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CICLO XXX

TITOLO TESI

A Multisectoral Analysis for economic policy: an application for healthcare systems and for labour market composition by skills

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To my parents,
too far away

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Acronyms

AUS = Australia
AUT =Austria
BEL = Belgium
BRA = Brazil
BGR = Bulgaria
CAN = Canada
CHN = China
CZE = Czech Republic
DEU = Germany
DNK = Denmark
ESP = Spain
FRA = France
GBR = United Kingdom
GRC = Greece
IND = India
ITA = Italy
JPN = Japan
MEX = Mexico
NLD = The Netherlands
PRT = Portugal
ROU = Romania
SWE = Sweden
TUR = Turkey
USA = United States

ABSTRACT IN ITALIAN

L'Agenda Digitale Europea stabilisce il ruolo chiave delle tecnologie dell'informazione e della comunicazione (TIC) grazie a un mercato digitale unico basato su internet veloce e superveloce e su applicazioni interoperabili, al fine di ottenere vantaggi socioeconomici sostenibili COM(2010)245. Le TIC producono un'innovazione di prodotto e cambiamenti strutturali all'interno di tutto il sistema economico e possiamo affermare che dal punto di vista produttivo agiscono come moltiplicatore della crescita economica. Infatti la domanda di TIC può stimolare una parte delle altre produzioni e questo può essere analizzato con una strumentazione ad-hoc che è quella multisettoriale. Inoltre come noto in letteratura economica e come confermato da dati statistici una maggiore incidenza della popolazione attiva formalmente istruita in associazione con l'adozione delle TIC è altamente correlata ad una crescita robusta, sostenibile ed equa COM(2010)2020. In questo quadro è importante valutare il ruolo delle TIC nel sistema economico, in particolare verrà analizzato il ruolo delle TIC sia rispetto ad un particolare settore quello della sanità, che dal lato dei soggetti che dovrebbero essere parte attiva nella gestione delle TIC ovvero la situazione delle abilità digitali dei lavoratori dipendenti.

Il primo articolo si focalizza sul ruolo delle TIC nella determinazione dell'output del settore sanitario, utilizzando il database WIOD (World Input-Output Database), di 24 paesi nell'arco temporale 2000-2014, tenendo conto anche dei differenti sistemi sanitari nazionali. La produzione del settore "Sanità e Servizi Sociali" assume, almeno in alcuni paesi specifici, il ruolo di stimolo all'innovazione che compensa ampiamente quello di peso sul bilancio pubblico.

Nel secondo articolo verrà analizzato come l'uso delle TIC stia progressivamente aumentando nel sistema sanitario italiano e in particolare come l'introduzione del Fascicolo Sanitario Elettronico (FSE), strumento di condivisione dei dati sanitari del singolo cittadino, potrebbe determinare cambiamenti nella produzione sui servizi sanitari. Verranno analizzati gli eventuali cambiamenti strutturali dei processi produttivi e della produzione totale applicando l'Analisi Strutturale di Decomposizione (SDA). La base dati di riferimento sarà la tavola di Input-Output riferita a due diversi periodi al fine di individuare i risultati sia degli effetti tecnologici sia della domanda finale a livello settoriale.

Infine l'ultimo articolo ha l'obiettivo di valutare le conseguenze dei cambiamenti nella composizione dell'occupazione per competenza digitale all'interno del flusso di produzione e distribuzione del reddito. Verrà costruita una Matrice di Contabilità Sociale (SAM) che consente di

rappresentare le relazioni tra i cambiamenti di produzione delle attività e i cambiamenti di compensazione dei dipendenti per competenze, grado di digitalizzazione e genere. LA SAM sviluppata nel documento è relativa all'Italia nel 2013; il lavoro è disaggregato in competenze formali / non formali / informali e, inoltre, competenze digitali / non digitali. Le abilità digitali del lavoro seguono la definizione di "competenza formale" della Commissione Europea (2000): i) competenza formale a seconda del livello di istruzione e formazione; ii) competenza non formale acquisita sul posto di lavoro e attraverso le attività delle organizzazioni e dei gruppi della società civile; iii) competenza informale non acquisita intenzionalmente durante la vita. In questo quadro è stata introdotta un'ulteriore classificazione di input di lavoro basata sull'uso / non utilizzo di computer collegati a Internet. Sulla base della SAM, è stato implementato un modello multisettoriale esteso. Infine, verrà individuata una struttura adeguata di domanda finale che consente di ottenere i migliori risultati in termini di valore aggiunto distribuiti a lavoratori più qualificati con una elevata competenza digitale.

ABSTRACT IN ENGLISH

The European Digital Agenda defines the key role of ICT from a digital single market based on fast and ultra fast internet and interoperable applications, to obtain sustainable economic and social benefits COM(2010)245. ICTs produce high product innovation and structural changes within the whole economic system and we may maintain that from a multisectoral viewpoint ICT has a multiplier effect on the economic growth, because the increase of ICT demand generates a stimulus in all productions. Furthermore as recognised in all economic literature, international institutions, as well as confirmed by periodic data released by National statistical offices, a higher incidence of formally educated working population in association with the adoption of ICT is highly correlated with robust, sustainable and equal growth patterns COM(2010)2020. In this framework, evaluating the role of ICTs in the whole economic system, both in particular the role of ICTs into the production of healthcare and into the value added with a disaggregation on the basis the digital skills on the compensation of employees.

In the first paper, the healthcare industry and its specific production process will be examined in the interaction with the other industries composing the production structure. The core of the paper is the role of ICT in the determination of the output of the sector. The application combines a world input-output table covering 24 countries for the period 2000-2014 using the World Input-Output Database (WIOD). The “Health and Social Services” industry attains then, at least in some specific countries, a role in stimulating innovation that amply pays off that of constituting a burden on the public budget.

The aim of the second paper is to describe how the healthcare systems, as well as other economic sectors, are evolving with the use of ICTs; in particular the introduction of the Electronic Health Record (EHR), as a tool to share the health data of a single citizen, can determine changes in the production of health services. A specific attention will be dedicated to the eventual structural changes in the productive processes and in the gross output. The multisectoral approach allows looking into the relation between healthcare services and the whole economic system. Applying the Structural Decomposition Analysis (SDA) to Input-output tables in different times in order to identify the results, at sector level, of the effects of technological coefficients and the final demand.

Finally, the purpose of the third paper is to evaluate the consequences of changes in the composition of employment by digital skill within the whole production and distribution of income. The tool adopted to address this issue is the building of the Social Accounting Matrix

(SAM), which allows representing the relations between the changes in the output of activities and the changes of compensation of employees by digital skills, degree and gender. The SAM developed in the paper is relative to Italy in 2013; moreover, labour is disaggregated into formal/no formal/informal competence and, additionally, digital/no digital skills. Labour digital skills are defined according to the formal competence declared by the European Commission (2000): i) formal competence depending on the level of education and training; ii) non-formal competence gained at the workplace and through the activities of social organisations and groups; iii) informal competence not acquired intentionally during life. In this framework has been introduced a further classification of labour input based on the use/non use of computers linked to the Internet. On the basis of the SAM, an extended multisectoral model is implemented. Finally, an appropriate structure of final demand, which allows obtaining the best results in terms of value added, distributed to more skilled workers with a high digital competence.

1 THE ECONOMIC IMPACT OF ICT IN HEALTHCARE

1.1 Introduction

The prevalent viewpoint on expenditure for health services is centred on the idea that, as a part of the public expense, it burdens the national budget often generating problems of economic sustainability in the long run (Parkin *et al.,* 1987). This turns out to be especially pertinent when referring to those economies where the role of the public administration is relevant. In the common practice, however, the impact of healthcare, both socio-economic and technological levels, is rather neglected. Nonetheless, the healthcare activity generates a relevant push towards innovation, through the high interaction it activates among the industries that constitute the reference cluster of the healthcare production industry (Ciaschini *et al.,* 2014).

In this sense, the study of the healthcare industry requires the in-depth analysis of the production domain which, starting from the healthcare production process broadens the study to all the production processes directly and indirectly involved. The healthcare industry and its specific production process needs a comparative description taking into consideration the relationship between healthcare output and Gross Domestic Product and the role of materials required in the generation of health output, the evaluation of the capacity of the system to generate value added and positive externalities to the economic system including employment (Porter, 2010).

The most common topic discussed in macroeconomics about healthcare services refers to health expenditure, seen as prevalently public and as such a target for frequent measures that are inspired simply by the constant attempt of rationalization general public expenditure for the realization of the long-term public debt sustainability (Baumol, 1967). Specifically, in the case where the funding involves a prevalent role of the public administration, the emerging problems are tied to the recognition of how the health services industry can appear to be a driving force for the whole economy even if, in some cases, merely at the local level (Okujaye and Murthy, 2002).

Moreover, health expenditure financed with taxation, either general or specific, poses questions regarding the opportunity of a direct public intervention, both as funding and producing healthcare, in order to evaluate the economic sustainability of the health system (Deaton, 2003). The main goal is then that of verifying the sustainability of the use of public resources in order to provide services mainly oriented to personal healthcare and, in particular, to those health services which can be supplied by the market (Olsen, 1998).

The willingness of the policy maker to deliver, at a specified degree, the health services coverage of the population can be inspired by various types of motivations originating from strictly healthcare considerations as well as social and cultural ones. From an economic standpoint, this would imply, at a greater degree, a sustainability problem in the case where the Public Administration should carry the cost, while no problem would arise if the complete process of demand and supply would shift the burden on the private sector (Clemente *et al.,* 2004).

The choice of devoting a relevant share of the private income to the purchase of this type of services goes through a market mechanism where general consequences would be perceived simply as market failure. The differences among national health systems may set out various difficulties concerning funding and sustainability. The analysis will be focused on the comparison between and among healthcare systems in 24 countries. The choice has not only an economic character but implies motivations of anthropologic, cultural and social characteristics such as the economic and social development of each and all the countries (Ciaschini *et al.,* 2011a).

Our interest concentrates, then, on the production processes, with special stress on healthcare, and on the contribution that each economic activity can provide. The production of healthcare is considered in its three main outcomes: Intermediate Demand, Value Added and Imports. The analysis of the healthcare services needed to face final demand requires the disaggregation of the production process to highlight the inputs needed. The various types of materials used, both domestic and imported, sum up with the value added components and imports of health services to give the value total health services supply. Within the healthcare intermediate demand framework, the commodities with ICT intensity will be analysed in relation to the healthcare output during the time series and the possible differences tied to the type of National Health System adopted (Weisbrod, 1991).

The introduction of ICT in the production processes, if well integrated, contributes to the change in the combination of these factors of production influencing the costs of the services delivered and on the amount of the primary factors utilized (Haux *et al.,* 2002). Changes in ICT can generate an economic impact on the entire economy whose evaluation in magnitude and sign for each component may well be not unique. The comparative data analysis is applied to 24 countries in the search for interesting dynamics in the ICT absorption. Once defined the list of commodities that compose the ICT sector, following the OECD indications, we will demonstrate how the ICT absorption has changed in each and all the countries in the time lapse 2000-2014.

The analysis is performed through an Input-Output model for 24 countries (Leontief, 1941): Australia, Austria, Belgium, Brazil, Bulgaria, Canada, China, Denmark, France, Germany, Japan, Greece, India, Italy, Mexico, the Netherlands, Portugal, United Kingdom, Czech Republic, Romania, Spain, Sweden, Turkey, USA. This type of model will enable us to underline the degree of interaction among the industries of interest and the relevance of healthcare in relation to the entire economic system under the viewpoint of the production processes in 15 years. The reference database is WIOD.

1.2 Comparative Analysis among 24 countries

In a worldwide setting, the characteristics of the health systems are manifold in relation to the organization, delivery of health services, funding and payment procedures. The countries can be, however, classified into two main schemes: the National Health Service (NHS) and the National Health Insurance (NHI). NHS is a publicly funded healthcare system, which is primarily financed through the general taxation system and is overseen by the Department of Health. The government role determines the centralization and decentralization of the healthcare (Mossialos *et al*., 2017). A synthetic representation can be shown in the following table (Table **1**).

Table 1 – Main characteristics of healthcare and public financing systems

Countries	Health Care System	Decentralization and Centralization	Public financing system
Australia	Universal public insurance program (Medicare)	Decentralization (three levels of government: federal; state and territory; and local)	General tax revenue; earmarked income tax
Austria	Statutory Health Insurance	Decentralization (the federal level and the regional level ("Länder") and a high degree of delegation of responsibility to self-governing bodies)	General tax revenue; insurance premiums
Belgium	Statutory Health Insurance	Decentralization (national level, communities and the regions)	Government subsidies; earmarked income tax
Brazil	National Health Service	Decentralization (three levels of government (federal, state and municipal)	General tax revenue
Bulgaria	Statutory Health Insurance	Decentralization (some competencies are delegated to municipalities)	General tax revenue; insurance premiums
Canada	Universal public insurance program (Medicare)	Decentralization (regionally administered)	Provincial/federal general tax revenue
China	Rural and Urban Social Insurance + Medical	Decentralization (Supervision by health authorities at the national,	Employee and employer payroll taxes, individual

	assistance fund	provincial, and local levels; some direct provision through public ownership of hospitals)	premium contributions, general tax revenue
Denmark	National Health Service	Decentralization (three levels: state, regions and municipalities)	General tax revenue
France	Statutory Health Insurance	Centralization	Employer/employee earmarked income and payroll tax; general tax revenue; earmarked taxes
Germany	Statutory Health Insurance	Decentralization (federal government, the Länder, and the various institutions and interest groups at the corporatist level)	Employer/employee earmarked payroll tax; general tax revenue;
Japan	Statutory Health Insurance	Mixed (Government regulates nearly all aspects of the universal Statutory Health Insurance System (SHIS). The regions implement the national regulations and develop regional health care delivery with their own budgets and funds allocated by the national government. The municipalities operate components of the SHIS and organize health promotion activities for their residents)	General tax revenue; insurance contributions
Greece	Statutory Health Insurance	Centralization (role of regional and local governments in health care planning, organization and provision is very limited)	General tax revenue; earmarked income tax
India	National Health Service	Decentralization (India's health sector has been shaped by its federal structure and the federal–state divisions of responsibilities and financing)	General tax revenue
Italy	National Health Service	Decentralization (the national level defines the core benefit package - *Livelli Essenziali di Assistenza – LEA* and the regional level has exclusive authority in execution-level planning and delivery of health care)	National earmarked corporate and value added taxes; general tax revenue and regional tax revenue
Mexico	Statutory Health Insurance	Decentralization (national and federal level)	Insurance premiums
Netherlands	Statutory Health Insurance	Decentralization (the national government has overall responsibility for setting health care priorities. Municipalities and health insurers are responsible for most outpatient long-term services and all youth care)	Earmarked payroll tax; community-rated insurance premiums; general tax revenue
Portugal	National Health Service	Centralization (the national level has responsibility for planning and resource allocation and the delivery of healthcare services is the to the level of the region and at the sub-regional level)	General tax revenue; earmarked income tax
United Kingdom	National Health Service	Decentralization (Responsibility for	General tax revenue;

		health legislation and general policy rests with Parliament, the Secretary of State for Health, and the Department of Health. The Department of Health provides stewardship for the overall health system, but day-to-day responsibility for running the NHS rests with a separate public body, NHS England)	earmarked income tax
Czech Republic	Statutory Health Insurance	Decentralization (regionally administered)	General tax revenue; earmarked income tax
Romania	Statutory Health Insurance	Centralization (highly centralized, with administrative regulation and financial control concentrated at the national level)	General tax revenue; insurance contributions
Spain	National Health Service	Decentralization (the regional health systems consists of a regional ministry (*Consejería de Salud*) holding health policy and health care regulation and planning responsibilities, and a regional health service performing as provider)	General tax revenue; earmarked income tax
Sweden	National Health Service	Decentralization (the national level is responsible for overall health and health care policy, the regional level is responsible for financing and delivering health services to citizens and the municipalities are responsible for care of the elderly and the disabled)	General tax revenue; national tax revenue
Turkey	Statutory Health Insurance	Centralization	Payments by employers and employees; government contributions
USA	Medicare, Medicaid and Private Insurance	Decentralization ("shared responsibility" between the government, employers, and individuals. Therefore there are the federal level - Medicare and Medicaid).	Medicare: payroll tax, premiums, federal tax revenue; Medicaid: federal, state tax revenue

Source: The Commonwealth Fund (2017); Health Systems in Transition for all Countries (different years); Country HIT profile (different years) and WHO report (different years).

A National Health System is that adopted by Brazil, Denmark, India, Italy, Portugal, Spain, Sweden and the United Kingdom. While the NHI is a legally enforced scheme of health insurance, that covers the population against the costs of health care. It may be run by the public sector, the private sector, or a combination of both. Funding mechanisms vary according to the specific country. National health insurance is usually established by national legislation but is not equivalent to government-run or government-financed healthcare. The countries, which have

adopted a system of the NHI type, are Austria, Belgium, Bulgaria, France, Germany, Japan, Greece, Mexico, the Netherlands, Czech Republic, Romania and Turkey[1].

In the USA Private Health Insurance, led by market rules, is associated with the presence of a system of Public Health Insurance as Medicare, serving the over 65 and some disabled, and Medicaid, aiding low-income individuals. In other countries similar to the USA, such as Canada and Australia there is an only one system called Medicare, characterized by a universal public health insurance system, aimed to grant access to an adequate health assistance at low prices (Thomson *et al*., 2012).

In all the countries, citizens can choose whether to get the public health coverage alone or a private insurance coverage in addition. In China, the system is based on the compulsory healthcare insurance "urban employee basic medical insurance" (UEBMI) and other two typologies of volunteer insurances "urban resident basic medical insurance" (URBMI) and "new rural cooperative medical system" (NRCMS) (William and Hsiao, 1995).

National healthcare systems are characterized by free and universal access mechanism to the healthcare services and are mainly based on the public financing from general taxation. While in the healthcare systems of the NHI type, public administration is not brought indirectly in the services provision and, often, does not collect specific financing resources (Ciaschini *et al.*, 2008). Within these contexts, Public Administration acts as direct distributor and the health service gains its own institutional independence. From Table **1** most countries have decentralized governance, so the national level is responsible for overall health care policy, while the regional or federal level is responsible sometimes for financing and delivering health services. Only France, Greece, Romania, Portugal and Turkey have a centralized responsibility for planning and resource allocation though often the delivery of healthcare services is at regional and sub-regional levels.

Under the healthcare supplier viewpoint the primary care system is private (the business collaboration of general medicine doctors regulated by contracts of private law), while the property of the hospital network is generally public with the presence, at different levels, of private distributors in Australia, Austria, Bulgaria, Denmark, Italy, France, Japan, Greece, Czech Republic, Romania, United Kingdom. Germany and Canada have a private primary care system (business collaboration of general medicine doctors), while for the hospital network there is an equilibrium between public and private providers. The private character of hospital cares and primary care can be found in the Netherlands, Belgium and USA; on the other hand, in Spain,

[1] See http://www.euro.who.int/en/countries.

Sweden and Brazil the supplier is mostly public both in the delivery of primary care and of hospital care. The hospital care is private and the primary care is public for Portugal and India. To conclude, in China, Mexico and Turkey there is the joint presence of the public and private system for hospital and primary care.

As to the sources of financing the most important once are general taxation and specific taxation, such as health contributions, default shares of income taxes, regional surtaxes and insurance premium. A private share is given in the form of joint participation to the expenses and direct payments.

Finally, payment mechanisms can be classified into payment mechanisms for primary care such as mix capitation, fee-for-service and pay-for-performance and payment mechanisms for the hospital care: global budget, fee-for service, payment per-diem system and case-based payment (Armeni *et al.,* 2013). All the countries took into consideration use as primary care payment mechanism the fee-for-service as the exclusive system or in combination with other payment systems. Australia, Austria, Belgium, Germany, Greece, China, Japan and Turkey utilize the fee for service exclusively. The combination between per mix capitation and payment for the service (fee-for-service) is used in Bulgaria, Canada, Denmark, India, the Netherlands, Romania and USA (Mossialos *et al.,* 2014). Italy, like France, Portugal, Sweden, UK and the Czech Republic are countries endowed with the combination of the largest number of payment mechanisms for primary care: per mix capitation, payment for the service (fee-for-service) and payments when particular objectives are reached (pay for performance). Brazil and Spain use the only mix capitation and in Mexico only pay for performance.

Under the viewpoint of the mechanisms of payment of the hospital healthcare, most countries use the fee-for-service and case based payment. The countries using only case based payment are France and Germany while Turkey uses only fee-for service and India has an only global budget mechanism. Bulgaria and Romania remunerate hospital cares through the combination between fee-for-service and case-based payment. Hospital care is paid using the combination of global budget and fee-for-service, in Belgium, Brazil, Czech Republic, Mexico, Portugal, and Spain. The combination of global budget, fee-for-service and per-diem payment, for the hospital healthcare is used in Austria and Greece. Furthermore the combination of payment of per-diem payment and case-based payment is used in Japan, USA while the combination of fee-for-service, per-diem payment and case-based payment and in Australia the combination of global payment, fee-for service and case-based management. The combination of global payment and

case-based management is used in Canada, Denmark, the Netherlands and the United Kingdom. Finally, the combination of global budget, per-diem payment and case based payment is used in China, Italy and Sweden. The ownership and mechanism of payment, both for primary care and hospital, are synthesized in Table **2** and Table **3** .

Table 2 – Primary care: provider ownership and mechanism of payment

Countries	Provider Ownership	Mix capitation	Fee-for service	Pay-for-performance
Australia	Private		X	
Austria	Private		X	
Belgium	Private		X	
Brazil	Public	X		
Bulgaria	Private	X	X	
Canada	Private	X	X	
China	Mixed		X	
Denmark	Private	X	X	
France	Private	X	X	X
Germany	Private		X	
Japan	Mostly private		X	
Greece	Private		X	
India	Mainly public; some private		X	
Italy	Private	X	X	X
Mexico	Public			X
Netherlands	Private	X	X	
Portugal	Public	X	X	X
United Kingdom	Private	X	X	X
Czech Republic	Private	X	X	X
Romania	Private	X	X	
Spain	Public	X		

Sweden	Mixed	X	X	X
Turkey	Mixed		X	
USA	Private	X	X	

Source: The Commonwealth Fund (2017); Health Systems in Transition for all Countries (different years); Country HIT profile (different years) and WHO report (different years).

Table 3 – Hospital: provider ownership and mechanisms of payment

Countries	Provider Ownership	Global budget	Fee-for service	Per diem-system	Case-based payment
Australia	Generally public with the private presence	X	X		X
Austria	Generally public with the private presence	X	X	X	
Belgium	Private	X	X		
Brazil	Almost all public	X	X		
Bulgaria	Generally public with the private presence		X		X
Canada	Equilibrium between public and private	X			X
China	Mixed	X	X		X
Denmark	Generally public with the private presence	X			X
France	Generally public with the private presence				X
Germany	Equilibrium between public and private				X
Japan	Mainly private some public		X	X	
Greece	Generally public with the private presence	X	X	X	
India	Private non-profit and for-profit and public	X			
Italy	Mostly public, some private	X		X	X

Mexico	Mixed	X	X		
Netherlands	Mostly Private	X			X
Portugal	Public	X	X		
United Kingdom	Generally public with the private presence	X			X
Czech Republic	Generally public with the private presence	X	X		
Romania	Generally public with the private presence		X		X
Spain	Public	X	X		
Sweden	Almost all public	X			X
Turkey	Mixed		X		
USA	Mix of non-profit, for-profit and public		X		

Source: The Commonwealth Fund (2017); Health Systems in Transition for all Countries (different years); Country HIT profile (different years) and WHO report (different years).

Health services production may undergo specific transitions through time due to different factors emerging from issues within the healthcare productive sector, the related national healthcare systems and the degree of integration made available by new technologies of information and communication. In case of positive effects on production costs deriving from the intensive use of ICT, it is possible to recover economic resources without altering the number of services supplied in this way and enhancing the efficiency of the productive system and improving the economic sustainability of healthcare systems.

To investigate the role of the sector healthcare within the whole economy, we need, at first, to analyse the relevance of the current health expenditure with respect to GDP for the 24 countries in the time period 2000-2014 associated with the trend of the absorption of commodities required by the health industry.

1.3 Input-Output Analysis: WIOD database and IO model

1.3.1 WIOD data base: main features

From the multisectoral viewpoint, the national economy is thought as a set of producing units organized into industries according to the output homogeneity. Each of these production units realizes two types of transactions, on the one side as purchaser from the remaining units of commodities and services to be used in its own production activity; on the other as seller of its own output. In a period of time, in general one year, among the various units composing the economy a set of transactions takes place, which is determined by the demands for final uses and by the technological characteristics of the economy.

Among the most recent attempts of providing world databases consistent of the Input-Output analysis benefit is the World Input-Output Database (WIOD) (Timmer *et al.,* 2015). The WIOD is part of a European Project that makes available yearly historical series of Input-output tables; the first release is available in 2013 related to the period 1995-2011 and the second release for the period 2000-2014[2] in 2016. The flows evaluation is determined in current basic prices, in millions of dollars while a summary of all transactions of the global economy among industries and final users in all the countries is given in the World Input-Output Table (WIOT). WIOT consists in the set of national input-output tables linked together through bilateral flows of international trade. Values WIOD are expressed in millions of US dollars and the market exchange rates are given at the current exchange rates. For the comparison among countries it is important to have data in constant prices but the WIOTs in pyp are available only in the first release. In the first release the WIOTs have been constructed based on gross output deflators from the National Accounts of each country, implicitly deflating imports by the exporters' gross output deflators. In this paper we have used the second release because the time period is the last one though we may have problems with its WIOTs on the interpretation of results because they are available only in current prices without the deflator index.

WIOTs (release 2016) offer the disaggregation of intermediate consumptions and of value added for 56 types of industries (ISIC REV.4), 4 institutional sectors that include Households, No Profit Organisations Serving Households (NPISH), Government and Rest of the World and 2 components of the capital formation gross fixed investment and changes in inventories and valuables. The allocation of industry outputs among users is given in the table rows. The

[2] WIOD release 2016.

accounting identity states that total output of each industry (given by the last element in each column) is equal to the sum of all output uses by that industry (given by the last element in each row).

Table 4 - Scheme of the IO Table

	Intermediate demand	Final demand						Total
	(56) Industries	Households	NPISH	Government	Gross fixed capital formation	Changes in inventories and valuables	Export	
(56) Industries	Domestic							
(56) Industries	Import							
	Value Added							
	Total							

Source: Timmer *et al*., 2012

The healthcare sector is a unique industry called "Human health and social work activities" splitting into 3 divisions: “Human health activities”, “Residential care activities” and “Social work activities without accommodation” [3] (see Table **5**).

Table 5 – Section Q “Human Health Activities”

Division	**Group**	**Class**	**Description**
Division 86			**Human health activities**
	861	8610	Hospital activities
	862	8620	Medical and dental practice activities
	869	8690	Other human health activities
Division 87			**Residential care activities**
	871	8710	Residential nursing care facilities
	872	8720	Residential care activities for mental retardation, mental health and substance abuse
	873	8730	Residential care activities for the elderly and disabled

[3] For further details see ISIC Rev.4.

	879	8790	Other residential care activities
Division 88			**Social work activities without accommodation**
	881	8810	Social work activities without accommodation for the elderly and disabled
	889	8890	Other social work activities without accommodation

Source International Standard Industrial Classification of all economic activities (ISIC), Rev.4

1.3.2 Input-Output model for the WIOD data base

Comparative analysis of the economic outcomes for *n* countries cannot be done without reference to multisectoral tools of analysis especially when reference is done to a single type of commodity or service, with the aim of detecting the changes in the role played by this commodity within the whole production system. Multisectoral analysis, through the use of the Input-Output matrix allows a detailed quantitative description and analysis of the production processes linked with healthcare production process and delivery of health services.

Making reference to the explanatory model, the total output requirements for given levels of final demands can be determined through the use of the technical coefficient matrix, which is the matrix of intermediate demands per unit of output exhibited by each industry. In this way it is possible to discuss quantitatively the various technologies used by the industries, and then also in the healthcare industry. Moreover, it is possible to evaluate the impact of technological changes, both in terms of changes in the technical coefficients configuration and changes induced in the demand/output relationship or in the output / value added at industry level. The central assumption is that the ratio the input required and the output produced does not vary according to the level of industry output. In this context of fixed technical coefficients the possibility of substitution among inputs does not exist. Such assumption of fixed technical coefficients, however, makes the model manageable and efficient in the quantitative application.

The IO model utilized is based on the fundamental equation:

$$\mathbf{x} = \mathbf{Z} + \mathbf{f} \tag{1}$$

In WIOTs the inter-sector transactions can be divided into domestic transactions and imports and we can consider $\mathbf{Z} = \mathbf{D} + \mathbf{M}$ where **D** is the matrix of domestic transactions and **M** is the matrix of imports (Miller and Blair, 2009).

The row vector **M** is the vector of total imports $\mathbf{m} = \mathbf{Mi}$ and we consider it as a negative final demand. We define **g** as the vector of final demand other than imports such that **f** = **g** + (−**m**).

If **M** is known and the equation (1) is expressed as $\mathbf{x} = \mathbf{Zi} + \mathbf{f}$, we obtain:

$$\mathbf{x} = (\mathbf{D} + \mathbf{M})\mathbf{i} + (\mathbf{g} - \mathbf{m}) \quad (2)$$

Considering the equivalence of $\mathbf{m} = \mathbf{Mi}$, we can cancel both terms **m** and **Mi**. The result is **x** = **Di** + **g**. From the intermediate flow table **D** the technical coefficient matrix **A** is easily determined as $\mathbf{A} = \mathbf{D}\hat{\mathbf{x}}^{-1}$. Finally, the reduced form of the Leontief model can be written as:

$$\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{f} \quad (3)$$

where $\mathbf{R} = (\mathbf{I} - \mathbf{A})^{-1}$is the Leontief inverse matrix. In the model, the final demand (consumption, investment and exports) is exogenously given and prices are fixed.

1.3.3 Linkages analysis for healthcare

Within the framework of Input-Output model, production by Healthcare has two kinds of economic effects on other sectors in the economy. If healthcare increases its output, this means there will be increased demands from sector healthcare (as a purchaser) on the sectors whose goods are used as inputs to production in healthcare. This type of study is based on the original analysis proposed by Rasmussen (Rasmussen, 1957) and, recently, further developed by various scholars with reference to the linkage analysis (Hirschman, 1958), (Jones, 1976), (Cohen and Levinthal, 1990), (Cuello *et al*. 1992), (Fikkert, 1997). The Linkage analysis allows highlighting and quantifying the backward and forward connections of key sector and the interdependences with other sectors.

The linkage can be calculated on the matrix A to determine the direct effect and on the Leontief inverse. In this paper the Leontief inverse represents the starting point to determine the relevance of a specific industry in activating backward and forward the outputs of all industries in the economy. For each sector the backward linkage is the contribution that intermediate inputs coming from other sectors gives to value its production. From the sum of each column of the Leontief's inverse:

$$r_{.j} = \sum_{i=1}^{m} r_{ij} \quad (4)$$

The increase of production in the sectors, which have strong upstream connections, will cause considerable increase of demand oriented to produce output from other sectors within the economic system.

The forward linkage is determined as a part of its output, which is sold to other sectors as the intermediate goods rather than as the final demand of economy. From each row sum of the Leontief's inverse:

$$r_{i.} = \sum_{j=1}^{m} r_{ij} \tag{5}$$

Some authors (Augustinovics, 1970; Beyers, 1976; Jones, 1976; Cella, 1984, Dietzenbacher, 1992; Miller and Lahr, 2001) suggest as a possible alternative for measuring forward linkages the Ghosh inverse $\mathbf{G} = (\mathbf{I} - \mathbf{B^d})^{-1}$ (Chang and Lahr, 2016).

Considering the averages $\left(\frac{1}{m}\right) \cdot r_{.j}$ with *j=1,2,.., m* (6) and $\left(\frac{1}{m}\right) \cdot r_{i.}$ with *i=1,2,.., m* (7), which represent an estimate of the direct and indirect increase in output (in the first one) and in the final demand (in the second one) when the final demand (in the first one) or the output (in the second one) rise by one unit. Normalizing these averages by the overall average it can carry out consistent inter-industry comparisons:

$$\frac{1}{m^2} \cdot \sum_{j=1}^{m} \sum_{i=1}^{m} r_{ij} = \frac{1}{m^2} \cdot \sum_{j=1}^{m} r_{.j} = \frac{1}{m^2} \cdot \sum_{i=1}^{m} r_{i.} \tag{6}$$

Two vectors of index will be obtained from equation (6), (7) and (8) (Ciaschini *et al.*, 2011b).

$$\pi_{.j} = \frac{\frac{1}{m} \cdot r_{.j}}{\frac{1}{m^2} \sum_{j=1}^{m} r_{.j}} \tag{9}$$

$$\pi_{i.} = \frac{\frac{1}{m} r_{i.}}{\frac{1}{m^2} \sum_{i=1}^{m} r_{i.}} \tag{10}$$

The first linkage defined as power of dispersion (9) is used to identify the ability to activate all industries outputs given a stimulus of the *j-th* final demand and the other linkage being defined

as sensitivity of dispersion (10) is used to determine the increase of *i-th* output given a unitary shock of all final demands.

When the power dispersion assumes a value greater than one ($\pi_{.j} > 1$), it shows how an increase in the *j-th* exogenous final demand determines a wider increase in output and vice versa when ($\pi_{.j} < 1$).

When the sensitivity dispersion assumes a value greater than one ($\pi_{i.} > 1$), it indicates that the increase of the *i-th* output activity is greater than all the others, given a unitary increase of the exogenous final demand and vice versa when ($\pi_{i.} < 1$).

Since the two linkages, built on Rasmussen's analysis, are statistical indexes, it is necessary to calculate the coefficients of variation; in order to see how the effect of the power and sensitivity indexes is distributed in the vector of production or final demand, respectively. In relation to power dispersion we obtain:

$$\sigma_{.j} = \frac{\sqrt{\frac{1}{m-1} * \sum_{i=1}^{m} * \left(r_{ij} - \sum_{i=1}^{m} r_{ij}\right)^2}}{\frac{1}{m} * \sum_{i=1}^{m} r_{ij}} \qquad \text{(i=1,...,m)} \qquad (11)$$

In the case of sensitivity of dispersion we have:

$$\sigma_{i.} = \frac{\sqrt{\frac{1}{m-1} * \sum_{j=1}^{m} * \left(r_{ij} - \sum_{j=1}^{m} r_{ij}\right)^2}}{\frac{1}{m} * \sum_{j=1}^{m} r_{ij}} \qquad \text{(i=1,...,m)} \qquad (12)$$

1.4 Empirical evidence on healthcare output

1.4.1 Healthcare output

The OECD defines the "total expenditure on healthcare" as measuring the final consumption of health goods and services plus capital investment in healthcare infrastructure. It includes expenditure both public and private sources (households included) on medical goods and services, on public health and prevention programmes and on administration (OECD, 2011a).

The health expenditure can be divided into current and capital expenditure. Considering the current health expenditure as common expenditure to deliver the healthcare services and according to the International Classification for Health Accounts–ICHA by different categories: healthcare by function (ICHA-HC); healthcare service provider industries (ICHA-HP); sources of funding healthcare (ICHA-HF) (OECD, 2011b). The capital expenditure defines how much the health system is investing in hospitals, medical technology and other equipment (OECD, 2015).

The described classification influences the analysis of the healthcare system since the priority lies on the expenditure for the final demand rather than on the production.

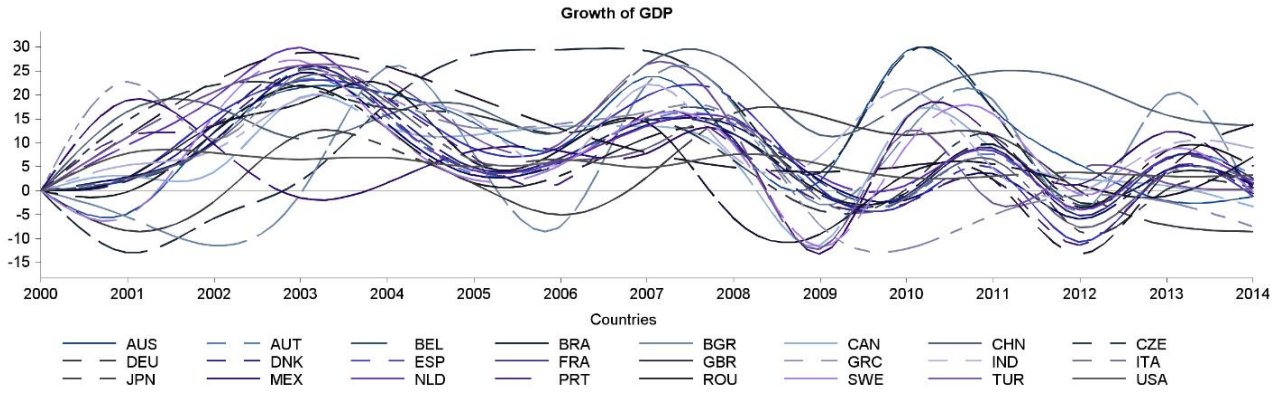
In literature the percentage of current health expenditure on GDP, as described previously, is widely discussed and debated. For example the index is used in evaluating the impact of the crisis, taking into consideration the resources being used and the financing measures being adopted (Portela, 2013).

