

Technological
Innovation
and the Effect
of the Employment
on the EU Countries

Technological Innovation and the Effect of the Employment on the EU Countries

By

Andrea Vicini

Cambridge
Scholars
Publishing



Technological Innovation and the Effect of the Employment
on the EU Countries

By Andrea Vicini

This book first published 2016

Cambridge Scholars Publishing

Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, UK

British Library Cataloguing in Publication Data

A catalogue record for this book is available from the British Library

Copyright © 2016 by Andrea Vicini

All rights for this book reserved. No part of this book may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of the copyright owner.

ISBN (10): 1-4438-8576-2

ISBN (13): 978-1-4438-8576-8

TABLE OF CONTENTS

List of Figures.....	vii
List of Tables.....	ix
List of Abbreviations.....	xi
Preface.....	xiii
Acknowledgments.....	xv
Author Biography.....	xvii
Chapter One.....	1
Introduction and main concepts	
1.1. Problem Statement	
1.2. Purpose of Research	
1.3. The importance of the debate and the meaning of this study	
1.4. Research Design	
1.5. Research Questions and Hypothesis	
1.6. Assumptions and Limitations	
1.7. Operational Definition	
Chapter Two.....	13
Theoretical and Historical Perspective of the Question	
2.1. Historical Perspective	
2.2. Theoretical Orientation for the current research	
2.3. Critical Analyses of Previous Research	
Chapter Three.....	47
Methodological and Epistemological Questions	
3.1. Research Design	
3.2. Research Questions and Hypothesis	
3.3. Population and Sampling Strategy	
3.4. Research Instrument	
3.5. Data Collection Procedures	

3.6. Data Analysis	
3.7. Summary and Conclusion	
Chapter Four	63
Analysis and Presentation of the Results	
4.1. Demographic Statistics	
4.2. Details of Analysis and Results	
4.3. Summary of Results	
Chapter Five	101
Conclusions and Policy Recommendations	
5.1. Summary of the Results	
5.2. Discussion of the Results	
5.3. Conclusions and Practical Recommendations	
5.4. Recommendations for Further Research	
Appendix A	115
Bibliography	119
Index of Authors.....	135

LIST OF FIGURES

- Figure 3-1: Mixed-Method Design Matrix with Mixed-Method Research Designs
- Figure 4-1: The measurement Framework of the Innovation Union scoreboard
- Figure 4-2: Summary Innovation Index (2013), for a Sample of Countries
- Figure 4-3: Global Innovation Index (2013), for the Countries Sampled
- Figure 4-4: Scatter Plot with Linear Relation between SII (2013) and UG Referred to (2000-2013)
- Figure 4-5: Scatter Plot with Linear Relation between GII (2013) and UG Referred to (2000-2013)
- Figure 4-6: Annual Unemployment Rate (2000-2013)
- Figure 4-7: Dispersion Graph with SII and the Range of Unemployment Rate (2010-2013)
- Figure 5-1: Movements in the Top Ten of the Global Innovation Index (2011-2014)

LIST OF TABLES

- Table 2-1: Synthesis of the Approaches to Innovation and Employment
- Table 2-2: Job Polarisation and the Different Theoretical Interpretations Proposed
- Table 2-3: The Different CMs and the Results Obtained by the Empirical Researches
- Table 3-1: Typology of Mixed Method Legitimation Types with Examples
- Table 4-1: Summary Innovation Index (2014), for the Countries Sampled
- Table 4-2: Global Innovation Index (2014), for the Countries Sampled
- Table 4-3: Global Innovation Index (2014). Two components and one ratio
- Table 4-4: Comparison among SII and GII, Referred to 2013
- Table 4-5: Elaboration on: SII (2013), GII (2013) and Average Growth Rate of Unemployment Rate (2000-2013)
- Table 4-6: SII (2013) and UG (2010-2013)
- Table 4-7: SII (2013) Combined with Unemployment Rates
- Table 4-8: SII (2013), Unemployment Range (2010-2013) and Results of the Research Questions (a) and (b)

