Diversities of Innovation

Innovation is often understood exclusively in terms of the economy, but it is definitely a result of human labour and ingenuity, and of the relationships among individuals and social groups. Some societies and governmental structures are clearly more successful than others: they act in divergent ways, fostering innovation and employment, and they utilize varied opportunities from different fields of research, from new products and from their educational systems.

Thus, innovation varies fundamentally between countries, and public policies – in matters such as energy technology, environmental technologies, facing climate change, and advancing conditions of life – can be determined according to different societies' needs.

This volume brings together a range of world experts to compare countries and continents and help develop a fuller picture of innovations and their social basis. It will be of interest to researchers in regional studies and economics, as well as labour unions, practitioners, and policy makers.

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Diversities of Innovation

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Routledge
Taylor & Francis Group
LONDON AND NEW YORK

First published 2019
by Routledge
2 Park Square, Milton Park, Abingdon, Oxon OX14 4RN

and by Routledge
52 Vanderbilt Avenue, New York, NY 10017

Routledge is an imprint of the Taylor & Francis Group, an informa business

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library

Library of Congress Cataloging-in-Publication Data
A catalog record has been requested for this book

ISBN: 978-1-138-18907-2 (hbk)
ISBN: 978-1-315-64183-6 (ebk)

Typeset in Bembo
by Integra Software Services Pvt. Ltd.

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Preface

There is a rich body of research and publications concerning different aspects of innovation. The views are different because the researchers' questions are different and academic disciplines have divergent interests. In addition, there has been a fundamental change because of globalisation and newly industrialised countries. Industries require different competences, potentials for innovation, markets, and demands, readinesses for technology transfer, skilled labour forces, networking, and levels of industrial development. The research on regions, human capital, countries, or industries helps to deepen our knowledge about innovation. Simultaneously with this growing variation, there is a search for best practice and governments employ similar policies and often aim at similar short lists of technologies. Nevertheless, the effects and the successes of public policies are very different – and the contexts in which they were developed and implemented were also highly divergent. Consequently, the processes of innovation and situations differ greatly.

This book aims at both a better understanding of the diversities of innovation and a discussion of the different contributions to innovation. It is important to understand that innovation is more than just a matter of entrepreneurs and academics. The socio-economic effects of innovation relate to the manufacturing of products and labour, which means these relate to appropriately skilled labour. This clearly characterises the kind of industrial development and opportunities which exist in different situations. Such differences are based on a match of industries, skills, public policies, research structures, societal structures providing for the labour, and access to markets. Although such situations are highly varied and indicate the diversities of such processes and have the potential to make it look ineffective, nevertheless there are opportunities for a better understanding. There are relationships between the different elements of innovation forming specificities and altogether forming precise situations, thus contributing to a rich diversity – but also referring to its origins and relationship.

There were two international workshops held at the University of Oxford and in Berlin with participants from academia, labour unions, and enterprises. The resultant highly constructive exchanges – of research, experiences and ideas – have found their way into this book. They reflect the shared view that individual academic disciplines, or particular views from practitioners, are

helpful to learn more about the process. To understand innovation better there is a need to combine such competences, which help to identify opportunities among the rich diversities of innovation. Matching the situation to the set of opportunities is clearly important, and in order to provide for socio-economic development, the role of the labour force of a region, country, or metropolis is critical. Consequently, the discussions paid particular attention to the constitution of individual situations and how contexts match the situations. This discussion is reflected in the structure of this book and will be continued during the workshops to come and help to provide for a deeper understanding of innovation and expand the comparative understanding of such processes.

This book can be read and used in the way it is laid out and may help the reader to think freely about new understandings which reach out across different countries, regions, and situations. But it may also be of interest for those who work on some of the individual subjects. The comparative view may contribute some additional perspectives and will link up with other variables, contexts, or processes of development. Innovation is obviously a highly complex process, which generates a lot of diversities that can be identified empirically. Although the full complexity may not always be within the scope of the analysis, it always helps to relate to existing situations rather than examining pre-defined indicators. The investigation of empirical situations helps a lot to understand the innovation process in general – and it is important to understand innovation as a process with different periods and contributions over time.

The creative and highly international context, of a discussion between academia, labour unions and practitioners, was generously supported by the *Hans-Böckler-Foundation, Düsseldorf, Germany*. The interest of the foundation in the comparative view of such processes made it possible to have this exchange of ideas over several years and is to be continued during the coming years. We all thank the foundation for their strong engagement. As an editor, I am also grateful to the patience of the authors while discussing and adjusting the chapters to make this edited book as coherent as an edited book can be. I look forward to the continuation of these activities and we happily welcome the new, additional contributors who have already joined our deliberations and those who, no doubt, will join us in future. We have explored a lot of open questions, which require a continued exchange of expertise between academia, labour unions, practitioners, and policy makers.

Ulrich Hilpert
Berlin and Jena

Part I

Introduction

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1 About socio-economic development, technology and government policies

Diversities of innovation

Ulrich Hilpert

Changing situations and newly emerging problems create a constantly rising demand for new technologies and innovation based on existing opportunities. Environmental problems, increasing climate change, transportation technologies and treatment of diseases call for advanced solutions, whilst urbanisation, social change, communications and the exchange of information create specific situations, which require the provision of technological products and services. There are many examples of new demands for technologies or technological solutions of existing and emerging problems (Hilpert 2016a). While exploring innovation and new technologies there are many dimensions, which are important and influence such processes. There is the relationship between public research and new technologies, human capital and education, regional situations and Islands of Innovation, existing opportunities and long waves of socio-economic exploitation. Many such constellations have been researched to provide a deeper understanding of their processes and to facilitate appropriate policies of different levels of government. The research is based on studies of different countries and regions with different governmental systems (federal vs. centralised) following different political ideologies (neo-liberal vs. social-democratic), based on different technologies requiring various contributions from academic research (biotechnology vs. environmental technologies). These concern different industries inhibiting the potential of innovation or the manufacture of new products (mechanical engineering vs. the application of new materials) and the fundamental change of existing products because of the supply with new parts (automotive industries applying electro-engines vs. 3D-printers manufacturing products). There is a rich diversity of situations referring to a similarly rich diversity of industries, research capabilities, human capital and industrial structures.

Thus, innovation and new technologies also converge with changes in products, manufacturing and organisation. While the first industrial revolution exploited the opportunities of steam engines by organising manufacturing accordingly, the current fourth industrial revolution exploits the opportunities of artificial intelligence and electronics, which have a fundamental impact on changing organisation globally. Consequently, what was innovative will not continue to be so, because becoming mature is a permanent process associated

with new technologies and innovation. The global dislocation of mature manufacturing and industrialisation to less-developed countries is a consequence of competition among industrialised countries and from newly industrialising countries referring to different levels of production costs and regulations. Thus, what is not appropriately innovative in leading western countries may match the situation in less advanced countries and may help to build an industrial basis at different locations in other situations. While it lacks its innovative contribution in leading countries, it has an innovative impact in other, less industrialised countries. The context is decisive when evaluating a development and a technology to induce innovation. Countries or locations based on a lower level of industrialisation can take innovative advantage of technology from the second or third industrial revolution, while in the most advanced situations Industry 4.0 is the challenge they have to face and to cope with. The technology applied needs to be new and have an innovative impact in the context where it is newly introduced.

While innovation is widely related to new technologies it is important to keep in mind that such new opportunities cannot be applied similarly in all situations. Different industries demand different technologies. As chemical and pharmaceutical industries benefit particularly from biotechnologies, robotics contributes to mechanical engineering and plant construction or carbon fibre may contribute to advance automobile industries. Even a similar technology referring to the same government programme may indicate divergent innovative development because of the situation, in which they are applied (Bagchi-Sen and Kedron 2016). In addition, new opportunities based on 3D-printers or gearless electric engines for cars may change the design and the way they are manufactured. The diversities of industries and technologies as well as the opportunities to introduce new products or to advance existing products indicate that specific innovations clearly demand particular conditions. Industrial structures help to identify such diversities easily because new technologies might be applicable in such industries and their products. If this is not the case new technological opportunities will emerge but have no impact on industries for which they are not suited. Accordingly, other technologies may suit better but may not be applicable in other industries elsewhere. While this appears to be clear and obvious, this has far reaching effects on participation in innovation and on the strategies underpinning innovation policies: technology is not innovative *per se*, its socio-economic opportunities depend on the suitability of the reference industries in which it is used (i.e. those industries in which an innovation may be applied to develop new products or processes) (Abel and Deitz 2009).

During different periods of industrialisation countries, regions and locations have developed particular industrial structures and manufacturing competences. Such specificities are to be identified easily and are well known. Silicon Valley and the San Francisco Bay Area are the home of outstanding microelectronics and computing industries, Seattle is an important base of Boeing and Microsoft. The Boston Area participates strongly in almost all new technologies. In East Asia electronics industries manufacture products, which are developed elsewhere

and are distributed across the world, or have become the basis for new global players as in Japan or Korea. German mechanical engineering is well known, French pharmaceutical industries are globally present and the Airbus Industry clearly indicates the locations which possess the tradition and competence to contribute to a product based on highly complex engineering. Many other examples can be added. It shows that these situations are highly diverse and the technologies demanded vary according to industries and locations. Traditions are continued through new technological opportunities and competences have constantly been enhanced to advance both the industry and the product. While this is taking place, the different processes draw upon diversities of technologies, which match particular opportunities at particular locations, which are the home of particular collections of industrial competences. The implicit selection processes taking place among technologies are a clear consequence of these divergent contexts. Technologies can contribute to socio-economic development only where they find appropriate contexts, which are usually characterised by existing reference industries.

The more complex such processes become, the more innovation is related to competences and traditions. Earlier periods of industrialisation (e.g. based on the steam engine) were highly innovative but they demanded fewer or only minor preconditions to be met. A transfer of such manufacturing industries to less advanced countries or locations was, of course, more easily achieved than would be the case for those industries, which require a complex manufacturing base. The labour force was usually unskilled or semiskilled, the manufacturing was widely organised along the assembly line and enterprises were structured in a rather hierarchical way. Consequently, countries and regions vary according to the innovative opportunities of these industries and complexity of their products. Regions or countries are ready to maintain their positions, when there are opportunities for socio-economic development based on innovation providing for advanced products or the advancement of manufacturing. There are clearly different opportunities, which may not be available in all situations. Future development depends on the matching of both situations and existing technologies of innovative opportunities.

Since different technologies emerge simultaneously divergent paths of innovation exist according to their applicability to reference industries. New challenges emerge due to the complexity of products and manufacturing, which can enjoy the advantage of new technologies only if the available labour is appropriately skilled and educated. Consequently, the socio-economic realisation of leading-edge innovation is related with human capital and an appropriate labour force. In addition, the existing labour force needs to meet the demands of the technologies to be applied. Thus, innovation needs industrial structures and a highly skilled labour force to exploit opportunities, which emerge from research and development. Such highly advanced processes can be created only when the appropriate situation exists. This makes innovation a highly selective process, which privileges particular

opportunities among the rich diversity of technologies to be applied. Given the highly varied situations formed by industries, the labour force and research infrastructures in different regions and countries, as a consequence innovation processes vary a lot and focus on different elements – even though the technological fields or the industries concerned are rather similar. Within this context, skills and education provide the enabling basis for socio-economic effects to be realised.[1] This necessitates more than just a discussion of human capital. It refers to systems of skilling and education, which have emerged over time in relationship with industrial competences. Skills and education are related with societal dynamics and social change creating particular situations. When it comes to innovation, industrial societies are more than just a description of a societal context or social structure, these might become a critical basis of constant socio-economic development.

Such processes of innovation are highly complex and they depend on a variety of dimensions including the question – which type of industrial revolution is most appropriate. In particular the appropriateness of a certain level of innovation indicates that there is more than just an arrangement of criteria required. It needs to suit a situation, which has emerged during prior industrial development. Consequently, particular contexts are prepared to take advantage of specific innovative opportunities (Hilpert 2016a); there are windows of opportunities, which are available for some regions or locations but not for others. The more demanding leading-edge innovation requires outstanding research, a highly skilled and educated labour force, modern industries and enterprises ready to collaborate and to transform ideas into socio-economic development, and hence the smaller is the number of locations, which can participate in such processes. Labour markets become highly important concerning human capital which is attracted, and the number of creative personnel, which are available. This convergence of quantity regarding the size of the labour market and concerning the quality of knowledge workers privileges certain arrangements, which can be met only in a small number of locations. Only a small number of locations perform in a way that is attractive to innovative labour or creative knowledge workers, so clearly those regions which can provide a large labour market for such personnel have a strong advantage. Size allows for more job opportunities or careers within a region or a location for spouses or partners of individuals in question to finding a job (Power and Lundmark 2004). Because of the size requirement metropolises provide the most appropriate situations for participation in such processes of leading-edge innovation (Franco and Filson 2000; Berry and Glaeser 2005; Coulombe and Tremblay 2009). Thus, most of the Islands of Innovation, which are in a position to concentrate such processes in a small geographic area, are located in metropolises (Lawton Smith and Waters 2005; Abel and Deitz 2009). There the context is formed to participate in such processes.

The context becomes very important for the participation of a location or region in such development and is critical for the level of innovation which can be applied (Hilpert 2016c). While participation during earlier periods of

industrial development did widely include unskilled or semiskilled labour (e.g. textile industries, the manufacturing of electronics, consumer goods, mass production in general) more advanced products did demand advanced skills and higher education. Such early industrialisation was widely separated from research and development, and manufacturing to a far extent was based on repetitive duties. The contribution of unskilled and semiskilled labour on such levels of industrialisation is quite high and privileges locations and countries, which can provide competent, cheap labour. Still today such situations exist (e.g. textile industries in Bangladesh) and attract industries to locate plants, which suit such situations and manufacture marketable goods although these industries are too mature to continue at other places or where these flourished before. This process is also to be seen among former developing countries, which became Newly Industrialised Countries (e.g. due to differences in production costs a dislocation of manufacturing from China to Vietnam has already taken place) was to be identified and it indicates different levels of industrial development. What is mature in one country can have an innovative effect in situations of other countries, where the context of development, regulation or production costs is different or less developed. Labour costs or regulations (e.g. concerning working conditions and environmental conditions) play an important role. To arrange such contexts for less advanced industrialisation is much less complex. It can be achieved comparatively easily through effective government agencies. When the demand for unskilled labour matches the situations in such countries, they can arrange the context for such manufacturing and establish a situation, which is considered to provide them with modernisation or innovation in socio-economic development.

Improvement of skills and education helps newly industrialised countries participate in more advanced industries and may create situations of sustainable innovation (e.g. Korea, Singapore and metropolises in China and India; Tsui-Auch, Chia and Liu 2016).[2] Thus, government policies are important to form the context for both less advanced processes of industrialisation and more modern processes of innovation. While the profits of capital invested can also be generated on the basis of less advanced industries, governments may have a particular interest in gaining more advanced processes of, innovation as they provide opportunities for higher values added through modern industries and for higher standards of living through higher incomes based on modern products. Standards of living are not merely to be measured on the basis of incomes but also concerning the advanced services supplied. Even smaller incomes can build large demands and markets, which are ready to allow for innovative and improved processes if the number of customers or clients is sufficiently large. Thinking about innovation could also indicate that a situation is formed, which allows for advanced supply (e.g. health service for poorer people). The context for such innovation is arranged with regard to investment, but even more important is a context with regard to a skilled and educated labour force and research capabilities, which meets the requirements of new industries, advanced technologies, modern manufacturing or innovative services.

While aiming at such processes to achieve higher levels of innovation some lessons from Western countries were suitable to learn from. The agglomeration of such capabilities privileges places where creative personnel can be attracted. In Western countries there is a high convergence of Islands of Innovation and metropolises, because such agglomerations of research institutes, spin-off enterprises from public research, education of innovative labour and participation in collaborative networks generate a strong dynamism towards synergies (Laudel 2005; Favell, Feldblum and Smith 2006; Hilpert 2016c). Such innovative metropolitan situations build innovative labour markets and attract a brain drain towards such metropolises (Power and Lundmark 2004; Berry and Glaeser 2005; Abel and Deitz 2009; Coulombe and Tremblay 2009).[3] The availability of highly divergent competences provides the potential for collaborative networking as a basis for advanced new products. Similarly, newly industrialised countries aim at building such agglomerations, which increasingly emerge as knots in innovative networks formed through collaborative research (Chung 2016).[4] Government policies are important both to form such contexts with increasing levels of innovation and to realise such aims towards advanced socio-economic development. But such policies can perform effectively only when they match the situations, which change over time. Windows of opportunities open and close, and the regional or national context provides for development only when a match with innovative opportunities at a particular point in time can be realised.[5] Such windows can open and close for leading-edge innovation and technology, but they can also relate to a translocation of manufacturing mature industries to less-developed countries where it acts as an innovation within this particular context. In addition, such processes which do not refer to the leading-edge processes can be combined with modern communication technologies or modern materials and make it less a matter of dislocation but more a relocation within a changed global context. Shared global markets still exist, and provide a dynamically changing context.

When it comes to the current fourth industrial revolution and digitisation, there are changes and windows of opportunities, which will affect most leading countries as well as the less-developed countries. In leading Western countries jobs with routine work will widely disappear, but only a few will be transferred to low-wage countries. Instead these jobs may be replaced through new equipment, robots or machines. Due to the change in production costs based on new technologies and the continuing high quality of products some manufacturing may even return from low-wage economies to traditional industrial centres characterised by high wages. Also some new opportunities may emerge on the basis of internal development based on emerging markets outside of Western countries. Consequently, innovation and new technologies change many situations and demand particular contexts. The increasing complexity of innovation requires a deeper understanding of how to create a context, and to provide for participation in beneficial socio-economic changes. Different societies, industrial structures and human capital are decisive, when building the basis for particular innovative

opportunities. There are rich diversities of innovation, which demand a deeper and systematic understanding of how to participate and which processes of innovation may be suitable.

Emerging divergent phenomena – different identifications of innovation

When exploring innovative products and processes of development, it becomes immediately obvious that countries vary in their areas of particular competence and that any individual country may vary in its specialisms and competences over time. The introduction of steam engines in England became the basis of mass production and of Manchester Capitalism. A reorganisation of manufacturing was introduced and the conflictual relationship between capital and labour was introduced (Marx 1962 [1890], 1963 [1893], 1964 [1894]; Smith 2008 [1776]). This initial industrialisation was characterised by simple products, the introduction of assembly lines and the split of manual work into simple individual production steps. Consequently, there were two levels of products to be considered: (1) the mass products employing the new machines and equipment and (2) the producers of capital goods such as machines and plant. Those who developed, designed and manufactured the new machines and plant enabled a massive increase in productivity. This period, which today can be identified as Industry 1.0, illustrates the innovation based on a technological competence and the capability of engineers to apply such opportunities to the economy and to meet the demands of the customers.

The relationship between application and development continues and it builds a particular competence among producers of capital goods. Design improved, reflecting customer demand and the utilisation of new technological opportunities, materials and scientific findings. It is this relationship between enterprises, supplying capital goods, mechanical engineering equipment, minerals and shipping, with their customers which allowed the building of a body of such competences. The demand for these products allowed the improvement of capital goods and for the increasing knowledge employed in design and manufacturing. The strength of such products provided the basis for exports to other countries with similar situations and demands. Dealing successfully with situations in their home countries helped to build a leading competence and a continuing export of goods, which were considered to be innovative for their time and situation when these were introduced during the early stages of industrialisation. A close relationship between markets and producers emerged as a basis for innovative products and indicated demand for particular kinds of products and their use by customers.

Consequently, a country or region may continue to have a leading competence in knowledge intensive capital goods as long as the markets' demand such products and suppliers can supply the markets (Piore and Sabel 1984; Sabel et al. 1991).[6] The attractive economic opportunities for such products

raise the interest of other potential capital goods suppliers to meet these markets (Chung 2016, Tsui-Auch, Chia and Liu 2016). Consequently, different situations of countries or regions provided the basis for divergent competences in innovative products (Hickie 2006; Hilpert 2006). In addition, because of the maturation of products and the dislocation of manufacturing to other countries' competences, which formerly were appropriate to markets and customers' demands leading industrialised countries may have lost those markets, or they adapted to the changing demands of their customers by providing improved and innovative products. The continuing modernisation of industrial manufacturing towards current digitisation and Industry 4.0 consequently changed the markets requiring particular competences to provide the products demanded. Continuing industrial change and modernisation increases both the demand for investment in modern equipment and the level of capital goods products alongside the increasing complexity of manufactured goods (O'Sullivan and Mitchell 2013; Dolphin 2015). A changing international division of labour based on newly industrialised countries and increasing international trade contribute to the continuously expanding markets for higher value added products. Consequently, industrial development in different countries derives from divergent opportunities concerning the manufacturing of consumer products and capabilities in the design of capital goods and complex products.

Such industries became highly attractive because these took particular advantage from processes of industrialisation elsewhere. To meet such constantly emerging and increasingly demanding opportunities, divergent competences were required. Such products were based on divergent competences, which were contributed by different partners or departments when they collaborate to meet market needs. The competences developed along with industrialisation and the increasing competition among manufacturing industries in areas of mass production created a continuing demand for better, more efficient and precise capital goods. Thus, when new technological opportunities were applied a relationship emerged between manufacturing in low-cost countries and the creation of appropriate industrial plants. Exporting such plants and equipment, traditionally by leading industrialised countries in Europe and the US, consequently allowed them to take advantage of industrialisation elsewhere. High value-added and increasing socio-economic growth created a strong attraction to such industries also towards these newly industrialised countries to follow opportunities of innovative development (Chung 2016; Liu 2016). Similar to European latecomers in industrialisation (e.g. Germany) more recently countries such as Japan, Korea or Singapore have changed from being importers of advanced products and capital goods, to become countries which can also enter such markets based on their own attractive products.

Such modern capital goods helped to keep locations in such a situation to provide for their markets although labour costs may have increased (Dhéret et al. 2014). On the other hand, countries with low-labour costs and little regulation may continue to supply markets needing less advanced capital goods.[7] The

demand for innovative tools and equipment may be highly divergent depending on the situation of a country. The more advanced the products are, and the higher the levels of their precision, the higher the demands concerning both human capital and leading-edge capital goods. Consequently the expectations regarding capital goods vary with the opportunities of existing labour. This strong relationship induces a competition among capital goods suppliers according to the demands and the levels of complexity required by consumers. Less innovative products need to be manufactured by less-skilled or unskilled workers and need different and simpler capital goods, which can also be supplied by newly industrialised countries. The improving competences located outside of the traditional industrial centres provides the basis for emerging centres in newly industrialised countries oriented in less advanced capital goods, which meet particular market demands. Consequently, there is a horizontal competition among technologically advanced countries and hierarchically with new centres of expertise gaining competences, which were not available to them before, and which help to upgrade their industrial development.

Such processes introduce new processes of accumulation of both capital and knowledge to be invested and applied in research, education and in the modernisation of industries. Nevertheless, there is a divergence of demands to be met by manufacturers of more simple capital goods, which help to develop new competences in such countries. Although these may not be state of the art, they may contribute to more mature manufacturing of less technology intensive products. Consequently, reflecting opportunities in the markets such competences are highly divergent among countries, because of divergent supplies of capital goods to these markets and the established research structures and traditions, which have emerged. Although in different markets similar areas might have been investigated, these were not identical, and because they may foster further product development they provide a basis for collaboration on new capital goods and high-value products (Hickie 2006). New technologies did help to modernise existing products and to make such opportunities available for new areas of application. The implementation of microelectronics in the 1980s helped to improve mechanical engineering and to develop more specialised machines (e.g. concerning parts for electronics or automobile industries contributing to supply chains). New materials allowed for the improvement of engines and energy plants, and more recently the improvement of batteries has allowed for innovation in automobile industries.

Competences from different origins were merged when new or fundamentally re-designed products entered the markets. Californian electronics industries and the findings of Silicon Valley facilitated the improvement of mechanical engineering in Germany and Switzerland. While it was research intensive to develop new products, such as personal computers and smart phones, it was less complex to manufacture them, and thus this could be located in countries with low-labour costs and weak regulations. Thus, highly regarded Apple products are manufactured in China. Other countries also gained from the transfer of knowledge and manufacturing capacities.

Korea became a major manufacturer in electronics products, and also Taiwan has become a home of well-designed personal computers and mechanical engineering. It is important to see how competences in research and design on the one hand, and management and manufacturing on the other hand, can create a particular synergy which is in the end embodied in new or fundamentally improved products. The diversity of areas and strategies of innovation matches opportunities in markets and manufacturing to meet consumers' demands (Hilpert 2016a).[8] Market niches, highly specialised markets or an optimum combination of technology with particular situations of manufacturing create both opportunities and diversities of socio-economic development based on processes of innovation, which suit the particular situation.