In this paper we analyse the current healthcare expenditure as a productive process, in particular the capacity to generate income and employment. It will be calculated as a percentage of the healthcare output on GDP (Socci *et al.*, 2015a). The healthcare output represents the healthcare production subdivided into intermediate input and value added. The index measures how the resources produced by each country are necessary to finance the healthcare system. Using the first or the second definition of current health expenditure, we will obtain different results: in the appendix there are both results taken from the OECD statistics[4] (see Table **12** in the appendix) and our own results. Specifically we observe a similar trend over time for both results but following our approach, the starting point of current healthcare expenditure is significantly higher for some countries compared to the value measured by OECD approach (for example, Sweden, Denmark and United Kingdom in EU) while for other countries is significantly lower (USA, Mexico, Turkey, India and China).

When we analyse the GDP growth (Figure 1) during the period (2000-2014) we can see a cyclical trend with a negative growth during the economic-financial crisis years, – three or more years of negative growth between 2008 and 2013 – in almost all countries . The countries most affected by sustained decline in GDP are all in the European Union (EU) (Ongaro et. al, 2015); Greece shows the worst results and for longer time. Only Australia maintains a positive GDP growth during the period.

[4] See the table in the Appendix for details the current health expenditure /GDP. Source OECD.

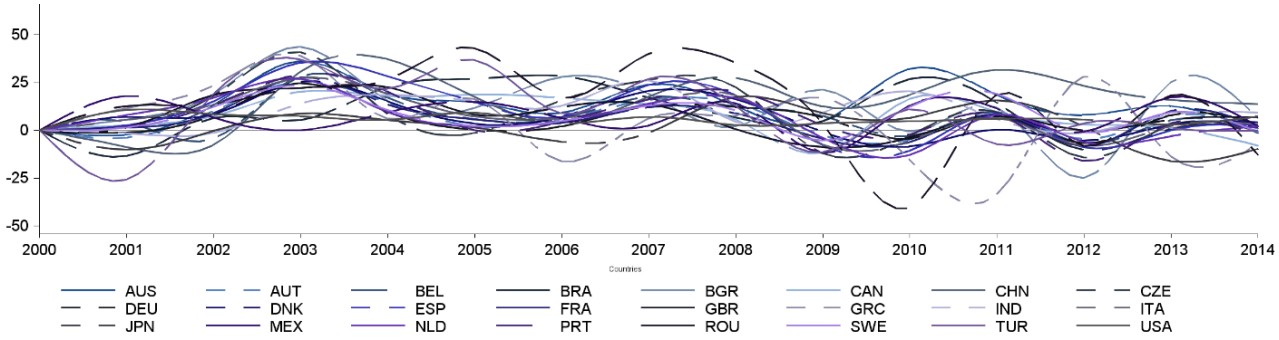
Figure 1 - “GDP growth (years 2000-2014) in %”



Source: our own calculations on WIOD data

From the other side the “Human Health Activities” output (Figure 2) has markedly slowed its growth or fallen in many European countries between 2008 and 2012. Romania, Greece and Bulgaria have experienced a significant reduction in output growth during “crisis-time” compared to the average growth rate before “crisis-time”.

Figure 2 - “Human Health Activities” output growth (years 2000-2014) in %



Source: our own calculations on WIOD data

Table 6 identifies six different groups of countries, on the basis of the trend of the ratio “Human Health Activities” output to GDP. The average of that ratio for the 24 countries being examined shows a light steady growth of the time: from 7% in year 2000 to 9% in year 2014. A group of countries lies durably over this percentage; they are Belgium, Portugal, United Kingdom, Germany, Denmark, the Netherlands, USA, France and Sweden.

Table 6 – "Human Health Activities" output/nominal GDP (years 2000-2014) in percentage

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Australia	7.0%	7.0	7.1	7.2	7.2	7.3	7.4	7.6	7.6	8.2	8.4	8.3	8.6	9.1	9.5
Austria	8.7	8.8	9.0	9.1	9.1	9.0	9.0	8.9	9.1	9.7	9.8	9.6	9.7	9.8	9.9
Belgium	9.5	9.8	10.0	10.2	10.2	10.3	10.2	10.3	10.8	12.0	12.2	12.1	12.4	12.7	12.6
Brazil	6.0	6.1	6.4	6.1	6.1	5.9	6.3	6.2	5.9	6.2	6.0	5.9	6.0	6.1	6.3
Bulgaria	5.6	5.2	5.9	5.4	5.4	5.9	5.6	5.2	4.7	5.1	5.7	5.8	5.4	6.4	6.2
Canada	8.2	8.6	8.8	8.9	8.9	8.9	9.0	9.2	9.2	9.2	9.1	9.0	9.0	9.0	9.0
China	3.9	3.6	3.4	3.7	4.0	5.3	4.7	4.4	4.3	4.3	4.3	4.6	5.0	5.1	5.3
Denmark	13.0	13.4	13.8	14.1	14.0	13.9	13.8	14.2	14.5	16.1	15.7	15.2	15.1	15.2	15.1
France	9.3	9.3	9.7	9.9	10.1	10.2	10.3	10.2	10.3	11.1	11.1	11.2	11.4	11.6	11.8
Germany	9.0	8.9	9.2	9.4	9.4	9.4	9.3	9.1	9.3	10.3	10.2	10.2	10.3	10.6	10.7
Japan	8.3	8.6	8.9	9.1	9.1	9.3	9.3	9.4	9.9	10.8	10.9	11.4	11.5	11.6	11.5
Greece	6.7	7.7	7.7	7.5	7.3	8.1	7.9	7.8	7.9	8.2	7.9	7.2	6.9	6.7	6.3
India	2.5	2.5	2.5	2.5	2.6	2.6	2.4	2.4	2.3	2.4	2.3	2.1	2.1	2.2	2.3
Italy	7.4	7.5	7.6	7.7	8.0	8.3	8.4	8.2	8.7	9.5	9.6	9.6	9.8	9.8	10.0
Mexico	2.8	3.1	3.2	3.2	3.1	3.0	2.9	2.9	3.0	3.3	3.2	3.2	3.2	3.4	3.4
Netherlands	8.9	9.2	10.3	10.8	10.6	10.5	10.4	10.1	10.7	12.4	12.6	12.7	13.2	13.5	13.4
Portugal	8.0	8.3	8.5	8.8	9.2	9.3	9.1	9.1	9.4	9.9	10.0	10.3	10.1	10.1	9.8
United Kingdom	10.4	10.8	11.3	11.7	12.1	12.3	12.6	12.6	12.9	14.3	14.2	14.0	14.0	13.8	13.4
Czech Republic	5.5	5.5	5.9	6.0	5.8	5.9	5.8	5.8	6.0	6.6	6.7	6.8	6.8	6.8	6.9
Romania	4.9	5.1	5.7	5.6	5.6	6.1	5.6	5.6	6.0	6.7	5.5	5.5	5.3	5.1	4.9
Spain	7.1	6.9	7.0	7.3	7.5	7.7	7.7	7.9	8.4	9.2	9.4	9.5	9.6	9.6	9.6
Sweden	12.4	13.0	13.6	13.7	13.3	13.4	13.2	13.0	13.4	14.5	13.9	14.0	14.4	14.7	14.8
Turkey	2.6	2.6	3.0	3.2	3.1	3.4	3.3	3.4	3.4	3.6	3.4	3.1	3.2	3.1	3.3
USA	9.4	9.9	10.4	10.6	10.6	10.6	10.6	10.7	11.2	11.9	11.9	12.0	12.0	12.0	12.0
Average	7.4	7.6	7.9	8.0	8.0	8.2	8.1	8.1	8.3	9.0	8.9	8.9	9.0	9.1	9.1

Source: our own calculations on WIOD data

When we analyse the figure in detail, we see how Denmark and Sweden lay much over the average (min. 7.4%, max 9.1%), between 12% and 15% during all the period. The trend of the consumption share for Sweden remains high for all the time though, while Denmark reached a peak in 2009 together with United Kingdom. In 2007 major structural reform in Denmark changed the administrative landscape by creating larger municipalities and regions and redistributing tasks and responsibilities. Moreover in the same year there were other reforms for the restructuring and modernization of the hospital sector (Olejaz et al., 2012). Also, in England some significant reforms were made in recent years (Health and Social Care Act 2012, completed in 2014 or early 2015), in Scotland (Health and Social Care Act 2012), in Wales (National Health Service Finance in 2013) and Northern Ireland (Transforming Your Care in 2011 and 2015) (Cylus et al., 2015).

A second group, above the average, located in the band that goes from 9% to 13% includes the Netherlands, Belgium and USA for which the share of consumed healthcare services increases gradually within this interval. In Belgium, several reforms since 2007 have been made with the aim of improving the performance of the health system (Gerkens *et al*., 2010).

France, Germany and Japan constitute a third group, slightly over the average; where the health production shares vary from 9% to 11% and remain constant over time.

The group that, in fact, represents the reference for the average trend is made up by Austria, Australia, Canada, Japan, Italy, Greece, Portugal and Spain, they draw a homogeneous and sufficiently smoothed trajectory, limited to shares located between 6% and 9%. The fifth group with result below the average (between 4-6%), is made up by Brazil, Bulgaria, Czech Republic and Romania. The last group represented by China, Mexico, Turkey and India lay much below the average with shares of 2-4%.

Shifting the attention to the productive process of healthcare services in the 24 analysed countries, we refer to the absorption of intermediate goods (including imports for healthcare) with respect to the total output of the healthcare sector. The results obtained are shown in Table **7**. The trajectories registered by countries such as China, Romania and Turkey emerge for the peculiarity and relevance locating in the highest interval at least for some periods in the time horizon. These countries could be defined as countries that need a more consistent absorption of intermediate goods and import with respect to other countries providing healthcare production. The trend of Bulgaria shows a fluctuating trend during the period. In Australia, France and Germany the percentage of absorbed intermediate goods is very low (under the average) in all the period. China starts from values around 61% in 2000, and after a slight decrease until 2004, shows a structural break in 2005 with an increase in the absorption until 68%. Then there is a slight decrease and it amounts at 65.6% in 2014. A relevant trend is also the one performed by Greece, which presents values under the average with a decrease by 6 p.p.s from 2005 to 2006. In 2011 the absorption of intermediate goods and import in Greece reaches the bottom at 20%; then it again increases by achieving values above 30%.

Table 7 - Intermediate goods/total output "Human Health Activities" (basic price) in percentage (years 2000-2014)

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Australia	20.4	20.5	20.5	20.5	20.5	20.5	20.5	20.5	21.0	21.4	21.8	22.1	22.4	25.7	25.7
Austria	29.8	29.2	29.1	29.2	29.0	29.2	29.0	29.1	28.8	28.4	28.4	28.7	28.5	28.6	28.5
Belgium	35.7	36.2	36.6	37.0	37.0	37.3	37.1	37.5	37.5	38.0	38.0	37.8	37.4	37.4	37.1
Brazil	37.3	37.3	40.2	40.7	41.5	41.1	40.9	38.8	36.5	36.7	36.6	36.1	34.5	34.1	34.0
Bulgaria	38.5	41.4	36.8	45.9	44.3	39.8	48.0	47.6	44.4	48.1	46.1	44.9	39.5	40.7	42.3
Canada	25.8	25.9	26.5	26.6	27.4	28.5	29.1	29.1	29.0	29.0	29.2	29.6	29.6	29.6	29.5
China	61.8	55.9	50.0	54.3	58.5	68.7	67.1	65.5	65.5	65.6	65.6	65.6	65.6	65.6	65.6
Denmark	21.0	21.7	22.1	22.1	22.4	22.9	23.3	24.5	25.1	24.5	23.7	23.6	24.1	24.2	24.7
France	22.3	22.1	21.3	21.4	21.0	21.2	20.7	20.3	19.9	19.8	19.3	19.4	19.6	19.7	19.7
Germany	29.1	29.0	28.1	28.5	28.1	27.9	28.3	28.8	28.8	29.6	28.9	28.8	28.1	28.1	27.7
Japan	43.0	42.5	43.1	42.4	42.1	42.3	42.2	41.3	41.6	40.3	39.4	40.4	41.0	42.0	42.0
Greece	32.1	29.9	32.0	33.8	31.6	32.1	26.5	25.6	24.5	27.8	27.0	20.8	32.6	30.4	30.5
India	37.4	36.0	34.3	33.1	33.6	34.1	34.8	35.4	35.3	35.4	35.4	35.4	35.2	35.0	35.0
Italy	32.7	33.4	34.1	34.8	34.9	35.1	35.3	36.4	36.9	36.6	35.8	35.9	36.0	35.9	36.1
Mexico	29.8	29.4	28.8	29.3	30.5	31.5	31.1	30.1	30.9	31.2	31.2	31.4	31.0	31.9	32.4
Netherlands	32.7	31.7	31.4	30.7	29.5	29.1	28.9	29.1	30.0	29.4	27.7	27.5	27.9	27.2	26.9
Portugal	37.4	35.0	34.7	35.0	35.3	33.9	34.8	34.7	36.9	37.6	38.1	39.7	38.3	38.3	38.1
United Kingdom	41.1	40.9	41.6	42.4	42.6	42.9	43.4	43.5	45.3	45.7	44.6	45.1	45.0	46.5	46.3
Czech Republic	38.1	35.4	33.7	35.6	34.2	33.7	34.5	37.7	36.8	36.9	36.9	36.7	36.2	36.5	36.6
Romania	54.1	54.9	49.3	48.5	48.9	48.7	49.1	49.0	48.8	53.0	40.1	43.6	45.3	47.7	41.3
Spain	30.7	30.6	30.5	30.8	32.0	33.1	32.8	33.5	33.1	32.5	31.2	31.8	32.4	31.6	32.7
Sweden	23.2	24.6	24.0	23.5	23.2	23.2	23.9	23.4	23.7	24.6	24.3	24.7	24.7	24.8	24.8
Turkey	48.0	47.8	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.6	47.5	47.5	47.5
USA	38.5	39.1	39.3	39.5	39.2	40.1	39.6	40.1	39.2	38.6	39.2	40.0	40.3	40.3	41.1
Average	35.0	34.6	34.0	34.7	34.8	35.2	35.4	35.4	35.3	35.8	34.8	34.9	35.1	35.4	35.2

Source: our own calculations on WIOD data

1.4.2 Relevance of ICT in healthcare services production: comparison among 24 countries (2000-2014)

In the few last years, the Information and Communication Technology (ICT) assumes a strategic role and generates several and different effects on the whole economic system (Doucek et. al, 2014). The integration of ICT into health care means being able to manage information on peoples' health and healthcare in more efficient ways for individual patients and groups of patients. Health-ICT in fact is also a reply to an emerging push to have more services and care supplied outside hospitals and to manage populations of patients. This feature of the out-of-hospital care model, while supporting quality and efficiency, is an articulated approach based on organizational effort to assign the task of managing patient connections. Electronic information and communication technology, as a means of producing unprecedented change, greatly depends both on the will and the ability of applying and integrating rapid technological change. The use of Health-ICT can improve the quality of care even in the sense that it makes health care more cost effective. In contexts other than the economic-financial crisis, the introduction of electronic health records and e-prescribing has had positive effects on cost-effectiveness and quality in some countries (Dobrev et al., 2010). Electronic health records have proven to be complex to implement

and are associated with high investment costs (Black et al., 2011), so may not be amenable to rapid introduction in a crisis situation. However, e-prescribing systems can be a critical tool for improving efficiency in the use of drugs and diagnostic tests if they are used to monitor prescribing patterns and are accompanied by measures to address inefficient prescribing behaviour.

Eleven countries reported changes to eHealth systems, including electronic prescribing for medicines (Belgium, Croatia, Czech Republic, France, Greece, Latvia, Portugal, Romania, Serbia, TFYR Macedonia, Turkey).

The analysis of the intermediate absorptions focuses on the output of the sector ICT employed by the healthcare. In analysing the percentage of ICT in the health sector for the different countries, it is also possible to (i) quantify the relative importance of the ICT sector in the health production of each country; (ii) and to so derive measure the effort of each country in the ICT investment for health in some certain years, rather than in other sectors; and (iii), and also to determine identify for each country the ICT categories that contribute less to healthcare production. Following the WIOT classification ICT sector is composed by six categories: “ICT Manufacturing Activities” (26), “ICT Equipment trade activities” (46), “Retail sale of ICT equipment in special stores” (47), “Software publishing” (58), “ICT services” (61-63) and “Other service activities” (R-S). Further analysis has been performed which relates to the aggregate ICT net of industry category 46.

At this point it is necessary to identify the group of industries that can be considered typical of the ICT sector with the aim of studying the absorption change of the group ICT for unit of products and of the industry health and social services (for the time-period 2000-2014). The main typical industries of the ICT sector are ICT manufacturing, distribution and services as shown in Table **8**. The classification of ICT in International Standard Industrial Classification of All Economic Activities (ISIC) rev. 4 intends to better reflect the growing importance of "information" in the social economy.

Table 8 - OECD classification in terms of classes ISIC rev. 4

ISIC Code	DESCRIPTION
	ICT Manufacturing Activities
26.10	Manufacture of electronic components
26.20	Manufacture of computers and peripheral equipment
26.30	Manufacture of communication equipment
26.40	Manufacture of consumer electronics
26.80	Manufacture of magnetic and optical media
	ICT Equipment trade activities
46.51	Wholesale of computers, computer peripheral equipment and software
46.52	Wholesale of electronic and telecommunications equipment and parts
	Retail sale of ICT equipment in special stores
47.41	Retail sale of computers, peripheral units, software & telecommunication equipment in special stores
	Software publishing
58.20	Software publishing
	ICT services
61	Telecommunications
62	Information technology services activities
63	Information services activities
	Repair of ICT equipment
95	Repair of computers and communication equipment

Source "ICT sector classification standards proposals based on ISIC Revision 4"

In the Table **9** we can see the results of an analysis at aggregate level, where the total absorbed ICT per unit of health production is shown. This figure shows that the highest value is given by Bulgaria (about 14%), Greece and Romania (about 12%), we can also see, the unconventional trend of the United Kingdom. The United Kingdom made a concerted effort in the mid-2000s to try the adjust to the explosion of public use of computers and information technology by introducing patient portals online and cross-departmental electronic record-keeping (Cylus *et al.*, 2015). However, the percentage fell from a value of 6.7% in 2008 to a value of around 3.9% in 2012. India shows the lowest share of ICT absorption around 2-3%. In Italy the share of ICT is around 6% until 2008 and then falls to a share of around 3.7% in 2012 and remain constant. Also China, that in Table **7** presented high percentages of absorption of intermediate goods, maintains the absorption in ICT above the average of 6% (for the considered time period).

Table 9 - ICT absorption per unit of output / total output "Human Health Activities" (basic price) in percentage (years 2000-2014)

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Australia	5.4	5.7	5.7	5.8	5.7	5.5	5.4	5.4	5.5	5.6	5.6	5.7	5.7	5.7	5.7
Austria	4.9	4.9	4.9	4.8	4.6	4.6	4.5	4.4	4.2	4.2	4.1	4.1	3.9	3.7	3.6
Belgium	6.3	6.3	6.6	6.6	6.7	6.7	6.5	6.6	6.3	5.8	4.6	4.6	4.3	4.1	4.0
Brazil	5.8	6.0	6.4	6.8	7.0	7.2	7.1	6.9	6.6	6.7	6.6	6.6	6.3	6.2	6.1
Bulgaria	13.5	13.7	11.7	14.9	13.6	12.3	14.2	12.9	12.1	13.7	13.5	12.1	10.2	10.5	12.5
Canada	4.1	4.2	4.3	4.2	4.4	4.5	4.7	4.8	4.8	4.8	4.7	4.7	4.7	4.8	4.8
China	7.4	6.4	5.2	6.0	6.8	8.8	8.7	8.5	8.6	9.0	9.3	9.3	9.5	9.5	10.0
Denmark	4.1	4.2	4.2	4.2	4.2	4.0	3.9	4.1	4.2	4.0	3.8	3.7	3.7	3.8	3.7
France	3.1	3.2	3.1	3.2	3.2	3.1	3.0	2.9	2.9	2.8	2.7	2.6	2.6	2.7	2.6
Germany	5.3	5.4	5.1	5.2	5.1	5.0	5.0	5.1	5.2	6.2	6.9	6.8	6.4	6.4	6.2
Japan	9.9	9.5	9.6	9.1	9.0	9.1	8.8	8.4	8.4	7.5	7.4	7.4	7.5	7.8	7.5
Greece	12.6	10.4	11.6	11.9	11.4	12.5	9.5	8.5	8.7	10.9	11.1	8.7	12.9	11.3	11.9
India	3.1	3.1	2.8	2.9	3.0	3.0	3.0	2.9	2.8	2.9	2.8	2.6	2.8	3.0	3.1
Italy	6.0	6.3	6.4	6.4	6.3	6.3	6.1	6.2	6.1	5.2	4.3	4.2	3.7	3.7	3.7
Mexico	4.4	4.2	4.1	4.2	4.6	4.9	4.9	4.9	4.8	5.0	5.2	5.4	5.5	5.8	6.0
Netherlands	7.0	7.1	7.3	7.1	6.7	6.5	6.7	6.6	6.7	5.4	4.5	4.4	4.5	3.9	4.0
Portugal	7.4	7.1	7.3	7.5	7.4	6.9	6.8	6.6	6.9	7.2	7.0	6.9	6.5	6.6	6.4
United Kingdom	6.2	6.3	6.3	6.4	6.4	6.3	6.5	6.5	6.7	5.9	4.0	3.9	3.9	4.0	4.2
Czech Republic	5.7	5.2	5.0	5.4	5.0	4.7	4.8	5.0	4.7	4.4	4.5	4.7	4.4	4.5	4.5
Romania	10.7	10.4	8.8	9.2	9.1	10.3	10.7	11.1	11.7	12.3	9.2	11.4	12.1	12.6	10.9
Spain	5.9	5.9	6.1	6.1	6.5	6.7	6.5	6.7	6.7	6.4	5.7	6.0	6.1	6.0	6.1
Sweden	2.5	2.7	2.5	2.5	2.5	2.5	2.6	2.5	2.5	2.7	2.7	2.7	2.8	2.8	2.8
Turkey	6.9	6.6	6.8	6.9	6.8	7.1	7.3	7.4	7.4	7.1	7.2	7.4	7.0	7.1	7.0
Usa	4.7	4.9	4.8	4.7	4.7	4.8	4.8	4.8	4.9	4.7	4.9	5.0	5.1	5.0	5.1
Average	6.37	6.24	6.11	6.33	6.28	6.39	6.33	6.24	6.23	6.27	5.93	5.87	5.92	5.90	5.93

Source: our own calculations on WIOD data

We decided to exclude this category from total ICT, because it was already included in the six categories of the ICT and causes endogeneity to the model. The comparison between ICT with trade activities and ICT without trade activities returns interesting very relevant results for Bulgaria, China, Greece and Romania. Indeed for these countries we observe a decrease about 4-5 p.p.s., when the ICT aggregate does not include the trade activities. Tis finding highlights the importance of the commercial services in total output "Human Health Activities".

1.5 A dispersion analysis for ICT and healthcare sectors: comparison among 24 countries (2000-2014)

We analyse the linkages, power and the sensitivity of dispersion, among the industries which are commonly used to support the policy maker. In the following tables and in the appendix are presented the results of power and the sensitivity of dispersion for the healthcare and ICT sectors.

Table 10 - Power of dispersion of “Human Health Activities” (years 2000-2014)

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Australia	0.69	0.70	0.69	0.69	0.70	0.70	0.71	0.71	0.71	0.71	0.72	0.73	0.74	0.77	0.77
Austria	0.82	0.80	0.80	0.79	0.79	0.78	0.78	0.78	0.77	0.77	0.77	0.77	0.77	0.77	0.76
Belgium	0.86	0.85	0.83	0.84	0.84	0.85	0.84	0.85	0.84	0.83	0.83	0.82	0.82	0.82	0.82
Brazil	0.93	0.92	0.95	0.96	0.97	0.96	0.95	0.93	0.91	0.93	0.93	0.92	0.89	0.89	0.89
Bulgaria	0.82	0.85	0.82	0.91	0.88	0.84	0.92	0.94	0.91	0.95	0.93	0.92	0.88	0.89	0.90
Canada	0.77	0.77	0.78	0.77	0.78	0.80	0.80	0.80	0.80	0.79	0.79	0.80	0.80	0.80	0.79
China	1.13	1.06	1.00	1.04	1.08	1.17	1.16	1.15	1.15	1.14	1.13	1.13	1.12	1.12	1.12
Denmark	0.77	0.77	0.77	0.78	0.78	0.76	0.76	0.76	0.77	0.75	0.76	0.75	0.75	0.76	0.76
France	0.73	0.72	0.72	0.72	0.72	0.71	0.70	0.70	0.69	0.69	0.68	0.68	0.67	0.68	0.68
Germany	0.81	0.81	0.80	0.80	0.80	0.79	0.79	0.79	0.78	0.79	0.79	0.78	0.79	0.79	0.79
Japan	0.96	0.95	0.96	0.95	0.94	0.93	0.93	0.91	0.89	0.88	0.88	0.88	0.89	0.90	0.91
Greece	0.87	0.86	0.87	0.91	0.89	0.89	0.83	0.82	0.81	0.84	0.82	0.77	0.87	0.86	0.85
India	1.04	1.01	0.98	0.96	0.97	0.98	1.01	1.02	1.01	1.01	1.00	1.00	1.02	1.02	1.02
Italy	0.81	0.81	0.82	0.82	0.82	0.82	0.82	0.83	0.83	0.82	0.78	0.78	0.77	0.77	0.78
Mexico	0.88	0.87	0.87	0.88	0.89	0.89	0.89	0.88	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Netherlands	0.86	0.88	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.82	0.81	0.80	0.80	0.78	0.79
Portugal	0.86	0.84	0.84	0.84	0.84	0.82	0.84	0.84	0.84	0.87	0.87	0.87	0.86	0.87	0.87
United Kingdom	0.90	0.89	0.90	0.92	0.92	0.93	0.93	0.93	0.95	0.93	0.91	0.92	0.92	0.92	0.92
Czech Republic	0.83	0.80	0.78	0.79	0.79	0.76	0.76	0.78	0.76	0.76	0.75	0.74	0.74	0.74	0.75
Romania	1.04	1.03	0.98	0.96	0.96	0.96	0.97	0.96	0.96	1.01	0.91	0.93	0.92	0.98	0.92
Spain	0.81	0.80	0.79	0.79	0.80	0.80	0.79	0.79	0.78	0.78	0.75	0.76	0.77	0.76	0.78
Sweden	0.75	0.77	0.76	0.77	0.76	0.76	0.76	0.75	0.75	0.75	0.77	0.77	0.77	0.77	0.78
Turkey	1.03	1.04	1.04	1.04	1.05	1.05	1.05	1.05	1.06	1.05	1.05	1.05	1.05	1.06	1.05
Usa	0.89	0.90	0.91	0.91	0.91	0.91	0.91	0.91	0.89	0.92	0.92	0.92	0.92	0.92	0.92

Source: our own calculations on WIOD data

Table **10** underlines the capacity of activation upstream of the sector “Human Health Activities”, that is how many goods and services from the productions of other industries are absorbed by healthcare sector. The analysis highlights that the value of the power of dispersion is less than one in most countries; meaning that the healthcare sector does not absorb in significant way products from other sectors. Only China[5], India and Turkey show value higher than one, in the years 2000-2014. Therefore the healthcare sector is likely to be independent from other sectors in all countries. However, analysing the coefficients of variation connected the power of dispersion linkages, we can see high values; meaning the effect of the power of dispersion is distributed among sectors. The power of dispersion of ICTs sector (see detailed data in the appendix) highlights that sectors assume a value higher than one, in particular: “ICT Manufacturing Activities” (Table **13**) for Australia, Brazil, China, Japan, India, Italy, Mexico, Netherlands, Portugal, Spain and Turkey; “ICT Equipment trade activities” (Table **15**), for Australia, Bulgaria and United Kingdom; “Software publishing” (Table **19**) in all countries except Australia, China, India, Turkey and USA; “Telecommunications” (Table **21**) for Australia, Austria, Brazil, Denmark, Netherlands, Portugal, Sweden, Turkey and USA; “Computer programming, consultancy and related activities”

[5] The power of dispersion bigger in China than one is in line with other studies (Ferracuti et al., 2018).

(Table **23**) for Austria, Belgium, China, Denmark and Portugal; "Other service activities" (Table **25**) for Australia, Brazil and China. The power of dispersion of "Retail sale of ICT equipment in special stores" (Table **17**) shows value less than one. The findings obtained of the power dispersion of ICT sectors are in line with other analysis, or rather all the sectors with high technological contents are key sectors for the economy (Mattioli and Lamonica, 2013).

Table 11 - Sensitivity of dispersion of "Human Health Activities" (years 2000-2014)

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Australia	0.54	0.54	0.54	0.54	0.54	0.55	0.55	0.55	0.56	0.56	0.57	0.58	0.59	0.60	0.60
Austria	0.61	0.61	0.61	0.60	0.60	0.59	0.58	0.58	0.57	0.57	0.58	0.58	0.58	0.58	0.58
Belgium	0.62	0.61	0.63	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.63	0.64	0.65	0.65
Brazil	0.61	0.60	0.61	0.61	0.62	0.61	0.61	0.61	0.60	0.62	0.62	0.62	0.61	0.61	0.62
Bulgaria	0.75	0.73	0.78	0.74	0.76	0.82	0.80	0.79	0.79	0.81	0.84	0.87	0.84	0.89	0.89
Canada	0.77	0.78	0.79	0.78	0.79	0.80	0.79	0.80	0.79	0.72	0.73	0.73	0.73	0.73	0.74
China	0.51	0.51	0.52	0.52	0.52	0.53	0.52	0.51	0.49	0.48	0.46	0.44	0.43	0.42	0.43
Denmark	0.65	0.65	0.65	0.66	0.66	0.65	0.65	0.65	0.65	0.65	0.66	0.65	0.65	0.66	0.66
France	0.60	0.60	0.60	0.60	0.61	0.61	0.60	0.60	0.60	0.60	0.59	0.59	0.59	0.60	0.60
Germany	0.60	0.60	0.60	0.60	0.60	0.59	0.60	0.60	0.59	0.59	0.58	0.58	0.58	0.59	0.59
Japan	0.62	0.62	0.62	0.62	0.62	0.61	0.60	0.59	0.59	0.61	0.62	0.61	0.61	0.62	0.62
Greece	0.65	0.65	0.64	0.66	0.67	0.67	0.66	0.66	0.66	0.66	0.64	0.64	0.64	0.65	0.64
India	0.62	0.61	0.61	0.61	0.61	0.62	0.63	0.63	0.63	0.63	0.62	0.61	0.63	0.63	0.63
Italy	0.55	0.55	0.55	0.55	0.55	0.55	0.54	0.54	0.54	0.57	0.57	0.57	0.58	0.58	0.59
Mexico	0.63	0.63	0.63	0.63	0.63	0.62	0.63	0.62	0.62	0.62	0.63	0.63	0.63	0.62	0.62
Netherlands	0.71	0.73	0.73	0.74	0.76	0.76	0.74	0.74	0.75	0.73	0.71	0.71	0.71	0.70	0.71
Portugal	0.64	0.64	0.64	0.65	0.65	0.65	0.65	0.65	0.65	0.67	0.68	0.67	0.68	0.69	0.69
United Kingdom	0.70	0.70	0.71	0.72	0.72	0.73	0.73	0.73	0.73	0.74	0.73	0.74	0.73	0.73	0.72
Czech Republic	0.53	0.53	0.54	0.52	0.54	0.55	0.54	0.54	0.54	0.56	0.55	0.56	0.55	0.55	0.56
Romania	0.65	0.66	0.69	0.67	0.68	0.69	0.67	0.67	0.67	0.65	0.65	0.66	0.63	0.65	0.66
Spain	0.68	0.67	0.66	0.67	0.67	0.66	0.65	0.65	0.66	0.67	0.64	0.65	0.66	0.66	0.67
Sweden	0.64	0.65	0.66	0.67	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.67	0.67
Turkey	0.67	0.67	0.69	0.71	0.71	0.71	0.70	0.69	0.69	0.67	0.67	0.67	0.67	0.67	0.67
Usa	0.57	0.58	0.59	0.59	0.59	0.58	0.58	0.57	0.57	0.61	0.60	0.59	0.59	0.59	0.59

Source: our own calculations on WIOD data

Table **11** shows the capacity of activation downstream of the sector "Human Health Activities" with respect to the other sectors. For all countries the index of the sensitivity of dispersion is less than one, that is the health sector does not provide goods and services to the other sectors, the health sector does not play an important role within the economic system. These results highlight how services provided by the healthcare industry are not absorbed if we stimulate all purchaser' activities. An increase of final demand in healthcare industries will produce a wider increase in all the other industries in the system. From the viewpoint of the sensitivity dispersion we can assume that the healthcare sector is not a key sector and it does not assume a role of stimulus to other sectors. As results confirm that the healthcare sector is oriented to the final demand. Additionally, the coefficients of variation of sensitivity of dispersion

linkages assume high value and in this case the effect of the sensitivity of dispersion is distributed among sectors also. The sensitivity of dispersion for the ICT sectors with value bigger than 1 (see the detailed data in the appendix), in particular: “ICT Manufacturing Activities” (Table **14**) for China, Japan, Netherlands, Portugal and Usa; “ICT Equipment trade activities” (Table **16**), for all countries; “Retail sale of ICT equipment in special stores” (Table **18**) for Belgium, Brazil, France, Greece, India, Italy, Mexico Netherlands, Portugal, United Kingdom, Czech Republic, Romania, Spain, Sweden and Turkey; “Software publishing” (Table **20**) only Denmark and Sweden ; “Telecommunications” (Table **22**) for all countries except Bulgaria and China; “Computer programming, consultancy and related activities” (Table **24**) for Australia, Denmark, France, Germany, Italy, Netherlands, United Kingdom and Sweden; “Other service activities” (Table **26**) for Australia, Austria, Germany and Netherlands. The results confirm that, for the most of the countries, ICTs are key sectors from the final demand side too, because they can increase the production to other sectors if they are stimulated.

1.6 Conclusions

The application of multisectoral analysis to the healthcare services production underlines the peculiar role of this activity within the industries composing the economy, in the face of a conventional viewpoint that treats health care exclusively from the expenditure side confining its role to that of a component of public expenditure. Healthcare expenditure in both aspects, of current and capital expenses, as well as all the components of public expenditure, rests on public budget, whose deficits by accumulation generate, eventually, the huge public debt that we have become accustomed to in recent years. Both the government final consumption and government gross capital formation in health care induce problems of deficit sustainability and funding.

The urgency of the theme of public debt tends to cut off all other aspects of the discussion: the very same specificity of health expenditure and sustainability is overwhelmed by the pressure being put forward by the effort of controlling the general public debt sustainability spelt out in the international agreements of fixing constant budget deficit/GDP ratios. Nonetheless the peculiarities of healthcare expenditure, tied as they are to the healthcare production process, technology and innovation put forward a picture of the healthcare production process, where convenient policies stimulating technological innovations may build up a virtuous circle between health oriented expenditure and technological innovation for the entire producing structure.

The suggestions emerging from the application of the multisectoral approach, on the contrary, allow for the treatment of health care at macroeconomic level. However, maintaining the focus on the specificity of the healthcare producing process and on the contribution it can provide to all other industries through innovation and ICT.

The careful scrutiny of the processes generating the healthcare output underlines that they are characterized, from an empirical viewpoint, by the absorption of specific production factors. Moreover, the healthcare industry is one of the few industries where a strong connection exists between current and capital expenditure. In the case of healthcare systems with public characteristics, this relationship can be attributed to the fact that the final demand tends to persist independently from new capital implementations.

In private healthcare systems, instead, the relationship between innovation and healthcare output goes through the requirement of the sector of continued investments in research. The resulting outcome in many cases leads to a structural change that can be consistently attributed to the adoption of R&D and ICT. The production of Human Health Activities assumes the role of key industry in countries in which a high intermediate-goods/value-added ratio emerges. The integration of health-ICT in health care can improve the quality of care by making the health care industry more cost effective.

The results we provide are preliminary in the sense that the copiousness of information in the WIOD database requires further and deeper analysis. The results seem to confirm, however, this role at least for some countries where the resort to ICT seems to be a conscious and deliberate policy target.

Further insight through multisectoral techniques applied to the database but also to the institutional framework of healthcare provision in each country will highlight a macroeconomic quantitative evaluation of health care provision as fuel for economic growth through technological innovation planned and issued by the policy maker.