LIST OF ABBREVIATIONS

AT	Austria
BERD	Business Expenditure in Research and Development
BLS	Bureau of Labour Statistics
CH	Switzerland
CIA	Central Intelligence Agency
CIS	Community Innovation Surveys
DE	Germany
DK	Denmark
EU	European Union
FDI	Foreign Direct Investment
FP7	EU's Seventh Framework Programme
FR	France
GDP	Gross Domestic Product
GII	Global Innovation Index
H_0	Null Hypothesis
H_1	Alternative Hypothesis
ICF	Intelligent Community Forum
ICT	Information and Communication Technology
IE	Ireland
IMF	International Monetary Fund
IPR	Intellectual Property Rights
IT	Italy
IUS	Innovation Union Scoreboard
JRC	Point Research Centre
MHT	Medium High Tech
OECD	Organisation for Economic Co-operation Development
PCT	Patent Cooperation Treaty
PRO	Public Research Organisation
R&D	Research and Development
R&I	Research Innovation
RDI	Research and Development Innovation
ROI	Return on Investment
SII	Summary Innovation Index
SMEs	Small and Medium Enterprises
TC	Technical/Technological Change
UG	Growth of Unemployment rate

UK	United Kingdom
US	United States
WB	World Bank
WIPO	World International Property Organisation

PREFACE

In the last decade, unemployment has become the main socio-economic emergence for developed countries. In Europe, although the majority of countries are classified as high income, and welfare mitigates the risks derived from unemployment, the high rate of unemployment remains a generator of poverty and exclusion, with many socio-economic consequences. For a long time, technological change, in particular when addressed to process and organisational innovation, appeared as a generator of unemployment. The central idea of this book is that although the effects of technological change, and in particular transformations, happened as a consequence of the ICT revolution, they are tangible and visible for all, and remain an ancient idea, which is a mixture of historic pre-concept and myth of the golden era. Second to these ideas, innovation and new technology are seen as the source of decline for the labour force, and the main cause of unemployment for the blue-collars, and then the white collars. The new challenge consists in discussing old convictions and embracing, with critical sense, new ideas, without following majority trend and rapid conclusions.

Probably for many readers a lot of concepts result and are presented in an original way, and some passages appear not completely related, however my scope is not to confirm an “old truth” but to break the old “straitjacket” in order to explore new paths, directions and opportunities for research, without falling into unavailability which is not constructive for scientific progress.

The neoclassical school, although praising a great number of followers and advocates with acceptance and exposing their paradigms similarly to the natural law, did not produce a theoretical model close to the real condition; in other terms not contributed to the understanding of the economic phenomena, reinforcing consciously, or in other cases subconsciously, the dominant ideas. This aspect appeared in all lucidity after the recent financial crisis (2007-2011). Its worst shortcoming is the pretension of express truths.

Economics science is not compatible with a monolithic vision composed of undisputable truths, but from concepts, which are variable during time and contexts, the plurality of thought and the methodological differences are vital for the progress of the *dismal science*.

ACKNOWLEDGMENTS

During my life, I have met many intelligent and courageous people who were ready to discuss old convictions, proposing new visions. To these minds, I want to dedicate the present work, to everyone who thinks with their head, free of any conditioning.

Naturally, I am grateful to my supporters, and so the first dedication is to my wife Gislaine, because with her intelligence, critical sense, and obsession for linguistics and socio-political questions, she helped me to improve the present work, sharpening my thought; her contribution in every field are irreplaceable for me.

Another dedication is in memory of my professor Giuseppe G. Castorina, who helped me to study and love foreign languages with naturalness, searching in every single word for visible and hidden meanings. As with all men of quality, he was extraordinarily intelligent, creative and innovative, and had the rare capability to listen and encourage the opinions and the proposals of students, without prejudice. In my view, this was and is an excellent strategy for promoting cultural growth and increasing the level of education, with the awareness that modern education should be based on dialectic forms and wide participation, and not a passive transfer of concepts. To him a sincere hug.

Special thanks is dedicated to the Cambridge Scholar's staff, my publisher who believed in the current project, and to Lloyd Barton, my proof-reader, who helped me to improve my thought, my work, and my text, with professionalism.

It is evident that the vision and all the opinions expressed in this book are imputable only to the author.

