The Role of FDI in Regional Innovation and Its Influence on the Emergence of Knowledge Spillover Effects

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Abstract Innovation plays a crucial role in regional development. There are a lot of ways how regional innovation could occur. One of them, important specially for less developed countries, is through foreign direct investment (FDI). Still, how these external flows of knowledge and innovation can influence regional growth and which policies are relevant to support them are not yet fully understood. This is especially important for CEE regions, which still show limited local knowledge and innovation endowment compare to European research area. We approached these issues by concentrating on the successful development of the automotive sector in Western Slovakia. Vast majority of companies in the sector are foreign owned, so the regional capabilities to utilize FDI as a most important source of knowledge and innovation are investigated. We chose the case study methodology based mainly on interviews with different actors in the industry. We showed the reasons and preconditions for the successful sector's development from adaptive to an endogenous innovation pattern. As result, evidence suggests that national policies' effectiveness very much depended on being tailored to regional and sector conditions for innovation creation or acquisition.

1 Introduction

Knowledge and innovation are considered to be key drivers of economic development. In a global world with a rapidly growing volume of knowledge and their complexity, it is almost impossible to create all the necessary knowledge for innovation within a single region or company (Krugman 1991). In other words, the ability to acquire knowledge from external environment and combine it with place-specific local resources is becoming the necessary precondition for successful innovation activities (Asheim and Isaksen 2002; NESTA 2010). One of the main external sources of knowledge is Foreign Direct Investment (FDI), specially

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Multinational Corporations (MNCs). Their global structures, networks and specific relations with their subsidiaries provide them better access to specific knowledge compare to domestic companies (Mudambi and Navarra 2004), leading to their better innovation performance (Criscuolo et al. 2010). However, regions differ very much in their ability to exploit available channels how to absorb knowledge from external environment (Capello et al. 2012).

From the theoretical perspective, this lead us to conceptual framework of "territorial patterns of innovation" enables us to understand the different modes of performing the different phases of the innovation process, highlighting the territorial specificities and preconditions that are behind different these modes (Capello et al. 2012). The concept identifies three main modes of using external knowledge to innovate depending mainly on ability of regions to produce or acquire the needed knowledge for innovation. We will look more closely on role of foreign direct investment, which is a key external factor influencing these flows, specially in countries like Slovakia. Several studies already confirm that FDI can ultimately be an important source of economic growth (Tiwari and Mutascu 2011; Driffield and Jones 2013), specially for Central Europe countries because of urgent need for restructuring (Ferenčíková and Fifeková 2006).The FDI function mainly in the role of transfer channel of knowledge and innovation, resulting in different spillovers effects to the host region.

Most previous studies concentrate on forward or backward linkages to domestic companies driven by FDI and the embeddedness of FDI in the local environment (e.g. Blomström and Kokko 1998, 2001; Meyer 2004; Javorcik 2004; Barrios et al. 2011). The vertical linkages in the Central and Eastern European countries as one of main recipient of FDI were also often analysed (Bosco 2001; Gorodnichenko et al. 2014; Jindra et al. 2009; Bučar et al. 2009; Havranek and Iršová 2011; Gentile-Luedecke and Giroud 2012) and some of them related also to automotive sector (Pavlínek 2004; Lábaj 2014; Pavlínek and Žížalová 2014). Considerably less attention is paid to inter-sectoral linkages from FDI as their importance is considered to be lower compare to other types of spillovers, mainly due to looser tights among different industries or their lower intensity compare to vertical linkages (Javorcik 2004; Nicolini and Resmini 2010). However, in case of FDI related linkages could play an important role (Kugler 2006). These studies brings very mixed results on importance of FDI, most of them found positive vertical spillovers, but for other types of spillovers are results more evenly distributed among positive, neutral and negative effects, concluding that the effects of FDI spillovers are usually depended on the specific factors as type of FDI, level of home or host country development or type of subsidiaries (Meyer and Sinani 2009; Narula and Dunning 2010).

Several studies try to investigate these factors influencing the spillovers (Blomström and Kokko 2003; Zhang et al. 2010; Nicolini and Resmini 2010) and have agreed than one of main factor could be consider the technology gap between foreign and domestic companies or absorptive capacity of domestic companies in broader terms, including the differences in technology, the institutional environment or human capital (Kokko 1994; Noorbakhsh et al. 2001; Iršová and Havránek 2013; Narula and Driffield 2012). The higher the differences are, the lower probability of spillovers. Another important factor is embeddedness of FDI (Phelps et al. 2003;

Mytelka and Barclay 2004; Masso et al. 2010) and several studies some studies show increasing embeddedness and spillovers in Central Europe countries, including Slovakia (Pavlínek 2004; Šipikal 2013; Domanski and Gwosdz 2009).