Such innovative opportunities are not equally available throughout a country. Individual regions, locations or metropolises develop their own profile based on industrial structures, available labour and research capabilities matched with public policy programmes. While they jointly may demonstrate the economic performance and strength of a country individually they are not identical but often highly divergent. There were continuously changing situations when new technologies were applied during periods of industrial development and transportation. Consequently, countries can inhibit highly divergent opportunities. The number of individual industrial regions or conurbations, which exist within a country, indicates divergent opportunities when new technologies are ready to be exploited. This affects a particular industrial sector that may be addressed but also concerning the application of technologies across different sectors based upon the competences, which are developed during collaboration of the different industries, which co-exist at the same location. The mix of industries may become fundamentally important when new technological opportunities emerge indicating that there are cross-industry opportunities.

Consequently, opportunities of innovation vary significantly, no matter whether these are based on new techno-scientific findings, new technologies to be applied or on the capability to organise and manage changing socio-economic situations. Existing structures, established research profiles and socio-cultural traditions create particularly different situations. Opportunities in microelectronics changed mechanical engineering and measurement instruments; biotechnology changed medical instruments and pharmaceuticals; and new materials changed automobiles and transportation. The number of innovative opportunities could be pursued widely and adding to the point that innovative processes are highly specific and follow highly divergent tendencies. Such innovative processes are particularly selective and include regions, which suit the opportunities in question (Hilpert 2006). The extent to which they can benefit from these processes depends on how strongly they match the conditions required for the exploitation of new techno-industrial opportunities, which meet market opportunities or are the basis for new customers and demands.

While industrial sectors need to be ready to exploit such technological opportunities, contrastingly, new technologies frequently can be applied in divergent situations and in a number of industries and products. Such

technologies link to divergent situations and allow multiple opportunities for producers of technologies to meet the demands of a rich number of customers, who rely on new technologies to make their products more innovative and continue to perform strongly in their markets. Such producers of new technologies, which are applied to a final product, are less dependent on markets for particular products but they need to keep their technologies innovative and applicable in many different industries (Sabel et al. 1991).[9] The situation associated with the new producer of the electric automobile Tesla and other brands of electric cars presents impressive examples. When designed and manufactured, more than 60 per cent of the parts for Tesla cars, come from German suppliers, predominantly from Bosch (private conversation with the author). While Tesla must directly compete with the electric car market, the suppliers can provide parts for all the brands and can take advantage of their competence for other products and markets. Thus, developing and providing new technological opportunities allows for a change in design and innovation in automobiles. In combination with the existing level of innovation, which is already achieved in the final product, manufacturing, market supply and management processes of innovation indicate a strong diversity concerning the quality of the final product, the individual markets and the socio-economic effects of such processes. Consequently, there is a rich diversity of innovation emerging, based on a situation that already exists.

When taking such situations into account it becomes obvious that industrial structures are important, but there is no need to focus on innovative processes *per se* (Breschi and Lissoni 2009). Competences and technological opportunities at other places can be as important as a complement to the industrial structures in regions far away from where they were generated. Thus, opportunities are created across different locations, technologies and sectors. The availability of such opportunities to be combined despite geographical distances increases the potential of innovative initiatives and processes (Hilpert 2016a). Diversity becomes richer, as more potential industries are emerging, most opportunities for new technologies are developed to suit such industries. Consequently, the globally growing number of locations of particular industries and competences allows for a constantly increase in the number of innovative situations.

The more specific such technologies became and the more these were applied across industrial sectors, the more divergent were the situations built upon the capabilities of clearly identifiable geographic areas (Bellini and Pasquinelli 2016). Such innovative situations emerge from opportunities induced because of individual combinations of industrial competences with new technologies, which are rarely replicated elsewhere. In addition, as the relationship between distant contributors to innovative processes is generally increasing, transportation becomes crucial for both collaboration on research and design and also for shipping parts and products. Thus, processes of innovation emerge in highly divergent situations following different opportunities and rationalities, but they are identifiable as a relationship between existing industrial competences and the opportunities of new technologies

in particular situations which are arranged by companies and researchers, or which relate to particular public policies.

Dynamisms of divergent opportunities – constellations of innovation and contextualisation

Although structures indicate existing competences and opportunities of innovation the process itself and the diversities documented clearly demand particular activities which change situations and allow for innovative findings and new products. The more advanced products and industries are, the more vital is the demand for academic and technological research. Thus a constant demand for various areas of public and private research is emerging and even increasing. Collaboration in public research across countries and continents builds bodies of knowledge and competence which in turn are related to particular regions or metropolises within countries. Due to the fact that strong competences are available only at a limited number of locations, consequently, newly launched government programmes on new areas of research are realised predominantly at established Islands of Innovation. Those locations can be clearly identified geographically and provide by far most new findings and opportunities.

Metropolitan situations have shown their strength in becoming hubs of such processes and they converge strongly with the collaborative system of Islands of Innovation. Innovative situations in metropolitan locations meet large labour markets for knowledge workers, which allow for people to change jobs and for opportunities for spouses to find employment (Power and Lundmark 2004; Coulombe and Tremblay 2009). In addition, the locations of leading-edge research attract academics, researchers and knowledge workers to take jobs in such stimulating environments (Mahroum 1999; Laudel 2005; Hilpert and Lawton Smith 2013; Trippl 2013). It is most interesting that the attraction of such locations continues over long periods of time and they are frequently recreated in different technologies at different points in time (Hickie 2006). Islands of Innovation have continued their leading position over three decades and despite the fact that dramatically increased funding opportunities in the leading countries allows for other locations to participate in such research areas (Hilpert 2016d) and to attract knowledge workers to take jobs in such newly emerging locations (Hilpert and Lawton Smith 2013). Simultaneously, new industrial countries have been successful in building centres of excellence in particular areas of academic research, which became recognised globally as partners in collaborative research (Mahroum 2000b). Thus, Seoul in Korea, Shanghai, Beijing and Hong Kong in China, Bangalore in India, and Singapore in Asia have emerged as Islands of Innovation concerning academic research, while at Rio de Janeiro or Sao Paulo in Brazil such opportunities are identifiable (Chung 2016; Hilpert 2016d).

Existing Islands of Innovation and newly emerging innovative locations outside of the traditional centres in western countries benefit from complementary

dynamism. Vital processes in outstanding Islands of Innovation help to continue modern industries or to modernise existing industries, while simultaneously additional competences from new industrial countries contribute to the global body of knowledge and allow for additional collaborations and more research findings to be applied. Although leading-edge research continues to be dominated by Europe and the US, there are newly established contributors when the opportunities for innovation are increased.[10] Consequently, high-tech industries or industries based on high-tech products can also emerge at different places to the established innovatory processes, which have already become well known over the last few decades. As new competitors emerge using additional competences there are also new collaborators available to participate in a rich diversity of innovation, and which can also contribute based on divergent cultures of research.

Participation in innovative development is fundamentally based on the capabilities which exist at individual locations. In science-based innovation participation in such collaborative networks is based on the building facilities of leading-edge research. Attractive opportunities in research and a thought-provoking environment help to bring innovative academics, researchers and knowledge workers to a particular location (Mahroum 2000a; Marginson 2006; Lawton Smith and Waters 2013; Hilpert 2013a). Due to new findings in research and well-regarded publications such locations are noticed because of their capabilities and become highly acceptable partners in research projects and locations for an exchange of scholars and personnel. Such vital situations can be arranged widely through government policies, which support research and education in particular areas. Although it may take some time to become recognised globally, some countries manage both to contribute to and participate in such networks almost within a single decade.

Spin-off enterprises from university research and university education, which also meet the regional demand for skills and competences, provide the basis for the future economic exploitation of research and academic knowledge. Since such enterprises also hold patents or are appropriate partners in R&D, simultaneously, they are active in the transfer of knowledge and technology to individual larger firms or entire industries. While the number of highly innovative research institutions and enterprises at a location allows for a greater number of fruitful collaborations, in addition, this situation also helps to develop innovative processes within a country and region (Simonen and McCann 2008; Breschi and Lissoni 2009). Consequently, such situations are characterised by a concentration on particular technologies and areas of research, which are favoured by the countries in question (Abel and Deitz 2009).

While building research centres can be achieved within a foreseeable period it is much more time consuming and difficult to establish an industrial competence to manufacture highly complex technological products based on an industrial history. Engineering helps to continuously improve products and the organisation of manufacturing. While the product itself might not be new (e.g. aircraft, automobiles, mechanical engineering, transportation, telephones,

optical and medical instruments) the application of new technologies had a fundamental impact by changing the product (Hickie 2016). Such constant improvements rarely demand immediate redesign of products or a reorganisation of manufacturing. Skills of blue-collar workers continue to be important and modernisation through the additional competences of workers help to take advantage of existing tacit knowledge in relationship with new technological opportunities.[11] Products and economic exploitation consequently demand such competences to allow for innovation.

New opportunities need to merge with the capabilities of existing industries to induce technology-based innovation. The skills of blue-collar workers, thus, become of critical importance for the economic realisation of innovation. Workers' tacit knowledge is important to apply such opportunities, because it widely contributes to modernisation that has socio-economic effects. Taking these factors into account industrial competences, a skilled workforce and the capability of particular products is a basis which turns opportunities into techno-industrial innovation of socio-economic significance. Such situations relate to particular development and competences in various areas, which cannot be built or transferred to another country or region easily. Consequently, processes of technology-based innovation, which require complex constellations of knowledge and skills, are closely related to particular contexts at those locations. It is clearly the relationship with the existing context which facilitates innovative impact when meeting new or changing markets.

New technologies need to relate to industries that are ready and prepared to apply and to take advantage of such opportunities. The improvement of final products will strengthen their market position and the modernisation of plants will make manufacturing more efficient and profitable. Such reference industries are characterised by highly individual circumstances forming divergent contexts because of both the innovative development and existing industrial structure at a location, as well as how the country is positioned in the global division of labour. Consequently, there are situations of research and technology-based innovation, which emerge from competences of existing industries and exploit opportunities in particular markets (Hickie 2006). Socio-economic and political contexts are important for innovation and they are decisive concerning participation in particular area of research. The context of a location or region needs to suit the opportunities of new technological opportunities under the conditions of both a global division of labour and global networks of collaboration.[12]

In countries and regions with highly innovative industries and enterprises appropriate situations can be supported or even organised by government policies which address highly skilled labour of all kinds and leading-edge research. The continuous upgrade of the labour force and constant support in particular areas of research helps to keep regions innovative. Thus, because of the constantly increased application of research and technologies to manufacturing there is a growing number of blue-collar labour who are university-trained engineers. Government policies addressed to both education and techno-scientific research help to provide a basis for highly innovative products, which

exhibit high values added. The extraordinary qualities of a product and opportunities for its application immediately create a market, which is formed by those who expect an advantage from exploiting such leading-edge technologies. The context of such innovation is formed by the situation of consumers creating a demand for such technological products which can be provided in regional or local situations ready to realise innovative developments, which are aimed at matching such demands. Strategic policies can help to build such innovative situations because they support the labour force required to apply technological opportunities during the manufacturing of high value-added products.

Markets and competition can create situations of continuing innovation in manufacturing technologies and of the more effective management of globalising industries. Digitisation and processes, which are associated with Industry 4.0 can provide opportunities for the relocation of manufacturing.[13] While low-labour costs were a basis for the dislocation of many areas of simple mass production to Newly Industrialising Countries, currently, there are tendencies for an even more complex system of global division of labour. In some longer established industrial areas a return of manufacturing is expected and, simultaneously, in less innovative countries processes of industrialisation require a changing relationship between low-cost manufacturing and the application of new technologies. There might be situations where the introductions from early periods such as Industry 3.0, or even 2.0, can help to provide some innovation. Such a situation needs to be complemented by organisation and management, which takes advantage of new technologies, namely information and communication technologies. Consequently, current situations do not provide early opportunities of early processes in less-developed countries to catch up with leading Western countries in particular industries. The current situation, which allows for an introduction of technologies from earlier periods of industrialisation, demands complementary technological and managerial advances to cope with a continuously changing and challenging globalisation.[14]

Again, contextualisation is decisive for innovation.[15] While a certain technology might be out-dated in leading innovative countries they can have an innovative impact in other situations where they are matched with low production costs and cheap labour. But, modern technologies create a new relationship between markets and consumers in a global division of labour. In particular information and communication technologies introduce wide-ranging changes. Digitisation characterises such changes in globalisation and, simultaneously, allows for a new definition of tailored contributions, when the gig-economy helps to exploit cheap university trained labour in less-developed countries. When jobs can be 'Taylorised' into pieces and result of their work can be transferred via internet, consequently, then orders will go to locations and countries where this can be achieved at low costs. Thus, new technologies associated with digitisation and Industry 4.0 can be found in different situations, which refer to changes based on diversities of innovation.[16] When particular arrangements of industries, techno-scientific research, skills, markets and costs meet new technologies there are different opportunities creating rich diversities of innovation.

Such processes frequently address existing markets with new, better and additional products but the formation of new markets creating a demand can also help to induce innovative solutions. While existing markets widely exclude people with small incomes from participation, in contrast, the formation of sufficient markets based on large numbers of people can create economically interesting opportunities. The different instruments and opportunities of government policies can help to create situations ready to apply improvements to services and make available technologies which were absent before.[17] Again, the relationship between existing socio-economic situations and innovation to improve these situations is important. The different situations when Western highly industrialised countries are compared to Newly Industrialised Countries (NICs), or even less-developed countries, provides a large area for improvement based on technologies, equipment or processes, which are outdated or inappropriate in more technologically advanced countries but can induce an innovative push and contribute to strengthen socio-economic development in other countries or regions. The context is important to understand what is considered to be an innovative process in a given context. Divergent socio-economic contexts clearly indicate divergent processes of innovation.

While these situations and processes are very different and often lagging far behind when looked at from leading-edge countries with advanced technological opportunities, nevertheless, these can be complemented by modern and current technological opportunities. Such combinations of less advanced equipment with appropriate new technologies make these innovative processes particularly individualised. It is not just to catch up through different phases of industrialisation and development, as currently leading countries did before, but it involves building their own markets and opportunities by benefitting from new technologies when applying those in situations where they match less advanced situations. Such contexts can be arranged through organisations which aim at collaboration and through government policies that take advantage of existing opportunities concerning diversities of innovation.[18] Organising markets, of course, is not just about introducing new technologies. This demands an idea or policies, which recognise the opportunities that exist in the situations they are facing. Such contexts do emerge in vital markets, but the character of the demand can also change to create more socio-economically advantageous markets.

Capable management and appropriate organisation play crucial roles in inducing innovation. The more complex such processes become the more obvious is the importance of non-technological contributions for effective implementation. The organisation of even a low-income population can provide a context that allows for better medical services, which is a significant improvement, although they may not yet be as state-of-the-art as in leading western countries. Organisation and management is clearly important for providing a context which allows for innovation. Similarly, although it is a very different situation, the highly complex organisation of aircraft industries with all their suppliers and application of new technologies and materials provides an example that refers to the demand for particular structures in

management and how these allow for the formation of the context required for innovation.[19] They need to take the opportunities to transform the context and to induce new and innovative situations. Thus, almost any kind of demand can provide opportunities for innovation and modernisation once these are organised to form a situation that creates new markets for products and services. New technologies help to manage this by building linkages across countries and continents, which create divergent processes of innovation according to the context they encounter (Hickie and Hilpert 2016).

Consequently, innovation varies due to its character in relation to both the kind and level of technology. Innovation does not exclusively follow from leading-edge technology and findings. It can also be generated by the application of existing technologies in different situations. Even such technologies, which may be outdated in leading western locations and countries can help to advance other situations. Nevertheless, the combination with some recent technologies (e.g. communication and information technologies or biotechnologies) indicates particular new processes for development. Although this may help some of developing countries or regions to identify their potential of innovation, it clearly indicates that such processes are highly embedded into the global processes. While leading-edge research and technologies build networks of innovation based on collaboration in research as well as in economic exploitation, even the processes, which can be identified in such less-developed situations demand complementarity in globally available technologies.[20] Although there are particular opportunities for national or regional policies it is obvious that the national or regional identification of innovative opportunities always includes the global environment of both available technologies and markets. Such phenomena emerge from constellations of individual situations and how these are embedded into a global environment.

Societies matter for socio-economic development

Industrial structures and innovative processes require particular competences and skills in the labour force. The better the skills and the more those match the requirements of modern industries and advanced products, the better are the opportunities for innovation.[21] Complex products with high value added, in general, need matching labour of high competence. It is important to understand the relationship between such labour and opportunities for innovation. While there are additional opportunities from applying new technologies, new materials or finding new areas of application, there are also regional situations characterised by a particular mix of industries, enterprises and labour force. Consequently, innovation is not just based on research, enterprises and industrial structures but simultaneously requires social structures, which are characterised by skilled labour. A mismatch of skills clearly limits the opportunities for beneficial economic effects based on manufacturing, whereas a rich variety of skills and competent enterprises increases the opportunities for applications, which allow for a transfer of

innovative competences across industries as a basis of new solutions, improvements and new products.[22]

It is a match of industrial structures, products and the skills of the labour force, which helps to identify innovative opportunities. While most advanced industries, and the continuous upgrading of skills and the rising percentage of highly skilled personnel within the labour force, help to apply most complex technologies and advanced manufacturing processes; it is also clear that less advanced industries cannot take advantage of higher skills to a similar extent. Migration of such labour can be identified. This is well known among knowledge workers, researchers and academics. Countries such as India and Italy are constant exporters of university-educated labour and those holding a PhD (Khadira 2001; Murano-Foadi and Foadi 2003; Ackers 2005; Laudel 2005; Marginson 2006). There is a frequent and constant exchange of personnel following the locations of Islands of Innovation and building a network among the regional innovative labour markets which widely converge with networks of collaboration concerning techno-scientific research and the economic exploitation of new technologies. (Hilpert and Lawton Smith 2013; Trippl 2013). Consequently, particular innovative regional or metropolitan societies are characterised by rather specific social structures, which require highly skilled people and a significantly higher proportion of population from abroad.[23]

Societies need to match the demand for both skilled blue-collar labour and university-educated labour in innovative industries.[24] Nevertheless, new technologies can also match the needs of particular locations, which are characterised by the needs of mass production industries. This may refer to textile and clothing industries as well as to the manufacturing of electronics products such as laptops or mobile phones. Low transaction costs and cheap unskilled labour continue to the advantage of China and the countries in South East Asia. Even rather custom-made production can be achieved despite geographic distances. Suits, shoes, shirts or rather simple metal products can be ordered to precise measurements and in particular via the internet, transmitting the precise information. Modern transportation systems help to reduce delivery periods and to provide markets close to the time of order. Three-dimensional measurements, transfer of the design and individual demands concerning material, outfit or variations can be transferred electronically and fabricated according to the customers' demands. Costs and prices for such products are reduced and, consequently, help to expand such markets. Similarly, costs of advanced electronic products (e.g. personal computers or smart phones) can be kept under control and meet the demands of markets rather spontaneously. Such transfer of information for manufacturing products can be conducted electronically. This helps to organise flexible manufacturing, In addition, the transportation of an individual product can be followed or steered according to changes in demand.

Similarly, in agricultural production, newly developed and highly fertile seeds can be applied without fundamental changes in the crop or harvest. While small farmers may not change their habits and local forms of agriculture

may continue, they can take advantage of newly bred crops, which of course creates a market for such seeds in future. Also in industrially organised agriculture the work practices do not change a lot, but new seeds and new farming equipment are developed and applied. Even printing books and journals can be separated. While printing journals and books demanded typesetters, today print follows from computer-based work and does not require such competence at the location of the work. The final work and the typesetting are entirely different contributions and are realised in different places. There is no need to be capable reading or setting type when print can be realised on the basis of electronically transferred proofs.

Thus, when these new technologies are introduced, they need not to be complemented by social classes that have gained high-level skills and advanced education. Basically, the work that needs to be done has not changed a lot. Sewing high-end clothing, manufacturing expensive shoes, assembling smart phones or growing crops continues and demands little new or additional knowledge. Whereas management of such business and the organisation of work and manufacturing has widely changed because of new information systems, the electronic transmission of design or fast intercontinental transportation. Workers in factories or in the fields face rather marginal improvements of their skills. Whereas those who run and maintain the equipment or manage the processing of an order and contact with distant customers have to improve their work capabilities with regard to technologies, language and appropriate process organisation. Nevertheless, there is a rather limited social change towards higher skills and a well-educated population. Such organisation of economy and manufacturing, or growing crops, can merge with new technologies and contributes to a continuation of globalisation, which favours advanced industrialised countries as developers and providers of such technologies and products. Although the transfer of manufacturing competences through plants and assembly lines, for example the automobile, steel or chemical industries (e.g. in Mexico, Brazil, India) did help to establish such industries. On the other hand, it it did not help much to build a strong infrastructure in research and development or design. Industrialisation continues to be widely oriented towards simple products and thus has little impact on building innovative societies, which require higher skills and education.

Nevertheless, reverse engineering helped to introduce an aircraft industry in Brazil based on smaller airplanes. When copyright, licensing and patenting was ignored in China or India this has helped to develop industrial competences, as have well-known processes of foreign investments, which were made by enterprises from leading western countries. Within former Third World countries, locations emerged based on industries and labour and ready to develop markets on the basis of their own products and on their own competences in research, design and manufacturing. Personnel could become highly skilled and well educated and today form societal situations which continuously help to provide the labour demanded by the modern manufacturing of products, which relate to modern industries and higher value added.

Consequently, advanced industries can be established in such countries and the supply of jobs helps to keep skilled and university educated labour at these locations. Taking advantage of certain market opportunities was related to social change, which is characterised by the growing share of people with skills and the level of education required.

While this indicates that there is already development, which relates to particular opportunities provided by the diversity of innovation, it again demonstrates the importance of an appropriate workforce and the jobs created. Thus, India has managed to establish a particularly well-recognised development in Bangalore which started with the electronics industry and software. It became one of the centres of computer games in the world. In addition it is well known for its competence in biotechnology. Similarly, metropolises like Singapore, Shanghai, Beijing, Hong Kong, Seoul, Rio de Janeiro or Sao Paulo became recognised centres in biotechnology attracting gifted researchers, knowledge workers and academics to take jobs (Hilpert 2013a, 2016d). But, simultaneously, India is an example of a country, which constantly is an exporter of talent and university educated labour force. (Mahroum 2000b; Khadira 2001; Marginson 2006). The leading universities of the country produce graduates with a high international reputation.

Such individuals frequently aim to take attractive job opportunities abroad (predominantly in North America or Europe). Also well-educated engineers or researchers of East Asian origin leave their countries and frequently start enterprises (e.g. in Silicon Valley) or are highly recognised employees of innovative firms (Mahroum 1999; Saxenian 2002; Ackers 2005). Thus they contribute to innovative societal situations abroad and continue to do so because of a lack of jobs in their countries of origin or because they enjoy the different social culture they now live in.[25] Consequently, the match of innovative jobs with appropriately skilled and educated personnel helps to build a regional society, which is characterised by the agglomeration of such individuals, while in their home countries their contribution towards an innovative society is missed (Ackers 2005; Farwick 2009). Simultaneously, in the regional or metropolitan contexts where they migrate to, there is a clear tendency towards both an internationalisation of such locations and a population from different national and cultural backgrounds (Saxenian 2002; Ackers 2005; Regets 2007).

Within individual countries trans-regional migration of highly skilled blue-collar workers was already well known (Ackers 2005). After 1990, in Europe such highly skilled blue-collar labour became increasingly mobile because they were free to move to other countries such as Britain or Germany. Labour markets attract innovative personnel and help to supply the workforce, which is required for modern economic processes. Hiring such additional personnel is limited to the number of jobs to be filled and so will not necessarily balance the available jobs with the available labour force in regions and countries with an oversupply of skilled personnel.[26] Although this allows for a flow of skilled personnel a mismatch in the exporting regions or countries will continue due

to the lack of appropriate jobs. Thus, skilled labour may exist in the exporting regions or countries but it needs to match industrial opportunities to support innovative processes. While innovation demands skilled labour to generate socio-economic effects, the labour needs to match opportunities of techno-industrial innovation.

Existing mismatches have serious effects on societies, because, existing skills cannot be exploited for innovation and higher value-added production. When labour markets for such employment are not available employers demand either additional education and further training or else jobs requiring less-skilled labour are filled with overqualified and experienced personnel (OECD 2017). A realisation of innovation and the generation of socio-economic effects needs a match of skills in the areas of modernisation. A labour force, which is formally well skilled but does not meet the areas of competences, which are required by modern and innovative industries, will not help such processes nor will make such places and attractive to locate advanced manufacturing. Focussing on university-trained labour, or on areas which are not currently demanded by such enterprises, will have neither a positive impact on socio-economic development nor on employment similar to that in leading countries or regions. The simultaneity of both innovative industries and innovative societies provides the basis for innovative processes because there is a match of industrial competences and a skilled labour force.