AUTHOR BIOGRAPHY

Andrea Vicini was born in 1969, in Rome, and received a degree in Political Science (1998) with major emphasis in Macroeconomics Policy and Theory from Sapienza University of Rome. He contributed to Research Projects analysing the dual technology and geopolitical strategy of the conversion of military industry, in the Centre of Study on International Policy (CESPI) in Rome, and at the same time, he served as an assistant professor at Sapienza University for three years. He completed his studies in Washington D. C. following lectures and seminars at Georgetown University, the World Bank and the IMF; in 2002 he obtained a MBA with honours, from the University Consortium For. Com in Rome.

Currently Andrea is a middle manager in an industrial company; he developed relevant professional experience working in international and domestic companies, in internal auditing, the compliance sector, risk management and finance control, obtaining an appropriate professional certification in Control Risk Self-Assessment (CRSA). At the same time, he is a member of professional organisations oriented on the study of economic and policy questions such as the Economist Intelligence Unit (EIU). He is a chartered Master in Business Administration recognised by the Association of Masters in Business Administration (AIMBA), and is a member of the Italian Association of Internal Auditors (AIIA), where he participates in meetings, seminars, and debates on economic and managerial questions. In 2015, he obtained a Ph.D. in Economics from the Swiss Management Centre University (SMCU), developing a research project about technology, innovations and employment. He is a member of the www.academia.edu, a platform for academics to share research papers and accelerate the world's research.

CHAPTER ONE

INTRODUCTION AND MAIN CONCEPTS

Innovation and employment are a complex collection of interdependent economic elements that has been a central question in the economic theoretical debate (Pianta, 2005). While a classical approach poses a question on whether “technology creates or destroy businesses?”, the recent research investigates the impact of diverse forms of innovation, catalysed by the structural and institutional factors determining the quantity of employment (Bogliacino, Piva, & Vivarelli, 2012). The impact of innovation with regard to the quality of jobs raises further questions on the type of jobs created or destroyed. The related research delves into the composition of how skills change and the way wage structure changes (Pianta, 2005). The consequent development of literature focuses on skill biased technological change and polarisation of wages (Supino, 2010). This aspect, although manifested in different forms and entities related to the countries studied, was particularly evident in the industrialised countries in which the economic transformation caused by the innovations is reflected in the job market and wage dynamic (Bisello, 2013).

The book analyses a body of scholarly research relevant to the subject within the scope of explanatory trajectories in advanced economic systems, to understand the development of relationships between innovation and employment. The first chapter explores the perspectives, scope and types of innovation and identifies its impact on employment opportunities. The second chapter studies the literature review related to the impact of employment on different scales, firms, sectors and, most importantly, on macroeconomic levels. The third chapter introduces the methodology employed in the research. The methods related to data and sampling are discussed in detail, highlighting the diverse facets and implications of the research in the present setting, further information is in appendix A. The fourth chapter focuses on evaluation of quantitative research data obtained.

The conclusion integrates the research results with theoretical assumptions to draw a generalisation in charting “optimal policy” with regards to collaboration between technological innovation and engagement. The paper also suggests the best conditions to raise a positive

collaboration in a macro-institutional setting. The final aim of the study is to set a criterion with a compass for future research subjects to observe the trajectory of this research report. In particular, in the contribution of this study, the institutional assets integrate the economic variables and the countries are examined as ecosystems in which the reciprocal relationship between the parts becomes the subject of study and comparison.

1.1 Problem Statement

The conventional approach considers innovation as a change agent of an economy with respect to technology, resulting in economic growth and employment (Bogliacino, Lucchese, & Pianta, 2013). The lack of explicit conceptualization of technology, in both individual decision-making and public policy tools, along with its exogenous nature, remains a limitation to Keynesian growth theories, as well as to Solow's growth model (Pianta, 2005). A real progress in the theoretical comprehension of the mechanisms and the role played by innovation and technology in the growth is reached with the introduction of the endogenous growth model (Conte, 2006). These models consider that economic growth is primarily the result of endogenous and not external forces. In particular the investments in human capital, innovation, and knowledge are significant contributors to economic growth in the long run (Romer, 1987). A deep analysis about the limits and the lack of the exogenous and endogenous theoretical models is conducted in chapter two.

The relevant modern theories have drawn near the subject of technology in relation to its impact on employment from two perspectives. First, the growth theories have gone from an exogenous view of technological change to individual/collective efforts as the basis of new growth theory. The proxy of technology, learning, and educational variables conceptualise innovation as an engine of endogenous growth. Second, labour economists have explained changes in employment and wages in relation to demography and other macroeconomic factors, such as wage costs, bargaining modes, and the flexibility of labour markets. The macroeconomic factors of competitiveness and technology also determine the changes in a nation's employment and wages (Pianta, 2005).