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1.8 Appendix

Table 12 – Current health expenditure /GDP in percentage

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Australia	7.6	7.7	7.9	7.9	8.1	8.0	8.0	8.1	8.3	8.6	8.5	8.6	8.7	8.8	9.1
Austria	9.2	9.3	9.4	9.6	9.6	9.6	9.5	9.5	9.6	10.1	10.1	9.9	10.1	10.2	10.3
Belgium	7.9	8.1	8.3	9.1	9.1	9.0	8.9	9.0	9.3	10.1	9.9	10.1	10.2	10.4	10.4
Brazil	7.0	7.2	7.1	7.0	7.1	8.3	8.4	8.3	8.2	8.6	6.1	6.0	6.0	6.2	..
Bulgaria	..	..	..	..	..	..	..	..	..	..	..	..	..	7.9	8.5
Canada	8.3	8.7	8.9	9.0	9.1	9.1	9.2	9.3	9.5	10.6	10.6	10.2	10.2	10.1	10.0
China	4.6	4.5	4.8	4.8	4.7	4.6	4.5	4.3	4.5	5.0	4.8	5.0	5.2	5.3	5.5
Denmark	8.1	8.4	8.7	8.9	9.0	9.1	9.2	9.3	9.5	10.7	10.4	10.2	10.3	10.2	10.3
France	9.5	9.7	10.0	10.0	10.1	10.2	10.0	10.0	10.1	10.8	10.7	10.7	10.8	10.9	11.1
Germany	9.8	9.9	10.1	10.4	10.1	10.3	10.1	10.0	10.2	11.2	11.0	10.7	10.8	11.0	11.1
Japan	7.2	7.4	7.5	7.6	7.7	7.8	7.8	7.9	8.2	9.1	9.2	10.6	10.8	10.8	10.8
Greece	7.2	8.0	8.2	8.2	7.9	9.0	9.0	9.1	9.4	9.5	9.6	9.1	8.8	8.3	7.9
India	4.3	4.5	4.4	4.3	4.2	4.3	4.2	4.2	4.3	4.4	4.3	4.4	4.4	4.6	4.8
Italy	7.6	7.8	7.9	7.9	8.2	8.4	8.5	8.2	8.6	9.0	9.0	8.8	9.0	9.0	9.0
Mexico	4.9	5.3	5.4	5.9	6.0	5.9	5.7	5.8	5.7	6.2	6.0	5.8	5.9	6.0	5.7
Netherlands	7.1	7.4	8.0	8.5	8.5	9.3	9.2	9.2	9.5	10.2	10.4	10.5	10.9	10.9	10.9
Portugal	8.4	8.4	8.6	8.9	9.3	9.4	9.1	9.1	9.4	9.9	9.8	9.5	9.3	9.1	9.0
United Kingdom	6.0	6.4	6.6	6.9	7.1	7.2	7.4	7.5	7.7	8.6	8.5	8.5	8.5	9.9	9.8
Czech Republic	5.7	5.9	6.2	6.6	6.4	6.4	6.2	6.0	6.4	7.3	6.9	7.0	7.0	7.8	7.7
Romania	..	..	..	..	..	..	..	..	..	..	..	..	..	5.3	5.1
Spain	6.8	6.8	6.8	7.5	7.6	7.7	7.8	7.8	8.3	9.0	9.0	9.1	9.1	9.0	9.1
Sweden	7.4	8.0	8.4	8.5	8.3	8.3	8.2	8.1	8.3	8.9	8.5	10.7	10.9	11.1	11.1
Turkey	4.6	4.9	5.1	5.1	5.0	4.9	5.2	5.3	5.3	5.5	5.1	4.7	4.5	4.4	4.3
Usa	12.5	13.2	14.0	14.5	14.5	14.5	14.7	14.9	15.3	16.3	16.4	16.4	16.4	16.3	16.5
Average	7.35	7.61	7.83	8.05	8.07	8.24	8.22	8.22	8.44	9.07	8.85	8.93	8.99	8.90	9.04

Source http://stats.oecd.org/Index.aspx?DataSetCode=SHA and http://ec.europa.eu/eurostat/data/database

Table 13 – Power of dispersion of " ICT Manufacturing Activities" (years 2000-2014)

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Australia	1.05	1.06	1.06	1.07	1.06	1.06	1.05	1.05	1.03	0.99	0.95	0.91	0.88	0.74	0.74
Austria	0.92	0.98	0.93	0.92	0.92	0.86	0.84	0.89	0.89	0.88	0.85	0.83	0.84	0.82	0.82
Belgium	1.01	1.01	0.98	0.97	1.00	0.95	0.93	0.94	0.94	0.94	0.90	0.89	0.91	0.90	0.90
Brazil	1.24	1.25	1.24	1.18	1.20	1.22	1.22	1.36	1.26	1.23	1.22	1.19	1.21	1.21	1.19
Bulgaria	1.18	1.17	1.12	1.08	1.05	1.06	1.05	1.02	0.96	0.98	0.98	0.97	0.93	0.89	0.89
Canada	0.86	0.93	0.92	0.90	0.88	0.88	0.88	0.89	0.89	0.89	0.87	0.86	0.87	0.88	0.87
China	1.37	1.36	1.34	1.33	1.36	1.41	1.39	1.35	1.37	1.41	1.45	1.47	1.46	1.47	1.46
Denmark	0.96	0.95	0.95	0.91	0.88	0.88	0.86	0.85	0.87	0.86	0.85	0.86	0.86	0.87	0.87
France	1.05	1.04	1.01	1.00	0.98	0.97	0.96	0.95	0.95	0.91	0.93	0.92	0.91	0.92	0.91
Germany	1.01	1.02	1.00	0.98	0.97	0.97	0.97	0.98	0.98	0.96	0.93	0.94	0.94	0.93	0.93
Japan	1.22	1.26	1.24	1.22	1.20	1.19	1.17	1.16	1.21	1.21	1.20	1.20	1.19	1.18	1.16
Greece	0.91	0.86	0.87	0.91	0.89	0.89	0.83	0.82	0.81	0.84	0.82	0.77	0.87	0.86	0.85
India	1.43	1.41	1.38	1.39	1.40	1.41	1.49	1.49	1.51	1.45	1.51	1.48	1.49	1.49	1.50
Italy	1.07	1.07	1.08	1.07	1.05	1.04	1.05	1.06	1.06	1.04	0.99	1.00	0.99	1.00	1.00
Mexico	1.26	1.22	1.26	1.25	1.23	1.31	1.28	1.37	1.24	1.20	1.16	1.15	1.20	1.20	1.19
Netherlands	1.19	1.26	1.30	1.34	1.35	1.30	1.30	1.28	1.33	1.22	1.13	1.15	1.16	1.06	1.09
Portugal	1.04	1.01	1.08	1.08	1.05	1.05	1.06	1.00	0.98	1.09	1.00	1.06	1.05	1.02	1.01
United Kingdom	1.00	1.05	1.06	1.08	1.03	1.02	1.04	1.02	0.97	0.99	0.91	0.91	0.90	0.89	0.90
Czech Republic	0.93	0.93	0.98	1.06	1.07	1.01	0.99	0.96	1.01	0.94	0.88	0.85	0.89	0.89	0.88
Romania	0.97	1.00	1.01	0.99	0.99	0.98	0.99	1.00	0.97	0.97	0.75	0.78	1.06	0.93	1.01
Spain	1.14	1.16	1.18	1.16	1.15	1.14	1.13	1.10	1.07	1.00	1.05	1.00	0.96	0.96	0.95
Sweden	1.08	1.17	1.12	1.02	0.92	0.93	0.93	0.94	0.96	0.90	0.84	0.80	0.79	0.77	0.77
Turkey	1.44	1.35	1.31	1.33	1.31	1.37	1.38	1.43	1.45	1.45	1.46	1.45	1.31	1.30	1.28
Usa	1.06	1.12	1.05	0.99	0.98	0.95	0.94	0.96	0.92	0.87	0.84	0.84	0.83	0.78	0.78

Source: our own calculations on WIOD data

Table 14 – Sensitivity of dispersion of " ICT Manufacturing Activities" (years 2000-2014)

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Australia	0.63	0.62	0.63	0.62	0.62	0.62	0.62	0.62	0.61	0.61	0.61	0.61	0.61	0.61	0.61
Austria	0.85	0.92	0.81	0.81	0.80	0.75	0.74	0.66	0.64	0.62	0.60	0.61	0.59	0.59	0.59
Belgium	0.66	0.63	0.61	0.61	0.60	0.59	0.59	0.59	0.59	0.58	0.59	0.59	0.59	0.60	0.60
Brazil	0.84	0.88	0.84	0.71	0.77	0.78	0.80	0.94	0.83	0.80	0.80	0.77	0.77	0.77	0.76
Bulgaria	0.70	0.75	0.82	0.71	0.63	0.61	0.59	0.58	0.53	0.54	0.55	0.55	0.56	0.57	0.55
Canada	0.68	0.66	0.64	0.62	0.62	0.61	0.60	0.60	0.60	0.60	0.60	0.59	0.60	0.61	0.61
China	1.47	1.53	1.45	1.44	1.62	1.77	1.64	1.34	1.26	1.37	1.79	1.85	1.86	1.87	1.81
Denmark	0.66	0.65	0.65	0.64	0.64	0.62	0.62	0.62	0.61	0.62	0.62	0.61	0.61	0.62	0.61
France	0.66	0.66	0.66	0.66	0.61	0.56	0.53	0.57	0.56	0.56	0.55	0.52	0.52	0.53	0.53
Germany	0.70	0.66	0.64	0.64	0.63	0.63	0.63	0.65	0.63	0.59	0.59	0.60	0.61	0.61	0.61
Japan	1.22	1.14	1.10	1.15	1.16	1.14	1.13	1.11	1.18	1.11	1.18	1.19	1.19	1.17	1.13
Greece	0.72	0.73	0.70	0.69	0.67	0.68	0.66	0.66	0.66	0.65	0.66	0.66	0.67	0.69	0.70
India	0.93	0.95	0.92	0.94	0.98	1.05	1.08	1.06	1.04	0.96	1.01	0.92	0.94	0.94	0.98
Italy	0.67	0.68	0.69	0.68	0.67	0.66	0.66	0.67	0.66	0.67	0.66	0.65	0.64	0.63	0.64
Mexico	1.12	0.98	0.96	0.92	0.77	0.90	0.88	1.06	0.79	0.72	0.68	0.69	0.74	0.73	0.73
Netherlands	1.29	1.13	1.03	1.01	1.06	1.01	1.01	1.06	1.07	0.88	0.83	0.82	0.82	0.93	0.92
Portugal	0.72	0.68	0.70	0.67	0.65	0.65	0.65	0.60	0.58	0.69	0.67	0.61	0.60	0.60	0.59
United Kingdom	0.61	0.60	0.59	0.59	0.59	0.59	0.58	0.64	0.58	0.67	0.62	0.62	0.64	0.68	0.69
Czech Republic	0.67	0.62	0.55	0.72	0.62	0.57	0.56	0.56	0.58	0.54	0.54	0.52	0.54	0.54	0.55
Romania	0.63	0.63	0.62	0.64	0.66	0.69	0.71	0.82	0.75	0.67	0.63	0.58	0.58	0.63	0.64
Spain	0.73	0.75	0.71	0.67	0.65	0.64	0.63	0.64	0.67	0.62	0.63	0.62	0.61	0.60	0.60
Sweden	1.05	1.14	0.90	0.84	0.87	0.84	0.86	0.85	0.83	0.84	0.80	0.75	0.74	0.74	0.73
Turkey	1.01	0.87	0.76	0.78	0.73	0.82	0.85	0.94	0.99	1.02	1.02	1.04	0.82	0.82	0.82
Usa	1.23	1.16	1.11	1.09	1.08	1.05	1.02	1.02	0.99	1.01	1.01	1.03	1.05	0.86	0.86

Source: our own calculations on WIOD data

Table 15 – Power of dispersion of " ICT Equipment trade activities" (years 2000-2014)

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Australia	1.05	1.05	1.05	1.04	1.05	1.05	1.05	1.05	1.05	1.04	1.04	1.04	1.04	1.05	1.05
Austria	0.94	0.93	0.93	0.92	0.92	0.91	0.89	0.89	0.88	0.89	0.90	0.90	0.90	0.89	0.90
Belgium	1.07	1.05	1.04	1.03	1.01	1.03	1.03	1.02	0.99	0.94	0.98	0.99	0.99	0.99	0.98
Brazil	0.89	0.88	0.89	0.90	0.89	0.89	0.88	0.88	0.87	0.89	0.89	0.89	0.89	0.89	0.90
Bulgaria	1.00	1.07	1.08	1.11	1.08	1.07	1.01	1.09	1.05	1.01	1.05	1.03	1.01	0.96	0.99
Canada	0.93	0.94	0.94	0.93	0.92	0.91	0.91	0.90	0.90	0.89	0.90	0.90	0.90	0.90	0.91
China	1.00	0.96	0.92	0.88	0.85	0.72	0.76	0.80	0.80	0.79	0.79	0.78	0.78	0.77	0.77
Denmark	0.97	0.98	0.98	0.98	0.98	0.99	0.98	0.97	0.96	0.95	0.95	0.95	0.96	0.97	0.96
France	0.97	0.96	0.98	0.97	1.01	1.01	1.01	1.01	0.99	0.98	1.01	1.00	1.01	1.01	1.01
Germany	0.99	0.96	0.93	0.93	0.96	0.94	0.95	0.93	0.92	0.92	0.97	0.96	0.93	0.93	0.94
Japan	0.85	0.85	0.86	0.86	0.84	0.83	0.82	0.81	0.80	0.80	0.79	0.78	0.78	0.80	0.80
Greece	0.94	0.95	0.98	0.96	0.97	1.00	0.98	0.98	0.97	0.98	0.96	0.95	0.95	0.94	0.94
India	0.76	0.75	0.75	0.74	0.74	0.75	0.76	0.76	0.76	0.76	0.75	0.75	0.77	0.77	0.76
Italy	0.98	0.97	0.97	0.97	0.97	0.97	0.97	0.98	0.97	0.98	0.97	0.96	0.96	0.95	0.96
Mexico	0.81	0.82	0.82	0.81	0.81	0.80	0.81	0.80	0.80	0.80	0.81	0.80	0.81	0.80	0.80
Netherlands	0.94	0.96	0.96	0.96	0.96	0.96	0.96	0.95	0.96	0.96	0.95	0.94	0.94	0.93	0.93
Portugal	0.95	0.95	0.94	0.94	0.95	0.94	0.94	0.94	0.93	0.92	0.92	0.88	0.85	0.85	0.85
United Kingdom	1.08	1.06	1.07	1.07	1.05	1.04	1.04	1.03	1.03	0.99	1.01	1.02	1.04	1.04	1.04
Czech Republic	0.96	0.94	0.93	0.95	0.97	0.93	0.93	0.93	0.95	1.00	1.02	1.03	1.02	1.03	1.04
Romania	0.84	0.86	0.87	0.87	0.87	0.87	0.87	0.86	0.82	0.83	1.28	1.31	1.12	1.18	1.15
Spain	0.91	0.90	0.90	0.93	0.94	0.95	0.95	0.95	0.94	0.95	0.95	0.94	0.93	0.92	0.93
Sweden	0.87	0.88	0.88	0.89	0.88	0.89	0.89	0.89	0.90	0.86	0.87	0.89	0.89	0.89	0.89
Turkey	0.90	0.93	0.94	0.94	0.94	0.94	0.95	0.95	0.95	0.94	0.95	0.96	0.96	0.97	0.97
Usa	0.80	0.80	0.83	0.83	0.84	0.83	0.83	0.83	0.83	0.80	0.84	0.85	0.85	0.85	0.85

Source: our own calculations on WIOD data

Table 16 – Sensitivity of dispersion of " ICT Equipment trade activities" (years 2000-2014)

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Australia	2.13	2.17	2.23	2.22	2.17	2.10	2.08	2.10	2.01	2.06	2.04	2.03	2.00	2.01	2.03
Austria	2.38	2.33	2.39	2.31	2.25	2.26	2.26	2.21	2.18	2.21	2.20	2.23	2.17	2.06	1.99
Belgium	2.83	2.83	2.89	2.84	2.85	2.85	2.77	2.81	2.81	2.43	2.06	2.14	2.09	2.03	1.99
Brazil	1.34	1.40	1.46	1.44	1.46	1.47	1.48	1.52	1.54	1.60	1.61	1.65	1.64	1.66	1.64
Bulgaria	2.80	2.72	2.68	2.87	2.72	2.76	2.71	2.60	2.48	2.43	2.43	2.44	2.44	2.60	2.60
Canada	1.68	1.72	1.73	1.71	1.69	1.67	1.69	1.77	1.78	1.71	1.75	1.79	1.78	1.80	1.83
China	2.48	2.34	2.16	1.87	1.59	1.27	1.33	1.42	1.54	1.64	1.71	1.73	1.80	1.86	1.91
Denmark	2.46	2.39	2.50	2.57	2.53	2.57	2.67	2.71	2.72	2.72	2.68	2.74	2.89	3.03	2.95
France	1.75	1.79	1.81	1.88	1.97	1.96	1.94	1.89	1.94	2.26	2.61	2.55	2.58	2.61	2.57
Germany	1.88	1.93	1.89	1.91	1.92	1.90	1.87	1.89	1.96	1.85	1.80	1.84	1.72	1.70	1.68
Japan	2.31	2.37	2.33	2.29	2.33	2.37	2.30	2.28	2.22	1.97	1.92	1.95	1.91	1.95	1.93
Greece	3.88	4.04	4.72	4.84	4.87	4.69	4.61	4.84	4.97	4.88	5.04	4.74	4.56	4.24	4.33
India	1.20	1.26	1.26	1.31	1.33	1.41	1.41	1.41	1.40	1.42	1.46	1.44	1.47	1.55	1.59
Italy	2.75	2.75	2.71	2.71	2.73	2.68	2.69	2.67	2.69	2.65	2.54	2.59	2.58	2.61	2.61
Mexico	1.83	1.75	1.76	1.85	1.85	1.87	1.88	1.89	1.87	1.90	1.92	1.91	1.87	1.93	1.96
Netherlands	2.54	2.52	2.74	2.66	2.69	2.63	2.68	2.74	2.77	2.68	2.61	2.62	2.65	2.55	2.67
Portugal	3.08	3.08	3.08	3.04	2.99	2.95	2.81	2.70	2.63	2.75	2.65	2.69	2.70	2.64	2.61
United Kingdom	2.02	2.11	2.02	2.03	2.02	1.94	1.92	1.91	1.87	1.89	1.81	1.71	1.67	1.59	1.59
Czech Republic	2.42	2.27	2.21	2.26	2.32	2.20	2.30	2.26	2.21	2.20	2.47	2.54	2.47	2.55	2.58
Romania	2.29	2.17	2.02	2.16	2.18	2.35	2.36	2.28	2.43	2.40	2.48	2.38	2.78	2.45	2.49
Spain	1.75	1.79	1.87	1.96	2.03	2.03	2.06	2.15	2.13	2.10	1.99	2.00	2.03	2.08	2.08
Sweden	1.44	1.42	1.46	1.48	1.46	1.48	1.48	1.46	1.54	1.51	1.55	1.57	1.59	1.56	1.59
Turkey	1.84	1.78	1.92	1.98	2.02	2.02	2.06	2.01	2.02	1.89	1.90	2.04	2.09	2.10	2.11
Usa	2.04	1.99	2.03	2.01	2.09	2.11	2.11	2.08	2.12	2.00	2.08	2.16	2.16	2.21	2.23

Source: our own calculations on WIOD data

Table 17 – Power of dispersion of " Retail sale of ICT equipment in special stores" (years 2000-2014)

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Australia	0.96	0.96	0.96	0.95	0.96	0.96	0.97	0.97	0.96	0.94	0.94	0.94	0.94	0.92	0.92
Austria	0.90	0.90	0.90	0.90	0.90	0.90	0.89	0.89	0.87	0.87	0.86	0.87	0.87	0.86	0.87
Belgium	1.04	1.03	1.01	0.97	0.96	0.94	0.92	0.92	0.91	0.86	0.87	0.87	0.86	0.87	0.87
Brazil	0.89	0.88	0.89	0.90	0.89	0.89	0.88	0.88	0.87	0.89	0.89	0.89	0.89	0.89	0.90
Bulgaria	0.83	0.85	0.85	0.83	0.81	0.82	0.83	0.90	0.90	0.78	0.81	0.87	0.90	0.90	0.92
Canada	0.93	0.93	0.92	0.90	0.91	0.90	0.90	0.90	0.89	0.89	0.89	0.89	0.89	0.89	0.90
China	1.00	0.96	0.92	0.88	0.85	0.72	0.76	0.80	0.80	0.79	0.79	0.78	0.78	0.77	0.77
Denmark	0.90	0.90	0.90	0.92	0.91	0.89	0.89	0.88	0.93	0.91	0.92	0.92	0.92	0.94	0.93
France	0.87	0.86	0.87	0.87	0.87	0.88	0.88	0.87	0.86	0.87	0.87	0.87	0.87	0.87	0.87
Germany	0.90	0.91	0.91	0.91	0.92	0.93	0.93	0.93	0.94	0.93	0.95	0.97	0.98	0.97	0.97
Japan	0.84	0.84	0.84	0.84	0.85	0.86	0.84	0.83	0.82	0.81	0.81	0.80	0.80	0.81	0.81
Greece	0.75	0.76	0.80	0.88	0.89	0.89	0.93	0.94	0.93	0.93	0.86	0.85	0.94	0.94	0.93
India	0.75	0.75	0.75	0.74	0.74	0.75	0.76	0.76	0.76	0.76	0.75	0.75	0.77	0.77	0.76
Italy	0.78	0.80	0.81	0.81	0.82	0.82	0.82	0.81	0.82	0.84	0.82	0.81	0.82	0.81	0.82
Mexico	0.80	0.81	0.81	0.80	0.80	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Netherlands	0.89	0.91	0.90	0.90	0.91	0.92	0.92	0.91	0.92	0.92	0.94	0.93	0.94	0.92	0.91
Portugal	0.91	0.91	0.91	0.91	0.91	0.90	0.91	0.90	0.90	0.89	0.89	0.84	0.83	0.83	0.83
United Kingdom	0.88	0.88	0.88	0.90	0.90	0.91	0.91	0.91	0.92	0.93	0.92	0.93	0.92	0.91	0.91
Czech Republic	0.88	0.84	0.87	0.87	0.91	0.89	0.89	0.90	0.90	0.92	0.92	0.95	0.96	0.95	0.96
Romania	0.84	0.86	0.87	0.87	0.87	0.87	0.87	0.84	0.88	0.89	1.11	1.16	1.07	1.16	1.14
Spain	0.78	0.79	0.80	0.81	0.82	0.82	0.81	0.81	0.81	0.81	0.80	0.79	0.79	0.79	0.80
Sweden	0.82	0.83	0.84	0.84	0.86	0.86	0.86	0.87	0.87	0.86	0.87	0.88	0.88	0.87	0.87
Turkey	0.87	0.91	0.92	0.92	0.93	0.92	0.93	0.93	0.93	0.92	0.93	0.94	0.95	0.95	0.95
Usa	0.82	0.81	0.82	0.83	0.86	0.84	0.86	0.86	0.85	0.88	0.88	0.88	0.88	0.89	0.88

Source: our own calculations on WIOD data

Table 18 – Sensitivity of dispersion of "Retail sale of ICT equipment in special stores" (years 2000-2014)

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Australia	0.97	0.99	0.97	0.97	0.96	0.96	0.98	0.98	0.99	1.00	1.02	1.05	1.04	0.99	0.99
Austria	0.85	0.85	0.86	0.84	0.83	0.82	0.80	0.80	0.79	0.80	0.79	0.81	0.79	0.78	0.79
Belgium	1.92	1.97	2.07	1.97	1.92	1.85	1.80	1.82	1.87	1.74	1.36	1.37	1.34	1.35	1.33
Brazil	1.72	1.68	1.60	1.73	1.72	1.76	1.80	1.86	1.88	1.95	1.97	2.02	2.16	2.18	2.15
Bulgaria	2.33	2.22	2.04	2.09	2.02	2.05	2.01	1.77	1.61	1.70	1.93	1.81	1.71	1.67	1.73
Canada	0.97	0.99	1.00	0.99	0.99	1.00	1.00	0.99	1.00	0.94	0.95	0.98	0.98	0.99	0.98
China	0.87	0.84	0.81	0.74	0.68	0.59	0.60	0.62	0.65	0.67	0.69	0.69	0.70	0.71	0.72
Denmark	0.76	0.76	0.77	0.78	0.77	0.77	0.76	0.75	0.76	0.78	0.79	0.79	0.78	0.79	0.78
France	1.23	1.23	1.26	1.29	1.30	1.28	1.26	1.23	1.24	0.99	0.68	0.68	0.67	0.67	0.68
Germany	0.91	0.91	0.92	0.91	0.90	0.90	0.89	0.89	0.88	0.93	0.95	1.05	1.04	1.06	1.07
Japan	0.94	0.95	0.94	0.93	0.91	0.85	0.84	0.87	0.86	0.90	0.90	0.88	0.88	0.89	0.90
Greece	2.24	2.15	1.85	1.77	1.59	1.55	1.47	1.48	1.37	1.40	1.47	1.44	1.38	1.37	1.36
India	1.82	1.85	1.85	1.90	1.92	1.97	1.94	1.92	1.91	1.94	2.00	1.98	2.02	2.15	2.20
Italy	1.65	1.69	1.68	1.68	1.66	1.65	1.62	1.62	1.60	1.27	0.84	0.82	0.85	0.86	0.86
Mexico	1.68	1.62	1.62	1.70	1.71	1.72	1.73	1.73	1.72	1.75	1.77	1.75	1.72	1.77	1.80
Netherlands	1.77	1.72	1.76	1.75	1.74	1.70	1.70	1.69	1.69	1.23	0.73	0.72	0.73	0.72	0.73
Portugal	1.26	1.35	1.40	1.46	1.42	1.28	1.28	1.34	1.30	1.18	1.17	1.18	1.09	1.21	1.23
United Kingdom	1.88	1.95	1.99	2.02	2.04	2.02	2.02	2.04	2.03	1.44	0.62	0.62	0.62	0.62	0.61
Czech Republic	1.31	1.32	1.46	1.39	1.40	1.37	1.40	1.38	1.41	1.52	1.55	1.59	1.61	1.57	1.56
Romania	1.87	1.77	1.66	1.77	1.79	1.92	1.93	1.94	2.03	1.95	2.13	1.82	2.08	1.96	1.91
Spain	1.73	1.74	1.77	1.76	1.78	1.78	1.75	1.74	1.75	1.37	0.90	0.90	0.89	0.90	0.90
Sweden	1.08	1.07	1.09	1.11	1.15	1.15	1.15	1.14	1.14	1.18	1.17	1.16	1.18	1.21	1.22
Turkey	1.49	1.45	1.56	1.59	1.63	1.63	1.66	1.62	1.63	1.53	1.54	1.65	1.69	1.68	1.71
Usa	0.76	0.76	0.77	0.77	0.76	0.75	0.75	0.73	0.73	0.78	0.77	0.76	0.75	0.76	0.75

Source: our own calculations on WIOD data

Table 19 – Power of dispersion of " Software publishing" (years 2000-2014)

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Australia	0.96	0.96	0.96	0.96	0.96	0.97	0.97	0.98	0.96	0.94	0.92	0.91	0.89	0.93	0.93
Austria	1.22	1.20	1.20	1.21	1.18	1.16	1.17	1.17	1.18	1.20	1.19	1.19	1.17	1.16	1.16
Belgium	1.15	1.17	1.16	1.15	1.16	1.11	1.11	1.10	1.06	1.06	1.12	1.12	1.13	1.13	1.13
Brazil	1.08	1.09	1.09	1.09	1.07	1.10	1.07	1.09	1.07	1.09	1.09	1.08	1.08	1.10	1.10
Bulgaria	1.11	1.09	1.11	1.08	1.08	1.04	1.06	1.11	0.94	0.97	0.98	0.95	0.98	0.93	0.96
Canada	1.10	1.09	1.09	1.09	1.09	1.08	1.08	1.07	1.07	1.07	1.06	1.08	1.08	1.07	1.06
China	0.43	0.44	0.45	0.44	0.43	0.41	0.41	0.41	0.41	0.40	0.41	0.40	0.40	0.39	0.39
Denmark	1.16	1.16	1.17	1.16	1.15	1.14	1.14	1.18	1.07	1.05	1.04	1.03	1.05	1.02	1.01
France	1.00	1.00	1.00	0.99	1.00	1.00	0.99	1.00	1.01	1.00	1.00	0.98	0.97	0.97	0.97
Germany	1.07	1.09	1.08	1.07	1.06	1.06	1.06	1.06	1.05	1.07	1.06	1.05	1.04	1.04	1.04
Japan	1.16	1.17	1.18	1.18	1.16	1.17	1.18	1.22	1.21	1.17	1.17	1.18	1.18	1.19	1.19
Greece	1.08	1.12	1.07	1.03	0.97	1.00	1.01	1.05	1.08	1.01	1.05	1.10	1.04	1.03	1.02
India	0.59	0.58	0.59	0.58	0.58	0.59	0.60	0.60	0.60	0.60	0.59	0.59	0.61	0.61	0.61
Italy	1.17	1.15	1.11	1.14	1.14	1.14	1.14	1.13	1.13	1.12	1.08	1.10	1.13	1.13	1.12
Mexico	0.96	0.96	0.97	0.97	0.98	0.97	0.97	0.97	0.96	0.96	0.96	0.96	0.97	0.96	0.97
Netherlands	1.03	1.05	1.02	1.03	1.03	1.06	1.07	1.06	1.05	1.03	1.03	1.04	1.05	1.03	1.03
Portugal	1.17	1.16	1.14	1.14	1.12	1.10	1.09	1.09	1.09	1.08	1.08	1.09	1.09	1.08	1.08
United Kingdom	1.02	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00	0.98	0.98	0.99	0.97	0.96	0.96
Czech Republic	1.16	1.19	1.13	1.13	1.11	1.10	1.09	1.02	1.04	1.06	1.05	1.05	1.02	1.00	0.96
Romania	1.06	1.00	1.01	1.01	1.01	0.97	0.98	1.51	1.44	1.06	1.14	1.26	1.01	0.95	1.00
Spain	1.11	1.11	1.11	1.11	1.12	1.11	1.12	1.13	1.10	1.10	1.09	1.11	1.12	1.12	1.12
Sweden	1.12	1.10	1.09	1.09	1.07	1.08	1.07	1.07	1.05	1.09	1.09	1.09	1.07	1.06	1.06
Turkey	0.55	0.57	0.57	0.58	0.58	0.58	0.59	0.59	0.60	0.59	0.59	0.60	0.60	0.61	0.60
Usa	1.05	1.07	1.00	0.96	0.93	0.90	0.96	0.88	0.89	0.93	0.89	0.88	0.87	0.87	0.87

Source: our own calculations on WIOD data

Table 20 – Sensitivity of dispersion of " Software publishing" (years 2000-2014)

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Australia	0.75	0.74	0.73	0.73	0.73	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.73	0.69	0.68
Austria	0.85	0.90	0.89	0.90	0.88	0.87	0.85	0.84	0.83	0.82	0.83	0.82	0.82	0.82	0.81
Belgium	0.79	0.79	0.78	0.79	0.78	0.74	0.74	0.74	0.71	0.70	0.75	0.73	0.70	0.70	0.70
Brazil	0.69	0.67	0.67	0.68	0.68	0.66	0.66	0.66	0.66	0.67	0.67	0.66	0.65	0.64	0.64
Bulgaria	0.61	0.62	0.62	0.63	0.63	0.64	0.66	0.67	0.62	0.61	0.58	0.59	0.58	0.58	0.56
Canada	0.69	0.69	0.70	0.69	0.69	0.69	0.70	0.69	0.69	0.68	0.68	0.67	0.66	0.66	0.66
China	0.43	0.44	0.45	0.44	0.43	0.41	0.41	0.41	0.41	0.40	0.41	0.40	0.40	0.39	0.39
Denmark	1.36	1.34	1.33	1.34	1.28	1.28	1.24	1.30	1.18	1.13	1.13	1.11	1.06	1.05	1.09
France	0.69	0.69	0.69	0.68	0.69	0.68	0.68	0.67	0.67	0.66	0.63	0.62	0.61	0.61	0.61
Germany	0.79	0.78	0.75	0.74	0.74	0.74	0.73	0.75	0.75	0.75	0.78	0.80	0.79	0.78	0.78
Japan	0.85	0.85	0.84	0.84	0.84	0.83	0.82	0.81	0.79	0.80	0.79	0.78	0.79	0.80	0.80
Greece	0.67	0.67	0.67	0.69	0.71	0.70	0.70	0.70	0.68	0.69	0.69	0.67	0.65	0.66	0.66
India	0.59	0.58	0.59	0.58	0.58	0.59	0.60	0.60	0.60	0.60	0.59	0.59	0.61	0.61	0.61
Italy	0.67	0.67	0.67	0.66	0.66	0.66	0.65	0.64	0.63	0.63	0.62	0.60	0.58	0.58	0.58
Mexico	0.71	0.71	0.71	0.71	0.71	0.69	0.70	0.69	0.69	0.69	0.69	0.69	0.69	0.68	0.68
Netherlands	0.87	0.87	0.84	0.84	0.84	0.86	0.86	0.86	0.84	0.84	0.86	0.84	0.84	0.82	0.82
Portugal	0.66	0.65	0.64	0.65	0.65	0.64	0.65	0.64	0.63	0.64	0.64	0.62	0.60	0.60	0.60
United Kingdom	0.93	0.90	0.89	0.87	0.85	0.84	0.81	0.79	0.78	0.78	0.82	0.81	0.80	0.78	0.75
Czech Republic	0.67	0.70	0.66	0.59	0.63	0.68	0.65	0.60	0.58	0.60	0.57	0.57	0.56	0.56	0.55
Romania	0.65	0.65	0.66	0.65	0.66	0.67	0.66	0.61	0.61	0.64	0.65	0.62	0.60	0.62	0.64
Spain	0.89	0.86	0.87	0.85	0.84	0.84	0.82	0.80	0.77	0.80	0.80	0.80	0.76	0.73	0.72
Sweden	1.08	1.06	1.04	1.04	1.03	1.03	1.00	0.98	0.98	1.01	1.01	0.99	1.00	0.99	0.98
Turkey	0.55	0.57	0.57	0.58	0.58	0.58	0.59	0.59	0.60	0.59	0.59	0.60	0.60	0.61	0.60
Usa	0.82	0.84	0.84	0.80	0.78	0.76	0.75	0.75	0.74	0.77	0.77	0.76	0.76	0.77	0.79

Source: our own calculations on WIOD data

Table 21 – Power of dispersion of " Telecommunications" (years 2000-2014)

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Australia	1.02	1.02	1.02	1.02	1.02	1.03	1.03	1.03	1.05	1.06	1.08	1.11	1.13	1.13	1.13
Austria	1.21	1.12	1.04	1.03	1.13	1.11	1.08	1.09	1.07	1.08	1.07	1.08	1.10	1.09	1.08
Belgium	0.93	0.98	0.94	0.97	0.95	0.94	0.95	0.94	0.93	1.02	1.03	1.01	1.03	1.07	1.06
Brazil	1.02	1.07	1.03	1.03	1.02	1.00	1.01	1.01	1.01	1.06	1.07	1.11	1.08	1.10	1.11
Bulgaria	0.81	0.80	0.81	0.83	0.79	0.84	0.83	0.84	0.69	0.86	0.86	0.88	0.92	0.91	0.88
Canada	0.89	0.89	0.89	0.88	0.88	0.87	0.87	0.87	0.87	0.86	0.85	0.86	0.86	0.86	0.86
China	0.77	0.80	0.82	0.82	0.84	0.95	0.87	0.78	0.78	0.78	0.79	0.79	0.78	0.77	0.77
Denmark	1.06	1.20	1.19	1.12	1.15	1.15	1.15	1.10	1.09	1.08	1.14	1.09	1.08	1.08	1.13
France	0.95	0.98	0.92	0.93	0.91	0.94	0.93	0.94	0.96	0.97	1.01	1.03	1.06	1.06	1.06
Germany	0.91	0.93	0.91	1.03	0.98	1.05	1.00	1.04	1.06	1.12	1.13	1.11	1.08	1.09	1.09
Japan	0.97	0.98	0.98	0.97	0.97	0.97	0.96	0.95	0.88	0.86	0.86	0.87	0.88	0.88	0.89
Greece	0.91	0.92	0.94	0.97	0.97	0.97	0.96	0.96	0.93	0.93	0.90	0.93	0.94	0.94	0.92
India	0.75	0.76	0.77	0.79	0.79	0.81	0.84	0.85	0.86	0.83	0.84	0.82	0.83	0.77	0.77
Italy	0.93	0.92	0.89	0.89	0.89	0.90	0.90	0.91	0.90	0.93	0.92	0.92	0.94	0.96	0.96
Mexico	0.87	0.87	0.89	0.88	0.86	0.85	0.84	0.84	0.83	0.84	0.83	0.84	0.87	0.87	0.87
Netherlands	1.08	1.11	1.06	1.02	1.02	1.01	1.01	1.00	1.00	0.98	0.95	0.94	0.96	0.88	0.90
Portugal	1.01	1.05	1.03	1.03	1.02	1.00	1.00	0.99	0.99	1.04	1.06	0.98	1.00	1.02	1.02
United Kingdom	0.89	0.91	0.91	0.91	0.92	0.94	0.95	0.92	0.90	0.90	0.92	0.92	0.92	0.92	0.92
Czech Republic	0.89	0.87	0.86	0.85	0.86	0.87	0.84	0.81	0.84	0.84	0.82	0.81	0.85	0.86	0.88
Romania	0.80	0.83	0.82	0.81	0.81	0.81	0.81	0.81	0.82	0.82	0.94	0.93	0.98	0.89	0.92
Spain	0.93	0.94	0.94	0.93	0.93	0.95	0.92	0.92	0.92	0.94	0.94	0.95	0.94	0.93	0.93
Sweden	1.12	1.15	1.16	1.16	1.17	1.20	1.20	1.22	1.22	1.20	1.18	1.18	1.19	1.19	1.18
Turkey	0.98	0.99	1.00	1.00	1.00	1.01	1.02	1.02	1.04	1.02	1.03	1.04	1.02	1.03	1.02
Usa	1.02	1.04	1.04	1.03	0.99	0.96	0.97	0.92	0.90	0.97	0.98	1.00	1.02	0.98	0.99