This highlights that it is not simply that skilled labour has to be available, but also that these skilled workers need to be suited to the innovative processes in their labour market. Given there is no match with the current opportunities there will be neither a strong enabling of existing industries and enterprises, nor will there be an attraction to locate particular areas of development and manufacturing to such places. While in well-matched situations, skills help to constantly modernise industrial structures,[27] this can hardly be noticed or expected where this match is missing. Thus, one can identify processes, which are the opposite to those based on established innovative societies. A continuing mismatch will reduce opportunities of innovation and induce a tendency to increasing societal polarisation. There is little innovation, less higher value added and only few can participate in this socio-economic development. Societies, which do not exhibit an innovative potential based on appropriate skills and education are at risk of falling behind and to have a growing population of skilled but inappropriately employed labour force.

While skills and education in innovative societies help individuals to participate in socio-economic development they cannot experience such a positive tendency in less innovative societies. Thus, the lack of attraction towards innovative industries to locate new plants and departments of research and development at such places introduces an attraction for particularly well-skilled and educated personnel to migrate to other places (Mahroum 2000a; Laudel 2005; Favell, Feldblum and Smith 2006; Marginson 2006). Consequently, locations, which are characterised by these situations, have strong disadvantages concerning opportunities for innovation because there is

a lack of appropriate industrial structures and a problem with supplying the labour force which matches the demand for skills as a basis of innovation. This is a difficult situation, because skilled labour will not find jobs nor frequently stay in the region because of the existing labour markets. On the other hand, new job opportunities are hard to provide since enterprises will not open new plants nor will start-ups emerge in large numbers due to the lack of an appropriate labour force. Nevertheless, suitable social structures and societal situations can be arranged during processes of development.[28] Over a period of generations a matching can be effective, when combining industrial development based on advanced industries and higher values added with government policies, which support the constant development of a skilled labour force. This helps to establish a societal situation, which is characterised by well-educated individuals ready to fill jobs in innovative industries.

The availability of such labour is important to allow for both products with higher value added and complex technologies. When taking into consideration that innovative processes are clearly characterised by regionally divergent processes of innovation this also indicates that regional societies and innovative industrial regions need to create matches for such development. In particular, Islands of Innovation, which are frequently based in metropolises are also both participating in, and contributing to, continental and global networks. Competences and products are exchanged as well as innovative labour moving among the regionalised innovative labour markets and integrating into both the innovative industries' labour forces and the metropolitan societies. Among these Islands of Innovation rather similar structures of both innovative industries and innovative societies have emerged and mutually contribute to innovative processes, which are widely globally and continentally embedded (Hilpert 2013a; Hickie and Hilpert 2016). A constant process of collaborative innovation within such networks of both R&D and economic exploitation has helped to further develop structures which are beneficial for all who participate in such exchanges. Established educational systems and universities, which are ready to provide graduates with the competences required enjoy support from public policies from different levels of government (Bercovitz and Feldman 2006).

While these are existing structures to be continued according to opportunities for innovation countries, regions and metropolises which aim at innovative processes, they will have to manage social change in a way that supplies the existing and emerging demand for a skilled and well-educated labour force. Societies which cannot build the skilled labour required will face problems in innovative development and consequently during future socio-economic development, providing attractive jobs and sustainable industrial structures. Those countries will generate an outward migration of highly skilled labour, which does not match the labour markets formed by the demand of enterprises and research institutions based in the sending region or country. Regional or metropolitan societies, which are characterised by a mismatch of skills will not have a positive impact on prosperity but may face frustration from those

employed in jobs below their skills and competences. Thus, similar to divergent industries, technologies and traditions in academic research and cultures the societal situations of locations vary a lot and indicate additional diversities, which are important at a basic level and have to be taken into consideration when understanding or inducing processes of innovation which suit the existing situation.

Diversified innovation

There are many different situations and constellations, which influence the individual processes of innovation. The relationship and driving forces for such development differ according to existing situations and emerging opportunities. Thus, innovation can be identified both as a process and by its result. This means, that products, services or the organisation of innovative manufacturing play a role and indicate that industrial structures and enterprises matter. Different products, specialisation or divergent application of new technological opportunities indicate the diversities of such processes, which need to be understood to have a better idea of innovation in general. Consequently, specific competences provide a basis for innovation, which relate to the exchange of[29] knowledge and the synergy of collaborations for new products. Clusters indicate such differences (Lawton Smith and Waters 2005; Simonen and McCann 2008), but even more interesting than a regional concentration of particular enterprises are the innovative opportunities, which include particular technologies, competences, research and skills for marketable products. While these inhibit particular opportunities and address new areas of industrial development certain new technologies they may not respond to other technologies or opportunities. Geography is an indicator for (Bercovitz and Feldman 2006) innovative processes, which exist in some situations or are not available in other constellations. It relates to on-going processes and indicates which enterprises and competences are included or related by collaboration in spite of geographic distance.[30]

Industrial sectors and competences, traditions in technologies and academic research or markets, which are supplied, are important to identify how diverse the geography of innovation is and where regions or metropolises can participate. It helps to visualise the diversity, but the process itself requires a workforce that is ready to manufacture innovative products or to offer innovative services. Highly skilled blue-collar labour, experienced knowledge workers and engineers, or gifted academics are not located in a geographically even distribution, although the general structures as indicated before may be similar. The uneven distribution of a workforce and differences among regional societies in the orientation towards skills and education indicate additional diversities concerning socio-economic development based on the exploitation of innovation and technologies. Although regions and their structures may tend to be similar due to such societal differences and the existing labour force there are significant differences in coping with technological change and innovative processes (Hilpert 1992). Regional or metropolitan societies of highly skilled

and well-educated workers provide a fundamental basis for such modern socio-economic processes. Shared attitudes of workers and entrepreneurs towards new technologies, and continuing change based on innovation associated with permanent adjustment and the modernisation of competences, allow firms and regions to take advantage of such changes much more spontaneously than orientations towards keeping and protecting established situations and structures.

Such a situation, which provides for the structure required and the labour force to realise the socio-economic development is embedded in a particular context. The process can have its positive effects only if both collaborators for academic research and for industrial R&D are available. Leading-edge research reaches out into new areas. While established areas of research have already formed their centres of excellence and provide for university-educated labour, new areas are based on a rather small scientific community, which has just emerged and is still limited by the number of institutions and individuals involved. Consequently, the lack of an academic labour force of a particular region or metropolis is balanced by the most efficient exploitation of those knowledge workers, researchers or academics who are ready for collaboration. International networks are formed to collaborate on such new research questions (Criscuolo 2005) followed by new findings, which are generated within such networks. Since these initiatives provide the basis for spin-off enterprises and start-up firms there are also economic partners emerging for collaboration on marketable products (Simonen and McCann 2008; Breschi and Lissoni 2009; Hilpert 2013b). Thus the context is widely influenced by the relationship with an international situation of collaboration and competence on the one hand, and marketable products on the other hand.

Thus, even technologies, equipment or skills, which are not state of the art, can induce innovative processes, when compared with the previous situation. The context and situation in the light of production costs can form constellations of resources, which are considered as an innovative improvement when compared with a previous situation. Similarly, services can be regarded as innovative in a particular context although they may not be state-of-the-art.[31] The arrangement of a context by forming markets even on a national basis can help to generate innovative improvements and can contribute to solutions of problems or standards of living. Although innovation is frequently understood in relation to state-of-the-art technology, products or services, using less advanced technologies can also have favourable socio-economic outcomes, provided they are addressed to the satisfaction of current market needs. The embeddedness of such situations and their relationship with markets helps to create innovative initiatives, although such technologies, organisations or markets in leading-edge contexts are outdated and may refer back to quite old industrial history. The implementation of technologies and the organisation of manufacturing, which are not at the state of Industry 4.0, are perfect examples to understand why these may be innovative in other situations.

Processes of development are understood in the light of these situations and existing opportunities. Since technologies or typical periods of industrial development can be identified along long waves they can be at different levels of innovation although they refer to similar technologies (e.g. cars, machines, electronics). Innovation and change are rather closely related. Although the context is important for what is considered to be of innovative impact, clearly, there can also be an application which is more at the forefront of innovation or which refers to maturation of a technology. Positions of countries, regions or metropolises differ by industries, technologies and over time during periods of socio-economic development. The relationship between the level of innovation and both the situation and the context characterised by a particular point in time is important to develop a deeper understanding of processes of innovation. This helps to identify the emergence of opportunities, the continuation in a different context and the change of opportunities in processes of development and change.

In taking this into consideration there is a clear relationship with societal structures characterised by increasing social classes with high-level skills and education as a basis for innovation. This indicates the positioning of countries and industries during such developments of long waves[32] and the relationship with the time to change social structures according to the demand for a higher-skilled labour force for advanced jobs. Innovative societies are characterised by permanent change towards skills and university education by gross numbers, share of the labour force, social classes and gender. While there is discussion about the demand for human capital by innovative industries it needs to be understood that to realise innovative processes such a labour force needs to be developed prior to the demand for it. Again, time and processes of development are to be understood in the light of innovative processes, which follow to, and from, such structures and opportunities.

Consequently, innovation is characterised by its diversity of sources, situations, contexts and processes over time. In addition there are differences concerning industries, research findings, available skills and social cultures, which influence how such processes are realised and become empirically identifiable. This also refers to the rich diversity of processes and opportunities for innovation allowing countries, regions or metropolises to position themselves according to their potentials and contexts. When understanding innovation as a process it allows for learning about the interrelationship among its different elements and how these contribute at a particular point in time, while understanding the context and driving forces. Government policies support different activities (e.g. scientific research, industrial change, skills and education, markets and trade) focussing on particular industries, technologies or skills. A closer look into the diversities of innovation will help to both understand why these cases are so highly specific and, simultaneously, to get a better idea of the general innovation process and how it is inhibited by the empirical diversities.

Notes

1 See the contribution by Michael Vassiliadis. See also the problem of lacking skills and the difference between basic education and skills acquired through training on the job in the contribution by Paul M.A. Baker, Matej Drev and Mariza Almeida. Although a basic education is fundamental to develop a skilled labour force, the system of gaining skills is important for the innovative processes to be realised or to participate in.
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7 See the contributions by Michael Vassiliadis and the one by Paul M.A. Baker, Matej Drev and Mariza Almeida on the role of innovative and skilled labour for modern industries.
8 See the contribution by Desmond Hickie, Neil Jones and Florian Schloderer on the importance matching both innovative opportunities and market opportunities.
9 See the chapter by Alberto Bramanti on how such innovative opportunities can contribute to existing industries and potential products.
10 See the contribution by Marc-Alain Rieu referring to the increasing demand for collaboration because of the intensive competition on new technologies and new products applying new technological opportunities. Consequently, academic research and economic exploitation is becoming more and more transnational continental or global.
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managing a particular situation which may not immediately be understood as fundamental to innovation see the chapter by Torsten Schunder and Sharmistha Bagchi-Sen.

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21 See the chapter by Michael Vassiliadis for the contribution of innovative labour for advanced socio-economic development.

22 See the chapter by Connie L. McNeely on the important contribution of diverse social and professional backgrounds to finding new opportunities of innovation, application and economic exploitation.

23 Concerning the relationship between industrial structures and the societal situation which provides for the skilled labour required see the chapter by Alberto Branmanti.

24 See the contribution by Francesco D. Sandulli and Elena Gimenez Fernandez on the problems of mismatching skills and demands on the labour markets, when there is an oversupply of skilled labour.

25 Concerning the role of both a culturally diverse labour force and situation in enterprises see the contribution of Connie L. McNeely.

26 See the chapter by Fancesco Sandulli and … concerning the importance of skilled labour and the problem of a mismatch between industrial structure and labour markets.

27 See the chapter of Michael Vassiliadis on the importance of a skilled labour force regarding innovative processes and constant industrial modernisation.

28 Concerning the role of highly skilled labour for societal change and the role of processes of innovation for industrial change see also the contribution by Sunyang Chung to this book.

29 Concerning the risk of similar research strategies and standardisation of research and development of new producers see the chapter by Alian-Marc Rieu

30 Concerning the decreasing need for geographic proximity and the increasing collaboration despite geographic distance see also the chapters by Xiangdong Chen, Ruixi Li, Xin Niu and Valerie Hunstock and by Alain-Marc Rieu.

31 For the innovative effect of contributions which may not be state of the art see the chapter by Torsten Schunder and Sharmistha Bagchi-Sen on the origination of a new context to improve the situation, which will be considered as innovative by those who can enjoy the new and better medical services.

32 For the development of the the long waves see the contribution by Walter Scherrer to this book.

References

Abel, J. and Deitz, R. 2009: Do colleges and universities increase their regions human capital? Federal Reserve Bank of New York: Staff Reports No. 401.

Ackers, L. 2005: Moving people and knowledge: scientific mobility in the European Union. In: *International Migration*, 43 (5), 99–131.

Bagchi-Sen, S. and Kedron, P. 2016: Governance of biofuel production in the United States. In: Hilpert, U. (Ed.): *Handbook of Politics and Technology*, Routledge Ltd., London and New York, 299–309.

Bellini, N. and Pasquinelli, C. 2016: Branding the innovation place: managing the soft infrastructure of innovation. In: Hilpert, U. (Ed.): *Handbook of Politics and Technology*, Routledge Ltd., London and New York, 79–90.

Bercovitz, J. and Feldman, M. 2006: Entrepreneurial universities and technology transfer: a conceptual framework for understanding knowledge-based economic development. In: *Journal of Technology Transfer*, 31, 175–188.

Berry, C. and Glaeser, E. 2005: The divergence of human capital levels across cities. In: Harvard University, Taubman Center Research, Working Papers, WP05-03, Cambridge, MA.

Breschi, S. and Lissoni, F. 2009: Mobility of skilled workers and co-invention networks: an autonomy of localized knowledge flows. In: *Journal of Economic Geography*, 9, 439–468.

Chung, S. 2016: Korean government and science technology development. In: Hilpert, U. (Ed.): *Handbook of Politics and Technology*, Routledge Ltd., London and New York, 222–235.

Coulombe, S. and Tremblay, J.-F. 2009: Migration and skills disparities across Canadian provinces. In: *Regional Studies*, 43 (1), 5–18.

Criscuolo, P. 2005: On the road again: research mobility inside the R&D network. In: *Research Policy*, 34, 1350–1365.

Dhéret, C., Morosi, M., Frontini, A., Hedberg, A. and Pardo, R. 2014: Towards a new industrial policy for Europe. In: ECP Issue Paper No 78, November.

Dolphin, T. 2015: *Technology, Globalisation and the Future of Work in Europe*. Essays on Employment in a Digitised Economy. IPPR, London.

Farwick, A. 2009: Internal migration, challenges and perspectives for the research infrastructure. In: Working Paper 97, Berlin: German Council for Social and Economic Data (RatSWD).

Favell, A., Feldblum, M. and Smith, M.P. 2006: Mobility, migration and technology workers: an introduction. In: *Knowledge Technology and Policy*, 29 (3), 3–6.

Franco, A.M. and Filson, D. 2000: Knowledge diffusion through employee mobility. In: Federal Reserve Bank of Minneapolis: Research Department Report 272, Minneapolis: Federal Reserve Bank of Minneapolis.

Hickie, D. 2006: Knowledge and competitiveness in the Aerospace industry: the cases of Toulouse, Seattle and North-West England. In: *European Planning Studies* (EPS), 14 (5), 697–716.

Hickie, D. 2016: Competition in international automotive and aircraft technologies. In: Hilpert, U. (Ed.): *Handbook of Politics and Technology*, Routledge Ltd., London and New York, 310–322.

Hickie, D. and Hilpert, U. 2016: Transatlantic comparison of continental innovation models: a differentiation of regionalised processes of innovation in Europe and the US. In: Hilpert, U. (Ed.): *Handbook of Politics and Technology*, Routledge Ltd., London and New York, 37–49.

Hilpert, U. 1991: *Regional Innovation and Decentralization. High tech industry and government policy*. Routledge Ltd., London and New York, 320.

Hilpert, U. 1992: *Archipelago Europe – Islands of Innovation*. Synthesis Report. Brussels: Commission of the European Communities, XII/411/92, 290.

Hilpert, U. 2006: Knowledge in the region: development based on tradition, culture and change. In: *European Planning Studies*, 14 (5), 581–599.

Hilpert, U. 2013a: Networking innovative regional labour markets. Towards spatial concentration and mutual exchange of competence, knowledge and synergy. In: Hilpert, U. and Lawton Smith, H. (Eds.): *Networking Regionalised Innovative Labour Markets*, 3–31. Routledge Ltd., London and New York.

Hilpert, U. 2013b: Labour for regional innovation. The role of researchers for development and patterns of recruitment. In: Hilpert, U. and Lawton Smith, H. (Eds.): *Networking Regionalised Innovative Labour Markets*, 35–57. Routledge Ltd., London and New York.

Hilpert, U. 2016a: *Handbook of Politics and Technology*. Routledge Ltd., London and New York, xxiii + 491.

Hilpert, U. 2016b: Changing opportunities in global and regional contexts: the relationship between politics and technology. In: Hilpert, U. (Ed.): *Handbook of Politics and Technology*, Routledge Ltd., London and New York, 1–34. intro.

Hilpert, U. 2016c: The culture-technology nexus: innovation, policy and successful metropolis. In: Hilpert, U. (Ed.): *Handbook of Politics and Technology*, Routledge Ltd., London and New York, 149–161.

Hilpert, U. 2016d: Metropolitan locations in international high-tech networks: collaboration and exchange of innovative labour as a basis for advanced socio-economic development. In: Hilpert, U. (Ed.): *Handbook of Politics and Technology*, Routledge Ltd., London and New York, 281–298.

Hilpert, U. and Lawton Smith, H. 2013: *Networking Regionalised Innovative Labour Markets*. Routledge Ltd., London and New York, 204.

Khadira, B. 2001: Shifting paradigms of globalization: the twenty-first century transition toward generics in skilled migration from India. In: *International Migration*, 39 (5), 45–71.

Laudel, G. 2005: Migrant currents among scientific elite. In: *Minerva*, 43, 377–395.

Lawton Smith, H. and Waters, R. 2005: Rates of turnover high-technology agglomerations: knowledge transfer in Oxfordshire and Cambridgeshire. In: *Area*, 37 (2), 189–198.

Lawton Smith, H. and Waters, R. 2013: High-technology local economies: geographical mbility of the highly sklled. In: Hilpert, U. and Lawton Smith, H. (Eds.): *Networking Regionalised Innovative Labour Markets*, Routledge Ltd., London and New York, 96–116.

Liu, X. 2016: China's path towards becoming a major world player in science and technology. In: Hilpert, U. (Ed.): *Handbook of Politics and Technology*, Routledge Ltd., London and New York, 380–395.

Mahroum, S. 1999: Global magnets: science and technology disciplines and departments in the United Kingdom. In: *Minerva*, 37, 379–390.

Mahroum, S. 2000a: Scientists and global spaces. In: *Technology and Society*, 22, 513–523.

Mahroum, S. 2000b: Scientific mobility: an agent of scientific expansion and institutional empowerment. In: *Science Communication*, 21, 367–378.

Marginson, S. 2006: Dynamics of national and global competition in higher education. In: *Higher Education*, 52, 1–39.

Marx, K. 1962 (1890): *Das Kapital. Kritik der politischen Ökonomie. Der Produktionsprozeß des Kapitals*. Vol. I, Marx Engels Werke, Bd. 23, Dietz Verlag, Berlin, 955.

Marx, K. 1963 (1893): *Das Kapital. Kritik der politischen Ökonomie. Der Zirkulationsprozeß des Kapitals*. Vol. II, Marx Engels Werke, Bd. 24, Dietz Verlag, Berlin, 559.

Marx, K. 1964 (1894): *Das Kapital. Kritik der politischen Ökonomie. Der Gesamtprozeß der kapitalistischen Produktion*. Vol. III, Marx Engels Werke, Bd. 25, Dietz Verlag, Berlin, 1007.

Murano-Foadi, S. and Foadi, J. 2003: Italian scientific migration: from brain exchange to brain drain. Paper presented on the Symposium on Science Policy, Mobility and Brain Drain in the EU and Candidate Countries at the Centre for Studies of Law and Policy in Europe. University of Leeds, July 27-28, 2003.

O'Sullivan, E., Mitchell N. 2013: International approaches to understanding the future of manufacturing. In: Future of Manufacturing Project: Evidence Paper, No 26. Government Office for Science, London.

OECD. 2017: *OECD Employment Outlook 2017*. OECD Publishing, Paris, 216.

Piore, M.J. and Sabel, C.F. 1984: *The Second Industrial Divide: Possibilities for Prosperity*. Basic Books, New York, NY, ix and 355.

Power, D. and Lundmark, M. 2004: Working through knowledge pools: market dynamics, the transference of knowledge and ideas and industrial clusters. In: *Urban Studies*, 41 (5/6), 1025–1044.

Regets, M. 2007: Research issues in the international migration of highly skilled workers. A perspective with data from the United States. In: Working Paper, SRS 07-203. Arlington, VA: Division of Science Resources Statistics, National Science Foundation.

Sabel, C.F., Herrigel, G., Kazis, R. and Deeg, R. 1991: Regional prosperities compared: Massachusetts and Baden-Württemberg. In: Hilpert, U. (Ed.): *1991. Regional Innovation and Decentralization: High tech industry and government policy*, Routledge Ltd., London and New York, 177–195.

Saxenian, A. 2002: Silicon valleys new immigrant high-growth entrepreneurs. In: *Economic Quarterly*, 16 (1), 20–31.

Simonen, J. and McCann, P. 2008: Firm innovation: the influence of R&D cooperation and the geography of human capital inputs. In: *Journal of Urban Economics*, 64 (1), 146–154.

Smith, A. 2008 (1776): *An Inquiry into the Nature and Causes of the Wealth of Nations*, ed. by K. Sunderland. Oxford Paperbacks, Oxford, UK, 688.

Trippl, M. 2013: Star scientists, islands of innovation and internationally networked labour markets. In: Hilpert, U. and Lawton Smith, H. (Eds.): *Networking Regionalised Innovative Labour Markets*, Routledge Ltd., London and New York, 58–77.

Tsui-Auch, L.S., Chia, S.I. and Liu, A. 2016: Putting Singapore on the global innovation map: the shifting role of the state in the rapidly changing environment. In: Hilpert, U. (Ed.): *Handbook of Politics and Technology*, Routledge Ltd., London and New York, 191–206.

Notes

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Chapter 3

1 The first wave was triggered by innovations in steam power and the textile industry and started in the 1790s in Britain, the second wave by the steam railway (1840s), the third by steel and heavy engineering (1880s), the fourth by applying the principles of mass production (late 1930s), and the fifth wave by modern information and communication technologies (late 1980s). For an overview see Scherrer (2016), for detailed descriptions of waves see Freeman and Louçã (2001).
2 Although the notion "surge of development" tends to be more adequate the wording "long wave" which is commonly used in the literature will also be used in this chapter.
3 The key factors or key inputs which drive a long wave are characterized by rapidly falling relative cost, an almost unlimited availability of supply over long periods, and a clear potential for use or incorporation in many products and processes throughout the whole economic system. As improvement innovations are subject to the law of diminishing returns and profits are competed-away the innovating impulse will dissipate over time.
4 Sundbo does not refer to the first and second long waves.
5 A TEP is based on new sets of interrelated technologies and organisational principles that allow a step change in potential productivity in practically all economic activities ("irruption phase"). Entrepreneurs' and investors' search for opportunities created by the new technology involves a huge amount of speculation which entails the build-up of a financial bubble ("frenzy phase"). The bubble's burst signals the "turning point" of the long wave. As social and institutional change is lagging behind technological change, only those societies which adapt its regulatory and institutional framework best to the requirements of the new TEP can exploit its economic potential fully ("synergy phase"). Finally, in the "maturity phase" markets become increasingly saturated and the potential for improvements within this TEP get exhausted. Consequently, both real-economy entrepreneurs and financial investors start searching for opportunities outside the prevailing paradigm thereby giving way to a new long wave.
6 "Science" is considered not only to be an activity performed within research-oriented organizations like universities or R&D departments of firms but also – which is particularly relevant in the early long waves – by individuals who search for technological novelties (e.g. by experimenting).
7 Because of its importance a distinct section is devoted below to education and skill formation policies.
8 It has to be borne in mind that the concept of "public sector innovation" is somewhat blurred as it lacks the test of acceptance in a competitive market which is the clear criterion of success for innovation in the private sector.