The fundamental disequilibrium in the nature of technical change is processed under the presumption of a general (or partial) equilibrium of markets, characterised by conditions that all output generates demand and all workers are ready to accept the wages offered in their employment. This assertion is known in economic literature as Say's Law (Say, 1855). The technological changes are often reduced to new production procedures

and new production functions, rather than models of product innovation. The studies pertaining to employment losses indicate the rare issues of permanent (or structural) unemployment as being against downward adjustments in wages, leading to the unemployed returning to work. The idealism embedded in this market condition is due to the lack of flexibility in the labour markets, excessive trade union power and institutional rigidities such as minimum wage. These factors are considered crucial in the diagnosis of a long-term high unemployment rate, and for this reason are assumed to be the starting point in many labour reforms implemented in many EU states in the last decades (Bogliacino et al., 2012; Conte, 2006). It is useful to highlight that many studies conducted in the past have adopted an incorrect perspective, which starts from the concept of general equilibrium (Bogliacino et al., 2012). The question is how the general equilibrium framework can be used to interpret one phenomenon (as the innovation) that is characterised by its nature of disequilibrium? It is clear that the general equilibrium is not the appropriate conceptual instrument. For this reason, in the present essay a theoretical framework was adopted which considers the change as the key point. The more convincing theoretical framework to study the continuous change produced by the innovation is the evolutionary approach, which enables the embedding of the nature of disequilibrium to economic change. An extensive discussion on his limits and assumptions is presented in the chapter 2 (Conte, 2006).

1.2 Purpose of the Research

The purpose of this research is to analyse the impact of innovation related to product initiation and development and the process of generating employment. This work highlights how the market enables the replacement of jobs lost by innovation, this concept is known in the literature as market compensation mechanism.

The scope of the current investigation is to study the way that the compensation mechanism operates in micro and macroeconomic settings, and which are the factors that, though not strictly objects of the economic analysis, can influence its success or failure. In addition to innovation and macro variables, the study projects synthesis of explicative variables, such as quality of education, skills/knowledge in R&D and institutional efficiency. In this work, aspects that are relevant to determining the competitive advantage in the new national contexts characterised by increase of competition and global strategy are analysed. In a context in which the arena is enlarged and thus the competition is increased, the

capability to promote new products and new processes is a decisive element to promote the business and so to track a persistent path of growth for the nations (Michie, Oughton, & Pianta, 2002).

1.3 The importance of the debate and the meaning of this study

The research problem includes the relationship between technological progress and employment because of job polarisation. Technology, with respect to information and communication technologies (ICT), is increasingly in use in the workplace. Nonetheless, with the advantages of ICT in enhancing efficiency and potency of an organisation, its impact on the labour market cannot be discounted. The advantage concerning technology favouring skilled labour has been more than offset by a nuanced phenomenon of job polarisation (Goos & Manning, 2007).

The phenomenon of polarisation features two distinct effects in the labour market: the top percentages of the wage distribution characterised by high-skilled workers increase, while the bottom parts characterised by low skilled workers are decreasing. This phenomenon is experienced in most developed countries, especially in the US (Jaimovich & Siu, 2012), UK (Goos & Manning, 2007) and in limited measure in Germany (Spitz-Oener, 2006).

The impact of such divergence affected by advancements in ICT has a negative bearing on society, as indicated in the research problem. The inclusion of social criterion in the study adds to its credibility. The previous studies on technology and employment reveals job losses up to 92% experienced in middle level occupations in the US within the first year of the recession had been (at least partially) substantiated by ICT (Intelligent Community Forum, 2013). Since the advent of ICT in the mid-1980s, the rate of employment decline has been estimated to be around 0.6% per annum (Intelligent Community Forum, 2013).