Source: our own calculations on WIOD data

Table 22 – Sensitivity of dispersion of " Telecommunications" (years 2000-2014)

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Australia	1.15	1.14	1.12	1.12	1.11	1.08	1.08	1.08	1.14	1.21	1.23	1.27	1.30	1.32	1.31
Austria	1.34	1.32	1.22	1.23	1.29	1.25	1.17	1.17	1.14	1.14	1.13	1.09	1.06	1.02	1.01
Belgium	1.01	1.09	1.11	1.16	1.16	1.13	1.12	1.07	1.04	1.22	1.21	1.12	1.14	1.17	1.14
Brazil	1.03	1.10	1.11	1.09	1.11	1.07	1.06	1.06	1.07	1.08	1.11	1.09	1.05	1.02	1.02
Bulgaria	0.92	0.97	1.06	1.09	1.10	0.96	0.93	0.92	1.03	1.19	1.16	1.12	1.08	1.13	1.05
Canada	1.30	1.31	1.31	1.29	1.29	1.28	1.28	1.27	1.27	1.21	1.20	1.20	1.20	1.20	1.22
China	0.75	0.80	0.86	0.88	0.92	0.99	0.91	0.83	0.81	0.78	0.74	0.73	0.75	0.74	0.76
Denmark	1.40	1.54	1.52	1.52	1.54	1.52	1.49	1.35	1.30	1.33	1.29	1.30	1.21	1.18	1.19
France	1.14	1.21	1.22	1.23	1.22	1.25	1.21	1.20	1.22	1.22	1.20	1.20	1.22	1.18	1.16
Germany	1.09	1.15	1.20	1.26	1.25	1.26	1.23	1.25	1.26	1.34	1.28	1.21	1.14	1.12	1.13
Japan	1.17	1.18	1.17	1.14	1.09	1.02	1.00	0.98	0.95	0.98	0.99	1.01	1.01	1.02	1.03
Greece	1.22	1.26	1.27	1.19	1.16	1.21	1.24	1.26	1.19	1.22	1.25	1.22	1.18	1.17	1.16
India	1.02	1.08	1.04	1.10	1.13	1.12	1.07	1.05	1.01	1.04	0.93	0.92	0.92	0.92	0.92
Italy	1.09	1.17	1.22	1.20	1.21	1.22	1.19	1.17	1.13	1.12	1.00	0.97	0.99	0.95	0.92
Mexico	1.24	1.27	1.19	1.20	1.21	1.17	1.27	1.31	1.31	1.40	1.30	1.23	1.21	1.22	1.20
Netherlands	1.08	1.13	1.13	1.14	1.13	1.11	1.09	1.08	1.04	1.04	1.10	1.08	1.07	1.03	1.03
Portugal	1.27	1.37	1.34	1.33	1.34	1.30	1.27	1.23	1.23	1.26	1.24	1.12	1.14	1.11	1.09
United Kingdom	1.18	1.17	1.18	1.18	1.17	1.16	1.14	1.12	1.11	1.11	1.11	1.10	1.10	1.11	1.07
Czech Republic	1.33	1.29	1.32	1.29	1.30	1.29	1.26	1.21	1.18	1.18	1.12	1.04	1.02	0.99	0.97
Romania	1.21	1.23	1.17	1.19	1.20	1.06	1.02	1.00	1.00	1.05	1.04	0.96	0.91	0.89	0.90
Spain	1.25	1.25	1.27	1.28	1.31	1.33	1.28	1.28	1.27	1.28	1.21	1.20	1.18	1.15	1.14
Sweden	1.16	1.18	1.23	1.22	1.17	1.17	1.17	1.16	1.15	1.18	1.17	1.15	1.18	1.16	1.15
Turkey	1.05	1.14	1.24	1.21	1.22	1.28	1.26	1.26	1.28	1.26	1.22	1.18	1.21	1.19	1.18
Usa	1.34	1.34	1.30	1.24	1.18	1.14	1.10	1.07	1.06	1.11	1.09	1.07	1.05	1.07	1.07

Source: our own calculations on WIOD data

Table 23 – Power of dispersion of "Computer programming, consultancy and related activities" (years 2000-2014)

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Australia	0.96	0.96	0.96	0.96	0.96	0.97	0.97	0.97	0.97	0.97	0.97	0.98	0.98	0.99	0.99
Austria	1.02	1.03	0.99	1.00	1.01	0.98	0.97	0.97	0.94	0.96	0.96	0.95	0.95	0.93	0.93
Belgium	1.01	0.97	0.96	0.96	0.97	0.95	0.96	0.95	0.93	1.02	1.02	1.00	0.97	0.98	0.97
Brazil	0.82	0.84	0.82	0.81	0.81	0.80	0.80	0.82	0.81	0.84	0.85	0.84	0.84	0.83	0.84
Bulgaria	0.98	0.91	0.93	0.88	0.89	0.88	0.89	0.87	0.79	0.89	0.84	0.84	0.84	0.81	0.86
Canada	0.98	0.97	0.97	0.95	0.95	0.94	0.94	0.93	0.93	0.93	0.92	0.92	0.91	0.92	0.92
China	1.24	1.25	1.25	1.21	1.19	1.23	1.14	1.03	1.02	1.02	1.03	1.04	1.04	1.03	1.03
Denmark	1.12	1.08	1.12	1.07	1.07	1.11	1.08	1.07	1.05	0.99	1.00	1.02	1.02	1.02	1.03
France	0.79	0.82	0.80	0.80	0.80	0.81	0.81	0.80	0.81	0.81	0.83	0.84	0.84	0.83	0.84
Germany	0.87	0.88	0.85	0.87	0.86	0.88	0.87	0.86	0.90	0.90	0.92	0.90	0.91	0.87	0.86
Japan	0.91	0.91	0.92	0.94	0.95	0.94	0.93	0.92	0.88	0.89	0.89	0.87	0.88	0.88	0.89
Greece	0.83	0.82	0.92	0.92	0.91	0.90	0.89	0.94	0.94	0.93	0.94	0.90	0.90	0.90	0.89
India	0.84	0.83	0.83	0.82	0.81	0.80	0.81	0.80	0.80	0.81	0.80	0.80	0.82	0.77	0.76
Italy	0.95	0.95	0.94	0.93	0.94	0.94	0.94	0.93	0.92	0.93	0.90	0.89	0.88	0.88	0.88
Mexico	0.86	0.86	0.88	0.87	0.88	0.86	0.86	0.86	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Netherlands	0.96	0.96	0.95	0.94	0.94	0.95	0.95	0.94	0.94	0.94	0.95	0.96	0.96	0.94	0.93
Portugal	1.04	1.02	1.01	1.02	1.01	0.99	0.97	0.95	0.94	0.96	0.95	0.93	0.93	0.93	0.93
United Kingdom	0.90	0.90	0.90	0.90	0.86	0.86	0.86	0.86	0.85	0.85	0.86	0.84	0.85	0.84	0.84
Czech Republic	0.87	0.90	0.88	0.86	0.91	0.87	0.86	0.87	0.85	0.88	0.89	0.87	0.87	0.86	0.86
Romania	0.68	0.77	0.79	0.83	0.83	0.84	0.84	0.71	0.68	0.73	0.79	0.80	0.84	0.89	0.89
Spain	0.83	0.82	0.80	0.79	0.80	0.80	0.83	0.86	0.85	0.85	0.88	0.90	0.89	0.89	0.89
Sweden	0.98	0.95	0.91	0.92	0.93	0.93	0.92	0.93	0.91	0.90	0.92	0.94	0.94	0.92	0.92
Turkey	0.88	0.88	0.89	0.89	0.90	0.90	0.91	0.91	0.93	0.91	0.92	0.92	0.91	0.92	0.91
Usa	1.00	0.94	0.90	0.87	0.83	0.83	0.82	0.87	0.87	0.91	0.92	0.91	0.92	0.91	0.90

Source: our own calculations on WIOD data

Table 24 – Sensitivity of dispersion of "Computer programming, consultancy and related activities" (years 2000-2014)

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Australia	1.14	1.11	1.09	1.08	1.07	1.03	1.03	1.02	1.06	1.13	1.15	1.17	1.20	1.21	1.20
Austria	0.98	1.02	1.05	1.01	1.03	1.01	1.00	0.99	0.96	0.98	0.97	0.97	0.95	0.95	0.94
Belgium	1.01	1.07	1.06	1.02	1.00	0.95	0.99	1.02	1.03	1.19	1.17	1.17	1.12	1.10	1.09
Brazil	0.91	0.95	0.96	0.93	0.94	0.90	0.89	0.88	0.88	0.90	0.91	0.91	0.90	0.92	0.94
Bulgaria	0.72	0.70	0.71	0.71	0.73	0.77	0.79	0.82	0.84	0.97	0.98	0.96	1.02	1.04	1.03
Canada	1.09	1.10	1.10	1.07	1.05	1.02	1.01	0.97	0.97	0.96	0.94	0.96	0.95	0.95	0.98
China	0.58	0.60	0.64	0.61	0.58	0.55	0.51	0.49	0.47	0.46	0.46	0.47	0.46	0.46	0.47
Denmark	1.32	1.33	1.44	1.33	1.37	1.36	1.35	1.42	1.42	1.56	1.53	1.53	1.49	1.41	1.38
France	1.15	1.20	1.18	1.15	1.15	1.16	1.18	1.17	1.20	1.10	0.98	0.99	0.98	0.98	0.99
Germany	1.06	1.14	1.12	1.12	1.11	1.16	1.15	1.19	1.23	1.31	1.34	1.38	1.42	1.44	1.40
Japan	0.93	1.00	1.04	1.04	1.05	1.04	1.04	1.06	1.07	1.08	1.07	1.04	1.04	1.06	1.04
Greece	0.68	0.68	0.67	0.67	0.69	0.70	0.71	0.68	0.68	0.68	0.70	0.71	0.73	0.73	0.74
India	0.77	0.77	0.78	0.80	0.81	0.79	0.74	0.64	0.73	0.80	0.68	0.75	0.81	0.88	0.94
Italy	1.10	1.14	1.20	1.16	1.15	1.13	1.12	1.12	1.11	1.22	1.19	1.20	1.12	1.14	1.14
Mexico	0.65	0.65	0.65	0.65	0.66	0.65	0.65	0.65	0.64	0.64	0.65	0.65	0.65	0.64	0.65
Netherlands	1.02	1.07	1.01	1.00	1.03	1.07	1.08	1.11	1.12	1.16	1.23	1.24	1.25	1.23	1.22
Portugal	0.85	0.85	0.88	0.90	0.90	0.91	0.92	0.90	0.90	0.97	0.98	0.94	0.99	1.00	0.97
United Kingdom	1.28	1.32	1.36	1.40	1.41	1.37	1.35	1.36	1.39	1.41	1.41	1.44	1.43	1.38	1.40
Czech Republic	0.73	0.75	0.77	0.77	0.80	0.87	0.91	0.99	0.99	1.08	1.12	1.16	1.15	1.16	1.12
Romania	0.80	0.82	0.82	0.80	0.78	0.77	0.79	0.92	0.91	0.85	1.06	1.04	1.02	1.14	1.16
Spain	0.74	0.77	0.79	0.78	0.78	0.77	0.78	0.80	0.80	0.83	0.80	0.83	0.86	0.85	0.82
Sweden	1.20	1.25	1.16	1.16	1.22	1.22	1.16	1.15	1.13	1.17	1.23	1.26	1.20	1.17	1.13
Turkey	0.66	0.68	0.70	0.70	0.71	0.71	0.71	0.72	0.72	0.71	0.71	0.71	0.71	0.72	0.71
Usa	0.93	0.92	0.91	0.90	0.88	0.87	0.89	0.91	0.93	0.97	0.97	0.99	1.02	1.06	1.08

Source: our own calculations on WIOD data

Table 25 – Power of dispersion of "Other services activities" (years 2000-2014)

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Australia	1.11	1.11	1.11	1.11	1.11	1.11	1.12	1.12	1.12	1.12	1.12	1.13	1.13	1.13	1.13
Austria	0.90	0.89	0.88	0.88	0.87	0.86	0.86	0.86	0.85	0.84	0.84	0.83	0.83	0.83	0.84
Belgium	0.95	0.94	0.94	0.96	0.96	0.96	0.96	0.96	0.95	0.99	0.99	0.97	0.98	1.00	1.01
Brazil	1.06	1.07	1.07	1.05	1.06	1.04	1.03	1.02	1.03	1.04	1.04	1.04	1.02	1.01	1.01
Bulgaria	0.86	0.86	0.90	0.93	0.92	0.91	1.01	1.02	0.91	0.89	0.92	0.92	0.88	0.96	1.06
Canada	1.02	1.01	1.00	0.99	0.99	1.00	0.99	0.98	0.98	0.98	0.98	0.99	0.99	0.99	0.98
China	1.13	1.07	1.02	1.01	1.00	0.98	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.98	0.98
Denmark	0.88	0.88	0.88	0.90	0.90	0.89	0.88	0.88	0.87	0.86	0.87	0.86	0.87	0.87	0.86
France	0.87	0.88	0.87	0.87	0.87	0.87	0.87	0.87	0.86	0.86	0.84	0.84	0.84	0.83	0.83
Germany	0.83	0.83	0.82	0.82	0.81	0.80	0.80	0.80	0.79	0.80	0.81	0.80	0.81	0.81	0.81
Japan	0.86	0.87	0.86	0.85	0.87	0.86	0.84	0.83	0.82	0.82	0.83	0.82	0.82	0.82	0.82
Greece	0.98	0.98	0.97	1.00	0.99	0.97	0.96	0.96	0.96	0.95	0.98	1.02	0.99	0.99	0.98
India	0.84	0.82	0.80	0.78	0.78	0.78	0.80	0.78	0.76	0.76	0.74	0.74	0.78	0.78	0.79
Italy	0.92	0.93	0.94	0.94	0.94	0.93	0.93	0.93	0.92	0.93	0.92	0.91	0.92	0.93	0.95
Mexico	0.85	0.85	0.85	0.84	0.84	0.83	0.84	0.83	0.84	0.84	0.85	0.85	0.86	0.84	0.85
Netherlands	1.00	1.02	1.01	1.01	1.01	1.01	1.02	1.01	1.01	0.99	0.97	0.96	0.95	0.96	0.95
Portugal	1.01	1.02	0.99	0.97	0.98	0.97	0.97	0.98	0.96	0.97	0.96	0.93	0.92	0.92	0.93
United Kingdom	0.92	0.92	0.93	0.92	0.90	0.91	0.91	0.90	0.90	0.86	0.84	0.85	0.84	0.84	0.84
Czech Republic	0.94	0.94	0.92	0.90	0.94	0.94	0.93	0.92	0.95	0.95	0.94	0.93	0.93	0.94	0.95
Romania	0.97	1.05	1.04	1.02	1.03	1.04	1.05	1.02	1.03	1.08	0.94	0.88	0.89	0.89	0.92
Spain	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.88	0.88	0.88	0.86	0.86	0.85	0.84	0.83
Sweden	0.94	0.93	0.93	0.94	0.93	0.93	0.93	0.93	0.92	0.93	0.93	0.94	0.93	0.93	0.93
Turkey	0.99	1.01	1.02	1.02	1.03	1.03	1.04	1.03	1.04	1.03	1.03	1.04	1.04	1.05	1.05
Usa	0.85	0.90	0.89	0.91	0.91	0.89	0.90	0.90	0.91	0.94	0.92	0.92	0.92	0.92	0.92

Source: our own calculations on WIOD data

Table 26 – Sensitivity of dispersion of "Other services activities" (years 2000-2014)

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Australia	1.05	1.05	1.05	1.05	1.04	1.03	1.01	1.01	1.02	1.04	1.03	1.06	1.06	1.08	1.11
Austria	0.79	0.79	0.79	0.79	0.79	0.78	0.77	0.77	0.76	0.78	0.79	0.78	0.78	0.78	0.79
Belgium	0.93	0.92	0.95	0.95	0.97	0.96	0.94	0.95	0.96	1.01	0.96	0.94	0.96	0.98	1.00
Brazil	0.83	0.83	0.82	0.80	0.80	0.82	0.81	0.81	0.80	0.83	0.82	0.81	0.81	0.81	0.81
Bulgaria	0.99	0.87	0.89	0.94	0.94	0.95	1.05	1.04	1.05	1.10	1.07	1.02	0.96	1.08	1.30
Canada	0.97	0.98	1.00	0.99	1.00	1.00	0.99	1.00	1.00	0.95	0.94	0.94	0.93	0.94	0.95
China	0.95	0.97	0.91	0.98	0.91	0.99	0.97	0.92	0.91	0.94	0.90	0.88	0.89	0.88	0.92
Denmark	0.93	0.94	0.92	0.95	0.96	0.95	0.94	0.93	0.91	0.94	0.91	0.90	0.89	0.90	0.89
France	0.82	0.82	0.83	0.83	0.84	0.84	0.84	0.83	0.83	0.84	0.85	0.83	0.82	0.81	0.82
Germany	1.06	1.05	1.05	1.05	1.05	1.05	1.06	1.06	1.06	1.04	1.01	0.99	0.98	0.98	0.98
Japan	0.81	0.81	0.82	0.82	0.82	0.80	0.78	0.77	0.77	0.79	0.77	0.77	0.77	0.78	0.79
Greece	1.01	1.02	1.03	1.03	1.04	1.08	1.09	1.10	1.09	1.08	1.03	1.05	1.03	1.05	1.07
India	0.98	0.97	0.95	0.94	0.95	0.95	0.87	0.91	0.87	0.92	0.91	0.88	0.88	0.87	0.88
Italy	0.95	0.95	0.96	0.95	0.95	0.94	0.93	0.94	0.94	0.94	0.92	0.91	0.92	0.93	0.95
Mexico	0.78	0.78	0.78	0.78	0.77	0.75	0.76	0.75	0.74	0.76	0.75	0.74	0.74	0.74	0.74
Netherlands	0.99	1.01	1.00	1.01	1.03	1.03	1.02	1.02	1.03	1.04	1.06	1.06	1.06	1.06	1.07
Portugal	0.82	0.81	0.80	0.80	0.81	0.80	0.80	0.81	0.81	0.82	0.82	0.79	0.78	0.79	0.80
United Kingdom	0.97	0.98	1.00	1.00	0.98	0.99	0.99	0.99	1.00	0.96	0.93	0.94	0.94	0.95	0.96
Czech Republic	0.81	0.80	0.81	0.79	0.82	0.81	0.81	0.78	0.78	0.79	0.79	0.81	0.82	0.82	0.83
Romania	1.01	0.98	0.95	0.96	0.95	1.01	1.08	1.09	1.07	1.02	0.80	0.81	0.83	0.86	0.87
Spain	0.81	0.81	0.81	0.82	0.83	0.82	0.80	0.80	0.82	0.86	0.88	0.91	0.91	0.91	0.92
Sweden	0.91	0.92	0.92	0.93	0.94	0.94	0.95	0.96	0.96	1.02	1.06	1.06	1.07	1.08	1.09
Turkey	0.80	0.84	0.88	0.91	0.88	0.86	0.88	0.87	0.87	0.84	0.85	0.87	0.86	0.85	0.87
Usa	0.96	0.97	0.97	0.96	0.93	0.88	0.89	0.88	0.86	0.92	0.89	0.88	0.90	0.90	0.91

Source: our own calculations on WIOD data

2 ELECTRONIC HEALTH RECORD IN ITALY'S HEALTHCARE SYSTEM: ECONOMIC PROFILES

2.1 Introduction

The e-health, the application of ICT in all healthcare functions, is playing an important role in the changes of all national healthcare systems and can improve the access to healthcare and increase the quality and effectiveness of the offered healthcare services (EC, 2004).

The Italian National Healthcare System, placed in the 21st position of the Euro Health Consumer Index (EHCI)[6], represents on one side a poverty index that the evolved society reached and on the other side a productive process, which is able to produce income driving the economic growth of specific geographic areas.

In 2013, the Gross Domestic Product to current price in Italy amounted at about 1,483,639 million euros[7] with the total healthcare expenditure in relationship to GDP equal to about 8% and the share of the public healthcare expenditure relative to total healthcare expenditure at around 75%.

The economic cost that a healthcare system must support to offer high quality in the delivery of the healthcare services is growing more and more, the reasons can be found mainly in ageing population and in new drugs development (EC, 2006). Firstly, ageing population and life expectancy increase are central to confirm the growth trend of the healthcare expenditure. Women's life expectancy, as it is well known, is greater than men's life expectancy; in 2013, the Italian average age is around 80 years for men and 85 years for women[8]. Secondly, what appears to considerably influence the dynamic of the healthcare expenditure is new drugs development and new technologies, which not only help to extend life, but can manage chronic diseases as well and impact of quality of life (McDaid, 2003).

OECD data reports lower ICT investment rates in Italy than in other countries of the European Union from 2000 to 2010; in 2010 the percentage is around 11% while in 2000 it was about 15%[9]. The citizens are using only few digital services in healthcare sector.

6 The Italy healthcare system, on the basis of the last available statistics, is positioning between Slovakia and Ireland and it is one of a few countries that have not registered an improvement in the index performance. Range 648 points on 1000 - Euro Health Consumer Index 2014 in http://www.healthpowerhouse.com/files/EHCI_2014/EHCI_2014_report.pdf

7 http://dati.istat.it

8 Data source Health for all - Italia, https://www.istat.it/it/archivio/14562

9 OECD https://data.oecd.org/ict/ict-investment.htm#indicator-chart

The effectiveness of those policies connected to innovation is tightly tied with the capacity of the whole productive system to have the necessary capitals to accept and apply that innovation; as to the patients their culture and sensitivity can give value to those important changes allowing a large cooperation in the launch and introduction of new digital technologicals.

In 2014, after years characterized by a linear cutting of the ICT expenditure, finally all the actors of the healthcare system saw an increase of the budget dedicated to digital innovation[10].

The proposed analysis intends to investigate how an introduction of the ICT[11] (Hochstadt and Keyt, 2009) and in particular of the Electronic Health Record (EHR), being one the pillars in the European and Italian Digital Agenda might determine changes in the production of healthcare services. The realization and the use of the EHR might significantly change the daily management of the productive process freeing resources previously invested in labour and in infrastructures to be later allocated in other productive activities with a consequent contribute improvement the primary factors. The EHR implemented in a small clinic did not change the amount of time spent by physicians with patients but the work of clinical and office staff changed significantly, and included decreases in time spent distributing charts, transcription and other clerical tasks (Caryon *et al.*, 2009).

A particular attention will be dedicated to the eventual structural changes in the absorption processes and in the healthcare services supply, which could take place within the productive processes.

We will use the multisectoral model highlighting the healthcare productive aspect in disaggregated terms (Ciaschini *et al*., 2007). The analysis will be focused on the symmetrical Input-Output table commodity by commodity in accordance with the classification CPA (Classification of Products by Activity) 2008 considering the product "Human health services" disaggregated in local health authorities, hospital services and other health services. We will analyse the Italian symmetrical Input-Output table in two different times, before and after introduction of EHR. The changes in the total output between the initial and final input-output table will be explored through the Structural Decomposition Analysis (SDA) in order to identify the technological or final–demand changes.

[10] http://www.digital4.biz/executive/approfondimenti/innovazione-digitale-in-sanita-segnali-positivi_43672155415.htm

[11] ICT investment is defined as the acquisition of equipment and computer software that is used in production for more than one year. ICT has three components: information technology equipment (computers and related hardware), communications equipment and software. Software includes acquisition of pre-packaged software, customised software and software developed in-house. This indicator is measured as a percentage of total non-residential gross fixed capital formation.

2.2 European and national strategy for e-health

The ICT use within the production and the delivery of the healthcare services assumes a strategic role from a dual viewpoint. Firstly, the effectiveness of the healthcare services, in particular those connected to the care of the person, is more and more related to the introduction of the process and product innovation. The effectiveness of the services delivered in the healthcare section could be connected with the ICT within the productive process in particular other factors of the production, intermediate goods and labour. The process and product innovation can contribute to the change of the effectiveness of the delivered services in terms of prevention and distribution timing of disease care. The typical examples can be highlighted just from the access phase to the healthcare, which is the relationship between the general practitioner and the patient then to then pass to the services with high ICT content, which can be specialized services delivered by complex structures, as well as delivered from hospital units and hospitals. Secondly the introduction of process and product innovations could produce both direct and indirect results of efficiency mainly in terms of the control of the costs in relationship with delivered services. In this way the absorption capacity of some types of goods and services are changing and are improving the productivity of some primary product factors such as labour and capital stock. The relevant examples are the timing for the production of a basic and specialized service. In particular, the innovations when well integrated could induce a decrease of the necessary time to deliver services and free resources in terms of labour and capital. They could be allocated in other activities to produce an improvement of productivity of the primary factors.

Actually the introduction of ICT might produce an attenuation of the dynamic of the production costs, with a possible decrease of the production costs without any contraction of the healthcare services delivered. That process requires the introduction of new technologies, which can improve the relationships between the expenditure core and the supply of the intermediate goods. The expenditure core defined as supply centre of the healthcare service can be in relationship with the delivery of labour and capital and with the expenditure core and the patients.

The focus will be on the economic efficiency connected to the introduction of the ICT; the main aspect is the sharing of the clinical data on the single patient through the introduction of the EHR. The last aspect represents at the same time a process and product innovation in terms of ICT and the impact in terms of economic costs could be quite significant. The positive effect of the ICT

introduction in the healthcare sectors is intensely connected with the capacity of the professionals.

The ICT policies, which aimed to reconstruct the "clinical history" of the patient, were analysed by national legislators through the introduction of the e-health.

Even the European Commission with the digital agenda[12] 2020 invests on the online healthcare, which will necessarily maintain healthcare assistance at accessible prices for every European patients ageing (EC, 2010).

The first action plan for electronic health[13] was adopted in 2004. Since then, the European Commission developed policy ventures aimed to disseminate a large application of the electronic health in all Europe[14] improving the quality of the medical assistance, decreasing the costs and favouring the autonomy of people living in isolated places. E-health covers the interaction between patients and health-service providers, institution-to-institution transmission of data, or peer-to-peer communication between patients and/or health professionals" [15] and permits obtaining consistent productivity increases and allowing in future the realization the healthcare systems focused on the citizen.

Some significant developments of e-health are healthcare network, EHR, telemedicine services, monitoring systems wearable, health portal and mobile health[16]. Actually about four in five European doctors have an Internet access and one fourth of European citizens use the network to access to the healthcare information. In 2014 only 13% of the citizens used the online services booking, 8% made one access to their clinical documents (for example medical report) and 5% made an online payment, though more than 20% of the population seems to be interested in these services[17]. A 2013 OECD survey detect that most countries had a national plan or policy to implement EHRs (22 of 25 countries) in 2011-12, and the majority had already begun to implement that plan (20 countries) (OECD, 2015). Figure **3** shows the results of the survey for the introduction of the EHRs within their national plan, in particular: 18 countries use the EHRs for

[12] Communication from the Commission, "A digital agenda for Europe". COM(2010)245 Final – 19.5.2010: European digital agenda identifies the fundamental actions based on the necessity to take on systematic way those seven difficult areas and it is a horizontal initiative that covers all three-growth dimensions of EU 2020. Furthermore it requests a high and continuous commitment both European Union and of the member states as the regional level. Its seven pillars are: a vibrant digital single market, interoperability and standards, trust and security, fast and ultra fast internet access, research and innovation, enhancing digital informatics literacy, skills and inclusion and ICT-enabled benefits for EU society.

[13] http://ec.europa.eu/information_society/activities/health/policy/ehtask_force/index_en.htm

[14] European Commission, e-Health - making healthcare better for European citizens: An action plan for a European e-Health Area, Brussels, 30.4.2004, Com(2004) 356 final

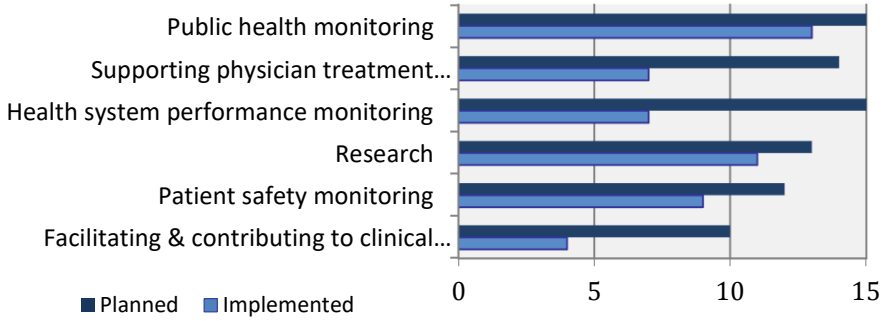
[15] European Commission, eHealth Action Plan 2012-2020 – Innovative healthcare for 21st century, Brussels, 6.12.2012, Com(2012) 736 final (page 3) "e-health is the use of ICT in health products, services and processes combined with organisational change in healthcare systems and new skills"

[16] Green paper on mobile health (mhealth), European commission, 10.4.2014, 219, final. "Mobile health covers medical and public health practice supported by mobile devices, such as, mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices".

[17] http://www.digital4.biz/executive/approfondimenti/sanita-digitale-in-italia-ripartono-gli-investimenti-17_43672155215.htm

public health and health system performance monitoring; 14 for supporting physicians treatment decisions and research; 13 for patient safety monitoring and 10 countries for facilitating or contributing to clinical trials.

Figure 3 - Planned and implemented uses of data from electronic health record systems - Note: Twenty-five countries responded to the survey



Source: OECD Health Care Quality Indicators Country Survey, 2012. (OECD, 2015)

The new opportunities for healthcare delivery brought forward by ICTs and the continued trend of ageing populations are opening new markets with large growth potential. Developments in ICTs are not only changing the way healthcare is delivered, but also offer patients a more active role in the prevention and monitoring of diseases[18].

The national strategy[19] considers investments of about € 1.51 billion each year to finance the plans "Italy strategy for ultra large broadband" and "Strategy for digital growth". Those investments can be supported using the resources made available by the European Commission, around € 1.65 billion each year. About 77% of these resources, around € 1.27 billion, is allocated on structural funds and usable after the approval of the national and regional operational programmes. Other European resources available to Italy derive from funds with direct management from European Commission about € 2.6 billion to seven years (about € 376 million pro year).

The plans cover, though not completely, the actions to realize the digital agenda. For this reason, besides the European funds, Italy can rely on 22 national tenders valued around € 13 billion. In particular 9 tenders, around € 6 billion (46% of the total resources) have a final goal in the digital agenda such as, for example, the thematic objective 2 (TO) "Information and

[18] OECD (2015), OECD Digital Economy Outlook 2015, OECD Publishing, Paris. DOI: http://10.1787/9789264232440-en
[19] http://ec.europa.eu/esf/main.jsp?catId=576&langId=en

communication technologies[20]" dedicated to implementation of the Digital Agenda. From 2014 to 2020 are available for this TO about € 2.7 billion on the ESF and ERDF. Those resources are inclusive of the national co-financing and the regions can use about 78% of them about € 2,143 million, with 22% being managed at national level (€ 605 million). About half of the TO 2 on ESF and ERDF, in value € 1.4 billion, is dedicated to the development of the broadband and ultra large band. Resources on the TO2 are not only available to realize the digital agenda but there are also cross policies, for example in "Research and Innovation" (TO1).

2.3 Electronic Health Record

The Electronic Health Record (EHR), established with law D.L. 18 October 2012, n. 179 ("Further urgent measures for the growth of Country"), allows sharing health and social health data for each person related to present and past medical episodes.

The adoption of digitized instruments in healthcare such as EHR is an innovation process characterized by the slow path around the total digitalization (Ben-Zion Ronnie *et al*., 2014); the success depends on many factors like the provision of appropriate infrastructure to support this process, the training and competence of health professionals (Slight *et al*., 2014) and a very strong change management and will produce important savings for health services and will reduce clinical errors, improving health (Hillestad *et al*., 2005).

Furthermore the institution of the pharmaceutical dossier is expected, which is basically a specific section of the EHR updated by the distributing pharmacy[21], in order to promote the quality, monitoring, pertinence and adequacy of the treatment to secure patient safety.

The digitalization process over the last years has accelerated the definition of national guidelines to realize EHR that to be used by all public and private-accredited facilities[22].

The minimum content of the EHR is established by a national law, which includes personal data first, in order to avoid errors. After this the person clinical data are collected to create the patient's clinical history: among health and social-health electronic documents we should mention emergency room reports, discharge summaries, medical reports, which usually stored in local repositories within the health facility. Furthermore there are other documents such as electronic

[20] "Improving access to ICT as well as their use and quality" - http://www.agenziacoesione.gov.it/it/pon_capacity_building/programma/Programma.html

[21] Art. 12 c. 2-bis del D.L. 18 October 2012, n., converted in law with change, law 17 December 2012, n. 221 "Further urgent measures for the growth of Country", so changed of the art. 17, c. 1, DL 21 July 2013, n.69, converted in Law with change of Law 9 August 2013, n 98 "Urgent regulations for the economy restart".

[22] Data of healthcare ministry:

- 101 Local health authorities (to 01/01/2017)
- 1384 Hospitals (active to 30/12/2016)

medical records, paediatric balance reports, prescriptions, home care documents, therapeutic plans, residential care and semi-residential documents, drugs, certificates, patient summary of the general practitioner to be included. There is finally the "Personal diary" section, which is reserved to each person to insert data, personal information, to attach the private medical reports and other information that can be useful in some situations and diseases in order to improve the services.

Using EHR the health data consultation will take place in real time without space limitations although today the personal history is limited to the health structures that delivered the services (for example hospitals, diagnostic services, private hospitals, health home, emergency rooms and urgent care). The immediate accesses to health data will allow reducing the exams (reduce duplication) and - from an administrative viewpoint – it will decrease the expenditure because of the electronic clinical documents (for example the printing of clinical documents and their delivery by the unit or administrative office)[23].

In the new health agreement 2014-2016, the article 5 "primary care" c. 5 is referred to the EHR as an adequate instrument to guarantee the continuity of the assistance and to the continuous update of the individual health records. Furthermore the article 15 "E-health" plans the development of flow of information of the New Informative Health System (in Italian the acronym is NSIS). This last agreement is a strategic plan to remove the barriers leading to only partial realization of public health needs [24].

2.4 Italy's healthcare system

Under the Italian Constitution[25], the Republic protects public health as a fundamental right of the person and guarantees all citizens universal access to healthcare, without discrimination based on income, gender or other social status factors.

Italy's health system, established with law 23 December 1978, is a regionally National Health Service (NHS) (Ferrè *et al.*, 2014) with universal coverage, solidarity, human dignity and health needs[26]. For the first time, it removed the fragmentation of different authorities through the centralization of all structures and services, in a given territory, ensuring the accessibility of

[23] *Fascicolo Sanitario Elettronico: stato dell'arte, modelli e prospettive*, Netics 2011.
[24] Agreement "*Patto per salute*" 2014-2016
[25] Art. 32 of Constitution "*La Repubblica tutela la salute come fondamentale diritto dell'individuo e interesse della collettività, e garantisce cure gratuite agli indigenti. Nessuno può essere obbligato a un determinato trattamento sanitario se non per disposizione di legge. La legge non può in nessun caso violare i limiti imposti dal rispetto della persona umana".*
http://www.salute.gov.it/portale/salute/p1_5.jsp?lingua=italiano&id=21&area=Il_Ssn&menu=principi.
[26] See the website http://international.commonwealthfund.org/countries/italy/

services to protect health. The Usl (local health unit) doesn't have the legal personality and the asset is acquired from municipality (Ruggeri, 1996)[27]. The financing procedures take into consideration the withdrawal resources and their distribution through institution of national health fund, which is determined by the approval of the state budget and is distributed to the regions and then to the Usl[28].

By the national laws 502/1992 and 517/1993, the regions become the level of responsible government for the organization and management of healthcare on the territory, at the disadvantage of the municipal level. The reform process sees the "companies" as the key element of regional systems (Anessi Pessina and Cantù, 2010). The local health authorities receive financing from regions, used to satisfy the territorial needs (for example the purchase the services delivered from hospital).

The legal acts, law 229/1999, the State-Regions agreement 8 August 2001 and the change of Title V of Constitution (article 117), ratify definitely the terms of regionalization and the region assume the role of the government of healthcare system.

The central government defines the "*livelli essenziali di assistenza*" (or essential care levels, LEA) by determining the amount of resources usually insufficient to be attributed to the regions: this results in the reduction of the region's effective power in problem solving. Italy's 21 regions and autonomous provinces are responsible for the actual planning and delivery of services. The National Health Service is almost all financed by public funds through national and regional taxes, direct payments from patients or forms of complementary private insurance. The financing mechanism of healthcare expenditure is twofold, firstly we consider the current expenditure as ordinary needs from Italian regions and secondly the capital expenditure, as infrastructural and technological investment of the healthcare system. The capital expenditure is concentred to regional level while the current expenditure is contracted ex ante to more level and then often levelled ex post (Ciaschini *et al*., 2009).