Chapter 4

1 For a recent reformulation of the *National Innovation System* model, see Mariana Mazzucato (2013). The book studies how the state has made, and can still make, a difference while being "entrepreneurial" and "creative".

2 It was the title of the Triple Helix conference, Stanford, July 2011.
3 Information and Communication Technology.
4 When some explain that the crisis is over, it is necessary to indicate that the crisis is systemic because it was first financial in the mid-2007. It became economic and social in 2008, then global and monetary, increasing international tensions and generating regional wars. When the crisis engulfed new industrial nations and energy producers, it generated an increased wave of mass migrations further deconstructing the world order.
5 In a neo-Marxist approach, Wolfgang Streeck (2014), in *Buying time. The delayed crisis of democratic capitalism*, refuses any sort of prophecy, fate or destiny. He explains the successive policies, which generated and justified at the same the fear of a long-term recession. But innovation is not taken into account. In this paper, I also refuse the prophecy of a long-term recession but try to find a response by extending the concept of innovation.
6 See my comments (Rieu 2006) in the debate "Inventer une *société de la connaissance*. Le Japon en comparaison". Ten years later my position is the same concerning China.
7 See Roger Hahn (1971). The book studies the mimetic rivalry between the Royal Society (1663) and the Paris Academy of science (1666) as well the European-wide consequences of this rivalry on the development of "modern science".
8 Concerning Japan, see Rieu (1996).
9 On the need to draw a distinction between "knowledge economy" and "knowledge society", see Rieu (2005).
10 See for instance the reports published by the Information Technology and Innovation Foundation (www.itif.org) or the role of innovation in President Obama's 2011 State of the Union speech. He officially converted to the innovation mantra in order to restore or reinvent the golden circle.
11 The Washington, DC Council on competitiveness was founded in 1986. See www.compete.org. Its reports tell the story of American anxiety of losing the basis of its post-war economic and military hegemony.
12 It will be popular: news from Brussels have explained that this field will be very "open". A strong risk today is not to see "security" becoming one of the "grand societal challenge". The risk is to see "security" becoming a fifth helix, in competition with "society", establishing direct relations with government, industry and universities. Establishing a fourth helix is to assert that "society" is the regulation between the state apparatus, industry and university, that "security" falls within this regulation.
13 Both plans were unfortunately stalled, the 3rd one when the 2008 crisis engulfed Japan, the 4th plan was expected to be launched in April 2011 but the 11 March 2011 catastrophe in Fukushima radically transformed the conditions of its implementation.
14 My paper (Rieu 1996) written for the Japan's National Institute of Research Advancement is a typical example of this conjuncture.

Chapter 5

1 Thus, for example, technological development is critical to meet productive capacity-building objectives in developing countries (UNCTAD 2007), and evidence indicates that one of the highest returns for a developing economy comes from investing in education for girls and women (World Bank 2012).
2 www.un.org/millenniumgoals
3 E.W. Lempinen of TWAS, in OWSD 2013.

1 An additional consideration, although one beyond the scope of this chapter, are the dimensions of the demand component, from students and learners on one side, and from employers on the other. One of the key changes being observed in policy innovation is the intentional inclusion of these stakeholders in developing workforce preparation solutions. Understanding student needs and perceptions is important to designing approaches that speak to the needs of the primary consumers of postsecondary education (Kunz & Staub 2016). Another change is the recognition that non-traditional (i.e. university) higher education is falling short of meeting the increasing complex skills needed by industry (Carew 2016).
2 (Hart Research, www.aacu.org/sites/default/files/files/LEAP/2015employerstudentsurvey.pdf).
3 https://sites.ed.gov/oii/
4 http://portal.mec.gov.br/index.php?option=com_docman&view=download&alias=22071-24092015-lancamento-estudos-pronatec-setec-pdf&category_slug=abril-2010-pdf&Itemid=30192)

Chapter 7

1 We defined overskilled middle-skilled workers as workers with upper and post-secondary educational levels employed in an elementary job.
2 Hausman test confirmed the convenience of fixed effects estimation in this sample.
3 We would consider middle-skill workers as those workers with a Upper and Post secondary (Non tertiary) Educational Level.
4 US President Donald Trump seems to embrace a similar point of view, since he has heralded a "new industrial revolution" during his campaign and first months of mandate in 2017. Similarly, in Europe some countries adopted similar plans to increase the demand for middle-skill workers in the industry such as Platform Industrie 4.0 in Germany or the Alliance Industrie du Futur in France.
5 While NNMI was supported by the US Congress, most of the programs to foster new skill development have found strong resistance by the Republican majority in the US Congress.
1 There are many more studies on various regions in specific industrial development, for example, which refer to Wu, Qianpo, Ning, Yuemin, "Analysis on City Networking in China—from the perspective of electronic and information companies"<Geographical Studies> (in Chinese), Vol 31, No. 2, (2012).
3 According to Eurostat classifications, manufacturing includes all activities in section C of the NACE (rev 2). This section encompasses industries involving the physical or chemical transformation of materials, substances or components into new products.
4 Multi-level governance requires a system of continuous negotiations among nested governments at different territorial tiers as a result of the broad process of institutional creation and decisional reallocation that had affected some previously centralised functions of the state (Marks 1993).
5 Here, the 'broader definition' refers to all that exceeds technological progress. Cultural, societal and aesthetic innovations – sometimes referred as 'soft innovation' (Stoneman 2010) – are key for shaping the developing paths of advanced regions.
6 In Greek mythology, a phoenix is a long-living bird that is cyclically regenerated or reborn. A phoenix rises to life from the ashes of its predecessor. A 'phoenix industry' is a new productive activity born from the ashes of a previous producer (frequently a large firm) that maintains some elements of its predecessor and adds new lifeblood.

7 269The story of photonics in Rochester (NY) is particularly instructive. Photonics – the science of using light in processes from advanced manufacturing to data transmission – has a strong footprint in Rochester. It emerged from the old photographic equipment and supply industry (Kodak's sector), and resulted in a hub focused on the design, manufacturing and packaging of circuits that combine photonic and electronic components. Integrated photonics have the potential to revolutionise the carrying capacity of Internet networks, improve performance in biological research, and they have applications in such areas as cyber defence, banking, investing, video conferencing and weather modelling. This sector accounts for an estimated 17,000 jobs in the region. In 2014, Rochester was chosen as the headquarters of the American Institute for Manufacturing Integrated Photonics (AIM Photonics), a first-class national institution. This is likely to boost the visibility and the attractiveness of the region.

8 Much of this case on the automotive industry in the West Midlands is based on Amison and Bailey (2014). Further information on the case is available in a detailed research report by the same authors (Amison and Bailey 2013).

9 *'In the Midlands case, rather than being a supporting factor, lack of access to capital has been a drag on the sector (…). Domestic finance for investment in manufacturing has been a problem for British industry, stretching as far back as to late XIX Century. Several interviews expressed the belief that "there is no finance available in the UK for manufacturing"'* (Amison and Bailey 2014: 403–404).

10 *'In essence, Industry 4.0 will involve the technical integration of Cyber-Physical Systems (CPS) into manufacturing and logistics, and the use of the Internet of things and services in industrial processes. This will have implication for value creation, business models, downstream services and work organisation'* (Industrie-Science Research Alliance 2013: 14).

11 All of the information reported here is extracted from the rich and up-to-date 'Regional Innovation Monitor' developed by Technopolis in partnership with the Fraunhofer Institute for Systems and Innovation Research ISI on behalf of the European Commission (Zenker and Schnabl 2016).

12 Different labels are used in the literature to indicate the pool of idiosyncratic regional assets enabling innovation processes and enhancing development paths. They include 'territorial capital' (OECD 2001), 'industrial commons' (Pisano and Shih 2012) and 'innovative milieu' (Ratti et al. 1997).

13 In an open-innovation model, firms use external ideas and internal ideas, as well as internal and external paths to market. Firms utilise open innovation to address two growth objectives: growth in the current business (incremental change) and growth in new business areas (step change).

15 The platform should have a strong service orientation, and focus on developing and delivering concrete services (e.g., advisory services, data and analysis services). At the same time, it should act as a vehicle to encourage and support collaboration among firms, clusters and regions.

16 This funding scheme is designed to improve the global competition of the UK's advanced manufacturing supply chain, and to help create or safeguard 5,000 jobs over the next five years (2015–2020).

17 For example, 4,750 units of the model S Tesla were sold in the US in the first quarter of 2013, which was more than conventionally powered premium cars in the EUR 70,000–90,000 price range produced by Audi, BMW, Lexus and Mercedes, each of which had sales of 1,500 to 3,000 cars in the same period.

18 270A 'type 2' arrangement is an alternative vision of multi-level governance. In this vision, the number of jurisdictions is vast rather than limited; jurisdictions are not aligned on just a few levels, but operate on diverse territorial scales; jurisdictions are functionally specific rather than multi-task; and jurisdictions are intended to be flexible rather than fixed (Hooghe and Marks 2001).

Chapter 13

1 The term 'to pay' should not be restricted to the concept of financial payment. Rather the concept of 'to pay' should be taken to mean many dimensions including acceptance, adoption, use, and propagation (to mention but a few aspects) of an innovation.
2 The name CERN is derived from the acronym for the French 'Conseil Européen pour la Recherche Nucléaire', or European Council for Nuclear Research, a provisional body founded in 1952 with the mandate of establishing a world-class fundamental physics research organisation in Europe. At that time, pure physics research concentrated on understanding the inside of the atom, hence the word 'nuclear'. Today, our understanding of matter goes much deeper than the nucleus, and CERN's main area of research is particle physics – the study of the fundamental constituents of matter and the forces acting between them. Because of this, the laboratory operated by CERN is often referred to as the European Laboratory for Particle Physics. (Available at www.cern.ch).
3 The Arab Spring was a swell of revolutionary activity that began in Tunisia on 18 December 2010 and spread throughout other Arab League countries.
4 317The Deindustrial Revolution: The rise and fall of UK manufacturing, 1870–2010 Centre for Business Research, University of Cambridge Working Paper No. 459 by Michael Kitson Centre for Business Research and Judge Business School, University of Cambridge Email: mk24@cam.ac.uk and Jonathan Michie Kellogg College and Department for Continuing Education, University of Oxford Email: jonathan.michie@kellogg.ox.ac.uk June 2014.
5 www.jfklibrary.org/JFK/JFK-in-History/JFK-on-the-Economy-and-Taxes.aspx [accessed March 2016].
6 For more details see www.povertyeducation.org/the-rise-of-asia.html [Accessed February 2016].
7 Ibid
8 For more details about the demise of Ireland's economy see http://ec.europa.eu/ireland/economy/irelands_economic_crisis/index_en.htm.
9 For more insight information about education in Ireland, see www.hea.ie/node/1557 [Accessed January 2017].
10 Ibid
11 For more in-depth information see www.cso.ie/en/media/csoie/census/documents/census2011profile9/Profile_9_What_we_know_full_doc_for_web.pdf [Accessed January 2017].
12 This was an IDA (Industry Development Authority) Ireland advertisement in 1980 to attract increased levels of FDI into Ireland.

References

Abel, J. and Deitz, R. 2009: Do colleges and universities increase their regions human capital? Federal Reserve Bank of New York: Staff Reports No. 401.

Ackers, L. 2005: Moving people and knowledge: scientific mobility in the European Union. In: *International Migration*, 43 (5), 99–131.

Bagchi-Sen, S. and Kedron, P. 2016: Governance of biofuel production in the United States. In: Hilpert, U. (Ed.): *Handbook of Politics and Technology*, Routledge Ltd., London and New York, 299–309.

Bellini, N. and Pasquinelli, C. 2016: Branding the innovation place: managing the soft infrastructure of innovation. In: Hilpert, U. (Ed.): *Handbook of Politics and Technology*, Routledge Ltd., London and New York, 79–90.

Bercovitz, J. and Feldman, M. 2006: Entrepreneurial universities and technology transfer: a conceptual framework for understanding knowledge-based economic development. In: *Journal of Technology Transfer*, 31, 175–188.

Berry, C. and Glaeser, E. 2005: The divergence of human capital levels across cities. In: Harvard University, Taubman Center Research, Working Papers, WP05-03, Cambridge, MA.

Breschi, S. and Lissoni, F. 2009: Mobility of skilled workers and co-invention networks: an autonomy of localized knowledge flows. In: *Journal of Economic Geography*, 9, 439–468.

Chung, S. 2016: Korean government and science technology development. In: Hilpert, U. (Ed.): *Handbook of Politics and Technology*, Routledge Ltd., London and New York, 222–235.

Coulombe, S. and Tremblay, J.-F. 2009: Migration and skills disparities across Canadian provinces. In: *Regional Studies*, 43 (1), 5–18.

Criscuolo, P. 2005: On the road again: research mobility inside the R&D network. In: *Research Policy*, 34, 1350–1365.

Dhéret, C., Morosi, M., Frontini, A., Hedberg, A. and Pardo, R. 2014: Towards a new industrial policy for Europe. In: ECP Issue Paper No 78, November.

Dolphin, T. 2015: *Technology, Globalisation and the Future of Work in Europe*. Essays on Employment in a Digitised Economy. IPPR, London.

Farwick, A. 2009: Internal migration, challenges and perspectives for the research infrastructure. In: Working Paper 97, Berlin: German Council for Social and Economic Data (RatSWD).

Favell, A., Feldblum, M. and Smith, M.P. 2006: Mobility, migration and technology workers: an introduction. In: *Knowledge Technology and Policy*, 29 (3), 3–6.

Franco, A.M. and Filson, D. 2000: Knowledge diffusion through employee mobility. In: Federal Reserve Bank of Minneapolis: Research Department Report 272, Minneapolis: Federal Reserve Bank of Minneapolis.

Hickie, D. 2006: Knowledge and competitiveness in the Aerospace industry: the cases of Toulouse, Seattle and North-West England. In: *European Planning Studies* (EPS), 14 (5), 697–716.

Hickie, D. 2016: Competition in international automotive and aircraft technologies. In: Hilpert, U. (Ed.): *Handbook of Politics and Technology*, Routledge Ltd., London and New York, 310–322.

Hickie, D. and Hilpert, U. 2016: Transatlantic comparison of continental innovation models: a differentiation of regionalised processes of innovation in Europe and the US. In: Hilpert, U. (Ed.): *Handbook of Politics and Technology*, Routledge Ltd., London and New York, 37–49.

Hilpert, U. 1991: *Regional Innovation and Decentralization. High tech industry and government policy*. Routledge Ltd., London and New York, 320.

Hilpert, U. 1992: *Archipelago Europe – Islands of Innovation*. Synthesis Report. Brussels: Commission of the European Communities, XII/411/92, 290.

Hilpert, U. 2006: Knowledge in the region: development based on tradition, culture and change. In: *European Planning Studies*, 14 (5), 581–599.

Hilpert, U. 2013a: Networking innovative regional labour markets. Towards spatial concentration and mutual exchange of competence, knowledge and synergy. In: Hilpert, U. and Lawton Smith, H. (Eds.): *Networking Regionalised Innovative Labour Markets*, 3–31. Routledge Ltd., London and New York.

Hilpert, U. 2013b: Labour for regional innovation. The role of researchers for development and patterns of recruitment. In: Hilpert, U. and Lawton Smith, H. (Eds.): *Networking Regionalised Innovative Labour Markets*, 35–57. Routledge Ltd., London and New York.

Hilpert, U. 2016a: *Handbook of Politics and Technology*. Routledge Ltd., London and New York, xxiii + 491.

Hilpert, U. 2016b: Changing opportunities in global and regional contexts: the relationship between politics and technology. In: Hilpert, U. (Ed.): *Handbook of Politics and Technology*, Routledge Ltd., London and New York, 1–34. intro.

Hilpert, U. 2016c: The culture-technology nexus: innovation, policy and successful metropolis. In: Hilpert, U. (Ed.): *Handbook of Politics and Technology*, Routledge Ltd., London and New York, 149–161.

Hilpert, U. 2016d: Metropolitan locations in international high-tech networks: collaboration and exchange of innovative labour as a basis for advanced socio-economic development. In: Hilpert, U. (Ed.): *Handbook of Politics and Technology*, Routledge Ltd., London and New York, 281–298.

Hilpert, U. and Lawton Smith, H. 2013: *Networking Regionalised Innovative Labour Markets*. Routledge Ltd., London and New York, 204.

Khadira, B. 2001: Shifting paradigms of globalization: the twenty-first century transition toward generics in skilled migration from India. In: *International Migration*, 39 (5), 45–71.

Laudel, G. 2005: Migrant currents among scientific elite. In: *Minerva*, 43, 377–395.

Lawton Smith, H. and Waters, R. 2005: Rates of turnover high-technology agglomerations: knowledge transfer in Oxfordshire and Cambridgeshire. In: *Area*, 37 (2), 189–198.

Lawton Smith, H. and Waters, R. 2013: High-technology local economies: geographical mbility of the highly sklled. In: Hilpert, U. and Lawton Smith, H. (Eds.): *Networking Regionalised Innovative Labour Markets*, Routledge Ltd., London and New York, 96–116.

Liu, X. 2016: China's path towards becoming a major world player in science and technology. In: Hilpert, U. (Ed.): *Handbook of Politics and Technology*, Routledge Ltd., London and New York, 380–395.

Mahroum, S. 1999: Global magnets: science and technology disciplines and departments in the United Kingdom. In: *Minerva*, 37, 379–390.

Mahroum, S. 2000a: Scientists and global spaces. In: *Technology and Society*, 22, 513–523.

Mahroum, S. 2000b: Scientific mobility: an agent of scientific expansion and institutional empowerment. In: *Science Communication*, 21, 367–378.

Marginson, S. 2006: Dynamics of national and global competition in higher education. In: *Higher Education*, 52, 1–39.

Marx, K. 1962 (1890): *Das Kapital. Kritik der politischen Ökonomie. Der Produktionsprozeß des Kapitals*. Vol. I, Marx Engels Werke, Bd. 23, Dietz Verlag, Berlin, 955.

Marx, K. 1963 (1893): *Das Kapital. Kritik der politischen Ökonomie. Der Zirkulationsprozeß des Kapitals*. Vol. II, Marx Engels Werke, Bd. 24, Dietz Verlag, Berlin, 559.

Marx, K. 1964 (1894): *Das Kapital. Kritik der politischen Ökonomie. Der Gesamtprozeß der kapitalistischen Produktion*. Vol. III, Marx Engels Werke, Bd. 25, Dietz Verlag, Berlin, 1007.

Murano-Foadi, S. and Foadi, J. 2003: Italian scientific migration: from brain exchange to brain drain. Paper presented on the Symposium on Science Policy, Mobility and Brain Drain in the EU and Candidate Countries at the Centre for Studies of Law and Policy in Europe. University of Leeds, July 27-28, 2003.

O'Sullivan, E., Mitchell N. 2013: International approaches to understanding the future of manufacturing. In: Future of Manufacturing Project: Evidence Paper, No 26. Government Office for Science, London.

OECD. 2017: *OECD Employment Outlook 2017*. OECD Publishing, Paris, 216.

Piore, M.J. and Sabel, C.F. 1984: *The Second Industrial Divide: Possibilities for Prosperity*. Basic Books, New York, NY, ix and 355.

Power, D. and Lundmark, M. 2004: Working through knowledge pools: market dynamics, the transference of knowledge and ideas and industrial clusters. In: *Urban Studies*, 41 (5/6), 1025–1044.

Regets, M. 2007: Research issues in the international migration of highly skilled workers. A perspective with data from the United States. In: Working Paper, SRS 07-203. Arlington, VA: Division of Science Resources Statistics, National Science Foundation.

Sabel, C.F., Herrigel, G., Kazis, R. and Deeg, R. 1991: Regional prosperities compared: Massachusetts and Baden-Württemberg. In: Hilpert, U. (Ed.): *1991. Regional Innovation and Decentralization: High tech industry and government policy*, Routledge Ltd., London and New York, 177–195.

Saxenian, A. 2002: Silicon valleys new immigrant high-growth entrepreneurs. In: *Economic Quarterly*, 16 (1), 20–31.

Simonen, J. and McCann, P. 2008: Firm innovation: the influence of R&D cooperation and the geography of human capital inputs. In: *Journal of Urban Economics*, 64 (1), 146–154.

Smith, A. 2008 (1776): *An Inquiry into the Nature and Causes of the Wealth of Nations*, ed. by K. Sunderland. Oxford Paperbacks, Oxford, UK, 688.

Trippl, M. 2013: Star scientists, islands of innovation and internationally networked labour markets. In: Hilpert, U. and Lawton Smith, H. (Eds.): *Networking Regionalised Innovative Labour Markets*, Routledge Ltd., London and New York, 58–77.

Tsui-Auch, L.S., Chia, S.I. and Liu, A. 2016: Putting Singapore on the global innovation map: the shifting role of the state in the rapidly changing environment. In: Hilpert, U. (Ed.): *Handbook of Politics and Technology*, Routledge Ltd., London and New York, 191–206.

Bispinck, R., Dribbusch, H. and Schulten, T. 2010: *German Collective Bargaining in a European Perspective: Continuous Erosion or Re-Stabilisation of Multi-Employer Agreements?* WSI Discussion Paper, No. 171, Düsseldorf.

BMWi. 2014: *Monitoringbericht*, Bundesministerium für Wirtschaft und Energie, Monitoring-Report. Digitale Wirtschaft 2014, Innovationstreiber IKT, Berlin, December.

Dustmann, Ch., Fitzenberger, B., Schönberg, U. and Spitz-Oener, A. 2014: From Sick Man of Europe to Economic Superstar: Germany's Resurgent Economy. In: *Journal of Economic Perspective*, Vol. 28, Number 1, Winter 2014, 167–188.

Economist. 2004: *Germany on the Mend*, November 17. www.economist.com/node/3352024.

Horváth & Partner. 2009: Innovationsstudie, *Das verschwendete Innovationspotenzial – geniale Ideen im Unternehmen finden und nutzen*. Stuttgart, 9–16.

IW. 2015: Institut der deutschen Wirtschaft Köln Consult GmbH, *Globale Kräfteverschiebung. Kräfteverschiebung in der Weltwirtschaft – Wo steht die deutsche Industrie in der Globalisierung?* Studie im Auftrag des BDI, Köln.

Kriegesmann, B. and Kley, T. 2012. *Mitbestimmung als Innovationstreiber. Bestandsaufnahme, Konzepte und Handlungsperspektiven für Betriebsräte*. Berlin: edition sigma.

OECD. 2013: Interconnected Economies. Benefiting from global value Chains. Paris: OECD. https://www.oecd.org/sti/ind/interconnected-economies-GVCs-synthesis.pdf.

Schwarz-Kocher, M., Kirner, E., Dispan, J., Jäger, A., Richter, U., Seibold, B. and Weißfloch, U. 2011. *Interessenvertretungen im Innovationsprozess. Der Einfluss von Mitbestimmung und Beschäftigtenbeteiligung auf betriebliche Innovationen*. Berlin: edition sigma.

VCI. 2013: *Die deutsche chemische Industrie 2030*. VCI-Prognos-Studie, Frankfurt, January, 2013.

Voß, W. 2013: *Ressourceneffizienz als Herausforderung für Teilsegmente der Basischemie in Deutschland*. Ein Projekt im Auftrag der Hans-Böckler-Stiftung, Bremen, September, 2013.

Zakaria, F. 2009: *The Post-American World*. New York, 2008 (Deutsche Ausgabe: Der Aufstieg der Anderen: das postamerikanische Zeitalter, Munich: Siedler).

Asheim, B., Coenen, l., Moodysson, J. and Vang, J. 2007: Constructing knowledge-based regional advantage: implications for regional innovation policy. In: *International Journal of Entrepreneurship and Innovation Management* 7 (2–5), 140–155.

Bessant, J. and Rush, H. 2009: Developing Innovation Capability: Meeting the Policy challenge. In: Drechsler, W.J.M., Kattel, R. and Reinert, E.S. (Eds.): *Techno-Economic Paradigms: Essays in Honour of Carlota Perez*. London: Anthem Press, 19–38.

Boekholt, P. 2010: The Evolution of Innovation Paradigms and their Influence on Research, Technological Development and Innovation Policy Instruments. In: Smits, R. E., Kuhlmann, St. and Shapira, P. (Eds.): *The Theory and Practice of Innovation Policy. An International Research Handbook*. Cheltenham: Edward Elgar, 333–362.

Castellacchi, F. 2005: Innovation, diffusion and catching up in the fifth long wave. In: *Futures* 38 (7), 841–863.

Chesbrough, H. and Crowther, A.K. 2006: Beyond high tech: early adopters of open innovation in other industries. In: *R&D Management* 36 (3), 229–236.

