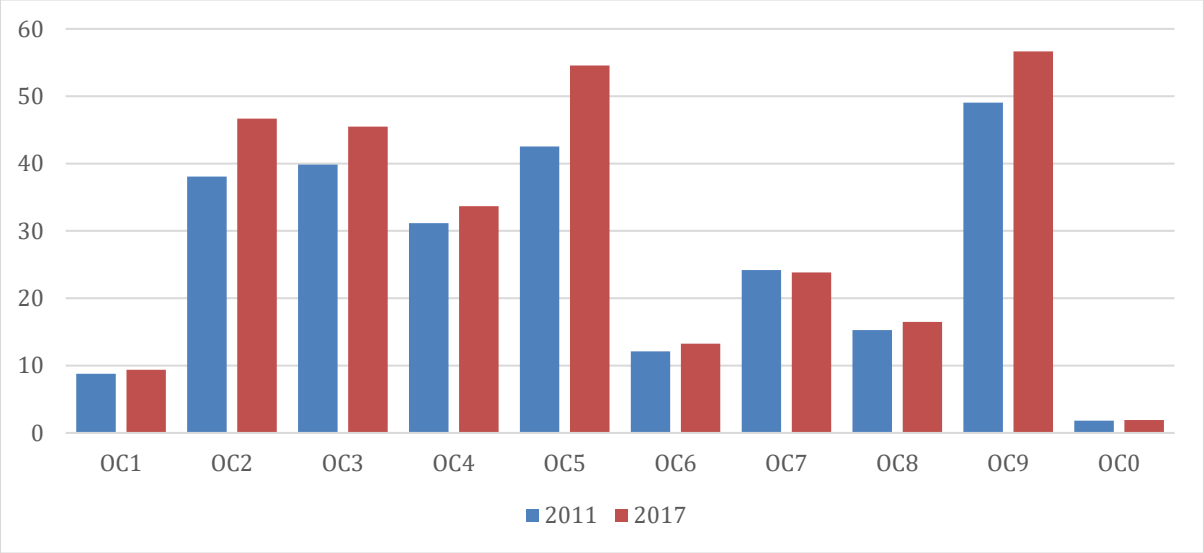



*Figure 0.53: Occupational multipliers, Italy, 2017*

In Figure 0.53 the occupational multipliers for Italy are presented for the years 2011 and 2017. The occupations with the highest multipliers in 2017 are:

- OC9, Elementary occupations
- OC5, Service and sales workers
- OC2, Professionals

The occupations with the highest increase in their multipliers between the years 2011 and 2017 are:

- OC5, Service and sales workers
- OC2, Professionals
- OC9, Elementary occupations

#### *2.3.5.1. Educational attainment level*

In Figure 0.54 the employment structure by educational attainment level for Italy is presented. Level 0-2 participation rate in employment decreased significantly in the examined period, while the participation rate of level 3-4 remained relatively stable and the participation rate of level 5-8 significantly increased.

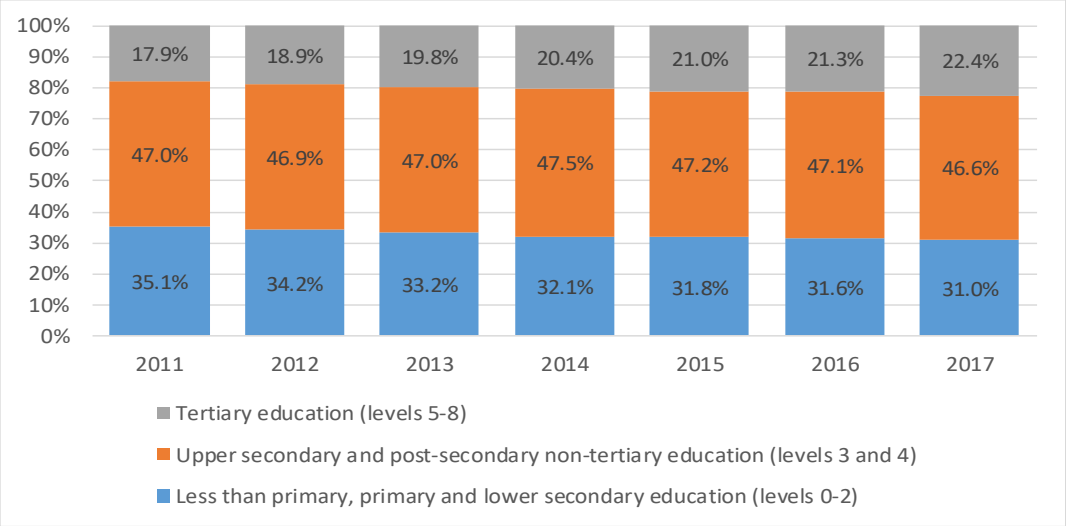



*Figure 0.54: Employment by educational attainment level, Italy*

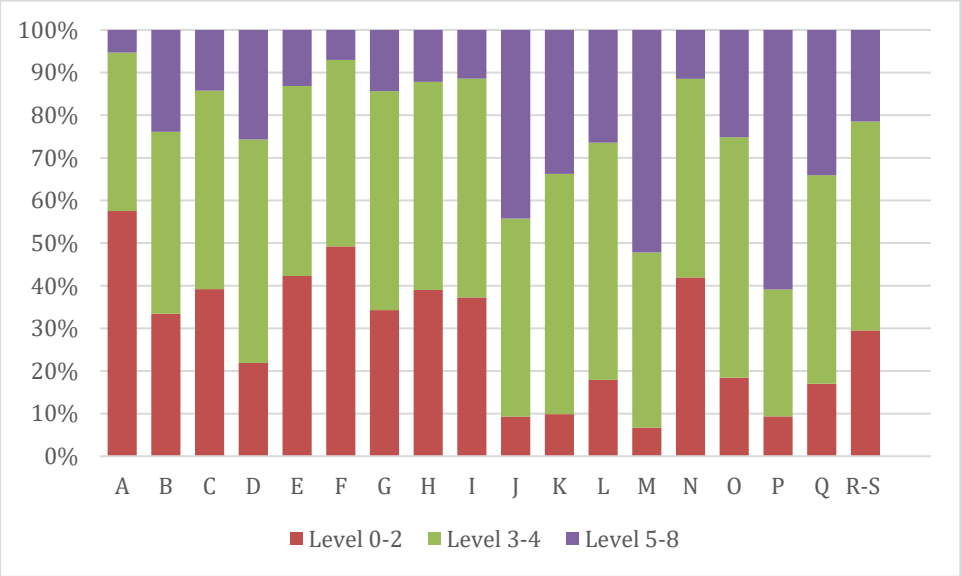



*Figure 0.55: Structure of employment by sector of economic activity and educational attainment level, Italy, 2017*

The sectors with the highest participation of low-skilled employment (Level 0-2) are:

- A, Agriculture, forestry and fishing
- F, Construction
- E, Water supply, sewerage, waste management and remediation activities

The sectors with the highest participation of medium-skilled employment (Level 3-4) are:

- O, Public administration and defence, compulsory social security
- K, Financial and insurance activities
- L, Real estate activities

The sectors with the highest participation of high-skilled employment (Level 5-8) are:

- P, Education
- M, Professional, scientific and technical activities
- J, Information and communication

### 2.3.5.2. Employability opportunities for MRAS

For the determination of the employability opportunities of MRAs in Italy, two composite indicators are used, the SIRIUS Indicator for Sectors (SIRIUS 1) and the SIRIUS Indicator for Occupations (SIRIUS 2). The construction of SIRIUS 1 requires the estimation of the Growth Indicator for Sectors (GIS) and the Sectoral Structure Similarity (SSS) and the construction of SIRIUS 2 requires, at first, the estimation of the Growth Indicator for Occupations (GIO) and the Occupational Structure Similarity (OSS).

The GIS and the SSS for Italy are shown in Figure 0.56.

The sectors with highest GIS are:

- C, Manufacturing
- G, Wholesale and retail trade, repair of motor vehicles and motorcycles
- P, Education
- A, Agriculture, forestry and fishing

Moreover, the sectors with the highest SSS are:

- C, Manufacturing
- A, Agriculture, forestry and fishing
- G, Wholesale and retail trade, repair of motor vehicles and motorcycles
- B, Mining and quarrying

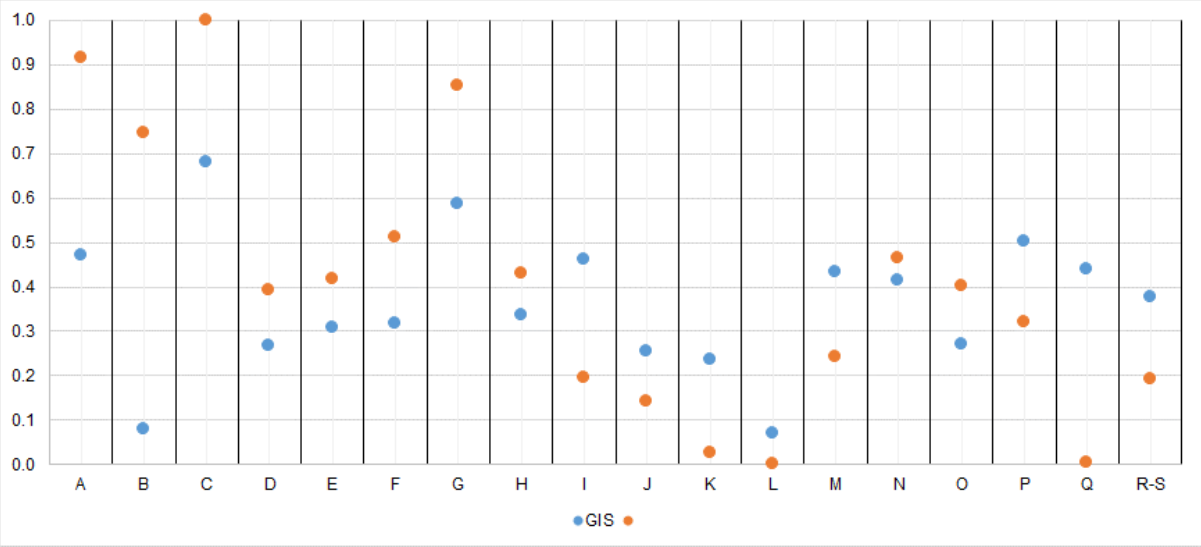



*Figure 0.56: GIS and SSS, Italy*

The values of the SIRIUS Indicator for Sectors (SIRIUS 1) are employed in order to rank the sectors and to identify the sectors of 1st priority for the integration of MRAs into the labour market of Italy. The SIRIUS 1 indicator is presented in Figure 0.57.

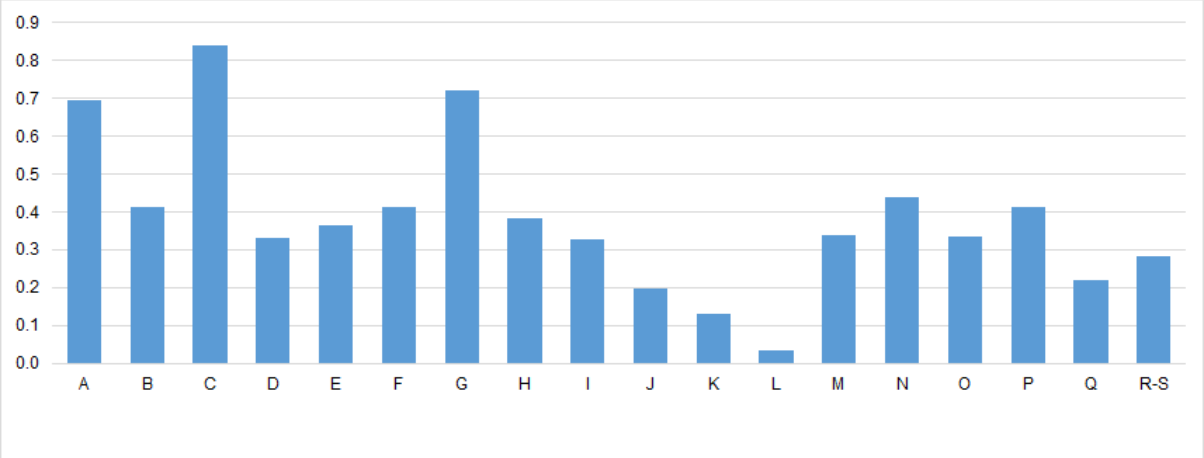



*Figure 0.57: SIRIUS 1, Italy*

Based on the above figure, the sectors of Italy which are determined as 1st priority for the employability of MRAs are:

- C, Manufacturing
- G, Wholesale and retail trade, repair of motor vehicles and motorcycles
- A, Agriculture, forestry and fishing
- N, Administrative and support service activities

The GIO and the OSD for Italy are shown in Figure 0.58.

The occupations with the highest GIO are:

- OC5, Service and sales workers
- OC3, Technicians and associate professionals
- OC2, Professionals
- OC9, Elementary occupations

Moreover, the occupations with the highest OSS are:

- OC4, Clerical support workers
- OC7, Craft and related trades workers
- OC6, Skilled agricultural, forestry and fishery workers
- OC1, Managers

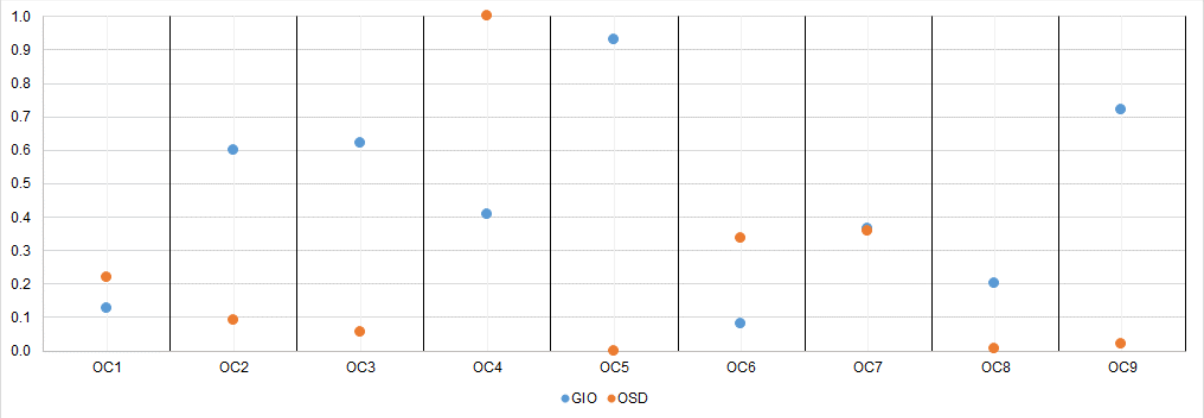



*Figure 0.58: GIO and OSS, Italy*

The values of the SIRIUS Indicator for Occupations (SIRIUS 2) are employed to rank the occupations and to identify the occupations of 1st priority for the integration of MRAs into the labour market of Italy. The SIRIUS 2 indicator is represented in Figure 0.59.

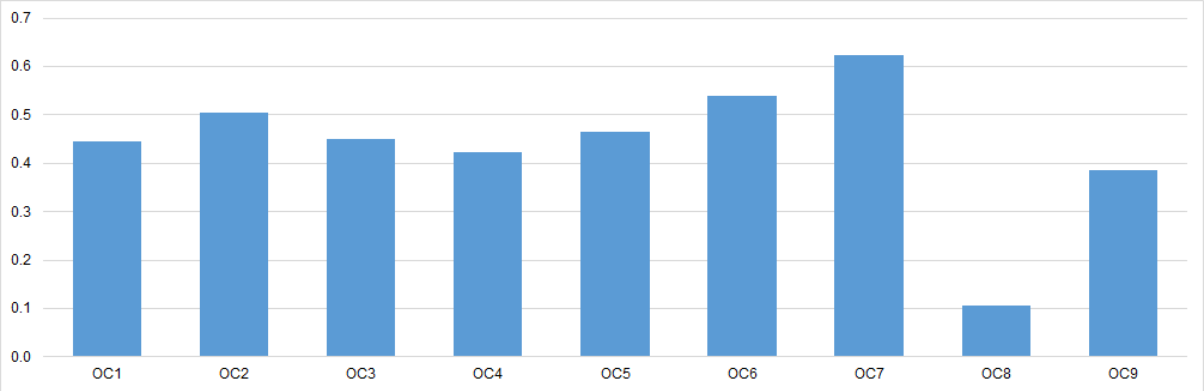



*Figure 0.59: SIRIUS 2, Italy*

Based on the above figure the occupations of Italy which are determined as 1st priority for the employability of MRAs are:

- OC4, Clerical support workers
- OC5, Service and sales workers
- OC2, Professionals
- OC3, Technicians and associate professionals

### 2.3.6. Finland

#### *2.3.6.1. Sectoral Analysis*

*The employment share of the primary sector of Finland was 4.26% in 2011 and decreased to 3.84% in 2017. The respective shares of employment in the manufacturing sector was 22.74% and 22.01% and in the tertiary sector 73% and 74.15%, respectively.*

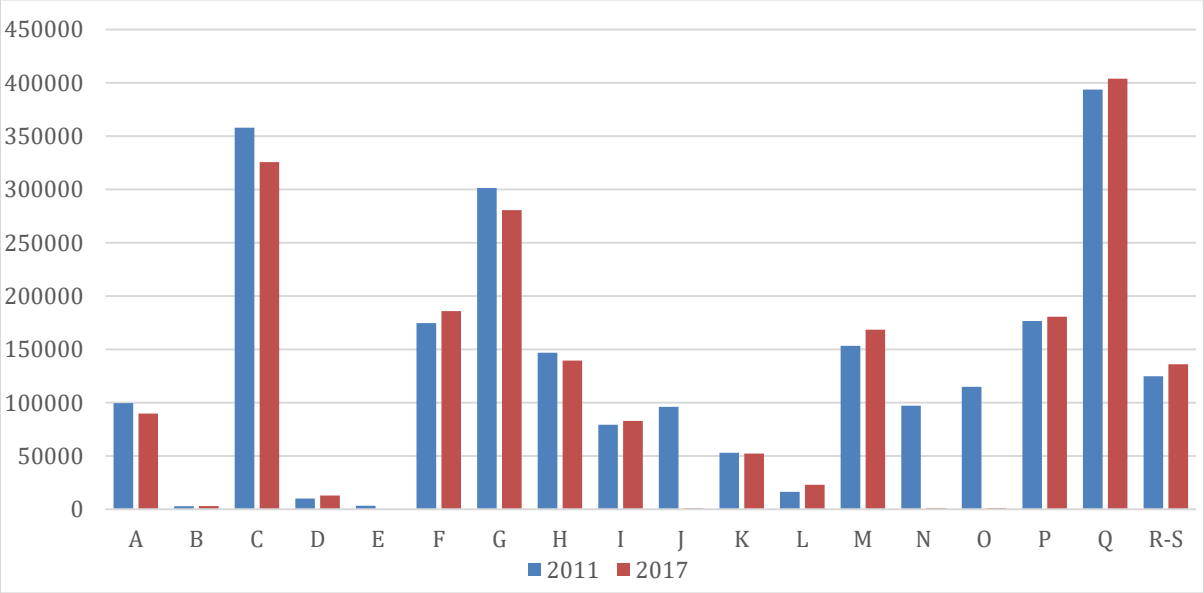



*Figure 0.60: Employment Structure by sector of economic activity, Finland (2011 & 2017)*

In Figure 0.32 the employment structure of Finland for the years 2011 and 2017 was represented on a sector-by-sector basis.

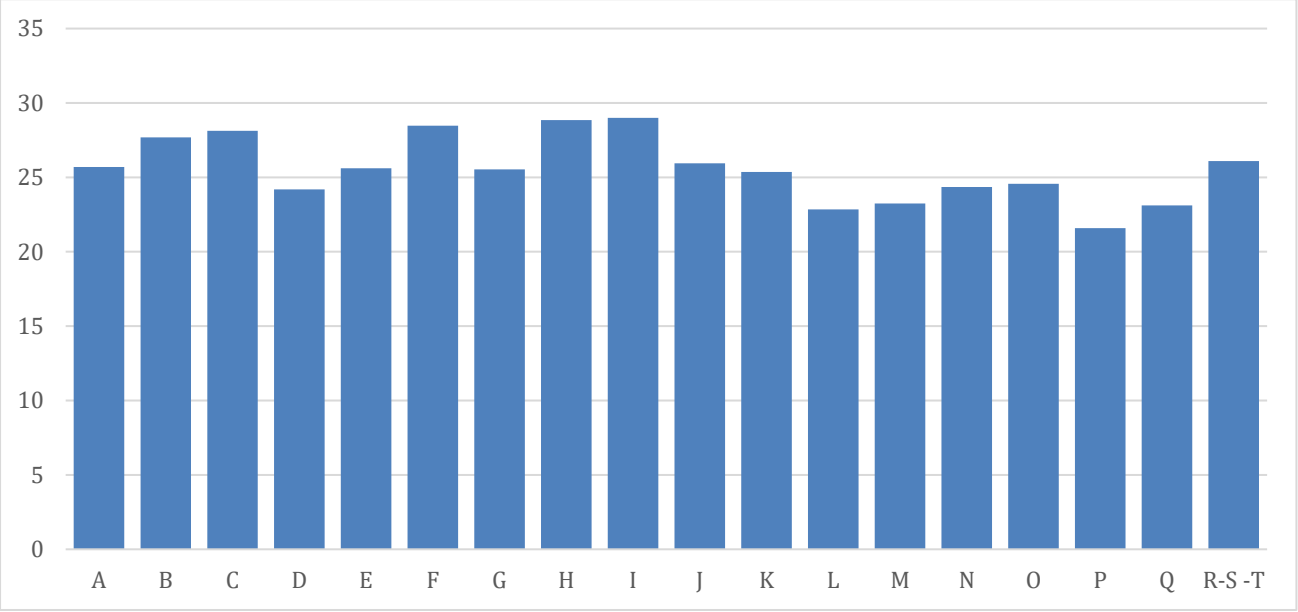



*Figure 0.61 Backward employment multipliers, Finland, 2017*

In Figure 0.61 the backward employment multipliers for Finland are represented for 2017. The sectors with the highest backward employment multipliers are:

- I, Accommodation and food service activities
- H, Transportation and storage
- F, Construction

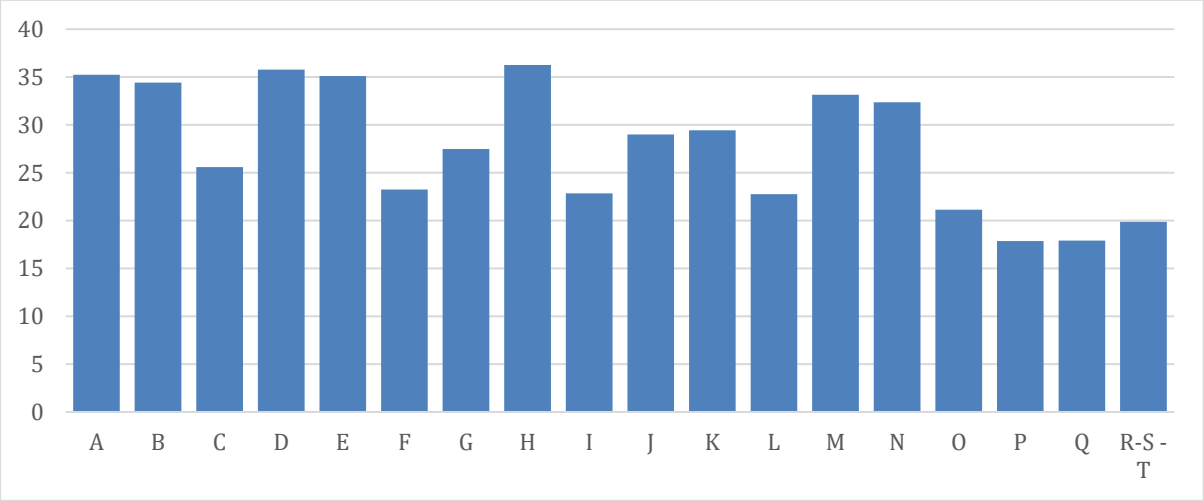



*Figure 0.62 Forward employment multipliers, Finland, 2017*

In Figure 0.63 the forward employment multipliers for Finland are represented for 2017. The sectors with the highest forward employment multipliers are:

- H, Transportation and storage
- D, Electricfiny, gas, steam and air condinioning supply
- A, Agriculture, forestry and fishing

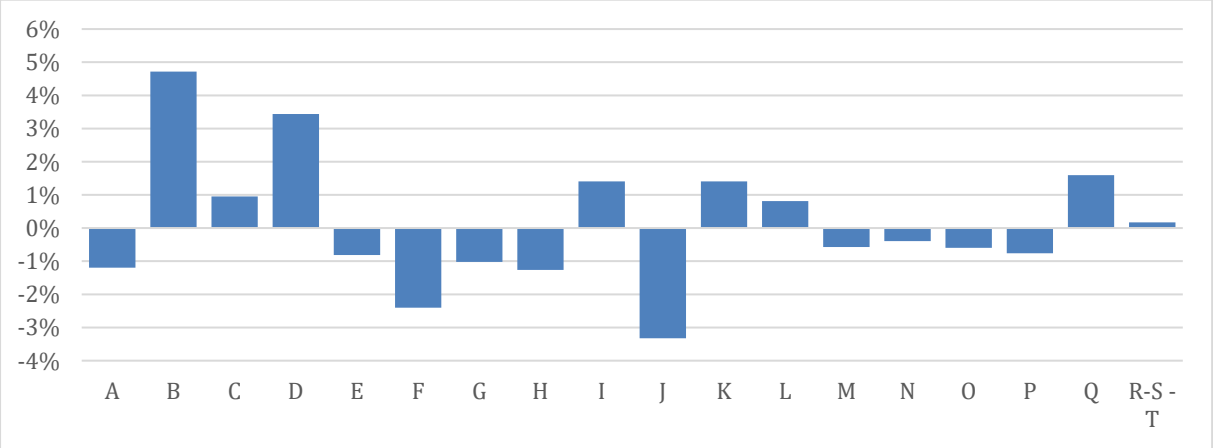



*Figure 0.63 Percentage change of the backward employment multipliers between the years 2011 and 2017, Finland*

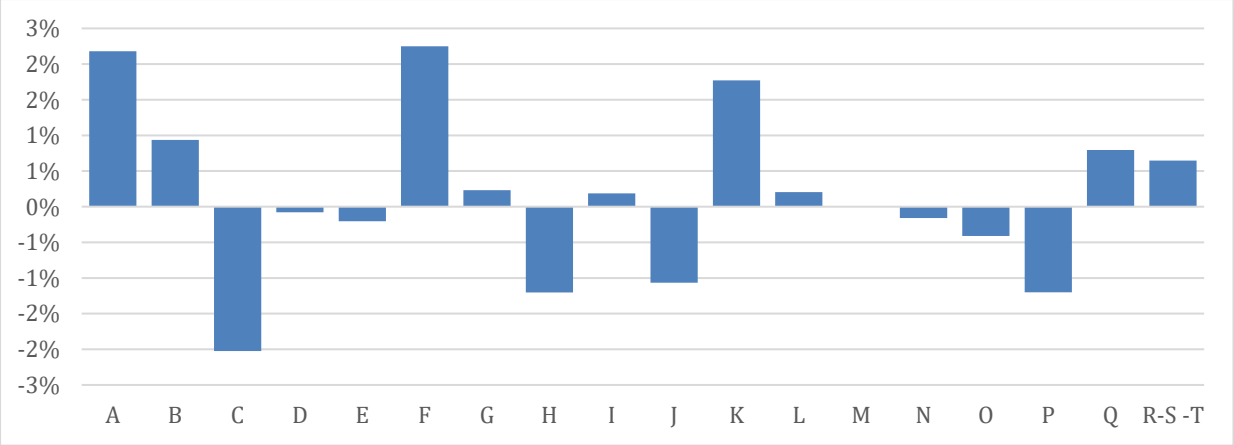



*Figure 0.64 Percentage change of the forward employment multipliers between the years 2011 and 2017, Finland*

In Figure 0.63 and Figure 0.64 the percentages change of backward and forward multipliers, respectively, are presented, for the years 2011 and 2017. The sectors with the highest increase in both multipliers are:

- D, Electricity, gas, steam and air conditioning supply
- E, Water supply, sewerage, waste management and remediation activities
- C, Manufacturing

#### *2.3.6.2. Occupations*

In Figure 0.65 the employment structure by occupation in Finland for the years 2011 and 2017 is presented.

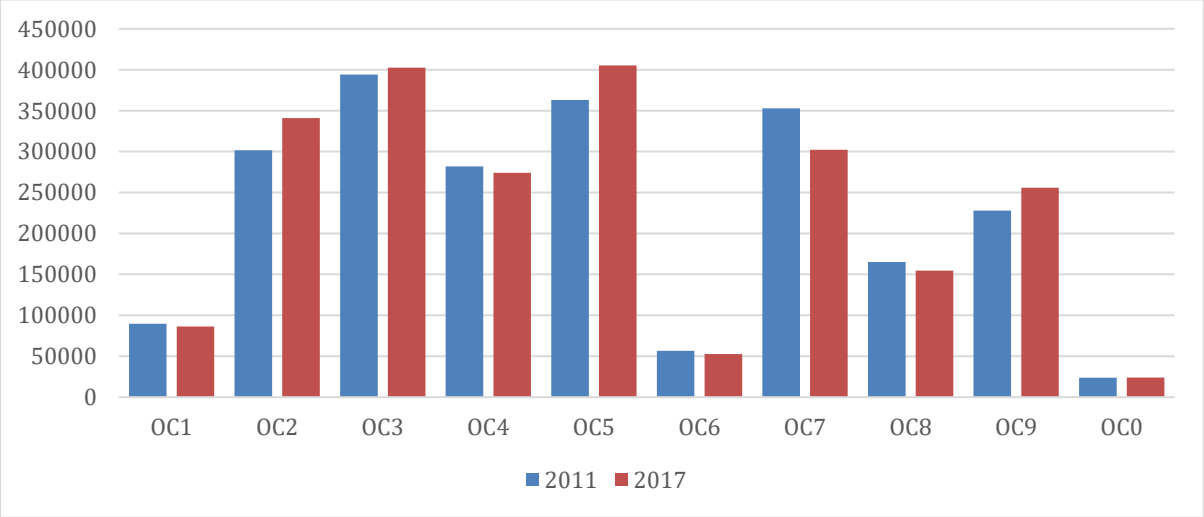



*Figure 0.65: Employment structure by occupation, Finland, 2011 & 2017*

The occupations with the highest participation rate in employment for 2017 are:

- OC5, Service and sales workers
- OC3, Technicians and associate professionals
- OC2, Professionals

The occupations with the highest increase in the percentage change of employment between the years 2011 and 2017 are:

- OC2, Professionals
- OC9, Elementary occupations
- OC5, Service and sales workers

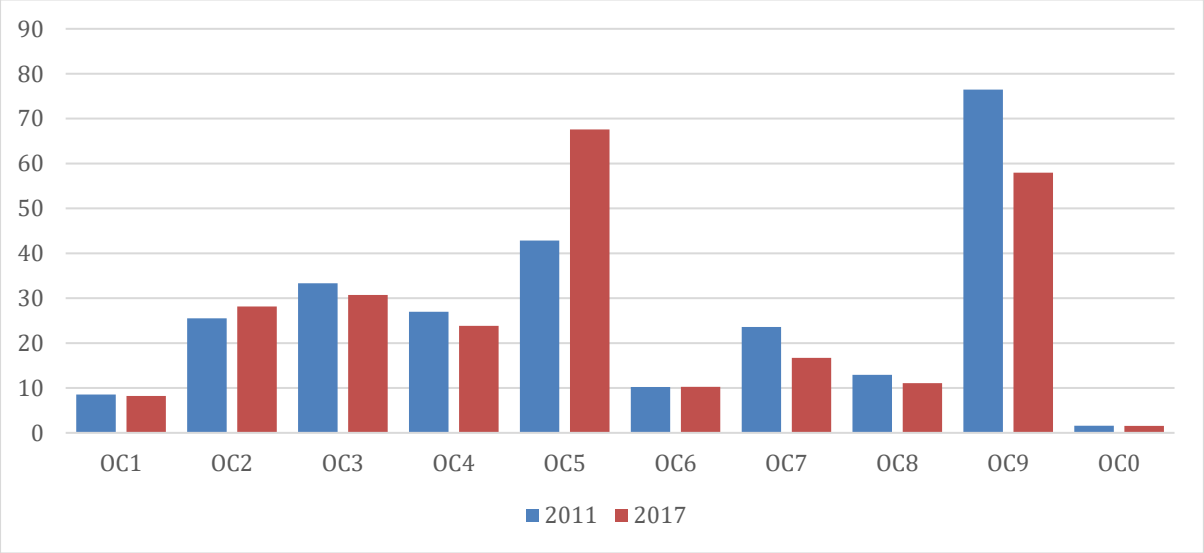



*Figure 0.66: Occupational multipliers, Finland, 2017*

InFigure 0.66 the occupational multipliers for Finland are represented, for the years 2011 and 2017. The occupations with the highest multipliers in 2017 are:

- OC9, Elementary occupations
- OC5, Service and sales workers
- OC3, Technicians and associate professionals

The occupations with the highest increase in their multipliers between the years 2011 and 2017 are:

- OC5, Service and sales workers
- OC2, Professionals
- OC6, Skilled agricultural, forestry and fishery workers

#### *2.3.6.1. Educational attainment level*

In Figure 0.67 the employment structure by educational attainment level for Finland is presented. Level 0-2 participation rate in employment significantly decreased for the period examined, while the participation rate of level 3-4 slightly decreased and the participation rate of level 5-8 significantly increased.

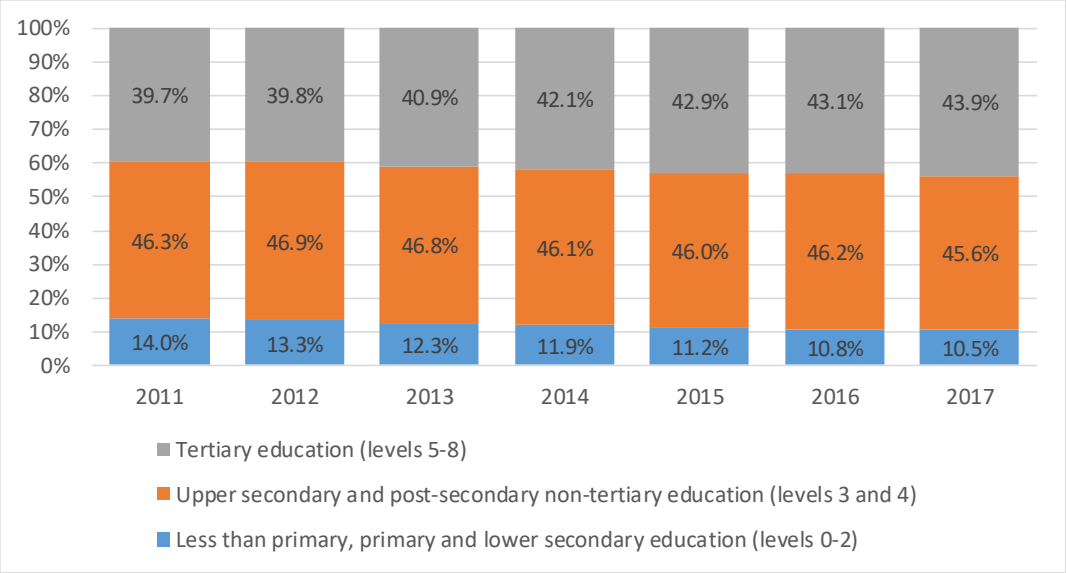



*Figure 0.67: Employment by educational attainment level, Finland*

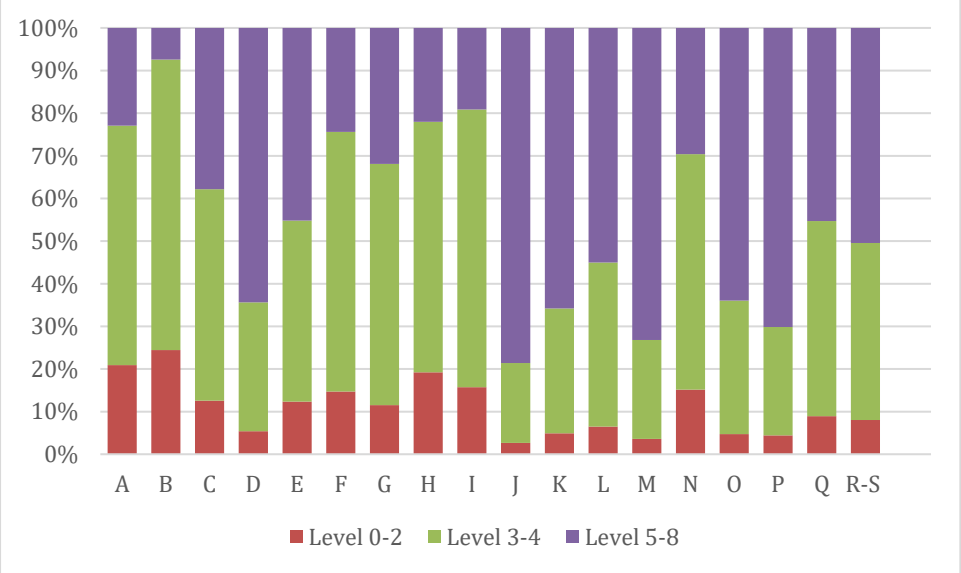



*Figure 0.68: Structure of employment by sector of economic activity and educational attainment level, Finland, 2017*

The sectors with the highest participation of low-skilled employment (Level 0-2) are:

- B, Mining and quarrying
- A, Agriculture, forestry and fishing
- H, Transportation and storage

The sectors with the highest participation of medium-skilled employment (Level 3-4) are:

- B, Mining and quarrying
- I, Accommodation and food service activities
- F, Construction

The sectors with the highest participation of high-skilled employment (Level 5-8) are:

- J, Information and communication
- M, Professional, scientific and technical activities

- P, Education

### 2.3.6.2. Job vacancy rate

Figure 0.69 shows the job vacancy rate for Finland in 2017. The sectors with the highest job vacancy rates are: Information and communication (J) and Real estate activities (L).