Special attention is given to role of FDI in innovation activities (Narula and Driffield 2012). In many host countries, the contribution of FDI to regional innovation is substantial compared with domestic contribution (Radosevic 1999). However, the empirical results of FDI effects are mixed. Some studies show a positive effects of FDI on ability of host countries to integrate in global value chains (Carlsson 2006), on mechanism of international technology transfer (Damijan et al. 2003) or on regional innovative performance (Cheung and Ping 2004). On the other hand, there are few studies referring the possible negative effects. FDI could crowd out the domestic technology or science oriented companies (Dyker 2001), increase the risk of technological lock-in by transferring their lower value-added production into host countries (Dunning 1994) or concentrate the sector in the hands of a few MNC with decision making outside the region (Rama 2008). Also regional specific characteristics (Rondé and Hussler 2005) as well as sectoral aspects (NESTA 2007) influence the ability to exploit FDI. The time also plays an important role; as FDI related R&D occur very often through the expansion of existing affiliates rather than through totally new investments or at least after some business experiences in host countries (Feinberg and Gupta 2004; UNCTAD 2005; Demirbag and Glaister 2010). All these suggest that real FDI impact could be seen in the longer term and that conditions during this evolution play a crucial role.

The aim of this chapter is to investigate the role of FDI as key channel of knowledge and innovation transfer in automotive sector in west part of Slovakia. Starting from the conceptual framework of territorial pattern of innovation (Capello et al. 2012), we investigate the role of FDI behind the upgrade of the automotive industry from an imitative to a creative adoption pattern of innovation.

From methodological point of view, mostly econometric studies (Damijan et al. 2003; Srholec 2009; Nicolini and Resmini 2010) or surveys (Javorcik 2008; Bučar et al. 2009) were used to investigate spillovers. Although these type of studies contribute to understand the scope and intensity of existing linkages, they usually do not offer a complete view of subsidiaries behaviour (Kennel 2007). To offer more complete overview, we used a case study methodology that enabled us to investigate in details interconnected linkages between different factors and actors of the innovation system to fully understand the impact of regional and sectoral characteristics on the creation, acquisition and implementation of knowledge and innovation. This allows us to be more precise to identify key elements of sector as well as region successful growth. By adopting both these perspectives, our qualitative case study focuses not on quantitative data or just single company, but rather on a specific and important sector within single region, analysing evolution of different stages of development with special attention to the role of FDI and it's different type of spillovers.

The rest of the chapter is organized as follows. At the beginning, we briefly describe the rationale for selecting this region and sector as well as used methodology. We continued with the sector's and region's development during the last two

decades. In the following part, we analyze this evolution from innovation pattern theoretical framework and try to identify the key local and external factors (with special attention to FDI as a key channel of knowledge and innovation creation and acquisition) that contribute to this evolution, including the support policies. Next, we discuss whether and how this mostly FDI driven development has influenced change of regional innovation pattern. At the end, we summarize some policy implications from this development.

2 Motivation of the Case Study and Methodology

The case study is interesting for two main reasons. Firstly, the region and the sector has experienced successful development in the last two decades. From basically non-existence of the sector in 1990, Slovakia has become the number one car producer per capita in world (Pavlínek et al. 2009), mainly due to three top level car producer: Volkswagen Slovakia (VW) in Bratislava; PSA Peugeot Citroën Slovakia (PSA) in Trnava and Kia Motors Slovakia (KIA) in Žilina, expecting fourth final car producer Jaguar Land Rover to start production in 2018. Furthermore, auto-components companies have increased the volume of their production more than tenfold within the last 10 years and their turnover is comparable to turnover of manufacturing plants of final car producers in Slovakia. The sector is today also key industrial sector in Slovakia, representing more than 30% of industrial production in Slovakia and generated more than 11% of value added directly or indirectly (Luptáčik et al. 2013). Despite the fact that Central European countries like Slovakia were supposed to concentrate on the labor intensive and most cost-sensitive segments of the automotive production value chain (Šipikal and Buček 2013), country has achieved higher degrees of industrialization, remarkable industrial upgrading and higher economic growth rates than some core economies of Western Europe (Pavlínek et al. 2009).

We analyse the west part of Slovakia, which includes two NUTS II regions—Bratislavský kraj (Bratislava) and Západné Slovensko (Western Slovakia). These NUTS II regions achieved remarkable growth in the last two decades compared to other European Union regions. The Gross Domestic Product (GDP) per capita in Purchasing Power Standard (PPS) in the NUTS2 region of Bratislava increased from 108% in 1999 of the EU average to 184% in 2013 and in Western Slovakia region from 48% in 1999 to 71% in 2013 (source: Eurostat). However, the knowledge and innovation activities measured by most used indicators as R&D spending, share of researchers or number of patents have been substantially lower compared to other Western Europe regions with a similar GDP level. For example, Bratislava region reached only 9.4 high tech patents per million inhabitants in 2008 (0.4 in Western Slovakia) and 23.39 patents per million inhabitants in 2008 (2.34 in Western Slovakia), much lower than in most of Western Europe metropolitan regions. On the contrary, the neighbouring NUTS2 to Bratislava—Austrian region Burgenland with GDP level around 75% of EU average, reached 76.39 patents per million

inhabitants. The situation has been improving over the time, but very slowly. In 2011, Bratislava still have only 32.08 patents and western Slovakia region only 7.07 patents per million inhabitants (source: EUROSTAT).