Drechsler, W.J.M. 2009: Governance in and of Techno-Economic Paradigm Shifts: Considerations for and from the Nanotechnology Surge. In: Drechsler, W.J.M., Kattel, R. and Reinert, E.S. (Eds.): *Techno-Economic Paradigms: Essays in Honour of Carlota Perez*. London: Anthem Press, 95–104.

Edquist, C. and Zabala-Iturriagagoitia, J.M. 2012: Public Procurement for Innovation as mission-oriented innovation policy. In: *Research Policy* 41, 1757–1769.

Freeman, C. 1987: *Technology Policy and Economic Performance: Lessons from Japan*. London: Pinter.

Freeman, C. and Louçã, F. 2001: *As Time Goes By. From the Industrial Revolutions to the Information Revolution*. Oxford: Oxford University Press.

Goldstein, J.S. 1988: *Long Cycles: Prosperity and War in the Modern Age*. New Haven and London: Yale University Press.

Grimsey, D. and Lewis, M. (Eds.). 2005: *The Economics of Public Private Partnerships*, International Library of Critical Writings in Economics, Volume 183. Cheltenham: Edward Elgar.

Hilpert, U. 1991: *Neue Weltmärkte und der Staat: staatliche Politik, technischer Fortschritt und internationale Arbeitsteilung*. Opladen: Westdeutscher Verlag.

Hilpert, U. (Ed.). 2003: *Regionalisation of Globalised Innovation. Locations for Advanced Industrial Development and Disparities in Participation*. London: Routledge.

Hirooka, M. 2003: Nonlinear dynamism of innovations and business cycles. In: *Journal of Evolutionary Economics* 13 (5), 549–576.

Kondratieff, N.D. 1926/1935: Die langen Wellen der Konjunktur. In: *Archiv für Sozialwissenschaft und Sozialpolitik* 56 (3), 573–609; English: The long waves in economic life. In: *The Review of Economic Statistics* XVII (6), 1935.

Kregel, J. 2009: Financial Experimentation, Technological Paradigm Revolutions and Financial Crisis. In: Drechsler, W.J.M., Kattel, R. and Reinert, E.S. (Eds.): *Techno-Economic Paradigms: Essays in Honour of Carlota Perez*. London: Anthem Press, 203–220.

Kristensen, I., McQuaid, R.W. and Scherrer, W. 2016: Public Private Partnership as an Instrument of Innovation Policy. In: Hilpert, U. (Ed.): *Routledge Handbook of Politics and Technology*. Oxford: Routledge, 249–261.

Lember, V., Kattel, R. and Kalvet, T. (Eds.). 2014: *Public Procurement, Innovation and Policy. International Perspectives*. Berlin: Springer.

Lundvall, B.Å. 1992: *National Systems of Innovation. Towards a Theory of Innovation and Interactive Learning*. London: Pinter.

Lundvall, B.Å. 2013: Innovation Studies: A Personal Interpretation of 'The State of the Art'. In: Fagerberg, J., Martin, B.A. and Andersen, E.S. (Eds.): *Innovation Studies. Evolution and Future Challenges*. Oxford: Oxford University Press, 21–70.

Mazzucato, M. 2011: *The Entrepreneurial State*. London: Demos.

Mensch, G. 1979: *Stalemate in Technology*. Cambridge, MA: Ballinger.

Nelson, R.R. (Ed.). 1993: *National Innovation Systems. A Comparative Study*. Oxford: Oxford University Press.

OECD. 2008: *Public-Private Partnerships*. Paris: Organisation for Economic Cooperation and Development.

Perez, C. 1983: Structural change and the assimilation of new technologies in the economic and social system. In: *Futures* 15, 357–375.

Perez, C. 2002: *Technological Revolutions and Financial Capital. The Dynamics of Bubbles and Golden Ages*. Cheltenham: Edward Elgar.

Perez, C. 2010: Technological revolutions and techno-economic paradigms. In: *Cambridge Journal of Economics* 34 (1), 185–202.

Rosenberg, N. and Frischtak, C.R. 1983: Long waves and economic growth: A critical appraisal. In: *American Economic Review* 73 (2), 146–151.

Scherrer, W. 2016: Technology and Socio-economic Development in the Long Run: A "Long Wave"-Perspective. In: Hilpert, U. (Ed.): *Routledge Handbook of Politics and Technology*. Oxford: Routledge, 50–64.

Scherrer, W. and Kristensen, I. 2016: Public Private Partnerships as a Systemic Instrument of Regional Innovation Policy. Evidence from Sweden. In: *International Public Administration Review* 14 (1), 37-54.

Solow, R.M. 1987: We'd better watch out. *New York Times Book Review*, July 12, 36.

Sundbo, J. 1995: Three paradigms in innovation theory. In: *Science and Public Policy* 22 (6), 399–410.

Sundbo, J. 1998: *The theory of innovation. Entrepreneurs, technology and strategy*. Cheltenham: Edward Elgar.

Van Gelderen, J. [J. Fedder, pseudo]. 1913/1996: Springvloed Baschouwingen over industrielle Outwikkalieng en prijsbeweging. In: *De Nieuwe Tijd* 184 (5/6); English: Springtide. Reflections on Industrial Development and Price Movements. In: Freeman, Ch. (Ed.): *Long Wave Theory*. Cheltenham: Edward Elgar, 1–56.

Verhoest, K., Petersen, O.H., Scherrer, W. and Soecipto, R.M. 2015: How do governments support the development of Public Private Partnerships? Measuring and comparing governmental PPP support across 20 European countries. In: *Transport Reviews* 35 (2), 118–139.

Wieczorek, A. and Hekkert, M. 2012: Systemic instruments for systemic innovation problems: A framework for policy makers and innovation scholars. In: *Science and Public Policy* 39, 74–87.

Burgelman, J.-C. Chloupkova, J. and Wobbe, W. 2015: Foresight in support of European research and innovation policies: The European Commission is preparing the funding of great society challenges. In: M. Pausch (Ed.): *The future of Europe*. Springerlink.com.

Etzkowitz, H. and Leydesdorff, L. 1998: The triple helix as a model for innovation studies. In: *Science & Public Policy* 25 (3), 195–203.

Gordon, R. 2010: *Revisiting U.S. productivity growth over the past century with a view of the future*. Working Paper 15834, Cambridge, MA: National Bureau of Economic Research. www.nber.org/papers/w15834.

Hahn, R. 1971: *Anatomy of scientific institution: Paris Academy of Science, 1666-1803*. Berkeley, CA: University of California Press.

Hilpert, U. (Ed.) 1994: *Zwischen Scylla Und Charybdis? Zum Problem Staatlicher Politik Und Nicht-Intendierter Konsequenzen*. Wiesbaden: Westdeutscher Verlag.

Leydesdorff, L. and Etzkowitz, H. 2003: Can 'the public' be considered as a fourth helix in university-industry-government relations? Report on the Fourth Triple Helix Conference, 2002. In: *Science and Public Policy* 30 (1), 55–61.

Mazzucato, M. 2013: *The entrepreneurial state: debunking public vs. private sector myths*. London: Anthem.

OECD. 1997: *National innovation systems*. Paris: OCDE Publications. https://www.oecd.org/science/inno/2101733.pdf

Rieu, A.-M. 1996: *Japan as a techno-scientific society: the new role of research & development*. TokyoNational Institute for Research Advancement Review. Autumn, 3–6. www.nira.or.jp/past/publ/review/96autumn/rieu.html.

Rieu, A.-M. 2005: *What is knowledge society?* STS Nexus, San Jose: Santa Clara University, Center for Science, Technology and Society. http://halshs.archives-ouvertes.fr/halshs-00552293/fr/.

Rieu, A.-M. 2006. Inventer une *société de la connaissance*. Le Japon en comparaison. www.diploweb.com/forum/japon07052.htm.

Rieu, A.-M. 2008: Géostratégie de la recherche et de l'innovation. In: *Hermès*, CNRS Editions 50, 67–73. http://halshs.archives-ouvertes.fr/halshs-00360140/fr/.

Rieu, A.-M. 2012: Beyond neo-liberalism: research policies and society. The case of Japan. In: *The Copenhagen Journal of Asian Studies* 29 (2), 58–78.

Rieu, A.-M. 2013: Thinking after Fukushima (2). Epistemic shift in human and social science. In: *Asia Europe Journal* 11 (1), 65–78.

Sterling, A. 2007: *A general framework for analyzing diversity in science, technology and society*. SPRU online paper 156. www.sussex.ac.uk/spru/. Accessed 9 February.

Streeck, W. 2014: *Buying time. The delayed crisis of democratic capitalism*. London: Verso.
Summers, L. 2013: www.youtube.com/watch?v=KYpVzBbQIX0. Accessed 8 November.
Aghion, P., Algan, Y. and Cahuc, P. 2008: Can Policy Influence Culture? CEPREMAP/ Docweb no. 0801. http://www.tinyurl.com/l8eprzu
Bhavnani, K., and Talcott, M. 2014: Interconnections and Configurations: Toward a Global Feminist Ethnography. In: Hesse-Biber, S.N. (Ed.). *Handbook of Feminist Research: Theory and Praxis*. Thousand Oaks, CA: Sage, 135-153.
Bonder, G. 2015: Foreword. In: Pearson et al.
Butler, R., Oldham, M. and Verderese, J. 2009: Why Diversity, Why Now? Creating Sustainable Competitive Advantage Through Diversity and Inclusion. *PricewaterhouseCoopers View* (Spring), 46–53.
Cárdenas, V. and Treuhaft, S. (Eds.). 2013: All-In Nation: An America that Works for All. Center for American Progress/PolicyLink. https://www.americanprogress.org/issues/race/reports/2013/07/24/70540/all-in-nation-an-america-that-works-for-all
Carey, D., Hill, C., and Kahin, B. 2012: Strengthening Innovation in the United States. Economics Department Working Paper No. 1001, Organization for Economic Cooperation and Development.
Catalyst. 2014: *The Gender Divide in Tech-Intensive Industries*. New York, NY: Catalyst.
Coates, R.D. 2012: *Covert Racism*. Chicago, IL: Haymarket Books.
Cohen, J.E. 2006: Human Population: The Next Half Century. In: Kennedy, D. (Ed.): *Science Magazine's State of the Planet 2006-7*. London: Island Press.
Craig, E., Thomas, R.J., Hou, C. and Mathur, S. 2011: No Shortage of Talent: How the Global Market Is Producing the STEM Skills Needed for Growth. In: *Accenture*.
DiTomaso, N., Post, C., and Parks-Yancy, R. 2007:
Workforce Diversity and Inequality: Power, Status, and Numbers. In: *Annual Review of Sociology* 33, 473–501.
Etzkowitz, H., Gupta, N., and Kemelgor, C. 2010: The Gender Revolution in Science and Technology. In: *Journal of International Affairs* 64 (1), 83-100.
European Commission (EC). 2000: *Science Policies in the European Union: Promoting Excellence Through Mainstreaming Gender Equality*. Brussels: EC.
European Commission (EC). 2008: *Benchmarking Policy Measures for Gender Equality in Science*. Brussels: EC.
European Commision (EC). 2009: *The Challenge in Research Funding: Assessing the European National Scenes*. Brussels: EC.
European Commission (EC). 2012a: *EU Skills Panorama Information and Communications Technologies (ICT) Sector Analytical Highlight*. Brussels: EC.
European Commission (EC). 2012b: *EU Skills Panorama STEM Skills Analytical Highlight*. Brussels: EC.
European Commission (EC). 2013: ICT for Competitiveness and Innovation. http://ec.europa.eu/enterprise/sectors/ict/index_en.htm.
European Union (EU). 2005: *The Business Case for Diversity: Good Practices in the Workplace*. Luxembourg: EU.
Forbes. 2011: Global Diversity and Inclusion: Fostering Innovation Through a Diverse Workforce. *Forbes/Insights*.
Frehill, L., McNeely, C.L., and Pearson, W., Jr. 2015: An International Perspective on Advancing Women in Science. In: Pearson et al.
Gardiner, J. 2000: Gender and Family in the Formation of Human Capital. In: Cook, J., Roberts, J. and Waylen, G. (Eds.): *Towards a Gendered Political Economy*. Seffield: PERC, 61–76.

Goertz, G. and Mazur, A. 2008: Mapping Gender and Politics Concepts: Ten Guidelines. In: Goertz, G. and Mazur, A. (Eds.): *Politics, Gender, and Concepts: Theory and Methodology*. Cambridge: Cambridge University Press, 14–43.

Hart, D. 2010: Introduction. In *Review of Policy Research* 27 (4), 387-388.

Herring, C. 2009: Does Diversity Pay? Race, Gender, and the Business Case for Diversity. In: *American Sociological Review* 74 (2), 208–224.

Hewlett, S.A., Marshall, M., and Sherbin, L. 2013: How Diversity Can Drive Innovation. In: *Harvard Business Review* (December).

Hilpert, U. 2012: Networking Regionalized Innovative Labour Markets: Towards Spatial Concentration and Mutual Exchange of Competence, Knowledge, and Synergy. In: Hilpert, U. and Lawton Smith, H. (Eds.): *Networking Regionalized Innovative Labour Markets*. London: Routledge, 35–57.

Hilpert, U. (Ed.). 2016: *Routledge Handbook of Politics and Technology*. London: Routledge.

Hunt, V., Layton, D. and Prince, S. 2015: *Diversity Matters*. In: McKinsey and Company.

Husu, L. 2015: A Comprehensive National Approach to Promote Gender Equality in Science: The Case of Norway. In: Pearson et al.

Insights. 2013: Fostering Innovation Through Diversity and Inclusion. The Insights Group.

InterAcademy Partnership (IAP). 2015: *Women for Science: Inclusion and Pariticipation in Academies of Science*. Pretoria: Academy of Science of South Africa.

International Labour Organization (ILO). 2012: *Global Employment Trends for Women*. Geneva: ILO.

International Labour Organization (ILO). 2016: *World Employment Social Outlook: Trends 2016*. Geneva: ILO.

Kandola, R. and Fullerton, J. 1998: *Diversity in Action*. London: Institute of Personnel and Development.

Kapur, D., and McHale, J. 2005: *Give Us Your Best and Brightest: The Global Hunt for Talent and Its Impact on the Developing World*. Washington, DC: Center for Global Development.

Lamberts, M., Ode, A., and Witkamp, B. 2014: *Racism and Discrimination in Employment in Europe*. ENAR Shadow Report. Brussels: European Network Against Racism.

Langdon, D., McKittrick, G., Beede, D., Khan, B., and Doms, M. 2011: STEM: Good Jobs Now and for the Future. Economics and Statistics Administration, Issue Brief No. 03-11 (US Department of Commerce).

Leggon, C., and McNeely, C.L. 2012: Promising Policies. In: Pearson, W., Jr., Frehill, L., and C. Didion (Eds.). *Blueprint for the Future: Framing the Issues of Women in Science in a Global Context*. Washington, DC: National Academies Press.

Leggon, C., McNeely, C.L., and Yoon, J. 2015: Advancing Women in Science: Policies for Progress. In: Pearson et al.

Leung, M.A., and McNeely, C.L. 2015: Opening Doors to Communities of Practice: Programmatic Interventions for Inclusion in the Computing Sciences. In: *IEEE Xplore/RESPECT* 2015. https://ieeexplore.ieee.org/document/7296520

Lund, S., Manyika, J., and Ramaswamy, S. 2012: Preparing for a New Era of Work. In: *McKinsey Quarterly* (November).

Mazur, B. 2010: Cultural Diversity in Organizational Theory and Practice. In: *Journal of Intercultural Management* 2 (2), 5–15.

McNeely, C.L., and Camacho, E.T. 2010: Conceptualizing STEM Workforce Migration in the Modern World Polity. In: *Labor: Supply and Demand eJournal*/ERN Public Policy Institutes Research Paper Series 2 (3). http://ssrn.com/abstract=1593393

McNeely, C.L., and Schintler, L. 2016: Recognizing Opportunities for S&T Workforce Development and Productivity: The Gendered Resource. In: Hilpert.

Milkman, K.L., Akinola, M. and Chugh, D. 2015: What Happens Before? A Field Experiment Exploring How Pay and Representation Differentially Shape Bias on the Pathway into Organizations. In: *Journal of Applied Psychology* 100 (6), 1678–1712.

Miller, B. and Atkinson, R.D. 2013: Are Robots Taking Our Jobs, or Making Them? In: *Information Technology and Innovation Foundations* (September). www2.itif.org/2013-are-robots-taking-jobs.pdf.

National Academy of Sciences (NAS). 2015: *Making Value for America: Embracing the Future of Manufacturing, Technology, and Work*. Washington, DC: National Academies Press.

National Academies of Sciences (NAS). 2016: *Promising Practices for Strengthening the Regional STEM Workforce Development Ecosystem*. Washington, DC: National Academies Press.

National Science Foundation (NSF). 2016: *Science and Engineering Indicators*. Arlington, VA: NSF.

New America. 2015: Technology for the People, By the People. Open Technology Institute. www.newamerica.org/oti/technology-for-the-people-by-the-people

O'Brien, J. 2014: The Diversity Equation: How Inclusiveness Is Driving Workplace Engagement. American Express Open Forum. www.americanexpress.com/us/small-business/openforum/articles/diversity-equation-inclusiveness-driving-workplace-engagement.

Omi, M. and Winant, H. 1994: *Racial Formation in the United States*. New York, NY: Routledge.

Organization for Economic Cooperation and Development (OECD). 2012: *Closing the Gap*. Paris: OECD.

Organization for Economic Cooperation and Development (OECD). 2015: *The Future of Productivity*. Paris: OECD.

Organization for Economic Cooperation and Development (OECD). 2016: Policy Forum of the Future of Work, Employment and Ministerial Meeting, 15 January 2016. www.oecd.org/employment/ministerial/policy-forum.

Page, S.E. 2007: *The Difference: How the Power of Diversity Creates Better Groups, Firms, Schools, and Societies*. Princeton, NJ: Princeton University Press.

Pearson, W., Jr., Frehill, L., and McNeely, C.L. (Eds.). 2015: *Advancing Women in Science: An International Perspective*. London: Springer.

Pennsylvania Institute of Certified Public Accountants (PICPA). 2015: *More Clients, More Talent, More Revenue: The Business Case and Toolkit for Diversity*. www.picpa.org.

Plan. 2009, 2015: *The State of the World's Girls*. plan-international.org/becauseiamagirl

Rees, T. 2002: *National Policies on Women and Science in Europe: A Report about Women and Science in Thirty Countries*. Luxembourg: Office for Official Publications of European Communities.

Root, H. 2013: *Dynamics Among Nations: The Evolution of Legitimacy and Development in Modern State*. Cambridge, MA: MIT Press.

Rothwell, J. 2013: The Hidden STEM Economy. Metropolitan Policy Program, Brookings Institution.

Ruggie, J.G. 2003: Taking Embedded Liberalism Global: The Corporate Connection. In: Held, D. and M. Koenig-Archibugi (Eds.): *Taming Globalization: Frontiers of Governance*. Cambridge: Polity Press.

Russell Reynolds Associates (RRA). 2009: *Different Is Better — Why Diversity Matters in the Boardroom*. New York: RRA, Inc.

Ryan, J., Hawdon, J. and Branick, A. 2002: The Political Economy of Diversity: Diversity Programmes in Fortune 500 Companies. In: *Sociological Research Online* 7 (1). www.socresonline.org.uk/7/1/ryan.html.

Schiebinger, L. and Schraudner, M. 2011: Interdisciplinary Approaches to Achieving Gendered Innovations in Science, Medicine, and Engineering. In: *Interdisciplinary Science Reviews* 36 (2), 154–167.

Schwab, K. 2016: *The Fourth Industrial Revolution*. Geneva: World Economic Forum.

Sirkin, H.L. 2016: Advanced Manufacturing Is Not a Job Killer, It's a Job Creator. *Forbes Magazine Online*. https://goo.gl/xfCcvL

Skerry, P. 2002: Beyond Sushiology: Does Diversity Work? In: *Brookings Review* 20 (1), 20–23.

Smyth, F.L. and Nosek, B.A. 2015: On the Gender-Science Stereotypes Held by Scientists: Explicit Accord with Gender-Ratios, Implicit Accord with Scientific Identity. In: *Frontiers in Psychcology*. Doi: 10.3389/fpsyg.2015.00415.

Teitelbaum, M.S. 2014: *Falling Behind? Boom, Bust, and the Global Race for Scientific Talent*. Princeton, NJ: Princeton University Press.

Trübswetter, A., Genz, K., Hochfeld, K. and Schraudner, M. 2016: Corporate Culture Matters — What Kinds of Workplaces Appeal to Highly Skilled Engineers? In: *International Journal of Gender, Science, and Technology* 8 (1), 46–66.

United Nations (UN). 1997: *Report of the Economic and Social Council for 1997*. New York: UN.

United Nations Conference on Trade and Development (UNCTAD). 2007: *Trade and Development Report, 2007*. Geneva: United Nations.

United Nations Educational, Scientific, and Cultural Organization (UNESCO). 2003: *Assessment of Resources, Best Practices, and Gaps in Gender, Science, and Technology in the Asia-Pacific Region*. Jakarta: UNESCO.

United Nations Educational, Scientific, and Cultural Organization (UNESCO). 2004: Comparative Study on Gender Dimension of Policies Related to the Development and Application of Science and Technology for Sustainable Development. In: *Regional Secretariat for Gender Equity in Science and Technology*. Jakarta: UNESCO.

United Nations Educational, Scientific, and Cultural Organization (UNESCO). 2007: *Science, Technology, and Gender: An International Report*. Paris: UNESCO.

World Bank. 2012: *World Development Report: Gender Equality and Development*. Washington, DC: World Bank.

World Economic Forum (WEF). 2013: *The Global Gender Gap Report*. Geneva: WEF.

Wrench, J. 2014: Ethnic Discrimination and Anti-Discrimination in Employment: A Comparative European Perspective. Presented at the Principles of Equality and Challenges of Discrimination: Problems and Effective Remedies/Global Governance Program, EUI Florence.

Abramovitz, M. 1986: Catching Up, Forging Ahead, and Falling Behind, *The Journal of Economic History*, 46 (2), 385–406.

Acemoglu, D. & Autor, D. 2011: Skills, Tasks and Technologies: Implications for Employment and Earnings, *Handbook of Labor Economics*, 4 (B), 1043–1171.

Acemoglu, D., Mostagir, M., & Ozdaglar, A. 2014: Managing Innovation in a Crowd, NBER Working Paper #19852.

Acs, Z.J., Szerb, L., & Autio, E. 2016: *Global Entrepreneurship and Development Index 2015*. London: Springer International Publishing.

Almeida, M.L.D. 2003: Da formulação à implementação: análise das políticas governamentais de educação profissional no Brasil. PhD Thesis, University of São Paulo. Available at: www.bibliotecadigital.unicamp.br/document/?code=vtls000308412

Altbach, P.G., Reisberg, L., & Rumbley, L.E. 2009: *Trends in Global Higher Education: Tracking an Academic Revolution*. Paris, France: United Nations Educational, Scientific and

Cultural Organization (UNESCO). Available at: www.uis.unesco.org/Library/Documents/trends-global-higher-education-2009-world-conference-en.pdf

Amorim, E. & Schwartzman, S. 2014: Educação Técnica e Vocacional nos Estados Unidos. In: Oliveira, M.P.P. et al. *Rede de Pesquisa Formação e Mercado de Trabalho Educação Profissional e Tecnológica*, Vol. 3. Brasília: IPEA/ABDI. (44–76).

Antonczyk, D., DeLeire, T., & Fitzenberger, B. 2010: Polarization and Rising Wage Inequality: Comparing the U.S. and Germany, University of Freiburg Working Paper, March 2010.

Arora, A., Branstetter, L., & Drev, M. 2013: Going Soft: How the Rise of Software-Based Innovation Led to the Decline of Japan's IT Industry and the Resurgence of Silicon Valley, *The Review of Economics and Statistics*, 95 (3), 757–775.

Auguste, Bryon & Mariani, Tyra. 2015. We Need to 'Rewire' the Labor Market. April 30, New America Foundation. https://context.newamerica.org/we-need-to-re-wire-e2ea173d6b31#.cblav8dk9

Baker, P.M.A., Breznitz, S., Seavey, A., & Bujak, K.R. 2015: 21st Century Universities as Drivers for Innovation: The Key Facets of Learning, Research, and Collaboration. In: Hilpert, U. (Ed.), *Handbook on Politics and Technology*. London: Taylor & Francis Ltd: Routledge. pp. 236–248.