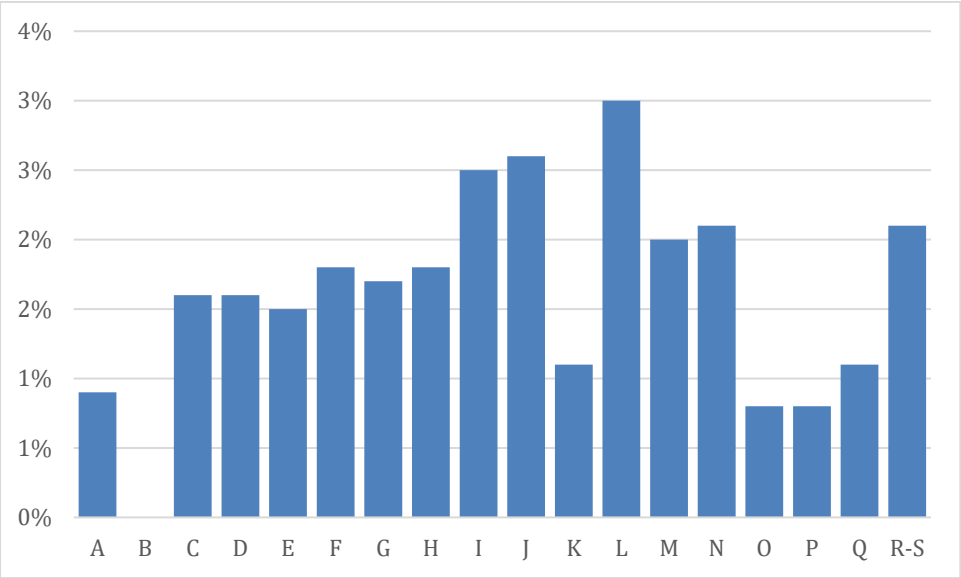



*Figure 0.69: Job vacancy rate, Finland, 2017*

### 2.3.6.3. Employability opportunities for MRAS

For the determination of the employability opportunities of MRAs in Finland two composite indicators are used, the SIRIUS Indicator for Sectors (SIRIUS 1) and the SIRIUS Indicator for Occupations (SIRIUS 2). The construction of SIRIUS 1 requires the estimation of the Growth Indicator for Sectors (GIS) and the Sectoral Structure Similarity (SSS) and the construction of SIRIUS 2 requires, at first, the estimation of the Growth Indicator for Occupations (GIO) and the Occupational Structure Similarity (OSS).

The GIS and the SSS for Finland are shown in Figure 0.70.

The sectors with highest GIS are:

- C, Manufacturing
- Q, Human health and social work activities
- G, Wholesale and retail trade, repair of motor vehicles and motorcycles
- H, Transportation and storage

Moreover, the sectors with the highest SSS are:

- F, Construction
- G, Wholesale and retail trade, repair of motor vehicles and motorcycles
- O, Public administration and defence, compulsory social security
- E, Water supply, sewerage, waste management and remediation activities

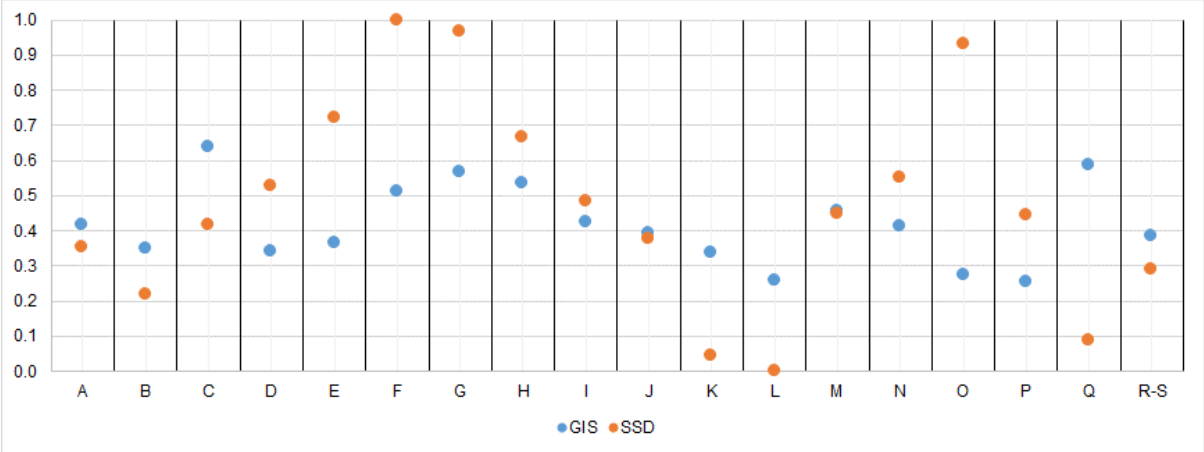



*Figure 0.70: GIS and SSS, Finland*

The values of the SIRIUS Indicator for Sectors (SIRIUS 1) are employed in order to rank the sectors and to identify the sectors of 1st priority for the integration of MRAs into the labour market of Finland. The SIRIUS 1 indicator is presented in Figure 0.71.

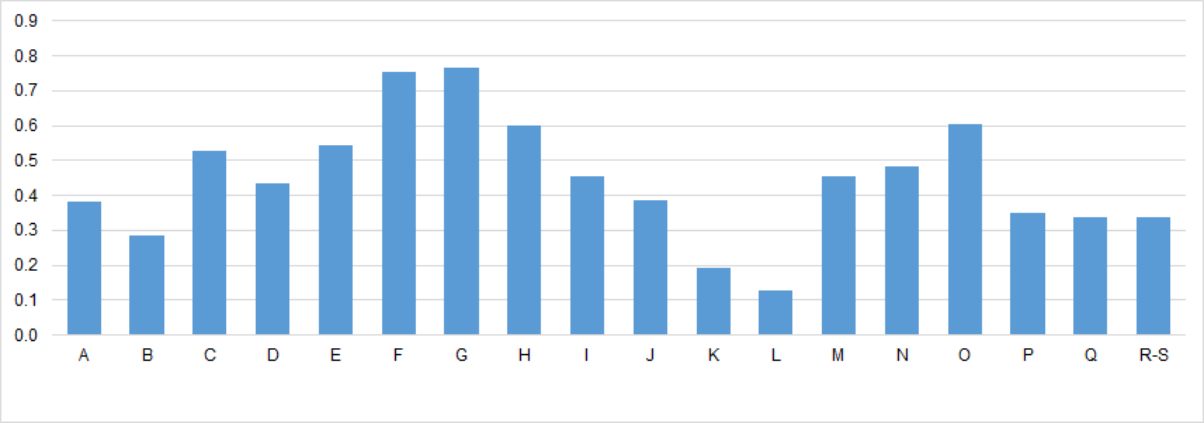



*Figure 0.71: SIRIUS 1, Finland*

Based on the above figure, the sectors of Finland which are determined as 1st priority for the employability of MRAs are:

- G, Wholesale and retail trade, repair of motor vehicles and motorcycles
- F, Construction
- O, Public administration and defence, compulsory social security
- H, Transportation and storage

The GIO and the OSD for Finland are shown in Figure 0.72.

The occupations with highest GIO are:

- OC5, Service and sales workers
- OC9, Elementary occupations
- OC3, Technicians and associate professionals
- OC2, Professionals

Moreover, the occupations with the highest OSS are:

- OC6, Skilled agricultural, forestry and fishery workers
- OC7, Craft and related trades workers
- OC1, Managers

- OC4, Clerical support workers

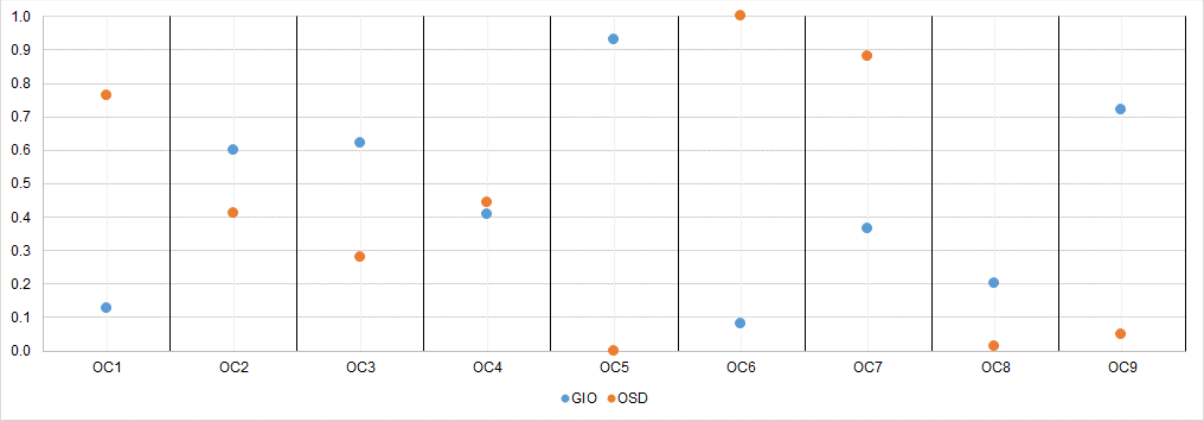



*Figure 0.72: GIO and OSS, Finland*

The values of the SIRIUS Indicator for Occupations are used to rank the occupations and to identify the occupations of 1st priority for the integration of MRAs into the labour market of Finland. The SIRIUS 2 indicator is presented in Figure 0.73.

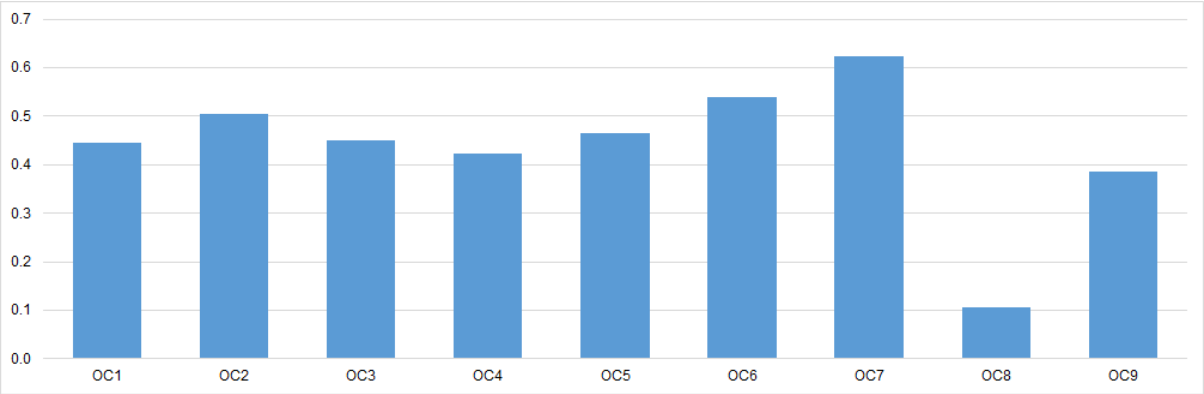



*Figure 0.73: SIRIUS 2, Finland*

Based on the above figure, the occupations of Finland which are determined as 1st priority for the employability of MRAs are:

- OC7, Craft and related trades workers
- OC6, Skilled agricultural, forestry and fishery workers
- OC2, Professionals
- OC5, Service and sales workers

### 2.3.7. United Kingdom

#### *2.3.7.1. Sectoral Analysis*

The employment share of the primary sector of the United Kingdom was 1.14% in 2011 and declined to 1.05% in 2017. The respective shares of employment in the manufacturing sector was 19.12% and 16.37% and in the tertiary sector 79.74% and 82.58%, respectively.

In Figure 0.74, the employment structure of the United Kingdom for the years 2011 and 2017 is represented on a sector-by-sector basis.

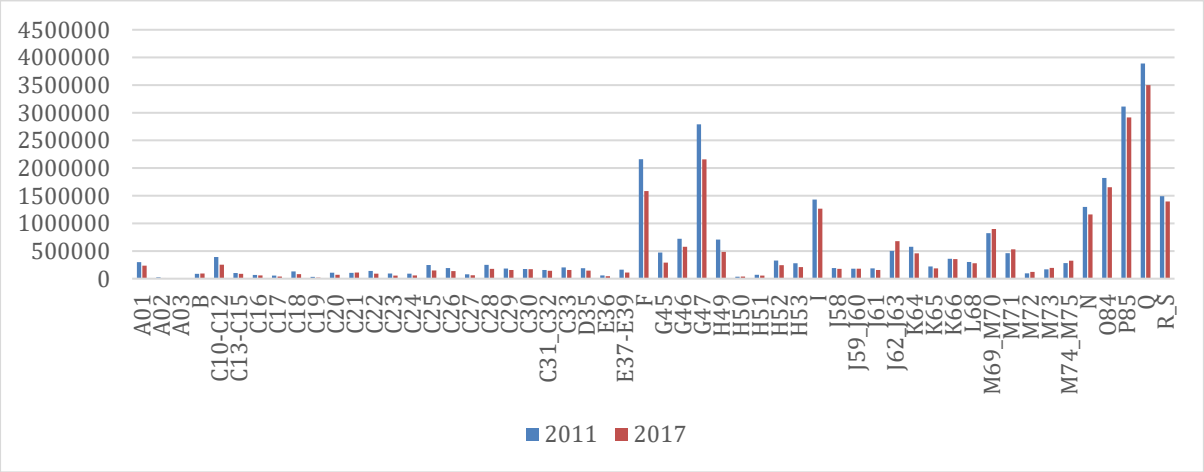



*Figure 0.74: Employment Structure by sector of economic activity, United Kingdom (2011 & 2017)*

The sectors with the highest participation rate in employment are:

- Q, Human health and social work activities
- P85, Education
- G47, Retail trade, except of motor vehicles and motorcycles
- O84, Public administration and defence, compulsory social security
- F, Construction
- R_S, Other service activities
- I, Accommodation and food service activities
- N, Administrative and support service activities
- M69_M70, Legal and accounting activities, activities of head offices, management consultancy activities
- J62_J63, Computer programming, consultancy and related activities, information service activities

The sectors with the highest increase in the percentage change of employment between the years 2011 and 2017 are:

- A03, Fishing and aquaculture
- J62_J63, Computer programming, consultancy and related activities, information service activities
- M72, Scientific research and development
- M73, Advertising and market research
- M71, Architectural and engineering activities, technical testing and analysis
- M74_M75, Other professional, scientific and technical activities, veterinary activities
- H50, Water transport
- M69_M70, Legal and accounting activities, activities of head offices, management consultancy activities
- C21, Manufacture of basic pharmaceutical products and pharmaceutical preparations
- B, Mining and quarrying

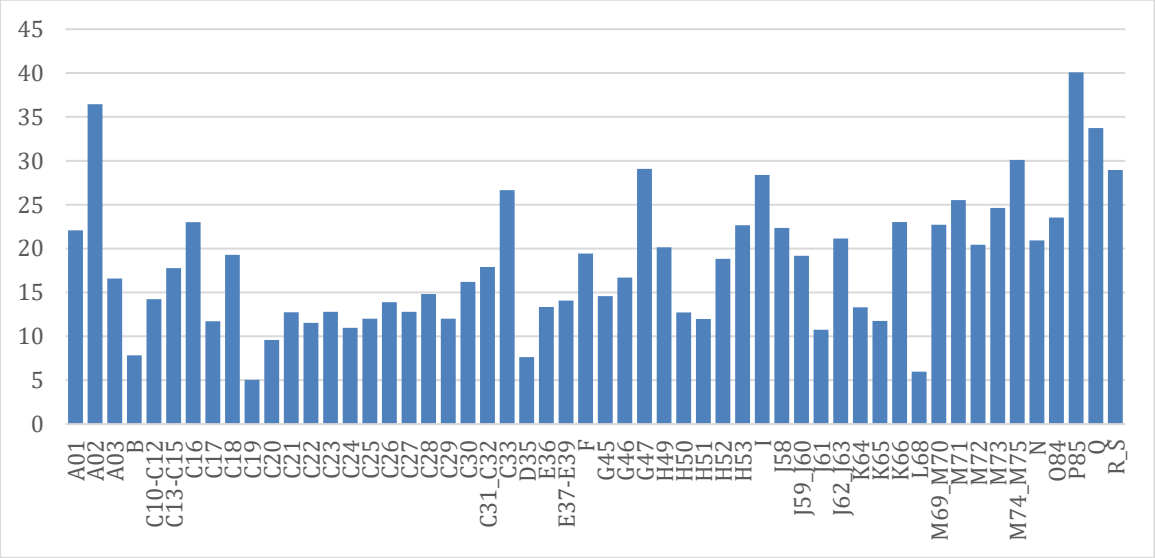



*Figure 0.75 Backward employment multipliers, United Kingdom, 2017*

In Figure 0.75, the backward employment multipliers for the United Kingdom are presented for 2017. The sectors with the highest backward employment multipliers are:

- P85, Education
- A02, Forestry and logging
- M69_M70, Legal and accounting activities, activities of head offices, management consultancy activities
- C33, Repair and installation of machinery and equipment
- M73, Advertising and market research
- M74_M75, Other professional, scientific and technical activities, veterinary activities
- M71, Architectural and engineering activities, technical testing and analysis
- H53, Postal and courier activities
- C16, Manufacture of wood and of products of wood and cork, except furniture, manufacture of articles of straw and plaiting materials
- N, Administrative and support service activities

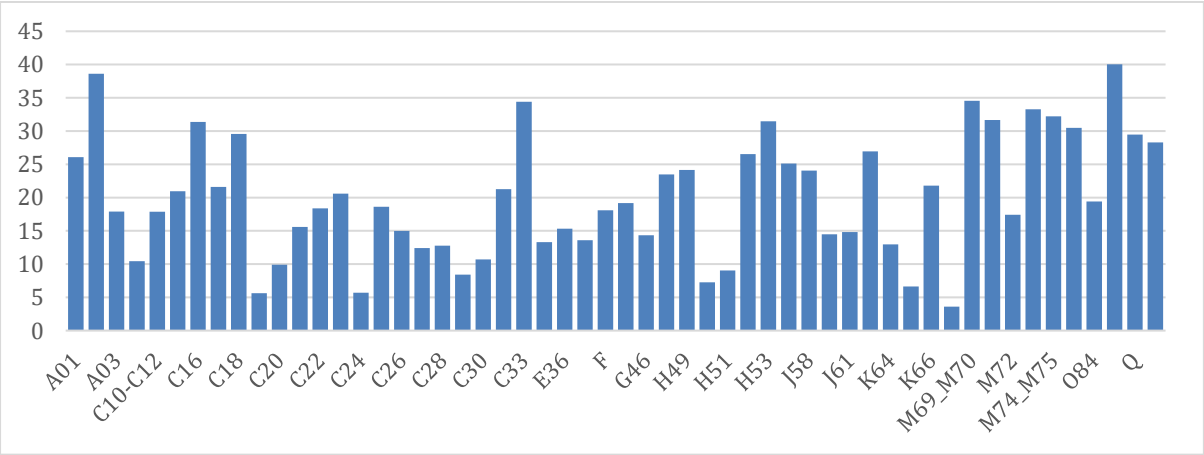



*Figure 0.76 Forward employment multipliers, United Kingdom, 2017*

In Figure 0.76, the forward employment multipliers for the United Kingdom are represented for 2017. The sectors with the highest forward employment multipliers are:

- P85, Education
- A02, Forestry and logging
- Q, Human health and social work activities
- M74_M75, Other professional, scientific and technical activities, veterinary activities
- G47, Retail trade, except of motor vehicles and motorcycles
- R_S, Other service activities
- I, Accommodation and food service activities
- C33, Repair and installation of machinery and equipment
- M71, Architectural and engineering activities, technical testing and analysis
- M73, Advertising and market research

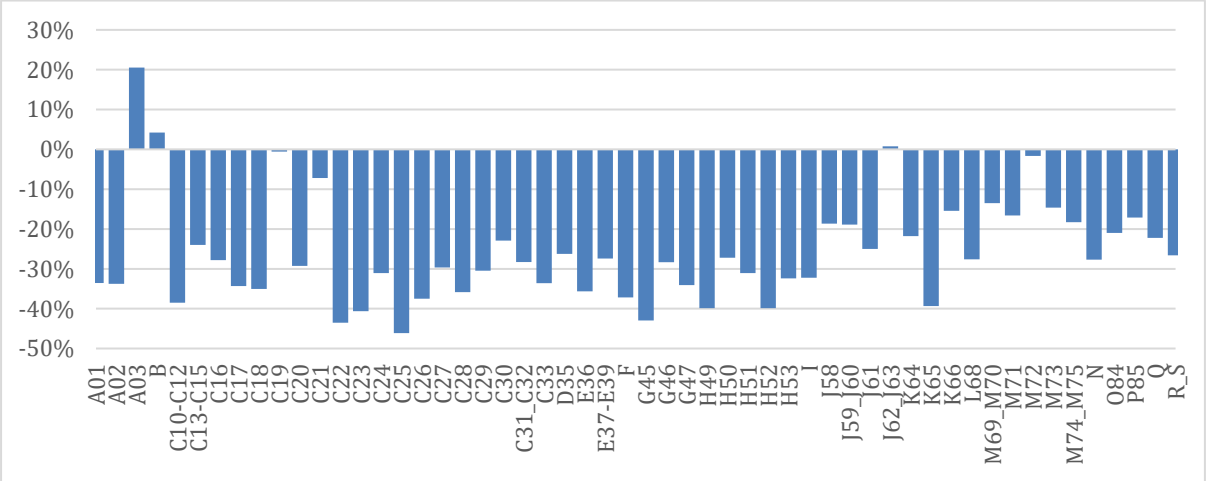



*Figure 0.77 Percentage change of the backward employment multipliers between the years 2011 and 2017, United Kingdom*

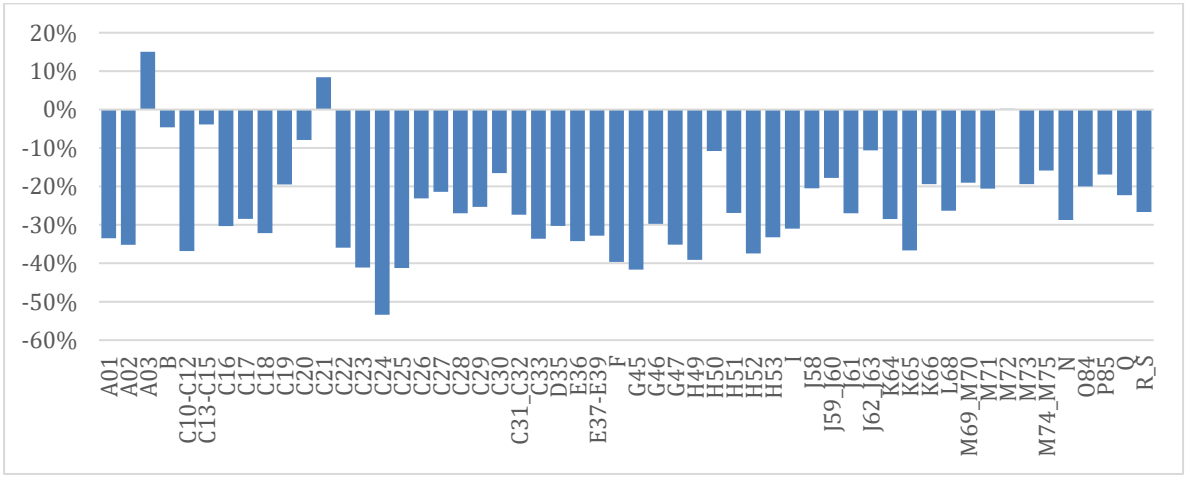



*Figure 0.78 Percentage change of the forward employment multipliers between the years 2011 and 2017, United Kingdom*

In Figure 0.77 and Figure 0.78 the percentage changes of backward and forward multipliers, respectively, are presented, between the years 2011 and 2017. The sectors with positive change in both multipliers are:

- A03, Fishing and aquaculture

- C21, Manufacture of basic pharmaceutical products and pharmaceutical preparations

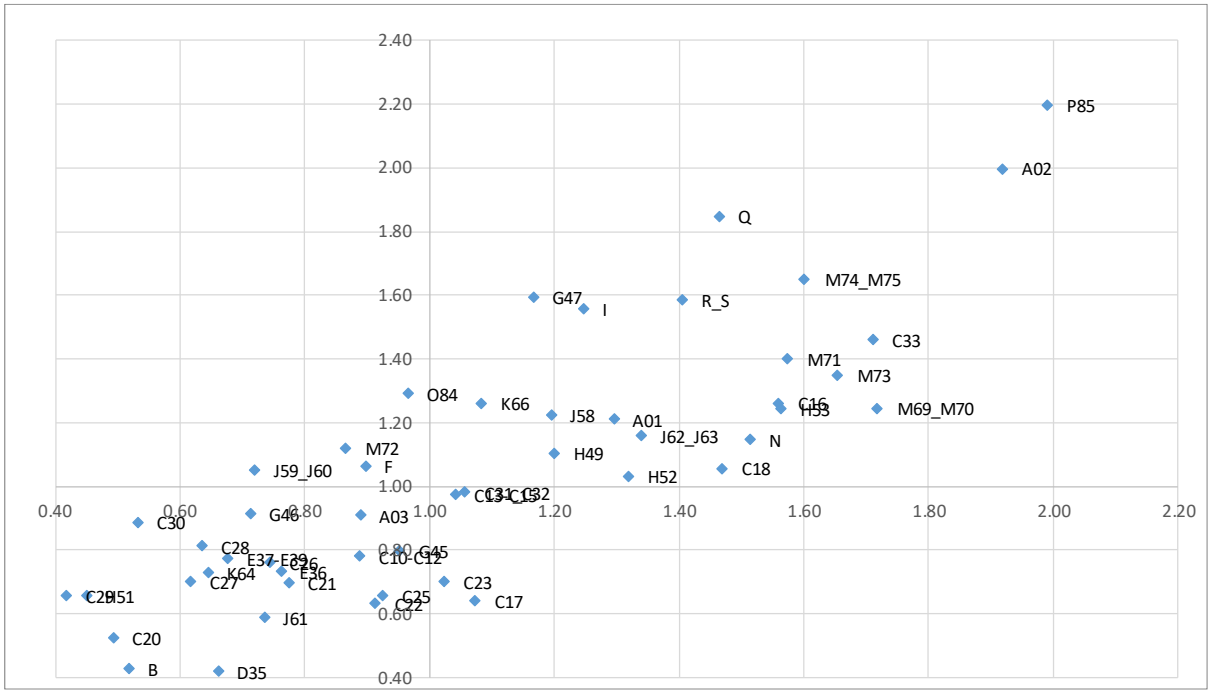



*Figure 0.79: Key sectors of employment, United Kingdom, 2017*

Figure 0.79 shows the key sectors of the United Kingdom. The figure is designed as follows: The horizontal axis represents the normalized forward employment multipliers and the vertical one the normalized backward employment multipliers. The two axes intersect at the point (1, 1). The particular presentation gives the ability to “map” the economy following the schema: A sector located in the first quadrant is a key sector of the economy, a sector located in the second quadrant is a Leontief key sectors, a sector located in the third quadrant is not a key sector, and, finally, a sector located in the fourth quadrant is Ghosh key sector. The key sectors of the United Kingdom are:

- A01, Crop and animal production, hunting and related service activities
- A02, Forestry and logging
- C16, Manufacture of wood and of products of wood and cork, except furniture, manufacture of articles of straw and plaiting materials
- C18, Printing and reproduction of recorded media
- C33, Repair and installation of machinery and equipment
- G47, Retail trade, except of motor vehicles and motorcycles
- H49, Land transport and transport via pipelines
- H52, Warehousing and support activities for transportation
- H53, Postal and courier activities
- I, Accommodation and food service activities
- J58, Publishing activities
- J62_J63, Computer programming, consultancy and related activities, information service activities
- K66, Activities auxiliary to financial services and insurance activities
- M69_M70, Legal and accounting activities, activities of head offices, management consultancy activities
- M71, Architectural and engineering activities, technical testing and analysis
- M73, Advertising and market research

- M74_M75, Other professional, scientific and technical activities, veterinary activities
- N, Administrative and support service activities
- P85, Education
- Q, Human health and social work activities
- R_S, Other service activities

#### 2.3.7.2. Occupations

In

*Figure 0.80: Employment structure by occupation, United Kingdom, 2011 & 2017*

, the employment structure by occupation of the United Kingdom for the years 2011 and 2017 is presented.

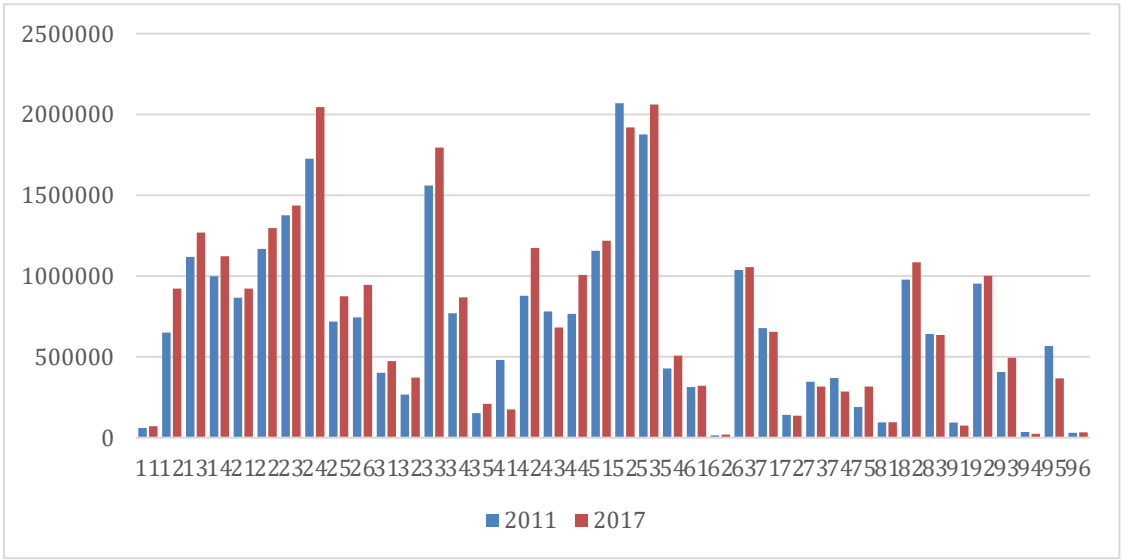



*Figure 0.80: Employment structure by occupation, United Kingdom, 2011 & 2017*

The occupations with the highest participation rate in employment for 2017 are:

- 12, Administrative and commercial managers
- 92, Agricultural, forestry and fishery labourers
- 74, Electrical and electronic trades workers
- 54, Protective services workers
- 11, Chief executives, senior officials and legislators
- 91, Cleaners and helpers
- 75, Food processing, wood working, garment and other craft and related trades workers
- 23, Teaching professionals
- 71, Building and related trades workers, excluding electricians
- 25, Information and communications technology professionals

The occupations with the highest increase in the percentage change of employment between the years 2011 and 2017 are:

- 14, Hospitality, retail and other services managers
- 26, Legal, social and cultural professionals
- 96, Refuse workers and other elementary workers
- 32, Health associate professionals
- 53, Personal care workers
- 52, Sales workers
- 12, Administrative and commercial managers
- 54, Protective services workers
- 22, Health professionals
- 73, Handicraft and printing workers

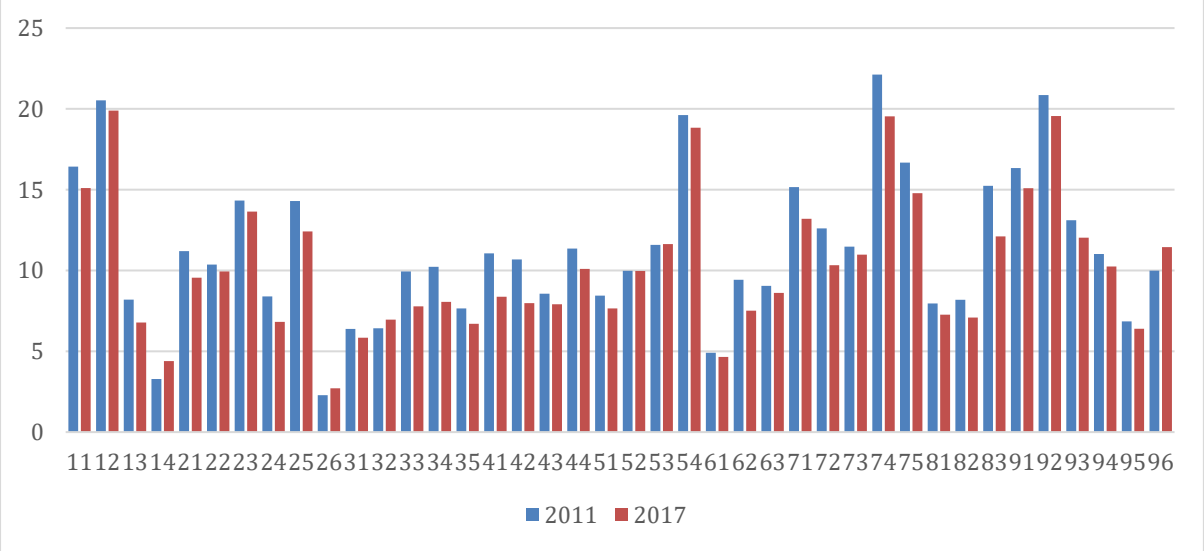



*Figure 0.81: Occupational multipliers, United Kingdom, 2011 & 2017*

In Figure 0.81, the occupational multipliers for the United Kingdom are presented, for the years 2011 and 2017. The occupations with the highest multipliers in 2017 are:

The occupations with the highest increase in their multipliers between the years 2011 and 2017 are:

- 53, Personal care workers
- 24, Business and administration professionals
- 52, Sales workers
- 33, Business and administration associate professionals
- 23, Teaching professionals
- 22, Health professionals
- 13, Production and specialised services managers
- 51, Personal service workers
- 42, Customer services clerks
- 14, Hospitality, retail and other services managers

The occupations with the highest increase in their multipliers between the years 2011 and 2017 are:

- 75, Food processing, wood working, garment and other craft and related trades workers
- 12, Administrative and commercial managers
- 32, Health associate professionals
- 35, Information and communications technicians
- 62, Market - oriented skilled forestry, fishery and hunting workers
- 42, Customer services clerks
- 44, Other clerical support workers
- 26, Legal, social and cultural professionals
- 93, Labourers in mining, construction, manufacturing and transport
- 25, Information and communications technology professionals

#### 2.3.7.1. Educational attainment level

In Figure 0.97 the employment structure by educational attainment level for the United Kingdom is presented. Level 0-2 participation rate in employment significantly decreased for the period examined, while the participation rate of level 3-4 decreased and the participation rate of level 5-8 significantly increased.