Secondly, vast majority of the companies in this industry is owned by foreign parents, mainly MNC. In most of the previous studies investigated the role of FDI in vertical and horizontal spillovers to domestic companies (e.g. Blomström and Kokko 1998; Pavlínek and Žížalová 2014; Kolasa 2008; Giroud et al. 2012). This case study shows the process of new industry creation and development nearly entirely based on firms external to the region. Instead of foreign to domestic linkages, whole industry is relies on "foreign to foreign" linkages. Due to non-existence of domestic companies the spillovers effects to them within the sector are basically at a zero level. However, this underlined the importance of inter sectoral linkages and the spillovers among FDI and all kind of public sector institutions as the main external knowledge and innovation sources into the region (Šipikal and Buček 2013). We try to show that environment itself (domestic companies in other sectors or knowledge based intensive services) with adequate support policies could change the innovation pattern within the region and lead to upgrading the innovation and productivity capabilities.

For inter-sectoral linkages, it is important that FDI comes from more innovative sector. From this perspective, the automotive sector is amongst the largest in R&D spending in the European Union. Total investment for research and development in the categories 'commercial vehicles and trucks' and 'automobiles and parts' reached nearly 45€ billion investment in 2015 (EC 2015). The actual investment and impact can be even multiplied, as these categories do not cover all automotive service or supplying industries. The development of patents applications registered by the sector underline the industry's innovative performance as well. In 2014, almost 14,600 patents were registered by this sector (EC 2015), number more than doubled from 2008 (EC 2009). All these figures suggest the decisive role of FDI in the local automotive industry in upgrading the innovation performance of the sector within the region.

We used qualitative case study methodology in the research. Data were mainly collected from a several personal interviews conducted with relevant actors. Together we interviewed 11 companies in the sector, dominantly foreign direct investors. We interviewed companies from small tier 3 firms at the bottom of the value chain through first level suppliers to final car producer. It was complemented with interviews at universities, research centers and other support organizations at the regional and national levels. Most of the interviews were held in 2012 and 2013, with some following questions later. Additional information was collected from official statistics, telephone interviews, existing studies, websites and other written official or internal materials of companies or institutions (specially their annual reports).

3 The Evolution of the Automotive Sector

After the collapse of the communist regime at the end of the 1990s, the automotive industry in Slovakia virtually did not exist. At that time, Volkswagen started a joint venture company for automotive components production with a Slovak company "BAZ" (Jakubiak et al. 2008). Due to uncertain development in Central Europe after regimes changes, foreign investors usually started with a low volume or bottom end value chain production (Pavlínek et al. 2009), viewed region as place for production, not research (Pickles et al. 2006), as it was also the case here.

The whole sector has undergone dramatic changes since then. The automotive production value rose from EUR 620 m in 1998 to EUR around 12,600 m in 2014 in the whole Slovakia, peaking at 13,682 m EUR in 2008 (Statistical Office of Slovak Republic). Vast majority of production has been produced in Western Slovakia. Slovakia has become the number one car producer per capita in world (Pavlínek et al. 2009). In 2016, VW ranks number one, KIA number two and PSA number six among biggest companies in Slovakia from all sectors based on their revenues (source: www.finstat.sk). Now, there is more than 300 firms in the automotive industry, but most of them foreign. From Top 50 companies in 2016, only one was domestic (source: www.finstat.sk). This increasing concentration of the production of the automotive sector in CEE has led to the increase in external economies of scale (Pavlínek et al. 2009). For incoming investors, the possibility to have several customers or suppliers within a "just in time" distance was very attractive. It was very good precondition for strengthening their competitiveness by enabled them to have only one production plants for several of them. As stated in an interview with Tier 1 supplier:

> We came here to supply VW. Now, VW counts for only 25% of our turnover. We have several other customers in the region, some in other sectors and large part of production is also exported. Today, we are here, because the place has good logistics and labour force.

This positive development of the automotive sector in Central and Eastern Europe was confirmed by several studies (Lorentzen et al. 2003; Pavlínek et al. 2009; Hardy et al. 2011). Although the key product innovation and implementation production decisions were still decided outside of the region, some shifts can be observed. This was mainly increased autonomy for subsidiaries on the side of MNCs and change from defensive low cost strategies to strategies associated with knowledge and innovation seeking as well as an introduction of aftercare programs on the side of public sector (Hardy et al. 2011).

Evolution has occurred also from spatial point of view. At the beginning, sector was established only in Bratislava. In the 90s, the sector production facilities spread also to other regions, but still was remain highly concentrated in Western Slovakia with around 60% of all employment and 70% of the production of the sector at the national level (Šipikal and Buček 2013). Now, more and more companies have started production also in less developed regions of Central and Eastern Slovakia.