Another investigation conducted in the US (Jaimovich & Siu, 2012) through the use of data from the Bureau of Labor Statistics study in the period 1981 to 2011, grouped the fall in employment into the categories of cognitive, manual, routine and non-routine (Acemoglu & Autor, 2010). On the one hand, the distinction between cognitive and manual occupations cropped up from the mental and physical activities relevant to job requirements. On the other hand, the distinction between routine and non-routine jobs is related to the different skill-sets needed to execute the task. The cognitive and manual occupation involves procedural and instruction based tasks, while the routine and non-routine work demands possession

of creativity, problem-solving, flexibility, socialising and networking skills for its successful culmination. Consequently, three types of jobs emerged and developed in conjunction with each other: non-routine cognitive (high-skilled) jobs, non-routine manual (low-skilled) jobs and routine cognitive and manual jobs (middle-skilled). The trend line for each combination indicates the following: (a) the first two combinations witnessed the share of each with regards to the total employment rise steadily over time, and (b) sharp polarisation of the third combination, witnessing its share drop from 58% in 1981 to 44% in 2011 (Jaimovich & Siu, 2012). A study by the European Centre for the Development of Vocational Training (2010) also indicates a projected growth of high-skilled jobs in the EU from 29% in 2010 to 35% in 2020. The demand for high-skilled jobs is estimated to rise by 3.5 million between 2010 and 2020, the demand for middle-level jobs is estimated to be stagnant during the period, being static at 50%, while the low-skilled jobs are expected to decline in the period by 20% (European Centre for the Development of Vocational Training, 2010). The Bureau of Labor Statistics (BLS) predicts a slightly different tendency with the middle-skilled, high-skilled and low-skilled jobs increasing by 11%, 15% and 8% respectively in the period 2006-2016 (Liming & Wolf, 2008). The differences in the forecast reflect the differences in the economic structures between the EU and the US.

The forecasts point towards job polarisation brought about by technological changes. The effect of an increment in social and political pressure brought about by a widening gap between the privileged and the deprived results in the erosion of middle and low-skilled jobs. The pervading impact of such erosion can lead to developed nations being pushed to the conditions that typify the problematic nations found at the rear end of the income ladder (Intelligent Community Forum, 2013). The holistic picture portrayed by the studies noted points towards job polarisation and unemployment caused by several causes. Nevertheless, the current research analyses the causes and possible remedies of unemployment caused by technological changes. The results of these analyses provide elements to implement policy which enables the conducting of countries in a virtuous path of growth and reduced unemployment, in one word: development.

1.4 Research Design

This research applies the conceptual framework of compensation theory, as it constitutes the bulwark behind technological unemployment. The theory of compensation seeks to spotlight the topic of technological

progress impacting employment and its scope in economics and management literature (Vivarelli, 2007; Malerba, 2006). The direction onward in this trajectory is through trying to find out whether or not the market mechanism is able to correct the job cuts due to process innovation in the short and long term. A comprehensive public policy should be in place as a buffer to the possible role of technology in enhancing unemployment.

The trust on the Neo-Schumpeterian approach, which perceives employment as an effect of a dynamic interaction of many forces, can be key to reducing technological unemployment, with the entrepreneur playing a fundamental role in the approach (Malerba, 2006; Boianovsky & Trautwein, 2010), along with the speed of readjustment as the key differentiating factor between frictional and structural unemployment (Malerba, 2006; Boianovsky & Trautwein, 2010).

Evolutionary theory argues that advanced economies are seeing a new techno-economic paradigm with the issue of ICT (Malerba, 2006). Such powerful technological advancements work both ways by creating, as well as depleting, large-scale employment opportunities. To answer the queries of the domains and extent of work created or depleted depends on the highly dynamic process shaping the capacity and type of technical innovation and the swiftness of its adoption, although technological dynamics are often not clearly distinct.

The number of jobs created and lost can be qualified by a complex set of mismatches between the geographical domain specified and the diverse skill-sets required. The digital revolution has affirmed the introduction of ICT and has redefined the relationship between labour and capital, pertaining to average labour productivity. This is pointed out in the Neo-classical model by reducing the business turnaround time. The diminution of business turnaround time is apparent in a number of ways, such as online proceedings and online trading, characterised by swifter movement of funds in exchange for goods and services. The drastic reduction of the time requested for every simple operation offered by digital opportunities has clear effects on employment. The knowledge revolution, easier access to goods and services, and reduction of time to accomplish a deal/transaction has profound influence on the increase of overall demand and supply for goods and services on most economic sectors. The sectors where the influence of ICT revolutions had traditionally been limited have also, to some extent, been influenced by digital and technological progress in relation to their demand and supply trajectories.