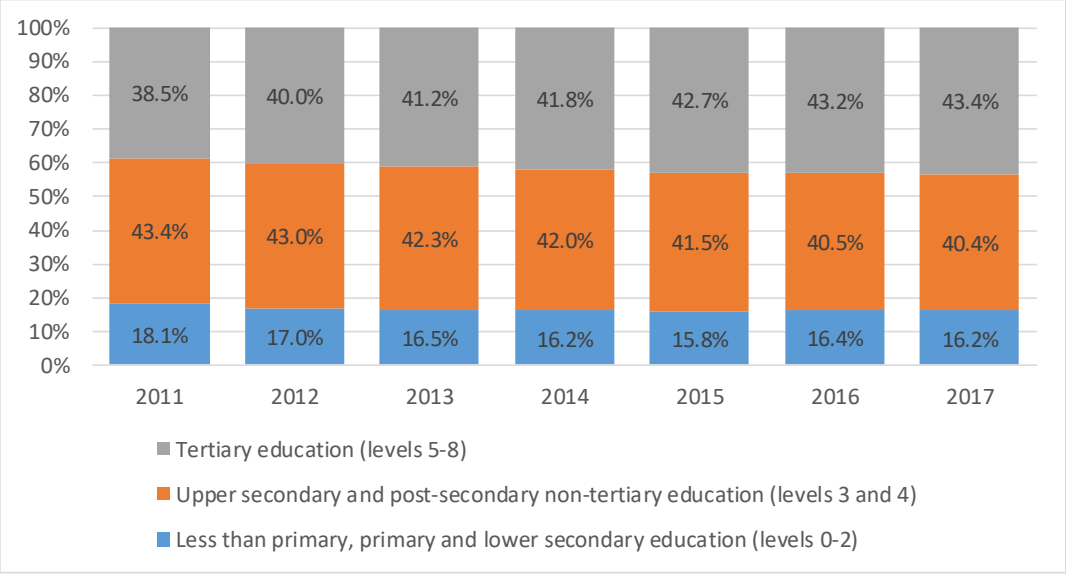



*Figure 0.82: Employment by educational attainment level, United Kingdom*

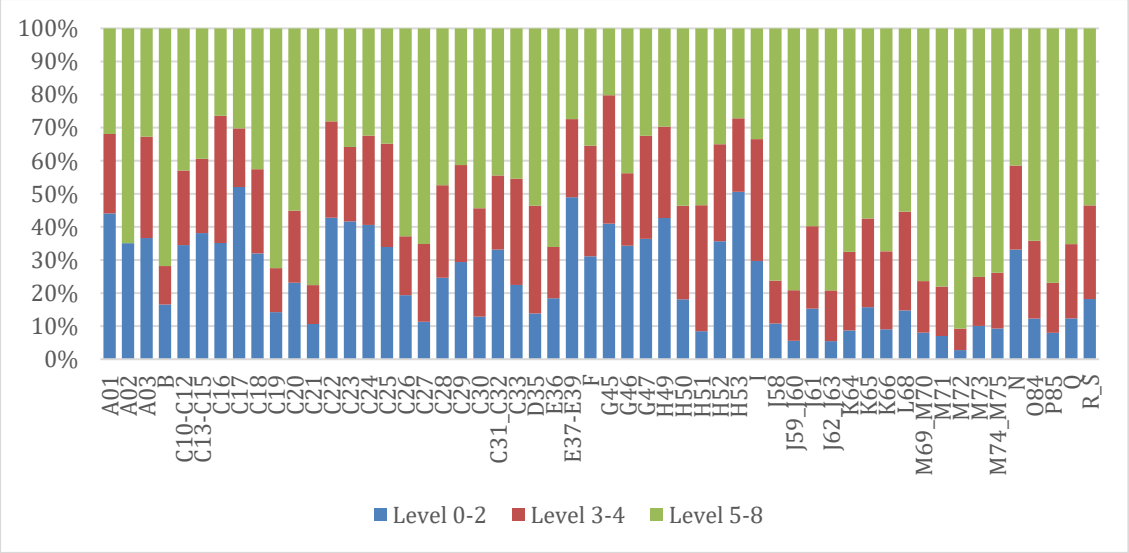



*Figure 0.83: Structure of employment by sector of economic activity and educational attainment level, United Kingdom, 2017*

The sectors with the highest participation of low-skilled employment (Level 0-2) are:

- C17, Manufacture of paper and paper products
- H53, Postal and courier activities
- E37-E39, Sewerage, waste collection, treatment and disposal activities, materials recovery, remediation activities and other waste management services
- A01, Crop and animal production, hunting and related service activities
- C22, Manufacture of rubber and plastic products

The sectors with the highest participation of medium-skilled employment (Level 3-4) are:

- G45, Wholesale and retail trade and repair of motor vehicles and motorcycles
- C16, Manufacture of wood and of products of wood and cork, except furniture, manufacture of articles of straw and plaiting materials
- H51, Air transport
- I, Accommodation and food service activities
- F, Construction

The sectors with the highest participation of high-skilled employment (Level 5-8) are:

- M72, Scientific research and development
- J62_J63, Computer programming, consultancy and related activities, information service activities
- J59_J60, Motion picture, video and television programme production, sound recording and music publishing activities, programming and broadcasting activities
- M71, Architectural and engineering activities, technical testing and analysis
- C21, Manufacture of basic pharmaceutical products and pharmaceutical preparations

#### *2.3.7.2. Job vacancy rate*

Figure 0.84 shows the job vacancy rate for the United Kingdom in 2017. The sectors with the highest job vacancy rates are: Accommodation and food service activities (I), Information and

communication (J), Real estate activities (L) and Arts, entertainment, recreation and other service activities (R-S).

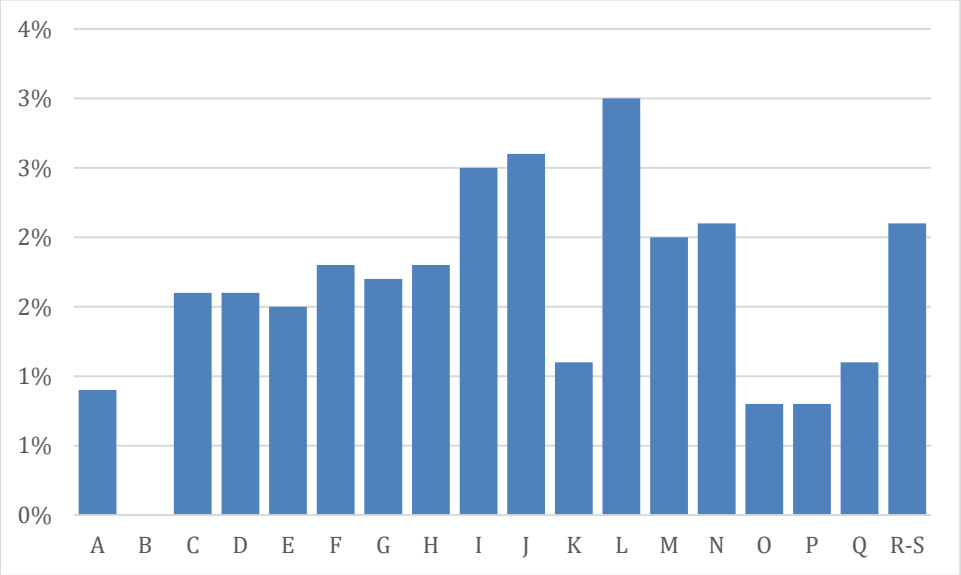



*Figure 0.84: Job vacancy rate, United Kingdom, 2017*

### 2.3.7.3. Employability opportunities for MRAS

For the determination of the employability opportunities of MRAs in the United Kingdom, two composite indicators are used, the SIRIUS Indicator for Sectors (SIRIUS 1) and the SIRIUS Indicator for Occupations (SIRIUS 2). The construction of SIRIUS 1 requires the estimation of the Growth Indicator for Sectors (GIS) and the Sectoral Structure Similarity (SSS) and the construction of SIRIUS 2 requires, at first, the estimation of the Growth Indicator for Occupations (GIO) and the Occupational Structure Similarity (OSS).

The GIS and the SSS for United Kingdom are shown in Figure 0.85.

The sectors with highest GIS are:

- Q, Human health and social work activities
- P85, Education
- G47, Retail trade, except of motor vehicles and motorcycles
- R_S, Arts, entertainment and recreation and other service activities
- O84, Public administration and defense, compulsory social security
- I, Accommodation and food service activities
- M69_M70, Legal and accounting activities, activities of head offices, management consultancy activities
- N, Administrative and support service activities
- J62_J63, Computer programming, consultancy and related activities, information service activities
- M71, Architectural and engineering activities, technical testing and analysis

Moreover, the sectors with the highest SSS are:

- C28, Manufacture of machinery and equipment n.e.c.
- H50, Water transport
- O84, Public administration and defense, compulsory social security
- C20, Manufacture of chemicals and chemical products
- M73, Advertising and market research
- M74_M75, Other professional, scientific and technical activities, veterinary activities

- C21, Manufacture of basic pharmaceutical products and pharmaceutical preparations
- C26, Manufacture of computer, electronic and optical products
- J59_J60, Motion picture, video and television program production, sound recording and music publishing activities, programming and broadcasting activities
- K66, Activities auxiliary to financial services and insurance activities

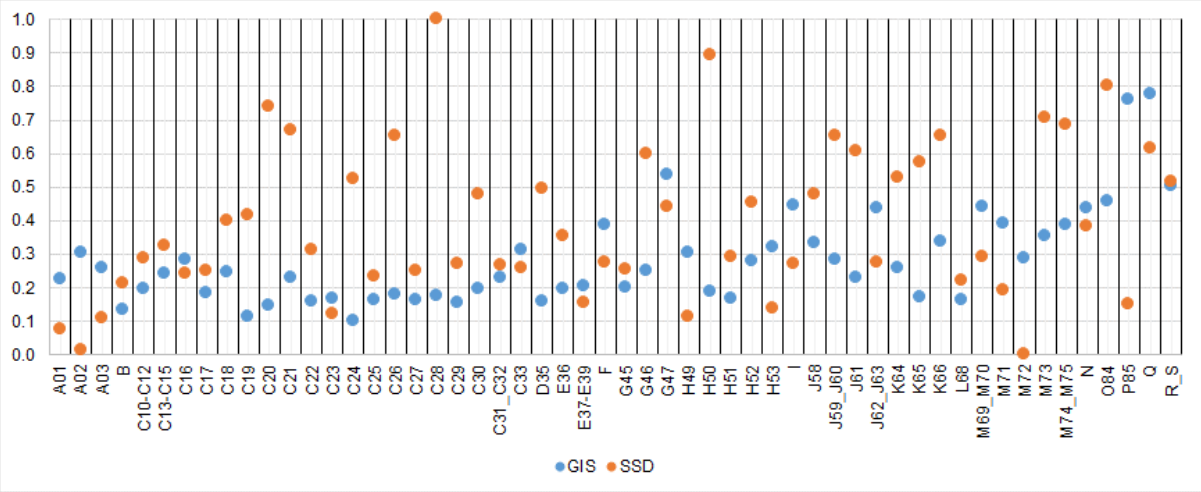



*Figure 0.85: GIS and SSS, United Kingdom*

The values of the SIRIUS Indicator for Sectors (SIRIUS 1) are employed in order to rank the sectors and to identify the sectors of 1st priority for the integration of MRAs into the labour market of United Kingdom. The SIRIUS 1 indicator is presented in Figure 0.86.

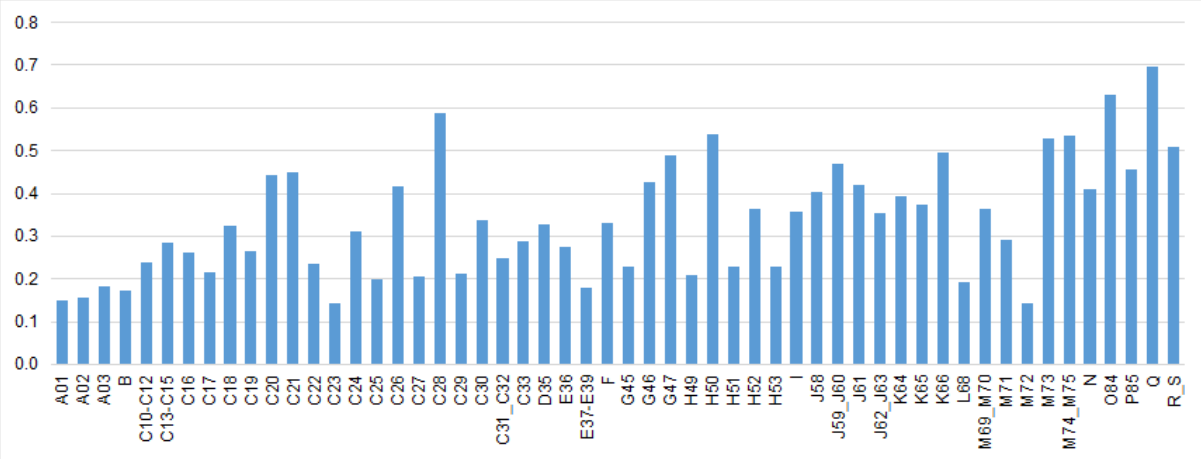



*Figure 0.86: SIRIUS 1, United Kingdom*

Based on the above figure, the sectors of the United Kingdom which are determined as 1st priority for the employability of MRAs are:

- Q, Human health and social work activities
- O84, Public administration and defense, compulsory social security
- C28, Manufacture of machinery and equipment n.e.c.
- H50, Water transport
- M74_M75, Other professional, scientific and technical activities, veterinary activities
- M73, Advertising and market research
- R_S, Arts, entertainment and recreation and other service activities

- K66, Activities auxiliary to financial services and insurance activities
- G47, Retail trade, except of motor vehicles and motorcycles
- J59_J60, Motion picture, video and television program production, sound recording and music publishing activities, programming and broadcasting activities

The GIO and the OSD for United Kingdom are shown in Figure 0.87.

The occupations with the highest GIO are:

- 33, Business and administration associate professionals
- 23, Teaching professionals
- 21, Science and engineering professionals
- 51, Personal service workers
- 12, Administrative and commercial managers
- 11, Chief executives, senior officials and legislators
- 41, General and keyboard clerks
- 24, Business and administration professionals
- 52, Sales workers
- 71, Building and related trades workers, excluding electricians

Moreover, the occupations with the highest OSS are:

- 83, Drivers and mobile plant operators
- 13, Production and specialised services managers
- 42, Customer services clerks
- 73, Handicraft and printing workers
- 43, Numerical and material recording clerks
- 95, Street and related sales and service workers
- 94, Food preparation assistants
- 11, Chief executives, senior officials and legislators
- 63, Subsistence farmers, fishers, hunters and gatherers
- 34, Legal, social, cultural and related associate professionals

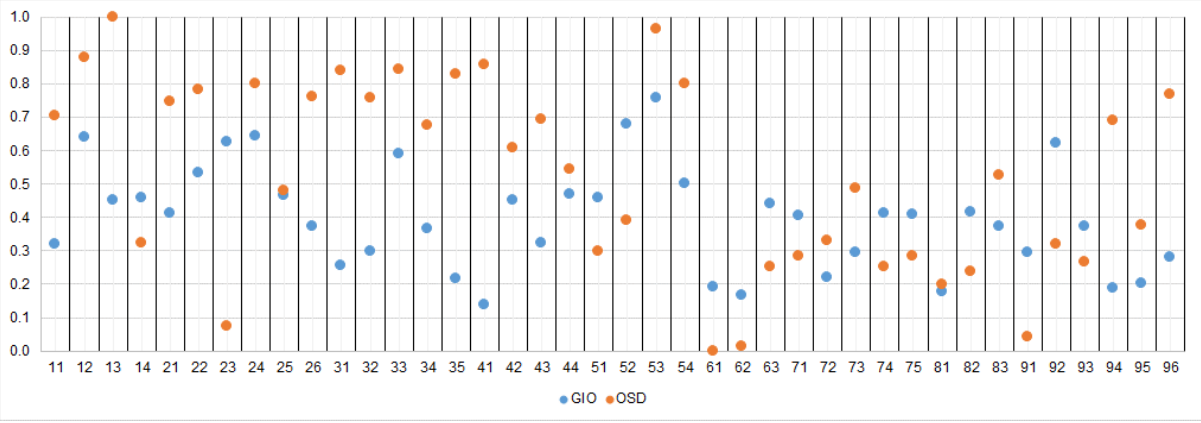



*Figure 0.87: GIO and OSS, United Kingdom*

The values of the SIRIUS Indicator for Occupations (SIRIUS 2) are employed in order to rank the occupations and to identify the occupations of 1st priority for the integration of MRAs into the labour market of the United Kingdom. The SIRIUS 2 indicator is presented in Figure 0.88.

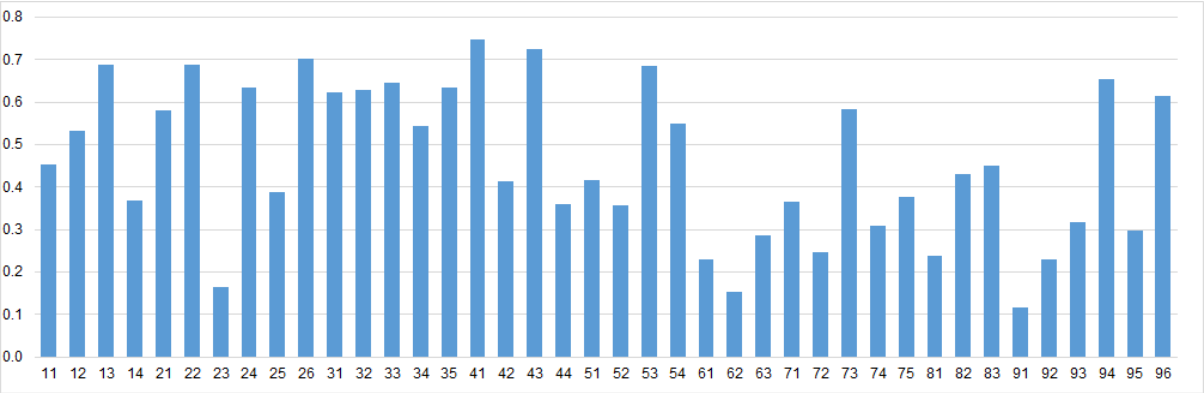



*Figure 0.88: SIRIUS 2, United Kingdom*

Based on the above figure, the occupations of the United Kingdom, which are determined as 1st priority for the employability of MRAs are:

- 83, Drivers and mobile plant operators
- 73, Handicraft and printing workers
- 22, Health professionals
- 92, Agricultural, forestry and fishery labourers
- 95, Street and related sales and service workers
- 82, Assemblers
- 41, General and keyboard clerks
- 53, Personal care workers
- 43, Numerical and material recording clerks
- 94, Food preparation assistants

The above analysis shows that the employability potential of MRAs in the United Kingdom is concentrated in one industrial and nine service sectors. The industrial sector is characterised by medium-high R&D intensity and the service sectors are characterized by low or medium-low R&D intensity. Moreover, the occupations with high employability potential are in the categories of professionals, technicians and associate professionals and clerical support workers.

### 2.3.8. Switzerland

#### *2.3.8.1. Sectoral Analysis*

The employment share of the primary sector in Switzerland was 3.52% in 2011 and declined to 3.11% in 2017. The respective shares of employment in the manufacturing sector was 22.32% and 20.55% and in the tertiary sector 74.16% and 76.34%, respectively.

In Figure 0.89 the employment structure of Switzerland for the years 2011 and 2017 is presented on a sector-by-sector basis.

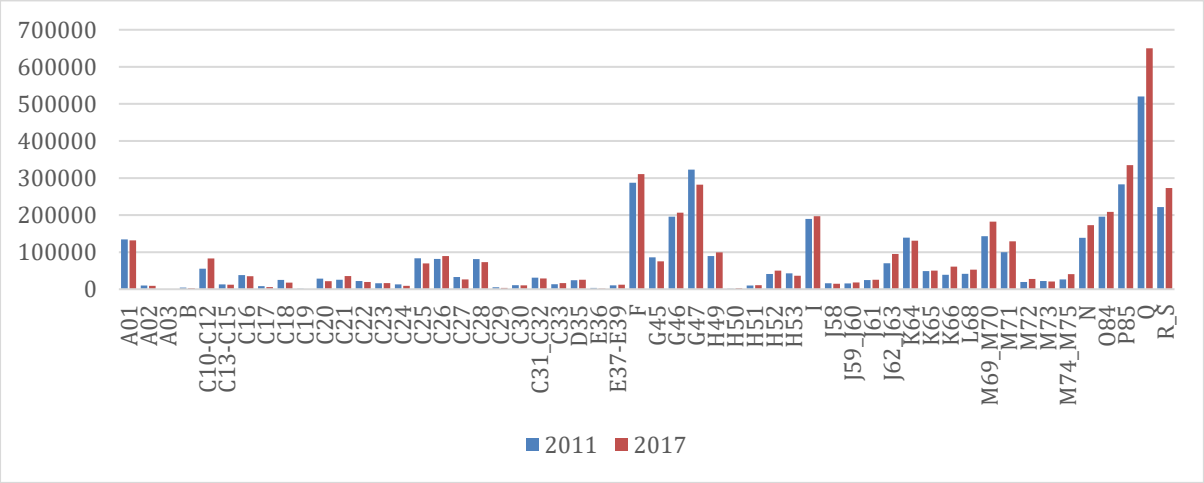



*Figure 0.89: Employment Structure by sector of economic activity, Switzerland (2011 & 2017)*

The sectors with the highest participation rate in employment are:

- Q, Human health and social work activities
- P85, Education
- F, Construction
- G47, Retail trade, except of motor vehicles and motorcycles
- R_S, Other service activities
- O84, Public administration and defence, compulsory social security
- G46, Wholesale trade, except of motor vehicles and motorcycles
- I, Accommodation and food service activities
- M69_M70, Legal and accounting activities, activities of head offices, management consultancy activities
- N, Administrative and support service activities

The sectors with the highest increase in the percentage change of employment between the years 2011 and 2017 are:

- H50, Water transport
- K66, Activities auxiliary to financial services and insurance activities
- M74_M75, Other professional, scientific and technical activities, veterinary activities
- C10 - C12, Manufacture of food products, beverages and tobacco products
- M72, Scientific research and development
- C21, Manufacture of basic pharmaceutical products and pharmaceutical preparations
- J62_J63, Computer programming, consultancy and related activities, information service activities
- M71, Architectural and engineering activities, technical testing and analysis
- L68, Real estate activities
- M69_M70, Legal and accounting activities, activities of head offices, management consultancy activities

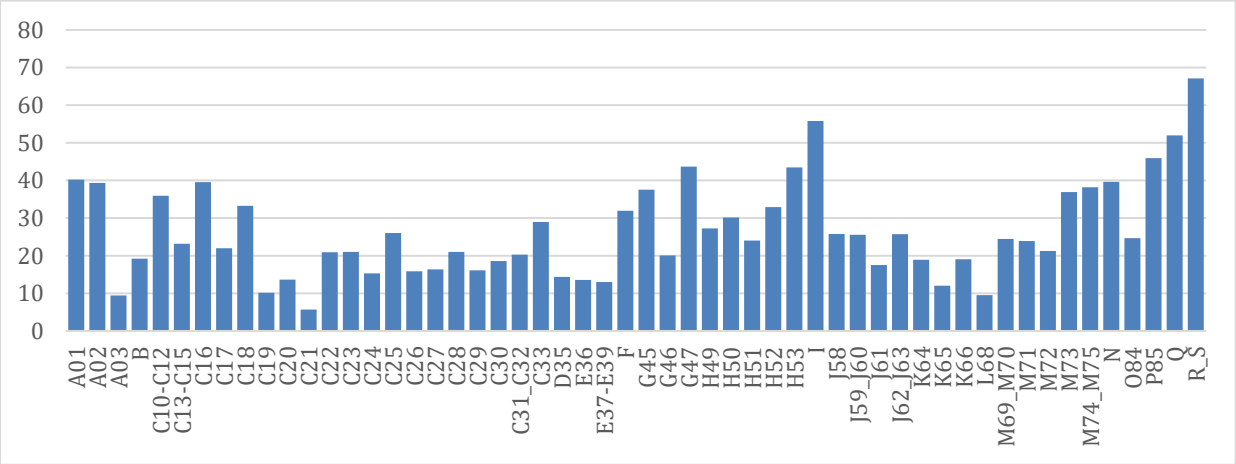



*Figure 0.90 Backward employment multipliers, Switzerland, 2017*

In Figure 0.90 the backward employment multipliers for Switzerland are represented, for 2017. The sectors with the highest backward employment multipliers are:

- R_S, Other service activities
- I, Accommodation and food service activities
- Q, Human health and social work activities
- P85, Education
- G47, Retail trade, except of motor vehicles and motorcycles
- H53, Postal and courier activities
- A01, Crop and animal production, hunting and related service activities
- N, Administrative and support service activities
- C16, Manufacture of wood and of products of wood and cork, except furniture, manufacture of articles of straw and plaiting materials
- A02, Forestry and logging

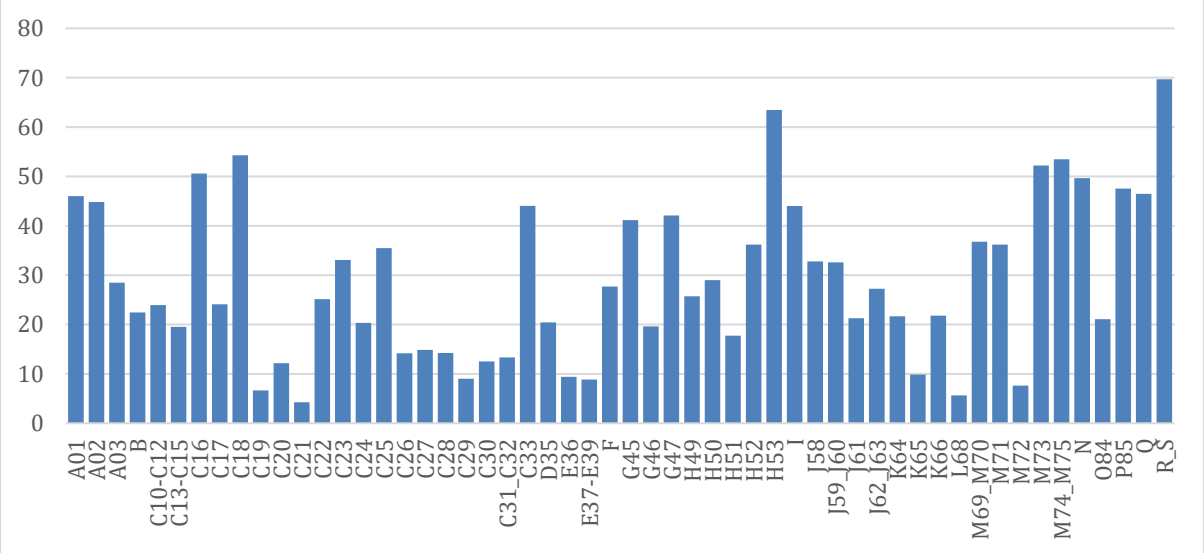



*Figure 0.91 Forward employment multipliers, Switzerland, 2017*

In Figure 0.91, the forward employment multipliers for Switzerland are presented for 2017. The sectors with the highest forward employment multipliers are:

- R_S, Other service activities
- H53, Postal and courier activities
- C18, Printing and reproduction of recorded media
- M74_M75, Other professional, scientific and technical activities, veterinary activities
- M73, Advertising and market research
- C16, Manufacture of wood and of products of wood and cork, except furniture, manufacture of articles of straw and plaiting materials
- N, Administrative and support service activities
- P85, Education
- Q, Human health and social work activities
- A01, Crop and animal production, hunting and related service activities

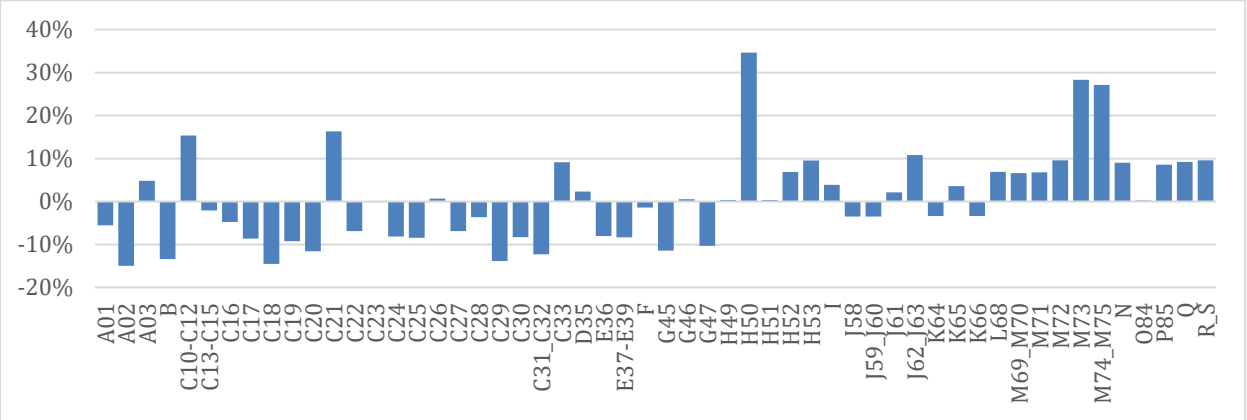



*Figure 0.92 Percentage change of the backward employment multipliers between the years 2011 and 2017, Switzerland*

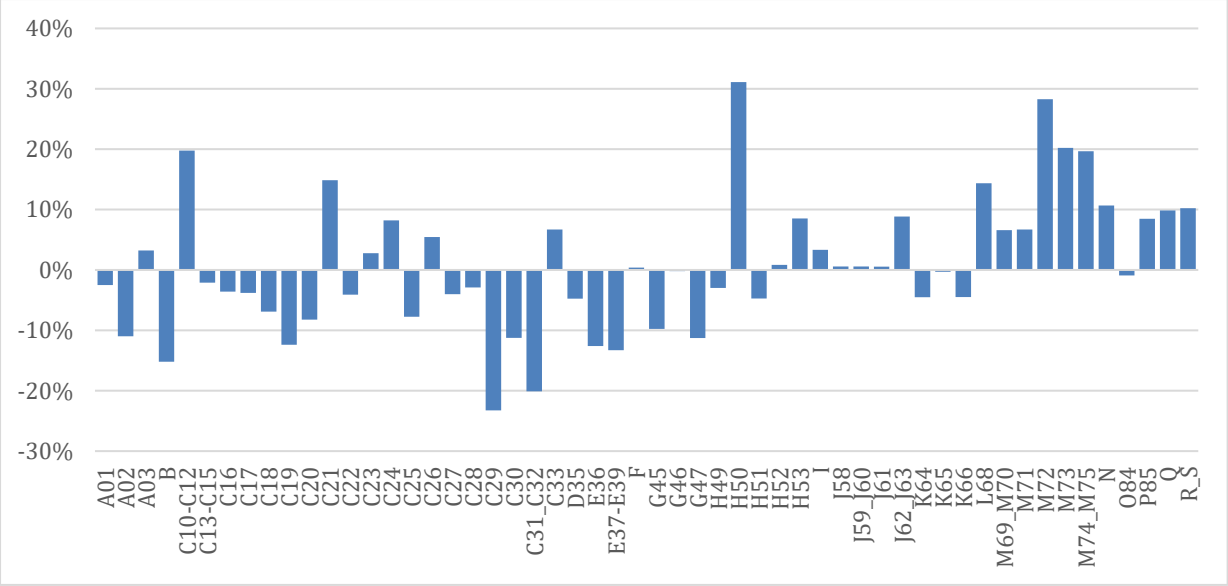



*Figure 0.93 Percentage change of the forward employment multipliers between the years 2011 and 2017, Switzerland*

In Figure 0.92 and Figure 0.93 the percentages changes of backward and forward multipliers, respectively, are presented, between the years 2011 and 2017. The sectors with the highest increase in both multipliers are:

- H50, Water transport
- M73, Advertising and market research
- M74_M75, Other professional, scientific and technical activities, veterinary activities
- M72, Scientific research and development
- C10-C12, Manufacture of food products, beverages and tobacco products
- C21, Manufacture of basic pharmaceutical products and pharmaceutical preparations
- L68, Real estate activities
- R_S, Other service activities
- N, Administrative and support service activities
- J62_J63, Computer programming, consultancy and related activities, information service activities

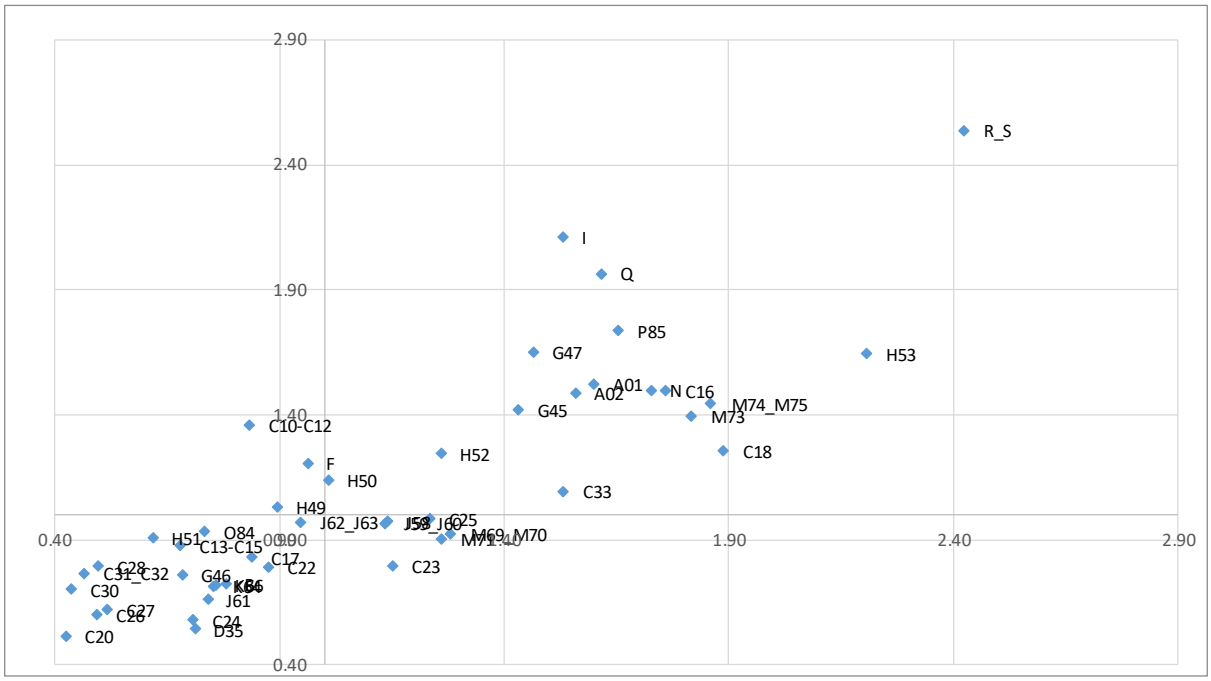



*Figure 0.94: Key sectors of employment, Switzerland, 2017*

Figure 0.79 shows the key sectors of Switzerland. The figure is designed as follows: The horizontal axis represents the normalized forward employment multipliers and the vertical one the normalized backward employment multipliers. The two axes intersect at the point (1, 1). The particular presentation gives the ability to "map" the economy following the schema: A sector located in the first quadrant is a key sector of the economy, a sector located in the second quadrant is a Leontief key sector, a sector located in the third quadrant is not a key sector, and, finally, a sector located in the fourth quadrant is Ghosh key sector. The key sectors of Switzerland are:

- A01, Crop and animal production, hunting and related service activities
- A02, Forestry and logging
- C16, Manufacture of wood and of products of wood and cork, except furniture, manufacture of articles of straw and plaiting materials
- C18, Printing and reproduction of recorded media

- C33, Repair and installation of machinery and equipment
- G45, Wholesale and retail trade and repair of motor vehicles and motorcycles
- G47, Retail trade, except of motor vehicles and motorcycles
- H52, Warehousing and support activities for transportation
- H53, Postal and courier activities
- I, Accommodation and food service activities
- M73, Advertising and market research
- M74_M75, Other professional, scientific and technical activities, veterinary activities
- N, Administrative and support service activities
- P85, Education
- Q, Human health and social work activities
- R_S, Other service activities

#### *2.3.8.2. Occupations*

In Figure 0.95 the employment structure by occupation in Switzerland for the years 2011 and 2017 is presented.