Several specific factors contributed to the high inflow of FDI. One of them was the geographical proximity. This proximity works in two ways. Firstly, Western

Slovakia was very good connected to the main Europe car markets allowing to export to them quite easily. Secondly, it was a very good complementarity of these two neighboring regions in terms of FDI needs. The Bratislava is a metropolitan region with strong urbanization effects (Buček et al. 2011) and one of the most developed region in Europe in terms of GDP per capita (186% of EU average, source: Eurostat), characterized by a well-diversified economy with good public research infrastructure (including public universities and research centres), skilled and qualified work force and many supporting organizations (including the sector of KIBS). Western Slovakia was one of the less developed regions with GDP per capita under 60% of EU average at the beginning, but with a lot of qualified and very cheap work force in the engineering and army industry from previous regime. This combination of quality and productivity/price ratio of work force together with relatively lower living costs and the proximity to the Bratislava region and its advantages and services enabled Western Slovakia to attract a critical mass of foreign investments, mainly in the automotive industry. This leads to the strong specialisation of Western Slovakia on the automotive industry. The accession of Slovak Republic to the European Union represented a further important opportunity for the sector's development, with the access to the whole European Union market without tariffs or trade limitations on exported production volumes (Šipikal and Buček 2013).

A special feature of this industry in Slovakia is its market diversity. While Volkswagen is oriented top-end cars, PSA Peugeot-Citroën assembles middle-class cars with orientation more on Central and East Europe market and Kia Motors has only factory in Europe here and produced lower-class models. Another final car producer Jaguar announced its investment, again with different type of car production. Moreover, car component producers are interconnected and often supply to not only carmakers in Slovakia, but also several carmakers abroad (mainly Hungary and Czech Republic) or even to other industries. This may be one of the reasons why the sector also has relative successfully managed to cope with the economic crisis.

The automotive has become also dominant among industry sectors in Slovak Republic. Three companies of the sector are among top ten companies in the country according the revenues. All of them are MNC, confirming dominant positions held by foreign firms. Except FDI in the final car production, the foreign subsidiaries are dominant also in the supplier sectors (specially in manufacture of engines, car electronics, cable harnesses and gears). For domestic enterprises is still very difficult to enter the even in the bottom level of value chain of the industry. In fact, first level suppliers are multinational foreign owned companies, while few domestic companies can be found among next levels of suppliers (Šipikal and Buček 2013), leading to depended market economy model (Nölke and Vliegenthart 2009). This is also consider as one of the main weaknesses for future development of the sector as well as region (Šipikal 2013; Pavlínek 2015).

All these preconditions were supported by strong government policy to attract FDI. In case of Slovakia, government investment incentives were "very aggressive" and could (mainly through infrastructure projects for investors, tax holidays or investment incentives) have important impact on the localization decisions of

MNC (Pavlínek et al. 2009). These measures were additionally complemented also by some support activities at a regional level (Šipikal et al. 2010). As several other studies shows (Pavlínek et al. 2009, 2016; Šipikal and Buček 2013), all above mentioned elements through FDI finally enabled the successful integration of Western Slovakia into the European automotive production system.

4 The Dynamics of Innovation Patterns

The innovation dynamics has evolved in a similar way to the sector itself. Based on concept of territorial patterns of innovation, Western Slovakia represents an imitative pattern of innovation (Capello et al. 2012) at the beginning of the industry development during last decade of previous millennium. The detailed theoretical concept of flow of knowledge and innovation is showed in Fig. 1.

Imitative innovation pattern relies on territorial attractiveness to FDI as a source of innovation in the region. The Western Slovakia was in the same position and nearly all knowledge and innovation was acquired through established foreign multinationals corporations. Development at the local level in terms of knowledge or innovation creation was the result of a passive reception of innovations from the environment external to the region.

As result, nearly all decisions about innovation, including product series or process technologies, were conducted outside the region. At this time, parent MNCs made decisions on nearly everything in the subsidiaries, even the basic production processes functionality was implemented by labour force from parent companies. Research activities were fully concentrated in parent companies. As summarized in the interview:

> At the beginning, we invested there just as market opportunity. Only few years after the collapse of the soviet bloc, we really were not sure what to expect there and it was related not only to political stability, but also to the quality of workforce and the business environment. Our Austrian technicians came here every week to set up and control crucial production processes, so we did not even think about research there.

Established subsidiaries were integral part of their own knowledge, innovation and production foreign networks with nearly no linkages with local environment. Even the mutual links among the foreign automotive companies were very limited. As an interviewee with production manager from one of subcontractor's reported:

> Customer centres allocated in several regions were responsible for the contact with clients. For example, the centre for Suzuki, which had factories in Hungary, was located in the Bratislava region. On the contrary, the customer centre for Volkswagen, where the biggest part of our production in Slovakia is supplied, was located in Germany. Neither of them had any interaction within the region.