[27] "A. RUGGERI, *L'evoluzione dei sistemi sanitari in Italia*, in Mecosan, supplemento al numero 18/1996, anno V, pag. 23.
[28] The transfers to the Local Health Unit (*USL*) and to the hospital based on cover "at the end of a list", rather on the complete cover of made expenditure.

2.5 Healthcare and productive interdependence: input-output analysis

2.5.1 Symmetrical Input-Output (I-O) Table for healthcare

A detailed representation of productive aspects of healthcare is needed to identify the changes in healthcare production following the introduction of EHR. The multisectoral approach satisfies that need through the disaggregation of the economic system, in particular in productive areas and it provides a complete context of the interaction of the economic system in disaggregated terms. Within the I-O schema the healthcare can be analysed as productive processes. The first application of the sectoral interdependence tables can be found in the year '80 in USA where the input-output tables are thought as a possible instrument by health system agencies (Frey *et al.*, 2010).

The symmetrical I-O table is a double entrance schema of inter-industry transactions represented in the form of a double entry table in which for the rows and for columns carried are registered respectively the absorptions and resources related to the production. In particular, each row represented the distribution of the output of specific commodities between intermediate and final demand. The intermediate demand is intended as the demand of each commodity from other commodities included that one considered (intra-sectoral demand). The final demand derived from the use of the commodity for final consumption, gross investment and exports. Each column provides the distribution of the input received from other commodities, while the value added consists in the contribution and net result of management to the output to the same commodity. The I-O table highlights that the equilibrium to the economic system depends on the interdependence among all the commodities.

The reference database for Italy is National Institute of Statistic (ISTAT), where for year 2013 there are only make and use table. The use table presents the uses of goods and services for commodities and industries, the components of the value added and it is built at the purchase price. The make table shows the total availability of resources classified for commodities and industries, distinguishing between domestic production and imports and it is usually built at basic prices. Starting from the make and use table distinguished we have constructed a symmetrical I-O table commodities by commodities, based on the CPA (Classification of Products by Activity) 2008, with "*Industry technology assumption"* (ITA).

Furthermore we have integrated this table in line with both the flows of information of the healthcare bodies operations ("*Sistema informativo sulle operazioni degli enti pubblici*" - *SIOPE*) and the healthcare bodies balances of the Ministry of Health and Ministry of Economic and

Finance. We have chosen a disaggregation of Human health services in three commodities (Ciaschini *et al*., 2007): “local health authorities”, “hospital services” and “other health services”. The need of healthcare sector disaggregation is given to focus on different healthcare services. In this case the symmetrical I-O table represents in a disaggregate way the absorptions and resources of the three healthcare commodities. The columns register the intermediate goods flow necessary for the production of three healthcare services, while the rows register the absorptions of three healthcare services useful to the production of other commodities and the final demand.

Figure 4 – Example of the Input-Output table with evidence the disaggregation of commodity “Human health services”

		Commodities						Final demand			Total
		Commodity 1	Commodity 2	.....	Local health authorities	Hospital services	Other health services	Final Consumption	Gross Investment	Exports	
Commodities	Commodity 1	Intermediate demand / consumption									
	Commodity 2										
	.....										
	Local health authorities										
	Hospital services										
	Other health services										
Value Added											
Imports											
Total											

The total output of healthcare commodity amounts to 120,879 (million euros), the final demand to 109,232 (million euros) and the intermediate demand to 11,621 (million euros). The value added is equal 74,413 (million euros) and the intermediate consumptions are about 46,374 (million euros).

At disaggregated level we can see that the “local health authorities” assume major relevance than the “hospital” and the “other services” because the “local health authorities” are responsible for the production of goods and services; for this reason, the “local health authorities” use demand many goods and services for their production from other industries. Indeed the total output for the “local health authorities” are about 87,197 (million euros), “hospital services” are about 27,933 (million euros) and “other health services” are about 5,748 (million euros).

Being the “Human health services” oriented to the final demand, we can see that the production for the final purposes is higher than the production the same goods demanded from other sectors as the intermediate purposes. The final demand for the “local health authorities” with about 84,553 (million euros), while the “hospital services” are about 21,183 (million euros) and “other health services” are about 3,496 (million euros). In particular, the final demand of the “local health authorities” from the Public Administration is higher than other two commodities, because they have the responsibility of organisational set-up and service delivery. The intermediate demand highlights a major value for the hospital services with 6,749 (million euros), the local health authorities are about 2,643 (million euros) and other health services are about 2,228 (million euros). The intermediate consumptions for the local health authorities are about 32,627 (million euros), hospital services are about 11,569 (million euros) and other health services are about 2,178 (million euros). Table **27** shows the flows of intermediate goods among three healthcare commodities.

Table 27 – Flows of intermediate goods among three healthcare commodities (million euros).

	Local health authorities	Hospital services	Other health services
Local health authorities	845	60	6
Hospital services	5,606	404	46
Other health services	1,931	139	15

Source: our own calculations on ISTAT data and SIOPE

The disaggregation of the goods of “Human health services” in three health commodities, following the real health system structure organizational, allow understanding the effects of the introduction of ICT in the truthful framework of the health system.

2.5.2 Input-Output Model

Leontief's model provides us with an empirically implementable general equilibrium system (Bulmer-Thomas, 1982) where the demand is equal to the offer and the productive levels depend on the conditions that satisfy the technological ratios between input requirements and total

production. The model is of stationary type and the theoretical prerequisites are based on the three fundamental assumptions (Leontief, 1941):

a) each industry produces by only one commodity;

b) each commodity is produced from only one industry;

c) each industry uses one technology of type Leontief.

Each commodity converts quantity of different commodity into a certain quantity of single commodity. Producing a certain quantity of output j are necessary a_{ij} unity of commodity i (ij=1….n) and the a_{ij} is defined input coefficient (Ciaschini, 2011).

Assuming that the economy can be categorized into *n* sectors, we have x_i the total output (production) of sector *i* and f_i the total final demand for sector *i*'s product, the equation following represents the way in which sector *i* distributes its product through intermediate demand to other sectors and to final demand (Miller and Blair, 2009):

$$x_i = z_{i1} + \cdots + z_{ij} + \cdots + z_{in} + f_i = \sum_{j=1}^{n} z_{ij} + f_i \quad (1)$$

The z_{ij} terms represent intermediate demand by sector *i* to all sectors *j*. The following equation represents the intermediate and final demand of the output of each of the *n* sectors:

$$\begin{aligned} x_1 &= z_{11} + \cdots + z_{1j} + \cdots + z_{1n} + f_1 \\ &\vdots \\ x_i &= z_{i1} + \cdots + z_{ij} + \cdots + z_{in} + f_i \\ &\vdots \\ x_n &= z_{n1} + \cdots + z_{nj} + \cdots + z_{nn} + f_n \end{aligned}$$

We obtain:

$$x = \begin{bmatrix} x_1 \\ \vdots \\ x_n \end{bmatrix}, \qquad Z = \begin{bmatrix} z_{11} & \cdots & z_{1n} \\ \vdots & \ddots & \vdots \\ z_{n1} & \cdots & z_{nn} \end{bmatrix} \qquad \text{and} \qquad f = \begin{bmatrix} f_1 \\ \vdots \\ f_n \end{bmatrix} \quad (2)$$

In matrix notation it is:

$$\boldsymbol{x} = \mathbf{Zi} + \mathbf{f} \tag{3}$$

For each vector of final demand it is possible to solve the system in a vector of total production. So, it is obtained the form of the Leontief model:

$$\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1} \cdot \mathbf{f} \tag{4}$$

where **A** matrix is called technological coefficients matrix and reflects the production process with the present technology. For every sector, the matrix reflects the direct inputs that are required for the production of one unit of output.

Matrix $\mathbf{L} = (\mathbf{I} - \mathbf{A})^{-1}$ is known as the Leontief's inverse or the total requirements matrix (Miller and Blair, 2009). The matrix represents all direct and indirect effects created to supply a single unit of final demand. Each element of inverse matrix estimates the direct and indirect effects of variation of the final demand of the whole economic system. Furthermore it allows evaluating the impact on each production caused by a variation of the final demand related to same production. The model described can be implemented if it considers the economic system completely exogenous to the model. When part of the final demand is made endogenous, in other terms it is inserted within the productive interrelations, we decide to close the model with respect to the component that we decide not to take into consideration.

2.5.3 Structural Decomposition Analysis

Structural decomposition analysis (SDA) is used to assess the changes in an economy among two o more sets of input-output data. Early applications were by Feldman, McClain and Palmer (1987) for the USA and Skolka (1989) for Austria. That static comparative method (Dietzenbacher, 2002) has seen several applications among changes in international trade technological change, energy use, workforce requirements and development planning in Rose and Casler (1996) give a detailed overview. More applications of different sorts include Dietzenbacher and Los (1997, 1998), Kagawa and Inamura (2001), Hoekstra, Michel and Suh (2016) and Chang and Lahr (2016). Furthermore in ICT sector we can see Roy, Das and Chakraborty (2002) and Toh and Thangavelu (2013).

The total change in gross outputs between two periods could be broken down into that part associated with changes in technology and that part related to changes in final demand over the period (Miller and Blair, 2009).

Analysing two data sets of Input – Output for two time periods 0 and 1 respectively, in terms of gross output we have $x^0 = L^0 f^0$ (period 0) and $x^1 = L^1 f^1$ (period 1). The change in the total output can be represented as follows:

$$\Delta x = x^1 - x^0 = L^1 f^1 - L^0 f^0 \quad (5)$$

For the decomposition of the total change in outputs it separates the changes in L $\Delta L = L^1 - L^0$ and the changes in f $\Delta f = f^1 - f^0$ and we assume that all data are expressed in constant prices. Furthermore several forms may be used in relation to weight between technology change and final demand in different time periods. In this case we can have four forms:

$$\Delta x = (\Delta L) f^0 + L^1 (\Delta f) \quad (6)$$

$$\Delta x = (\Delta L) f^1 + L^0 (\Delta f) \quad (7)$$

$$\Delta x = (\Delta L) f^0 + L^0 (\Delta f) + (\Delta L)(\Delta f) \quad (8)$$

$$\Delta x = (\Delta L) f^1 + L^1 (\Delta f) - (\Delta L)(\Delta f) \quad (9)$$

Dietzenbacher and Los (1997, 1998) consider that the average of all the forms can be defined as an acceptable approach. We can view this as follows:

$$\Delta x = \frac{1}{2} \Delta L \, (f^0 + f^1) + \frac{1}{2} (L^0 + L^1) \, \Delta f \quad (10)$$

The first term represents the technology change in the total output with the final demand unchanged. Respectively the second term gives the final demand change with the constant technology.

2.5.4 Introduction of Electronic Health Record: changes in productive aspects

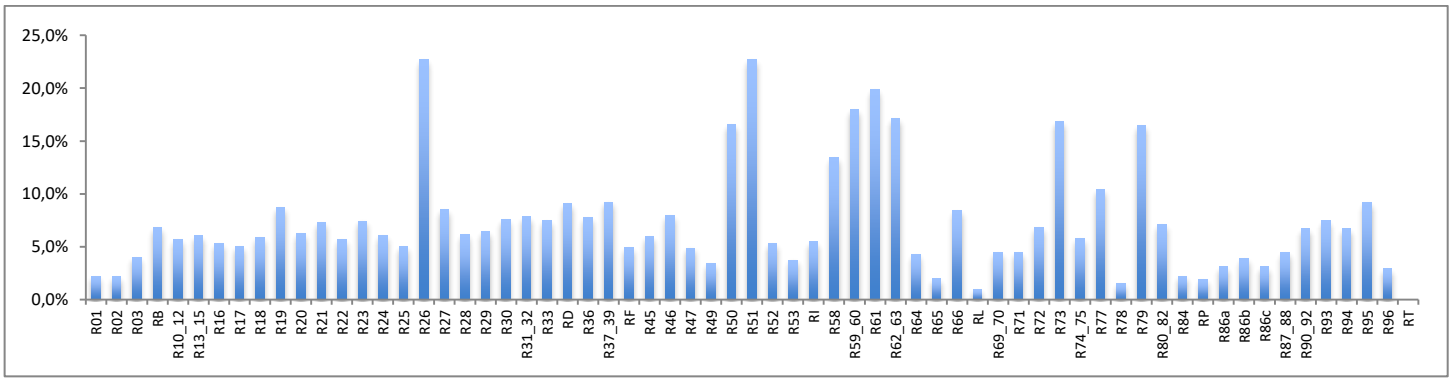
The analysis contemplates the following disaggregation: three commodities for healthcare, "local health authorities", "hospitals services" and "other health services", and six sectors for ICT. For ICT in detailed, see Table **28**, we have considered: "Computer, electronic and optical products" (R26), "Wholesale trade services, except of motor vehicles and motorcycles" (R46), "Telecommunications services" (R61), "Computer programming, consultancy and related services and Information services" (R62_63), "Rental and leasing services" (R77) and "Repair services of computers and personal and household goods" (R95).

Table 28 - Eurostat classification in terms of classes CPA 2008 codes and definitions of ICT commodities (ISIC rev. 3)

CPA code	DESCRIPTION
R26	Computer, electronic and optical products
R46	Wholesale trade services, except of motor vehicles and motorcycles
R46.5	Wholesale trade services of information and communication equipment
R61	Repair services of computers and personal and household goods
R62_63	Computer programming, consultancy and related services and Information services
R77	Rental and leasing services
R77.33.1	Rental and leasing services of office machinery and equipment
R95	Repair services of computers and personal and household goods

On the base of ICT definition, the following figure represents the percentage of ICT in each commodity output. In year 2013 the ICT expenditure absorbed in Healthcare services is under the average and is divided into 3.1% for "local health authorities" (R86a), 3.9% for "hospitals services" (R86b) and 3.1% for "other health services" (R86c) (Figure **5**).

Figure 5 – Percentage of ICT on sectoral total output (year 2013)

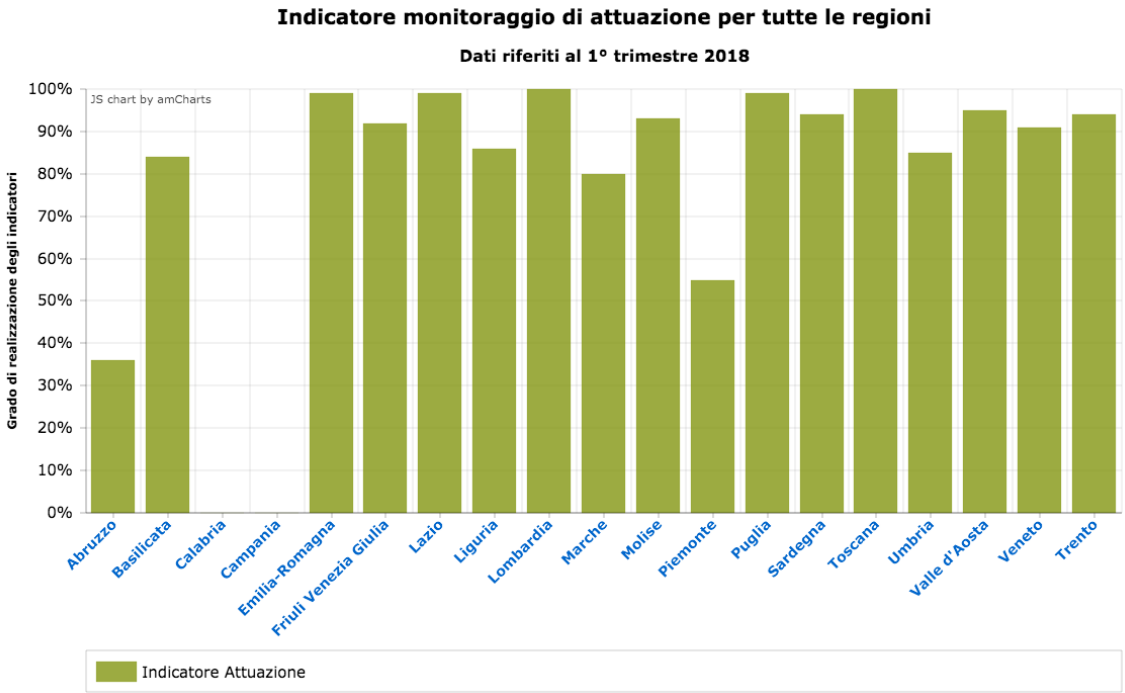


Source: our own calculations on ISTAT data

The implementation of the EHR is considered at two levels, the national level and regional level, since the EHR will be realized at the regional level and then linked to other regions to achieve a national wide level.

In Italy the realization of EHR is, for many regions, in trial phase; Figure **6** represents the percentage of realization of EHR and we can see that there is high variability among regions and two region have a percentage equal to 0. On the other hand only two regions, Lombardy and Tuscany, have reached 100%.

Figure 6 – Monitoring indicator of realization in all Italian Region (first quarter of year)



Source: "*Fascicolo Sanitario Elettronico*" (https://www.fascicolosanitario.gov.it/monitoraggio/a)

Considering the state of the art of the EHR in Italy, we have constructed the I-O table that considers the investment and realization in one year, defined "year n+1". Starting from the Make and Use table, we have constructed the IO table for the year 2013, successively on its base, we have constructed the table "year n+1" adding the current ICT expenditure. This assumption allows simulating the effects of the introduction of the EHR in Italy.

At national level we have: the realization of the central infrastructure for EHR (2013 Decree Law No. 69 art. 17 c. 15-quinquies), for which € 10 million were allocated in 2014 and € 5 million in 2015; the realization of the national citizens registry (2014 Stability Law, December 2013, No. 147) for which € 2 million were allocated both in 2013 and in 2014 only € 1 million in 2015. At the regional level each region presented a project to realize EHR with an expected investment of around € 20 per capita (in capital account) and € 5 per capita for the management and innovation of the EHR as annual cost (in current account).

The following Table **29** and Table **30** represent the unitary gross fixed investment and the current expenditure in relation to the different commodities respectively with high digital content.

At unitary level of gross fixed investment we suppose to divide the 20 euros among the ICT commodities in relation to percentage of absorption the six ICT products in the healthcare commodities. The major value is in “Wholesale trade services, except of motor vehicles and motorcycles” (R46), “Rental and leasing services” (R77), “Computer programming, consultancy and related services and Information services” (R62_63), “Computer, electronic and optical products” (R26), “Repair services of computers and personal and household goods” (R95) and “Telecommunications services” (R61) (Table **29**).

Table 29 – Unitary investment for the implementation of EHR (in euro)

CPA codes	Gross fixed Investment
R26	2.714
R46	7.852
R61	1.349
R62_63	2.220
R77	4.374
R95	1.491
Total	20.000

Source: our own calculations on ISTAT data

At unitary level of the current expenditure we supposed that the three healthcare commodities will increase of 5 euros and it is divided among six ICT commodities. The ICT commodities maintain the same weight as the distribution in Table **30**.

Table 30 – Unitary current expenditure for the implementation of EHR (in euro)

CPA codes	Local health authorities	Hospital	Other services	Total
R26	0.461	0.183	0.034	0.678
R46	1.352	0.528	0.083	1.963
R61	0.260	0.061	0.016	0.337
R62_63	0.377	0.150	0.028	0.555
R77	0.712	0.339	0.043	1.094
R95	0.253	0.101	0.019	0.373
Total	3.416	1.362	0.222	5.000

Source: our own calculations on ISTAT data

For the calculation of the total amount at both gross fixed investment and current expenditure the unitary expenditure is multiplied for the population of year 2013[29] obtaining the gross investment about € 1,193.71 million and annual total amount of about € 298 million. Supposing the implementation to the EHR in 2013 we modify only the healthcare production adding the current expenditure of EHR and the gross investment into ICT sectors. At the end we have the new I-O table for year 2013, after the introduction of EHR, and then we apply a traditional Leontief's model to obtain a gross output changed and higher than the previous one. We consider the same basic price for year 2013 without the application of the gross output deflators. The model based on the database can evaluate the effects on principal macroeconomic variables through the policy in relation to the introduction of EHR. At the first time, we have analysed the sum of coefficients of the inverse matrix, they represent the output multiplier and show the direct and indirect effects. In the "year n+1", we obtain the increase of the coefficients and we have a multiplier effect for the local health authorities about 1.7, for the "hospital services" are about 1.9 and for "other health services" 1.7.

Applying the SDA we evaluate the different structural changes into technological coefficients and into final demand. The obtained results do not explain the efficiency and effectiveness of the EHR but they could provide some relevant economic evidence in relation to the chances of technological coefficients and final demand.

The results shown in Table **31** reveal that the gross output changed depends on about 7% of technological coefficients and 93% of final demand. In details, we have a significant reduction of

[29] Population to 01/01/2013 59.685.227 - http://demo.istat.it/pop2013/index.html

technology coefficient of “Basic pharmaceutical product” (about -37.23) and “Hospital services” (about -27.22); decreasing also the “Local health authorities” (-4.25), “Other health services” (-9.55) and “Residential care services and Social work services without accommodation” (-6.05), “Chemicals and chemical products” (-5.50) and “Furniture and Other manufactured goods” (-13). On the other hand the ICT sectors register an important increase, in “Computer, electronic and optical products” about (47.61), “Wholesale trade services, except of motor vehicles and motorcycles” (120.71), “Computer programming, consultancy and related services and Information services” (38.82), “Telecommunications services” (24.56) and “Rental and leasing services” (67.48). The decrease of healthcare services can be justified with a major integration between hospital and territory because the EHR is a platform to share health information about citizens in real time.

On the other side, the increase of final demand, caused by the increase of current expenditure, both from viewpoint of household and public administration.

Table 31 – Gross outputs changed through SDA (million euros)

	Commodities	Technology change	Final-demand change	Delta X
R01	Products of agriculture, hunting and related services	2.32	22.34	24.66
R02	Products of forestry, logging and related services	0.05	0.86	0.91
R03	Fish and other fishing products; aquaculture products; support services to fishing	-0.02	0.39	0.36
RB	Mining and quarrying	4.29	52.55	56.84
R10_12	Food products, Beverages and tobacco products	1.55	32.56	34.11
R13_15	Textiles, wearing apparel and leather and related products	1.80	20.27	22.07
R16	Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials	-0.11	12.36	12.25
R17	Paper and paper products	2.25	25.68	27.93
R18	Printing and recording services	1.45	13.53	14.98
R19	Coke and refined petroleum products	3.48	42.61	46.09
R20	Chemicals and chemical products	-5.50	75.23	69.73
R21	Basic pharmaceutical products and pharmaceutical preparations	-37.23	48.00	10.77
R22	Rubber and plastics products	2.96	30.20	33.16
R23	Other non-metallic mineral products	1.72	19.91	21.62
R24	Basic metals	9.33	62.71	72.04
R25	Fabricated metal products, except machinery and equipment	8.02	55.21	63.23
R26	Computer, electronic and optical products	47.61	215.81	263.42
R27	Electrical equipment	5.02	29.53	34.56

R28	Machinery and equipment n.e.c.	4.40	28.85	33.26
R29	Motor vehicles, trailers and semi-trailers	2.46	19.61	22.06
R30	Other transport equipment	1.45	8.76	10.21
R31_32	Furniture and Other manufactured goods	-13.00	27.23	14.24
R33	Repair and installation services of machinery and equipment	0.11	17.12	17.24
RD	Electricity, gas, steam and air conditioning	1.09	82.06	83.15
R36	Natural water; water treatment and supply services	0.04	1.78	1.81
R37_39	Sewerage services; sewage sludge, Waste collection, treatment and disposal services; materials recovery services and Remediation services and other waste management services	1.37	32.15	33.52
RF	Constructions and construction works	-6.06	33.68	27.62
R45	Wholesale and retail trade and repair services of motor vehicles and motorcycles	0.79	8.87	9.66
R46	Wholesale trade services, except of motor vehicles and motorcycles	120.71	576.82	697.52
R47	Retail trade services, except of motor vehicles and motorcycles	-2.22	14.76	12.53
R49	Land transport services and transport services via pipelines	6.69	72.48	79.16
R50	Water transport services	0.29	3.78	4.07
R51	Air transport services	0.61	7.28	7.89
R52	Warehousing and support services for transportation	12.51	76.27	88.79
R53	Postal and courier services	0.33	5.96	6.29
RI	Accommodation and food services	-1.25	32.12	30.87
R58	Publishing services	0.84	7.36	8.20
R59_60	Motion picture, video and television programme production services, sound recording and music publishing and Programming and broadcasting services	2.23	14.46	16.69
R61	Telecommunications services	24.56	119.34	143.90
R62_63	Computer programming, consultancy and related services and Information services	38.82	188.93	227.75
R64	Financial services, except insurance and pension funding	3.51	76.95	80.46
R65	Insurance, reinsurance and pension funding services, except compulsory social security	0.34	8.64	8.98
R66	Services auxiliary to financial services and insurance services	3.62	41.12	44.74
RL	Real estate services	1.21	69.13	70.34
R69_70	Legal and accounting services and Services of head offices; management consulting services	-6.77	92.41	85.63
R71	Architectural and engineering services; technical testing and analysis services	-6.78	62.67	55.89
R72	Scientific research and development services	-0.07	8.69	8.61
R73	Advertising and market research services	4.13	36.00	40.13
R74_75	Other professional, scientific and technical services and Veterinary services	-3.14	32.31	29.17

R77	Rental and leasing services	67.48	310.98	378.46
R78	Employment services	0.23	9.57	9.81
R79	Travel agency, tour operator and other reservation services and related services	1.12	7.45	8.57
R80_82	Security and investigation services, Services to buildings and landscape and Office administrative, office support and other business support services	0.43	63.15	63.58
R84	Public administration and defence services; compulsory social security services	0.41	3.46	3.87
RP	Education services	-0.45	6.15	5.70
R86a	**Local health authorities**	-4.25	393.48	389.23
R86b	**Hospital services**	-27.72	155.66	127.94
R86c	**Other health services**	-9.55	30.59	21.04
R87_88	Residential care services and Social work services without accommodation	-6.05	6.13	0.08
R90_92	Creative, arts and entertainment services, Library, archive, museum and other cultural services and Gambling and betting services	0.76	6.51	7.27
R93	Sporting services and amusement and recreation services	0.80	6.08	6.88
R94	Services furnished by membership organisations	0.32	3.12	3.45
R95	Repair services of computers and personal and household goods	21.12	93.09	114.20
R96	Other personal services	-3.53	4.19	0.66
RT	Services of households as employers; undifferentiated goods and services produced by households for own use	0.00	0.00	0.00
		282.91	3,666.93	3,949.84

Source: our own calculations on ISTAT data

The empirical application confirms the policy objective; since the implementation of EHR creates changes in intermediate flows so as to reduce the healthcare commodities, at least in the first period (first year)[30].

2.6 Conclusions

E-health represents the core of the major national and regional reforms following the European strategy in the last years. The Electronic Health Record (EHR) is one of the objectives and it is more and more important to evaluate its impact on the healthcare system. The introduction of EHR in healthcare shows a potential evident change because it is observed a different recombination in

[30] Zuhndi U., Mori S., and Kamegai K., "Analyzing the role of ICT sector to the national economic structural changes by decomposition analysis: The case of Indonesia and Japan." International Congress on Interdisciplinary Business and Social Science. Procedia – Social and Behavioral Sciences 65 (2012) 749-754. The results show that ICT sectors have a significant effect in changing the structure of the national economy in Japan, but not in Indonesia (1990-2000).

the productive processes, in particular, there are evident advantages, both in intermediate, services and in added value for the patients: for example decrease of the personal data errors, tight and continuous integration among healthcare structures in order to exchange clinical data, speed access to the healthcare data by professionals and patients. The economic impact could look to the capacity of the healthcare system, through the EHR, to redesign clinical and administrative processes in order to improve the supply and demand of healthcare, through the dematerialization of papers.

In this paper we have analysed the impact of the introduction of EHR in the Italian Health System. In this framework the multisectoral approach is appropriate because it allows to measure the interconnections among industries and quantifying the effects. The economic policy purpose is to evaluate the structural effects in technological and final demand changes.

Starting from the Make and Use table for year 2013 we have constructed the symmetrical Input-Output table with a particular disaggregation of the healthcare commodity in: local health authorities, hospital services and other health services, because it is important to see the changes among healthcare sectors. Later we have constructed a new table I-O for year 2013+1, with unchanged price respect to 2013, where we have added the current expenditure and the gross investment for the implementation of EHR. The table is expressed in basic price of year 2013.

Finally we have chosen to apply the Structural Decomposition Analysis (SDA) to identify the change of sectoral output and quantify, in separate way, the technological and final demand changes.

The results show that in all sectors the greater weight is of the final demand. The technological changes, even if slightly, confirm that the whole intermediate production has been modified. The introduction of EHR produces a decrease of healthcare services in the intermediate demand but an increase in the final demand. In particular the reduction of the intermediate demand among three commodities of healthcare (local health authorities, hospital services and other health services) and relative components as basic pharmaceutical products and residential care could confirm how the ICT can improve the effectiveness and quality of care.

Another aspect is the possibility of carrying out epidemiological studies by age groups and geographical areas. The technological tool allows to analyse the best practices in the treatment of specific diseases, because it allows the construction of standard care pathways and the evaluation of the effectiveness and efficiency of treatments.

Further analysis after the introduction of the EHR in all Italian regions might consider the application of SDA to the multiregional Input-Output table to investigate the changes in technological coefficients or final demand in all healthcare commodities for all Italian regions.

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2.8 Appendix

Table 32 - Commodities

R01	Products of agriculture, hunting and related services
R02	Products of forestry, logging and related services
R03	Fish and other fishing products; aquaculture products; support services to fishing
RB	Mining and quarrying
R10_12	Food products, Beverages and tobacco products
R13_15	Textiles, wearing apparel and leather and related products
R16	Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials
R17	Paper and paper products
R18	Printing and recording services
R19	Coke and refined petroleum products
R20	Chemicals and chemical products
R21	Basic pharmaceutical products and pharmaceutical preparations
R22	Rubber and plastics products
R23	Other non-metallic mineral products
R24	Basic metals
R25	Fabricated metal products, except machinery and equipment
R26	Computer, electronic and optical products
R27	Electrical equipment
R28	Machinery and equipment n.e.c.
R29	Motor vehicles, trailers and semi-trailers
R30	Other transport equipment
R31_32	Furniture and Other manufactured goods
R33	Repair and installation services of machinery and equipment
RD	Electricity, gas, steam and air conditioning
R36	Natural water; water treatment and supply services
R37_39	Sewerage services; sewage sludge, Waste collection, treatment and disposal services; materials recovery services and Remediation services and other waste management services
RF	Constructions and construction works
R45	Wholesale and retail trade and repair services of motor vehicles and motorcycles
R46	Wholesale trade services, except of motor vehicles and motorcycles
R47	Retail trade services, except of motor vehicles and motorcycles
R49	Land transport services and transport services via pipelines
R50	Water transport services
R51	Air transport services
R52	Warehousing and support services for transportation
R53	Postal and courier services
RI	Accommodation and food services
R58	Publishing services
R59_60	Motion picture, video and television programme production services, sound recording and music publishing and Programming and broadcasting services
R61	Telecommunications services
R62_63	Computer programming, consultancy and related services and Information services
R64	Financial services, except insurance and pension funding
R65	Insurance, reinsurance and pension funding services, except compulsory social security
R66	Services auxiliary to financial services and insurance services
RL	Real estate services
R69_70	Legal and accounting services and Services of head offices; management consulting services
R71	Architectural and engineering services; technical testing and analysis services
R72	Scientific research and development services
R73	Advertising and market research services
R74_75	Other professional, scientific and technical services and Veterinary services
R77	Rental and leasing services
R78	Employment services
R79	Travel agency, tour operator and other reservation services and related services
R80_82	Security and investigation services, Services to buildings and landscape and Office administrative, office support and other business support services
R84	Public administration and defence services; compulsory social security services

RP	Education services
R86a	Local health authorities
R86b	Hospital services
R86c	Other health services
R87_88	Residential care services and Social work services without accommodation
R90_92	Creative, arts and entertainment services, Library, archive, museum and other cultural services and Gambling and betting services
R93	Sporting services and amusement and recreation services
R94	Services furnished by membership organisations
R95	Repair services of computers and personal and household goods
R96	Other personal services
RT	Services of households as employers; undifferentiated goods and services produced by households for own use

3 LABOUR DIGITAL SKILLS AMONG INDUSTRIES: A MACRO MULTIPLIERS ANALYSIS

3.1 Introduction

Developed countries have been hit by a severe economic crisis and financial over the period 2008-2014. However a more intensive process of globalisation and integration of international markets has occurred since the second half of 1990s with a consequent redistribution of production phases among countries along global value chains. Moreover, these changes have been favoured through a more pervasive application of ICT technologies both to services, and to manufacturing. Generally the interaction of the above-mentioned elements determined in 2008-2014 a decrease in total output and employment level. Moreover, the composition of output and employment changed with increasing level in (both high- and low-skill-intensive) services and a reduction in (especially low-technology) manufacturing and construction. The economic recovery underway until now seems to confirm these trends and laggard countries in the new international labour division (such as the European Mediterranean countries) seem to underperform both in terms of skill supply, and in terms of productivity patterns and economic growth.

To this respect, at the European level the reform strategies outlined in the Horizon 2020 stress for improvements in employment levels, productivity and social cohesion. The principal pillars are: “Innovation Union”, “Youth on the move”, “A digital agenda for Europe” and “An agenda for new skills and jobs” (European Commission, 2010). Within this framework the targets to achieve by 2020 are: 75% of the population aged 20-64 should be employed, 3% of EU’ GDP should be invested in R&D and the share of early school leavers should be under 10% and at least 40% of the younger generation should have a tertiary degree.

Several microeconomic studies[31] confirm complementarity between technology and skills in improving countries’ productivity performance (OECD, 2003)[32]. In this framework the paper would complete this viewpoint through the multisectoral approach, which has the advantage to represent the relations between changes in the output of productive sectors and the changes of compensation of employees by skills, digitalization and gender.

[31] Bresnahan, T.F., E. Brynjolfsson, and L.M. Hitt (2002), “Information Technology, Workplace Organization and the Demand for Skilled Labor: Firm-Level Evidence”, Quarterly Journal of Economics, Vol. 117, February, pp. 339-376.
[32] OECD 2003. Ict and Economic Growth: Evidence from OECD Countries, Industries and Firms – ISBN 92-64-10128-4.

Digital competence is defined as a combination of knowledge, skills and attitudes appropriate to a digital context, where a confident and critical use of information Society technology (IST) is needed for work, leisure, learning and communication (European Commission, 2006). According to this definition, around 40% of the European Union (EU) population have an insufficient level of digital skills, of which 22% have none at all. Furthermore, schools and education systems are not yet ready to carry out the technology potential of digital technologies (OECD, 2016 and Colby *et al*., 2014). The level of education assumes a significant impact on the employability and labour compensation (OECD, 2013a)[33]. A huge significant policy effort, systemic reforms in education and training and investments in human capital will be required, in order to achieve the target (European Commission, 2016). As already mentioned, the European Commission '*2010 Digital Agenda for Europe*' devoted a whole pillar to enhance digital skills, literacy and inclusion. In particular, the development of individual digital skills has received much attention as a remedy for digital inequality (Matzat and Sadowski, 2012). The '*Digital Agenda for Europe*' implemented several investment frameworks to address digital equality and to help employees to identify their digital gap supporting them for a life transition (Leahy and Wilson, 2014). OECD also recognised the relevance of digital economy as key issue for innovation, growth and social prosperity during the 2016 Ministerial Meeting[34].

Up to now the measurement of labour force skills has remained highly problematic (Martinaitis, 2014). For this reason the OECD has developed a comprehensive Skills Strategy, that helps countries to identify the strengths and weaknesses of their national skills systems, to benchmark them internationally, and to develop policies able to transform better skills into better jobs, economic growth and social inclusion (Directorate for Science and Innovation, 2016).

The tool adopted to better address this issue is of the Social Accounting Matrix (SAM), which allows representing the relations between the changes in the output of activities and the changes of employees compensation by skills, digitalisation degree and gender. The SAM developed in the paper is relative to Italy in 2013; moreover labour is disaggregated into formal/non formal/informal competence and, additionally, digital/non digital skills. Labour digital skills are defined according to the formal competence declared by the European Commission

[33] OECD (2013). Education at a Glance 2013. OECD Indicators. OECD Publishing, Paris

[34] See the final declaration at the http address: http://www.oecd.org/internet/ministerial/. "*The world economy is becoming ever more digital; that growing use of and investment in digital technologies and knowledge-based capital is profoundly transforming our societies*". In this framework "*the digital economy is a powerful catalyst for innovation, growth and social prosperity; that our shared vision is to promote a more sustainable and inclusive growth focused on well-being and equality of opportunities, where people are empowered with education, skills and values, and enjoy trust and confidence*". This declaration creates the opportunity to analyse which policies can be adopted to a accelerate the transition toward a full digitalised world.