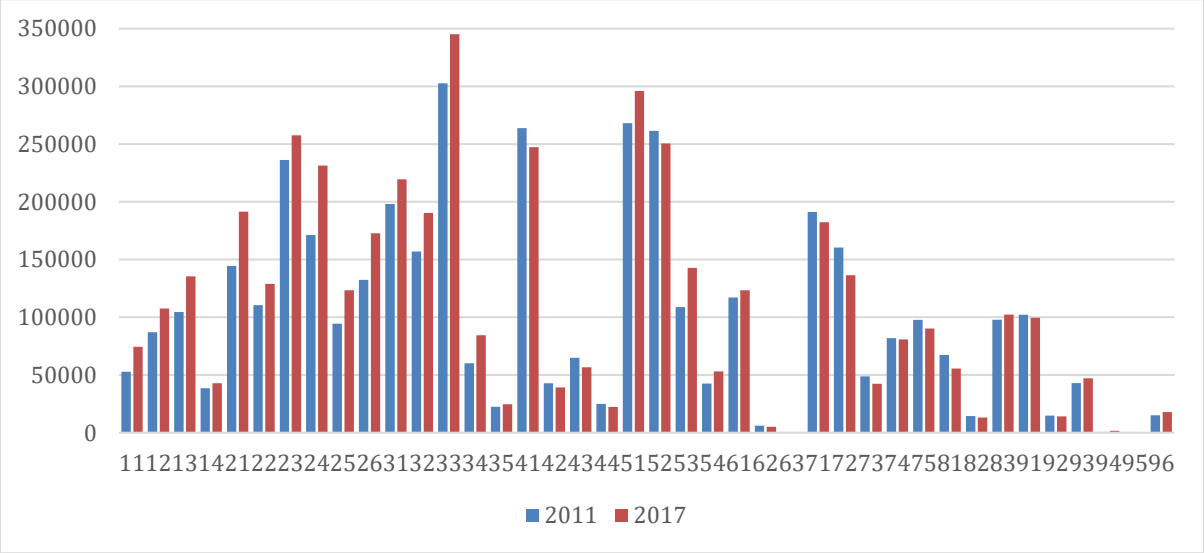



*Figure 0.95: Employment structure by occupation, Switzerland, 2011 & 2017*

The occupations with the highest participation rate in employment for 2017 are:

- 11, Chief executives, senior officials and legislators
- 12, Administrative and commercial managers
- 92, Agricultural, forestry and fishery labourers
- 74, Electrical and electronic trades workers
- 91, Cleaners and helpers
- 23, Teaching professionals
- 72, Metal, machinery and related trades workers
- 21, Science and engineering professionals
- 25, Information and communications technology professionals
- 83, Drivers and mobile plant operators

The occupations with the highest increase in the percentage change of employment between the years 2011 and 2017 are:

- 81, Stationary plant and machine operators
- 21, Science and engineering professionals
- 32, Health associate professionals
- 96, Refuse workers and other elementary workers
- 54, Protective services workers
- 91, Cleaners and helpers
- 83, Drivers and mobile plant operators
- 13, Production and specialized services managers
- 92, Agricultural, forestry and fishery labourers
- 42, Customer services clerks

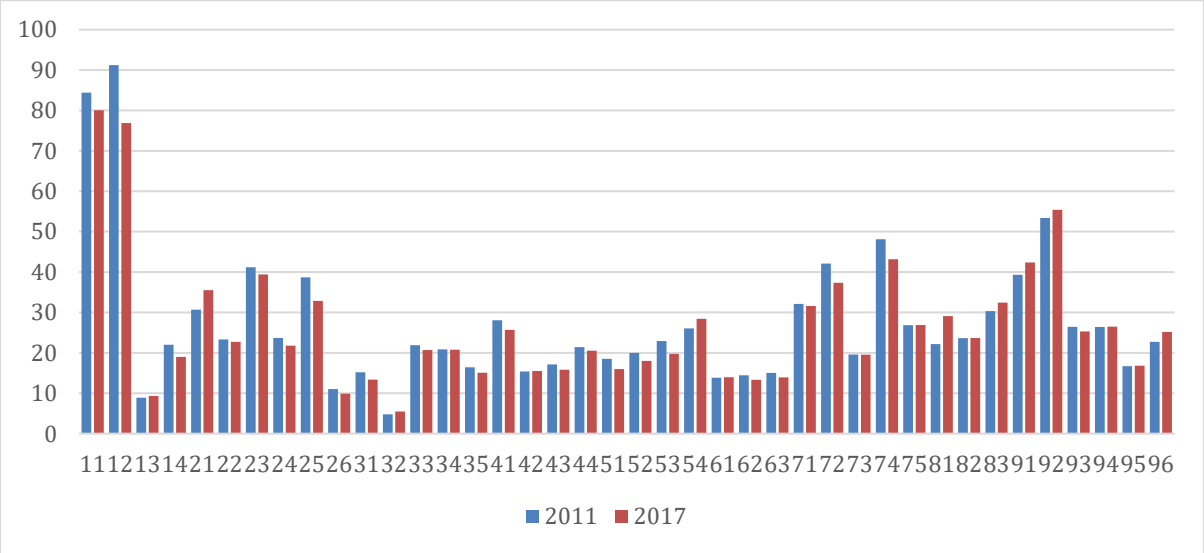



*Figure 0.96: Occupational multipliers, Switzerland, 2011 & 2017*

In Figure 0.96 the occupational multipliers for Switzerland are presented, for the years 2011 and 2017. The occupations with the highest multipliers in 2017 are:

- 33, Business and administration associate professionals
- 51, Personal service workers
- 23, Teaching professionals
- 52, Sales workers
- 41, General and keyboard clerks
- 24, Business and administration professionals
- 31, Science and engineering associate professionals
- 21, Science and engineering professionals
- 32, Health associate professionals
- 71, Building and related trades workers, excluding electricians

The occupations with the highest increase in their multipliers between the years 2011 and 2017 are:

- 94, Food preparation assistants
- 34, Legal, social, cultural and related associate professionals

- 95, Street and related sales and service workers
- 24, Business and administration professionals
- 21, Science and engineering professionals
- 53, Personal care workers
- 25, Information and communications technology professionals
- 26, Legal, social and cultural professionals
- 13, Production and specialised services managers
- 54, Protective services workers

#### 2.3.8.3. Skills

In Figure 0.97 the employment structure by educational attainment level for Switzerland is presented. Level 0-2 and level 3-4 participation rate in employment significantly decreased for the period examined, while the participation rate of level 5-8 significantly increased.

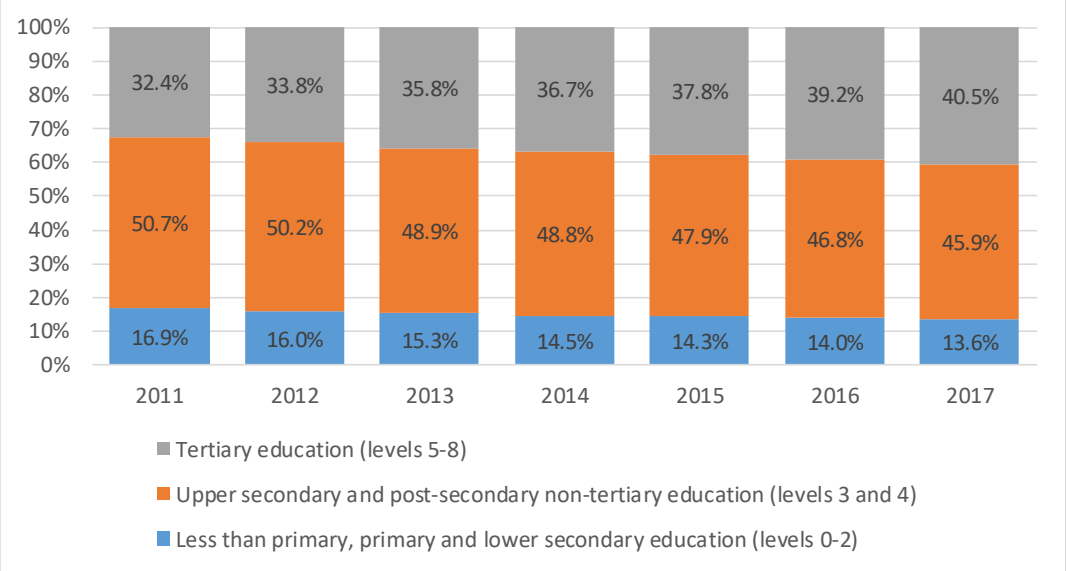



*Figure 0.97: Employment by educational attainment level, Switzerland*

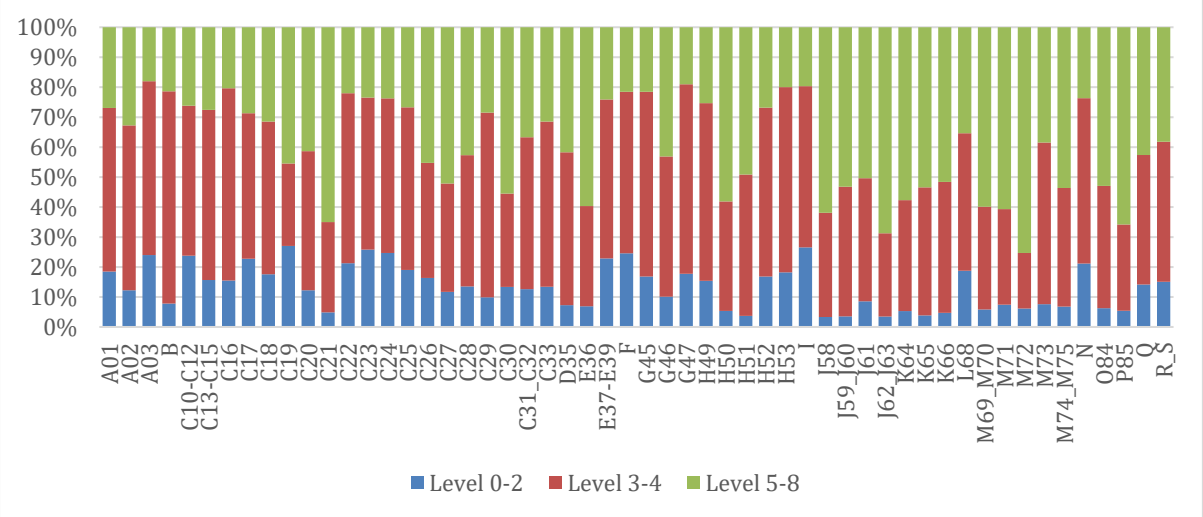



*Figure 0.98: Structure of employment by sector of economic activity and educational attainment level, Switzerland, 2017*

The sectors with the highest participation of low-skilled employment (Level 0-2) are:

- C19, Manufacture of coke and refined petroleum products
- I, Accommodation and food service activities
- C23, Manufacture of other non-metallic mineral products
- C24, Manufacture of basic metals
- F, Construction

The sectors with the highest participation of medium-skilled employment (Level 3-4) are:

- B, Mining and quarrying
- C16, Manufacture of wood and of products of wood and cork, except furniture, manufacture of articles of straw and plaiting materials
- G47, Retail trade, except of motor vehicles and motorcycles
- H53, Postal and courier activities
- G45, Wholesale and retail trade and repair of motor vehicles and motorcycles

The sectors with the highest participation of high-skilled employment (Level 5-8) are:

- M72, Scientific research and development
- J62_J63, Computer programming, consultancy and related activities, information service activities
- P85, Education
- C21, Manufacture of basic pharmaceutical products and pharmaceutical preparations
- J58, Publishing activities

#### *2.3.8.4. Job vacancy rate*

Figure 0.99 shows the job vacancy rate for Switzerland in 2017. The sectors with the highest job vacancy rates are: Accommodation and food service activities (I), Information and communication (J), Real estate activities (L), Professional, scientific and technical activities (M), Administrative and support service activities (N) and Arts, entertainment, recreation and other service activities (R-S).

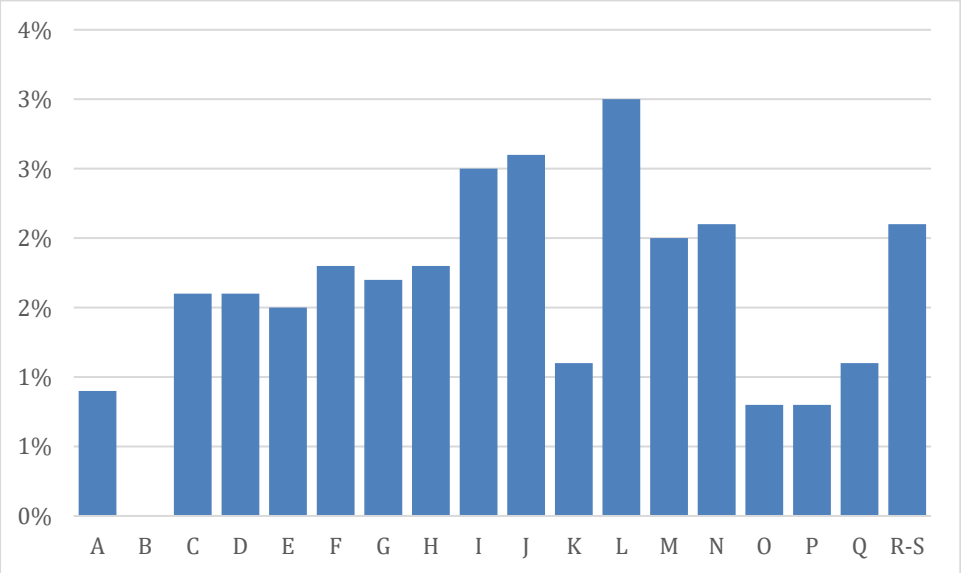



*Figure 0.99: Job vacancy rate, United Kingdom, 2017*

### 2.3.8.5. Employability opportunities for MRAS

For the determination of the employability opportunities of MRAs in Switzerland two composite indicators are used, the SIRIUS Indicator for Sectors (SIRIUS 1) and the SIRIUS Indicator for Occupations (SIRIUS 2). The construction of SIRIUS 1 requires the estimation of the Growth Indicator for Sectors (GIS) and the Sectoral Structure Similarity (SSS) and the construction of SIRIUS 2 requires, at first, the estimation of the Growth Indicator for Occupations (GIO) and the Occupational Structure Similarity (OSS).

The GIS and the SSS for Switzerland are shown in Figure 0.100.

The sectors with the highest GIS are:

- Q, Human health and social work activities
- R_S, Arts, entertainment and recreation and other service activities
- P85, Education
- I, Accommodation and food service activities
- G47, Retail trade, except of motor vehicles and motorcycles
- N, Administrative and support service activities
- F, Construction
- H53, Postal and courier activities
- M74_M75, Other professional, scientific and technical activities, veterinary activities
- M69_M70, Legal and accounting activities, activities of head offices, management consultancy activities.

Moreover, the sectors with the highest SSS are:

- C24, Manufacture of basic metals
- C30, Manufacture of other transport equipment
- C13-C15, Manufacture of textiles, wearing apparel and leather products
- G46, Wholesale trade, except of motor vehicles and motorcycles
- C28, Manufacture of machinery and equipment n.e.c.
- F, Construction
- C29, Manufacture of motor vehicles, trailers and semi - trailers
- R_S, Arts, entertainment and recreation and other service activities
- N, Administrative and support service activities
- C10-C12, Manufacture of food products, beverages and tobacco products

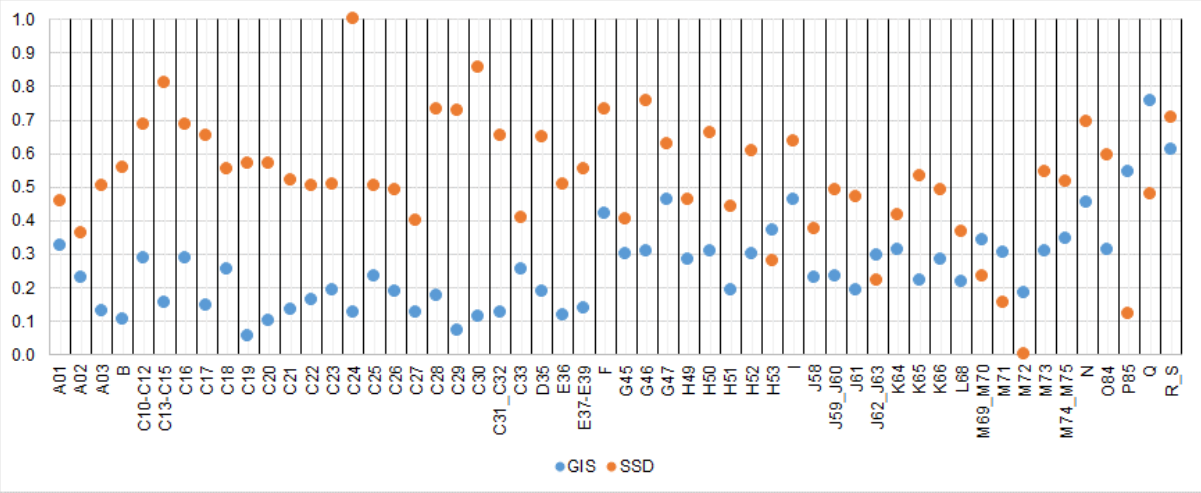



*Figure 0.100: GIS and SSS, Switzerland*

The values of the SIRIUS Indicator for Sectors (SIRIUS 1) are used to rank the sectors and to identify the sectors of 1st priority for the integration of MRAs into the labour market of Switzerland. The SIRIUS 1 indicator is presented in Figure 0.101.

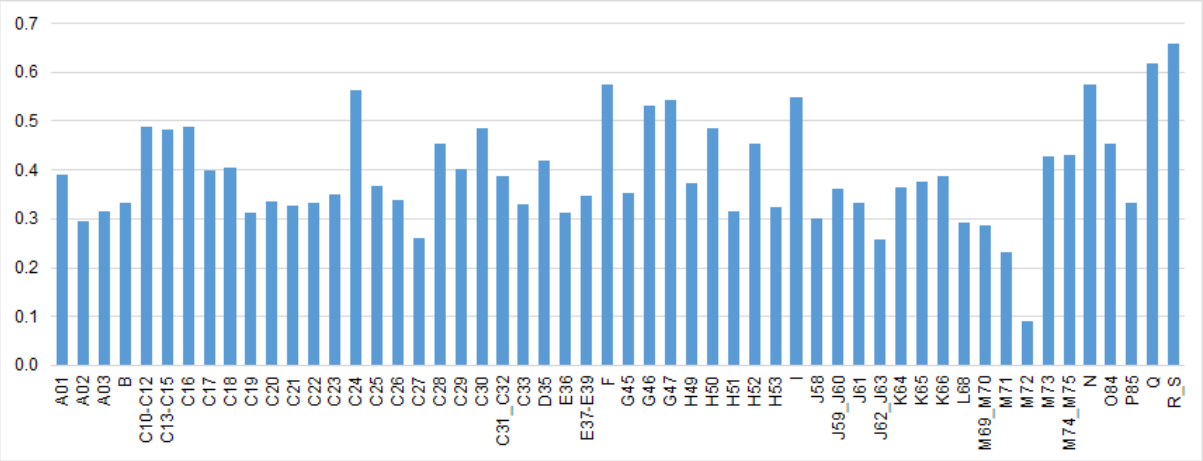



*Figure 0.101: SIRIUS 1, Switzerland*

Based on the above figure, the sectors of Switzerland which are determined as 1st priority for the employability of MRAs are:

- R_S, Arts, entertainment and recreation and other service activities
- Q, Human health and social work activities
- F, Construction
- N, Administrative and support service activities
- C24, Manufacture of basic metals
- I, Accommodation and food service activities
- G47, Retail trade, except of motor vehicles and motorcycles
- G46, Wholesale trade, except of motor vehicles and motorcycles
- C10-C12, Manufacture of food products, beverages and tobacco products
- C16, Manufacture of wood and of products of wood and cork, except furniture, manufacture of articles of straw and plaiting materials

The GIO and the OSD for Switzerland are shown in Figure 0.102.

The occupations with the highest GIO are:

- 33, Business and administration associate professionals
- 23, Teaching professionals
- 21, Science and engineering professionals
- 51, Personal service workers
- 12, Administrative and commercial managers
- 11, Chief executives, senior officials and legislators
- 41, General and keyboard clerks
- 24, Business and administration professionals
- 52, Sales workers
- 71, Building and related trades workers, excluding electricians

Moreover, the occupations with the highest OSS are:

- 83, Drivers and mobile plant operators
- 13, Production and specialised services managers

- 42, Customer services clerks
- 73, Handicraft and printing workers
- 43, Numerical and material recording clerks
- 95, Street and related sales and service workers
- 94, Food preparation assistants
- 11, Chief executives, senior officials and legislators
- 63, Subsistence farmers, fishers, hunters and gatherers
- 34, Legal, social, cultural and related associate professionals

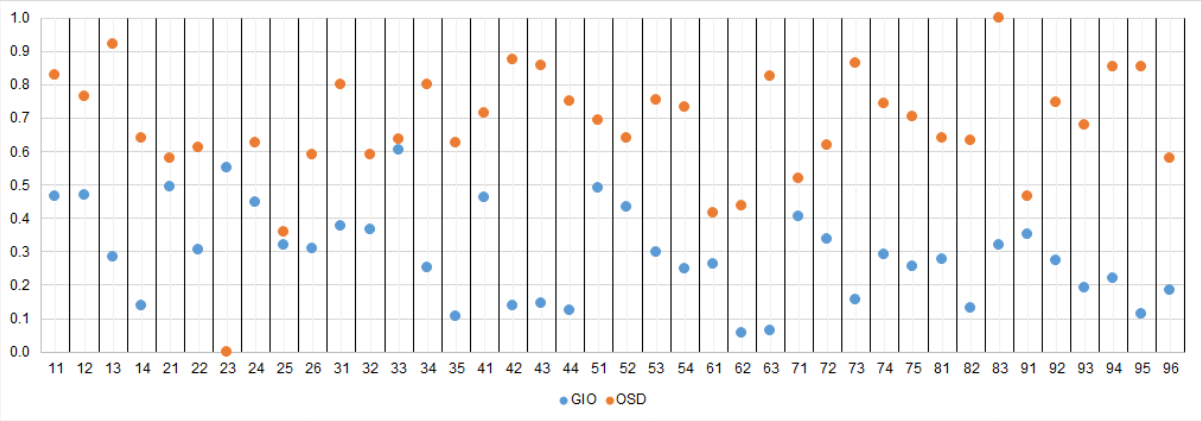



*Figure 0.102: GIO and OSS, Switzerland*

The values of the SIRIUS Indicator for Occupations (SIRIUS 2) are employed in order to rank the occupations and to identify the occupations of 1st priority for the integration of MRAs into the labour market of Switzerland. The SIRIUS 2 indicator is presented in Figure 0.103.

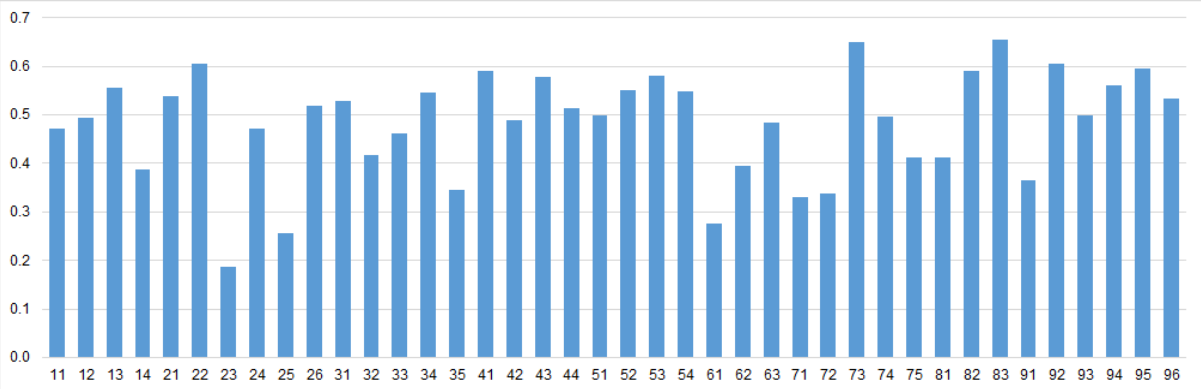



*Figure 0.103: SIRIUS 2, Switzerland*

Based on the above figure, the occupations of Switzerland which are determined as 1st priority for the employability of MRAs are:

- 83, Drivers and mobile plant operators
- 73, Handicraft and printing workers
- 22, Health professionals
- 92, Agricultural, forestry and fishery labourers
- 95, Street and related sales and service workers
- 82, Assemblers
- 41, General and keyboard clerks
- 53, Personal care workers
- 43, Numerical and material recording clerks

- 94, Food preparation assistants

The above analysis shows that the employability potential of MRAs in Switzerland are concentrated in three industrial and seven services sectors. The industrial sectors are characterised by medium-low and medium R&D intensity and the services sectors are characterized by low R&D intensity. Moreover, the occupations with high employability potential are in the categories Clerical support workers, Plant and machine operators and assemblers and Elementary occupations.

### 2.3.9. Conclusions

For the evaluation of the results and for the comparative examination of the MRAs employability among the SIRIUS countries we employ the Spearman rank correlation coefficient.[15]

In Table 0.3 the rank of sectors based on the Growth Indicator of Sector (GIS), the Sectoral Structure Similarity (SSS) and the SIRIUS Indicator for Sectors (SIRIUS 1) are listed for the Czech Republic, Greece, Denmark, the United Kingdom and Switzerland[16]. For each country, the sectors with the highest values are highlighted.

*Table 0.3: Sectors' rank for GIS, SSS and SIRIUS 1*

| | Growth Indicator for Sectors (GIS) | | | | | Sectoral Structure Similarity (SSS) | | | | | SIRIUS Indicator for Sectors (SIRIUS 1) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Czech Republic | Greece | Denmark | United Kingdom | Switzerland | Czech Republic | Greece | Denmark | United Kingdom | Switzerland | Czech Republic | Greece | Denmark | United Kingdom | Switzerland |

[15] Spearman rank correlation coefficient, commonly referred to as Spearman's rho coefficient, is a statistic used to measure the ordinal association between the rankings of two variables. It assesses how well the relationship between two variables can be described using a monotonic function. A rho test is a non-parametric hypothesis test for statistical dependence based on the tau coefficient. The Spearman correlation between two variables will be high when observations have a similar (or identical for a correlation equal to 1) rank between the two variables, and low when observations have a dissimilar (or fully opposed for a correlation of −1) rank between the two variables.

Given a sample of paired data $(X_1, Y_1), (X_2, Y_2), \dots, (X_n, Y_n)$, the values of $X$ and $Y$ are converted to rank, creating the paired data $(R_1, S_1), (R_2, S_2), \dots, (R_n, S_n)$, where $R_i$ is the rank of $X_i$ and $S_i$ is the rank of $Y_i$. The Spearman rank correlation coefficient $rho$ is given by equation:

$$rho = 1 - \frac{6 \cdot \sum_{i=1}^{n} {D_i}^2}{n(n^2 + 1)}$$

, where $D_i = R_i - S_i$

The Spearman rank-correlation coefficient ranges from -1 to 1. A rho coefficient near 1 indicates a strong positive association between the ranks for the two variables, while a rho coefficient near -1 indicates a strong negative association between the ranks for the two variables. A rho coefficient of 0 indicates no association between the ranks for the two variables.

[16] Note that Finland and Italy are not included in the evaluation of the results, since the available data for these countries follow the 1-digit classification of sectors, so they are not compatible with the results of the rest of SIRIUS countries.

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **A01** | 17 | 2 | 51 | 32 | 11 | 50 | 6 | 46 | 52 | 40 | 45 | 1 | 52 | 52 | 23 |
| **A02** | 33 | 18 | 50 | 19 | 30 | 52 | 8 | 49 | 53 | 48 | 53 | 9 | 53 | 51 | 48 |
| **A03** | 11 | 45 | 54 | 24 | 45 | 47 | 3 | 39 | 51 | 33 | 41 | 7 | 50 | 48 | 44 |
| **B** | 41 | 38 | 46 | 52 | 51 | 29 | 14 | 33 | 44 | 22 | 36 | 16 | 37 | 50 | 39 |
| **C10-C12** | 23 | 13 | 33 | 37 | 22 | 18 | 11 | 21 | 31 | 10 | 18 | 11 | 23 | 37 | 9 |
| **C13-C15** | 27 | 27 | 48 | 28 | 41 | 30 | 7 | 11 | 27 | 3 | 32 | 10 | 24 | 32 | 13 |
| **C16** | 32 | 16 | 32 | 22 | 21 | 42 | 1 | 30 | 41 | 11 | 43 | 2 | 28 | 35 | 10 |
| **C17** | 47 | 48 | 39 | 39 | 42 | 25 | 10 | 29 | 40 | 14 | 37 | 18 | 32 | 42 | 22 |
| **C18** | 22 | 15 | 25 | 27 | 25 | 7 | 25 | 34 | 24 | 24 | 10 | 22 | 33 | 28 | 20 |
| **C19** | 54 | 51 | 53 | 53 | 54 | 4 | 31 | 32 | 23 | 20 | 14 | 41 | 40 | 34 | 45 |
| **C20** | 51 | 46 | 47 | 51 | 52 | 39 | 43 | 3 | 4 | 21 | 47 | 53 | 11 | 13 | 35 |
| **C21** | 46 | 34 | 37 | 31 | 44 | 41 | 45 | 6 | 7 | 27 | 44 | 48 | 14 | 12 | 41 |
| **C22** | 37 | 35 | 40 | 48 | 40 | 15 | 20 | 36 | 28 | 31 | 28 | 26 | 38 | 38 | 37 |
| **C23** | 31 | 47 | 30 | 44 | 34 | 34 | 9 | 41 | 49 | 29 | 39 | 17 | 42 | 53 | 32 |
| **C24** | 42 | 52 | 41 | 54 | 46 | 16 | 13 | 1 | 16 | 1 | 33 | 24 | 7 | 29 | 5 |
| **C25** | 13 | 32 | 21 | 46 | 28 | 27 | 19 | 37 | 42 | 32 | 15 | 20 | 35 | 46 | 28 |
| **C26** | 45 | 42 | 45 | 40 | 37 | 36 | 40 | 18 | 8 | 34 | 42 | 49 | 26 | 16 | 34 |
| **C27** | 40 | 40 | 38 | 47 | 48 | 21 | 26 | 48 | 39 | 45 | 34 | 32 | 48 | 45 | 51 |
| **C28** | 29 | 53 | 28 | 41 | 39 | 20 | 32 | 2 | 1 | 5 | 25 | 43 | 5 | 3 | 15 |
| **C29** | 10 | 54 | 43 | 50 | 53 | 8 | 2 | 24 | 35 | 7 | 5 | 8 | 30 | 43 | 21 |
| **C30** | 36 | 20 | 22 | 35 | 50 | 13 | 16 | 5 | 19 | 2 | 22 | 15 | 9 | 25 | 11 |
| **C31_C32** | 21 | 31 | 34 | 30 | 47 | 22 | 12 | 26 | 36 | 13 | 20 | 13 | 25 | 36 | 24 |
| **C33** | 43 | 50 | 36 | 17 | 26 | 14 | 34 | 45 | 37 | 43 | 27 | 45 | 47 | 31 | 40 |
| **D35** | 48 | 36 | 44 | 49 | 36 | 1 | 33 | 22 | 18 | 15 | 7 | 33 | 29 | 27 | 19 |
| **E36** | 50 | 43 | 52 | 36 | 49 | 9 | 27 | 35 | 26 | 30 | 23 | 34 | 46 | 33 | 46 |
| **E37-E39** | 38 | 41 | 35 | 33 | 43 | 38 | 5 | 38 | 46 | 23 | 40 | 6 | 41 | 49 | 33 |
| **F** | 4 | 12 | 7 | 11 | 7 | 37 | 4 | 23 | 32 | 6 | 11 | 4 | 13 | 26 | 3 |
| **G45** | 14 | 25 | 19 | 34 | 19 | 24 | 23 | 47 | 38 | 44 | 13 | 25 | 39 | 41 | 31 |
| **G46** | 26 | 26 | 11 | 26 | 16 | 2 | 24 | 10 | 13 | 4 | 3 | 27 | 8 | 14 | 8 |
| **G47** | 1 | 1 | 1 | 3 | 5 | 6 | 21 | 28 | 22 | 17 | 1 | 3 | 4 | 9 | 7 |
| **H49** | 9 | 19 | 18 | 18 | 23 | 35 | 17 | 43 | 50 | 39 | 26 | 14 | 36 | 44 | 27 |
| **H50** | 20 | 39 | 6 | 38 | 14 | 23 | 35 | 4 | 2 | 12 | 17 | 39 | 3 | 4 | 12 |
| **H51** | 52 | 44 | 49 | 43 | 35 | 11 | 36 | 42 | 29 | 41 | 31 | 42 | 49 | 39 | 43 |
| **H52** | 28 | 24 | 29 | 23 | 18 | 3 | 28 | 31 | 21 | 18 | 6 | 28 | 27 | 21 | 16 |
| **H53** | 15 | 21 | 8 | 16 | 8 | 33 | 30 | 53 | 48 | 49 | 21 | 29 | 44 | 40 | 42 |
| **I** | 6 | 3 | 5 | 6 | 4 | 19 | 15 | 27 | 34 | 16 | 9 | 5 | 10 | 23 | 6 |
| **J58** | 53 | 29 | 14 | 15 | 29 | 46 | 49 | 25 | 20 | 46 | 52 | 52 | 19 | 18 | 47 |
| **J59_J60** | 39 | 17 | 17 | 21 | 27 | 31 | 41 | 18 | 8 | 34 | 35 | 35 | 17 | 10 | 30 |
| **J61** | 49 | 30 | 24 | 29 | 33 | 44 | 47 | 15 | 12 | 38 | 50 | 47 | 18 | 15 | 38 |
| **J62_J63** | 25 | 10 | 12 | 9 | 20 | 49 | 51 | 44 | 33 | 51 | 51 | 46 | 34 | 24 | 52 |
| **K64** | 35 | 28 | 27 | 25 | 12 | 45 | 48 | 16 | 15 | 42 | 46 | 51 | 21 | 19 | 29 |
| **K65** | 44 | 23 | 31 | 42 | 31 | 12 | 38 | 12 | 14 | 26 | 24 | 36 | 20 | 20 | 26 |
| **K66** | 12 | 37 | 26 | 14 | 24 | 28 | 41 | 18 | 8 | 34 | 16 | 44 | 22 | 8 | 25 |
| **L68** | 34 | 49 | 42 | 45 | 32 | 17 | 29 | 50 | 43 | 47 | 29 | 38 | 51 | 47 | 49 |
| **M69_M70** | 24 | 7 | 10 | 7 | 10 | 48 | 50 | 40 | 30 | 50 | 48 | 40 | 31 | 22 | 50 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **M71** | 16 | 4 | 13 | 10 | 17 | 51 | 52 | 51 | 45 | 52 | 49 | 31 | 43 | 30 | 53 |
| **M72** | 30 | 33 | 23 | 20 | 38 | 54 | 54 | 54 | 54 | 54 | 54 | 54 | 54 | 54 | 54 |
| **M73** | 19 | 14 | 20 | 13 | 15 | 40 | 44 | 9 | 5 | 25 | 38 | 37 | 12 | 6 | 18 |
| **M74_M75** | 18 | 11 | 15 | 12 | 9 | 26 | 39 | 14 | 6 | 28 | 19 | 30 | 15 | 5 | 17 |
| **N** | 7 | 9 | 4 | 8 | 6 | 10 | 18 | 17 | 25 | 9 | 4 | 12 | 6 | 17 | 4 |
| **O84** | 5 | 6 | 2 | 5 | 13 | 32 | 37 | 7 | 3 | 19 | 8 | 19 | 1 | 2 | 14 |
| **P85** | 2 | 8 | 9 | 2 | 3 | 53 | 53 | 52 | 47 | 53 | 30 | 50 | 45 | 11 | 36 |
| **Q** | 3 | 5 | 3 | 1 | 1 | 43 | 46 | 8 | 11 | 37 | 12 | 21 | 2 | 1 | 2 |
| **R_S** | 8 | 22 | 16 | 4 | 2 | 5 | 22 | 13 | 17 | 8 | 2 | 23 | 16 | 7 | 1 |

The application of the Spearman rank-correlation coefficient in the above data leads to the following results, in Table 0.4. The rho for GIS is higher among the countries, than the relative coefficient for SSS and SIRIUS 1. The higher similarity in GIS rank is observed between United Kingdom and Switzerland and the lower between Czech Republic and Greece. The rho of SSS shows in general that the rank of countries is not similar, with the exception of Denmark and the United Kingdom, which shows high rank similarity in SSS. The rho of SIRIUS 1 shows in general that the rank of countries is not similar, with the exception of Denmark and the United Kingdom, Denmark and Switzerland which show high rank similarity in SSS. It should be noted that the value of SSS and SIRIUS 1 depends on the educational attainment level structure of MRAs.

*Table 0.4: Spearman rank-correlation coefficient for GIS, SSS and SIRIUS 1*

| | **GIS** | | | | **SSS** | | | | **SIRIUS 1** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Greece** | **Denmark** | **United Kingdom** | **Switzerland** | **Greece** | **Denmark** | **United Kingdom** | **Switzerland** | **Greece** | **Denmark** | **United Kingdom** | **Switzerland** |
| **Czech Republic** | 0.597 | 0.622 | 0.627 | 0.678 | 0.286 | 0.247 | 0.282 | 0.573 | 0.35 | 0.393 | 0.28 | 0.655 |
| **Greece** | | 0.657 | 0.755 | 0.768 | | -0.065 | -0.432 | 0.547 | | 0.03 | -0.367 | 0.503 |
| **Denmark** | | | 0.722 | 0.769 | | | 0.861 | 0.691 | | | 0.799 | 0.731 |
| **United Kingdom** | | | | 0.783 | | | | 0.39 | | | | 0.435 |

The rho for GIS is higher among the countries, than the relative coefficient for SSS and SIRIUS 1. The higher similarity in the GIS rank is observed between the United Kingdom and Switzerland and the lower between the Czech Republic and Greece.

The rho of SSS shows in general that the rank of countries is not similar, with the exception of Denmark and the United Kingdom, which shows high rank similarity in SSS. Furthermore, the rho of SIRIUS 1 shows in general that the rank of countries is not similar, with the exception of Denmark and the United Kingdom, and Denmark and Switzerland which show high rank similarity in SIRIUS 1. It should be noted that the value of SSS and SIRIUS 1 strongly depend on the educational attainment level structure of MRAs.