Also the public sector did not play any positive role in innovation activities. There were nearly no regionally specific, but internationally recognized, research in public

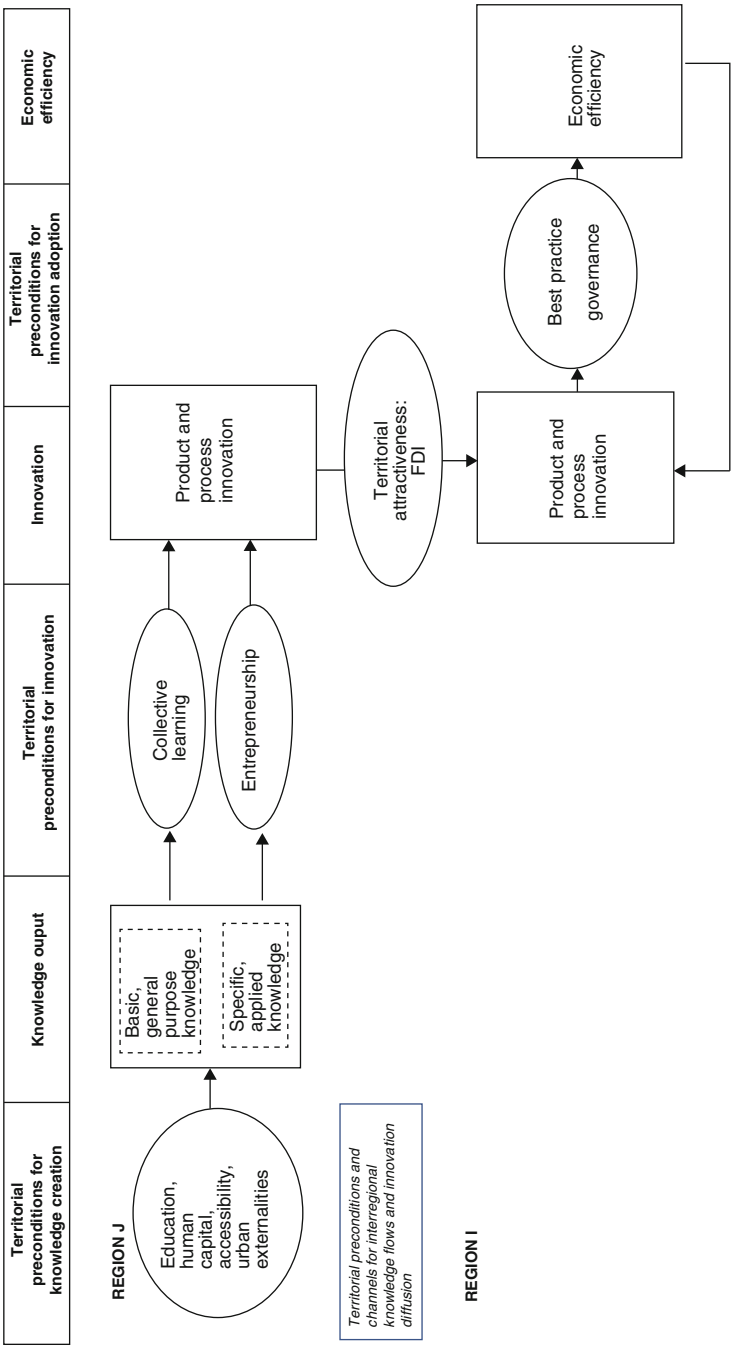

Fig. 1 Original imitation innovation pattern. Source: Capello et al. (2012)

universities or research centers which could be seen as a contribution of the region to international knowledge creation in the relevant fields of automotive sector.

However, this *"pattern is not necessarily the less efficient innovation pattern"* (Capello et al. 2012). Territorial attractiveness with adequate preconditions (mainly skilled and cost effective labour force and aggressive support policies in case of Western Slovakia), has led to huge inflows of FDI to automotive sector, resulting in high industry growth in the region and consequently in high economic growth of whole region.

At the beginning, innovation design, development and implementation were exclusively tasks of parent MNCs. The task of the subsidiaries was only smoothly executed these prepared innovations. Due to cost effectiveness, many foreign companies started to shift the whole production into regions like Western Slovakia, while still keeping research in their parent countries. However, certain kind of research activities needs experiences from production processes or testing on devices directly used in production. Since the whole production was relocated apart from home countries, it was necessary for the firms to transfer a substantial proportion of their R&D tasks to their subsidiaries (Šipikal and Buček 2013). This reallocation also required to change organizational structure and establishment of specialised units within subsidiaries responsible for the development of R&D. As CEO of one of automotive suppliers reported:

> Higher involvement in innovation activities compared to the past is related to the progressive labour force improvement as well as to knowledge acquisition directly from the production process. This shift was more visible mainly after production cancellation directly in the company head office. The development of new products without a direct possibility to examine some of the items in the production process cannot be fully done in the parent company and, therefore, started to be partly executed in this plant. In the last year, this plant also introduced its own innovations based on its own patent protection solution, which was previously the domain of the parent company. The firm also uses the system of innovatory movement for the moderate improvement of production processes. Tacit knowledge from the direct experience of production process plays a key role.

Experiences from production process also contribute to higher involvement of people from subsidiaries in global network as they became members of the different international teams of their parent companies. This consequently increases their own knowledge and abilities to contrive and develop innovative solutions.

Process innovations were also strongly demanded by management of subsidiaries. The main role of Slovak subsidiaries within the global value chains has been the efficient production of allocated products. The knowledge acquisition from the production process and its improvement represents for management of local companies a key success factor.