(2000): i) formal competence depending on the level of education and training; ii) non-formal competence gained at the workplace and through the activities of social organisations and groups; iii) informal competence not acquired intentionally during life time. In this framework a further classification of labour input based on the use/non use of computer linked to the Internet has been introduced. On the basis of the SAM an extended multisectoral model (Ciaschini and Socci, 2003) is implemented. Finally, an appropriate structure of final demand as driver of output and value added changes is identified.

3.2 Digital skills and labour market for innovation

There are clear links between investments in R&D policy, industrial policy, education policy and regional policy as key strategies for increasing innovation performance (Reports EU Innovation part I and II). Each country define a policy mix to support innovation with differences depending on the socio-economic conditions and cultural context and more recently the European Union has defined policy actions to support a more effective development and implementation of such policy reforms. In 2006 the European Parliament and the European Council have introduced the concept of "Competences", which are defined as a combination of knowledge, skills and attitudes appropriate to the context. In relation to education policy, the European Parliament and the European Council has favoured The development of individuals' digital skills has received much attention as a remedy for digital inequality (Matzat and Sadowski, 2012) within the more broad concept of "competences"[35].

The European digital agenda aims at supporting information and communication technology (ICT) in order to reach the EU 2020 goals.

Education[36] - in its both social and economic roles - has a key role to develop human capital. While education remains the responsibility of the EU's Member States, the European Commission provides funding and works on several policy initiatives and missions. They are the following: the "*Agenda for New Skills and Jobs*", the "*Communication on Rethinking Education*", the "*Communication on Opening Up Education*" and "*Skills for youth*" of DG CONNECT, and Education, Audiovisual and Culture under DG EAC.

The Digital Skills and Jobs Coalition does not have a specific budget to support its activities, but there are several funding sources at European and national level to support projects boosting

[35] In 2006 the European Parliament and the European Council have introduced the concept of "*Competences*", which are defined as a combination of knowledge, skills and attitudes appropriate to the context.

[36] See Perna et. al., 2015 and Burgess, 2016.

digital skills. The European Structural and Investment Funds (2014-2020) which should be used for ICT education, are: the European Social Fund with more than 80 billion Euros earmarked for human capital; the "*Youth Employment Initiative*" 3.2 billion; and the European Regional Development Fund aims to strengthen economic and social cohesion in the European Union by correcting divides between its regions.

The direct funds are: "Erasmus+" with 14.7 billion Euros; the "*Employment and Social Innovation*" (EaSI) with about 0.9 billion Euros; and "*Your first Job*". The European Commission in the "*Europe's Digital Progress Report 2016*" analyses the human capital and divides the digital skills into many categories: operational, formal, information, communication, content creation and strategic skills (Van Deursen *et al*., 2014).

In order to have a thriving Digital Economy and a Digital Single Market, it is of outmost importance that firms and individuals (such as consumers, employees/workers or learners etc.) have at their disposal sufficient digital skills to realise the potential effects of the economic and societal advantages. A mismatch between demand and supply would typically affect labour market policies, possibly educational policies, and may even go as far as affecting migration policies (DG Communications Networks, Content & Technology, 2015).

For this reason this analysis considers different aspects: identifying the ICT specialists' segment of employment both on demand- and on supply side and measuring the level of population digital skills. The ICT specialists' segment of employment can be analysed in terms of enterprises employing ICT specialists that are employees for whom ICT is the main job, and, in other terms, of people employed with ICT specialists skills. The definition of the ICT Specialists' occupations is based on the ISCO-08 classification (International Standard Classification of Occupation). It includes ICT service managers (code 133), ICT professionals (code 25), ICT technicians (35) and some other groups, from electronic and telecommunications engineers (code 215) up to ICT installers and servicers (code 7422).

From the viewpoint of the population digital skills on the basis of "Digital Competence Framework" published in 2010 and updated with the project "DigComp 2.0", identify 5 key components of digital competence: information and data literacy; communication and collaboration; digital content creation; and safety and problem solving.

Within each of the five areas, there are other competences monitored by the ICT-survey. People need to have competences in each of these areas in order to achieve goals related to work, employability, learning, leisure and participation in society.

The ICT survey collects information about activities realised during the previous 3 months by Internet and computer users covering four of the five domains (the safety domain is not covered as adequate indicators are not yet available within the survey). It is assumed that persons having performed certain activities have the corresponding skills (digital skills indicators derived from 2016 Eurostat Survey on ICT Usage by Individuals).

The population is classified in 4 types: "*above basic*" when the population realizes all activities in all 4 domains; "*basic*" when the population realizes some activities in all 4 domains; "*low*" if it has some activities in some domains; and "*no skills*" if it does not have competence in all domains. In the last category presumably it can be counted all the people that do not use the Internet over the period. Furthermore the study on "*ICT for work: Digital Skills in the Workplace*" is available to know more detailed information about digital skills demand and supply.

The Programme for the International Assessment of Adult Competences (PIAAC) background questionnaire includes a range of information regarding the factors influencing skill development and maintenance such as education, engagement with literacy and numeracy and ICTs. The survey also gathers information and data on how adults use their skills at home, at work and in the wider community. The questionnaire considers a unique share for the whole economic system because it doesn't have a disaggregation by industry. The competences can be divided in formal, no formal and informal according to the EU definition (European Commission, 2000).

Labour digitalisation is inserted in an economic framework characterised by an increasing interdependence degree among countries and by a more pervasiveness of international trade and globalisation (OECD (2017)[37]. About 30% of export of OECD countries (40% in manufacturing and 20 in services) originates abroad and 1/3 of the jobs in OECD countries depend on the global chain value (GVC). Moreover, countries with a higher participation to GVC can benefit from a higher annual growth rate of productivity ranging from 0.8 to 2.2 p.p.s, and this effect is not only limited to directly involved sectors, but spreads also to the remaining sectors in presence of an adequate skill supply. Small firms (OECD, 2017) are generally less internationally integrated and also lower skill-intensive than large ones.

The position of each country/sector in GVC (high value-added advanced vs. low value-added traditional activities) depends on the endowment and quality mix of skill supply. For example, Italy shows an unsatisfactory performance in terms of percentage of high skilled workers and it is not specialised in advanced sectors, by registering a stagnant productivity dynamics. The

[37] See OECD, 'OECD Skill Outlook 2017. Skills and global value chains', 2017.

opposite occurs for Finland and Japan, which are countries specialised in technologically advanced industries and, simultaneously, register a high share of high skilled workers (see OECD, 2017). ICT generic skills (i.e. using technologies for professional purposes) can be distinguished from ICT specialist skills (i.e. programming, developing applications and managing networks). For both these skills Italy shows a gap with the best performers with an incidence on total employment equal, respectively, to 15-20% and 4% compared to 25-30% and 6% of Germany and 30-40% and 10% of best performers. The new economic context requires strong cognitive skills, the readiness to learn (adaptability to often changing circumstances) and the ability to manage and communicate, that is workers with social and emotional skills (managing, communicating, self-organising) (OECD, 2016b[38]).

Furthermore, in the UK - a country with a high openness to international trade - the export represents 18% of the world share of financial sector, 8% of business sectors and 5% of ICT, so that exports in knowledge-Intensive services (KISs) represent 30% of UK services trade. Spain and Italy instead show a low weight of ICT (only 1.22 and 1.27, respectively, the share of R&D expenditure on GDP) (see OECD , 2017c[39]).

OECD, 2017c assesses employment shifts from manufacturing to services registered in OECD countries. Manufacturing employs 11% of workers in France, 13.2% in Spain and 15.5% in Italy (in line with EU average). In both the latter countries a large share of manufacturing employment is represented by low-tech manufacturing. Services have been polarising between KISs and personal care and retail services. These latter have been developing especially in Spain, Italy and France.

Labour demand by skill depends on technological and demographic patterns (see OECD, 2017b[40]). As to technological trends, repetitive cognitive and craft skill tasks (i.e. clerical work, bookkeeping, basic para-legal work and reporting) are increasingly automated. In the next future pervasiveness of big data, artificial intelligence and ICT, as well as the increasing power of computers will involve not only routine tasks, but non-routine tasks too. Moreover, complex activities are increasingly being decomposed into smaller micro-tasks; many of them could be automated. This creates long sequences of differently skilled tasks in a satisfactory level of global

[38] OECD, 'Skills for a digital world', 2016, background report for 21-23 June 2016 Ministerial Meeting on the Digital Economy, OECD Digital Economic Papers No. 250. See also OECD 2013, 'OECD Skills Outlook 2013 - PIAAC 1st results from the Survey of Adult Skills', 2013, OECD 2013.
[39] See OECD, 'OECD Employment Outlook 2017', 2017.
[40] See OECD, 'Getting skill right: good practice in adapting to changing skill needs', 2017

productivity, which requires good performances for each micro-task (see OECD, 2017b[41]). As to demographic patterns, the next future will register the retirement of many older workers, who will increase the demand of health- and care-related services. These latter sectors require specific and advanced skills.

Skill trends are strictly linked to digitalisation (OECD, 2013b[42]). In OECD countries 70% of households have access to the Internet. Moreover, 95 or 85% of large or medium sized businesses and 65 of firms use Internet for working. The degree of pervasiveness of innovation is higher than showed by growing weight of KISs and high-technology manufacturing (HTM). ICT and automation are indeed spread in traditional sectors, such as agriculture (introduction of biotechnology and use of robot and internet for GPS and IT sales).

Low skill supply in OECD countries is disappointing. Relevant components of the labour force (OECD, 2013b) achieve a low proficiency score in literacy, numeracy and/or in problem solving[43]. Furthermore, the percentage of population without any or not enough basic skills ranges from 7% in best performing countries (the Netherlands, Norway and Sweden) to 23% in worst ones (among them also Italy, Spain and Portugal). The percentage of adults with a high level of proficiency on the problem solving ranges cross-country only between 3 and 9%. This is confirmed by the lack of digital skills, so a large share of adult population ranging between 7 and 27% is not able to use computers. In this context, Nordic countries and the Netherlands have been more successful than other countries in creating a computer-friendly environment. Finland and Japan have larger shares of top-performers than Italy and Spain[44], which have the lowest level of proficiency both in literacy and in numeracy.

Skill supply is correlated with formal education attainment, so that formal education represents the main mechanism through which proficiency is achieved. However, formal education and skills are not perfectly aligned (see OECD, 2013b): 1) more-information processing skills are weaker correlated with education than numeracy and literacy; 2) skills enabled by each education degree are not similar over countries (people with tertiary education and those who have not completed secondary education show a high cross-country variability with a relatively

[41] Conversely, in traditional activities, characterized by a short sequence of low skilled tasks, a higher variability of performances is compatible with the target to achieve some level of productivity.
[42] See OECD, 'OECD Skills Outlook 2013 - PIAAC 1st results from the Survey of Adult Skills', 2013.
[43] That is performing multi-step operations to integrate, interpret and synthesise information from complex or lengthy texts involving conditional and/or competing information.
[44] In these countries the main problem is the high incidence of those people able only to read short texts with a single piece of information or to process simple counting, sorting and arithmetic operations.

low level in Italy and Spain)[45]. This could not offer a clear signal of owned skills for firms, by making it more difficult and costly the match on the labour market. So, conditional variance represents an indicator of the quality of education, both in terms of effectiveness and of amount of expenditure in education[46].

Furthermore, a low share of graduates - especially in Science Technology Engineering Mathematics (STEM) (OECD, 2016[47]) - is strongly correlated with the loss of skills. In Italy the percentage of 25-64 year old graduates amounts to 18% vs. 44% in UK and 35% in Spain. The share of STEM graduates amounts to 16% in UK vs. only 7% in Italy and 9% in Spain and France.

Anyway, formal education is not the only source of effective (especially complex problem solving) skill. A way to develop such skills is given by life-long learning (LLL) and vocational employment training (VET) programmes, which are supporting both skilled and unskilled occupations, as respectively, allowing learning to effectively face the higher risk of unemployment and the need of reskilling due to GVC participation, as well as allowing to update existing competences so to keep pace with the evolution of technology. However, only high skilled workers participate actively in LLL and VET programmes, for which the gap between Scandinavian countries and Italy is renewed[48].

In OECD countries ¼ of workers are professionals or skilled technicians and this is inserted into a process of increasing weight of high-educated workers over the period 1998-2009 vs. a decrease of low- and medium-educated workers (OECD, 2013b). However, 200 millions of adults in OECD countries do have low literacy proficiency and 60% of them lack both numeracy, and literacy. These workers are so exposed to a decreasing labour demand via offshoring and automation with consequent job losses and/or wage reduction in the short run (OECD, 2013b). In this regard, technology change (Berger and Frey, 2016[49]) has been one of the key drivers behind the rapid deindustrialisation undergoing in OECD with lower perspectives of job over the forthcoming decades.

[45] 25-34 year old Japanese upper secondary graduates are the same numeracy and literacy skills than Italian graduates in the same age class.

[46] In Japan and in the Czech Republic the conditional distribution of skills to education is very low and this indicates a very high quality of educational system, especially in tertiary education. Other countries, such as Poland, Spain and Portugal show a higher variability. in low performing countries social background (as parents' skills) is a driving factor of educational attainment, differently from high performing countries characterised by a better and higher expenditure in education.

[47] See 'Education at a glance 2016'.

[48] Countries with low skills use less this opportunity (50% of eligible workers in UK vs. only 20% in Italy, 32% in France and 35 in Spain) and the probability to participate to those programmes is explained by skill proficiency.

[49] See Berger, T. and C. Frey (2016), 'Structural Transformation in the OECD: Digitalisation, Deindustrialisation and the Future of Work', OECD Social, Employment and Migration Working Papers, No. 193, OECD Publishing, Paris.

In this regard, we can think of job polarisation and hollowing-out of the skills content of occupations (Goos, Manning, Salomons, 2009[50]; Oesch and Menes, 2010[51]; Fernandez-Macias, 2012[52]). The economic and technological changes underway (see OECD, 2017c[53]) have determined a significant reallocation of employment across sectors and occupations, so contributing to build skill imbalances, with an upward trend of high-skilled and low-skilled workers differently from middle ones. The match between labour supply and demand (see OECD, 2017c) could determine three possible effects: i) higher risk of unemployment for low-skilled workers, as they are more exposed to offshoring than high-skilled; ii) labour shortages (not covered jobs) for high skilled tasks in advanced sectors inserted into the GVC; iii) misalignments between skill owned by employees and skill requested on the jobs (mismatch) As for the first point, long-term unemployment can depreciate and determine obsolescence of skills (see OECD, 2012[54]). As for the second point, in OECD countries 41% (about 30%) of firms looking for ICT specialists find it difficult to fill vacancies (see OECD, 2016b).

The structures by contract and time schedule also affect skill developments. Temporary contracts - i.e. fixed-term contracts - FTCs - and part time work (OECD, 2013b and OECD, 2016c[55]), generally, require a lower use of skills and capital accumulation than open-ended contracts (OECs), except in the UK. Only long-term and full time work relations indeed could justify investments in firm specific skills both by employees and by employers. Often, young people and foreign-born workers are disproportionately employed with temporary and part-time contracts. Moreover, FTC or part-time workers register high probabilities to remain in those statuses with higher risks of depreciation of the human capital (OECD, 2014[56]).

A for policy consequences (OECD, 2017), Governments should design policies to ease firms' reorganisation and enhance productivity, so leading to job creation. As to skills, policies in the form of LLL and VET programmes should be implemented, to re-skill and up-skill (that is, protecting existing high skills from deterioration and increasing the level of skills) workers. Policies should be coordinated among countries because of spill-over effects. Specific skill policies should be launched in order to promote a better use of skills on the job, also by coordinating educational,

[50] See Goos, M., A. Manning and A. Salomons (2009), 'Job Polarization in Europe', American Economic Review, Vol. 99, No. 2, pp. 58-63
[51] See Oesch, D. and J.R. Menes (2010), "Upgrading or Polarization? Occupational Change in Britain, Germany, Spain and Switzerland, 1990-2008", Socio-Economic Review, Vol. 9, pp. 503-531.
[52] See Fernandez-Macias, E. (2012), "Job Polarization in Europe? Changes in the Employment Structure and Job Quality, 1995-2007", Work and Occupations, pp. 1-26. http://dx.doi.org/10.1177/0730888411427078
[53] See OECD, 'OECD Employment Outlook 2017', 2017.
[54] See OECD, 'OECD Employment Outlook, 2012', 2012.
[55] See 'Employment Outlook 2016'.
[56] See 'Employment Outlook 2014'.

migration and employment protection legislation (EPL) policies. Finally, Governments should ease the stabilisation of temporary contracts and hire of voluntarily inactive people (such as women with children). Moreover, tax reforms reducing tax burden of low skilled workers to the level of high skilled enhancing reforms and supporting changes in the productive system towards higher value-added GVC segments should be implemented (see OECD, 2013b).

Also the Italian Statistical Office (ISTAT) has reported the data about the effect of digitalisation in Italy during a relation before the Parliament in July 2017[57] in the framework of the Government "4.0 Industry - The Italian way for the manufacturing competitiveness" plan. Over the period 2011-2016 employment has grown by 160,000 workers with a decrease of 408,000 over 2011-2013 and an increase of 567,000 in 2014-2016. However, trends by occupations have been very diversified. Employment increased by 403,000 in qualified professions in retail and services, 330,000 in scientific professions and professionals, but also in non qualified occupations (+268,000). Conversely, employment in executive jobs diminished by 106,000. 27 out of 221 occupations above 20,000 employees have registered a gain by cumulatively 1.6 million against the loss by 1.0 million in the 24 loosing occupations (jobs in construction sector and in office jobs).

The weight of ICT employment on total employment was 3.3%, a share only slightly lower than in France and in Germany (3.6% and 3.7%, respectively). High qualified managerial and technical profession registered over the period 2011-2016 an increase in the weight on total ICT employment from 23% to 31%. Clearly, these weights are very heterogeneous among sectors.

Moreover, Italy shows a huge gap with respect to EU28 in the share of labour force with digital competences (23% and 32%, respectively) with the lowest percentage among 5 main European countries. This gap is especially high for the adult labour force. Moreover, digital competences are strongly correlated also with the participation to life-long-learning programmes.

3.3 Social Accounting Matrix for skill analysis

The Social Accounting Matrix (SAM) represents the best useful and efficient tool to analyse formal and digital skills by gender on the labour compensation among industries. Richard Stone with his research team in 1960 introduced for the first time the Social Accounting Matrix defining that as the representation of transactions in a socio-economic system (Round, J. 2003)[58]. The social accounting finds the origins in the quantitative research of the English team called "Political

[57] See ISTAT document at the following http address: http://www.istat.it/it/files/2017/07/A-AUDIZIONE-12-LUGLIO_LAVORO-4.0.pdf.
[58] Round Jeffrey I., 2003. "Constructing SAMs for Development Policy Analysis", Economic System Research, 15, 161-183.

Arithmeticians", made about at the end of the eighteenth century (Socci, 2004)[59]. As for Quesnay[60], his 'Tableau economique' could be reproduced in a SAM schema and, so, multipliers could be calculated. In this way, one can assess the best sectoral policy in order to help either landlords and farmers, or artisans. In 1942 Hicks established the concepts and standards for national economic accounts, providing information needed for macroeconomic analysis (short-term demand-management and long-term dynamics). In that context the separation between the System of National Accounts (SNA) and the System of Social and Demographic Statistics (SSDS) was evaluated as the main shortcoming of the building of the national accounts structure in 1940s. Distribution of employment opportunities and living standards in a society are inextricably interwoven with the structure of production and the distribution of resources[61]. The interest about the interrelated aspects of inter-industry structure and distributional issues has changed over time: in 1940s and 1950s the former aspect was prevailing; since 1960s the latter aspects emerged, also thanks to the ILO World Employment Programme[62] in 1970s. The first complete SAM experiences have been made in 1960s with the Cambridge Growth Project, where SAM was the information system counter-part of the Cambridge Growth Model. More complete models were built in1970s with Iran, Sri Lanka and Swaziland.

The Social Account Matrix (SAM) has been used for development studies since 1970s, by combining the advantage of being inserted in the framework of national accounts with flexibility related to the quality of available data and to the purpose of analysis.

The most recent developments of the SAM have been the System of Economic and Social Accounting matrices and Extensions (SESAME) and the National Accounting Matrix including Environmental Accounts (NAMEA), developed in the framework of sustainable development after the Rio de Janeiro Summit[63]. SESAME[64] constitutes an integration of the SAM, which integrates economic, social and environmental accounts and indicators, as well as monetary and non-

[59] Socci C., 2004. "Distribuzione del reddito e analisi delle politiche economiche per la Regione Marche", Giuffrè Editore.
[60] See also Philips (1955), "The Tableau Economique as a Simple Leontief System" and Barna (1975) "Quesnay's Tableau in Modern Guise".
[61] See A. R. Roe, "Flow of Funds as a Tool of Analysis in Developing Countries" in "Social Accounting Matrices - A Basis for Planning", edited by G. Pyatt and J. I. Round, World Bank.
[62] See International Labour Office (1970),"Towards Full Employment: A Program for Colombia", Geneva, (1971), "Matching Employment Opportunities and Expectations: A Program of Action for Ceylon", vols. 1 and 2, Geneva, (1973), "Employment and Income Policies for Iran", Geneva. (1973b), "Strategies for Employment Promotion: An Evaluation of Four Interagency Employment Missions", Geneva, and (1976), "Employment, Growth and Basic Needs: A One-World Problem", Geneva.
[63] S. Kjosev, "Social Accounting Matrix - Methodological Basis for Sustainable Development Analysis", 2012.
[64] Keuning, S. & Timmerman, J. (1995). An information-system for economic, environmental and social statistics - integrating environmental data into the SESAME, NA-076, Statistics Netherlands, 1995, Voorburg, the Netherlands, Keuning, S. (1998). Interaction between national accounts and socio-economic policy, Review of Income and Wealth, Series 44, Number 3, September 1998 Sustainable Development – Policy and Urban Development -Tourism, Life Science, Management and Environment. Keuning, S. (2000). Accounting for welfare in SESAME, in: Household Accounting – Experience in Concepts and Compilation, Handbook of National Accounting, Studies in Methods, Series F, No. 75/Vol.2, 2000, United Nations, New York

monetary data[65]. Finally, the NAMEA integrates environmental aspects and has been developed as a systematic supplement of the national accounts.

A SAM can be defined as a double entry square table that reflects the circular flow of income of an economy during a given period of time (Miller and Blair, 2009)[66]. By following King (1985)[67], the SAM organises national accounts and social data, by providing a static image and a statistical basis for the creation of a plausible model. In the SAM incomings (rows) are equal to outgoings (columns), so generating a square matrix. More particularly, the SAM can be obtained by disposing national accounts (domestic product and expenditure account; national disposable income and outlays; capital account; rest of the world) and by opportunely decomposing them by sector and institutions. The advantages of the SAM[68] can be synthesised as follows: a) SAM combines indicators of growth, allocation of income and poverty in one coherent framework, useful for macroeconomic analysis and planning; b) SAM is a useful tool for assuring greater consistency and adequacy among sources; c) SAM is an integrated statistical database for macroeconomic models.

It describes all the phases of circular flow of income from its generation in the production process (total output and value added generation) through its allocation in the distributive process (value added by factor, primary and secondary distribution of income) to the use of the disposable income (final demand) (Stone, 1985)[69]. The first phase (Thorbeck, 1985[70]) is given by production, where activities are classified according to criteria such as type of commodity, level of technology, and prevailing form of organization. These production activities generate a flow of value added which is distributed to various production factors, in turn, broken down according to labour skills, type of capital, and land classification. The resulting factorial income distribution provides the major source of income for the institutions - including different types of households classified according to different socioeconomic criteria. Primary income is redistributed among institutions through transfers, such as taxes and subsidies. Finally, the net disposable income is utilised by institutions for consumptions and investments.

[65] E.g. compensation of employees decomposed into hours worked and average hourly wage rate). So, this schema allows giving a comprehensive framework about the total use of time by the members of a community.
[66] Miller R.E., Blair P.D., Input-Output Analysis: Foundations and Extensions. (2009). Cambridge University Press, New York.
[67] B.B. king (1985), "What is a SAM?" in "Social Accounting Matrices - A Basis for Planning", edited by G. Pyatt and J. I. Round, World Bank, Ch. 1, 1985.
[68] See G. Pyatt and J. I. Round (1985a), "Social accounting matrices for development planning" in "Social Accounting Matrices - A Basis for Planning", edited by G. Pyatt and J. I. Round, World Bank, Ch. 2, 1985, in "Social Accounting Matrices - A Basis for Planning", edited by G. Pyatt and J. I. Round, World Bank, 1985.
[69] Stone, R. 1985. " The disaggregation of the household sector in the national accounts", in Pyatt and Round (eds.), 1985a, pp. 145-185.
[70] E. Thorbeck (1985), "The Social Accounting Matrix and Consistency-Type Planning Models" in "Social Accounting Matrices - A Basis for Planning", edited by G. Pyatt and J. I. Round, World Bank, 1985.

Within the SAM each row records the details of receipts by each particular account while each column (which follows the same ordering as the rows) records the corresponding expenditures, so that all the interconnections between sectors are drawn down and the sum of each row equals to the sum of the corresponding column (square matrix).

The representation of the circular flow of income within the SAM finds the starting point in the National Accounting Matrix (NAM) that consists in the matrix representation of National Accounts. The basic scheme of NAM (see Table **33**) can be represented on the bases of the circular flow of income, starting from the production and final demand, the primary allocation and the secondary distribution of income, the capital formation and the rest of the world. The first column with header "commodities" represents the production of all the Industries (M), indirect net taxes on goods (INT) and the imports (N). The first row registers the intermediate flows (U) absorbed within the productive processes, the final demand from Institutional sectors (C), from Capital Formation (I) and from the Rest of the World (E). In the second column are recorded all intermediate requirement of goods and services (U) and the value added (Va). The third column represents the primary distribution of income that is the value added distribution among primary factors in the domestic production (GNI) and abroad (Tr). In the fourth column are recorded the secondary distribution and use of disposable income, which regards on the redistribution process between the institutional sectors (T+Tr) and to the Rest of the World (Tr). The saving (S) is determined as a difference between the total row and the total column. The fifth column represents the gross investments (I). At the end there is the account that registers the current transactions between the Rest of the World and national economy (Tr) to obtain the positive or negative final balance (+/- A).

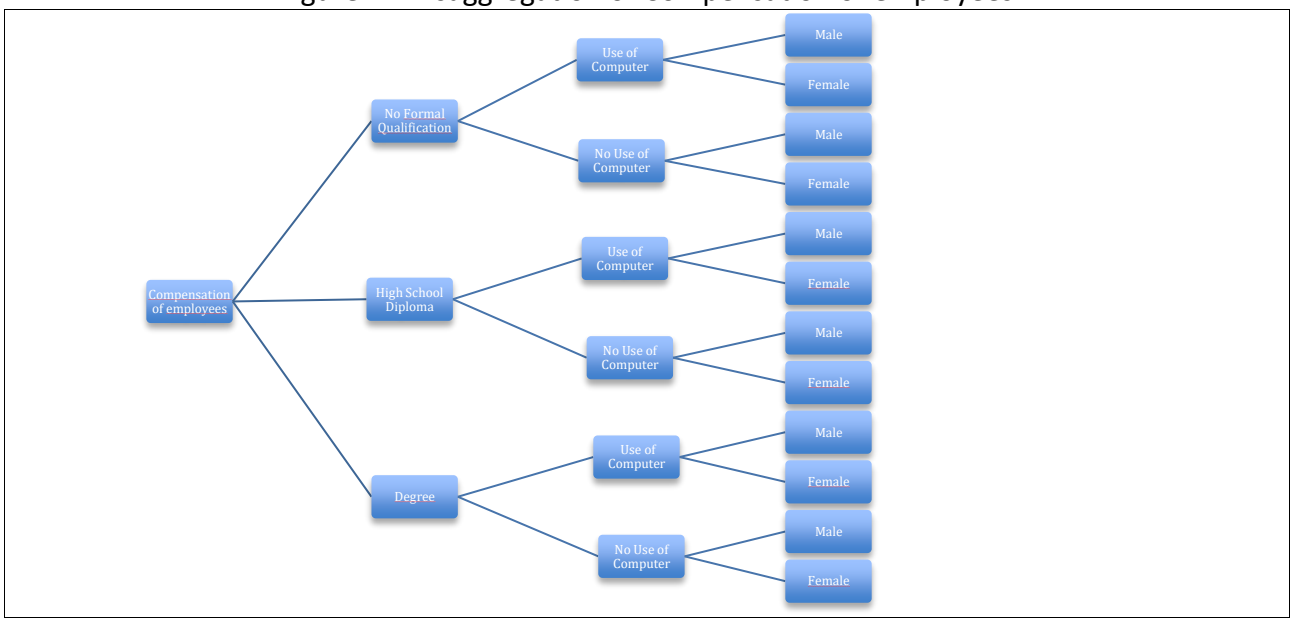
Table 33 – National Accounting Matrix

		Commodities	Industries	Primary Factors	Institutional Sectors	Capital Formation	Rest of the World	Total
		1	2	3	4	5	6	7
Commodities	1		U		C	I	E	q
Industries	2	M						X
Primary Factors	3		Va				Tr	Y
Institutional Sectors	4	INT		GNI	T+Tr		Tr	Yn
Capital Formation	5				S		(+/-)A	K
Rest of the World	6	N		Tr	Tr			b
Total	7	q	X	Y	Yn	K	b	

Source: Socci, 2004, p. 18

The NAM classification includes 63 commodities and 63 industries and has not been modified. Conversely, the decomposition of the value added has brought to 15 components, articulated into 12 compensation of employees' components (see Figure **7**), mixed income, gross operating surplus and taxes less subsidies on production. The institutional sectors are divided into 6 components. Finally, we do have a capital formation account.

Figure 7 - Disaggregation of Compensation of employees



3.4 Data description

Data from the National Accounts database (ISTAT, 2016), as well as well on employment by industry and formal competence have been used. In particular, the Italian National Statistical Institute ISTAT released in 2017 the NAM for 2013.

Value added - as measured in the NAM - was disaggregated by skills and digital competences. As for gender and skill decomposition, Eu-klems data have been employed. They presented a poorly sectoral disaggregation (e.g. the manufacture was presented as a single unit), which had to be opportunely converted into more detailed classification. This result has been achieved by taking into account the intensity of investment in ICT and R&D in terms of value added under the assumption that a higher intensity is strictly correlated with the use of more skilled workers.

The classification by digital skills has been obtained through the "*digital economy and society classification*" (ISTAT, 2016). These data are compiled according to the 2008 SNA and CPA 2008. The statistics in section digital economy and society describe the employees with formal and non-formal competence based on the usage of computer and computer with access to the Internet during the work. These data have a slightly deeper detail in sectoral classification. The transition toward the extremely detailed classification of NAM has been made by using the above mentioned procedure.

Finally, the paper has used the data from Programme for the International Assessment of Adult Competencies (PIIAC) data released by OECD[71]. They are compatible with ISTAT data on digital society and are complementary with them.

The disaggregation of the "Compensation of employees" components is made in relation to formal qualification. In detail, we have 3 groups of skills: no formal qualification up to the primary school diploma, high school diploma and university degree (Eu-Klems source).

For each formal qualification we have a further disaggregation by "computer use" and "computer non use"[72], as proxy; so we are defining the "workers with skills" to define "Skill" and "No skill - Unskill". Moreover, the gender detail is presented for each above-mentioned category in line with the data of formal competence in database Eu-Klems. So there are 12 components of compensation of employees. For this disaggregation we use different database: Eu-Klems, National institute of statistics of Italy (ISTAT), Eurostat and the Europe survey PIIAC (Programme for the international assessment of adult competencies) coordinated by OECD. Table **34** represents a synthetic NAM for Italy 2013 with a disaggregation in 12 components of compensation of employees. The disaggregation in the NAM is in millions of euro.

[71] PIAAC (Programme for the International Assessment of Adult Competencies) is tool engineered by OECD to estimate skill endowment (reading, numeracy and problem-solving) of 16-65 years old labour force. It is a is the, a biannual survey assessing skills of adult population. It involved 2012 24 OECD countries and 166.000 adults in its 2012 first edition.

[72] The definition of "Computer use" is based on the question B4 "*Using computer with access to internet at least once a week*" from the ISTAT survey questionnaire "*Rilevazione sulle tecnologie dell'informazione e della comunicazione nelle imprese (ICT)*".

Table 34 – National Accounting Matrix for Italy 2013 (million euros)

		Commodities	Industries	Primary Factors	Institutional Sectors	Capital Formation	Rest of the World	Total
		1	2	3	4	5	6	7
Commodities	1		1,640,245		1,313,562	272,062	431,689	3,657,558
Industries	2	3,084,351						3,084,351
Compensation of employees - No Formal Qualification – Computer Non Use - M	3		86,274				1,048	87,322
Compensation of employees - No Formal Qualification - Computer Non Use - F			43,843				420	44,263
Compensation of employees - No Formal Qualification – Computer Use - M			28,023				0	28,023
Compensation of employees - No Formal Qualification – Computer Use - F			6,888				0	6,888
Compensation of employees - High School - Computer Non Use - M			60,300				383	60,683
Compensation of employees - High School - Computer Non Use - F			47,566				282	47,847
Compensation of employees - High School – Computer Use - M			113,979				1,005	114,984
Compensation of employees - High School – Computer Use - F			72,710				666	73,376
Compensation of employees - Degree - Computer Non Use - M			12,806				172	12,978
Compensation of employees - Degree - Computer Non Use - F			16,119				186	16,306
Compensation of employees - Degree – Computer Use - M			79,404				427	79,831
Compensation of employees - Degree – Computer Use - F			69,267				418	69,686
Mixed Income			0				0	0
Gross operating surplus			758,496				0	758,496
Taxes less subsidies on production			48,431				0	48,431
Institutional Sectors	4	160,493		1,452,121	1,604,193		94,890	3,311,697
Capital Formation	5				287,479		-15,417	272,062
Rest of the World	6	412,714		-3,008	106,463			516,169
Total	7	3,657,558	3,084,351	1,449,113	3,311,697	272,062	516,169	

Source: our own calculations on ISTAT data

In terms of percentage we would present for each kind of compensation of employees the first 5 commodities with the highest value. The following graphs represent the percentage of compensation of employees within the SAM respect of the total of the same components.

In first time we present the results for the “Computer Non Use - Digital Unskill”.

Figure 8 – % Compensation of employees - No Formal Qualification - Computer Non Use – Male

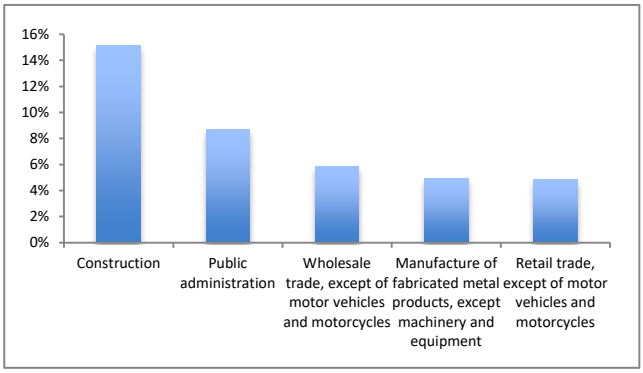
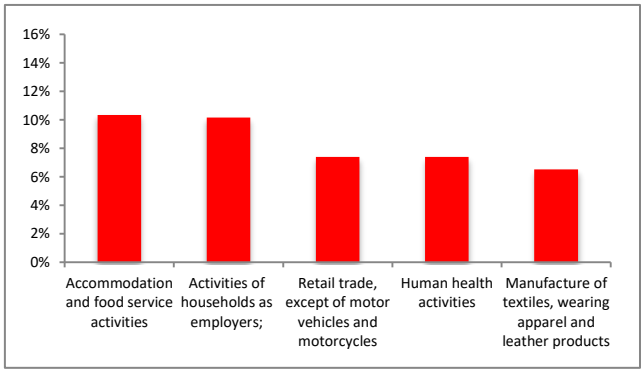


Figure 9 - % Compensation of employees - No Formal Qualification - Computer Non Use - Female



Source: our own calculations on ISTAT data

As for the "No Formal Qualification" component, both males (see Figure **8**) and females (see Figure **9**) show a similar coefficient concentration in the first 5 sectors about 40%; however, sectors are different in both genders in 4 out of 5 cases. As for male employment, Construction (VF) covers about 15% of male workers, followed by "Public Administration and defence; compulsory social security" (VO) with 9% and "Wholesale trade, except of motor vehicles and motorcycles" (V46) with 6%. The last two sectors are "Fabricated metal products, except Manufacture of fabricated metal products, except machinery and equipment" (V25) and "Retail trade, except of motor vehicles and motorcycles" (V47) with about 5%. Female employment is higher instead in "Accommodation and food activities" (VI) and "Activities of households as employers, undifferentiated goods- and services-producing activities of households for own use" (VT) with about 10%. The other three sectors "Retail trade, except of motor vehicles and motorcycles" (V47), "Human health activities" (V86) and "Manufacture of textiles, wearing apparel and leather products" (V13_15) with about 7%.