In conclusion, it should be noted that the examined countries show medium to strong association among the sectors' rank order. Namely, despite the differences of the SIRIUS countries structure and features of employment, the results of the Growth Indicator for sectors (GIS) results in similar rankings. However, the Sectoral Structure Similarity (SSS) results in

sectors' rank orders with low association among the countries. The last finding means that the level of similarity between the MRAs' educational attainment level and the labour market demand of the SIRIUS countries is of high diversity. Or, in other words, that the sectors with labour demand similar to the MRAs education attainment level are different between the examined economies. For the interpretation for this important finding we should consider the differences of MRAs educational attainment level between the countries. Finally, the low to medium association among the rank order of SIRIUS 1, is the result of the low SSS accosiation.

Using the online application of SIRIUS, our SIRIUS partners can identify the rank order of sectors for different MRAs characteristics.

In Table 0.5 the rank of sectors based on the Growth Indicator for Occupations (GIO), the Occupational Structure Similarity (OSS) and the Sectoral Employability Indicator (SIRIUS 2) are listed for the Czech Republic, Greece, Denmark, the United Kingdom and Switzerland[17]. For each country, the occupations with the highest value are highlighted.

*Table 0.5: Sectors' rank for GIO, OSS, SIRIUS 2*

| | Growth Indicator for Occupations (GIO) | | | | | Occupational Structure Similarity (OSS) | | | | | SIRIUS Indicator for Occupations (SIRIUS 2) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Czech Republic | Greece | Denmark | United Kingdom | Switzerland | Czech Republic | Greece | Denmark | United Kingdom | Switzerland | Czech Republic | Greece | Denmark | United Kingdom | Switzerland |
| **11** | 35 | 38 | 35 | 27 | 6 | 7 | 23 | 9 | 15 | 8 | 28 | 29 | 15 | 19 | 26 |
| **12** | 33 | 18 | 50 | 19 | 30 | 19 | 26 | 4 | 3 | 12 | 24 | 24 | 7 | 18 | 23 |
| **13** | 11 | 45 | 54 | 24 | 45 | 24 | 20 | 1 | 1 | 2 | 23 | 30 | 1 | 4 | 11 |
| **14** | 41 | 38 | 46 | 52 | 51 | 10 | 15 | 31 | 27 | 22 | 8 | 9 | 32 | 26 | 33 |
| **21** | 23 | 13 | 33 | 37 | 22 | 35 | 38 | 8 | 14 | 33 | 30 | 20 | 11 | 15 | 15 |
| **22** | 27 | 27 | 48 | 28 | 41 | 32 | 35 | 13 | 10 | 30 | 15 | 21 | 10 | 5 | 3 |
| **23** | 32 | 16 | 32 | 22 | 21 | 40 | 40 | 40 | 37 | 40 | 36 | 40 | 40 | 38 | 40 |
| **24** | 47 | 48 | 39 | 39 | 42 | 31 | 34 | 15 | 8 | 28 | 33 | 36 | 12 | 10 | 27 |
| **25** | 22 | 15 | 25 | 27 | 25 | 36 | 39 | 28 | 23 | 39 | 38 | 39 | 28 | 24 | 39 |
| **26** | 54 | 51 | 53 | 53 | 54 | 33 | 36 | 20 | 12 | 31 | 32 | 25 | 17 | 3 | 18 |
| **31** | 51 | 46 | 47 | 51 | 52 | 12 | 25 | 3 | 6 | 11 | 11 | 28 | 6 | 12 | 17 |
| **32** | 46 | 34 | 37 | 31 | 44 | 34 | 37 | 10 | 13 | 32 | 35 | 32 | 26 | 11 | 29 |
| **33** | 37 | 35 | 40 | 48 | 40 | 26 | 30 | 16 | 5 | 25 | 31 | 35 | 21 | 8 | 28 |
| **34** | 31 | 47 | 30 | 44 | 34 | 3 | 24 | 14 | 18 | 10 | 5 | 18 | 8 | 17 | 14 |
| **35** | 42 | 52 | 41 | 54 | 46 | 28 | 32 | 17 | 7 | 27 | 34 | 33 | 13 | 9 | 35 |
| **41** | 13 | 32 | 21 | 46 | 28 | 21 | 29 | 6 | 4 | 18 | 20 | 38 | 16 | 1 | 7 |
| **42** | 45 | 42 | 45 | 40 | 37 | 2 | 19 | 18 | 19 | 3 | 7 | 22 | 23 | 23 | 24 |
| **43** | 40 | 40 | 38 | 47 | 48 | 6 | 21 | 11 | 16 | 5 | 6 | 26 | 3 | 2 | 9 |
| **44** | 29 | 53 | 28 | 41 | 39 | 1 | 27 | 23 | 20 | 14 | 1 | 37 | 33 | 28 | 19 |
| **51** | 10 | 54 | 43 | 50 | 53 | 13 | 12 | 29 | 29 | 20 | 13 | 11 | 24 | 22 | 20 |
| **52** | 36 | 20 | 22 | 35 | 50 | 4 | 18 | 32 | 24 | 24 | 14 | 34 | 34 | 29 | 12 |
| **53** | 21 | 31 | 34 | 30 | 47 | 30 | 31 | 2 | 2 | 13 | 19 | 27 | 4 | 6 | 8 |

[17] Note that Finland and Italy are not included in the evaluation of the results, since the available data for these countries follow the 1-digit classification of occupations, so they are not compatible with the results of the rest of the SIRIUS countries.

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **54** | 43 | 50 | 36 | 17 | 26 | 14 | 28 | 5 | 9 | 17 | 16 | 31 | 14 | 16 | 13 |
| **61** | 48 | 36 | 44 | 49 | 36 | 39 | 3 | 39 | 40 | 38 | 40 | 5 | 39 | 36 | 38 |
| **62** | 50 | 43 | 52 | 36 | 49 | 38 | 2 | 37 | 39 | 37 | 37 | 3 | 37 | 39 | 32 |
| **63** | 38 | 41 | 35 | 33 | 43 | 29 | 4 | 26 | 34 | 9 | 21 | 6 | 25 | 33 | 25 |
| **71** | 4 | 12 | 7 | 11 | 7 | 15 | 17 | 36 | 30 | 35 | 22 | 16 | 36 | 27 | 37 |
| **72** | 14 | 25 | 19 | 34 | 19 | 9 | 16 | 35 | 26 | 29 | 25 | 23 | 35 | 34 | 36 |
| **73** | 26 | 26 | 11 | 26 | 16 | 8 | 14 | 19 | 22 | 4 | 2 | 2 | 2 | 14 | 2 |
| **74** | 1 | 1 | 1 | 3 | 5 | 23 | 5 | 25 | 33 | 16 | 27 | 13 | 30 | 31 | 22 |
| **75** | 9 | 19 | 18 | 18 | 23 | 18 | 8 | 27 | 31 | 19 | 26 | 17 | 31 | 25 | 30 |
| **81** | 20 | 39 | 6 | 38 | 14 | 25 | 6 | 33 | 36 | 23 | 29 | 12 | 29 | 35 | 31 |
| **82** | 52 | 44 | 49 | 43 | 35 | 22 | 10 | 34 | 35 | 26 | 9 | 7 | 9 | 21 | 6 |
| **83** | 28 | 24 | 29 | 23 | 18 | 11 | 13 | 7 | 21 | 1 | 17 | 10 | 18 | 20 | 1 |
| **91** | 15 | 21 | 8 | 16 | 8 | 37 | 1 | 38 | 38 | 36 | 39 | 1 | 38 | 40 | 34 |
| **92** | 6 | 3 | 5 | 6 | 4 | 16 | 11 | 24 | 28 | 15 | 10 | 4 | 20 | 37 | 4 |
| **93** | 53 | 29 | 14 | 15 | 29 | 17 | 9 | 30 | 32 | 21 | 3 | 8 | 27 | 30 | 21 |
| **94** | 39 | 17 | 17 | 21 | 27 | 5 | 22 | 12 | 17 | 7 | 12 | 19 | 5 | 7 | 10 |
| **95** | 49 | 30 | 24 | 29 | 33 | 20 | 7 | 21 | 25 | 6 | 4 | 14 | 22 | 32 | 5 |
| **96** | 25 | 10 | 12 | 9 | 20 | 27 | 33 | 22 | 11 | 34 | 18 | 15 | 19 | 13 | 16 |

The application of the Spearman rank-correlation coefficient in the above data leads to the following results in Table 0.6.

*Table 0.6: Spearman rank-correlation coefficient for GIO, OSS and SIRIUS 2*

| | **GIO** | | | | **OSS** | | | | **SIRIUS 2** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Greece** | **Denmark** | **United Kingdom** | **Switzerland** | **Greece** | **Denmark** | **United Kingdom** | **Switzerland** | **Greece** | **Denmark** | **United Kingdom** | **Switzerland** |
| **Czech Republic** | 0.503 | 0.553 | 0.399 | 0.478 | 0.174 | 0.199 | 0.110 | 0.686 | 0.192 | 0.362 | 0.126 | 0.660 |
| **Greece** | | 0.623 | 0.629 | 0.565 | | -0.492 | -0.703 | 0.219 | | -0.161 | -0.479 | 0.112 |
| **Denmark** | | | 0.543 | 0.691 | | | 0.880 | 0.571 | | | 0.791 | 0.677 |
| **United Kingdom** | | | | 0.717 | | | | 0.303 | | | | 0.451 |

The rho for GIO is higher among the countries than the relative coefficient for OSS and SIRIUS 2. The highest similarity (with rho equal to 0.717) in GIO rank is observed between the United Kingdom and Switzerland and the lowest (rho equal to 0.399) between the Czech Republic and the United Kingdom. High (low) similarity between two countries means that the rank order of occupations is (not) correlated.

The rho of OSS shows in general that the rank of countries is not similar, with the exception of Denmark and the United Kingdom, which shows high rank similarity in OSS and between the United Kingdom and Greece which have high inversed similarity. Furthermore, the rho of SIRIUS 2 shows, in general, that the rank of the countries is not similar, with the exception of Denmark and the United Kingdom, Denmark and Switzerland and the Czech Republic and Switzerland, which show relatively high rank similarity in SIRIUS 2. It should be noted that the

value of OSS and SIRIUS 2 strongly depend on the educational attainment level structure of MRAs.

In conclusion, the examined countries show small to medium association among the occupations' rank order. Namely, the differences of occupational structure of employment in the SIRIUS countries structure lead to diversed ranking based on the Growth Indicator for occupations (GIO). Moreover, the Occupational Structure Similarity (OSS) results occupations' rank orders with low association among the countries. The last finding means that the occupations with labour demand similar to the MRAs education attainment level are different between the examined economies. For the interpretation of this important finding, we should keep in mind should the differences of MRAs educational attainment level between the countries. Finally, the low to medium association among the rank order of SIRIUS 1 is the result of the low GIO and OSS accosiation.

The above findings indicates that MRAs integration policies which will focus on the increase of their employability in the host country labour market, should focus in different sectors and occupations for each country. Or, in other words, that the integration policies in a cross country level could cover a wide ranges of sectors and occupations, giving the abiltity of integration to MRAs with different characteristics.

Using the online application (see http://sirius.semfe.ntua.gr/2/), our SIRIUS partners can identify the rank order of occupations for different MRAs characteristics.

Finally, Table 0.7 and Table 2.8 summarize the 1st priority sectors and occupations by country in order to increase the employability of MRAs, based on the current MRAs educational attainment level. Additionally, in Table 0.7 the R&D intensity of the 1st priority sectors is presented. Note that the classification of sectors is as follows: LI: Low R&D intensity, MLI: Medium-Low R&D intensity, MHI: Medium-High R&D intensity, HI: High R&D intensity.

*Table 0.7: 1st priority sectors for MRAs*

| | **Czech Republic** | | **Greece** | | **Denmark** | | **United Kingdom** | | **Switzerland** | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sector | R&D Intensity | Sector | R&D Intensity | Sector | R&D Intensity | Sector | R&D Intensity | Sector | R&D Intensity |
| 1 | Retail trade, except of motor vehicles and motorcycles | LI | Crop and animal production, hunting and related service activities | LI | Public administration and defense, compulsory social security | - | Human health and social work activities | - | Arts, entertainment and recreation and other service activities | LI |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 | Arts, entertainment and recreation and other service activities | LI | Manufacture of wood and of products of wood and cork | MLI | Human health and social work activities | - | Public administration and defense, compulsory social security | - | Human health and social work activities | - |
| 3 | Wholesale trade, except of motor vehicles and motorcycles | LI | Retail trade, except of motor vehicles and motorcycles | LI | Water transport | LI | Manufacture of machinery and equipment n.e.c. | MHI | Construction | LI |
| 4 | Administrative and support service activities | LI | Construction | LI | Retail trade, except of motor vehicles and motorcycles | LI | Water transport | LI | Administrative and support service activities | LI |
| 5 | Manufacture of motor vehicles, trailers and semi - trailers | MHI | Accommodation and food service activities | LI | Manufacture of machinery and equipment n.e.c. | MHI | Other professional, scientific and technical activities, | MLI | Manufacture of basic metals | MI |
| 6 | Motion picture, video and television program production, sound recording and music publishing activities, programming and broadcasting activities | LI | Sewerage, waste collection, treatment and disposal activities, and other waste management services | LI | Administrative and support service activities | LI | Advertising and market research | MLI | Accommodation and food service activities | LI |
| 7 | Electricity, gas, steam and air conditioning supply | LI | Fishing and aquaculture | LI | Manufacture of basic metals | MI | Arts, entertainment and recreation and other service activities | LI | Retail trade, except of motor vehicles and motorcycles | LI |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 8 | Public administration and defense, compulsory social security | - | Manufacture of motor vehicles, trailers and semi - trailers | MHI | Wholesale trade, except of motor vehicles and motorcycles | LI | Activities auxiliary to financial services and insurance activities | LI | Wholesale trade, except of motor vehicles and motorcycles | LI |
| 9 | Accommodation and food service activities | LI | Forestry and logging | LI | Manufacture of other transport equipment | MHI | Retail trade, except of motor vehicles and motorcycles | LI | Manufacture of food products, beverages and tobacco products | MLI |
| 10 | Printing and reproduction of recorded media | MLI | Manufacture of textiles, wearing apparel and leather products | MLI | Accommodation and food service activities | LI | Motion picture, video and television program production, sound recording and music publishing activities, programming and broadcasting | LI | Manufacture of wood and of products of wood and cork | MLI |

| | **Finland** | **Italy** |
|---|---|---|
| 1 | Wholesale and retail trade, repair of motor | Manufacturing |
| 2 | Construction | Wholesale and retail trade, repair of motor |
| 3 | Public administration and defence, compulsory | Agriculture, forestry and fishing |

*Table 0.8: 1st priority occupations for MRAs*

| | **Czech Republic** | **Greece** | **Denmark** | **United Kingdom** | **Switzerland** |
|---|---|---|---|---|---|
| **1** | Other clerical support workers | Cleaners and helpers | Production and specialised services managers | General and keyboard clerks | Drivers and mobile plant operators |
| **2** | Handicraft and printing workers | Handicraft and printing workers | Handicraft and printing workers | Numerical and material recording clerks | Handicraft and printing workers |
| **3** | Labourers in mining, construction, manufacturing and | Market-oriented skilled forestry, fishery and hunting workers | Numerical and material recording clerks | Legal, social and cultural professionals | Health professionals |
| **4** | Street and related sales and service workers | Agricultural, forestry and fishery labourers | Personal care workers | Production and specialised services managers | Agricultural, forestry and fishery labourers |

| | | | | | |
|---|---|---|---|---|---|
| **5** | Legal, social, cultural and related associate professionals | Market-oriented skilled agricultural workers | Food preparation assistants | Health professionals | Street and related sales and service workers |
| **6** | Numerical and material recording clerks | Subsistence farmers, fishers, hunters and gatherers | Science and engineering associate professionals | Personal care workers | Assemblers |
| **7** | Customer services clerks | Assemblers | Administrative and commercial managers | Food preparation assistants | General and keyboard clerks |
| **8** | Hospitality, retail and other services managers | Labourers in mining, construction, manufacturing and | Legal, social, cultural and related associate professionals | Business and administration associate professionals | Personal care workers |
| **9** | Assemblers | Hospitality, retail and other services managers | Assemblers | Information and communications technicians | Numerical and material recording clerks |
| **10** | Agricultural, forestry and fishery labourers | Drivers and mobile plant operators | Health professionals | Business and administration professionals | Food preparation assistants |

| | **Finland** | **Italy** |
|---|---|---|
| **1** | Craft and related trades workers | Clerical support workers |
| **2** | Skilled agricultural, forestry and fishery workers | Service and sales workers |
| **3** | Professionals | Professionals |

# 3. General Conclusions

Lately, the issue of migration has become a hot heated topic for nearly every country in the world since the number of international migrants worldwide has continued to grow. In this context, the present report consists of two main parts. The first part of this report aimed at identifying the SIRIUS economies and the sectors of economic activity that could be considered as being “labour absorbing”. The econometric investigation used was twofold. Firstly, using the GVAR framework, the dynamic interlinkages and the potential spillover effects among the various SIRIUS economies were uncovered. The implicit assumption in this framework is that there is labour mobility among the various economies. In this context, the results of the GVAR estimation pinpointed the labour absorbing economies in the dataset. Next, using the VAR/VEC framework, we investigated if there was any specific labour absorbing sectors for all the SIRIUS economies. The implicit assumption was that there was labour mobility across the various sectors, but not necessarily across the various economies. Note, that the results of the two methodologies employed are not mutually exculsive. In other words, based on our two step approach, the first step provided evidence for the total economy, whereas the second step provided evidence for the sectoral dimesion of the economy. Therefore, a labour absorbing economy identified in the first step, implies that the economy in total could attract more labour from the rest of the economies in order to increase its production. On the other hand, a labour absorbing sector, identified in the second step, implies that this specific sector could attract, independently, more labour from the rest of the sectors in order to increase its production. The fundamental difference in the second step is that the labour attracted by a sector comes directly from the labour force of the respective economy, whereas, in the first step, the labour attracted by an economy comes both from the rest of the economies, as well form the respective economy.

At the first step, in order to identify the SIRIUS economies that could be considered as being “labour absorbing”, we use aggregate national data for the time period 2008-2016. Econometrically, in order to take into consideration the complex labour dynamics among the various SIRIUS economies as well as the potential spillover effects among the various countries, this report employed a GVAR model for all the economies. At the second step, this report analysed the labour absorbing sectors in the SIRIUS economies. In this context, sectoral data for the economies of Switzerland (CH), Czech Republic (CZ), Finland (FI) and, United Kingdom (UK), Greece (GR), Denmark (DK) and Italy (IT), that cover the four main sectors of economic activity, i.e. Primary sector (A, Nace Rev.2), Secondary sector (B-F, Nace Rev.2), Manufacturing sector (C, Nace Rev.2), and Tertiary sector (G-U, Nace Rev.2), that capture each sector’s output (Y) and Labour (L), were employed for the time period 2008-2016.

One of the main findings of the first part of the report is that the aggregate output of the UK has a statistically significant effect on the aggregate labour dynamics of the Czech Republic, Finland and Switzerland. This could be attributed to the strong business links and the interconnection between the UK and these economies, mainly in terms of trade and financial relations (WIOT, 2016). Another finding of the GVAR model employed is the fact that the economies of the UK, Switzerland, Finalnd and the Czech Republic could be considered as being “labour absorbing”.

Another main finding is that the economies of Switzerland and Greece have the highest “labour absorbing” capability for MRAs in the sense that all their sectors are characterized as being “labour absorbing”. Then, the economies of Finland and the Czech Republic have three labour absorbing sectors, whereas Denmark presents two and the UK only one labour absorbing sector, respectively. It should be noted that, with the exception of Italy, the primary sector in all the economies could be considered as being “labour absorbing”. This implies that in most economies there is a dire need for labourers in the Agriculture, Forestry, Fishing and other related activities sector. Finally, another interesting finding is the fact that the secondary

sector is considered to be “labour absorbing” for all the SIRIUS economies with the exception of Italy and the UK, whereas the manufacturing and tertiary sectors are considered to be “labour absorbing” for three out of seven SIRIUS economies.

In other words, based on our GVAR analysis the economies of the UK, Switzerland, Finland and the Czech Republic can attract extra labourers from the other SIRIUS economies. In this context, in these economies, any potential future migration flows have increased potential of being integrated into their labour markets. As far as the VAR/VEC sectoral econometric analysis is concerned, the results presented previously, showed that the SIRIUS economies have the capacity to reallocate their labour force between the various economic sectors in a way that would lead an increase to their industrial production. Therefore, the MRAs that are integrated in the labour force of each economy have increased potential of being employed to the specific sectors described above. Namely, the primary sectors of all the economies except Italy are labour absorbing as well as the secondary sectors of all the ecomomies with the exception of the UK and Italy, and, finally, the manufacturing and tertiary sectors in three out of seven SIRIUS economies.

Now, as far as the second part of the report is concerned, the application of the methodology for the estimation of the employability of migrants, refugees and asylum seekers (MRAs) in the examined economies was carried out in three different stages: The first stage involved the determination of the sector and the occupation with relative high growth potential, the second stage determined the similarity of MRAs’ educational attainment level with the current educational attainment level of all the sectors and the occupations of the examined economies, while the third stage involved the determination of the sectors and the occupations with relatively high integration potential for MRAs. At this point, it should be emphasized that the identification of skills and the collection of analytical data on the skills requirements in the European labor market would provide an approach of the employability potential which is not identifiable through the education attainment level.

Based on the findings of the first stage, significant diversity among the sectors and the occupations of the examined countries that boost economic growth, was evident. This diversity is driven by the countries’ different specialization patterns and structural characteristics, which are present in the labour market features.

Furthermore, the findings of the second stage showed that the sectors and the occupations with a required educational attainment level closer to the MRAs’, are different among the examined countries. The interpretation for this must be sought, besides the diversity defined in the first stage, at the different characteristics of MRAs with respect to their educational attainment level.

Finally, based on the Input Output (IO) analysis which complements the G/VAR/VEC approach, the employability potential for MRAs was identified in a wide range of sectors and occupations among the examined countries. Analytically, MRAs’ potential for integration:

- in the Czech Republic are concentrated in two industrial (Manufacture of motor vehicles, trailers and semi – trailers & Printing and reproduction of recorded media) and eight services sectors (Retail trade, except of motor vehicles and motorcycles, Arts, entertainment and recreation and other service activities, Wholesale trade, except of motor vehicles and motorcycles, Administrative and support service activities, Warehousing and support activities for transportation, Electricity, gas, steam and air conditioning supply, Public administration and defense, compulsory social security, Accommodation and food service activities). The the occupations with high employability potential are in the categories of elementary occupations, craft and related trades workers and clerical support workers.
- in Denmark are concentrated in three industrial (Manufacture of machinery and equipment n.e.c., Manufacture of basic metals, Manufacture of other transport equipment) and seven services sectors (Public administration and defense,

compulsory social security, Human health and social work activities, Water transport, Retail trade, except of motor vehicles and motorcycles, Administrative and support service activities, Wholesale trade, except of motor vehicles and motorcycles, Manufacture of other transport equipment, Accommodation and food service activities). The occupations with high employability potential can be found in a wide range of occupations such as craft and related trades workers, clerical support workers, service and sales workers.

- in Greece are concentrated in three primary (Crop and animal production, hunting and related service activities, A03; Fishing and aquaculture, A02; Forestry and logging), three industrial (Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials, Manufacture of motor vehicles, trailers and semi – trailers, Manufacture of textiles, wearing apparel and leather products) and four services sectors (Retail trade, except of motor vehicles and motorcycles, Construction, Accommodation and food service activities, Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services). The occupations with high employability potential are in the categories of skilled agricultural workers, plant and machine operators and assemblers and elementary occupations.
- in Switzerland are concentrated in three industrial (Manufacture of basic metals, Manufacture of food products, beverages and tobacco products, Manufacture of wood and of products of wood and cork, except furniture, manufacture of articles of straw and plaiting materials) and seven services sectors (Arts, entertainment and recreation and other service activities, Human health and social work activities, Construction, Administrative and support service activities, Accommodation and food service activities, Retail trade, except of motor vehicles and motorcycles, Wholesale trade, except of motor vehicles and motorcycles). The occupations with high employability potential are in the categories Clerical support workers, Plant and machine operators and assemblers and Elementary occupations.
- in the United Kingdom are concentrated in one industrial (Manufacture of machinery and equipment n.e.c) and nine services sectors (Human health and social work activities, Public administration and defense, compulsory social security, Water transport, Other professional, scientific and technical activities, veterinary activities, Advertising and market research, Arts, entertainment and recreation and other service activities, Activities auxiliary to financial services and insurance activities, Retail trade, except of motor vehicles and motorcycles, Motion picture, video and television program production, sound recording and music publishing activities, programming and broadcasting activities). The occupations with high employability potential are in the categories of professionals, technicians and associate professionals and clerical support workers.

The lack of available data makes the comparative discussion of findings for Finland and Italy not possible. In Finland, MRAs integration potential is found in services sectors and in the occupational categories of Craft and related trades workers, Skilled agricultural, forestry and fishery workers and Professionals. In Italy, MRAs integration potential is found in manufacturing, services and primary sectors and in the occupational categories of Clerical support workers, Service and sales workers and Professionals. Of course, all the results and findings presented in this report are subject to the inherent assumptions of the models employed.

# Appendix A: Classification Description & Results of Employability Indicators

*Table A.1: ISCED Aggregation of Educational Attainment Level*

| Level | ISCED 2011 | Description |
|---|---|---|
| **0** | Early childhood Education (01 Early childhood educational development) | Education designed to support early development in preparation for participation in school and society. Programmes designed for children below the age of 3. |
| **0** | Early childhood Education (02 Pre - primary education) | Education designed to support early development in preparation for participation in school and society. Programmes designed for children from age 3 to the start of primary |
| **1** | Primary education | Programmes typically designed to provide students with fundamental skills in reading, writing and mathematics and to establish a solid foundation for learning. |
| **2** | Lower secondary education | First stage of secondary education building on primary education, typically with a more subject - oriented curriculum. |
| **3** | Upper secondary education | Second/final stage of secondary education preparing for tertiary education and/or providing skills relevant to employment. Usually with an increased range of subject options and streams. |
| **4** | Post - secondary non - tertiary education | Programmes providing learning experiences that build on secondary education and prepare for labour market entry and/or tertiary education. The content is broader than secondary but not as complex as tertiary education. |
| **5** | Short - cycle tertiary education | Short first tertiary programmes that are typically practically - based, occupationally - specific and prepare for labour market entry. These programmes may also provide a pathway to other tertiary programmes. |
| **6** | Bachelor or equivalent | Programmes designed to provide intermediate academic and/or professional knowledge, skills and competencies leading to a first tertiary degree or equivalent qualification. |
| **7** | Master or equivalent | Programmes designed to provide advanced academic and/or professional knowledge, skills and competencies leading to a second tertiary degree or equivalent qualification. |
| **8** | Doctoral or equivalent | Programmes designed primarily to lead to an advanced research qualification, usually concluding with the submission and defense of a substantive dissertation of publishable quality based on original research. |

Source: UNESCO

*Table A.2: Classification of sectors of economic activity, NACE Rev. 2, 1-dig*

| | |
|---|---|
| **A** | Agriculture, forestry and fishing |
| **B** | Mining and quarrying |
| **C** | Manufacturing |
| **D** | Electricity, gas, steam and air conditioning supply |
| **E** | Water supply, sewerage, waste management and remediation activities |
| **F** | Construction |
| **G** | Wholesale and retail trade, repair of motor vehicles and motorcycles |
| **H** | Transportation and storage |
| **I** | Accommodation and food service activities |
| **J** | Information and communication |
| **K** | Financial and insurance activities |
| **L** | Real estate activities |
| **M** | Professional, scientific and technical activities |
| **N** | Administrative and support service activities |
| **O** | Public administration and defence, compulsory social security |
| **P** | Education |
| **Q** | Human health and social work activities |
| **R** | Arts, entertainment and recreation |
| **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 organizations and bodies |

Source: Eurostat

*Table A.3: Classification of sectors of economic activity, NACE Rev. 2, 2-digit and R&D Intensity*

| ID | Name | R&D |
|---|---|---|
| **A01** | Crop and animal production, hunting and related service activities | LI |
| **A02** | Forestry and logging | LI |
| **A03** | Fishing and aquaculture | LI |
| **B** | Mining and quarrying | MLI |
| **C10 - C12** | Manufacture of food products, beverages and tobacco products | MLI |
| **C13 - C15** | Manufacture of textiles, wearing apparel and leather products | MLI |
| **C16** | Manufacture of wood and of products of wood and cork | MLI |
| **C17** | Manufacture of paper and paper products | MLI |
| **C18** | Printing and reproduction of recorded media | MLI |
| **C19** | Manufacture of coke and refined petroleum products | MLI |
| **C20** | Manufacture of chemicals and chemical products | MHT |
| **C21** | Manufacture of basic pharmaceutical products and pharmaceutical preparations | HI |
| **C22** | Manufacture of rubber and plastic products | MI |
| **C23** | Manufacture of other non - metallic mineral products | MI |
| **C24** | Manufacture of basic metals | MI |
| **C25** | Manufacture of fabricated metal products, except machinery and equipment | MLI |
| **C26** | Manufacture of computer, electronic and optical products | HI |
| **C27** | Manufacture of electrical equipment | MHI |
| **C28** | Manufacture of machinery and equipment n.e.c. | MHI |
| **C29** | Manufacture of motor vehicles, trailers and semi - trailers | MHI |
| **C30** | Manufacture of other transport equipment | MHI |
| **C31_C32** | Manufacture of furniture, other manufacturing | MI |
| **C33** | Repair and installation of machinery and equipment | MI |
| **D35** | Electricity, gas, steam and air conditioning supply | LI |
| **E36** | Water collection, treatment and supply | LI |
| **E37 - E39** | Sewerage, waste collection, treatment and disposal activities, and other waste management services | LI |
| **F** | Construction | LI |
| **G45** | Wholesale and retail trade and repair of motor vehicles and motorcycles | LI |
| **G46** | Wholesale trade, except of motor vehicles and motorcycles | LI |
| **G47** | Retail trade, except of motor vehicles and motorcycles | LI |
| **H49** | Land transport and transport via pipelines | LI |
| **H50** | Water transport | LI |
| **H51** | Air transport | LI |
| **H52** | Motion picture, video and television program production, sound recording and music publishing | LI |
| **H53** | Postal and courier activities | LI |
| **I** | Accommodation and food service activities | LI |
| **J58** | Publishing activities | MHI |
| **J59_J60** | Motion picture, video and television program production, sound recording and music publishing activities, programming and broadcasting activities | LI |
| **J61** | Telecommunications | MLI |
| **J62_J63** | Computer programming, consultancy and related activities, information service activities | MHI |
| **K64** | Financial service activities, except insurance and pension funding | LI |
| **K65** | Insurance, reinsurance and pension funding, except compulsory social security | LI |
| **K66** | Activities auxiliary to financial services and insurance activities | LI |
| **L68** | Real estate activities | LI |
| **M69_M70** | Legal and accounting activities, activities of head offices, management consultancy activities | MLI |
| **M71** | Architectural and engineering activities, technical testing and analysis | MLI |
| **M72** | Scientific research and development | HI |
| **M73** | Advertising and market research | MLI |
| **M74_M75** | Other professional, scientific and technical activities, veterinary activities | MLI |
| **N** | Administrative and support service activities | - |
| **O84** | Public administration and defense, compulsory social security | - |
| **P85** | Education | - |
| **Q** | Human health and social work activities | - |
| **R-S** | Arts, entertainment and recreation and other service activities | LI |

Source: Eurostat and WIOD

*Table A.4: Classification of Occupations – ISCO - 08, 1 - digit*

| |
|---|
| OC1 - Managers |
| OC2 - Professionals |
| OC3 - Technicians and associate professionals |
| OC4 - Clerical support workers |
| OC5 - Service and sales workers |
| OC6 - Skilled agricultural, forestry and fishery workers |
| OC7 - Craft and related trades workers |
| OC8 - Plant and machine operators and assemblers |
| OC9 - Elementary occupations |
| OC0 - Armed forces occupations |

Source: Eurostat

*Table A.5: Classification of Occupations – ISCO - 08, 2 - digit*

| ID | Name |
|---|---|
| **11** | Chief executives, senior officials and legislators |
| **12** | Administrative and commercial managers |
| **13** | Production and specialised services managers |
| **14** | Hospitality, retail and other services managers |
| **21** | Science and engineering professionals |
| **22** | Health professionals |
| **23** | Teaching professionals |
| **24** | Business and administration professionals |
| **25** | Information and communications technology professionals |
| **26** | Legal, social and cultural professionals |
| **31** | Science and engineering associate professionals |
| **32** | Health associate professionals |
| **33** | Business and administration associate professionals |
| **34** | Legal, social, cultural and related associate professionals |
| **35** | Information and communications technicians |
| **41** | General and keyboard clerks |
| **42** | Customer services clerks |
| **43** | Numerical and material recording clerks |
| **44** | Other clerical support workers |
| **51** | Personal service workers |
| **52** | Sales workers |
| **53** | Personal care workers |
| **54** | Protective services workers |
| **61** | Market-oriented skilled agricultural workers |
| **62** | Market-oriented skilled forestry, fishery and hunting workers |
| **63** | Subsistence farmers, fishers, hunters and gatherers |
| **71** | Building and related trades workers, excluding electricians |
| **72** | Metal, machinery and related trades workers |
| **73** | Handicraft and printing workers |
| **74** | Electrical and electronic trades workers |
| **75** | Food processing, wood working, garment and other craft and related trades workers |
| **81** | Stationary plant and machine operators |
| **82** | Assemblers |
| **83** | Drivers and mobile plant operators |
| **91** | Cleaners and helpers |
| **92** | Agricultural, forestry and fishery labourers |
| **93** | Labourers in mining, construction, manufacturing and transport |
| **94** | Food preparation assistants |
| **95** | Street and related sales and service workers |
| **96** | Refuse workers and other elementary workers |