Baker, P.M.A., Bujak, K.R., & DeMillo, R.A. 2012: The Evolving University: Disruptive Change and Institutional Innovation. In proceedings of the 4th International Conference on Software Development for Enhancing Accessibility and Fighting Info-exclusion. In: *Elsevier Procedia Computer Science*, Vol 14. Porto, Portugal, 330–335.

Baker, P.M.A., Moon, N.W., & Ward, A.C. 2006: Virtual Exclusion and Telework: Barriers and Opportunities of Technocentric Workplace Accommodation Policy, *WORK: A Journal of Prevention, Assessment and Rehabilitation*, 27 (4): 421–430.

Boudarbat, B., Lemieux, T., & Riddell, W. 2010: The Evolution of the Returns to Human Capital In: *Canada*, 1980–2005, IZA Working Paper No.4809, March 2010.

Brewer, D.C. & Tierney, W.G. 2011: Barriers to Innovation in U.S. Higher Education. In Wildavsky, B., Kelly, A.P., & Carey, K. (Eds.), *Reinventing Higher Education: The Promise of Innovation*. Cambridge, MA: Harvard Education Press. (11–40).

Carew, D. 2016: Young Workers without College Degrees Face Uncomfortable Truths. The Hill Blog. June 23, 2016. Available at: http://thehill.com/blogs/pundits-blog/economy-budget/284569-young-workers-without-college-degrees-face-uncomfortable

Cassiolato, J.E. 2015: Evolution and Dynamics of the Brazilian National System of Innovation. In: Shome, P. & Sharma, P. (Eds.), *Emerging Economies*. New Delhi: Springer. (265–310).

Castioni, R. 2013: Planos, Projetos e Programas de Educação Profissional: Agora é a vez do PRONATEC, *Revista Sociais E Humanas*, 26 (1), 25–42.

Cirera, X., Marin, A., & Markwald, R. 2015: Explaining export diversification through firm innovation decisions: The case of Brazil. *Research Policy*, 44(10), 1962–1973.

CGEE (2009). *Os Novos Instrumentos de Apoio À Inovação: Uma Avaliação Inicial*. Brasília: Centro de Gestão e Estudos Estratégicos—Associação Nacional de Pesquisa e Desenvolvimento das Empresas Inovadoras.

Conselho Nacional de Educação (CNE). 2001: *Diretrizes Curriculares Nacionais para a formação de Professores da Educação Básica*. Brasilia: MEC.

Cornell University, INSEAD, and WIPO. 2016: *The Global Innovation Index 2016: Winning with Global Innovation*. Ithaca, Fontainebleau, and Geneva.

Coutinho, L.E. 1994: *Estudo da Competitividade da Indústria Brasileira. 4ª Edição*. Rio de Janeiro: Papirus.

De Negri, F., Negri, J. A., & Lemos, M. B. 2009: Impactos do ADTEN e do FNDCT sobre o desempenho e os esforços tecnológicos das firmas industriais brasileiras. *Revista Brasileira de Inovação*, 8(1), 211–254.

Freeman, C. 2002: Continental, National and Sub-National Innovation Systems – Complementarity and Economic Growth, *Research Policy*, 31, 191–211.

Garicano, L. & Rossi-Hansberg, E. 2006: The Knowledge Economy at the Turn of the Twentieth Century: The Emergence of Hierarchies, *Journal of the European Economic Association*, 4, 396–403.

Gerlach F. & Ziegler, A. 2015: From Problem Child to Poster Boy: The New Image of German Industry and Industrial Policy. In: Gerlach, F., Schietinger, M., & Ziegler, A. (Eds.), *A Strong Europe – But Only with a Strong Manufacturing Sector: Policy Concepts and Instruments in Ten EU Member States*. Düsseldorf: Schüren Verlag. (58–79).

Goldin, C. & Katz, L. 2010: *The Race between Education and Technology*. Cambridge, MA: Harvard University Press.

Greenhalgh, C. & Rogers, M. 2012: *Innovation, Intellectual Property, and Economic Growth*. Princeton, NJ: Princeton University Press.

Gupta, N., Weber, C., Pena, V., Shipp, S.S., & Healey, D. 2013: *Innovation Policies of Brazil (No. IDA-P-5039)*. Alexandria, VA: Institute For Defense Analyses.

Handel, M.J. 2015: *The Future of Employment, Wages, and Technological Change. Emerging Trends in the Social and Behavioral Sciences: An Interdisciplinary, Searchable, and Linkable Resource*. John Wiley and Sons. doi:10.1002/9781118900772.etrds0338

Herran, C. & Rodriguez, A. 2000: Secondary Education in Brazil: Time to Move Forward, InterAmerican Development Bank, Report No. BR-014, World Bank, Report No, 19409-BR.

Hilpert, U. 2006: Knowledge in the Region: Development Based on Tradition, Culture and Change, *European Planning Studies*, 14 (5), 581–599.

Holzer, H. 2015: *Higher Education and Workforce Policy: Creating More Skilled Workers (and Jobs for Them to Fill)*. Washington, DC: Brookings Institution. Available at: www.brookings.edu/~/media/research/files/papers/2015/04/workforce-policy-briefs-holzer/polarization_jobs_policy_holzer.pdf

Holzer, H.J., & Lerman, R.I. 2009: *The Future of Middle-Skill Jobs (Vol. 41)*. Washington, DC: Brookings: Center on Children and Families.

INEP (Instituto Nacional De Estudos E Pesquisas). 2014: *Censo da Educação Superior 2012: Resumo Técnico*. Brasília: Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira. Available at: http://download.inep.gov.br/download/superior/censo/2012/resumo_tecnico_censo_educacao_superior_2012.pdf, accessed on November, 23, 2015.

International Labour Organization. 2007: *The Role of Trade Unions in Workers' Education: The Key to Trade Union Capacity Building*, Background Paper ISRTU/2007.

IPEA (Instituto de Pesquisa Econômica Aplicada). 2013: *Duas décadas de desigualdade e pobreza no Brasil medidas pela Pnad/IBGE. Comunicado 159*. Brasília: Instituto de Pesquisa Econômica Aplicada. Available at: http://ipea.gov.br/portal/images/stories/PDFs/comunicado/131001_comunicadoipea159.pdf

Jacoby, T. 2014: Why Germany Is So Much Better at Training Its Workers, In: *The Atlantic*. October 16, 2014. Available at: www.theatlantic.com/business/archive/2014/10/why-germany-is-so-much-better-at-training-its-workers/381550/

Kunz, J.S. & Staub, K.E. 2016: Subjective Completion Beliefs and the Demand for Postsecondary Education (February 22, 2016). University of Zurich, Department of Economics, Working Paper No. 218. Available at: http://ssrn.com/abstract=2736955

Lerman, R. 2014: Expanding Apprenticeship Opportunities in the United States. In: M. Kearney and B. Harris (Eds.), *Policies to Address Poverty in America*. The Hamilton Project. Washington, DC: Brookings Institution, pp. 79–86.

Mazzucato, M. & Penna, C. 2016: *The Brazilian Innovation System: A Mission-Oriented Policy Proposal*. Brasília, DF: Centro de Gestão e Estudos Estratégicos. Available at: www.cgee.org.br/documents/10195/1774546/The_Brazilian_Innovation_System-CGEE-MazzucatoandPenna-FullReport.pdf

MDS (Ministério do Desenvolvimento Social e Combate à Fome). 2014: *Plano Brasil Sem Miséria. Caderno de Resultados*. Brasília: MDS. Available at: www.mds.gov.br/webarquivos/publicacao/brasil_sem_miseria/cadernodegraficosbsm-35anos.pdf, accessed on November, 23, 2015.

Mitchell, M. & Leachman, M. 2015: *Years of Cuts Threaten to Put College Out of Reach for More Students*. Washington, DC: Center on Budget and Policy Priorities.

Moon, N. W., Linden, M. A., Bricout, J. C., & Baker, P. 2014: Telework rationale and implementation for people with disabilities: Considerations for employer policymaking. *Work*, 48(1), 105–115. doi:10.3233/WOR-131819.

National Academy of Sciences. 2013: *Education for Life and Work: Developing Transferable Skills and Knowledge for the 21st Century*. Washington, DC: National Academies Press.

National Research Council (US) Committee on Comparative National Innovation Policies: Best Practice for the 21st Century. 2012: *Rising to the Challenge: U.S. Innovation Policy for the Global Economy*. Wessner, C.W., Wolff, A.W., (Eds.), Washington, DC: National Academies Press (US). Available at: www.ncbi.nlm.nih.gov/books/NBK98691//10.17226/13386

Nelson, R. 1995: Recent Evolutionary Theorizing About Economic Change, *Journal of Economic Literature*, 33 (1), 48–90.

OECD. 2013: Education Policy Outlook: Brazil. Available at: www.oecd.org/education/policyoutlook.htm

Páscoa, A. 2004: In Search of an Innovative Environment – The new Brazilian Innovation Law. World Intellectual Property Organization. Available at: www.wipo.int/sme/en/documents/brazil_innovation.htm

Peralta, K. 2015: Apprenticeships Could Be Gateway to Middle Class – European Style Earn-as-You-Learn Programs Are Gaining Traction in the U.S. In: *U.S. News* (January 12, 2015). Available at: www.usnews.com/news/articles/2015/01/12/apprenticeships-could-provide-a-pathway-to-the-middle-class

Pinto, E.C. & Macedo Cintra, M.A. 2015: América Latina e China: Limites econômicos e políticos ao desenvolvimento. Available at: www.ie.ufrj.br/images/pesquisa/publicacoes/discussao/2015/TD_IE_017_2015_PINTO_GONALVES.pdf, accessed on July, 15, 2015.

Romer, P. 1994: The Origins of Endogenous Growth, *Journal of Economic Perspectives*, 8 (1), 3–22.

Salles-Filho, S., Bonacelli, M. B., Carneiro, A. M., De Castro, P. F. D., & Santos, F. O. 2011. Evaluation of ST&I programs: a methodological approach to the Brazilian Small Business Program and some comparisons with the SBIR program. *Research Evaluation*, 20(2), 159-171.

Stuart, M., Huzzard, T., & Oup, S. 2015: Unions, the Skills Agenda and Workforce Development. In: Buchanan, J., Finegold, D., Mayhew, K., Warhurst, C. (eds) *Oxford Handbook on Skills and Training*. Oxford: Oxford University Press.

Takahashi, A. & Wünsch, R. 2010: Cursos superiores de tecnologia em gestão: reflexões e implicações da expansão de uma (nova) modalidade de ensino superior em administração no Brasil, *Revista de Administração Pública*, 44 (2), 385–414.

Torpey, E. & Hogan, A. 2016: *Working in a Gig Economy*. Washington, DC: U.S. Bureau of Labor Statistics (May). Available at: www.bls.gov/careeroutlook/2016/article/what-is-the-gig-economy.htm

Van Horn, C., Greene, T., & Edwards, T. Eds. 2015: *Transforming U.S. Workforce Development Policies for the 21st Century*. Washington, DC: Federal Reserve Bank and the W.E. Upjohn Institute.

Waters, J. 2015: How Nanodegrees Are Disrupting Higher Education: New "micro" online certification programs are changing the educational pathways to success in certain industries. Campus Technology (08/05/15). Available at: https://campustechnology.com/articles/2015/08/05/how-nanodegrees-are-disrupting-higher-education.aspx

Zinn, R. & Van Kluenen, A. 2014: *Making Workforce Data Work: How States Can Use Education and Workforce Data to Develop Skilled Workers and Strong Economies*. Washington, DC: National Skills Coalition.

Accenture. (2014): *Bridge the gap: Rebuilding America's middle skills*. Burning Glass, Boston.

Acemoglu, D. (1998): Why do new technologies complement skills? Directed technical change and wage inequality. The Quarterly Journal of Economics, 113(4), 1055–1089.

Acemoglu, D. & Autor, D. (2011): Skills, tasks and technologies: Implications for employment and earnings. Handbook of Labor Economics, 4, 1043–1171.

Agut, S., Peiró, J. M. & Grau, R. (2009): The effect of overeducation on job content innovation and career-enhancing strategies among young Spanish employees. Journal of Career Development, 36, 159–182.

Autor, D. (2010): *US labor market challenges over the longer term*. Federal Reserve Board of Governors.

Autor, D. (2015): Why are there still so many jobs? The history and future of workplace automation. The Journal of Economic Perspectives, 29(3), 3–30.

Autor, D. & Dorn, D. (2013): The growth of low-skill service jobs and the polarization of the US labor market. The American Economic Review, 103(5), 1553–1597.

Autor, D., Dorn, D. & Hanson, G. H. (2016): The china shock: Learning from labor market adjustment to large changes in trade (No. w21906). National Bureau of Economic Research.

Autor, D., Dorn, D., Katz, L. F., Patterson, C. & Van Reenen, J. (2017): Concentrating on the fall of the labor share (No. 23108). National Bureau of Economic Research.

Bartel, A. P. & Lichtenberg, F. R. (1987): The comparative advantage of educated workers in implementing new technology. The Review of Economics and Statistics, 69(1), 1–11.

Baumol, W. J. (2004): Education for innovation: Entrepreneurial breakthroughs vs. corporate incremental improvements (No. w10578). National Bureau of Economic Research.

Bradley, D., Kim, I. & Tian, X. (2016): Do unions affect innovation? Management Science, 63(7), 2251–2271.

Brynin, M. & Longhi, S. (2009): Overqualification: Major or minor mismatch? Economics of Education Review, 28(1), 114–121.

Brynjolfsson, E. & McAfee, A. (2014): *The second machine age: Work, progress, and prosperity in a time of brilliant technologies*. WW Norton & Company.

Dippel, C., Gold, R. & Heblich, S. (2015): Globalization and its (dis-) content: Trade shocks and voting behavior (No. w21812). National Bureau of Economic Research.

Dolado, J., Jansen, M., Felgueroso, F., Fuentes Hutfilter, A. & Wölfl, A. (2013): Youth labour market performance in Spain and its determinants: A micro-level perspective (No. 1039). OECD Publishing.

Erdogan, B., & Bauer, T. N. (2009): Perceived overqualification and its outcomes: The moderating role of empowerment. Journal of Applied Psychology, 94(2), 557.

Erdogan, B., Bauer, T. N., Peiró, J. & Truxillo, D. M. (2011): Overqualified employees: Making the best of a potentially bad situation for individuals and organizations. Industrial and Organizational Psychology, 4(2), 215–232.

Fernald, J. G. & Jones, C. I. (2014): The future of US economic growth. The American Economic Review, 104(5), 44–49.

Fine, S., & Nevo, B. (2008): Too smart for their own good? A study of perceived cognitive overqualification in the workforce. The International Journal of Human Resource Management, 19(2), 346–355.

Feldman, D. C. (1996): The nature, antecedents and consequences of underemployment. Journal of Management, 22(3), 385–407.

Freel, M. S. (2003): Sectoral patterns of small firm innovation, networking and proximity. Research Policy, 32(5), 751–770.

Freeman, C. (1995): The 'National System of Innovation' in historical perspective. Cambridge Journal of Economics, 19(1), 5–24.

Goos, M. & Manning, A. (2003): McJobs and MacJobs: The growing polarisation of jobs in the UK, in: Dickens, R., Gregg, P., Wadsworth, J. (eds.) The Labour Market Under New Labour. Palgrave Macmillan, London.

Goos, M., Salomons, A. & Vandeweyer, M. (2013): Job polarization during the great recession and beyond. Euroforum policy paper 2, KU Leuven.

Gould, E. D. (2015): Explaining the Unexplained: Residual Wage Inequality, Manufacturing Decline, and Low-Skilled Immigration. CEPR Discussion Paper No. DP10649. Available at SSRN: https://ssrn.com/abstract=2615909.

Greenwood, J. (1997): The third industrial revolution: Technology, productivity, and income inequality (No. 435). American Enterprise Institute.

Hamersma, M., Edzes, A. & van Dijk, J. (2015): Underqualification as an opportunity for low-educated workers. Environment and Planning C: Government and Policy, 33(1), 83–103.

Heyes, J., Tomlinson, M. & Whitworth, A. (2016): Underemployment and well-being in the UK before and after the great recession. Work, Employment & Society, 31(1), 71–89. doi:10.1177/0950017016666199.

Holzer, H. (2015): Job market polarization and US worker skills: A tale of two middles. Brookings Institution Economic Studies Working Paper, April, 6.

Huiban, J. P. & Bouhsina, Z. (1998): Innovation and the quality of labour factor: An empirical investigation in the French food industry. Small Business Economics, 10(4), 389–400.

Hulten, C. & Ramey, V. (2019): Introduction: Skills, education, and US economic growth: Are US workers being adequately prepared for the 21st century world of work? in Hulten, C. & Ramey, V. (eds.) Education, skills, and technical change: Implications for future US GDP growth. University of Chicago Press. Chicago.

Kleinknecht, A. & Verspagen, B. (1990): Demand and innovation: Schmookler re-examined. Research Policy, 19(4), 387–394.

Kuznets, S. (1955): Economic growth and income inequality. The American Economic Review, 45(1), 1–28.

Leiponen, A. (2005): Skills and innovation. International Journal of Industrial Organization, 23 (5), 303–323.

Lin, B., Law, K. & Zhou, J. (2017): Why is underemployment related to creativity and OCB? A task crafting explanation of the curvilinear moderated relations. Academy of Management Journal, 60(1), 156–177.
Luksyte, A. & Spitzmueller, C. (2015): When are overqualified employees creative? It depends on contextual factors. Journal of Organizational Behavior, 37(5), 635–653.
Makkonen, T. & Lin, B. (2012): Continuing vocational training and innovation in Europe. International Journal of Innovation and Learning, 11(4), 325–338.
Maynard, D. C., Joseph, T. A., & Maynard, A. M. (2006): Underemployment, job attitudes, and turnover intentions. Journal of Organizational Behavior: The International Journal of Industrial, Occupational and Organizational Psychology and Behavior, 27(4), 509–536.
Mazzolari, F. & Ragusa, G. (2013): Spillovers from high-skill consumption to low-skill labor markets. Review of Economics and Statistics, 95(1), 74–86.
Michaels, G., Natraj, A. & Van Reenen, J. (2014): Has ICT polarized skill demand? Evidence from eleven countries over twenty-five years. Review of Economics and Statistics, 96(1), 60–77.
Nelson, R. R. & Winter, S. G. (1982): The Schumpeterian tradeoff revisited. The American Economic Review, 72(1), 114–132.
Oldenski, L. (2014): Offshoring and the polarization of the US labor market. Industrial & Labor Relations Review, 67(3 suppl), 734–761.
Ozgen, C., Nijkamp, P. & Poot, J. (2013): The impact of cultural diversity on firm innovation: Evidence from Dutch micro-data. IZA Journal of Migration, 2(1), 18.
Piva, M. & Vivarelli, M. (2007): Is demand-pulled innovation equally important in different groups of firms? Cambridge Journal of Economics, 31(5), 691–710.
Sandulli, F. D., Baker, P. M., & López-Sánchez, J. I. (2013): Can small and medium enterprises benefit from skill-biased technological change? Journal of Business Research, 66 (10), 1976–1982.
Sandulli, F. D., Baker, P. M., & López-Sánchez, J. I. (2014): Jobs mismatch and productivity impact of information technology. The Service Industries Journal, 34(13), 1060–1074.
Shipton, H. J., West, M. A., Parkes, C. L., Dawson, J. F. & Patterson, M. G. (2006): When promoting positive feelings pays: Aggregate job satisfaction, work design features, and innovation in manufacturing organizations. European Journal of Work and Organizational Psychology, 15(4), 404–430.
Strauss, H. & De la Maisonneuve, C. (2009): The wage premium on tertiary education: New estimates for 21 OECD countries. OECD Journal: Economic Studies, 2009, 183–210.
Toner, P. (2011): Tradespeople and technicians in innovation. In Fostering enterprise: The innovation and skills nexus–research readings, 127.
Vona, F. & Consoli, D. (2015): Innovation and skill dynamics: A life-cycle approach. Industrial and Corporate Change, 24(6), 1393–1415.
Wu, C. H., Tian, A., Luksyte, A. & Spitzmueller, C. (2017): On the association between perceived overqualification and adaptive behavior. Personnel Review, 46(2), 339–354.
Zhou, J. & George, J. M. (2001): When job dissatisfaction leads to creativity: Encouraging the expression of voice. Academy of Management Journal, 44(4), 682–696.
Agnihotri, A. 2012: Revisiting the debate over the bottom of the pyramid market. In: *Journal of Macromarketing*, **32** (4), 417–423.
Agnihotri, A. 2015: Low-cost innovation in emerging markets. In: *Journal of Strategic Marketing*, **23** (5), 399–411.
Anand, G. 2009: The Henry Ford of heart surgery. *The Wall Street Journal*. In: https://www.wsj.com/articles/SB125875892887958111.

Aoyama, Y. 2012: Geography of economic governance: Industrial dimensions of state-market relations.

Aziz, A., Sarason, Y. & Hanley, G. 2013: Ayzh at a crossroad: Maternal health for whom? In: WDI Publishing. Purchasable at http://wdi-publishing.com/casedetail.aspx?cid=1429329.

Bach, J. & Stark, D. 2002: Innovative ambiguities: NGOs' use of interactive technology. In: *Eastern Europe. Studies in Comparative International Development*, **37** (2), 3–23.

Bound, K. & Thornton, I. W. 2012: *Our frugal future: Lessons from India's innovation system*. Nesta, London.

Das, S. 2014: The Economic Times. Devi Shetty opens low-cost health care venture in Cayman Islands outside US regulatory reach. In: http://articles.economictimes.indiatimes.com/2014-02-24/news/47635802_1_devi-shetty-narayana-health-indian-doctors Accessed: 29.04.2016.

Das, S. & Sharma, Y. S. 2015: The Economic Times. Government shuts doors on private insurers in Rashtriya Swasthya Bima Yojana. In: http://articles.economictimes.indiatimes.com/2015-01-06/news/57748116_1_rsby-rashtriya-swasthya-bima-yojana-insurance-companies Accessed: 29.04.2016.

Doh, J. P. & Teegen, H. 2002: Nongovernmental organizations as institutional actors in international business: Theory and implications. In: *International Business Review*, **11** (6), 665–684.

Embrace. 2016: Embrace global. In: Company Website. http://embraceglobal.org/ Accessed: 29.04.2016.

Fletcher, R. 2005: International marketing at the bottom of the pyramid. In: ANZMAC 2005 Conference: Marketing in International and Cross-Cultural Environments. www.anzmac.org/conference_archive/2005/cd-site/pdfs/9-Marketing-Int-C-Cultural-Env/9-Fletcher.pdf Accessed: 27.07.2014.

George, G., McGahan, A. M. & Prabhu, J. 2012: Innovation for inclusive growth: Towards a theoretical framework and a research agenda. In: *Journal of Management Studies*, **49** (4), 661–683.

Guth, M. 2005: Innovation, social inclusion and coherent regional development: A new diamond for a socially inclusive innovation policy in regions. In: *European Planning Studies*, **13** (2), 333–349.

Hauschildt, J. & Salomo, S. 2011: *Innovationsmanagement*. Vahlen, München.

Hietapuro, M. 2011: Partnerships in BOP business. In: https://aaltodoc.aalto.fi/bitstream/handle/123456789/661/hse_ethesis_12529.pdf?sequence=1 Accessed: 29.04.2016.

Kallen, H. M. 1973: Innovation. In: Etzioni, A. Etzioni-Halevy, E. (Publ.), *Social change – Sources, patterns and consequences*. 2nd ed., Basic Books, New York, 447–450.

Karnani, A. 2006: Mirage at the bottom of the pyramid. In: http://deepblue.lib.umich.edu/bitstream/handle/2027.42/57215/wp835?sequence=1 Accessed: 27.07.2014.

Karnani, A. 2007: The mirage of marketing to the bottom of the pyramid. In: *California Management Review*, **49** (4), 90–111.

Kolk, A., Rivera-Santos, M. & Rufín, C. 2013: Reviewing a decade of research on the "base/bottom of the pyramid"(BOP) concept. In: *Business & Society*, **53** (3), 338–377.

Lambell, R., Ramia, G., Nyland, C. & Michelotti, M. 2008: NGOs and international business research: Progress, prospects and problems. In: *International Journal of Management Reviews*, **10** (1), 75–92.

Lundvall, B. A. 2009: Innovation as an interactive process: User-producer interaction to the national system of innovation: Research paper. In: *African Journal of Science, Technology, Innovation and Development*, **1** (2 & 3), 10–34.

Madsen, S. T. 1997: Between people and the state: NGOs as troubleshooters and innovators. In: Lindberg, S. & Sverrisson, A. (Eds.): *Social movements in development*, Palgrave Macmillan, London, UK, 252–273.