Figure 10 - % Compensation of employees - High School Diploma - Computer Non Use – Male

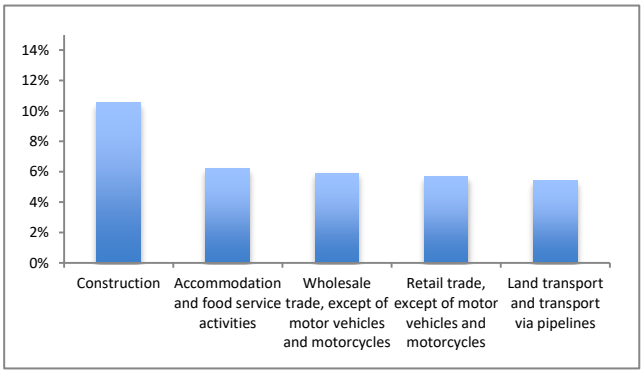
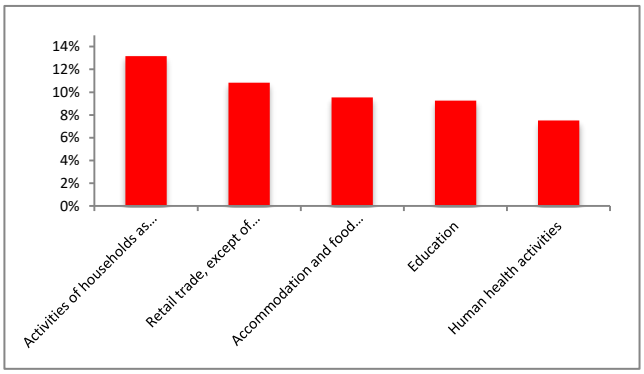


Figure 11 - % Compensation of employees - High School Diploma - Computer Non Use - Female



Source: our own calculations on ISTAT data

For the "High School Diploma" component, Construction (VF) (about 11%) is the male (see Figure **10**) sector absorbing the male employment followed by "Accommodation and food activities" (VI), "Wholesale trade, except of motor vehicles and motorcycles" (V46), "Retail trade, except of motor vehicles and motorcycles" (V47) and "Land transport and transport via pipelines" (V49) with a weight of about 6%. Female employment (see Figure **11**) seems to be more concentrated in the first 5 sectors (about 50%), with the prevalence of gender-specific sectors: "Activities of households as employers, undifferentiated goods- and services-producing activities of households for own use" (VT) with 13%; "Retail trade, except of motor vehicles and motorcycles" (V47) with 11%, "Accommodation and food activities" (VI) and "Education" (VP) with about 10%. "Human health activities" (V86) absorbs about 8% of female employment.

Figure 12 - % Compensation of employees - Degree - Computer Non Use - Male

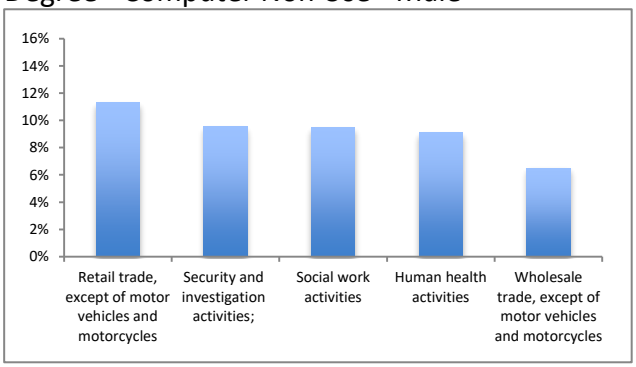
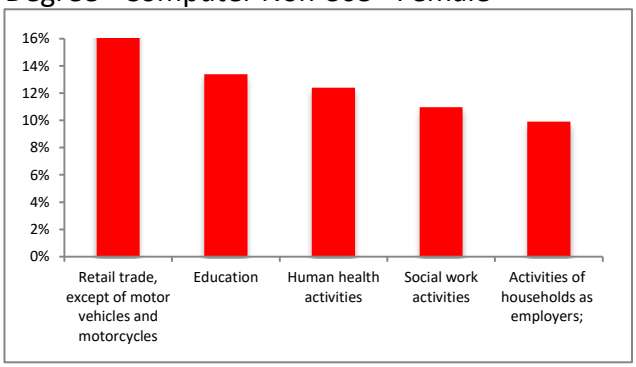


Figure 13 - % Compensation of employees - Degree - Computer Non Use - Female



Source: our own calculations on ISTAT data

As for the "Degree" component (see Figure **12** and Figure **13**), preceding graphs show a lower concentration of male employment vs. female one with a cumulated percentage of about 46% vs. 66%, respectively. Sectors are the same in 3 out 5 cases with a marked prevalence of female employment. Common sectors are: "Retail trade, except of motor vehicles and motorcycles" (V47) about 11% for male and 19% for female, "Social work activities" (V87_88) about 9% for male and 11% for female and "Human health activities" (V86) with about 9% and 12% respectively. The sectors with a male prevalence are "Security and investigation activities; services to buildings and landscape activities; office administrative, office support and other business support activities" (V80_82) with 10% and "Wholesale trade, except of motor vehicles and motorcycles" (V46) with 7%. Education (VP) and "Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use" (VT) (13% and 10%, respectively) show instead a marked female prevalence.

From the viewpoint "Computer Use – Digital Skill" we have the results following.

Figure 14 - % Compensation of employees - No Formal Qualification - Computer Use – Male

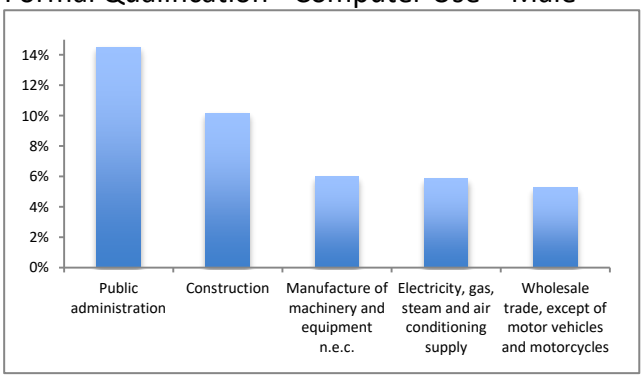
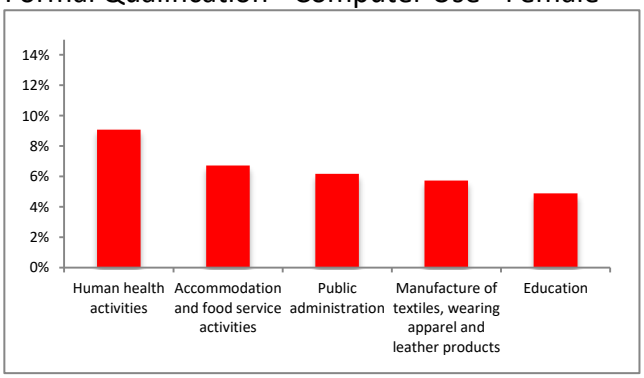


Figure 15 - % Compensation of employees - No Formal Qualification - Computer Use - Female



Source: our own calculations on ISTAT data

For “No Formal Qualification” component, generally males (see Figure **14**) are more concentrated in the first 5 sectors than females (42% vs. 33%) and sectors are different in 4 out 5 sectors. The common sector is the “Public Administration and defence; compulsory social security” (VO) with about 15% for males and 6% for females. Furthermore, male employment shows the highest incidences in Construction (VF) with 10%, followed by “Manufacture of machinery and equipment n.e.c” (V28) “Electricity, gas, steam and air conditioning supply” (VD) and “Wholesale trade, except of motor vehicles and motorcycles” (V46) with a percentage of about 6%. For the female component (see Figure **15**), the characterising sectors are “Human health activities” (V86) with 9%, followed by “Accommodation and food activities” (VI), Manufacture of textiles, wearing apparel and leather products” (V13_15) and Education (VP) with about 6%.

Figure 16 – % Compensation of employees - High School Diploma – Computer Use - Male

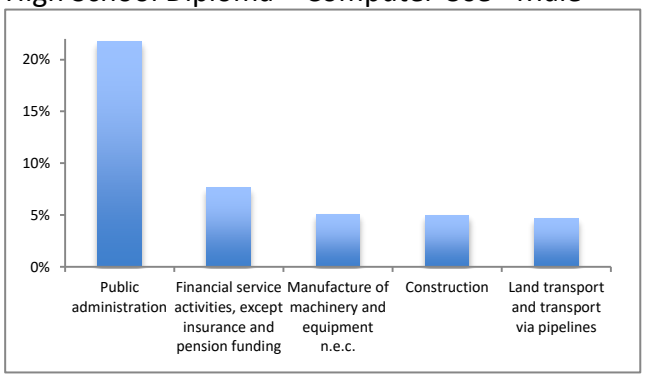
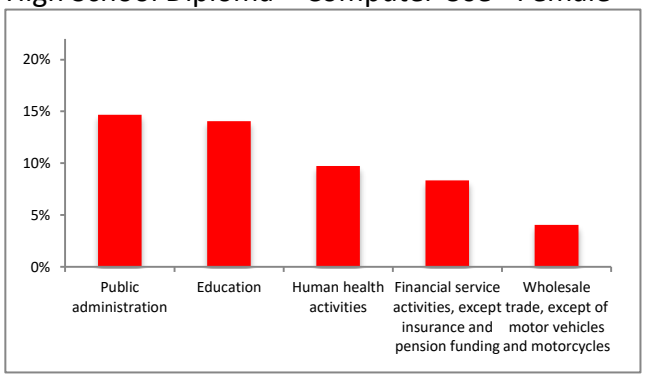


Figure 17 – % Compensation of employees - High School Diploma – Computer Use - Female



Source: our own calculations on ISTAT data

As for the “High school diploma” component (see Figure **16** and Figure **17**), female employment shows a slight prevalence respect to males with a cumulated percentage in the first 5 sectors of 51% vs. 44% vs. respectively. Females and Males register a different sectoral distribution in 3 out of 5 sectors. Common sectors are “Public Administration and defence; compulsory social security” (VO) (with about 22% for males and 15% for females) and “Financial service activities, except insurance and pension funding” (V64) (8% for both males and females). More specifically, as for females, characterising sectors are Education (VP) with 14%, “Human health activities” (V86) with 10%, and “Wholesale trade, except of motor vehicles and motorcycles” (V46) with 4%.

Figure 18 – % Compensation of employees - Degree – Computer Use - Male

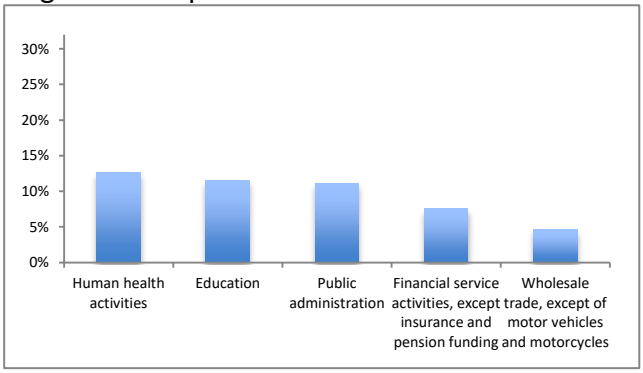
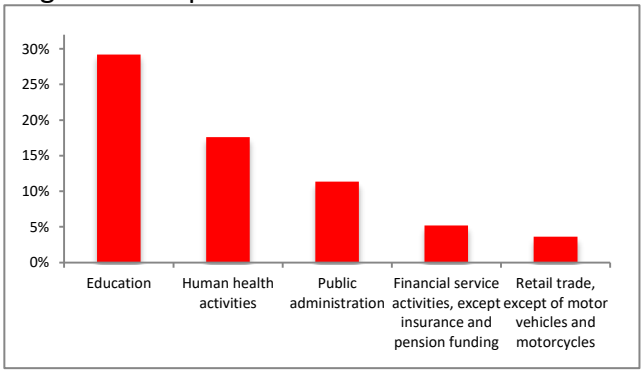


Figure 19 – % Compensation of employees - Degree – Computer Use - Female



Source: our own calculations on ISTAT data

As for the "Degree" component (see Figure **18** and Figure **19**), the first 5 sectors seem to absorb a lower share of male employment than of female ones (47% vs. 67%, the cumulative percentage). Sectoral profiles seem to be similar between both genders in 4 out of 5 cases with the exception of "Wholesale trade, except for motor vehicles and motorcycles" (V46) (5% of male employment) and "Retail trade, except of motor vehicles and motorcycles" (V47) (4% for females). Female employment seems to be markedly higher than male one in Education (VP) (29% and 12%, respectively) and "Human health activities" (V86) (18% for females and 13% for males).

Gender gap is reduced in "Public Administration and defence; compulsory social security" (VO) (11% for both genders) and "Financial service activities, except insurance and pension funding" (V64) (8% for males and 5% for females).

3.5 Extended Multisectoral Model

The methodology is founded on the construction of Social Accounting Matrix (SAM) in which will be represented in disaggregated terms the compensation of employees on the basis of digital characteristics; they will be divided into "workers with skills" and "workers non skills". Furthermore, it might be applied further segmentations related to digital competence.

For this reason in this work the extended multi-sectoral model (Ciaschini and Socci, 2003) is chosen implemented on the Social Account Matrix. This kind of models allows evaluating the policy on the major operators (commodities, primary factors, Institutional Sector) in each point of the income circular flow; modelling an exogenous shock on the policy variable and observing the effects on every formalized variable. The model allows representing the structural relations between productive activities, institutional sectors that carry out the function of production, the

utilization of income and creation of saving. Using the multi-sectoral approach we might analyse the composition of the labour market divided into worker with “digital skills” and “digital non skills” in all industries with high-level ICT.

The model is commodity by commodity with industry technology with $\mathbf{B} = \mathbf{Use} \cdot \hat{\mathbf{g}}^{-\mathbf{1}}$, where **Use** table and $\hat{\mathbf{g}}^{-1}$ the inverse of the diagonal matrix of total output **X**. So, a quadratic matrix commodity by commodity could be reached: $\mathbf{A} = \mathbf{BM}$, where $\mathbf{M} = \mathbf{Make} \cdot \hat{\mathbf{q}}^{-\mathbf{1}}$ is the product of the make table industries by commodities (**M**) e of the inverse of the diagonal matrix of commodity vector q.

The main equation of the model is:

$$\mathbf{x} = \mathbf{A} \cdot \mathbf{x} + \mathbf{f}(\mathrm{x}) \tag{0}$$

and in a model with a make and use structure it can be rewritten as following:

$$\mathbf{q} = \mathbf{B} \cdot \mathbf{M} \cdot \mathbf{q} + \mathbf{f}(\mathrm{q}) \tag{1}$$

which provides a general formulation of the demand driven model with the demand being partly endogenous (i.e. function of q), and partly exogenous.

The share of value added on output can be obtained as the difference between 1 and the sum of coefficients of intermediate inputs of each j production (j=1….m):

$$l_j = 1 - \sum_{i=0}^{m} a_{ij} \tag{2}$$

L(m,m) is the diagonal matrix of the coefficients of value added shares Total value added by commodity can be obtained as the product of matrix **L** with vector **q** of gross output by commodity:

$$\mathbf{v}^{\mathrm{io}}(\mathrm{q}) = \mathbf{L} \cdot \mathbf{q} \tag{3}$$

The matrix of value added $\mathbf{VA}_{\boldsymbol{c}}$ generation commodity by commodity can be obtained as the product of the **VA(use)**(m,m) matrix, whose va_{ij} generic element represents the ratio of each value added component and the total value added amount by industry.

$$\boldsymbol{VA_c} = \mathbf{VA} \cdot \mathbf{M} \cdot \hat{q}^{-1} \tag{4}$$

More generally, a matrix $\mathbf{v^c}(\mathrm{q})$ can be obtained as:

$$\mathbf{v}^{\mathrm{c}} = \mathbf{V} \cdot \mathbf{v}^{\mathrm{io}} \tag{5}$$

where $\mathbf{V}_{(c,m)}$ represents the value added generating matrix by components, whose v_{ij} generic element is the result of the ratio between the i component of value added and the total value by commodity.

Now the primary income by component could be decomposed into institutional sectors in following way:

$$\mathbf{v}^{\mathrm{h}} = \mathbf{P} \cdot \mathbf{v}^{\mathrm{c}} \tag{6}$$

where $\mathbf{P}_{(h,c)}$ shows the structural matrix of distribution shares of value added by components. The generic p_{ij} element is given by the ratio between the j component of value added and the i institutional sector. The whole value added includes also net primary income from the rest of the world (from domestic to national dimension).

Disposable income is obtained by correcting the primary income assigned to institutional sectors through a matric of transfers in the secondary distribution between institutional sectors **T**:

$$\mathbf{y} = (\mathbf{I} + \mathbf{T}) \cdot \mathbf{v}^{\mathrm{h}} \tag{7}$$

where $\mathbf{T}_{(h,h)}$ shows net transfers between institutional sectors and whose generic element t_{ij} is obtained through the ratio between net transfers the total primary income assigned to the institutional sector. Disposable income includes overseas net transfers.

Disposable income can be utilised both to finance consumption expenditures $\mathbf{F} \cdot \mathrm{y}$, and investment decisions $\mathbf{K} \cdot \mathbf{y}$; a share of final demand is considered exogenous $\mathbf{f}^0$:

$$\mathbf{f}(\mathrm{q}) = \mathbf{F} \cdot \mathbf{y} + \mathbf{K} \cdot \mathbf{y} + \mathbf{f}^0 \tag{8}$$

Consumption demand depends both on the structure of consumptions of institutional sectors by products $\mathbf{F}^{1}_{(m,h)}$, and on institutional sectors' consumption propensity coefficients $\mathbf{C}_{(h,h)}$:

$$\mathbf{F} = \mathbf{F^1} \cdot \mathbf{C} \tag{9}$$

As for the demand for investment, it is obtained as follows:

$$\mathbf{K} = \mathbf{K^1} \cdot \mathbf{S} \cdot (\mathbf{I} - \mathbf{C}) \tag{10}$$

where $\mathbf{K}^{1}_{(m,h)}$ shows the structure of investment demands of institutional sectors by commodity and s is a scalar indicating the active saving, that is the share of investment on saving. Scalar s could be also replaced by a diagonal matrix $\mathbf{S}_{(h,h)}$, where each singular element could be obtained a the ratio of the value of investment and saving of each institutional sector.

Consumption and investment decisions could be summed up into one component relative to the total endogenous demand:

$$\mathbf{D} = \mathbf{F} + \mathbf{K} \tag{11}$$

and

$$\mathbf{f}(\mathrm{q}) = \mathbf{D} \cdot \mathbf{y} + \mathbf{f^0} \tag{12}$$

The solution of the model is represented by equation 13 expressed in its structural form:

$$\mathbf{R} = [\mathbf{I} - \mathbf{A} - \mathbf{D} \cdot (\mathbf{I} + \mathbf{T}) \cdot \mathbf{P} \cdot \mathbf{V} \cdot \mathbf{L}]^{-\mathbf{1}} \tag{13}$$

The equation 13 can also be written in its reduced form as:

$$\mathbf{q} = \mathbf{R} \cdot \mathbf{f^0} \tag{14}$$

The previous equation could be also expressed in terms of value added by components, by multiplying both the right side, and the left one by the term:

$$\mathbf{v}^{\mathrm{c}}(\mathrm{q}) = \mathbf{V} \cdot \mathbf{L} \cdot \mathbf{q} = \mathbf{V} \cdot \mathbf{L} \cdot \mathbf{R} \cdot \mathbf{f^0} \tag{15}$$

3.6 Singular Value Decomposition

The inverse matrix **R** combines the direct and indirect effects due to generation of value added, primary distribution, secondary distribution, as well as to final expenditure of income caused by changes in exogenous final demand. The matrix **R** contains takes into account both direct and indirect effects due to a change in the vector of exogenous final demand. So the multi-sectoral approach allows calculating the level (or the change) of total production of each good given the level of (a shock in) the final demand. So the matrix **R** contains disaggregated multipliers, which represent useful tools to study the economic impact of macroeconomic variables. Each element of this matrix represents the requested quantity of the *i*-th good necessary to produce an additional unit of the final demand of *j*-th good. In the traditional approach for the equation (14) unitary structures of the final demand are assumed. Anyway, in this way the issues related to the composition of the final demand are completely overlooked and this could affect relevantly results. An innovative approach that can exceed the limits of Leontief's multipliers is the Macro multiplier (MM) Approach. This methodology has been introduced by Ciaschini (1988) and widely debated and discussed in articles and conferences; it represents an innovation compared to the traditional analysis based on the absolute value change and balance (Ciaschini *et al*.2011a)[73]. Relevant papers are Lancaster and Tiesmenetsky (1985), Meyer (2000)[74], and Ciascini *et al.* (2016)[75] exploiting the singular value decomposition (SVD). This technique allows bringing out several structures optimal or convenient to the economic policy targets. It becomes critical in the case of policy evaluation based on the concept of modulus. The SVD technique decomposes the inverse matrix in the following way:

$$\mathbf{R} = \mathbf{U} \cdot \mathbf{Z} \cdot \mathbf{W}^{\mathbf{T}} \qquad (16),$$

where $\mathbf{U}$ and $\mathbf{W}$ are two *n x n* sized orthonormal matrices and $\mathbf{Z}$ is a *n x n* sized diagonal matrix with real and positive elements (macro-multipliers).

Using the previous defined matrices the matrix $\mathbf{R}$ can be expressed as follows:

$$\mathbf{R} = z_1 \cdot \mathbf{u_1} \cdot \mathbf{w_1} + z_2 \cdot \mathbf{u_2} \cdot \mathbf{w_2} + \ldots\ldots\ldots + z_n \cdot \mathbf{u_n} \cdot \mathbf{w_n} = \sum_{\mathbf{i=1}}^{\mathbf{n}} z_i \cdot \mathbf{u_i} \cdot \mathbf{w_i} \qquad (17),$$

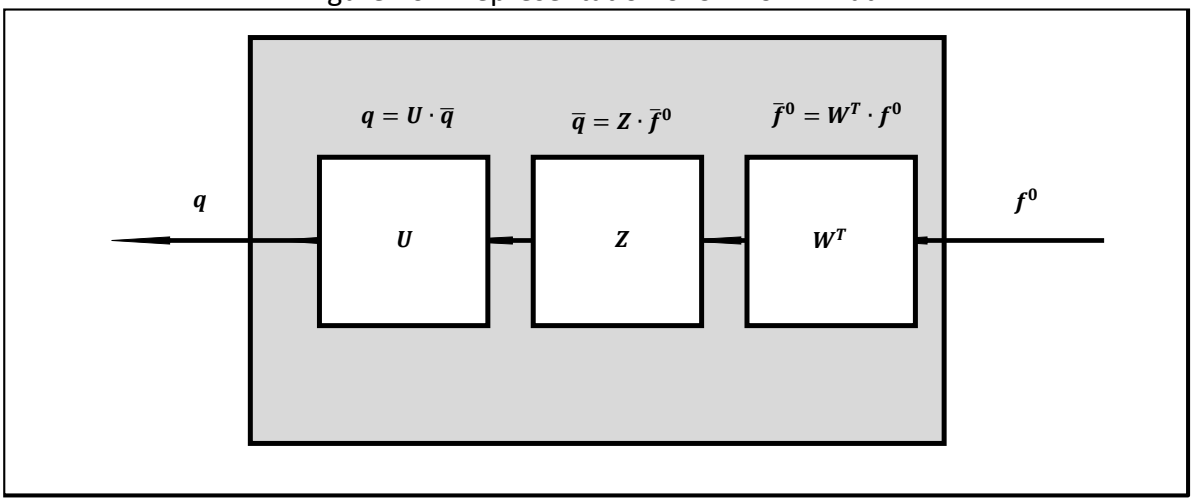
[73] M. Ciaschini, Pretaroli R. and Socci C., "Balance, Manhattan norm and Euclidean distance of industrial policies for the U.S.", Structural Change and Economic Dynamics, 2011.
[74] C.D. Meyer, "Matrix analysis and applied linear algebra", SIAM.
[75] M. Ciaschini, Socci C. and L. Toffoli, "The role of the education industry in the U:S. extended income circular flow", 2016.

where $\mathbf{w_i}$ is the *i-th* column of the matrix $\mathbf{W}$, $\mathbf{u_i}$ is the *i-th* column of the matrix $\mathbf{U}$, and z_i is the *i-th* singular value of the matrix $\mathbf{Z}$. Since the columns of matrix $\mathbf{W}$ are orthonormal, in $z_i \cdot \mathbf{u_i} \cdot \mathbf{w_i}$ only the stimulus given by the control vector $\mathbf{w_i}$ is transmitted, multiplied by the scalar z_i and transformed in the target vector $\mathbf{u_i}$. This can be shown also by substituting (17) in (14), rearranging terms and assuming $\mathbf{U^T} \cdot \mathbf{q} = \bar{\mathbf{q}}$ and $\mathbf{W1}^{\mathrm{T}} \cdot \mathbf{f^0} = \bar{\mathbf{f}}^{\mathbf{0}}$:

$$\bar{\mathbf{q}} = \mathbf{Z} \cdot \bar{\mathbf{f}}^{\mathbf{0}} \qquad (18).$$

The previous equation shows how the target vector $\mathbf{q}$ is represented in the orthonormal basis defined by matrix $\mathbf{U}$ by the vector $\bar{\mathbf{q}}$, so as control vector $\mathbf{f^0}$ is represented by $\bar{\mathbf{f}}^{\mathbf{0}}$ in the orthonormal basis defined by the matrix $\mathbf{W}$. The equations of the (18) are completely independent each other, so that a specific structure defined by a column of the matrix $\mathbf{W}$ activates only one singular value, so to obtain the output lying in the specific column of the matrix $\mathbf{U}$ scaled up by the convenient macro-multiplier. They are macro-multiplier (MM), as they determine the scale of all element of a specific output structure (Ciaschini and Socci, 2007)[76]. The process is represented in the following figure.

Figure 20 – Representation of SVD on R matrix



By using $\mathbf{V} \cdot \mathbf{L} \cdot \mathbf{R}$, as in equation (13), one obtains:

[76] M. Ciaschini, Socci C., "Final Demand impact on output: a Macro Multiplier approach", Journal of Policy Modelling, 2007.

$$\boldsymbol{R_{VA}} = \mathbf{V} \cdot \mathbf{L} \cdot \mathbf{R} = \mathbf{U^{VA}} \cdot \widehat{\mathbf{Z}^{\mathbf{VA}}} \cdot \mathbf{W^{VA^T}} = \sum_{\mathbf{i=1}}^{\mathbf{v}} \mathbf{z_i^{va}} \cdot \mathbf{u_i^{va}} \cdot \mathbf{w_i^{va}} \quad (19)$$

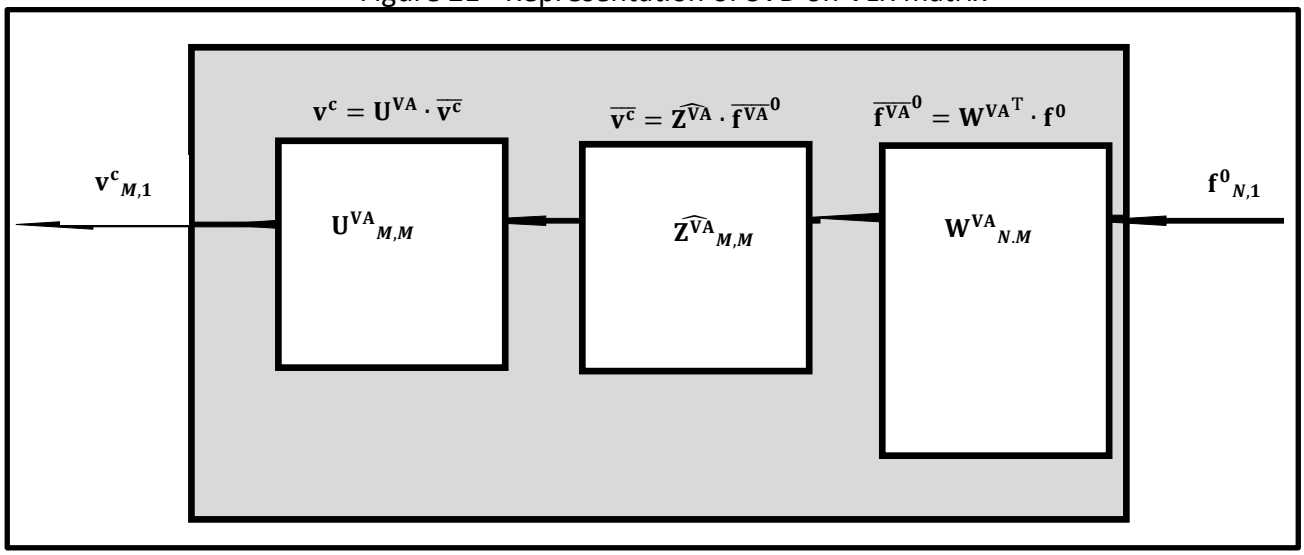
where the matrix $\mathbf{U}^{\mathrm{VA}}$ and the matrix $\mathbf{W}^{\mathrm{VA}}$ are two orthonormal matrices and $\mathbf{Z}^{\mathrm{VA}}$ is a diagonal matrix with positive elements (multipliers). Furthermore, $\boldsymbol{w_i^{va}}$is the t-th column of the matrix $\mathbf{W}^{\mathrm{VA}}$, $\boldsymbol{u_i^{va}}$ is the i-th column of the matrix $\mathbf{U}^{\mathrm{VA}}$, and $\boldsymbol{z_i^{va}}$ is the i-th singular value of the matrix $\mathbf{Z}^{\mathrm{VA}}$. By substituting (19) in (15), rearranging terms and assuming $\mathbf{U^{VA^T}} \cdot \mathbf{v^c(q)} = \overline{\mathbf{v^c}}$ and $\mathbf{W^{VA^T}} \cdot \mathbf{f^0} = \overline{\mathbf{f^{VA}}}^{\mathbf{0}}$:

$$\overline{\mathbf{v^c}} = \mathbf{Z^{VA}} \cdot \overline{\mathbf{f^{VA}}}^{\mathbf{0}} \quad (20)$$

where $\overline{\mathbf{v^c}}$ is the target vector and $\overline{\mathbf{f^{VA}}}^{\mathbf{0}}$ the control vector. Considering that the R_{VA} is a a matrix with dimension 15 value added components (m=1…m) by 63 commodities (n=1…n), we have 15 policy targets and 63 policy controls.

The equation (20) shows how the target $\mathbf{v^c}$ is represented by the vector $\overline{\mathbf{v^c}}$ in the orthonormal basis defined by matrix $\mathbf{U}^{\mathrm{VA}}$, so as control vector $\mathbf{f^0}$ is represented by $\overline{\mathbf{f^{VA}}}^{\mathbf{0}}$ in the orthonormal basis defined by the matrix $\mathbf{W}^{\mathrm{VA}}$. The equations of each sum in (19) are completely independent each other one singular macro-multiplier $\mathbf{z}_i^{va}$, so to obtain the output lying in the specific column of the matrix $\mathbf{U}^{\mathrm{VA}}$ (Ciaschini and Socci, 2007). The process is represented in Figure **21**. In this context the modulus of the dominant structure $\mathbf{w}_1^{va}$ associated with the macro-multiplier $\mathbf{z}_1^{va}$ allows obtaining the highest modulus of the target variable $\mathbf{u}_1^{va}$**.**

Figure 21 - Representation of SVD on VLR matrix



In other words, a policy structure given by a row of the $\mathbf{W^{VA^T}}$ matrix transforms the exogenous final demand vector into the control variable. This contributes to determine the level of the target variable through the convenient multiplier. The new value added vector is given by multiplying the $\mathbf{U^{VA}}$ matrix by the target variable. One can adopt or the best demand structure with the highest multiplier, or a combination of demand structures that allow strengthening the effects on specific components of value added (in our case, the highest skilled workers with digital competences).

Analysing all the structures the objective variables are $z_1^{va} \cdot \mathbf{u_1^{va}}$ and $z_2^{va} \cdot \mathbf{u_2^{va}}$. The following equations present the formalisation of the linear combination of structure 1 and structure 2:

$$f^0 = \alpha_1 \cdot \mathbf{w}_1 + (1 - \alpha_1) \cdot \mathbf{w}_2 \tag{21}$$

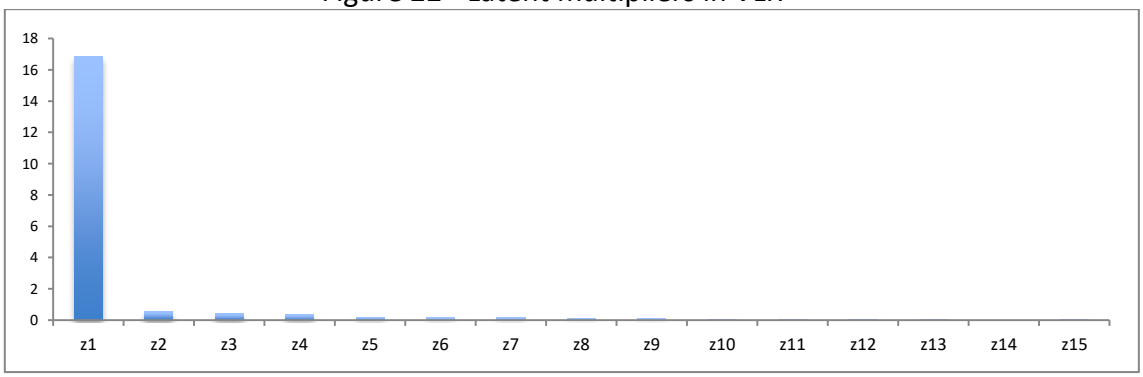
$$\mathbf{vc} = \alpha_1 \cdot z_1 \cdot \mathbf{u}_1 + (1 - \alpha_1) \cdot z_2 \cdot \mathbf{u}_2 \tag{22}$$

where the equation (21) represents the combined input structure and the equation (22) the combined effect on value added component as output.

3.7 Macro Multiplier Analysis and relationship between final demand and value added

The multipliers obtained by the decomposition are 63 and they are activated from 63 final demand structures and then generate 63 value added structures (output). The first 15 MMs are represented as in Figure **22** and only the first one is greater than 1 exerting an expansive effect on the target variable.

Figure 22 - Latent multipliers in VLR

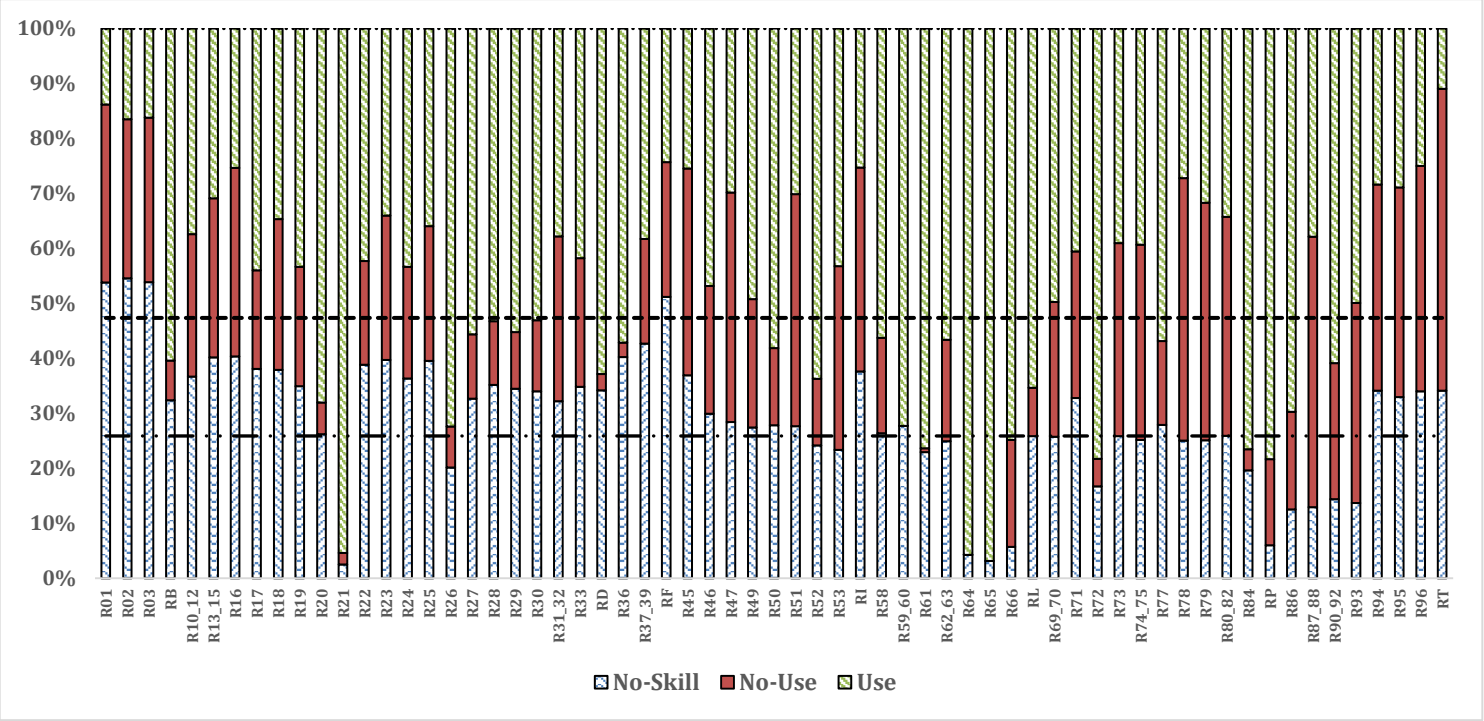


Source: our own calculations on ISTAT data

MMs quantify the aggregate effects of the demand structures; furthermore MMs are connected with total production structures given a shock on the final demand. The paper addresses the issue of developments of employment by skill by simulating a shock on the final demand in the commodities with high skill intensity, in order to obtain the larger effect on skilled components of value added. That policy can be focused on the commodities with high skill intensity defined as the share of skilled labour compensation on the total labour compensation. The first structure is associated to the highest multiplier and therefore it presents a high impact on all components. The third structure seems to be particularly favourable to skilled and digitalised labour components. The other structures are instead less relevant. The first and the third multiplier cover about 91% of the total value of multipliers.