Source: Eurostat

*Table A.6: Analytical Results, Employment by sector of economic activity, Czech Republic*

| | Forward Multipliers | | Backward Multipliers | | Structure of employment | Change of Employment |
|---|---|---|---|---|---|---|
| | 2011 | 2017 | 2011 | 2017 | 2017 | 2011-2017 |
| **A01** | 29.62 | 30.38 | 28.02 | 27.25 | 2.31% | 2.92% |
| **A02** | 28.78 | 28.28 | 21.69 | 27.25 | 0.56% | -2.68% |
| **A03** | 32.71 | 44.77 | 27.97 | 27.25 | 0.05% | 40.44% |
| **B** | 20.35 | 21.53 | 18.79 | 27.25 | 0.76% | -16.39% |
| **C10-C12** | 18.09 | 18.42 | 24.40 | 27.25 | 2.56% | 9.11% |
| **C13-C15** | 24.04 | 25.96 | 29.06 | 27.25 | 1.28% | 5.65% |
| **C16** | 29.39 | 26.17 | 28.99 | 27.25 | 0.89% | -17.45% |
| **C17** | 17.72 | 16.15 | 20.17 | 27.25 | 0.46% | -1.31% |
| **C18** | 38.96 | 45.85 | 24.84 | 27.25 | 0.51% | 7.22% |
| **C19** | 13.52 | 13.25 | 6.55 | 27.25 | 0.09% | -8.56% |
| **C20** | 8.54 | 7.95 | 12.89 | 27.25 | 0.75% | 5.91% |
| **C21** | 10.03 | 11.69 | 16.19 | 27.25 | 0.30% | 15.67% |
| **C22** | 15.04 | 14.46 | 14.77 | 27.25 | 1.72% | 2.70% |
| **C23** | 23.94 | 23.92 | 21.48 | 27.25 | 1.36% | 5.42% |
| **C24** | 12.01 | 13.18 | 14.95 | 27.25 | 1.22% | -1.54% |
| **C25** | 23.22 | 23.51 | 23.54 | 27.25 | 3.82% | 8.55% |
| **C26** | 6.80 | 6.85 | 9.37 | 27.25 | 1.39% | 6.14% |
| **C27** | 9.33 | 10.33 | 12.23 | 27.25 | 1.60% | 18.07% |
| **C28** | 10.28 | 11.61 | 16.47 | 27.25 | 2.33% | 20.00% |
| **C29** | 25.90 | 23.03 | 23.58 | 27.25 | 4.61% | 30.39% |
| **C30** | 13.35 | 16.73 | 14.89 | 27.25 | 0.62% | 41.94% |
| **C31_C32** | 23.91 | 26.41 | 28.11 | 27.25 | 1.67% | 20.95% |
| **C33** | 26.10 | 23.23 | 23.28 | 27.25 | 0.83% | -20.62% |
| **D35** | 13.95 | 14.29 | 9.38 | 27.25 | 1.03% | -9.03% |
| **E36** | 21.93 | 19.65 | 21.66 | 27.25 | 0.29% | -20.35% |
| **E37-E39** | 18.83 | 21.16 | 20.26 | 27.25 | 0.68% | 6.14% |
| **F** | 25.33 | 26.66 | 27.30 | 27.25 | 7.57% | -10.81% |
| **G45** | 33.75 | 40.47 | 24.79 | 27.25 | 1.87% | 24.49% |
| **G46** | 22.38 | 21.96 | 18.53 | 27.25 | 2.71% | -12.33% |
| **G47** | 42.00 | 47.26 | 39.07 | 27.25 | 7.29% | 1.18% |
| **H49** | 30.83 | 30.07 | 29.17 | 27.25 | 4.02% | -12.52% |
| **H50** | 42.80 | 48.06 | 39.87 | 27.25 | 0.05% | -9.06% |
| **H51** | 19.10 | 15.89 | 21.24 | 27.25 | 0.12% | -49.39% |
| **H52** | 18.46 | 22.73 | 13.92 | 27.25 | 1.06% | 91.34% |
| **H53** | 42.30 | 47.56 | 39.37 | 27.25 | 0.90% | -0.02% |
| **I** | 34.55 | 36.59 | 39.03 | 27.25 | 3.59% | -2.33% |
| **J58** | 20.99 | 12.97 | 26.04 | 27.25 | 0.29% | -25.81% |
| **J59_J60** | 14.88 | 19.17 | 16.31 | 27.25 | 0.37% | 24.12% |
| **J61** | 20.21 | 18.72 | 12.65 | 27.25 | 0.52% | -27.86% |
| **J62_J63** | 24.74 | 27.26 | 19.68 | 27.25 | 1.70% | 15.47% |
| **K64** | 27.05 | 27.57 | 15.13 | 27.25 | 1.19% | -9.93% |
| **K65** | 17.60 | 16.89 | 23.79 | 27.25 | 0.40% | -23.94% |
| **K66** | 43.52 | 51.92 | 38.10 | 27.25 | 0.70% | 22.09% |
| **L68** | 11.59 | 12.49 | 9.76 | 27.25 | 0.77% | -7.34% |
| **M69_M70** | 33.23 | 33.85 | 24.51 | 27.25 | 1.58% | -3.25% |
| **M71** | 28.64 | 34.91 | 20.02 | 27.25 | 1.39% | 42.45% |
| **M72** | 19.02 | 23.83 | 18.42 | 27.25 | 0.48% | 42.70% |
| **M73** | 31.76 | 40.23 | 22.69 | 27.25 | 0.67% | 36.26% |
| **M74_M75** | 32.03 | 39.23 | 23.48 | 27.25 | 0.81% | 67.13% |
| **N** | 35.20 | 39.09 | 28.68 | 27.25 | 2.52% | 11.62% |
| **O84** | 23.88 | 27.72 | 28.52 | 27.25 | 6.47% | 4.20% |
| **P85** | 38.79 | 47.12 | 39.78 | 27.25 | 6.64% | 14.06% |
| **Q** | 33.00 | 37.56 | 36.77 | 27.25 | 7.07% | 10.31% |
| **R_S** | 32.41 | 37.62 | 34.52 | 27.25 | 3.52% | 4.08% |

*Table A.7: Analytical Results, Employment by occupation, Czech Republic*

| | Multipliers by Occupation | | Structure of Employment by Occupation | Change in Employment Structure by Occupation |
|---|---|---|---|---|
| | 2011 | 2017 | 2017 | 2011-2017 |
| 11 | 28.02 | 25.95 | 38562 | -9.34% |
| 12 | 21.68 | 22.69 | 51804 | 49.24% |
| 13 | 27.97 | 17.78 | 98847 | 5.11% |
| 14 | 18.78 | 20.45 | 41850 | -26.61% |
| 21 | 24.39 | 24.64 | 86773 | 70.62% |
| 22 | 29.05 | 30.73 | 89668 | 20.44% |
| 23 | 28.98 | 27.59 | 206053 | 9.04% |
| 24 | 20.16 | 19.51 | 87507 | 59.10% |
| 25 | 24.84 | 27.11 | 56310 | 36.07% |
| 26 | 6.55 | 6.17 | 95102 | 16.72% |
| 31 | 12.88 | 12.70 | 291478 | 2.30% |
| 32 | 16.18 | 17.48 | 113993 | -1.62% |
| 33 | 14.77 | 17.10 | 408685 | -7.43% |
| 34 | 21.47 | 25.65 | 62783 | 3.34% |
| 35 | 14.94 | 15.40 | 70289 | -0.06% |
| 41 | 23.53 | 24.69 | 100745 | 44.18% |
| 42 | 9.37 | 9.88 | 68008 | -0.31% |
| 43 | 12.23 | 14.01 | 235039 | 5.01% |
| 44 | 16.47 | 17.89 | 57798 | -11.58% |
| 51 | 12.85 | 13.34 | 247056 | 2.96% |
| 52 | 14.89 | 18.39 | 320904 | -1.10% |
| 53 | 28.10 | 31.28 | 60714 | 38.78% |
| 54 | 23.28 | 21.51 | 102691 | -4.54% |
| 61 | 9.38 | 9.22 | 48786 | -9.37% |
| 62 | 21.64 | 18.59 | 14267 | -12.12% |
| 63 | 20.23 | 23.48 | 3470 | 58.99% |
| 71 | 27.30 | 29.07 | 273937 | -7.50% |
| 72 | 24.79 | 30.06 | 323282 | 4.41% |
| 73 | 18.52 | 18.76 | 43344 | -17.90% |
| 74 | 39.06 | 43.39 | 106092 | -7.25% |
| 75 | 29.16 | 30.03 | 120624 | 11.41% |
| 81 | 102.80 | 120.39 | 204114 | -1.96% |
| 82 | 21.21 | 20.44 | 132084 | 13.74% |
| 83 | 13.90 | 18.28 | 340463 | 4.66% |
| 91 | 46.73 | 61.42 | 92901 | -10.91% |
| 92 | 39.02 | 40.24 | 13086 | -15.80% |
| 93 | 26.03 | 23.48 | 118555 | 7.74% |
| 94 | 16.30 | 19.22 | 8975 | 53.73% |
| 95 | 12.65 | 11.80 | 663 | -91.40% |
| 96 | 19.67 | 23.62 | 30397 | 9.50% |

*Table A.8: Analytical Results, Employment by sector of economic activity, Denmark*

| | Forward Multipliers | | Backward Multipliers | | Structure of | Change of |
|---|---|---|---|---|---|---|
| | 2011 | 2017 | 2011 | 2017 | 2017 | 2011-2017 |
| A01 | 17.54 | 14.85 | 17.55 | 15.42 | 0.56% | 2.68% |
| A02 | 24.94 | 21.10 | 26.34 | 15.42 | 0.07% | -13.59% |
| A03 | 10.07 | 4.66 | 11.19 | 15.42 | 0.03% | 24.56% |
| B | 7.11 | 8.50 | 4.01 | 15.42 | 0.16% | -22.12% |
| C10-C12 | 20.13 | 16.10 | 23.76 | 15.42 | 2.20% | 0.23% |
| C13-C15 | 14.67 | 12.22 | 20.66 | 15.42 | 0.18% | -2.79% |
| C16 | 35.52 | 33.57 | 31.77 | 15.42 | 0.33% | -2.83% |
| C17 | 26.80 | 24.72 | 23.55 | 15.42 | 0.19% | -3.22% |
| C18 | 50.49 | 47.88 | 30.65 | 15.42 | 0.25% | -16.44% |
| C19 | 3.07 | 3.30 | 4.67 | 15.42 | 0.03% | -16.81% |
| C20 | 12.78 | 10.55 | 16.74 | 15.42 | 0.51% | 5.58% |
| C21 | 10.89 | 10.17 | 16.25 | 15.42 | 1.08% | 36.78% |
| C22 | 24.93 | 22.10 | 24.89 | 15.42 | 0.52% | -4.51% |
| C23 | 32.24 | 33.03 | 26.17 | 15.42 | 0.53% | 6.20% |
| C24 | 15.67 | 17.26 | 17.85 | 15.42 | 0.19% | 9.00% |
| C25 | 34.17 | 36.26 | 29.11 | 15.42 | 1.35% | 5.96% |
| C26 | 16.21 | 13.96 | 20.93 | 15.42 | 0.64% | -7.06% |
| C27 | 18.40 | 18.35 | 21.83 | 15.42 | 0.41% | -4.09% |
| C28 | 18.27 | 17.42 | 22.06 | 15.42 | 2.30% | -0.55% |
| C29 | 19.88 | 18.83 | 25.56 | 15.42 | 0.16% | -16.72% |
| C30 | 15.55 | 30.24 | 21.89 | 15.42 | 0.10% | -7.52% |
| C31_C32 | 20.54 | 20.74 | 27.39 | 15.42 | 0.82% | 7.23% |
| C33 | 35.60 | 29.61 | 26.95 | 15.42 | 0.37% | 7.54% |
| D35 | 16.21 | 15.75 | 11.46 | 15.42 | 0.41% | -1.22% |
| E36 | 14.27 | 11.97 | 17.86 | 15.42 | 0.03% | -26.79% |
| E37-E39 | 30.80 | 28.00 | 23.00 | 15.42 | 0.42% | 2.93% |
| F | 23.63 | 25.06 | 30.16 | 15.42 | 6.05% | 10.17% |
| G45 | 38.41 | 39.23 | 34.44 | 15.42 | 1.73% | 2.79% |
| G46 | 26.63 | 26.38 | 26.01 | 15.42 | 6.00% | 5.27% |
| G47 | 63.54 | 69.06 | 66.93 | 15.42 | 8.82% | 8.56% |
| H49 | 40.90 | 38.92 | 27.64 | 15.42 | 2.18% | 9.17% |
| H50 | 2.68 | 3.17 | 7.28 | 15.42 | 0.43% | 7.71% |
| H51 | 19.22 | 14.96 | 16.90 | 15.42 | 0.19% | -32.96% |
| H52 | 21.89 | 22.26 | 25.53 | 15.42 | 1.14% | 12.34% |
| H53 | 72.61 | 68.25 | 47.85 | 15.42 | 0.81% | -23.76% |
| I | 49.14 | 56.38 | 51.50 | 15.42 | 4.19% | 34.86% |
| J58 | 50.81 | 45.90 | 38.53 | 15.42 | 0.80% | -2.59% |
| J59_J60 | 36.03 | 36.10 | 29.47 | 15.42 | 0.52% | 16.87% |
| J61 | 32.17 | 28.37 | 23.23 | 15.42 | 0.56% | -13.66% |
| J62_J63 | 41.41 | 40.12 | 30.98 | 15.42 | 2.07% | 17.55% |
| K64 | 27.29 | 25.19 | 22.12 | 15.42 | 2.11% | -11.18% |
| K65 | 26.57 | 26.00 | 28.26 | 15.42 | 0.77% | 0.42% |
| K66 | 37.06 | 37.52 | 20.55 | 15.42 | 0.34% | 26.34% |
| L68 | 13.20 | 13.63 | 9.69 | 15.42 | 1.22% | 6.14% |
| M69_M70 | 51.78 | 55.24 | 30.20 | 15.42 | 2.11% | 19.66% |
| M71 | 39.61 | 39.73 | 32.08 | 15.42 | 1.80% | 25.17% |
| M72 | 32.75 | 29.57 | 34.85 | 15.42 | 0.71% | 0.87% |
| M73 | 43.83 | 43.63 | 33.96 | 15.42 | 0.40% | -2.43% |
| M74_M75 | 47.68 | 49.47 | 32.47 | 15.42 | 0.55% | 27.00% |
| N | 53.05 | 54.76 | 43.89 | 15.42 | 5.68% | 21.60% |
| O84 | 29.01 | 49.67 | 31.99 | 15.42 | 9.87% | 88.72% |
| P85 | 48.00 | 35.02 | 50.91 | 15.42 | 7.15% | -22.71% |
| Q | 58.05 | 37.18 | 62.46 | 15.42 | 14.22% | -32.61% |
| R_S | 36.94 | 35.13 | 37.93 | 15.42 | 3.69% | 0.98% |

*Table A.9: Analytical Results, Employment by occupation, Denmark*

| | Multipliers by Occupation | | Structure of Employment by Occupation | Change in Employment Structure by Occupation |
|---|---|---|---|---|
| | 2011 | 2017 | 2017 | 2011-2017 |
| 11 | 17.55 | 15.42 | 29143 | -14.34% |
| 12 | 26.34 | 22.83 | 37790 | -8.46% |
| 13 | 11.19 | 12.32 | 30064 | 0.60% |
| 14 | 4.01 | 4.03 | 8186 | 24.03% |
| 21 | 23.76 | 20.34 | 62565 | 5.30% |
| 22 | 20.66 | 17.91 | 103109 | 9.67% |
| 23 | 31.77 | 30.63 | 246413 | 6.07% |
| 24 | 23.55 | 23.07 | 63911 | 12.13% |
| 25 | 30.65 | 30.59 | 43297 | 22.29% |
| 26 | 4.67 | 4.76 | 67341 | -20.15% |
| 31 | 16.74 | 14.34 | 63836 | -7.54% |
| 32 | 16.25 | 16.40 | 26334 | 0.49% |
| 33 | 24.89 | 22.07 | 147508 | -11.11% |
| 34 | 26.17 | 26.75 | 33693 | -39.65% |
| 35 | 17.85 | 19.48 | 13496 | 11.19% |
| 41 | 29.11 | 29.87 | 112099 | -17.46% |
| 42 | 20.93 | 18.91 | 27191 | -7.42% |
| 43 | 21.83 | 23.33 | 34819 | 33.94% |
| 44 | 22.06 | 21.52 | 29731 | -6.45% |
| 51 | 25.56 | 24.53 | 71124 | 4.35% |
| 52 | 21.89 | 31.90 | 161074 | 23.76% |
| 53 | 27.39 | 26.90 | 221289 | -6.78% |
| 54 | 26.95 | 20.65 | 23288 | -62.34% |
| 61 | 11.46 | 11.42 | 11736 | 4.51% |
| 62 | 17.86 | 15.24 | 1036 | 4.25% |
| 63 | 23.00 | 23.30 | 70489 | 8.83% |
| 71 | 30.16 | 31.48 | 66962 | 0.20% |
| 72 | 34.44 | 34.81 | 6410 | -3.31% |
| 73 | 26.01 | 25.82 | 27991 | 2.99% |
| 74 | 66.93 | 72.75 | 16778 | 13.89% |
| 75 | 27.64 | 27.02 | 53883 | 6.11% |
| 81 | 7.28 | 6.66 | 20520 | -28.65% |
| 82 | 16.90 | 14.64 | 54507 | 4.72% |
| 83 | 25.53 | 26.22 | 87957 | -12.95% |
| 91 | 47.85 | 44.74 | 2360 | -13.98% |
| 92 | 51.50 | 57.35 | 110353 | -10.20% |
| 93 | 38.53 | 35.09 | 21464 | 52.45% |
| 94 | 29.47 | 29.87 | 21627 | 51.98% |
| 95 | 23.23 | 24.02 | 20851 | 33.63% |
| 96 | 30.98 | 33.71 | 30397 | 9.50% |

*Table A.10: Analytical Results, Employment by sector of economic activity, Greece*

| | Forward Multipliers | | Backward | | Structure of | Change of |
|---|---|---|---|---|---|---|
| | 2011 | 2017 | 2011 | 2017 | 2017 | 2011-2017 |
| **A01** | 55.54 | 53.78 | 56.70 | 54.14 | 11.62% | -6.85% |
| **A02** | 84.67 | 46.06 | 86.13 | 54.14 | 0.10% | -37.85% |
| **A03** | 20.05 | 14.82 | 23.08 | 54.14 | 0.34% | -37.75% |
| **B** | 7.98 | 12.85 | 14.80 | 54.14 | 0.34% | 17.33% |
| **C10-C12** | 8.50 | 11.78 | 23.42 | 54.14 | 3.59% | 30.22% |
| **C13-C15** | 21.06 | 23.59 | 26.98 | 54.14 | 0.83% | -20.38% |
| **C16** | 42.12 | 45.73 | 34.92 | 54.14 | 0.27% | -49.68% |
| **C17** | 12.58 | 10.99 | 18.21 | 54.14 | 0.17% | -18.04% |
| **C18** | 34.23 | 42.96 | 22.44 | 54.14 | 0.42% | 20.22% |
| **C19** | 1.96 | 1.40 | 4.57 | 54.14 | 0.15% | 35.40% |
| **C20** | 13.25 | 13.20 | 15.22 | 54.14 | 0.26% | -15.46% |
| **C21** | 10.68 | 14.17 | 19.30 | 54.14 | 0.41% | 26.76% |
| **C22** | 19.43 | 21.66 | 16.80 | 54.14 | 0.44% | 23.13% |
| **C23** | 25.13 | 18.85 | 18.74 | 54.14 | 0.31% | -48.19% |
| **C24** | 10.31 | 8.61 | 11.22 | 54.14 | 0.26% | -40.75% |
| **C25** | 22.43 | 22.81 | 19.12 | 54.14 | 0.94% | -11.06% |
| **C26** | 21.82 | 20.17 | 14.57 | 54.14 | 0.11% | 20.99% |
| **C27** | 12.41 | 15.03 | 14.50 | 54.14 | 0.24% | 5.53% |
| **C28** | 20.89 | 10.35 | 22.87 | 54.14 | 0.14% | -68.35% |
| **C29** | 18.35 | 8.26 | 23.46 | 54.14 | 0.03% | -68.73% |
| **C30** | 29.55 | 38.64 | 22.94 | 54.14 | 0.15% | -14.20% |
| **C31_C32** | 28.04 | 26.36 | 31.82 | 54.14 | 0.61% | -35.88% |
| **C33** | 18.93 | 14.78 | 11.76 | 54.14 | 0.18% | -40.37% |
| **D35** | 12.20 | 15.19 | 8.50 | 54.14 | 0.84% | 56.05% |
| **E36** | 20.00 | 19.26 | 16.03 | 54.14 | 0.17% | -27.90% |
| **E37-E39** | 14.01 | 15.82 | 13.47 | 54.14 | 0.55% | 2.26% |
| **F** | 17.93 | 18.27 | 25.77 | 54.14 | 3.93% | -38.17% |
| **G45** | 21.96 | 20.47 | 21.78 | 54.14 | 1.84% | -18.89% |
| **G46** | 24.92 | 17.69 | 19.00 | 54.14 | 3.27% | -59.75% |
| **G47** | 45.60 | 58.41 | 39.58 | 54.14 | 12.93% | -2.62% |
| **H49** | 25.32 | 24.20 | 22.59 | 54.14 | 2.38% | -22.11% |
| **H50** | 2.49 | 3.44 | 7.52 | 54.14 | 0.94% | 31.43% |
| **H51** | 7.44 | 7.51 | 10.32 | 54.14 | 0.22% | 45.88% |
| **H52** | 25.72 | 27.93 | 14.70 | 54.14 | 1.06% | 10.55% |
| **H53** | 38.70 | 39.93 | 21.35 | 54.14 | 0.39% | -15.31% |
| **I** | 18.68 | 20.64 | 28.02 | 54.14 | 9.90% | 24.25% |
| **J58** | 14.36 | 14.76 | 18.59 | 54.14 | 0.43% | -19.30% |
| **J59_J60** | 21.22 | 26.83 | 22.01 | 54.14 | 0.33% | -14.47% |
| **J61** | 10.34 | 12.05 | 8.27 | 54.14 | 0.77% | 2.22% |
| **J62_J63** | 22.98 | 30.68 | 20.33 | 54.14 | 0.80% | 39.11% |
| **K64** | 21.85 | 23.63 | 11.11 | 54.14 | 1.63% | -3.65% |
| **K65** | 4.35 | 15.41 | 7.37 | 54.14 | 0.60% | 200.41% |
| **K66** | 50.28 | 34.39 | 31.76 | 54.14 | 0.27% | -63.13% |
| **L68** | 9.34 | 10.20 | 1.41 | 54.14 | 0.11% | -55.07% |
| **M69_M70** | 37.22 | 42.05 | 21.39 | 54.14 | 3.01% | 4.21% |
| **M71** | 53.48 | 63.76 | 40.73 | 54.14 | 1.58% | -9.55% |
| **M72** | 10.26 | 6.51 | 15.19 | 54.14 | 0.10% | -47.02% |
| **M73** | 25.15 | 27.78 | 15.88 | 54.14 | 0.32% | -31.51% |
| **M74_M75** | 37.43 | 35.62 | 23.36 | 54.14 | 0.43% | -34.82% |
| **N** | 32.85 | 30.92 | 27.13 | 54.14 | 2.40% | -13.39% |
| **O84** | 16.87 | 16.76 | 21.75 | 54.14 | 8.75% | -18.83% |
| **P85** | 25.30 | 28.78 | 26.17 | 54.14 | 7.79% | -3.02% |
| **Q** | 18.36 | 23.47 | 21.26 | 54.14 | 5.94% | -2.78% |
| **R_S** | 27.28 | 20.87 | 31.44 | 54.14 | 4.45% | -30.90% |

*Table A.11: Analytical Results, Employment by occupation, Greece*

| | Multipliers by Occupation | | Structure of Employment by Occupation | Change in Employment Structure by Occupation |
|---|---|---|---|---|
| | 2011 | 2017 | 2017 | 2011-2017 |
| **11** | 2.00 | 0.99 | 7589 | -42.69% |
| **12** | 7.98 | 3.27 | 24404 | -66.23% |
| **13** | 15.48 | 9.66 | 37229 | -27.38% |
| **14** | 14.89 | 9.34 | 100866 | -52.38% |
| **21** | 66.43 | 78.22 | 117242 | 3.36% |
| **22** | 10.42 | 17.07 | 94925 | 20.39% |
| **23** | 24.32 | 26.29 | 273153 | -9.74% |
| **24** | 43.38 | 55.94 | 101119 | 11.58% |
| **25** | 11.23 | 15.77 | 16576 | 27.55% |
| **26** | 47.45 | 57.28 | 118989 | -0.51% |
| **31** | 36.63 | 17.21 | 78177 | -43.62% |
| **32** | 8.91 | 10.75 | 77501 | -14.86% |
| **33** | 43.51 | 59.61 | 121270 | 9.85% |
| **34** | 15.65 | 13.50 | 31678 | 5.27% |
| **35** | 9.44 | 16.10 | 16941 | 43.88% |
| **41** | 55.43 | 71.41 | 212645 | 3.15% |
| **42** | 22.95 | 24.40 | 84812 | 15.15% |
| **43** | 25.28 | 24.00 | 66363 | -17.02% |
| **44** | 30.61 | 21.24 | 67236 | -54.89% |
| **51** | 31.43 | 33.67 | 252030 | 14.98% |
| **52** | 95.14 | 109.97 | 521452 | -6.93% |
| **53** | 6.62 | 12.33 | 20201 | 43.83% |
| **54** | 11.50 | 26.55 | 88198 | 6.88% |
| **61** | 67.18 | 61.13 | 456289 | -9.66% |
| **62** | 52.55 | 24.52 | 17213 | -43.88% |
| **63** | 43.95 | 27.18 | 190175 | -46.68% |
| **71** | 55.23 | 47.84 | 109682 | -17.95% |
| **72** | 16.37 | 25.95 | 15944 | 14.68% |
| **73** | 17.36 | 20.72 | 69541 | -14.16% |
| **74** | 40.13 | 44.29 | 107477 | -14.80% |
| **75** | 30.92 | 28.03 | 66850 | -22.73% |
| **81** | 4.88 | 2.44 | 4013 | -55.00% |
| **82** | 54.43 | 56.43 | 185795 | -3.89% |
| **83** | 89.73 | 72.80 | 157599 | -19.54% |
| **91** | 5.79 | 13.95 | 32234 | 4.42% |
| **92** | 22.40 | 34.48 | 71175 | -8.87% |
| **93** | 1.67 | 2.05 | 20508 | 27.10% |
| **94** | 0.38 | 1.32 | 925 | 181.51% |
| **95** | 9.92 | 13.00 | 27507 | 16.46% |
| **96** | 2.58 | 3.43 | 60703 | 9.87% |

*Table A.12: Analytical Results, Employment by sector of economic activity, Finland*

| | Forward Multipliers | | Backward Multipliers | | Structure of employment | Change of Employment |
|---|---|---|---|---|---|---|
| | 2011 | 2017 | 2011 | 2017 | 2017 | 2011-2017 |
| **A** | 34.49 | 35.24 | 26.00 | 25.69 | 1.86% | -9.75% |
| **B** | 34.09 | 34.41 | 26.44 | 25.69 | 0.06% | 7.14% |
| **C** | 26.12 | 25.59 | 27.86 | 25.69 | 6.73% | -9.05% |
| **D** | 35.80 | 35.77 | 23.39 | 25.69 | 0.27% | 27.72% |
| **E** | 35.18 | 35.10 | 25.82 | 25.69 | 0.16% | 139.39% |
| **F** | 22.74 | 23.25 | 29.18 | 25.69 | 3.84% | 6.41% |
| **G** | 27.41 | 27.47 | 25.79 | 25.69 | 5.80% | -6.87% |
| **H** | 36.69 | 36.25 | 29.22 | 25.69 | 2.88% | -5.04% |
| **I** | 22.80 | 22.85 | 28.60 | 25.69 | 1.71% | 4.54% |
| **J** | 29.31 | 28.99 | 26.84 | 25.69 | 2.10% | 6.04% |
| **K** | 28.92 | 29.44 | 25.01 | 25.69 | 1.08% | -1.51% |
| **L** | 22.72 | 22.76 | 22.67 | 25.69 | 0.48% | 41.10% |
| **M** | 33.14 | 33.15 | 23.38 | 25.69 | 3.48% | 9.92% |
| **N** | 32.41 | 32.36 | 24.44 | 25.69 | 2.31% | 15.04% |
| **O** | 21.22 | 21.13 | 24.71 | 25.69 | 2.33% | -1.83% |
| **P** | 18.07 | 17.86 | 21.75 | 25.69 | 3.73% | 2.32% |
| **Q** | 17.77 | 17.91 | 22.76 | 25.69 | 8.35% | 2.57% |
| **R-S –T** | 19.73 | 19.86 | 26.05 | 25.69 | 2.81% | 9.06% |

*Table A.13: Analytical Results, Employment by occupation, Finland*

| | **Multipliers by Occupation** | | **Structure of Employment by Occupation** | **Change in Employment Structure by Occupation** |
|---|---|---|---|---|
| | 2011 | 2017 | 2017 | 2011-2017 |
| **OC1** | 8.54 | 8.21 | 89690 | -3.85% |
| **OC2** | 25.51 | 28.16 | 301660 | 13.02% |
| **OC3** | 33.32 | 30.73 | 394220 | 2.11% |
| **OC4** | 26.99 | 23.85 | 281960 | -2.78% |
| **OC5** | 42.83 | 67.58 | 362980 | 11.65% |
| **OC6** | 10.22 | 10.25 | 56540 | -6.88% |
| **OC7** | 23.59 | 16.72 | 352900 | -14.36% |
| **OC8** | 12.92 | 11.08 | 165050 | -6.35% |
| **OC9** | 76.46 | 57.95 | 227900 | 12.26% |
| **OC0** | 1.60 | 1.54 | 23780 | 0.76% |

*Table A.14: Analytical Results, Employment by sector of economic activity, Italy*

| | Forward Multipliers | | Backward Multipliers | | Structure of employment | Change of Employment |
|---|---|---|---|---|---|---|
| | 2011 | 2017 | 2011 | 2017 | 2017 | 2011-2017 |
| **A** | 22.11 | 27.63 | 19.68 | 23.36 | 1.96% | 4.74% |
| **B** | 12.21 | 7.37 | 7.53 | 23.36 | 0.07% | -18.93% |
| **C** | 9.36 | 11.60 | 10.75 | 23.36 | 9.42% | -0.91% |
| **D** | 10.44 | 15.47 | 6.80 | 23.36 | 0.27% | -6.02% |
| **E** | 12.99 | 17.07 | 12.03 | 23.36 | 0.52% | 10.65% |
| **F** | 11.61 | 11.49 | 14.98 | 23.36 | 3.18% | -20.98% |
| **G** | 14.16 | 16.10 | 14.54 | 23.36 | 7.40% | 1.09% |
| **H** | 14.19 | 16.58 | 11.23 | 23.36 | 2.50% | 3.34% |
| **I** | 14.36 | 17.15 | 16.24 | 23.36 | 3.26% | 22.02% |
| **J** | 11.66 | 13.58 | 9.52 | 23.36 | 1.27% | 4.00% |
| **K** | 13.74 | 15.84 | 8.05 | 23.36 | 1.43% | -1.92% |
| **L** | 3.97 | 4.60 | 1.82 | 23.36 | 0.32% | 0.14% |
| **M** | 19.14 | 23.22 | 12.10 | 23.36 | 3.28% | 5.17% |
| **N** | 19.12 | 22.97 | 14.53 | 23.36 | 2.17% | 13.48% |
| **O** | 10.97 | 10.15 | 12.86 | 23.36 | 2.83% | -12.28% |
| **P** | 22.06 | 22.95 | 22.66 | 23.36 | 3.63% | 4.84% |
| **Q** | 12.84 | 14.02 | 15.60 | 23.36 | 4.19% | 10.65% |
| **R-S –T** | 16.27 | 17.48 | 17.45 | 23.36 | 2.31% | 4.16% |

*Table A.15: Analytical Results, Employment by occupation, Italy*

| | Multipliers by Occupation | | Structure of Employment by Occupation | Change in Employment Structure by Occupation |
|---|---|---|---|---|
| | 2011 | 2017 | 2017 | 2011-2017 |
| **OC1** | 8.79 | 9.37 | 896900 | -3.85% |
| **OC2** | 38.06 | 46.67 | 3016600 | 13.02% |
| **OC3** | 39.85 | 45.48 | 3942200 | 2.11% |
| **OC4** | 31.14 | 33.68 | 2819600 | -2.78% |
| **OC5** | 42.54 | 54.57 | 3629800 | 11.65% |
| **OC6** | 12.12 | 13.25 | 565400 | -6.88% |
| **OC7** | 24.19 | 23.82 | 3529000 | -14.36% |
| **OC8** | 15.28 | 16.48 | 1650500 | -6.35% |
| **OC9** | 49.04 | 56.67 | 2279000 | 12.26% |
| **OC0** | 1.82 | 1.92 | 237800 | 0.76% |

*Table A.16: Analytical Results, Employment by sector of economic activity, United Kingdom*

| | Forward Multipliers | | Backward Multipliers | | Structure of | Change of |
|---|---|---|---|---|---|---|
| | 2011 | 2017 | 2011 | 2017 | 2017 | 2011-2017 |
| **A01** | 39.20 | 26.07 | 33.23 | 22.08 | 0.95% | -21.08% |
| **A02** | 59.57 | 38.62 | 55.01 | 22.08 | 0.06% | -39.60% |
| **A03** | 15.56 | 17.90 | 13.76 | 22.08 | 0.04% | 157.13% |
| **B** | 10.95 | 10.44 | 7.51 | 22.08 | 0.37% | 4.43% |
| **C10-C12** | 28.28 | 17.87 | 23.15 | 22.08 | 1.02% | -35.58% |
| **C13-C15** | 21.79 | 20.95 | 23.38 | 22.08 | 0.35% | -14.07% |
| **C16** | 45.05 | 31.38 | 31.86 | 22.08 | 0.24% | -10.33% |
| **C17** | 30.20 | 21.60 | 17.84 | 22.08 | 0.16% | -29.59% |
| **C18** | 43.59 | 29.57 | 29.69 | 22.08 | 0.33% | -36.81% |
| **C19** | 7.00 | 5.63 | 5.07 | 22.08 | 0.08% | -41.88% |
| **C20** | 10.77 | 9.92 | 13.55 | 22.08 | 0.28% | -34.66% |
| **C21** | 14.37 | 15.58 | 13.73 | 22.08 | 0.45% | 7.22% |
| **C22** | 28.69 | 18.38 | 20.41 | 22.08 | 0.36% | -35.91% |
| **C23** | 34.97 | 20.59 | 21.55 | 22.08 | 0.22% | -40.08% |
| **C24** | 12.20 | 5.69 | 15.91 | 22.08 | 0.24% | -34.34% |
| **C25** | 31.68 | 18.62 | 22.29 | 22.08 | 0.60% | -40.19% |
| **C26** | 19.50 | 14.99 | 22.22 | 22.08 | 0.56% | -28.14% |
| **C27** | 15.79 | 12.42 | 18.20 | 22.08 | 0.24% | -23.22% |
| **C28** | 17.51 | 12.78 | 23.09 | 22.08 | 0.71% | -29.08% |
| **C29** | 11.28 | 8.42 | 17.26 | 22.08 | 0.63% | -13.72% |
| **C30** | 12.83 | 10.71 | 21.01 | 22.08 | 0.69% | -2.09% |
| **C31_C32** | 29.26 | 21.26 | 24.95 | 22.08 | 0.57% | -10.51% |
| **C33** | 51.82 | 34.41 | 40.15 | 22.08 | 0.64% | -22.47% |
| **D35** | 19.09 | 13.31 | 10.34 | 22.08 | 0.59% | -22.32% |
| **E36** | 23.29 | 15.32 | 20.74 | 22.08 | 0.18% | -23.31% |
| **E37-E39** | 20.24 | 13.60 | 19.39 | 22.08 | 0.45% | -32.48% |
| **F** | 29.96 | 18.09 | 30.93 | 22.08 | 6.39% | -26.58% |
| **G45** | 32.85 | 19.16 | 25.56 | 22.08 | 1.17% | -38.28% |
| **G46** | 20.41 | 14.35 | 23.29 | 22.08 | 2.33% | -19.93% |
| **G47** | 36.20 | 23.47 | 44.11 | 22.08 | 8.69% | -22.76% |
| **H49** | 39.67 | 24.16 | 33.51 | 22.08 | 1.95% | -31.32% |
| **H50** | 8.12 | 7.25 | 17.48 | 22.08 | 0.16% | 11.42% |
| **H51** | 12.38 | 9.05 | 17.36 | 22.08 | 0.22% | -21.09% |
| **H52** | 42.44 | 26.55 | 31.31 | 22.08 | 0.98% | -26.07% |
| **H53** | 47.13 | 31.47 | 33.52 | 22.08 | 0.84% | -25.39% |
| **I** | 36.38 | 25.11 | 41.89 | 22.08 | 5.10% | -11.47% |
| **J58** | 30.27 | 24.06 | 27.48 | 22.08 | 0.71% | -8.15% |
| **J59_J60** | 17.61 | 14.48 | 23.66 | 22.08 | 0.73% | 0.07% |
| **J61** | 20.28 | 14.81 | 14.32 | 22.08 | 0.64% | -15.32% |
| **J62_J63** | 30.14 | 26.94 | 20.98 | 22.08 | 2.73% | 34.85% |
| **K64** | 18.14 | 12.97 | 17.01 | 22.08 | 1.84% | -20.67% |
| **K65** | 10.47 | 6.63 | 19.37 | 22.08 | 0.75% | -15.67% |
| **K66** | 27.05 | 21.81 | 27.22 | 22.08 | 1.43% | -1.67% |
| **L68** | 4.90 | 3.61 | 8.25 | 22.08 | 1.13% | -6.82% |
| **M69_M70** | 42.65 | 34.54 | 26.27 | 22.08 | 3.62% | 9.21% |
| **M71** | 39.86 | 31.66 | 30.60 | 22.08 | 2.14% | 15.30% |
| **M72** | 17.38 | 17.42 | 20.78 | 22.08 | 0.49% | 26.76% |
| **M73** | 41.29 | 33.27 | 28.84 | 22.08 | 0.78% | 15.61% |
| **M74_M75** | 38.27 | 32.21 | 36.83 | 22.08 | 1.31% | 15.15% |
| **N** | 42.76 | 30.47 | 28.93 | 22.08 | 4.68% | -10.58% |
| **O84** | 24.27 | 19.42 | 29.80 | 22.08 | 6.66% | -9.20% |
| **P85** | 48.18 | 40.04 | 48.36 | 22.08 | 11.75% | -6.27% |
| **Q** | 37.92 | 29.47 | 43.37 | 22.08 | 14.10% | -10.08% |
| **R_S** | 38.55 | 28.28 | 39.44 | 22.08 | 5.63% | -6.29% |