Misra, M. 2013: Warmth for newborns: The embrace infant warmer. In Satia, J., Misra, M., Arora, R. & Neogi, S. (Eds.): (2013). *Innovations in maternal health: Case studies from India*, SAGE Publications, New Delhi, India, 147–157.

Mitlin, D., Hickey, S. & Bebbington, A. 2007: Reclaiming development? NGOs and the challenge of alternatives. In: *World Development*, **35** (10), 1699–1720.

Mulgan, G., Tucker, S., Ali, R. & Sanders, B. 2007: Social innovation: What it is, why it matters and how it can be accelerated. Skoll Centre for Social Entrepreneurship.

Narula, R. & Dunning, J. H. 2010: Multinational enterprises, development and globalization: Some clarifications and a research agenda. In: *Oxford Development Studies*, **38** (3), 263–287.

Novartis. 2014: Corporate responsibility performance report 2013. Novartis AG 2014. In: www.novartis.com/sites/www.novartis.com/files/documents/cr-performance-report-2013.pdf.

Novartis. 2016: Corporate responsibility performance report 2015. Novartis AG 2016. In: www.novartis.com/sites/www.novartis.com/files/novartis-cr-performance-report-2015.pdf.

Oetzel, J. & Doh, J. P. 2009: MNEs and development: A review and reconceptualization. In: *Journal of World Business*, **44** (2), 108–120.

Parthasarathy, B., Aoyama, Y. & Menon, N. 2015: Innovating for the bottom of the pyramid: Case studies in health care from India. In: Hostettler, S., Hazboun, E. & Bolay, J.C. (Eds.): *Technologies for development*, Springer International Publishing, Cham, 55–69.

Paunov, C. 2013: Innovation and inclusive development. OECD Science, Technology and Industry Working Papers, 2013/01, OECD Publishing, Paris. http://dx.doi.org/10.1787/5k4dd1rvsnjj-en

Pfitzer, M., Bockstette, V. & Stamp, M. 2013: Innovating for shared value. In: *Harvard Business Review*, **91** (9), 100–107.

Prahalad, C. K. 2009: *The fortune at the bottom of the pyramid, revised and updated 5th anniversary edition: Eradicating poverty through profits*. Prentice Hall, New Jersey.

Ramani, S. V. & Mukherjee, V. 2014: Can breakthrough innovations serve the poor (BOP) and create reputational (CSR) value? Indian case studies. In: *Technovation*, **34** (5), 295–305.

Rangan, V. K. & Thulasiraj, R. D. 2007: Making sight affordable (innovations case narrative: The Aravind eye care system). In: *Innovations*, **2** (4), 35–49.

Rashtriya Swasthya Bima Yojana (RSBY). 2009: Rashtriya Swasthya Bima Yojana (RSBY). In: www.rsby.gov.in/about_rsby.aspx Accessed: 29.04.201654ii.

Reddy, P. 2005, R&D-related FDI in developing countries: Implications for host countries. In: *Globalization of R&D and developing countries*. United Nations, New York, 89-105.

Roberts, E. B. 1987: *Generating technological innovation*. Oxford University Press, New York, USA.

SadreGhazi, S. n.d.: Challenges of corporate involvement in pro-poor innovation. In: www.ungs.edu.ar/globelics/wp-content/uploads/2011/12/ID-359-SadreGhazi-Inclusive-Innovation.pdf Accessed: 27.07.2014.

Sehgal, V., et al. 2010: The importance of frugal engineering. In: *Strategy and Business*, **16** (59), 20–25.

Sengupta, R. 2013: Sustainable and inclusive innovations in health care delivery–A business model perspective. *GIZ India & CII-ITC Centre of Excellence for Sustainable Development*.

Seyfang, G. & Smith, A. 2007: Grassroots innovations for sustainable development: Towards a new research and policy agenda. In: *Environmental Politics*, **16** (4), 584–603.

Tasavori, M. 2013: The entry of multinational companies to the base of the pyramid: A network perspective. In: www.essex.ac.uk/ebs/research/working_papers/WP2013-8_Tasavori_multinational_companies.pdf Accessed: 27.07.2014.

Tiwari, R. & Herstatt, C. 2012a: Open global innovation networks as enablers of frugal innovation: Propositions based on evidence from India (No. 72). Working Paper, Technologie-und Innovationsmanagement, Technische Universität Hamburg-Harburg. In: www.econstor.eu/bitstream/10419/68261/1/733539696.pdf Accessed: 27.07.2014.

Tiwari, R. & Herstatt, C. 2012b: Frugal innovations for the 'unserved' customer: An assessment of India's attractiveness as a lead market for cost-effective products (No. 69). Working Papers/Technologie-und Innovationsmanagement, Technische Universität Hamburg-Harburg. In: www.econstor.eu/bitstream/10419/55862/1/687849292.pdf Accessed: 27.07.2014.

Utz, A. & Dahlman, C. 2007: Promoting inclusive innovation. In: Dutz, M. A. (Ed.): 2007: *Unleashing India's innovation: Toward sustainable and inclusive growth*, World Bank Publications, Washington DC, 105–128.

Vermeulen, P. A. M., Bertisen, J., Geurts, J. L. A., Kandachar, P., & Halme, M. 2008: Building dynamic capabilities for the base of the pyramid. In: Kandachar, P. & Halme, M. (Eds.): *Sustainability challenges and solutions at the base of the pyramid*, Routledge, London, 369-386.

Weidner, K. L., Rosa, J. A. & Viswanathan, M. 2010: Marketing to subsistence consumers: Lessons from practice. In: *Journal of Business Research*, **63** (6), 559–569.

Yaziji, M. & Doh, J. 2009: *NGOs and corporations: Conflict and collaboration*. Cambridge University Press, Cambridge.

Zahn, E. & Weidler, A. 1995: Integriertes innovations management. In: Zahn, E. (Ed.): *Handbuch Technologiemanagement*, Schäffer-Poeschel Verlag, Stuttgart, 351-376.

Zapf, W. 1989: Über soziale Innovationen. In: *Soziale Welt*, **40** (H. 1/2), 170–183.

Zelenika, I. & Pearce, J. M. 2011: Barriers to appropriate technology growth in sustainable development. In: *Journal of Sustainable Development*, **4** (6), 12.

The Asian and Pacific Centre for Transfer of Technology (APCTT) (1986), Technology Policies and Planning Republic of Korea, Bangalore, India: APCTT.

Bell, R. M. N. 1985: *Technical Change in Infant Industries: A Review of Empirical Evidence*. New York, NY: World Bank. Working Paper.

Caillods, F. 1984: "Education, Organization of Work and Indigenous Technological Capacity", In: Fransman, M. and King, K. (Eds.): *Technological Capability in the Third World*. Houndmills and London: MacMillan Press, pp. 211–222.

Cho, H., Lee, E., Lee, C. and Kim S. 2002: *Review of S&T Human Resource Policies in Korea*. Seoul: Science and Technology Policy Institute (STEPI).

Chung, S. 2003: "Innovation in Korea", In: Shavina, L. V. (Ed.): *The International Handbook on Innovation*. Oxford: Pergamon, pp. 890–903.

Chung, S. 2012: "Technology and Developing Countries", In: Chung, S. (Ed.): *Technology and Management*. Seoul: Kyongmoonsa, Chapter 12, pp. 517–563.

Chung, S. 2014: *A Study on Improving Education System and Revising Curricula for Nurturing Convergence-Type Talent*. Seoul, Korea: Presidential Advisory Council on Science and Technology (PACST).

Chung, S. 2015: *A Policy Study on the Detailed Programs and Interaction among Universities, Public Research Institutes, and Universities in the INNOPOLIS Gwangju*. Daejon: INNOPOLIS Foundation.

Chung, S. 2016: "Korean Government and Science and Technology Development", In: Hilpert, U. (Ed.): *Routledge Handbook of Politics and Technology*. London and New York, NY: Routledge, pp. 222–235.

Clark, N. 1985: *The Political Economy of Science and Technology*. Oxford: Basil Blackwell.
Eom, M. and Park, J. 2007: "The Determinants of S&T Workforce Shortage in Korean Manufacturing Sectors", *Journal of Technology Innovation*, Vol. 15, No. 2, pp. 25–40.
Florida, R. 2002: *The Rise of the Creative Class. And How It's Transforming Work, Leisure and Everyday Life*. New York, NY: Basic Books.
Florida, R. 2005: *The Flight of the Creative Class: The New Global Competition for Talent*. New York, NY: HarperCollins.
Hong, S. 2012: "History and Future Direction of S&T Manpower Policy", *Science and Technology Policy*. Seoul: Science and Technology Policy Institute (STEPI), pp. 166–173.
INNOPOLIS Foundation. 2014: *Action Plan of INNOPOLIS Gwangju in 2014*. Daejon: INNOPOLIS Foundation.
International Institute for Management Development (IMD). Each Year: *The IMD World Competitiveness Yearbook*. Lausanne: IMD.
Jeong, K., Lee, J. and Lee, Y. 2010: "An Exploration of Compensation Satisfaction Determinants and Influence Analysis on Job Commitment for S&T Manpower", *Journal of Technology Innovation*, Vol. 18, No. 2, pp. 1–32.
Kim, L. 1997: *Imitation to Innovation: The Dynamics of Korea's Technological Learning*. Boston, MA: Harvard Business School Press.
King, K. 1984: "Science, Technology and Education in the Development of Indigenous Technological Capbility", In: Fransman, M. and King, K. (Eds.): *Technological Capability in the Third World*. Houndmills and London: MacMillan Press, pp. 31–64.
Korea Education Development Institute (KEDI). Each Year: *Korea Education Statistics*. Seoul: KEDI.
Korea Industrial Technology Association (KOITA). Each Year: *Annual Report of Industrial Science and Technology*. Seoul: KOITA.
Korea International Trade Association (KITA). Each Year: *Trade Statistics*. Seoul: KITA.
Mazzoleni, R. and Nelson, R. R. 2007: "Public Research Institutions and Economic Catch-Up", *Research Policy*, Vol. 36, pp. 1512–1528.
Min, C. 2012: "Analysis of the Compensation Level and Portfolio for Advanced S&T Manpower", *Journal of Technology Innovation*, Vol. 18, No. 1, pp. 219–245.
Ministry of Education (MOE) 2013: *Internal Documents*. Seoul: MOE.
Ministry of Science and Technology (MOST). 1983: *1983 Science and Technology Annual*. Seoul: MOST.
Ministry of Science and Technology (MOST). 1989: *1989 Science and Technology Annual*. Seoul: MOST.
Ministry of Science and Technology (MOST), Ministry of Science, ICT and Future Planning and Korea Institute of S&T Evaluation and Planning (KISTEP). Each Year: *Report on the Survey of Research and Development in Science and Technology*. Seoul: MOST.
Ministry of Strategy and Finance (MOSF) and Other Ministries. 2005: *Basic Plan for Nurturing and Supporting S&T Manpower to Realize a Creative and Strong Talent Nation*. Seoul: MOST.
Ministry of Strategy and Finance (MOSF) and Other Ministries. 2011: *The 2nd Basic Plan for Nurturing and Supporting to Realize a Creative and Strong S&T Manpower Nation*. Seoul: MOST.
National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. 2005: *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*, Washington, D.C.
National S&T Information Service (NTIS). Each Year: *S&T Statistics Services*. Seoul: NTIS.
Statistics Korea (KOSTAT). Each Year: *The Major Statistics of Korean Economy*. Seoul: KOSTAT.

Organisation for Economic Co-operation and Development (OECD). 1992a: "The Supply of Scientists and Engineers: Current Trends and Concerns", In: OECD (Eds.): *Technology and the Economy: The Key Relationship*. Paris: OECD, Chapter 6, pp. 135–148.

Organisation for Economic Co-operation and Development (OECD). 1992b: "Human Resources and New Technologies in the Production System", In: OECD (Eds.): *Technology and the Economy: The Key Relationship*. Paris: OECD, Chapter 7, pp. 149–166.

Song, B. 1990: *The Rise of the Korean Economy*. Oxford and New York, NY: Oxford University Press.

Westphal, L. E., Rhee, Y. W. and Pursell, G. 1984: "Sources of Technological Capability in South Korea", In: Fransman, M. and King, K. (Eds.): *Technological Capability in the Third World*. Houndmills and London: MacMillan Press, pp. 279–300.

Yoon, J. H. 2006: *The Korean S&T Policy*. Seoul: Gyongmoonsa.

Acs, Z., 2000: *Regional Innovation, Knowledge, and Global Change;* [M]. New York, NY, USA: Frances Pinter.

An, Z., 2006: *Regulation reformation and organizational change on harmonizing development of metropolitan regi2005ons (in Chinese)* [M]. Beijing, China: Economic Science Press.

Bell, G.G., 2005: Clusters, Networks and Firm Innovativeness. *Strateg. Manag. J.*, *26*, 287–295.

Braczyk, H.J., and Cooke, P.N. and Heidenreich, M., 1998: *Regional Innovation Systems: The Role of Governances in a Globalized World*; [M]. London, UK: Psychology Press.

Broekel, T., 2012: Collaboration intensity and regional innovation efficiency in Germany—A conditional efficiency approach. In: *Industry and Innovation 19* (2), 155–179.

Buesa, M., Heijs, J. and Baumert, T., 2010: The determinants of regional innovation in Europe: A combined factorial and regression knowledge production function approach. In: *Research Policy 39* (6), 722–735.

Caniëls, M.C., 2000: *Knowledge Spillovers and Economic Growth: Regional Growth Differentials across Europe*; [M]. Cheltenham, UK: Edward Elgar Publishing

Chen, K. and Kenney, M., 2007: Universities/research institutes and regional innovation systems: The cases of Beijing and Shenzhen. In: *World Development 35* (6), 1056–1074.

China City Statistical Yearbook, 2013, 2014, *and 2015*: edited by City Social and Economic Investigation Department, National Statistical Bureau, Published by China Statistic Press, Beijing, China.

Cooke, P., 1996: The new wave of regional innovation networks: Analysis, characteristics and strategy[J] *Small Bus. Econ*, *8*, 159–171.

Cooke, P. and Morgan, K., 1990: *Learning through networking: Regional innovation and the lessons of Baden-Wurttemberg [M].* Regional Industrial Research Report no. 5. Cardiff: University of Wales.

De la Mothe, J. and Paquet, G., 1998: Local and regional systems of innovation as learning socio-economies. *Econ. Sci. Technol. Innov.*, *14*, 1–18.

Deyle, H. G. and Grupp, H., 2005: Commuters and the regional assignment of innovative activities: A methodological patent study of German districts. In: *Research Policy 34* (2), 221–234.

Dosi, G., 1988: Sources, procedures, and microeconomic effects of innovation. *J. Econ. Lit.*, *26*, 1120–1171.

DrÃ¼ke, H., 2003: Selective performance admit government failure: the complexities of the Italian regionalism in innovation, in: Hilpert, U. (Ed.), *Regionalisation of Globalised Innovation: Locations for advanced industrial development and disparities in participation*. Routledge Ltd., London and New York, 73–93.

Feldman, M. P., 1994: Knowledge complementarity and innovation. In: *Small Business Economics 6* (5), 363–372.

Fischer, M. M., Diez, J. R., and Snickars, F., 2001: *Metropolitan innovation systems: Theory and evidence from three metropolitan regions in Europe* [M]. Berlin: Springer.

Fritsch, M. and Slavtchev, V., 2010: How does industry specialization affect the efficiency of regional innovation systems? In: *The Annals of Regional Science 45* (1), 87–108.

Fischer, M., Diez, J.R., and Snickars, F., 2002: Metropolitan Innovation Systems: Theory and Evidence from Three Metropolitan Regions in Europe. *Eur. Plan. Stud.*, *10*, 275–279.

Gai, W.q. and Wang, J., 1999: Function of regional networking on small high tech companies in China. In: *China Soft Science 9* (in Chinese), 102–106.

Griliches Z., 1992: The search for R&D spillovers. In: *The Scandinavian Journal of Economics 94* (Supplement), 29–47.

Hall, P. and Markusen, A., 1985: High technology and regional-urban policy. In: *Silicon Landscapes*. Crows Nest, Australia: Allen and Unwin, 144–151.

Han, L., Lachang L., Lezhang W., and Yuan R., 2010: Innovation space in metropolitan areas in Guangdong Province in China. In: *Economic Geography 12* (in Chinese), 1978–1984.

Hao, Y. and Tang, J., 2009: Regional innovation capacity and its constrain factors, province based panel data investigation between 1997 and 2007. In: *Management Journal 6* (9) (in Chinese), 1182–1187.

Hickie, D., Islands of Innovation in the UK economy: high-technology, networking and public policy, in: Hilpert, U. (Ed.), *Regionalisation of Globalised Innovation: Locations for advanced industrial development and disparities in participation*. Routledge Ltd., London and New York, 53–72.

Hilpert, U., Globalisation and selective localisation of industry and innovation: the role of government in regionalising socio-economic development, in: Hilpert, U. (Ed.), *Regionalisation of Globalised Innovation: Locations for advanced industrial development and disparities in participation*. Routledge Ltd., London and New York, 3–28.

Hilpert, U. and Lawton Smith, H. (Eds.), 2013: Networking of regionalised innovative labourmarket. Abingdon-on-Thames, UK: Routledge.

Jaffe, A. B., 1989: Real effects of academic research [J]. In: *American Economic Review 79*, 957–970.

Johnson, W. H. A. and Liu, Q., 2011: Patenting and the role of technology markets in regional innovation in China: An empirical analysis. In: *Journal of High Technology Management Research 22*, 14–25.

Liu, C., Li, Z., Xu, J. and Ye, J., 2010: Spatial analysis on restructuring of "Metropolitan Region" in Pearl River Delta in China—Example of facility construction cross-administrative boundary [J]. In: *International City Planning 25* (2) (in Chinese), 31–38.

Liu, X., 2005: Analysis and report on regional innovation capacity in China: 2004–2005, [J]. In: *Study of Science and Technologies 12* (in Chinese), 5–14.

Malecki, E. J., 1981: Science, technology, and regional economic development: Review and prospects. In: *Research Policy 10* (4), 312–334.

Nelson, R., 1993: *National innovation systems—A comparative analysis* [M]. Oxford, UK: Oxford University Press.

Padmore, T. and Gibson, H., 1998: Modelling systems of innovation: II. A framework for industrial cluster analysis in regions. In: *Research Policy 26* (6), 625–641.

Padmore, T., Schuetze, H. and Gibson, H., 1998: Modeling systems of innovation: An enterprise-centered view. In: *Research Policy 26* (6), 605–624.

Pavitt, K. and Patel, P., 1994: Uneven (and divergent) technological accumulation among advanced countries. In: *Industrial and Corporate Change 3*, 759–787.

Polanyi, M., 1996: *The tacit dimension*. London: Routledge & Kegan Paul.

Song, L., 2010: *Polarized development of metropolitan innovation system: Situations and evaluations* [D], (in Chinese). PhD thesis at Beihang University.

Song, L. and Chen, X., 2009: Comparison of innovation space among major four larger metropolitan areas in China. In *China Soft Science 10* (in chinese), 100–108.

Stöhr, W. B., 1986: Regional innovation complexes. In: *Regional Science 59* (1), 29–44.

Sweeney, G. P., 1987: *Innovation, entrepreneurs regional development*. London: Frances Pinter, ISBN 0-86187-647-4.

Varga, A., 1999: Time-space patterns of US innovation: Stability or change? In: Manfred M. Fischer, Luis Suarez-Villa, and Michael Steiner (Ed.), *Innovation, networks and localities*. Berlin/Heidelberg: Springer, 215–234.

Verspagen, B., 1993: Uneven growth between rivals: Informal know-how trading. In *Research Policy 16*, 291–302.

Wang, J., 1997: Networking environment: The new change of industrial organization, (in Chinese). In: *Strategies and Management Journal 3* (in Chinese), 109–144.

Wu, Q. and Ning, Y., 2012: Analysis on City Networking in China—From perspective of electronic and information companies (in Chinese).[J]. In: *Geographical Studies 31* (2) 201-219.

Li, X., 2009: China's regional innovation capacity in transition: An empirical approach [J]. In: *Research Policy 38*, 338–357.

Xie, F.J. and Xiaoyu, Y. and Zihui, G., 2010: The bottleneck problems and policy recommendations of the development of Shanghai patent technology industry [J]. In: *Technology and Economy 29* (8), 13–16.

Xie, F.J. and Xu, H.M., 2007: Study on the modes of metropolitan innovation system (in Chinese) [J]. *China Econ. Rev., 3*, 1–7.

Zhang, B., Yao, F. and Zhang, J., 2004: *Technology Transfer from Formal Soviet Union to China, 1949–1966* (in Chinese). Shandong, China: Shandong Press.

Zhou, T., 2010: *China city innovation report blue book*, (in Chinese). Beijing, China: Hong Qi Press.

Aghion, P., Boulanger, J., Cohen, E. 2011: *Rethinking Industrial Policy*. Brussels: Bruegel Policy Brief Issue 2011/04, June.

Ambrosetti. 2016: *The Environment for Innovation: Drivers for the Growth of Italian Company and Italy*. Milan: The European House.

Amison, P., Bailey, D. 2013: *Industrial Diversity and Innovation Spillovers: Dynamic Innovation and Adoption*. Working Paper No 45. WWW for Europe, Welfare Wealth Work, Coventry University, November.

Amison, P., Bailey, D. 2014: Phoenix Industries and Open Innovation? The Midlands Advanced Automotive Manufacturing and Engineering Industry. In: *Cambridge Journal of Regions, Economy and Society* 7 (3), 397–411.

Andermon, A., Gustavsson, M. 2011: *Job Polarization and Task-Biased Technological Change: Sweden 1975–2005*. Working Paper No. 15, Department of Economics. Uppala: Uppala University.

Asheim, B., Boschma, R., Cooke, P. 2011: Constructing Regional Advantage: Platform Policies Based on Related Variety and Differentiated Knowledge Bases. In: *Regional Studies* 47 (7), 893–904.

Autor, D., Dorn, D. 2009: *The Growth of Low Skill Service Jobs and the Polarization of the US Labour Market*. Working Paper, No. 15150. Washington, DC: NBER.

Bailey, C., de Propis, L. 2014: Manufacturing Reshoring and Its Limits: The UK Automotive Case. In: *Cambridge Journal of Regional Economy and Society* 7, 379–395.

Bailey, D., Cowling, K., Tomlinson, P.R. (Eds.). 2015: *New Perspectives on Industrial Policy for a Modern Britain*. Oxford: Oxford University Press.

Barca, F. 2009: *An Agenda for a Reformed Cohesion Policy. A Placed-Based Approach to Meeting European Union Challenges and Expectation*. Independent Report prepared at the request of Danuta Hüber, Commissioner for Regional Policy, April.

Beaven, R., May-Gillings, M., Hay, G., Steve, J., Wilson, R. 2014: *Working Futures 2012–2022*. Evidence Report No 83, March. London: UK Commission for Employment and Skills.

Bianchi, P., Laboury, S. 2016: *Towards a New Industrial Policy*. Milan: McGraw Hill Education.

BIS. 2013: *Hollowing Out and the Future of the Labour Market*. BIS Research Paper, No 134. London: Department for Business Innovation & Skills.

BIS. 2015: *Advanced Manufacturing Supply Chain Initiative: Process Evaluation Study*. BIS Research Paper, No 223. London: Department for Business Innovation & Skills.

Bormann, R., Fink, P., Iwer, F., Schade, W. 2015: *Like a Phoenix from the Ashes? On the Future of the Automotive Industry in Germany*. WISO Diskurs, No. 19. Bonn: Friedrich Ebert Stiftung.

Boschma, R. 2005: Proximity and Innovation: A Critical Assessment. In: *Regional Studies* 39 (1), 61–74.

Boschma, R. 2008: *Constructing Regional Advantage: Related Variety and Regional Innovation Policy*. Report for the Dutch Scientific Council for Government Policy. Utrecht: University of Utrecht.

Braczyk, H.-J., Cooke, P., Heidenreich, M. (Eds.). 1998: *Regional Innovation Systems*. London: UCL Press.

Bramanti, A. 2015a: *Policy Paper sulle politiche di rilancio e sostegno all'economia lombarda*. Rapporto Finale, ECO 15014. Milano: Éupolis Lombardia.

Bramanti, A. 2015b: Nuove alleanze nel percorso scuola–lavoro. In: *Scuola Democratica* 3, 617–641.

Bramanti, A. 2016: Clusters, Unlike Diamonds, Are not Forever. The European Way to Global Competition. In: Hilpert, U. (Ed.), *Routledge Handbook of Politics and Technology*. Abingdon, Oxon: Routledge, 354–366.