The macro-economic approaches consider public policy, while the micro-economic approaches include the study of firms. The blend of the

two approaches in terms of the variables considered gives birth to a complex system, subject to continuous change. The key consideration, as per Schumpeterian terms, is the comparison between the rate at which technological innovation and diffusion eliminates employment, versus the rate at which new economic activities create jobs (Conte, 2006). In the consideration of this model, a number of factors, such as the nature of innovation (product and process), the time lag of the diffusion required in the innovation processes, and so on, become part of the explicit variables, as they are not related to the action and reaction of the institutions. This is a relevant aspect because our analysis considers the institution as a fundamental element of the framework in which is manifested the economic activity. Thus, the choice to adopt complex indexes as explained in the next chapters is fundamentally driven by the need to obtain a design with enough approximation of the national ecosystem.

The importance of interdisciplinary research and the need to put together different areas of knowledge, and different methods and practices in the model, has been pointed out by a prominent Schumpeterian scholar, Franco Malerba (2006, p. 22-23):

“In addition, in the realm of innovation and the evolution of industries, research needs to be interdisciplinary. It means that the full understanding of topics such as innovation and the evolution of industries require the integration of economics, history, sociology, technology, management and organisation. Interdisciplinary means eclecticism and openness to new contributions coming from different fields of research. Schumpeter might, I think, have approved, he was after all a sociologist as he was an economist.”

1.5 Research Questions and Hypothesis

The ambition of the current investigation is to build new paradigms in the economic phenomena, to this end, two research questions, along with their corresponding hypotheses, have been formulated as follows:

- a) Does a relationship between technological innovation and employment exist?
- b) Is there an optimal policy to promote a positive collaboration between technological innovation and employment?

It is useful to point out that these questions are qualitative, although dealing with the support of data, indices that are for his nature quantitative.

The object of the investigation is the study of the relationship between innovation and employment and not the estimation about how many jobs are created, the reciprocal relationship from the aggregate and not the entity. However, in the presence of a relationship between innovation and employment, the analysis focuses its attention on the determinants of this relationship, which can be considered the pillars of a positive collaboration between technological innovation and employment.

Investigation in relation to the research questions is useful in order to draw paradigms and generalisation with regard to other subsidiary yet complementary questions, such as the polarisation of skills and wages. Most developed countries have experienced a rise in wage inequality because of increasing use of ICT in the workplace. In making a tighter link between job polarisation and workers' wages (Boehm, 2013), two interrelated questions come into the foreground:

- 1) Whether there has been a fall in the middle-skill occupation wages because of their routine nature.
- 2) Whether job polarisation explicates the overall change in the wage distribution. These sub-questions are mentioned in the five pillars of the optimal policy, which are examined in chapters two and five.

1.6 Assumptions and Limitations

This research project is based on the theoretical assumptions derived from the literature review with elaboration of original deductions, and supported by data analysis. For this purpose, the current research utilises a sequential exploratory design, one of the most popularly deployed strategies of inquiry consisting of the mixed-methods research design, where an effort is made to expand upon the findings of one method with the help of another (Creswell, 2009). In the current investigation, theoretical paradigms are combined with quantitative techniques to work out or expand assumptions underlying the theory or exercise. The presumptions are derived from published literature, which are then followed up using quantitative statistical techniques of correlation analysis, trying to demonstrate a relationship between technological innovation and engagement levels of developed countries with the support of secondary published data. The survey concentrates on European countries, taking eight developed European countries as a sample. The sample is consistent in terms of its resemblance to the population, ensuring higher generalisation, reliability and validity of the obtained results. The countries identified for the present investigation are: Austria, Denmark,

France, Germany, Ireland, Italy, Switzerland and the United Kingdom. Secondary data (reports published by official statistical institutions like Eurostat, IMF and World Bank) are used in the current investigation.

The study starts with some conceptual or philosophical thoughts or beliefs, projecting them as popular nomenclature of knowledge claims, paradigms, or assumptions (Creswell, 2009). Each idea or belief is shaped by the researcher's area of discipline, the belief system of the faculty, the advisors employed, as well as the past research experience of the topic/area in question. These assumptions guide the research and the process it follows by setting guidelines and direction for the researchers during the course of the investigation to its logical conclusion. Four assumptions are involved in the research, with each corresponding to the nature of the research work undertaken (Creswell, 2009, p. 147-182):

- post-positivism (quantitative study),
- constructivism (qualitative study),
- advocacy/participants (qualitative study),
- pragmatism (mixed-methods study).