*Table A.17: Analytical Results, Employment by occupation, United Kingdom*

| | Multipliers by Occupation | | Structure of Employment by Occupation | Change in Employment Structure by Occupation |
|---|---|---|---|---|
| | 2011 | 2017 | 2017 | 2011-2017 |
| **11** | 16.43 | 15.10 | 59576 | 17.93% |
| **12** | 20.52 | 19.89 | 649657 | 41.94% |
| **13** | 8.19 | 6.78 | 1118830 | 13.38% |
| **14** | 3.28 | 4.40 | 998911 | 12.34% |
| **21** | 11.19 | 9.56 | 866042 | 6.50% |
| **22** | 10.36 | 9.94 | 1168118 | 10.99% |
| **23** | 14.33 | 13.64 | 1376099 | 4.35% |
| **24** | 8.40 | 6.82 | 1725152 | 18.58% |
| **25** | 14.30 | 12.41 | 718389 | 21.82% |
| **26** | 2.29 | 2.71 | 743857 | 27.09% |
| **31** | 6.38 | 5.84 | 401577 | 17.94% |
| **32** | 6.42 | 6.96 | 266434 | 39.59% |
| **33** | 9.94 | 7.78 | 1559664 | 15.09% |
| **34** | 10.23 | 8.05 | 769941 | 12.69% |
| **35** | 7.66 | 6.70 | 151894 | 37.78% |
| **41** | 11.06 | 8.37 | 480660 | -63.60% |
| **42** | 10.68 | 7.98 | 877300 | 33.76% |
| **43** | 8.56 | 7.91 | 780587 | -12.63% |
| **44** | 11.35 | 10.10 | 766182 | 31.33% |
| **51** | 8.44 | 7.65 | 1155979 | 5.36% |
| **52** | 9.98 | 9.97 | 2068985 | -7.20% |
| **53** | 11.58 | 11.63 | 1876529 | 9.85% |
| **54** | 19.61 | 18.83 | 427760 | 18.55% |
| **61** | 4.91 | 4.65 | 313713 | 2.38% |
| **62** | 9.42 | 7.52 | 14585 | 33.91% |
| **63** | 9.05 | 8.61 | 1037550 | 1.70% |
| **71** | 15.16 | 13.20 | 677953 | -3.46% |
| **72** | 12.60 | 10.33 | 140913 | -3.81% |
| **73** | 11.47 | 10.98 | 345814 | -8.48% |
| **74** | 22.12 | 19.53 | 368850 | -22.59% |
| **75** | 16.67 | 14.78 | 189778 | 66.44% |
| **81** | 7.96 | 7.27 | 94418 | 1.42% |
| **82** | 8.19 | 7.08 | 978081 | 10.94% |
| **83** | 15.24 | 12.11 | 640878 | -0.96% |
| **91** | 16.33 | 15.09 | 93346 | -19.94% |
| **92** | 20.86 | 19.56 | 952776 | 5.14% |
| **93** | 13.11 | 12.03 | 405979 | 21.83% |
| **94** | 11.02 | 10.24 | 35296 | -31.85% |
| **95** | 6.85 | 6.40 | 567115 | -35.34% |
| **96** | 9.99 | 11.45 | 30397 | 9.50% |

*Table A.18: Analytical Results, Employment by sector of economic activity, Switzerland*

| | Forward | | Backward | | Structure of | Change of |
|---|---|---|---|---|---|---|
| | 2011 | 2017 | 2011 | 2017 | 2017 | 2011-2017 |
| **A01** | 47.20 | 46.02 | 42.61 | 40.24 | 2.91% | -2.07% |
| **A02** | 50.34 | 44.80 | 46.27 | 40.24 | 0.20% | -9.81% |
| **A03** | 27.59 | 28.48 | 8.99 | 40.24 | 0.00% | 0.00% |
| **B** | 26.45 | 22.43 | 22.18 | 40.24 | 0.07% | -30.09% |
| **C10-C12** | 20.00 | 23.95 | 31.17 | 40.24 | 1.84% | 49.34% |
| **C13-C15** | 19.94 | 19.52 | 23.67 | 40.24 | 0.27% | -6.97% |
| **C16** | 52.47 | 50.59 | 41.55 | 40.24 | 0.78% | -7.03% |
| **C17** | 25.04 | 24.09 | 24.04 | 40.24 | 0.13% | -30.13% |
| **C18** | 58.31 | 54.28 | 38.88 | 40.24 | 0.39% | -29.58% |
| **C19** | 7.61 | 6.67 | 11.21 | 40.24 | 0.02% | -56.73% |
| **C20** | 13.27 | 12.18 | 15.45 | 40.24 | 0.48% | -23.49% |
| **C21** | 3.70 | 4.25 | 4.90 | 40.24 | 0.79% | 39.09% |
| **C22** | 26.22 | 25.15 | 22.46 | 40.24 | 0.43% | -11.01% |
| **C23** | 32.20 | 33.09 | 21.05 | 40.24 | 0.36% | 2.11% |
| **C24** | 18.80 | 20.34 | 16.65 | 40.24 | 0.20% | -28.88% |
| **C25** | 38.46 | 35.47 | 28.44 | 40.24 | 1.54% | -16.43% |
| **C26** | 13.45 | 14.19 | 15.77 | 40.24 | 1.98% | 9.71% |
| **C27** | 15.46 | 14.84 | 17.59 | 40.24 | 0.59% | -19.11% |
| **C28** | 14.68 | 14.26 | 21.81 | 40.24 | 1.62% | -9.91% |
| **C29** | 11.75 | 9.02 | 18.71 | 40.24 | 0.08% | -29.88% |
| **C30** | 14.12 | 12.54 | 20.27 | 40.24 | 0.23% | -5.81% |
| **C31_C32** | 16.70 | 13.34 | 23.13 | 40.24 | 0.65% | -6.65% |
| **C33** | 41.29 | 44.05 | 26.52 | 40.24 | 0.37% | 21.40% |
| **D35** | 21.47 | 20.44 | 14.04 | 40.24 | 0.56% | 4.72% |
| **E36** | 10.78 | 9.42 | 14.75 | 40.24 | 0.04% | -50.69% |
| **E37-E39** | 10.21 | 8.85 | 14.18 | 40.24 | 0.27% | 15.85% |
| **F** | 27.61 | 27.71 | 32.39 | 40.24 | 6.88% | 8.16% |
| **G45** | 45.62 | 41.17 | 42.41 | 40.24 | 1.66% | -12.72% |
| **G46** | 19.68 | 19.64 | 19.97 | 40.24 | 4.57% | 5.63% |
| **G47** | 47.45 | 42.10 | 48.71 | 40.24 | 6.24% | -12.63% |
| **H49** | 26.51 | 25.72 | 27.17 | 40.24 | 2.20% | 11.25% |
| **H50** | 22.11 | 28.98 | 22.39 | 40.24 | 0.07% | 123.27% |
| **H51** | 18.63 | 17.76 | 23.94 | 40.24 | 0.24% | 8.98% |
| **H52** | 35.89 | 36.19 | 30.82 | 40.24 | 1.11% | 22.05% |
| **H53** | 58.47 | 63.45 | 39.67 | 40.24 | 0.81% | -15.04% |
| **I** | 42.60 | 44.02 | 53.74 | 40.24 | 4.36% | 3.89% |
| **J58** | 32.60 | 32.79 | 26.70 | 40.24 | 0.33% | -8.50% |
| **J59_J60** | 32.40 | 32.59 | 26.50 | 40.24 | 0.41% | 16.68% |
| **J61** | 21.16 | 21.27 | 17.14 | 40.24 | 0.56% | 2.39% |
| **J62_J63** | 25.03 | 27.24 | 23.20 | 40.24 | 2.11% | 36.04% |
| **K64** | 22.69 | 21.67 | 19.58 | 40.24 | 2.89% | -6.08% |
| **K65** | 9.89 | 9.86 | 11.62 | 40.24 | 1.11% | 2.40% |
| **K66** | 22.81 | 21.79 | 19.70 | 40.24 | 1.35% | 55.76% |
| **L68** | 4.93 | 5.64 | 8.91 | 40.24 | 1.17% | 27.30% |
| **M69_M70** | 34.50 | 36.77 | 22.94 | 40.24 | 4.03% | 27.30% |
| **M71** | 33.93 | 36.20 | 22.38 | 40.24 | 2.86% | 29.38% |
| **M72** | 5.95 | 7.64 | 19.38 | 40.24 | 0.61% | 42.71% |
| **M73** | 43.42 | 52.21 | 28.78 | 40.24 | 0.46% | -5.04% |
| **M74_M75** | 44.68 | 53.47 | 30.04 | 40.24 | 0.90% | 55.18% |
| **N** | 44.86 | 49.66 | 36.35 | 40.24 | 3.83% | 24.67% |
| **O84** | 21.26 | 21.07 | 24.59 | 40.24 | 4.61% | 6.65% |
| **P85** | 43.83 | 47.54 | 42.29 | 40.24 | 7.41% | 18.35% |
| **Q** | 42.31 | 46.48 | 47.58 | 40.24 | 14.39% | 24.99% |
| **R_S** | 63.23 | 69.70 | 61.26 | 40.24 | 6.04% | 23.26% |

*Table A.19: Analytical Results, Employment by occupation, Switzerland*

| | Multipliers by Occupation | | Structure of Employment by Occupation | Change in Employment Structure by Occupation |
|---|---|---|---|---|
| | 2011 | 2017 | 2017 | 2011-2017 |
| **11** | 84.42 | 80.06 | 52816 | 40.79% |
| **12** | 91.21 | 76.88 | 87090 | 23.56% |
| **13** | 8.88 | 9.32 | 104487 | 29.54% |
| **14** | 22.02 | 19.01 | 38454 | 11.24% |
| **21** | 30.70 | 35.51 | 144488 | 32.47% |
| **22** | 23.33 | 22.72 | 110475 | 16.63% |
| **23** | 41.20 | 39.41 | 236159 | 9.04% |
| **24** | 23.69 | 21.76 | 171253 | 35.07% |
| **25** | 38.70 | 32.85 | 94374 | 30.68% |
| **26** | 11.02 | 9.89 | 132307 | 30.56% |
| **31** | 15.19 | 13.39 | 198081 | 10.77% |
| **32** | 4.76 | 5.48 | 156960 | 21.29% |
| **33** | 21.90 | 20.70 | 302616 | 14.08% |
| **34** | 20.84 | 20.77 | 60065 | 40.44% |
| **35** | 16.44 | 15.08 | 22454 | 9.93% |
| **41** | 28.07 | 25.69 | 263851 | -6.29% |
| **42** | 15.38 | 15.52 | 42735 | -8.33% |
| **43** | 17.15 | 15.84 | 64828 | -12.51% |
| **44** | 21.42 | 20.56 | 24931 | -10.67% |
| **51** | 18.53 | 15.99 | 268173 | 10.37% |
| **52** | 20.00 | 17.99 | 261460 | -4.20% |
| **53** | 22.91 | 19.75 | 108795 | 31.19% |
| **54** | 26.04 | 28.42 | 42588 | 24.54% |
| **61** | 13.85 | 13.97 | 117143 | 5.32% |
| **62** | 14.44 | 13.34 | 6075 | -17.02% |
| **63** | 15.03 | 13.93 | 0 | 0.00% |
| **71** | 32.10 | 31.59 | 191224 | -4.70% |
| **72** | 42.09 | 37.34 | 160417 | -14.98% |
| **73** | 19.59 | 19.56 | 48745 | -13.12% |
| **74** | 48.11 | 43.17 | 81909 | -1.36% |
| **75** | 26.82 | 26.89 | 97703 | -7.63% |
| **81** | 22.16 | 29.08 | 67358 | -17.57% |
| **82** | 23.63 | 23.66 | 14410 | -8.51% |
| **83** | 30.34 | 32.44 | 97826 | 4.59% |
| **91** | 39.34 | 42.39 | 102138 | -2.59% |
| **92** | 53.39 | 55.40 | 14832 | -4.96% |
| **93** | 26.44 | 25.31 | 42889 | 9.77% |
| **94** | 26.41 | 26.48 | 627 | 157.74% |
| **95** | 16.71 | 16.82 | 90 | 38.89% |
| **96** | 22.72 | 25.18 | 15118 | 18.38% |

*Table A.20: GIS, SSS and SIRIUS 1, Czech Repuplic*

| | GIS | SSS | SIRIUS 1 |
|---|---|---|---|
| **A01** | 0.375 | 0.144 | 0.260 |
| **A02** | 0.241 | 0.099 | 0.170 |
| **A03** | 0.432 | 0.165 | 0.299 |
| **B** | 0.211 | 0.535 | 0.373 |
| **C10-C12** | 0.340 | 0.614 | 0.477 |
| **C13-C15** | 0.309 | 0.529 | 0.419 |
| **C16** | 0.242 | 0.336 | 0.289 |
| **C17** | 0.165 | 0.578 | 0.372 |
| **C18** | 0.341 | 0.785 | 0.563 |
| **C19** | 0.086 | 0.899 | 0.493 |
| **C20** | 0.138 | 0.372 | 0.255 |
| **C21** | 0.170 | 0.353 | 0.261 |
| **C22** | 0.224 | 0.654 | 0.439 |
| **C23** | 0.274 | 0.431 | 0.352 |
| **C24** | 0.206 | 0.631 | 0.419 |
| **C25** | 0.422 | 0.558 | 0.490 |
| **C26** | 0.171 | 0.416 | 0.294 |
| **C27** | 0.221 | 0.603 | 0.412 |
| **C28** | 0.284 | 0.603 | 0.444 |
| **C29** | 0.461 | 0.381 | 0.421 |
| **C30** | 0.231 | 0.688 | 0.460 |
| **C31_C32** | 0.343 | 0.598 | 0.470 |
| **C33** | 0.199 | 0.681 | 0.440 |
| **D35** | 0.148 | 1.000 | 0.574 |
| **E36** | 0.147 | 0.771 | 0.459 |
| **E37-E39** | 0.224 | 0.383 | 0.303 |
| **F** | 0.691 | 0.410 | 0.550 |
| **G45** | 0.419 | 0.586 | 0.502 |
| **G46** | 0.316 | 0.938 | 0.627 |
| **G47** | 0.792 | 0.810 | 0.801 |
| **H49** | 0.461 | 0.424 | 0.443 |
| **H50** | 0.360 | 0.598 | 0.479 |
| **H51** | 0.118 | 0.723 | 0.420 |
| **H52** | 0.296 | 0.912 | 0.604 |
| **H53** | 0.411 | 0.518 | 0.464 |
| **I** | 0.534 | 0.607 | 0.570 |
| **J58** | 0.111 | 0.256 | 0.184 |
| **J59_J60** | 0.223 | 0.526 | 0.374 |
| **J61** | 0.148 | 0.321 | 0.235 |
| **J62_J63** | 0.317 | 0.150 | 0.233 |
| **K64** | 0.232 | 0.283 | 0.257 |
| **K65** | 0.180 | 0.712 | 0.446 |
| **K66** | 0.425 | 0.543 | 0.484 |
| **L68** | 0.233 | 0.619 | 0.426 |
| **M69_M70** | 0.335 | 0.159 | 0.247 |
| **M71** | 0.377 | 0.107 | 0.242 |
| **M72** | 0.277 | 0.000 | 0.138 |
| **M73** | 0.366 | 0.371 | 0.368 |
| **M74_M75** | 0.374 | 0.567 | 0.470 |
| **N** | 0.520 | 0.725 | 0.622 |
| **O84** | 0.624 | 0.519 | 0.572 |
| **P85** | 0.765 | 0.084 | 0.425 |
| **Q** | 0.731 | 0.326 | 0.529 |
| **R_S** | 0.513 | 0.871 | 0.692 |

*Table A.21: GIS, SSS and SIRIUS 1, Greece*

| | GIS | SSS | SIRIUS 1 |
|---|---|---|---|
| **A01** | 0.723 | 0.813 | 0.768 |
| **A02** | 0.255 | 0.701 | 0.478 |
| **A03** | 0.116 | 0.869 | 0.493 |
| **B** | 0.161 | 0.599 | 0.380 |
| **C10-C12** | 0.279 | 0.621 | 0.450 |
| **C13-C15** | 0.201 | 0.701 | 0.451 |
| **C16** | 0.260 | 1.000 | 0.630 |
| **C17** | 0.094 | 0.631 | 0.363 |
| **C18** | 0.262 | 0.429 | 0.345 |
| **C19** | 0.071 | 0.385 | 0.228 |
| **C20** | 0.105 | 0.256 | 0.181 |
| **C21** | 0.175 | 0.236 | 0.205 |
| **C22** | 0.174 | 0.470 | 0.322 |
| **C23** | 0.105 | 0.641 | 0.373 |
| **C24** | 0.068 | 0.606 | 0.337 |
| **C25** | 0.178 | 0.537 | 0.358 |
| **C26** | 0.135 | 0.270 | 0.202 |
| **C27** | 0.138 | 0.427 | 0.283 |
| **C28** | 0.055 | 0.380 | 0.218 |
| **C29** | 0.051 | 0.910 | 0.481 |
| **C30** | 0.227 | 0.564 | 0.395 |
| **C31_C32** | 0.192 | 0.615 | 0.404 |
| **C33** | 0.077 | 0.353 | 0.215 |
| **D35** | 0.174 | 0.372 | 0.273 |
| **E36** | 0.129 | 0.408 | 0.268 |
| **E37-E39** | 0.136 | 0.852 | 0.494 |
| **F** | 0.302 | 0.860 | 0.581 |
| **G45** | 0.209 | 0.443 | 0.326 |
| **G46** | 0.203 | 0.431 | 0.317 |
| **G47** | 0.798 | 0.461 | 0.630 |
| **H49** | 0.252 | 0.551 | 0.402 |
| **H50** | 0.138 | 0.348 | 0.243 |
| **H51** | 0.126 | 0.328 | 0.227 |
| **H52** | 0.219 | 0.404 | 0.311 |
| **H53** | 0.226 | 0.392 | 0.309 |
| **I** | 0.532 | 0.598 | 0.565 |
| **J58** | 0.198 | 0.174 | 0.186 |
| **J59_J60** | 0.257 | 0.270 | 0.264 |
| **J61** | 0.195 | 0.216 | 0.205 |
| **J62_J63** | 0.310 | 0.104 | 0.207 |
| **K64** | 0.198 | 0.191 | 0.195 |
| **K65** | 0.221 | 0.289 | 0.255 |
| **K66** | 0.164 | 0.270 | 0.217 |
| **L68** | 0.091 | 0.396 | 0.244 |
| **M69_M70** | 0.369 | 0.110 | 0.240 |
| **M71** | 0.500 | 0.075 | 0.288 |
| **M72** | 0.178 | 0.000 | 0.089 |
| **M73** | 0.263 | 0.247 | 0.255 |
| **M74_M75** | 0.302 | 0.282 | 0.292 |
| **N** | 0.335 | 0.539 | 0.437 |
| **O84** | 0.398 | 0.319 | 0.359 |
| **P85** | 0.339 | 0.059 | 0.199 |
| **Q** | 0.478 | 0.219 | 0.349 |
| **R_S** | 0.225 | 0.460 | 0.343 |

*Table A.22: GIS, SSS and SIRIUS 1, Denmark*

| | GIS | SSS | SIRIUS 1 |
|---|---|---|---|
| **A01** | 0.104 | 0.313 | 0.209 |
| **A02** | 0.110 | 0.298 | 0.204 |
| **A03** | 0.066 | 0.377 | 0.221 |
| **B** | 0.135 | 0.492 | 0.313 |
| **C10-C12** | 0.205 | 0.619 | 0.412 |
| **C13-C15** | 0.128 | 0.684 | 0.406 |
| **C16** | 0.214 | 0.552 | 0.383 |
| **C17** | 0.174 | 0.561 | 0.368 |
| **C18** | 0.239 | 0.486 | 0.363 |
| **C19** | 0.086 | 0.507 | 0.297 |
| **C20** | 0.130 | 0.904 | 0.517 |
| **C21** | 0.175 | 0.824 | 0.500 |
| **C22** | 0.171 | 0.430 | 0.300 |
| **C23** | 0.221 | 0.359 | 0.290 |
| **C24** | 0.168 | 1.000 | 0.584 |
| **C25** | 0.261 | 0.429 | 0.345 |
| **C26** | 0.149 | 0.626 | 0.388 |
| **C27** | 0.175 | 0.305 | 0.240 |
| **C28** | 0.224 | 0.975 | 0.599 |
| **C29** | 0.158 | 0.597 | 0.377 |
| **C30** | 0.259 | 0.837 | 0.548 |
| **C31_C32** | 0.201 | 0.587 | 0.394 |
| **C33** | 0.176 | 0.316 | 0.246 |
| **D35** | 0.156 | 0.600 | 0.378 |
| **E36** | 0.094 | 0.433 | 0.263 |
| **E37-E39** | 0.181 | 0.410 | 0.296 |
| **F** | 0.410 | 0.600 | 0.505 |
| **G45** | 0.287 | 0.312 | 0.300 |
| **G46** | 0.374 | 0.724 | 0.549 |
| **G47** | 0.664 | 0.573 | 0.618 |
| **H49** | 0.289 | 0.350 | 0.319 |
| **H50** | 0.417 | 0.869 | 0.643 |
| **H51** | 0.119 | 0.354 | 0.236 |
| **H52** | 0.224 | 0.548 | 0.386 |
| **H53** | 0.408 | 0.164 | 0.286 |
| **I** | 0.490 | 0.585 | 0.538 |
| **J58** | 0.322 | 0.590 | 0.456 |
| **J59_J60** | 0.297 | 0.626 | 0.462 |
| **J61** | 0.254 | 0.660 | 0.457 |
| **J62_J63** | 0.366 | 0.341 | 0.354 |
| **K64** | 0.230 | 0.653 | 0.441 |
| **K65** | 0.215 | 0.684 | 0.449 |
| **K66** | 0.232 | 0.626 | 0.429 |
| **L68** | 0.162 | 0.269 | 0.215 |
| **M69_M70** | 0.375 | 0.361 | 0.368 |
| **M71** | 0.333 | 0.242 | 0.288 |
| **M72** | 0.258 | 0.000 | 0.129 |
| **M73** | 0.283 | 0.733 | 0.508 |
| **M74_M75** | 0.317 | 0.661 | 0.489 |
| **N** | 0.518 | 0.650 | 0.584 |
| **O84** | 0.657 | 0.778 | 0.717 |
| **P85** | 0.382 | 0.190 | 0.286 |
| **Q** | 0.609 | 0.758 | 0.684 |
| **R_S** | 0.299 | 0.667 | 0.483 |

*Table A.23: GIS, SSS and SIRIUS 1, United Kingdom*

| | GIS | SSS | SIRIUS 1 |
|---|---|---|---|
| **A01** | 0.224 | 0.077 | 0.150 |
| **A02** | 0.302 | 0.013 | 0.157 |
| **A03** | 0.258 | 0.108 | 0.183 |
| **B** | 0.136 | 0.212 | 0.174 |
| **C10-C12** | 0.195 | 0.286 | 0.240 |
| **C13-C15** | 0.242 | 0.327 | 0.284 |
| **C16** | 0.282 | 0.243 | 0.263 |
| **C17** | 0.183 | 0.249 | 0.216 |
| **C18** | 0.248 | 0.400 | 0.324 |
| **C19** | 0.114 | 0.417 | 0.266 |
| **C20** | 0.147 | 0.738 | 0.443 |
| **C21** | 0.228 | 0.671 | 0.450 |
| **C22** | 0.161 | 0.313 | 0.237 |
| **C23** | 0.168 | 0.121 | 0.145 |
| **C24** | 0.100 | 0.522 | 0.311 |
| **C25** | 0.165 | 0.232 | 0.198 |
| **C26** | 0.179 | 0.652 | 0.416 |
| **C27** | 0.162 | 0.251 | 0.207 |
| **C28** | 0.177 | 1.000 | 0.589 |
| **C29** | 0.154 | 0.272 | 0.213 |
| **C30** | 0.198 | 0.478 | 0.338 |
| **C31_C32** | 0.231 | 0.265 | 0.248 |
| **C33** | 0.313 | 0.260 | 0.287 |
| **D35** | 0.159 | 0.494 | 0.327 |
| **E36** | 0.196 | 0.356 | 0.276 |
| **E37-E39** | 0.205 | 0.153 | 0.179 |
| **F** | 0.388 | 0.273 | 0.331 |
| **G45** | 0.202 | 0.255 | 0.229 |
| **G46** | 0.252 | 0.598 | 0.425 |
| **G47** | 0.537 | 0.440 | 0.489 |
| **H49** | 0.304 | 0.115 | 0.209 |
| **H50** | 0.186 | 0.893 | 0.539 |
| **H51** | 0.169 | 0.291 | 0.230 |
| **H52** | 0.280 | 0.451 | 0.365 |
| **H53** | 0.321 | 0.137 | 0.229 |
| **I** | 0.444 | 0.273 | 0.359 |
| **J58** | 0.333 | 0.477 | 0.405 |
| **J59_J60** | 0.284 | 0.652 | 0.468 |
| **J61** | 0.232 | 0.606 | 0.419 |
| **J62_J63** | 0.437 | 0.273 | 0.355 |
| **K64** | 0.257 | 0.529 | 0.393 |
| **K65** | 0.172 | 0.574 | 0.373 |
| **K66** | 0.338 | 0.652 | 0.495 |
| **L68** | 0.165 | 0.221 | 0.193 |
| **M69_M70** | 0.440 | 0.290 | 0.365 |
| **M71** | 0.390 | 0.194 | 0.292 |
| **M72** | 0.286 | 0.000 | 0.143 |
| **M73** | 0.352 | 0.708 | 0.530 |
| **M74_M75** | 0.388 | 0.685 | 0.537 |
| **N** | 0.437 | 0.383 | 0.410 |
| **O84** | 0.459 | 0.801 | 0.630 |
| **P85** | 0.759 | 0.151 | 0.455 |
| **Q** | 0.777 | 0.616 | 0.696 |
| **R_S** | 0.504 | 0.516 | 0.510 |

*Table A.24: GIS, SSS and SIRIUS 1, Finland*

| | GIS | SSS | SIRIUS 1 |
|---|---|---|---|
| **A** | 0.415 | 0.353 | 0.384 |
| **B** | 0.349 | 0.219 | 0.284 |
| **C** | 0.638 | 0.417 | 0.528 |
| **D** | 0.341 | 0.526 | 0.433 |
| **E** | 0.365 | 0.723 | 0.544 |
| **F** | 0.510 | 1.000 | 0.755 |
| **G** | 0.568 | 0.967 | 0.768 |
| **H** | 0.534 | 0.667 | 0.601 |
| **I** | 0.424 | 0.485 | 0.454 |
| **J** | 0.393 | 0.378 | 0.386 |
| **K** | 0.339 | 0.045 | 0.192 |
| **L** | 0.257 | 0.000 | 0.128 |
| **M** | 0.458 | 0.448 | 0.453 |
| **N** | 0.414 | 0.550 | 0.482 |
| **O** | 0.275 | 0.930 | 0.603 |
| **P** | 0.256 | 0.446 | 0.351 |
| **Q** | 0.586 | 0.086 | 0.336 |
| **R-S** | 0.386 | 0.290 | 0.338 |

*Table A.25: GIS, SSS and SIRIUS 1, Italy*

| | GIS | SSS | SIRIUS 1 |
|---|---|---|---|
| **A** | 0.471 | 0.916 | 0.693 |
| **B** | 0.079 | 0.747 | 0.413 |
| **C** | 0.681 | 1.000 | 0.840 |
| **D** | 0.267 | 0.393 | 0.330 |
| **E** | 0.309 | 0.419 | 0.364 |
| **F** | 0.316 | 0.512 | 0.414 |
| **G** | 0.587 | 0.852 | 0.719 |
| **H** | 0.335 | 0.431 | 0.383 |
| **I** | 0.462 | 0.194 | 0.328 |
| **J** | 0.256 | 0.141 | 0.199 |
| **K** | 0.235 | 0.026 | 0.130 |
| **L** | 0.069 | 0.000 | 0.034 |
| **M** | 0.433 | 0.243 | 0.338 |
| **N** | 0.414 | 0.464 | 0.439 |
| **O** | 0.269 | 0.402 | 0.335 |
| **P** | 0.502 | 0.321 | 0.411 |
| **Q** | 0.439 | 0.005 | 0.222 |
| **R-S** | 0.377 | 0.192 | 0.284 |

*Table A.26: GIS, SSS and SIRIUS 1, Switzerland*

| | GIS | SSS | SIRIUS 1 |
|---|---|---|---|
| **A01** | 0.327 | 0.457 | 0.392 |
| **A02** | 0.229 | 0.364 | 0.296 |
| **A03** | 0.128 | 0.502 | 0.315 |
| **B** | 0.107 | 0.557 | 0.332 |
| **C10-C12** | 0.289 | 0.687 | 0.488 |
| **C13-C15** | 0.154 | 0.812 | 0.483 |
| **C16** | 0.289 | 0.686 | 0.487 |
| **C17** | 0.145 | 0.650 | 0.398 |
| **C18** | 0.256 | 0.552 | 0.404 |
| **C19** | 0.054 | 0.570 | 0.312 |
| **C20** | 0.101 | 0.568 | 0.334 |
| **C21** | 0.135 | 0.519 | 0.327 |
| **C22** | 0.162 | 0.504 | 0.333 |
| **C23** | 0.192 | 0.506 | 0.349 |
| **C24** | 0.128 | 1.000 | 0.564 |
| **C25** | 0.233 | 0.503 | 0.368 |
| **C26** | 0.187 | 0.491 | 0.339 |
| **C27** | 0.124 | 0.398 | 0.261 |
| **C28** | 0.175 | 0.732 | 0.454 |
| **C29** | 0.073 | 0.728 | 0.401 |
| **C30** | 0.114 | 0.856 | 0.485 |
| **C31_C32** | 0.125 | 0.651 | 0.388 |
| **C33** | 0.253 | 0.407 | 0.330 |
| **D35** | 0.188 | 0.650 | 0.419 |
| **E36** | 0.117 | 0.506 | 0.312 |
| **E37-E39** | 0.138 | 0.554 | 0.346 |
| **F** | 0.419 | 0.731 | 0.575 |
| **G45** | 0.300 | 0.404 | 0.352 |
| **G46** | 0.307 | 0.758 | 0.533 |
| **G47** | 0.461 | 0.627 | 0.544 |
| **H49** | 0.284 | 0.463 | 0.373 |
| **H50** | 0.309 | 0.659 | 0.484 |
| **H51** | 0.192 | 0.439 | 0.316 |
| **H52** | 0.301 | 0.606 | 0.453 |
| **H53** | 0.372 | 0.279 | 0.326 |
| **I** | 0.462 | 0.637 | 0.550 |
| **J58** | 0.229 | 0.376 | 0.302 |
| **J59_J60** | 0.235 | 0.491 | 0.363 |
| **J61** | 0.194 | 0.472 | 0.333 |
| **J62_J63** | 0.298 | 0.220 | 0.259 |
| **K64** | 0.314 | 0.414 | 0.364 |
| **K65** | 0.222 | 0.531 | 0.376 |
| **K66** | 0.283 | 0.491 | 0.387 |
| **L68** | 0.216 | 0.367 | 0.291 |
| **M69_M70** | 0.341 | 0.232 | 0.287 |
| **M71** | 0.305 | 0.157 | 0.231 |
| **M72** | 0.183 | 0.000 | 0.091 |
| **M73** | 0.309 | 0.546 | 0.427 |
| **M74_M75** | 0.346 | 0.515 | 0.430 |
| **N** | 0.455 | 0.693 | 0.574 |
| **O84** | 0.313 | 0.596 | 0.455 |
| **P85** | 0.544 | 0.123 | 0.334 |
| **Q** | 0.754 | 0.479 | 0.617 |
| **R_S** | 0.610 | 0.708 | 0.659 |

*Table A.27: GIO, OSS and SIRIUS 2, Czech Republic*

| | GIO | OSS | SIRIUS 2 |
|---|---|---|---|
| **11** | 0.191 | 0.839 | 0.449 |
| **12** | 0.293 | 0.690 | 0.456 |
| **13** | 0.227 | 0.613 | 0.464 |
| **14** | 0.185 | 0.772 | 0.560 |
| **21** | 0.399 | 0.378 | 0.388 |
| **22** | 0.338 | 0.397 | 0.527 |
| **23** | 0.462 | 0.000 | 0.260 |
| **24** | 0.361 | 0.406 | 0.354 |
| **25** | 0.302 | 0.234 | 0.207 |
| **26** | 0.259 | 0.384 | 0.373 |
| **31** | 0.521 | 0.724 | 0.543 |
| **32** | 0.299 | 0.384 | 0.325 |
| **33** | 0.657 | 0.538 | 0.383 |
| **34** | 0.278 | 0.866 | 0.608 |
| **35** | 0.232 | 0.485 | 0.354 |
| **41** | 0.385 | 0.664 | 0.478 |
| **42** | 0.217 | 0.910 | 0.571 |
| **43** | 0.481 | 0.848 | 0.588 |
| **44** | 0.214 | 1.000 | 0.849 |
| **51** | 0.472 | 0.722 | 0.530 |
| **52** | 0.596 | 0.865 | 0.528 |
| **53** | 0.328 | 0.462 | 0.486 |
| **54** | 0.266 | 0.720 | 0.510 |
| **61** | 0.168 | 0.074 | 0.129 |
| **62** | 0.131 | 0.084 | 0.244 |
| **63** | 0.223 | 0.463 | 0.472 |
| **71** | 0.510 | 0.718 | 0.468 |
| **72** | 0.653 | 0.778 | 0.455 |
| **73** | 0.181 | 0.805 | 0.700 |
| **74** | 0.350 | 0.624 | 0.451 |
| **75** | 0.362 | 0.693 | 0.453 |
| **81** | 0.698 | 0.607 | 0.421 |
| **82** | 0.349 | 0.657 | 0.559 |
| **83** | 0.662 | 0.745 | 0.502 |
| **91** | 0.404 | 0.120 | 0.144 |
| **92** | 0.209 | 0.702 | 0.544 |
| **93** | 0.315 | 0.693 | 0.678 |
| **94** | 0.222 | 0.853 | 0.531 |
| **95** | 0.059 | 0.685 | 0.669 |
| **96** | 0.235 | 0.510 | 0.491 |

*Table A.28: GIO, OSS and SIRIUS 2, Denmark*

| | GIO | OSS | SIRIUS 2 |
|---|---|---|---|
| **11** | 0.154 | 0.705 | 0.483 |
| **12** | 0.208 | 0.814 | 0.561 |
| **13** | 0.196 | 1.000 | 0.659 |
| **14** | 0.127 | 0.409 | 0.318 |
| **21** | 0.268 | 0.730 | 0.499 |
| **22** | 0.353 | 0.677 | 0.534 |
| **23** | 0.704 | 0.000 | 0.109 |
| **24** | 0.314 | 0.669 | 0.496 |
| **25** | 0.323 | 0.467 | 0.353 |
| **26** | 0.178 | 0.612 | 0.463 |
| **31** | 0.217 | 0.852 | 0.575 |
| **32** | 0.193 | 0.694 | 0.391 |
| **33** | 0.391 | 0.662 | 0.429 |
| **34** | 0.193 | 0.674 | 0.561 |
| **35** | 0.205 | 0.646 | 0.487 |
| **41** | 0.365 | 0.753 | 0.481 |
| **42** | 0.179 | 0.629 | 0.417 |
| **43** | 0.299 | 0.694 | 0.634 |
| **44** | 0.207 | 0.529 | 0.309 |
| **51** | 0.316 | 0.460 | 0.407 |
| **52** | 0.678 | 0.407 | 0.280 |
| **53** | 0.574 | 0.872 | 0.607 |
| **54** | 0.087 | 0.775 | 0.484 |
| **61** | 0.145 | 0.128 | 0.128 |
| **62** | 0.120 | 0.176 | 0.211 |
| **63** | 0.327 | 0.483 | 0.391 |
| **71** | 0.341 | 0.293 | 0.236 |
| **72** | 0.231 | 0.388 | 0.254 |
| **73** | 0.238 | 0.622 | 0.650 |
| **74** | 0.447 | 0.484 | 0.338 |
| **75** | 0.298 | 0.470 | 0.338 |
| **81** | 0.088 | 0.404 | 0.352 |
| **82** | 0.227 | 0.401 | 0.552 |
| **83** | 0.323 | 0.748 | 0.463 |
| **91** | 0.246 | 0.167 | 0.156 |
| **92** | 0.517 | 0.510 | 0.438 |
| **93** | 0.317 | 0.446 | 0.384 |
| **94** | 0.309 | 0.689 | 0.603 |
| **95** | 0.261 | 0.611 | 0.421 |
| **96** | 0.301 | 0.590 | 0.453 |