The labour compensation of the Italian productive structure is composed as it follows: not-skilled workers with 25.9%; workers with secondary or tertiary education without digital competences with 21.5%; workers with secondary or tertiary education with digital competences with 52.6% (see Figure **23**). These shares are effected by huge wage differentials between the 3 categories: +22.2% between second and first one above mentioned, +36.6% the third and second above mentioned categories. The sectors with the highest percentage of "Computer use - Digital Skill" (see green bars in the following graph) is "Insurance, reinsurance and pension funding services, except compulsory social security" (R65) equal 96.8%. Other relevant sectors are with highest in "Financial services, except insurance and pension funding" (R64) and "Basic pharmaceutical products and pharmaceutical preparations" (R21) with an incidence above 95%. Moreover, among services "Scientific research and development services" (R72) and "Education services" (RP) emerge with 78.3%. Also "Public administration and defence services; compulsory social security services" (R84) and "Telecommunications services" (R61) have intensities amounting to 76.5% and 76.3%, respectively. "Services auxiliary to financial services and insurance services" (R66), "Computer, electronic and optical products" (R26) and "Motion picture, video and television programme production services, sound recording and music publishing and Programming and broadcasting services" (R59_60) have got a high incidence of workers with secondary or tertiary education with digital competences (amounting to 74.9%, 72.4% and 72.3% respectively).

Figure 23 – Skill labour compensation intensity by commodities



Source: our own calculations on ISTAT data

Using the MM approach we can identify a set of endogen structures adequate to our objective, obviously increasing the value added components with high formal competence and digital skill. All the 15 output structures resulting from Singular Value Decomposition are shown in appendix. The first structure (see Table **35**) is associated with the highest multiplier and therefore it presents a high impact on all components. The third structure seems to be particularly favourable to skilled and digitalised labour components. The other structures are instead less relevant. The first and the third multiplier cover about 91% of the total value of multipliers.

Table 35 – Adequate structures to increase value added with formal competence and digital skills

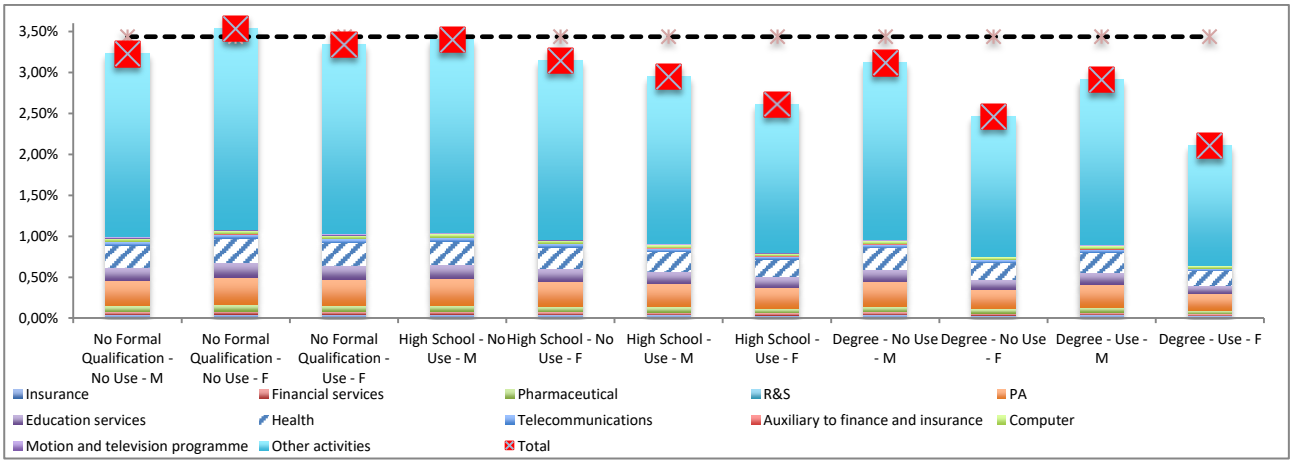
	Structures	
Value added components	$z_1^{va} \cdot \mathbf{u_1^{va}}$	$z_3^{va} \cdot \mathbf{u_3^{va}}$
1	1.683	-0.084
2	0.939	-0.104
3	0.597	0.005
4	0.139	-0.000
5	1.239	-0.079
6	0.904	-0.113
7	2.032	0.104

8	1.149	0.119
9	0.242	-0.020
10	0.240	-0.015
11	1.398	0.213
12	0.881	0.247
13	0.000	-0.000
14	16.386	-0.029
15	0.803	0.076

Source: our own calculations on ISTAT data

Using the structure 1, the effects on the value added components are always positive both for skilled and for non-skilled workers. However, the main effects are for non-skilled female workers and low - skilled digitalised male employment (both around 3.5%). The value added attributable to digitalised components are slightly lower than non-digitalised ones, by amounting to 3.0% for makes and ranging between 2.0-2.5% for females). The digitalised not-skilled components register an impact near to 3.5%. As for the decomposition by activity, it emerges that the "Other activities" segment is higher for not-skilled than for skilled, while the effects due to the Public Administration, education and health services are similar among all work categories.

Figure 24 – Effect on the value added components related an increase 1% of the final demand using the structure 1

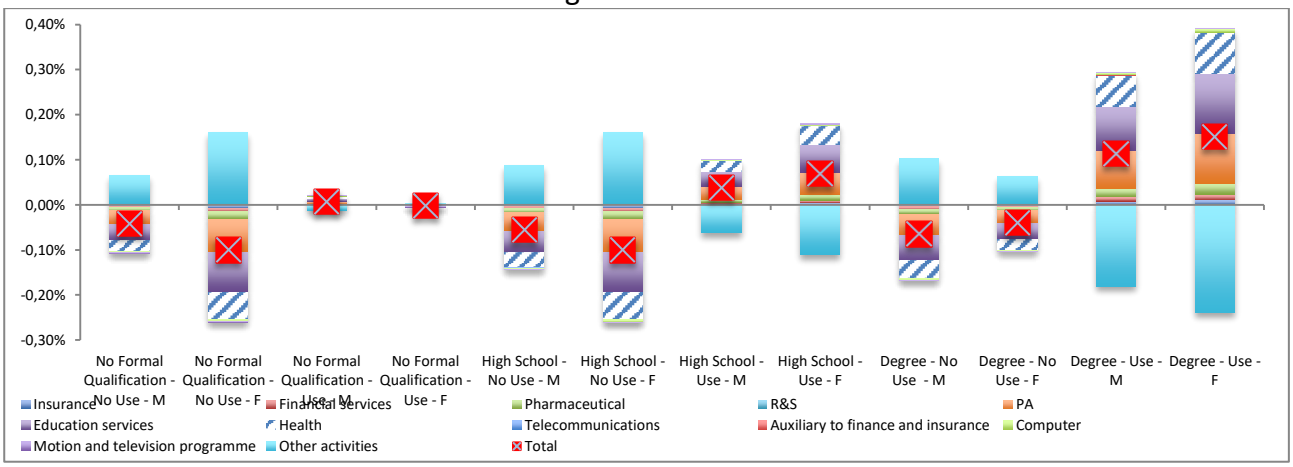


Source: our own calculations on ISTAT data

Using the structure 3 (see Figure **25**) positive effects are registered only for the digitalised workers with an impact ranging from 0.11-0.15% for high skilled workers and 0.04-0.07% for medium-skilled females. All high skill-intense activities contribute positively to the labour value added components, with a particularly marked effects for Public Administration, education and

health services. Other activities have a negative impact on (especially high-skilled) digitalised segments. The not-relevant role of research and development is the result of the low weight of this activity on the total output in Italy.

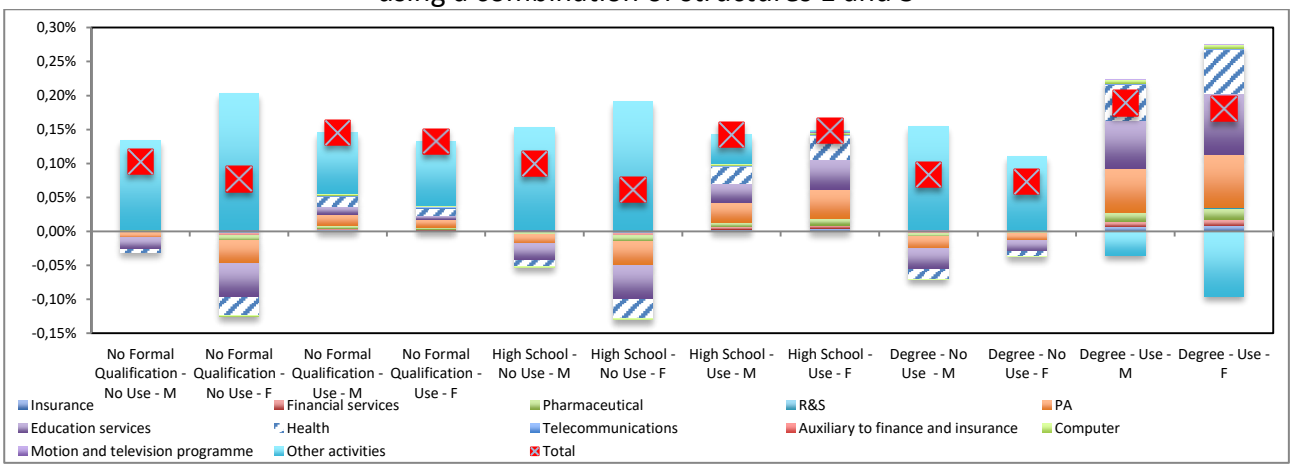
Figure 25 – Effect on the value added components related an increase 1% of the final demand using the structure 3



Source: our own calculations on ISTAT data

As a consequence of previous conclusions, we can take a combination of structures 1 and 3 to maximise the impact in terms of skilled segments of value added. This combined policy supports both medium-skilled (around 0.24%) and high-skilled (around 0.19%) digitalised components. Furthermore, the complementarity between the high- and medium-skilled work and the low-skilled digitalised work (around 0.19%) is confirmed. Furthermore, the increase in digitalised high-skilled workers' employment implies a higher employment in digitalised medium- and low-skilled workers driven by the production function of education and public administration activities, as well in pharmaceutical products (in lower extent). Digitalisation seems also to exert an effect, as shown by the "Other activities" component; this activity has a positive effect only on the high-skilled digitalised components differently from all the other components, by showing a clear skill-bias of technological change.

Figure 26 – Effect on the value added components related an increase 1% of the final demand using a combination of structures 1 and 3

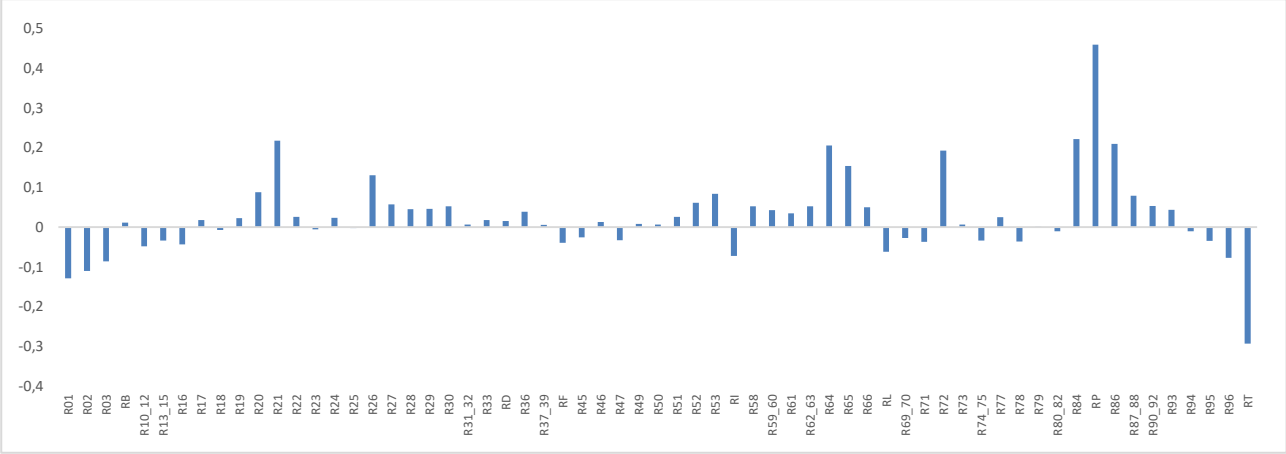


Source: our own calculations on ISTAT data

The resulting combined structure of policy controls is shown in Figure **26**. It shows that all digitalised segments perform better than non-digitalised ones. The best performers are both the high-skilled ranging around 0.20%, followed by the low- and medium-skilled ranging around 0.15%. However there are different patterns with a particularly high contribution from Public Administration, education and health services for high-and medium-skilled workers and a relevant contribution of other activities to low-skilled digitalised segments. As for the non-digitalised components, the role of the other activities prevails with negative or positive low contributions by the skill-intensive activities. The R&D activity seems to be not very significant both for non-digitalised, and for digitalised segments.

The resulting combined structure of policy controls is shown in the following figure. The commodities with the highest impact are the following: Education (RP with 0.46), Public administration (R84 with 0.22), Basic pharmaceutical products and pharmaceutical preparations (R21 with 0.22), Human health services (R86 with 0.21), Financial services (R64 with 0.21), R&D products (R72 with 0.19) and Insurance (R65 with 0.15).

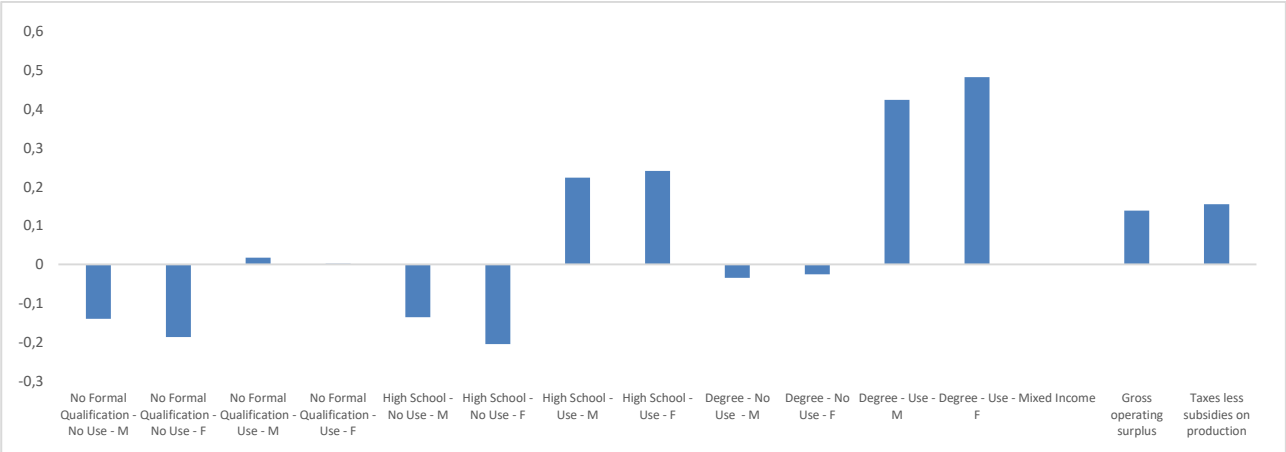
Figure 27 – Mix control structures 1 and 3



Source: our own calculations on ISTAT data

The effect on value added components by skill of the previously defined structure is given by the following figure. The highest impact is on the labour components with digital skills. Advantages are distributed according to formal educational attainment: the most favoured are tertiary educated workers (both males with 0.22 and females with 0.24) followed by secondary educational attainment (males with 0.42 and females with 0.48). The impact is higher for women than for men (especially for less skilled components), so to reduce the gender gap existing in the Italian labour market.

Figure 28 –1 and 3 mixed target structures



Source: our own calculations on ISTAT data

3.8 Conclusion and policy implication

Globalisation and knowledge based technological development (ICT) have generally determined relevant changes in the composition of the labour market with a polarisation between high skilled and digitalised occupations and low skilled and non-digitalised ones. The deeper integration among international products and labour markets has produced changes in the global value chain.

In this framework, international institutions, in particular the European Commission emphasised the key role of digitalisation (that is the increase of the weight of high skilled occupation on total employment) to achieve a more robust and sustainable growth by gaining a more favourable position in the international division of labour. At the same time, policies have been implemented and funds earmarked. In Italy a total of 610 small and medium-sized enterprises (SMEs) have been selected for funding under the SME Instrument. The companies received a total amount of €146 million to share between their projects to get their innovations faster on the market[77].

The paper has analysed the incidence of formal and digital skills by gender on the labour compensation within a SAM scheme for the Italian economy in 2013. In this way 12 labour components have been identified. Furthermore, the paper has evaluated the economic impact of policy instruments on the composition of the labour compensation through the MM approach based on an extended multisectoral model. Final demand is expressed in terms of commodities produced by activities, both as primary, and as secondary products. The decomposition of the R_{VA} matrix allows extracting the different structures of final demand. A linear combination of 2 structures has been extracted, in order to maximise the effects in terms of digitalised and skilled value added components.

Generally, the commodities employing the largest share of digitalised workers turned out to be insurance, reinsurance and pension funding services, financial services, pharmaceutical products, education services, R&D and Public Administration. Female employment seems to be more "segregated" in education and human health services. These commodities are relevant both in terms of size on the economic system and in terms of skill intensity (i.e. the share of skilled labour compensation on the total labour compensation).

Public Administration, education and health services seem to be the activities mainly increasing the value added component devoted to high-skilled digitalised workers. The R&D, telecommunications, financial and insurance services, as well pharmaceutical products seem to

[77] See "EIC SME Instrument data hub" https://sme.easme-web.eu/#.

generate low share of value added in Italy. The high reliance of high-skilled digitalised work on activities strictly tied to public finance is therefore both the sign of the inadequacy of innovative private sectors, and risks to employ very qualified workers in low innovative jobs with consequent inadequate productivity developments. Moreover, innovation does not seem to spread from innovative activities to the remaining productive system, as indicated by the low or negative contribution of other activities to educated value added segments and their relevant and positive contribution to low skilled and low digitalised segments. Simultaneously, the concentration of high-skilled labour in the public sector exposes them to the risks and uncertainties linked to public finance consolidation, especially in countries with a high debt/GDP ratio.

Moreover, employing high-skilled workers in the so called “public” sector could reduce the size of labour supply adequate to cover the complex and non-routine jobs in the high-value added phases of GVC. This could perpetuate the current specialisation of Italy in traditional and low technology productions with the consequent risks of increasing productivity gaps with the other developed countries and of increasing international competition with developing countries. Only effective industrial policies aimed at supporting innovation, increasing labour demand and supply of high-skilled digitalised workers and creating opportunities to develop private innovative sectors could help to escape from the inadequate and critical international position of the country. As for the latter remark, governments could introduce tax incentives for innovative firms, by directly supporting the inflows of FDIs, and/or launch a long-term investment plan creating new reliable opportunities for the expansion of innovative sectors. This latter target could benefit from a deep process of spending review, which could also open more room for E-Government tools and so to adequately use high-qualified workers employed in the Public Administration.

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3.10 Appendix

Table 36 - Commodities

R01	Products of agriculture, hunting and related services
R02	Products of forestry, logging and related services
R03	Fish and other fishing products; aquaculture products; support services to fishing
RB	Mining and quarrying
R10_12	Food products, Beverages and tobacco products
R13_15	Textiles, wearing apparel and leather and related products
R16	Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials
R17	Paper and paper products
R18	Printing and recording services
R19	Coke and refined petroleum products
R20	Chemicals and chemical products
R21	Basic pharmaceutical products and pharmaceutical preparations
R22	Rubber and plastics products
R23	Other non-metallic mineral products
R24	Basic metals
R25	Fabricated metal products, except machinery and equipment
R26	Computer, electronic and optical products
R27	Electrical equipment
R28	Machinery and equipment n.e.c.
R29	Motor vehicles, trailers and semi-trailers
R30	Other transport equipment
R31_32	Furniture and Other manufactured goods
R33	Repair and installation services of machinery and equipment
RD	Electricity, gas, steam and air conditioning
R36	Natural water; water treatment and supply services
R37_39	Sewerage services; sewage sludge, Waste collection, treatment and disposal services; materials recovery services and Remediation services and other waste management services
RF	Constructions and construction works
R45	Wholesale and retail trade and repair services of motor vehicles and motorcycles
R46	Wholesale trade services, except of motor vehicles and motorcycles
R47	Retail trade services, except of motor vehicles and motorcycles
R49	Land transport services and transport services via pipelines
R50	Water transport services
R51	Air transport services
R52	Warehousing and support services for transportation
R53	Postal and courier services
RI	Accommodation and food services
R58	Publishing services
R59_60	Motion picture, video and television programme production services, sound recording and music publishing and Programming and broadcasting services
R61	Telecommunications services
R62_63	Computer programming, consultancy and related services and Information services
R64	Financial services, except insurance and pension funding
R65	Insurance, reinsurance and pension funding services, except compulsory social security
R66	Services auxiliary to financial services and insurance services
RL	Real estate services
R69_70	Legal and accounting services and Services of head offices; management consulting services
R71	Architectural and engineering services; technical testing and analysis services
R72	Scientific research and development services
R73	Advertising and market research services
R74_75	Other professional, scientific and technical services and Veterinary services
R77	Rental and leasing services
R78	Employment services
R79	Travel agency, tour operator and other reservation services and related services
R80_82	Security and investigation services, Services to buildings and landscape and Office administrative, office support and other business support services
R84	Public administration and defence services; compulsory social security services
RP	Education services
R86	Human health services

R87_88	Residential care services and Social work services without accommodation
R90_92	Creative, arts and entertainment services, Library, archive, museum and other cultural services and Gambling and betting services
R93	Sporting services and amusement and recreation services
R94	Services furnished by membership organisations
R95	Repair services of computers and personal and household goods
R96	Other personal services
RT	Services of households as employers; undifferentiated goods and services produced by households for own use

Table 37 - Industries

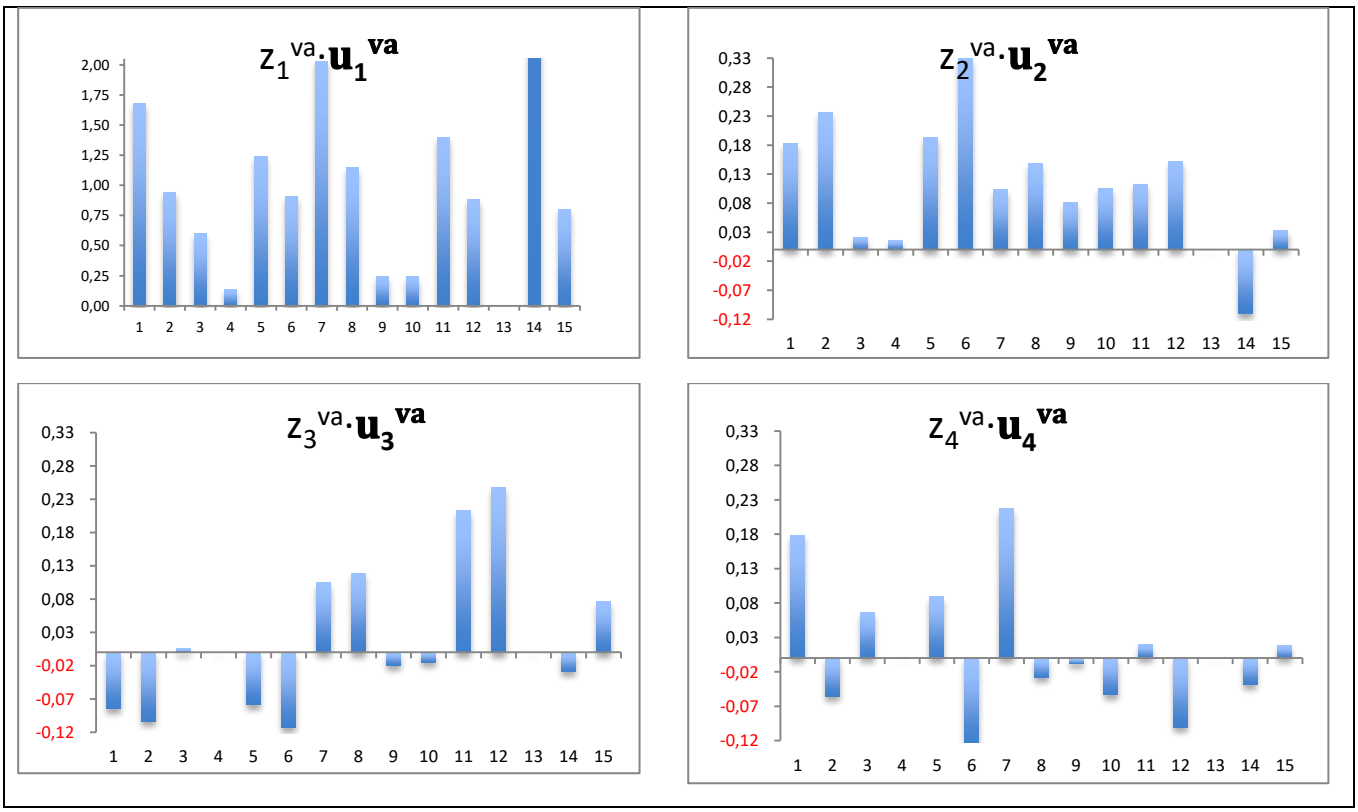
V01	Crop and animal production, hunting and related service activities
V02	Forestry and logging
V03	Fishing and aquaculture
VB	Mining and quarrying
V10_12	Manufacture of food products, beverages and tobacco products
V13_15	Manufacture of textiles, wearing apparel and leather products
V16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
V17	Manufacture of paper and paper products
V18	Printing and reproduction of recorded media
V19	Manufacture of coke and refined petroleum products
V20	Manufacture of chemicals and chemical products
V21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
V22	Manufacture of rubber and plastic products
V23	Manufacture of other non-metallic mineral products
V24	Manufacture of basic metals
V25	Manufacture of fabricated metal products, except machinery and equipment
V26	Manufacture of computer, electronic and optical products
V27	Manufacture of electrical equipment
V28	Manufacture of machinery and equipment n.e.c.
V29	Manufacture of motor vehicles, trailers and semi-trailers
V30	Manufacture of other transport equipment
V31_32	Manufacture of furniture; other manufacturing
V33	Repair and installation of machinery and equipment
VD	Electricity, gas, steam and air conditioning supply
V36	Water collection, treatment and supply
V37_39	Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services
VF	Construction
V45	Wholesale and retail trade and repair of motor vehicles and motorcycles
V46	Wholesale trade, except of motor vehicles and motorcycles
V47	Retail trade, except of motor vehicles and motorcycles
V49	Land transport and transport via pipelines
V50	Water transport
V51	Air transport
V52	Warehousing and support activities for transportation
V53	Postal and courier activities
VI	Accommodation and food service activities
V58	Publishing activities
V59_60	Motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activities
V61	Telecommunications
V62_63	Computer programming, consultancy and related activities; information service activities
V64	Financial service activities, except insurance and pension funding
V65	Insurance, reinsurance and pension funding, except compulsory social security
V66	Activities auxiliary to financial services and insurance activities
VL	Real estate activities (excluding imputed rent)
V69_70	Legal and accounting activities; activities of head offices; management consultancy activities
V71	Architectural and engineering activities; technical testing and analysis
V72	Scientific research and development
V73	Advertising and market research
V74_75	Other professional, scientific and technical activities; veterinary activities
V77	Rental and leasing activities
V78	Employment activities
V79	Travel agency, tour operator reservation service and related activities
V80_82	Security and investigation activities; services to buildings and landscape activities; office administrative, office support and other business support activities
VO	Public administration and defence; compulsory social security
VP	Education
V86	Human health activities
V87_88	Social work activities

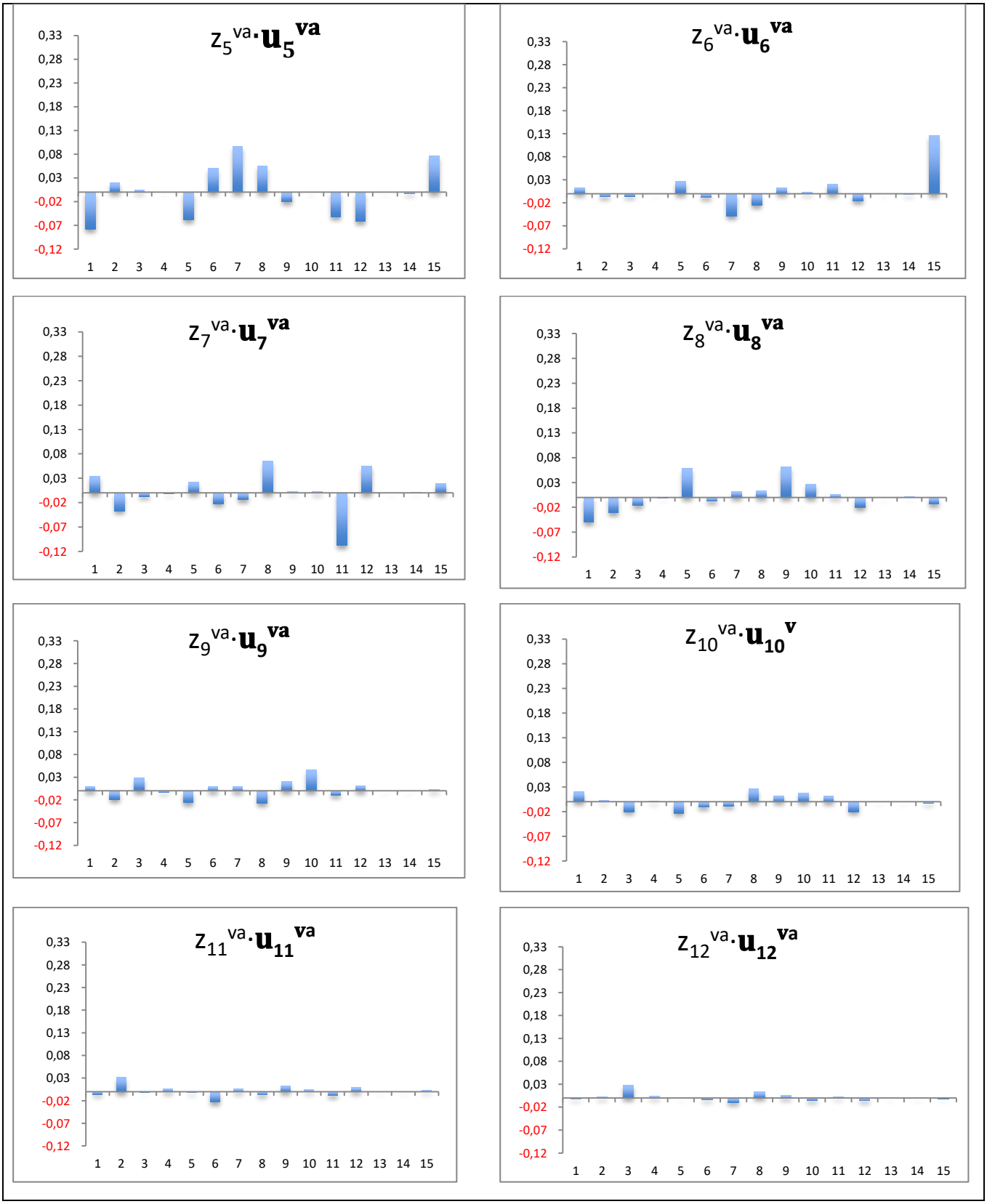
V90_92	Creative, arts and entertainment activities; libraries, archives, museums and other cultural activities; gambling and betting activities
V93	Sports activities and amusement and recreation activities
V94	Activities of membership organisations
V95	Repair of computers and personal and household goods
V96	Other personal service activities
VT	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use

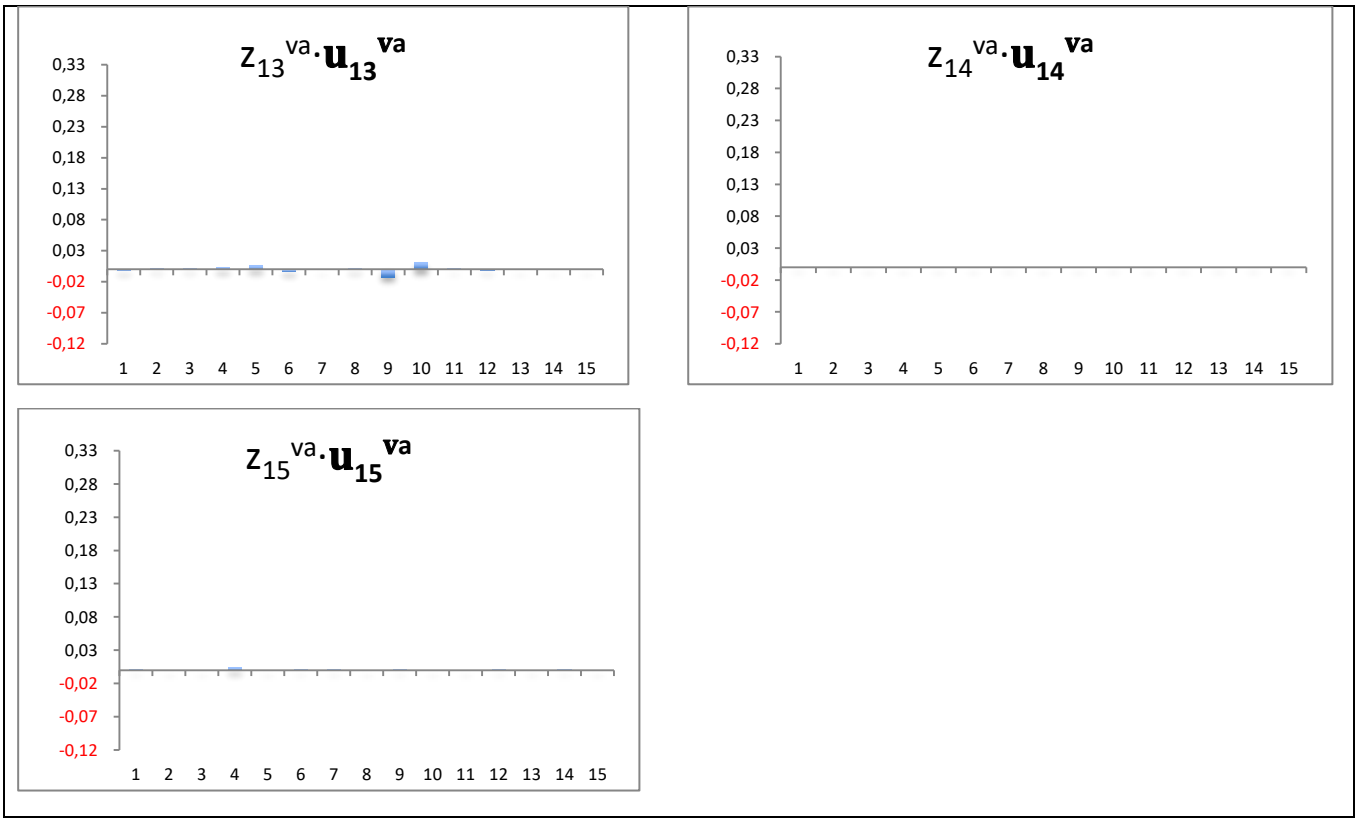
Table 38 - Components of value added

VA01	Labour: No Formal Qualification -Non Use - M
VA02	Labour: No Formal Qualification -Non Use - F
VA03	Labour: No Formal Qualification -Use - M
VA04	Labour: No Formal Qualification -Use - F
VA05	Labour: High School - Non Use - M
VA06	Labour: High School - Non Use - F
VA07	Labour: High School - Use - M
VA08	Labour: High School - Use- F
VA09	Labour: Degree - Non Use - M
VA10	Labour: Degree - Non Use - F
VA11	Labour: Degree - Use - M
VA12	Labour: Degree - Use - F
VA13	Mixed Income
VA14	Gross operating surplus
VA15	Taxes less subsidies on production

Figure 29 - Output structures from the singular value decomposition




$z_5^{va}.u_5^{va}$
$z_6^{va}.u_6^{va}$
$z_7^{va}.u_7^{va}$
$z_8^{va}.u_8^{va}$
$z_9^{va}.u_9^{va}$
$z_{10}^{va}.u_{10}^{v}$
$z_{11}^{va}.u_{11}^{va}$
$z_{12}^{va}.u_{12}^{va}$
0,33
0,28
0,23
0,18
0,13
0,08
0,03
-0,02
-0,07
-0,12
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15



Source: our own calculations on ISTAT data