The current investigation utilises a mixed-method research design, with the scope of pragmatism-driven assumptions or knowledge claims serving as its beginning stage. The assumptions are appropriately manifested to respond to the concerns of technological advancements, catalysing the job polarisation. The threat of job polarisation, if not heeded, can lead to dire global consequences of catering to an income rise of only 1-2% of the world population, leaving the balance in the doldrums, socially and economically (Intelligent Community Forum, 2013). This sufficiently exhibits a clear priority of the eagerness and a substantial desire to find possible results to the existing problem, by deploying appropriate methods to leverage the pragmatic assumptions. Moreover, this investigation was based along compensation theory, attempts to view the situation within a theoretical framework of employment. The entire process reflects an attempt to achieve social and political justice by narrowing the wide gap between the privileged and deprived classes in developed nations by meeting the basic tenet of pragmatic assumptions (Creswell, 2009). The existence of limitations in an investigation is inevitable, arising from the constraints of the inability to direct all subjects involved in the research. In this research, the limitation is characterised by the leaving out of certain events relating to the purpose of technical changes in employment.

The limitations of this study are elucidated below.

- 1) The scope of the investigation is limited merely to developed EU nations, for developing countries, it is necessary to review some assumptions, considering that the comparison between countries in different stages of growth, (in Rostow's sense) can lead to biased results (Vivarelli, 2012).
- 2) The usage of secondary data gathered from the reports published from various recognised sources is generally accepted in macroeconomics analysis and comparison, in particular in the econometrics survey, which are subjected to a wide discretion in the formulation of the algorithms and in the choice of variables.

1.7 Operational Definitions

First of all it is useful to present the main concepts that are adopted in the present book. In concise and non-controversial terms, the scope limits the misunderstanding which is generated by an incorrect sharing of conceptualization.

Despite many definitions available for innovation, the economic literature (Frankelius, 2009) of this paper uses Schumpeter's study, recognised as the most influential and pioneering, as the most appropriate one, and which has therefore been applied to the study (Schumpeter, 1934).

1. Introduction of a new product or a qualitative change in an existing product;
2. Process innovation new to an industry;
3. The opening of a new market;
4. Development of new sources of supply for raw materials or other inputs;
5. Changes in industrial organisation processes.

The Schumpeterian concept stresses the dynamic nature of innovation and highlights implicitly the well-known difference between invention and innovation. To increase the understanding of the exposition, it is useful to bring out some other fundamental concept related to technological unemployment: the compensation mechanism. This economic theory, since the outset, has levelled out existing economic forces that can spontaneously compensate for employment reduction caused by technological advances. In Ricardo's words, the "working class opinion" is qualified by the fright of being forced out as a causal agency of technical change (Ricardo, 1821).

On the contrary, the academic and political debate has been dominated by an ex-ante confidence of market compensation of dismissing workers. The current economic debate related to the employment impact of innovation is characterised by a focus on the market compensation forces, with a potential to counterbalance the initial labour-saving impact of process innovation and job-producing effects of product introduction (Vivarelli, 2012, p.2).

Another relevant concept that is useful in order to understand the rapid change of the labour market after an innovation shock is the effect known in the literature as ‘job polarisation’. This phenomenon, (widely observed and studied, starting from the 1990s), refers to the increasing concentration of employment in the highest-and lowest-wage occupations, as jobs in middle-skill occupations disappear (Jaimovich & Siu, 2012). This paper attempts to investigate the capturing and measuring of the forces mentioned.

With regards to considering a country as developed or a high-income one, the World Bank (2013) has put a threshold of an average annual income of \$12,476 or more to be a developed nation and less than that to be a developing or low and middle income country.

The present list of concepts is not exhaustive, with opportunity for more specific and contextualised concepts introduced in the course of the paper.

After this introduction to the question discussed, in the next chapter, the innovation employment relationship will be examined, starting from a historical perspective, which considers the classical (Smith, Ricardo, Marx) as the start point. Then, the other points of view will be examined, and at the end the critics relating to the current debate will be presented.