*Table A.29: GIO, OSS and SIRIUS 2, Greece*

| | GIO | OSS | SIRIUS 2 |
|---|---|---|---|
| **11** | 0.015 | 0.406 | 0.266 |
| **12** | 0.013 | 0.380 | 0.291 |
| **13** | 0.073 | 0.440 | 0.266 |
| **14** | 0.083 | 0.521 | 0.451 |
| **21** | 0.389 | 0.241 | 0.315 |
| **22** | 0.235 | 0.253 | 0.306 |
| **23** | 0.367 | 0.000 | 0.050 |
| **24** | 0.326 | 0.258 | 0.194 |
| **25** | 0.131 | 0.153 | 0.157 |
| **26** | 0.328 | 0.245 | 0.286 |
| **31** | 0.099 | 0.394 | 0.277 |
| **32** | 0.140 | 0.245 | 0.251 |
| **33** | 0.359 | 0.326 | 0.199 |
| **34** | 0.110 | 0.394 | 0.325 |
| **35** | 0.151 | 0.305 | 0.247 |
| **41** | 0.475 | 0.358 | 0.186 |
| **42** | 0.217 | 0.454 | 0.302 |
| **43** | 0.156 | 0.418 | 0.284 |
| **44** | 0.099 | 0.374 | 0.193 |
| **51** | 0.442 | 0.572 | 0.404 |
| **52** | 0.848 | 0.469 | 0.242 |
| **53** | 0.151 | 0.307 | 0.281 |
| **54** | 0.257 | 0.366 | 0.253 |
| **61** | 0.629 | 0.882 | 0.483 |
| **62** | 0.084 | 0.907 | 0.534 |
| **63** | 0.190 | 0.809 | 0.482 |
| **71** | 0.254 | 0.479 | 0.348 |
| **72** | 0.156 | 0.504 | 0.294 |
| **73** | 0.160 | 0.522 | 0.685 |
| **74** | 0.255 | 0.646 | 0.378 |
| **75** | 0.160 | 0.593 | 0.346 |
| **81** | 0.011 | 0.633 | 0.384 |
| **82** | 0.381 | 0.590 | 0.478 |
| **83** | 0.359 | 0.558 | 0.443 |
| **91** | 0.162 | 1.000 | 0.814 |
| **92** | 0.217 | 0.586 | 0.531 |
| **93** | 0.092 | 0.592 | 0.476 |
| **94** | 0.202 | 0.415 | 0.316 |
| **95** | 0.127 | 0.598 | 0.377 |
| **96** | 0.134 | 0.300 | 0.371 |

*Table A.30: GIO, OSS and SIRIUS 2, Italy*

| | GIO | OSS | SIRIUS 2 |
|---|---|---|---|
| **OC1** | 0.113 | 0.220 | 0.166 |
| **OC2** | 0.826 | 0.092 | 0.459 |
| **OC3** | 0.838 | 0.054 | 0.446 |
| **OC4** | 0.543 | 1.000 | 0.771 |
| **OC5** | 0.982 | 0.000 | 0.491 |
| **OC6** | 0.088 | 0.338 | 0.213 |
| **OC7** | 0.446 | 0.358 | 0.402 |
| **OC8** | 0.250 | 0.005 | 0.128 |
| **OC9** | 0.743 | 0.021 | 0.382 |

*Table A.31: GIO, OSS and SIRIUS 2, Finland*

| | GIO | OSS | SIRIUS 2 |
|---|---|---|---|
| **OC1** | 0.128 | 0.764 | 0.446 |
| **OC2** | 0.600 | 0.410 | 0.505 |
| **OC3** | 0.621 | 0.280 | 0.450 |
| **OC4** | 0.406 | 0.442 | 0.424 |
| **OC5** | 0.929 | 0.000 | 0.465 |
| **OC6** | 0.079 | 1.000 | 0.539 |
| **OC7** | 0.365 | 0.882 | 0.624 |
| **OC8** | 0.202 | 0.012 | 0.107 |
| **OC9** | 0.722 | 0.050 | 0.386 |

*Table A.32: GIO, OSS and SIRIUS 2, United Kingdom*

| | GIO | OSS | SIRIUS 2 |
|---|---|---|---|
| **11** | 0.320 | 0.702 | 0.452 |
| **12** | 0.640 | 0.878 | 0.533 |
| **13** | 0.450 | 1.000 | 0.687 |
| **14** | 0.458 | 0.323 | 0.369 |
| **21** | 0.412 | 0.746 | 0.579 |
| **22** | 0.532 | 0.783 | 0.686 |
| **23** | 0.625 | 0.075 | 0.166 |
| **24** | 0.642 | 0.800 | 0.633 |
| **25** | 0.465 | 0.479 | 0.387 |
| **26** | 0.371 | 0.759 | 0.701 |
| **31** | 0.257 | 0.837 | 0.622 |
| **32** | 0.297 | 0.758 | 0.629 |
| **33** | 0.590 | 0.843 | 0.647 |
| **34** | 0.366 | 0.675 | 0.544 |
| **35** | 0.216 | 0.827 | 0.634 |
| **41** | 0.138 | 0.857 | 0.748 |
| **42** | 0.449 | 0.609 | 0.412 |
| **43** | 0.322 | 0.692 | 0.724 |
| **44** | 0.468 | 0.544 | 0.360 |
| **51** | 0.459 | 0.299 | 0.415 |
| **52** | 0.678 | 0.392 | 0.356 |
| **53** | 0.755 | 0.962 | 0.684 |
| **54** | 0.500 | 0.800 | 0.548 |
| **61** | 0.192 | 0.000 | 0.229 |
| **62** | 0.167 | 0.013 | 0.153 |
| **63** | 0.441 | 0.252 | 0.287 |
| **71** | 0.406 | 0.283 | 0.366 |
| **72** | 0.220 | 0.328 | 0.248 |
| **73** | 0.295 | 0.486 | 0.582 |
| **74** | 0.413 | 0.253 | 0.310 |
| **75** | 0.407 | 0.283 | 0.375 |
| **81** | 0.176 | 0.199 | 0.239 |
| **82** | 0.414 | 0.237 | 0.431 |
| **83** | 0.371 | 0.527 | 0.449 |
| **91** | 0.293 | 0.040 | 0.116 |
| **92** | 0.620 | 0.318 | 0.228 |
| **93** | 0.374 | 0.266 | 0.319 |
| **94** | 0.188 | 0.688 | 0.654 |
| **95** | 0.203 | 0.374 | 0.297 |
| **96** | 0.279 | 0.767 | 0.613 |

*Table A.33: GIO, OSS and SIRIUS 2, Switzerland*

| | GIO | OSS | SIRIUS 2 |
|---|---|---|---|
| **11** | 0.465 | 0.829 | 0.471 |
| **12** | 0.467 | 0.765 | 0.493 |
| **13** | 0.283 | 0.920 | 0.555 |
| **14** | 0.137 | 0.641 | 0.386 |
| **21** | 0.495 | 0.580 | 0.537 |
| **22** | 0.304 | 0.610 | 0.606 |
| **23** | 0.550 | 0.000 | 0.187 |
| **24** | 0.448 | 0.624 | 0.471 |
| **25** | 0.319 | 0.357 | 0.256 |
| **26** | 0.309 | 0.591 | 0.519 |
| **31** | 0.375 | 0.800 | 0.528 |
| **32** | 0.364 | 0.590 | 0.418 |
| **33** | 0.603 | 0.637 | 0.460 |
| **34** | 0.251 | 0.800 | 0.545 |
| **35** | 0.107 | 0.625 | 0.344 |
| **41** | 0.461 | 0.714 | 0.591 |
| **42** | 0.139 | 0.873 | 0.490 |
| **43** | 0.144 | 0.857 | 0.577 |
| **44** | 0.122 | 0.751 | 0.513 |
| **51** | 0.491 | 0.694 | 0.499 |
| **52** | 0.434 | 0.638 | 0.551 |
| **53** | 0.296 | 0.753 | 0.579 |
| **54** | 0.247 | 0.732 | 0.548 |
| **61** | 0.262 | 0.417 | 0.277 |
| **62** | 0.056 | 0.438 | 0.395 |
| **63** | 0.064 | 0.825 | 0.484 |
| **71** | 0.406 | 0.520 | 0.329 |
| **72** | 0.338 | 0.619 | 0.338 |
| **73** | 0.155 | 0.865 | 0.649 |
| **74** | 0.291 | 0.742 | 0.496 |
| **75** | 0.257 | 0.704 | 0.413 |
| **81** | 0.275 | 0.639 | 0.411 |
| **82** | 0.131 | 0.632 | 0.591 |
| **83** | 0.319 | 1.000 | 0.654 |
| **91** | 0.352 | 0.466 | 0.364 |
| **92** | 0.271 | 0.747 | 0.604 |
| **93** | 0.189 | 0.679 | 0.499 |
| **94** | 0.221 | 0.851 | 0.561 |
| **95** | 0.114 | 0.853 | 0.596 |
| **96** | 0.183 | 0.577 | 0.534 |

# Appendix B: Input-Output Analysis

## B.1. Introduction

The input-output analysis (IOA) and all the related methodological and empirical extensions, are based on the analytical and methodological framework developed by Wassily Leontief in the 1930s. Input-Output Analysis explores the interrelations (interdependencies) among the different sectors of economic activity for a specific economy, and quantifies the reciprocal productive linkages. The quantification of the productive linkages is due a system of linear equations that quantifies the relationships (balance) between inputs and outputs of the economic system, or else the distribution of the product of each branch in all economic uses of the reference system (W. Leontief, 1991; W. W. Leontief, 1936). In other word, the input-output analysis is a production theory that reflects the operation of an economic system, based on the interdependence of its economic activities (Livas, 1994).

In the recent years, the input–output model becomes a popular approach for economic analysis and scheduling, as shown by the introduction of input-output tables into national accounts system. The methodological extensions of input-output analysis are met in many different areas of the economics science, with a wide range of case study and empirical applications. Such research fields are: growth economics, labour economics, regional economics, energy and environment economics. Moreover, IOA is applied to examine the productive structure of an economic system (national, regional, local) to asses economic and social policies as well as for macroeconomic and sectoral projections (Maria Markaki, Belegri-Roboli, Michaelides, Mirasgedis, & Lalas, 2013; Maria Markaki, Belegri-Roboli, Sarafidis, & Mirasgedis, 2017; Miller & Blair, 2009; Suh, 2009).

In this study, IOA will be used, firstly, to identify the dynamic sector and the dynamic occupations of the examined economies and secondly, to estimate the employability potential of MRAS. To this end, the IOA analytical framework will be shortly described, focusing of measures connected with the characteristics of employment.

The assumption of IO are (W. Leontief, 1991, p. 182; Livas, 1994, p. 26) are:

- Each commodity is produced by only one sector of economic activity and the firms within the sector use a single method of production. or, in different words, the same production function. The consequence of this assumption is that each sector produce only one primary output and that all firms in a sector have the same production function. Note that, in this framework, joint production is ruled out.
- External economies and diseconomies are ruled out, namely the inputs purchased by each sector must be solely a function of the sector's output This assumption means that the production process of each sector does not benefit or burden any other sector. From another point of view, it could be stated that the cumulative effect of carrying on all types of production is the sum of the separate effects, or, that the returns to scale of the production function are constant.
- The technical coefficients are fixed or a sector’s inputs are a linear function of its output. In this production function (production function of Leontief), all inputs are perfect complements and the marginal product of every one of them being zero with the exception of the specific combination defined by the production function. This assumption means that there is no substitution among inputs and is the most restrictive assumption.
- The problems of capacity and capital are ignored, since there is no restriction in the supply of factors of production. This hypothesis means that the supply of productive factors is perfectly elastic.

According to the assumption of fixed technical coefficients, the technology of a sector is unique, so capital and labor are used in constant proportions. The resulting production function is the Leontief type:

$$Q = c\left[min(\frac{L}{a}, \frac{K}{b}\right] = c\frac{\frac{L}{a} + \frac{K}{b} - \left|\frac{L}{a} - \frac{K}{b}\right|}{2} \quad \text{(B.1)}$$

Where c is a parameter expressing the productivity level, and a and b are constant parameters expressing the way labour (L) and capital (K) are combined to produce the quantity (Q) of the product.

In the Leontief type production function, the only effective way to produce a given quantity of products is to combine labour and capital with the ratio $^{a}/_{b}$. Otherwise, the firm will pay for resources that will not add anything to production. In this case, the inputs are perfectly complementary

Two basic models are formed in the framework of input-output analysis: The Leontief model and the Ghosh model. Both models describe the economic linkages of a system from a different point of view. In particular, in the Leontief's model (demand model) final demand is considered to be the exogenous variable, while the Ghosh's model (supply model) the primary inputs are considered to be an exogenous. In both models, the interconnections of the economy are considered fixed and through these fixed interconnections the endogenous variables are calculated.

Based on the theoretical assumptions of the input-output analysis and the Leontief type production function, Leontief's input-output model is compiled. The basic mathematical formulas that express the economy in this case express the distribution of the total output of each sector to the intermediate demand of all sectors and to all categories of final demand. Therefore, Leontief's input-output model calculates changes in the output of the economy due to exogenous changes in the final demand.

Alternatively, the Ghosh-type input-output model, based on the assumption of fixed allocation factors, is based on mathematical formulas that reflect the distribution of total industry output in the intermediate supply to all sectors and to all categories of value added. Ghosh's input-output model calculates changes in the output of the economy due to exogenous changes in primary inputs.

## B. 2. The Leontief model and the Ghosh model

At the core of the IOA lies the matrix of intermediate transactions of an economy, which describes the inter-sectoral relations of the economy. The matrix of transactions is a dual input matrix and can be read in two different ways, with respect to the lines and the columns. The lines describe the product's flows from each industry that is considered to be a producer to each industry considered to be a consumer, or else the distribution of the output of each sector to the others. The lines describe, in other words, the intermediate supply of the economy. The columns describe the flows needed for the production of a sector from all the sectors of the economy or else the composition of inputs required to produce the final product of each sector from the rest. Or, the columns describe the intermediate demand of the examined economy (Belegri-Roboli, Markaki, & Michaelides, 2010, p. 33; Miller & Blair, 2009, p. 95)

Production technology, in IOA, is expressed through technological coefficients which represent the cost structure of each sector. Technological coefficients reflect the average among alternative production techniques applied simultaneously to the various enterprises in the sector of interest. These production techniques may include from the oldest, but still active method, to the most up-to-date.

For an economy with n sectors of economic activity, where $X_i$ is the production of sector i, $Y_i$ the final demand for the product of sector i and $z_{ij}$ the monetary flows from sector i to sector j, the following equations describe the production of n sectors:

$$\begin{aligned} X_1 &= z_{11} + z_{12} + \cdots + z_{1n} + Y_{1n} \\ X_2 &= z_{21} + z_{22} + \cdots + z_{2n} + Y_{2n} \\ \vdots \quad &\vdots \quad \vdots \quad \vdots \quad \vdots \\ X_n &= z_{n1} + z_{n2} + \cdots + z_{nn} + Y_{nn} \end{aligned} \tag{B.2}$$

Set:

$X = \begin{bmatrix} X_1 \\ X_2 \\ \dots \\ X_n \end{bmatrix}$, $Z = \begin{bmatrix} z_{11} & z_{12} & \dots & z_{1n} \\ z_{21} & z_{22} & \dots & z_{2n} \\ \dots & \dots & \dots & \dots \\ z_{n1} & z_{n2} & \dots & z_{nn} \end{bmatrix}$ and $Y = \begin{bmatrix} Y_1 \\ Y_2 \\ \dots \\ Y_n \end{bmatrix}$,

where Z the matrix of intermediate transactions, X the vector of output by sector and Y the vector of final demand by sector. Then

$$X = Z + Y \tag{B .3}$$

Following the assumptions of the fixed ratio of inputs and the Leontief-type production function, the production of a sector defines the amount of its intermediate purchases. That is, the value of the intermediate transactions of each branch depend is analogous to its product and the following transformation results:

$$\begin{aligned} X_1 &= \alpha_{11}X_1 + \alpha_{12}X_2 + \cdots + \alpha_{1n}X_n + Y_1 \\ X_2 &= \alpha_{21}X_1 + \alpha_{22}X_2 + \cdots + \alpha_{2n}X_n + Y_2 \\ \vdots \quad &\vdots \quad \vdots \quad \vdots \quad \vdots \\ X_n &= \alpha_{n1}X_1 + \alpha_{n2}X_2 + \cdots + \alpha_{nn}X_n + Y_n \end{aligned} \tag{B .4}$$

Where $A = \begin{bmatrix} \alpha_{11} & \alpha_{12} & \dots & \alpha_{1n} \\ \alpha_{21} & \alpha_{22} & \dots & \alpha_{2n} \\ \dots & \dots & \dots & \dots \\ \alpha_{n1} & \alpha_{n2} & \dots & \alpha_{nn} \end{bmatrix}$, the matrix of technical coefficients or direct requirements matrix.

Then:

$$X = AX + Y => (I - A)X = Y \tag{B .5}$$

If the matrix $(I - A)$ is invertible (so $|I - A| \neq 0$) then:

$$X = (I - A)^{-1}Y \tag{B .6}$$

Where $(I - A)^{-1}$ is the Leontief inverse matrix or Leontief total requirement matrix.

The elements of the matrix $(I - A)^{-1}$ are the interdependency coefficients. An Interdependency coefficient $l_{ij}$is expressing the total (direct and indirect) impact in sector i if the final demand of j is increase by one unit.

Note that the typical element of the matrix $(I - A)^{-1}$equals:

$$l_{ij} = \frac{\partial X_i}{\partial Y_j} \tag{B .7}$$

A different approach in the framework of IOA is introduced by Ghosh (Ghosh, 1958). In the Ghosh-type model the output of each sector is depending on the sector's primary input (the

elements of value added). Therefore, the Leontief-type model links the distribution of final demand to the production requirements, while the model of Ghosh links the cross-sectoral distribution of the product with the added value.

In the Ghosh-type model the economy is describe by the equation:

$$X = XA^* + VA \qquad \text{(B .8)}$$

Where $A^* = \hat{X}^{-1}Z$, and VA the vector of value added by sector of economic activity. matrix A* is the matrix of distribution coefficients of the economy.

If the matrix $(I - A^*)$ is invertible (so $|I - A^*| \neq 0$) then:

$$X = V(I - A^*)^{-1} \qquad \text{(B .9)}$$

where $(I - A^*)^{-1}$, is the inverse matrix of Ghosh.

The typical elements of the matrix $(I - A^*)^{-1}$ in the position ij is expressing the total (direct and indirect) impact in sector j if the value added of i is increase by one unit.

Note that the typical element of the matrix $(I - A^*)^{-1}$equals:

$$l_{ij}^* = \frac{\partial X_i}{\partial VA_j} \qquad \text{(B .10)}$$

### B. 3. Multipliers in Input-Output Analysis

The application of IOA involves the existence of an input-output table for the examined economic system. An input-output table at the one hand the structure of the economy's production technology and on the other it represents an advanced system of national accounts (Livas, 1994, p. 59). The specialization and the application of analytical tools of IOA is possibly with both the Leontief model and the Ghosh model.

A basic extension of IOA is the estimation of multipliers. In general, multipliers in IOA can ne described as a system of induced financial transactions that follows a disturbance in the economy.

If, for example a disturbance (shock) occurs in a component of a sector's final demand, the disturbance is expected to cause a direct change in industry output. This change will cause a first wave of demand from the suppliers of the sector. Subsequently, these suppliers will develop a second wave of demand in order to meet the secondary demand due to the initial change. In turn, these suppliers will exhibit a third wave of demand to meet the demand of the previous wave, and so on. Thus, a number of subsequent waves of demand are created in the economy, which are expressed through a multiplier (Belegri-Roboli et al., 2010). In the IOA, the effect of a multiplier is analysed into two components: the direct one and indirect one.

- The direct effect is the disturbance in one sector or the respective impact on the sectors' output.
- The indirect effect is the changes caused by the intermediate demand to cover the disturbance.

Therefore, depending on the measure of consideration, using the multiplication table $(I - A)^{-1}$ or $(I - A^*)^{-1}$ , the overall impact (direct plus indirect) on the economy, after an exogenous disturbance, is estimated. $(I - A)^{-1}$ ή $(I - A^*)^{-1}$.

The estimation of IOA multipliers the definition of the direct coefficients for an element of primary inputs. These coefficients result as the ratio of the examined measure of the industry to its gross output:

$$direct_i = \frac{w_i}{X_i} \quad \text{(B .11)}$$

where: $w_i$ the element of the examined measure for sector i, $X_i$ the gross output of sector i, and i = 1,……,n the sectors of economic activity. Direct coefficients estimate how much an industry's primary input will increase if its output is increased by one unit.

The vector of the total backward multipliers with respect to the measure considered, is given by the equation:

$$backward' = direct'(I - A)^{-1} \quad \text{(B .12)}$$

where $backward$ is the vector of the total backward multipliers of the examined measure. Each element j of the backward multipliers vector indicates the overall increase in the examined measure for the economy, which is required to satisfy an one unit increase in the final demand of sector j.

Accordingly, in order to calculate the direct and indirect (total) forward multiplier, the matrix$(I - A^*)^{-1}$ is used. The vector of total forward multipliers is given by the equation:

$$forward = (I - A^*)^{-1} direct \quad \text{(B.13)}$$

where $forward$ is the vector of the total forward multipliers of the examined measure.

The most important advantage of input-output analysis arises from the ability to measure the indirect effects each sector generates, or the effect that depend on its intersectoral relationships in the economy. The difference between total and direct multipliers expresses the value of indirect multipliers. This relationship reflects the change in the examined measure, which is resulting to the interconnections of the sector under consideration with the others.

### *B.3.1. Employment Multipliers*

The direct coefficient of employment is defined as:

$$l_i = \frac{L_i}{X_i} \quad \text{(B .14)}$$

Where if $l_i$ is the direct coefficient of employment of sector i, $L_i$ is the employment of sector I and $X_i$ is the gross output of sector i. $l_i$ shows the direct change in the employment of a sector of the economic system due to a unit change in its production.

In matrix formation the vector of direct coefficients $l\ equals$:

$$l = L\hat{X}^{-1} \quad \text{(B .15)}$$

Which equals:

$$L = l\hat{X} => L = l(I - A)^{-1}Y \quad \text{(B .16)}$$

A unitary change in a sector's final demand according to the above relationship will create new demand for employment, which, as described in the above section, will lead to an increase in employment, which is determined by the multiplier.

The element $b_{L,i}$ shows the change in total employment (direct and indirect) of the economy caused by a unit change in the sector's i final demand.

Similarly, the total forward employment multipliers ($b_L^*$) are defined by the equation:

$$b_L^* = (I - A^*)^{-1}L \quad \text{(B .17)}$$

The element $b_{L,i}^*$ shows the change in total employment (direct and indirect) of the economy caused by a unit change in the sector's i primary inputs.

The employment multipliers described above quantify the horizontal , and vertical effect of the economic structure, or the connectedness of the economy (European Commission, 2005, p. 66), to employment. The comparison of the value between the multiplier of a sector and of the average of the economy, provides a methodology for identifying key sectors or sector leaders for employment. Therefore, the most interconnected sectors of the economy are the most important, in the sense that they contribute to a greater extent in strengthening the internal dynamics of the reference system and promoting employment.

For the assessment of the key sectors in respect to employment, we normalize the forward and backward multipliers, so that the relative importance of each sector can be estimated in relation to the average of the economy. That is, for the identification of key sectors, the average effect of a sector is compared with the average impact of all sectors of the economy, which is derived from the normalization of the forward or the backward multiplier:

$$\overline{BL(t)} = \frac{b_{L,i}}{\sum_{i=1}^{n} b_{L,i} / n} \qquad \text{(B .18)}$$

and

$$\overline{FL(t)} = \frac{b^{*}_{L,i}}{\sum_{i=1}^{n} b^{*}_{L,i} / n} \qquad \text{(B .19)}$$

where:

$\overline{BL(t)}$ the normalized backward multiplier of employment

$\overline{FL(t)}$ the normalized forward multiplier of employment

If $\overline{\mathrm{BL(t)}} > 1$, then an increase in the sector's final demand by one unit will cause a larger change in the output of the economy than the average change that would be caused by the corresponding change in any other industry. And, if $\overline{\mathrm{FL(t)}} > 1$, , then an increase in the sector's primary by one unit will cause a larger change in the output of the economy than the average change that would be caused by the corresponding change in any other industry. All economic sectors can be classified as follows:

| | |
|---|---|
| Key sector | if $\overline{BL(t)} > 1$ and $\overline{FL(t)} > 1$ |
| Leontief key sector | if $\overline{BL(t)} > 1$ and $\overline{FL(t)} < 1$ |
| Ghosh key sector, | if $\overline{BL(t)} < 1$ and $\overline{FL(t)} > 1$ |
| Not key sector, | if $\overline{BL(t)} < 1$ and $\overline{FL(t)} < 1$ |

### *B.3.2. Occupational Multipliers*

The implementation of IO for the estimation of backward employment multipliers can be extended to the estimation of employment multiplier by occupation. However, the estimation of employment multiplier by occupation requires the data availability of the structure of employment by sector and occupation.

Let $\mathrm{OC}$ be a matrix representing the structure of employment by sector and occupation, so that the columns of the matrix represent the n sectors of economic activity in which an economy is divided and the lines the m occupations in which employment is divided.

Then, following the approach of employment job multipliers, the direct coefficients by occupation and sector are given by the relationship:

$$oc = \mathrm{OC} \cdot \hat{X}^{-1} \qquad \text{(B .20)}$$

The multipliers by occupation and sector are described by the equation:

$$b_{oc} = \mathrm{oc} \cdot (I - A)^{-1} \qquad \text{(B .21)}$$

The element $b_{oc,ij}$ expresses the total (direct and indirect) change in the employment of the sector j and the occupation i, resulting a unit change in sectors i final demand.

The summation of the columns of matrix $b_{oc}$ is the vector of employment coefficients by occupation. The elements of the vector are expressing the overall change in employment by occupation following a unitary increase in final demand for all the sectors of the economy.

# References and sources


Artis, M. J and Zhang, W. (1997). International Business Cycles and the ERM: Is There a European Business Cycle?, *International Journal of Finance & Economics*, 2(1): 1-16.

Becker, W., Paruolo, P., Saisana, M., & Saltelli, A. (2016). Weights and importance in composite indicators: mind the gap. *Handbook of Uncertainty Quantification*, 1–30.

Belegri-Roboli, A., Markaki, M., & Michaelides, P. (2010). *The intersectoral relations of Greek Economy*. INE/GSEE.

Belegri-Roboli, A., Michaelides, P. G., Konstantakis, K. N., & Markaki, M., Marinos T., (2018). *Labour Market Barriers and Enablers*. Retrieved from https://www.sirius-project.eu/sites/default/files/attachments/SIRIUS%20WP1-D1.2.pdf

Bénétrix, Agustin S. & Lane, Philip R. & Shambaugh, Jay C., (2015). **International currency exposures, valuation effects and the global financial crisis**," *Journal of International Economics*, 96(S1): 98-109.

Benton, M., & Diegert, P. (2018). *A Needed Evidence Revolution: Using cost-benefit analysis to improve refugee integration programming*. Brussels: MPI Europe.

Bredtmann, J. (2014). Microeconometric analyses of market and non-market labor supply.

Breiman, L. A. & Freedman, D. F. (1983). How many variables should be entered in a regression equation*? Journal of American Statistics Association*, 78, 131-136.

Canova, F. and J. Marriman (1998), Sources and propagation of international output cycles: Common shocks or transmission?,*Journal of International Economics*, 46: 133-66.

Carmo, R. M., Rio, C., & Medgyesi, M. (2018). *Reducing Inequalities: A Challenge for the European Union?* Springer.

Cedefop. (2016). *Future skill needs in Europe: critical labour force trends*. Luxembourg: Publications Office of the European Union.

Chiswick, B., and Hatton T. J. (2003), International Migration and the Integration of Labor Markets; in Bordo M. D. Taylor A.M.. and Williamson J.G. (eds). *Globalization in Historical Perspective*, University of Chicago Press, 65-117

Chudik, A. & M. H. Pesaran (2011). Infinite dimensional VARs and factor models. *Journal of Econometrics*, 163, 4-22.

De Smedt, J., le Vrang, M., Papantoniou, A. (2015). ESCO: Towards a Semantic Web for the European Labor Market., in: *Proceedings of the Workshop on Linked Data on the Web, LDOW 2015*. Presented at the 24th International World Wide Web Conference (WWW 2015), Florence, Italy.

Desjardins, R., Thorn, W., Schleicher, A., Quintini, G., Pellizzari, M., Kis, V., & Chung, J. E. (2013). *OECD skills outlook 2013: First results from the survey of adult skills*. Paris: OECD Publishing.

Dickey, D., A., & Fuller, W., A. (1979). Distribution of the estimators for Autoregressive Time Series with a unit root. *Journal of the American Statistical Association*, 74, 427-431.

Dočekalová, M. P., & Kocmanova, A. (2016). Composite indicator for measuring corporate sustainability. *Ecological Indicators*, *61*, 612–623.

Engle, R., & Granger, C., (1987). Cointegration and error correction representation estimation and testing. *Econometrica*, 55, 251-276.

European Commission. (2005). *EU sectoral competitiveness indicators* (Vol. 24). Luxembourg: European Communities.

European Commission. (2015). *Measuring Skills Mismatch* (Analytical Web Note No. 7/2015). Luxembourg: Publications Office of the European Union.

European Commission. (2016). *A new skills agenda for Europe: Working together to strengthen human capital, employability and competitiveness*. Strasbourg: European Commission.

Galindo-Rueda, F., & Verger, F. (2016). *OECD taxonomy of economic activities based on R&D intensity*. Paris: OECD Publishing.

Ghosh, A. (1958). Input-output approach in an allocation system. *Economica*, *25*(97), 58–64.

Hamilton J. (1994).*Time Series Analysis,* Princeton: Princeton University Press.

Intrernational Labour Organazation (2015), “ILO global estimates on Migrnat Workers”, Report.

Janger, J., Schubert, T., Andries, P., Rammer, C., & Hoskens, M. (2017). The EU 2020 innovation indicator: A step forward in measuring innovation outputs and outcomes? *Research Policy*, *46*(1), 30–42.

Johansen, S. & Juselius, K. (1990). *Maximum Likelihood Estimation and Inference on Cointegration with Applications to the Demand for Money*. Oxford Bulletin of Economics and Statistics, 52, 169-210.

Johansen, S. (1995), *Likelihood-Based Inference in Cointegrated Vector Autoregressive Models*. New York: Oxford University Press.

Junge, F. and Patuzzi, L. (2016), Integration at the Crossroads of Employment. Report of the IQ Symposium on Labour Market Integration of Immigrants in Germany and Europe, *Migration Policy Practice*, Vol. VI. No 2.

Karlsdóttir, A., Sigurjónsdóttir, H.R., Hildestrand A. S., and Cuadrado A. (2017), Policies and measures for speeding up labour market integration of refugees in the Nordic region: A knowledge Overview, *Nordregio Working Paper* 2017:8.

Kirkwood, S., Goodman, S., McVittie, Ch., and A., McKinlay (2016), Refugees, Asylum-Seekers and Integration, *The Language of Asylum*, pp. 143-161.

Konle-Seidl, R. (2018), *Integration of refugees in Austria, Germany and Sweden: Comparative Analysis,* Policy Department A: Economic and Scientific Policy, European Parliament.

Konstantakis K.N., Michaelides P.G. & Tsionas E. (2016). System estimation of GVAR with two dominants and network theory: Evidence for BRICs. *Economic Modelling*, 51, 604-616.

Konstantakis K.N., Michaelides P.G. & Vouldis A. (2016). Non-Performing Loans (NPLs) in a crisis economy: Long-Run Equilibrium Analysis with a real time VEC model for Greece (2001-2015). *Physica A: Statistical mechanics and Applications*, 451, 149-156.

Konstantakis K.N., Soklis G. & Michaelides. P.G. (2017). Tourism Expenditures and Crisis Transmission: A General Equilibrium GVAR analysis with Network Theory. *Annals of Tourism Research*, 66, 74-94

Koop, G. (2013). Forecasting with Medium and Large Bayesian VARs. *Journal of Applied Econometrics*, 28: 177–203.

Koop, G., M. H. Pesaran & S. M. Potter (1996). Impulse Response Analysis in Nonlinear Multivariate Models. *Journal of Econometrics*, 74, 119–147.

Korobilis, D. (2013a). Assessing the Transmission of Monetary Policy Using Time-varying Parameter Dynamic Factor Models. *Oxford Bulletin of Economics and Statistics*, 75(2), 157-179.

Korobilis, D. (2013b). VAR forecasting using Bayesian Variable Selection. *Journal of Applied Econometrics,* 28, 204–230.

Leontief, W. (1936). Quantitative input and output relations in the economic systems of the United States. *The Review of Economic Statistics*, *18*, 105–125.

Leontief, W. (1991). The economy as a circular flow. *Structural Change and Economic Dynamics*, *2*(1), 181–212. https://doi.org/10.1016/0954-349X(91)90012-H

Livas, P. (1994). *Input-Output Analysis (In Greek)*. Stamoulis.

Lutkepohl H. (2005). *New Introduction to Multiple Time Series Analysis, Springer-Verlag Berlin Heidelberg*

Markaki, M., Belegri-Roboli, A., Michaelides, P., Mirasgedis, S., & Lalas, D. P. (2013). The impact of clean energy investments on the Greek economy: An input–output analysis (2010–2020). *Energy Policy*, *57*, 263–275. https://doi.org/10.1016/j.enpol.2013.01.047

Markaki, M., Belegri-Roboli, A., Sarafidis, Y., & Mirasgedis, S. (2017). The carbon footprint of Greek households (1995–2012). *Energy Policy*, *100*, 206–215. https://doi.org/10.1016/j.enpol.2016.10.031

Merz, M., Hiete, M., Comes, T., & Schultmann, F. (2013). A composite indicator model to assess natural disaster risks in industry on a spatial level. *Journal of Risk Research*, *16*(9), 1077–1099.

Michaelides P.G., Tsionas E.G. & Konstantakis K.N., (2018). Debt Crisis in Europe (2001-2015): A Network General Equilibrium GVAR Approach. Journal of *Economic Dynamics and Control*, DOI: 10.1016/j.jedc.2018.01.047.

Miller, R. E., & Blair, P. D. (2009). *Input-output analysis: foundations and extensions*. Cambridge University Press.

Mutl, J. (2009). Consistent Estimation of Global VAR Models. *Economics Series*, 234, Institute for Advanced Studies.

OECD, & JRS. (2008). *Handbook on constructing composite indicators: methodology and user guide*. OECD publishing.

OECD. (2016). *Making integration work: Refugees and others in need of protection*. Paris: OECD Publishing.

Pesaran, M. H. & Shin, Y. (1998). Generalized impulse response analysis in linear multivariate models. *Economics Letters*, 58(1), 17–29.

Pesaran, M. H., T. Schuermann & S. M. Weiner (2004). Modelling Regional Interdependencies Using A Global Error-Correcting Macroeconometric Model. *Journal of Business and Economics Statistics*, 22, 129-162.

Peschner, J., & Fotakis, C. (2013). Growth potential of EU human resources and policy implications for future economic growth. *Brussels: DG Employment Working Paper*, *3*, 2013.

Phillips Peter C. B. & Perron, P. (1988). Testing for a Unit Root in Time Series Regression. *Biometrika*, 75(2), 335–346.

Pikos, A., & Thomsen, S. L. (2016). Rising work complexity but decreasing returns.

RISE. (2013). *Research Needs Analysis - Comparative Report (Ireland, United Kingdom and Germany)*. Nottingham: Nottingham Trent University. Retrieved from https://rise-project.eu/ie/documents/2013/12/needs-analysis-report.pdf/

Saisana, M., & Tarantola, S. (2002). *State-of-the-art report on current methodologies and practices for composite indicator development*. Citeseer.

Speed T.P. & Yu Bin (1992). Model selection and Prediction: Normal Regression. *Annals of the Institute of Statistical Mathematics*, 45, 35-54.

Stock, J., H., and Watson M., W., (2001). Vector Auto-regressions. Journal of *Economic Perspectives*, 15, 101-115.

Suh, S. (2009). *Handbook of input-output economics in industrial ecology* (Vol. 23). Springer Science & Business Media.

Tangian, A. (2007). Analysis of the third European survey on working conditions with composite indicators. *European Journal of Operational Research*, *181*(1), 468–499.

Timmer, M. P., Dietzenbacher, E., Los, B., Stehrer, R., & Vries, G. J. (2015). An illustrated user guide to the world input–output database: the case of global automotive production. *Review of International Economics*, *23*(3), 575–605. https://doi.org/10.1111/roie.12178

Timmer, M. P., Los, B., Stehrer, R., & de Vries, G. J. (2016). *An anatomy of the global trade slowdown based on the WIOD 2016 release*. Groningen Growth and Development Centre, University of Groningen.

Tsionas E.G., Konstantakis K.N. & Michaelides P.G. (2016). Bayesian GVAR with k-endogenous dominants & Input Output weights: Financial and Trade channels in crisis transmission for BRICs, Journal of International Financial Markets Institutions and Money, 42, 1-26.

UN new. (2017), retrieved at: https://news.un.org/en/story/2017/01/548912-un-agency-data-labour-migration-shows-150-million-migrants-global-workforce

Wold, H. (1954). A Study in the Analysis of Stationary Time Series. Second revised edition, with an Appendix on "Recent Developments in Time Series Analysis" by Peter Whittle. Almqvist and Wiksell Book Co., Uppsala.

Wooldridge. J. M., (2013). Introductory Econometrics: A Modern Approach. 5th ed. Mason. OH: South-Western.

Zimmermann K. F. (2016), *Refugee and Migrant Labor Market Integration: Europe in Need of a New Policy Agenda*, EUI Conference on the Integration of Migrants and Refugees, 29 -30 September 2016.