Above mentioned facts leads to a clear division of innovation activities between parent firm and subsidiary. The subsidiaries have started to be strongly involved in the process innovations and, in certain cases, have gained partial autonomy in these processes. Supporting the fact that subsidiaries' age (Gentile-Lüdecke and Giroud 2012) and higher degree of autonomy (Birkinshaw et al. 1998) are positively related to the volume of knowledge and innovation transfer, MNCs gradually developed

confidence in the knowledge and innovation creation abilities of their local suppliers and subsidiaries.

These types of innovations primarily rely on information from internal sources about the process of production, so they are very hard to be captured by typical measures of innovation output such as patents or R&D indicators. This could explain why regions like Bratislava or Western Slovakia shows lower innovation activities, measured by traditional indicators as patents, compare to their economic performance measured by GDP. However, despite not being measured, 'hidden' innovations are very important for companies in this very competitive industry. As confirmed by an interviewee responsible for process innovation (Šipikal and Buček 2013):

> Product innovation is handled within the head office. Any idea oriented to these innovations which will arise in Slovakia is automatically shifted to the head office. The firm has opened departments in Slovakia which are focused on process innovation. At the same time, the firm mainly uses own internal programme, in the framework of which we are implementing innovative activities suggested by employees. These activities generate savings of approximately 10 m EUR per year. Within this system, we implement more than 6000 small process innovations per year. Innovative improvements are consistent with the strategic targets of the factory and there exists also an ongoing comparison with other subsidiaries of the parent company.

This could be also one of the reasons why regions as Western Slovakia have lower traditional innovation output (e.g. number of patents) despite of a quite frequent innovation activity within industry, if we consider innovation as a continuous upgrade of products and specially processes that leads to improvement of economic performance of company, not only as research related activities. Several interviewed firms confirm this scenario of the continuous implementation of innovation within them, which are not a result of internal R&D activities.

Moreover, as several companies mentioned in interviews, intellectual property rights system does not offer the necessary benefits regarding process innovations. These innovations are closely interconnected with concrete production facilities of the company, so they do not usually plan to sell these achievements to competition or companies from different sector. This make the patent protection only administrative workload without any planned benefits. On the contrary, there are some negative aspects. One of them is the risk of patent abuse by the competition, specially out of European Union, where the enforcement of patent protection is very low. Finally, the process innovation requires tacit knowledge from production processes and it is very difficult to transfer them into patents. As mentioned by CEO of one of KIBS in the interview:

> We did some patents application for process innovation before, but it doesn't help us very much. For each customer, the solution is unique, so we must adjust our solution every time. On the other hand, we have no chance to find out if someone else used our solution or not. It's not visible on final product and we cannot goes to the factories and look at their production processes.

All above mentioned processes, mainly including creation of external linkages, diversification of innovation activities and demand driven upgrade of public research

centres and universities, has led to gradual shift from *"imitative innovation pattern to a creative application innovation pattern"* (Šipikal and Buček 2013). As shown the Fig. 2, innovation activities within this pattern lies on the combining of external knowledge, incoming from linkages with external regions, with local specialised knowledge in the regional economy (Capello et al. 2012).

The presented shift very much helps also during the 2008–2009 economic crisis. At first, it led to a substantial decrease (19.2%) in the sector's output following by similar decrease of output in the supplier industry. There were 13 bankruptcies, closures and relocations abroad in the Slovak automotive industry during and immediately after the economic crisis. Nine of these involved the labor-intensive assembly of cable harnesses, an area especially sensitive to labour costs (Pavlínek 2015). However, in 2013 all total numbers for whole sector were back and sector is now stronger than before crisis. The specialization on process innovation could play a role why sector, despite of economic crisis and excessive capacities of the industry in Europe, still raise. It looks like economic crisis prioritizes the effectiveness of the production process.

5 The Factors Behind the Change

However, the change of the innovation pattern has occurred under certain conditions that have led to successful transformation of the innovation pattern in the region. From theoretical perspective, the main advantage of the regions in upgrade of the innovation pattern is usually considered the human capital (Capello et al. 2012) and this was confirmed also in this case. The labour force played a key role in attracting of FDI flows (Šipikal and Buček 2013), with a competitive position in all important areas—availability, quality and wage level of labour. Especially a great availability of workforce after collapse of many state owned engineering and defense industry companies after velvet revolution leads to excessive supply of qualified workforce. Human capital represents the important factor of knowledge acquisition or creation also in later stages of the development, because it plays a decisive role in region's ability to create, acquire or implement process innovations. The quality of this capital allows to understand highly advanced multinational companies production processes and even to propose additional upgrades or improvements. This is the case of manpower working directly in the production as well as intermediate management. Specially abilities of management in the field of production and organisational innovation seems to be very important for successful innovation upgrade of companies, which result in higher efficiency and production flexibility.

The improvement of the human capital was also partly happened thanks to established foreign multinational companies. Most of them had visiting programmes and on regular basis sent their managers and employees from Slovakia to their head offices or international training centers for acquiring new knowledge. Another frequently used practice was participation of employees from subsidiaries in centrally planned innovation activities or R&D projects as a part of international teams.