Bramanti, A., Fratesi, U. 2009: The Dynamics of an 'Innovation Driven' Territorial System. In Senn, L., Fratesi, U. (Eds.), *Growth in Interconnected Territories: Innovation Dynamics, Local Factors and Agents*. Berlin: Springer Verlag, 59–91.

Bramanti, A., Lazzeri, G. 2016: Smart Specialisation and Policy-Mix: Economic and Political Challenges within the Italian Experience. In: *RSA Annual Conference, Building Bridges: Cities and Regions in a Transnational World*, 4–6 April, Graz.

Brandes, F., Lejour, A., Verweij, G., van der Zee, F. 2007: *The Future of Manufacturing in Europe*. The Hague: CPB, Netherlands Bureau for Economic Policy Analysis.

Cappellin, R. 2016: Investments, Balance of Payment Equilibrium and a New Industrial Policy in Europe. In: *RSA Annual Conference, Building Bridges: Cities and Regions in a Transnational World*, 4–6 April, Graz.

Cappellin, R., Wink, R. 2009: *International Knowledge and Innovation Network. Knowledge Creation and Innovation in Medium-Technology Clusters*. Cheltenham: Edward Elgar.

Caragliu, A., Nijkamp, P. 2008: *The Impact of Regional Absorptive Capacity on Spatial Knowledge Spillovers*. Discussion Paper, No. 119. Amsterdam: Timberger Institute.

CEDEFOP. 2013: Roads to Recovery: Three Skill and Labour Market Scenarios for 2025. In: *Briefing Note* June 2013.

Chesbrough, H.W., Appleyard, M.M. 2007: Open Innovation and Strategy. In: *California Management Review* 50 (1), 57–75.

Christophenson, S. 2009: Building 'Phoenix Industries' in Our Old Industrial Cities. In: Tomaney, J. (Ed.), *The Future of Regional Policy*. London: The Smith Institute, 77–86.

Christopherson, S., Martin, R., Sunley, P., Tyler, P. 2014: Reindustrialising Regions: Rebuilding the Manufacturing Economy? In: *Cambridge Journal of Regional Economy and Society* 7, 351–358.

Cohen, W.M., Levinthal, A. 1990: Absorptive Capacity: A New Perspective on Learning and Innovation. In: *Administrative Science Quarterly* 35 (1), 128–152.

Confindustria Lombarda. 2016: *Lombardia 2030. Piano Strategico*. Milano: LIUC Università Cattaneo, Fondazione Edison.

Cooke, P. 2012: *Complex Adaptive Innovation Systems. Relatedness and Transversality in the Evolving Region*. Regions and Cities. London: Routledge.

de la Mothe, J., Paquet, G. (Eds.). 1998: *Local and Regional Systems of Innovation*. Boston, MA: Kluwer Academic Publishers.

Deloitte. 2014: *Industry 4.0 – Challenges and Solutions for the Digital Transformation and Use of Exponential Technologies*. Zurich: Deloitte Switzerland.

Dettori, B., Marrocu, E., Paci, R. 2013: Total Factor Productivity, Intangible Assets and Spatial Dependence in the European Regions. In: *Regional Studies* 46 (10), 1401–1416.

Dhéret, C., Morosi, M., Frontini, A., Hedberg, A., Pardo, R. 2014: *Towards a New Industrial Policy for Europe*. ECP Issue Paper No 78, November.

Dolphin, T. 2014: *Gathering Strength. Backing Clusters to Boost Britain's Exports*. London: IPPR.

Dolphin, T. (Ed.). 2015: *Technology, Globalisation and the Future of Work in Europe. Essays on Employment in a Digitised Economy*. London: IPPR.

European Commission. 2013: *Factories of the Future*. Luxembourg: Publications Office of the European Union.

European Commission. 2014: *For a European Industrial Renaissance*. COM (2014) 14/2, Luxembourg: Publications Office of the European Union.

Faludi, A. 2012: Multi-level (Territorial) Governance: Three Criticisms. In: *Planning Theory & Practice* 13 (2), 197–211.

Farshchi, M.A., Janne, O.E.M., McCann, P. (Eds.). 2009: *Technological Change and Mature Industrial Regions*. Cheltenham: Edward Elgar.

Foray, D. 2015: *Smart Specialisation: Opportunities and Challenges for Regional Innovation Policies*. Abingdon, Oxon: Routledge.

Foray, D., Goenaga, X. 2013: *The Goals of Smart Specialisation*. S3 Policy Brief Series, No 01/2013. Sivilla: JRC Scientific and Policy Reports.

Fratesi, U., Rodríguez-Pose, A. 2016: The Crisis and Regional Employment in Europe: What Role for Sheltered Economies? In: *Cambridge Journal of Regions, Economy and Society* 9 (1), 33–57.

Frenken, K., Van Oort, F., Verburg, T. 2007: Related Variety, Unrelated Variety and Regional Economic Growth. In: *Regional Studies* 41 (5), 685–697.

Fujimoto, T. 2011: The Japanese Manufacturing Industries: Its Capabilities and Challenges. *21st International Conference on Flexible Automation and Intelligent Manufacturing*.

Garcilazo, J.E., Martins, J.O., Tompson, W. 2010: *Why Policies May Need to be Place-Based to be People-Centred*. VOX, CEPR's Policy Portal. www.voxeu.org

Gill, I. 2009: *Regional Development Policies: Place-based or People-Centred?* VOX, CEPR's Policy Portal. www.voxeu.org

Goos, M., Manning, A. 2007: Lousy and Lovely Jobs. The Rising Polarization of Work in Britain. In: *The Review of Economics and Statistics* 89 (1), 118–133.

Goos, M., Manning, A., Salomons, A. 2009: Job Polarization in Europe. In: *American Economic Review. Papers and Proceedings* 99 (2), 58–63.

Guastella, G., van Oort, F.G. 2015: Regional Heterogeneity and Interregional Research Spillovers in European Innovation: Modelling and Policy Implications. In: *Regional Studies* 49 (11), 1772–1787.

Heng, S. 2014: *Industry 4.0 – Upgrading of Germany's Industrial Capabilities on the Horizon*. Current Issues, Sector Research. Frankfurt am Main: Deutsche Bank.

Hilpert, U. 2016: The Culture–Technology Nexus. Innovation Policy and the Successful Metropolis. In: Hilpert U. (Ed.), *Routledge Handbook of Politics and Technology*. Abingdon, Oxon: Routledge, 149–161.

Hilpert, U., Lawton Smith, H. (Eds.). 2012: *Networking Regionalised Innovative Labour Markets*. London & New York, NY: Routledge.

Hooghe, L., Marks, G. 2001: Types of Multi-Level Governance. In: *European Integration online Papers (EIoP)* 5 (11), 1–32.

IDA. 2012: *Emerging Global Trends in Advanced Manufacturing*. IDA Paper No 4603. Alexandria: Institute for Defense Analysis.

Industry-Science Research Alliance. 2013: *Recommendations for Implementing the Strategic Initiative INDUSTRIE 4.0*. Frankfurt am Main: Final Report of the INDUSTRIE 4.0 Working Group.

Isaksen, A., Trippl, M. 2014: Regional Industrial Path Development in Different Regional Innovation Systems: A Conceptual Analysis. In *Paper in Innovation Studies*. No 17, CIRCLE. Lund: Lund University Press.

Kaiser, R., Prange, H. 2004: Managing Diversity in a System of Multi-Level Governance: The Open Method of Co-ordination in Innovation Policy. In: *Journal of European Public Policy* 11 (2), 249–266.

Kampelmann, S., Rycx, F. 2011: *Task-Biased Changes of Employment and Remuneration: The Case of Occupations*. Discussion Paper, No. 5470. Berlin: IZA.

Koschatzky, K., Stahlecker, T. 2010: *Cohesion Policy in the Light of Place-Based Innovation Support. New Approaches in Multi-Actors, Decentralised Regional Settings with Bottom-Up Strategies?* WP Firms and Regions, No R1/2010. Karlsruhe: Fraunhofer ISI.

Marks, G. 1993: Structural Policy and Multilevel Governance in the EC. In: Cafruny, A.W., Rosenthal, G.G. (Eds.): *The State of the European Community*, Vol 2, *The Maastricht Debates and Beyond*. Boulder, CO: Harlow Longman, 391–410.

Mazzucato, M. 2013: *The Entrepreneurial State. Debunking Public vs. Private Sector Myths*. UK and USA: Anthem Press.

McIntosh, S. 2013: *Hollowing out and the Future of the Labour Market*. Research Paper No 134, October. London: Department for Business Innovation & Skills.

Moretti, E. 2012: *The New Geography of Jobs*. Boston, MA: Houghton Mifflin Harcourt.

Morgan, K. 2013: The Regional State in the Era of Smart Specialisation. In: *Ekonomiaz* 83 (2), 102–125.

Morkuté, G., Koster, S., Van Dijk, J. 2016: Employment Growth and Inter-Industry Job Reallocation: Spatial Patterns and Relatedness. In: *Regional Studies* Online article (DOI: 10.1080/00343404.2016.1153800).

Niosi, J. 2010: *Building National and Regional Innovation Systems*. Cheltenham: Edward Elgar.

O'Sullivan, E., Mitchell, N. 2013: *International Approaches to Understanding the Future of Manufacturing*. Future of Manufacturing Project: Evidence Paper, No 26. London: Government Office for Science.
OECD. 2001: *OECD Territorial Outlook*. Paris: OECD Publishing.
OECD. 2015: *Education Indicators in Focus*. April. Paris: OECD Publishing.
Pisano, G.P., Shih, W.C. 2009: Restoring American Competitiveness. In: *Harvard Business Review* 87 (7–8).
Pisano, G.P., Shih, W.C. 2012: Does America Really Need Manufacturing. In: *Harvard Business Review* 90 (3).
Pitelis, C. 2015: DIP-ly Speaking: Debunking Ten Myths, and Business Strategy-Informed Development Industrial Policy. In: Bailey, D., Cowling, K., Tomlinson, P.R. (Eds.), *New Perspectives on Industrial Policy for a Modern Britain*. Oxford: Oxford University Press, 17–40.
PwC, Strategy 2014: *Industry 4.0. Opportunities and Challenges of the Industrial Internet*. Munich: PricewaterhouseCoopers Aktiengesellschaft Wirtschaftsprüfungsgesellschaft.
Quatraro, F. 2016: Co-evolutionary Patterns in Regional Knowledge Bases and Economic Structure: Evidence from European Regions. In: *Regional Studies* 50 (3), 513–539.
Ratti, R., Bramanti, A., Gordon, R. (Eds.) 1997: *The Dynamics of Innovative Regions. The GREMI Approach*. Aldershot: Ashgate.
Rodríguez-Pose, A., di Cataldo, M., Rainoldi, A. 2014: *The Role of Government Institutions for Smart Specialisation and Regional Development*. JRS Technical Report, No. 4. Brussels: European Commission.
Rutten, R., Boekema, F. (Eds.). 2007: *The Learning Regions. Foundations, State of the Art, Future*. Cheltenham: Edward Elgar.
Sedita, S.R., de Noni, I., Pilotti, L. 2015: How Do Related Variety and Differentiated Knowledge Bases Influence the Resilience of Local Production System? In *Paper in Innovation Studies*. No 20, CIRCLE. Lund: Lund University.
Stephenson, P. 2013: Twenty Years of Multi-Level Governance: 'Where Does it Come From? What is it? Where is it Going?'. In: *Journal of European Public Policy* 20 (6), 817–837.
Stoneman, P. 2010: *Soft Innovation. Economics, Product Aesthetics, and the Creative Industries*. Oxford: Oxford University Press.
Storz, C., Schäfer, S. 2011: *Institutional Diversity and Innovation*. London: Routledge Studies in Global Competition, Routledge.
Timmer, M.P., Inklaar, R., O'Mahony, M., van Ark, B. 2010: *Economic Growth in Europe*. Cambridge: Cambridge University Press.
Tomaney, J. (Ed.). 2009: *The Future of Regional Policy*. London: The Smith Institute.
Torre, A., Rallet, A. 2005: Proximity and Localization. In: *Regional Studies* 39 (1), 47–59.
WEF-UNIDO. 2014: *The Future of Manufacturing: Driving Capabilities, Enabling Investments*. Geneva: World Economic Forum.
Zenker, A., Schnabl, E. 2016: *Regional Innovation Monitor-Plus 2016*. Brussels: Regional Innovation Report, Baden-Württemberg (Industry 4.0 and Smart Systems).
Adner, R. 2017: "Ecosystem as Structure: An Actionable Construct for Strategy". In: *Journal of Management*, vol. 43, no. 1, 39–58.
Aerospace Growth Partnership. 2012: *Aerospace Growth Partnership, Reach for the Skies. A Strategic Vision for the UK Aerospace Industry*, UK Government, London, UK.
Airbus. 2017: *Global Market Forecast. Growing Horizons, 2017–2036*, Airbus, Toulouse.
Azouzi, R. 2014: "Training the Next Generation". In: *Aerospace*, vol. 41, no. 10, 36–37.
Boeing. 2017: *Current Market Outlook 2017–2036*, Boeing Commercial Airplanes, Seattle, WA.

Cliff, R., Ohlandt, C. & Yang, D. 2011: *Ready for Takeoff. China's Advancing Aerospace Industry*, RAND Corporation, Washington, DC.

Confederation of Indian Industry. 2010: *Changing Dynamics. India's Aerospace Industry*, Confederation of Indian Industry/Price Waterhouse Coopers, New Delhi.

de Meyer, A., Williamson, P., Joshi, H. & Dula, C. 2014: *Rolls-Royce in Singapore: Harnessing the Power of the Ecosystem to Drive Growth*, Singapore Management University, Singapore.

European Union. 2011: *Flightpath 2050. Europe's Vision for Aviation*, European Union, Brussels.

Hickie, D. 2006: "Knowledge and Competitiveness in the Aerospace Industry: The Cases of Toulouse, Seattle and North-west England". In: *European Planning Studies*, vol. 14, no. 5, 697–716.

Hilpert, U. 2016: "Metropolitan Locations in International High-tech Networks: Collaboration and Exchange of Creative Labour as a Basis for Advanced Socio-economic Development". In: *The Routledge Handbook of Politics and Technology*, ed. U. Hilpert, Routledge, Abingdon, UK, 281–298.

IATA. 2013: *IATA Technology Roadmap*, 4th edn, June. Available: www.iata.org/whatwedo/environment/Documents/technology-roadmap-2013.pdf.

ICF International. 2012: *Global Aerospace Sector. M&A update*. Available: www.catalystcf.co.uk/56-global-aerospace-industry-sector-note-summer-2012.pdf.

Maisonneuve, F., Santo, M., Ménard, H. & Schmid, J. 2013: *Internationalization and Competitiveness of Aerospace Suppliers, a Joint Analysis of Germany and France. h and z Unternehemensberatung AG, Munich and Kea and Partners*. Available: www.keapartners.co.uk/sites/default/files/keapartners/hz_keapartners_aerospace_0.pdf.

PwC 2010: *A and D Insights. Accelerating Global Growth*, Price Waterhouse Coopers, London.

PwC 2011: *A and D Insights. Gaining Technological Advantage*, Price Waterhouse Coopers, London.

PwC. 2012: *Gaining Altitude. Globalization. Aerospace Suppliers Need a Flight Plan to Sustain Growth*, Price Waterhouse Coopers, London.

Ro, S. 2013: *Boeing's 787 Dreamliner Is Made of Parts from All Over the World*, Business Insider UK. Available: www.uk.businessinsider.com/boeing-787-dreamliner-structure-suppliers-2013-10?r=US&IR=T.

Santo, M. & Schmid, J. 2012: *Internationalization and Competitiveness of Aerospace Suppliers*, h and z Unternehemensberatung AG, Munich.

Seattle Times. 2013: *Up to 700 Engineers at Boeing Losing Jobs*. Available: www.seattletimes.com/business/up-to-700-engineers-at-boeing-losing-jobs/.

Vertesy, D. & Szirmai, A. 2010: *Interrupted Innovation: Innovation System Dynamics in Latecomer Aerospace Industries*, United Nations University, Maastricht.

Walker, C. 2014: "Mind the Skills Gap". In: *Aerospace*, vol. 41, no. 4, 18–21.

Washington State. 2015: *Workforce Training and Education Coordinating Board. Aerospace Manufacturing Skills. Supply, Demand and Outcomes for Washington's Aerospace Training Programs*, Washington State, Olympia, WA.

Wilhelm, S. 2014: "Boeing Takes 737 and 787 Lessons to Better Build the 777X Wing", In: *Puget Sound Business Journal*, Available: www.bizjournals.com/seattle/news/2014/10/23/boeing-taps-737-and-787-lessons-to-better-build.html.

Benneworth, P., Amanatidou, E., Edwards Schachter, M., Gulbrandsen, M. 2016: *Social Innovation Futures: Beyond Policy Panacea and Conceptual Ambiguity*. Working Paper for the TIK Group Series. Norway: University of Oslo. (online) Available from: http://hdl.handle.net/10261/132837 (Accessed March 2016).

Berners-Lee, T. 2000: *Weaving the Web*. London, UK: Butler and Tanner.
Bugge, K.-E., O'Gorman, B., Hill, I., Welter, F. 2010: Regional sustainability, innovation and welfare through an adaptive process model. In: Sarkis, J., Cordeiro, J.J., Vazquez Brust, D. (Eds.): *Facilitating Sustainable Innovation through Collaboration: A Multi-Stakeholder Perspective*. Dordrecht, The Netherlands: Springer, 77–96.
Carayannis, E.G., Campbell, D.F.J., Grigoroudis, E.T., De Oliveira Monteiro, S. 2017: Introduction. Chap 1. In: De Oliveira Monteiro, S., Carayannis, E.G. (Eds.): *The Quadruple Innovation Helix Nexus*. New York, NY: Palgrave, 1–38.
Central Statistics Office (CSO). 2000: A Redmond (Ed.): *That Was then This Is Now: Change in Ireland, 1949–1999 A Publication to Mark the 50th Anniversary of the Central Statistics Office*. Dublin: CSO.
De Bruijn, P., Lagendijk, A. 2005: Regional innovation systems in the Lisbon strategy. *European Planning Studies* Vol. 13 No. 8, 1153–1172.
Department of Finance 2011: *The Irish Economy in Perspective*. Dublin: Government Publication Office.
Dicken, P. 2003: *Global Shift: Reshaping the Global Economic Map in the 21st Century*. New York, NY: The Guilford Press.
Donnelly, W., Weber, M. 2017: *The Creation and Impact of Open Innovation Ecosystems for the Digital Markets of the Future*. Research, Innovation and Science Policy Experts Open Knowledge Markets Report. Brussels: European Commission. (pending).
Drudy, P.J. 1995: From protectionism to enterprise: A review of Irish industrial policy. In: Burke, A.E. (Ed.): *Enterprise and The Irish Economy*. Dublin: Oak Tree Press, 30–48.
Dutta, S., Lanvin, B., (Eds.) 2013: *The Local Dynamics of Innovation*. (online) Available from: www.wipo.int/edocs/pubdocs/en/economics/gii/gii_2013.pdf (Accessed October 2016).
eFluids. 2016: *Characteristics of Fluids*. (online) Available from: www.princeton.edu/~asmits/Bicycle_web/fluids.html (Accessed November 2016). Princeton, NJ: Princeton University.
European Innovation Scoreboard (EIS). 2016: (online) Available from: http://ec.europa.eu/DocsRoom/documents/17842 p.53 (Accessed December 2016). Brussels: European Union.
European Union. 2012: *Ireland's Economic Crisis* (online) Available from: http://ec.europa.eu/ireland/economy/irelands_economic_crisis/index_en.htm (Accessed February 2016). Brussels: European Union.
Fallah, M.H., Ibrahim, S. 2004: Knowledge spillover and innovation in technological clusters. *Proceedings, IAMOT 2004 Conference*, Washington, DC, 1–16.
Garvin, T. 2004: *Preventing the Future – Why Was Ireland so Poor for so Long?* Dublin: Gill and Macmillan.
Ghazal, R., Zulkhibri, M. 2015: Determinants of innovation outputs in developing countries evidence from panel data negative binomial approach. *Journal of Economic Studies* Vol. 42 No. 2, 237–260.
Handy, C. 1995: *The Empty Raincoat*. London, UK: Arrow Books.
Hilpert, U. 2016: *Routledge Handbook of Politics and Technology*. Devon, UK: Routledge.
Holm, U., Malmberg, A., Solvell, O. 2002: *MNC Impact on Local Clusters: The Case of Foreign Owned Subsidiaries in Sweden*. Working Paper Series, Institute of International Business. Stockholm: School of Economics.
Kennedy, K.A. 1995: Irish enterprise in the 20th century. In: Burke, A.E. (Ed.): *Enterprise and The Irish Economy*. Dublin: Oak Tree Press, 39–56.

Kitson, M. and Michie, J. 2014: *The Deindustrial Revolution: The rise and fall of UK manufacturing, 1870–2010*, Working Paper No. 459, University of Cambridge; Centre for Business Research.

Kugler, M. 2002: Externalities from foreign direct investment: The sectoral pattern of spillovers and linkages. (online) Available from: http://elsa.berkeley.edu/users/bardhan/e271_f01/nov5.pdf (Accessed October 2003).

Linhart, R. 1981: *The Assembly Line*. Translated from the French, by M. Crosland. Amherst, MA: University of Massachusetts Press. (Original work published in 1978).

OCDE. 2011: *Economic Policy Reforms 2011: Going for Growth*. OECD Publishing. (online) Available from: http://dx.doi.org/10.1787/growth-2011-en (Accessed October 2016).

Ogden, F. 1993: *The Last Book You'll Ever Read*. Macfarlane and New York, NY: Walter and Ross.

O'Gorman, B. 2007: *MNEs and New Enterprise Creation: Do MNEs Have a Direct Impact on the Amount of New Indigenous High-Tech Strt-Ups in Ireland*. PhD Thesis. London, UK: Middlesex University.

O'Gorman, B., Cooney, T. 2007: An anthology of enterprise policy in Ireland. In: Cooney, T. (Ed.): *Special Edition of Irish Journal of Management*. Dublin: Blackhall Publishing, 1–27.

O'Gorman, B., Donnelly, W. 2016: Ecosystems of open innovation: Their applicability to the growth and development of economies within small countries and regions. In: Hilpert, U. (Ed.): *Routledge Handbook of Politics and Technology*. Devon, UK: Routledge, 262–278.

Oughton, C., Landabaso, M., Morgan, M. 2002: The regional innovation paradox: Innovation policy and industrial policy. *Journal of Technology Transfer* Vol. 27 No. 1, 97–110.

Regional Innovation Scoreboard (RIS). 2016: (online) Available from: https://ec.europa.eu/growth/industry/innovation/facts-figures/regional_en (Accessed November 2016). Brussels: European Union.

Ridley, M. 2016: *The Evolution of Everything: How Small Changes Transform Our Word*. London, Great Britain: 4th Estate.

Scheerer, W. 2016: Technology and scoio-economic development in the long run: A 'long-wave' perspective. In: Hilpert, U. (Ed.): *Routledge Handbook of Politics and Technology*. Devon, UK: Routledge, 50–64.

Schumpeter, J.A. 1934: *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest and the Business Cycle*. Harvard Economic Studies Vol. 46. Cambridge, MA: Harvard College.

Schumpeter, J.A. 2003: *Capitalism, Socialism and Democracy*. Abington, UK: Taylor and Francis. (Original work published in 1943).

Schwab, K. 2016: *The Fourth Industrial Revolution*. New York, NY: World Economic Forum: Crown Business.

Simon, L. 2004: *Dark Light: Electricity and Anxiety from the Telegraph to the X-Ray*. Orlando, FL: Harcourt.

Smith, A. 1991: *Wealth of Nations*. New York, NY: Prometheus Books. (Original work published in 1776).

Walsh, B. 1999: What's in store for the celtic tiger? *Irish Banking Review*, Spring, Vol.1 No.1, 2–15.

Welter, F., Kolb, S., O'Gorman, B., Bugge, K.E., Hill, I., Peck, F., Roncevic, B. 2008: How to make regions (more) innovative. In: Fueglistaller, U., Volery, T., Weber, W. (Eds.): *Innovation, Competitiveness, Growth and Tradition in SMEs*. Papers presented to the Rencontres de St-Gall 2008, Beiträge zu den Rencontres de St-Gallen 2008, KMU-Verlag

HSG ISBN 10: 3-906541-26-6 ISBN-13: 978-3-906541-26-6. St. Gallen: University of St. Gallen, 440–464.

Zahra, S.A., Dharwadkar, R., George, G. 2000: *Entrepreneurship in Multinational Subsidiaries: The Effects of Corporate and Local Environmental Contexts*. Working Paper No.99. Atlanta, GA: Georgia State University.