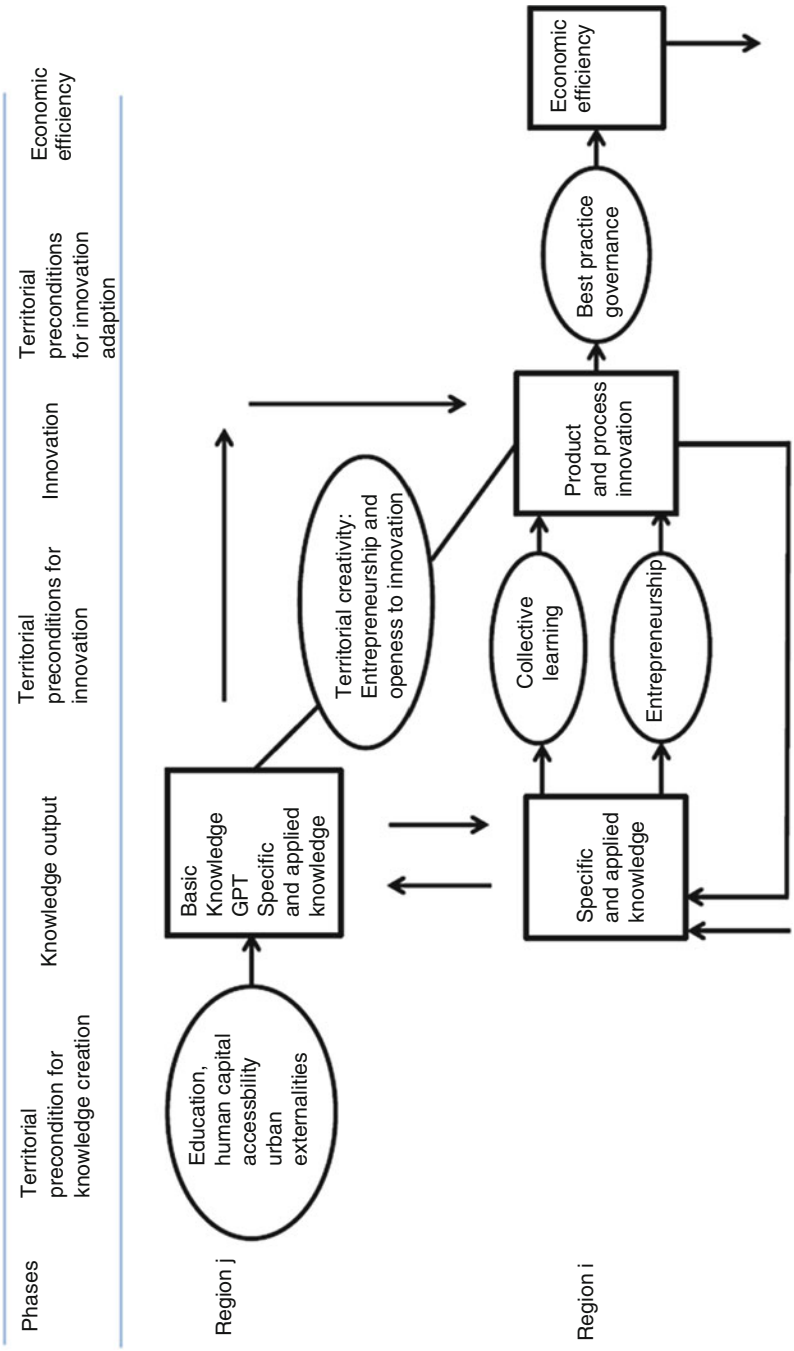

Fig. 2 Present innovation pattern in the region of Western Slovakia (automotive industry). Source: Šipikal and Buček (2013)

This was also important part of mind changes of the local labour force, lead to better understanding of the purpose and necessity of innovation. These activities were carried out in spite of the risk that part of the labor force subsequently remained abroad and had to be replaced, because those who stayed remarkably contributed to improvement of innovation processes within subsidiaries. As mentioned in interviews (Šipikal and Buček 2013):

> We have been regularly sent employees to our other branches. Some of them remained abroad and never came back, but still help our company in other positions there. But those who's came back are very important for us, because they came back with much more positive attitude toward innovations. We are not sure why, but it's probably because they left routine, experienced new people and equipment and feel privileges that company gave them these opportunities. But numbers has showed important increase in their innovation suggestions after their arrival from abroad experience.

It looks like this short-term inter-regional migration was much more important in the upgrade of innovation pattern compare to intra-regional migration (Šipikal and Buček 2013). According to the interviews, the intra-regional migration has insignificant influence on knowledge or innovation activities of local companies.

The key benefit of this short term programmes within these companies was a dramatic change of perception of knowledge and innovation creation or acquisition and their role to improve or maintain competitiveness of local firms. The employees in the socialist establishment did not consider their role to be actively involved in the development or innovation of the enterprise. After they saw the employees from their parent companies, they perception usually changed. This has gradually led to the formalisation of the innovation process within companies. Although the important role of knowledge and innovation for competitiveness has been recognized, there was no formal structures of innovation management within organizational structure of firm. Companies usually did not have a special department or responsible manager directly oriented on innovations. Currently, situation is quite different. Vast majority of firms have a sophisticated supporting system of knowledge and innovation creation and implementation. However, the more internationalized and multinational a company is, the more detailed this system is and the more it is connected to the strategic planning and firm management (Šipikal and Buček 2013). We observe two reasons for it and both are result of more developed organizational structures within multinational companies. Firstly, they pay much more attention to measure achieved improvements from implementation of proposed innovation activities and evaluation of their impact on economic performance, productivity, or employees' satisfaction are more integrated into company managerial decisions. Secondly, their internal system to support employees to suggest innovation suggestions improvement is much more elaborated and with better and tailored motivation tools. Several companies in the interviews confirm the fact that improved system lead to much higher innovation activities from employees compare to the past.

Higher formalization of R&D activities also occurred in the form of new research departments, occasionally as new R&D centres. These activities have also stimulated creation of new knowledge, but their role in the innovation activities is still quite limited in the region and only very few of them are in Slovakia (Švač 2010).

Reallocation to Central Europe countries is more oriented on applied "routine" research and development, while basic and product research or radical innovation usually remain allocated in parent and centralized R&D centres of foreign multinationals (Pavlínek et al. 2009). The investment in R&D has increased over the years. In 2012, total value was more than 29 Mil. EUR, several times higher amount than few years before and it represents 6% of total private R&D spending in Slovakia (Luptáčik et al. 2013). Regarding the tasks of these centers, two-thirds of them in Central Europe are located together with manufacturing plants (Pavlínek et al. 2009), so we could expect incremental and applied R&D related to process innovations at these centers.

The one way flow of innovation and knowledge flows at the beginning has changed to bidirectional and complementary. Subsidiaries no more only acquire innovation from their parent MNCs, but also contribute to enlarging the knowledge base of their MNC's headquarters. Foreign investors built 1062 new plants in Central and Eastern Europe during 1997 and 2009 and 121 from them in Slovakia (EY 2010). All these factories located here continuously develop and accumulate important knowledge about the production processes and could significantly contribute to future product and process innovations within whole production network of MNCs. Therefore, also other supporting firms in the region as universities or KIBS are mainly focused on innovation activities aimed to improve the efficiency, logistics or fluency of production processes. They are concentrated on process and product innovations including new tools and devices for production, new types of materials used in their production processes, new software for production logistics to find out the ways that the current production would be more quick, economically, easily, or with the lower level of waste (Šipikal and Buček 2013).

Very important role played a support policy, especially from national government. At the beginning, support was massive and mainly in the form of investment stimuli. These incentives can be considered as aggressive. Moreover, they could strongly affect the new plants' location (Pavlínek et al. 2009). Only three final car producer companies (Volkwagen, PSA Peugeot-Citroën and KIA Motors) obtained more than 700 million euro of state aid (Šipikal and Buček 2013). Many foreign suppliers including companies like Deplhi, Hella, Getrag Ford, Mobis, Eismann, Sachs or Continental which followed those MNCs also obtained investment incentives. The tax allowances, grants for newly-created work positions, land and infrastructure provision were most common stimuli provided by the national government (www.statnapomoc.sk). The initial concentration on the generation of a critical mass of FDI rather than on the higher value added or R&D foreign investment was critical for the future success of the region's development (Šipikal 2013). This stress the role of a close relationship between two traditionally separated policies—innovation policy and FDI promotion policy (Guimon 2009). A majority of industry consists of foreign investors which are on higher technology level than local companies of local public sector, so they are usually not interested in cooperating with them if not properly motivated, so some new policy measures were introduced as sector progress over the years. Most of the them are no longer related to the support of territorial attractiveness (Šipikal 2013) The government introduces new support

R&D activities and special support for creation of specialised competence centers at universities focused on the specialised areas of R&D with obligatory participation from private as well as public sectors (Šipikal 2013). However, policy must continuously adjust to remain competitive. Long-term investment in human capital (technical higher education, dual vocational training system), measures for supporting networking, creativity and knowledge creation seems to be very important for maintaining and improving the competitiveness of companies based in Slovakia in the sector and it is crucial for the increase in value-added production activities (Šipikal 2013; Pavlínek 2016). This strongly support the theoretical framework of pattern of innovation as well as other similar approaches like smart specialization, highlighting the need to adjust innovation policies to the current level of sector and region innovation development to achieve successful economic growth (Foray et al. 2009; Capello et al. 2012; Šipikal 2013).

The critical mass of FDI play also crucial role. Critical mass is important to stabilize the whole system and allow to create synergy effects (Szanyi et al. 2010). We already mentioned that more than 300 companies are active in automotive. *"Increased concentration of automotive production in Slovakia led to increasing external scale economies which improved the competitiveness of Slovak based automotive subsidiaries (Pavlínek et al. 2009)"*. This is one of the main differences compare to other analysed sectors, where FDI were isolated with difficulties to find adequate partners (Capello et al. 2012). Without critical mass the pressure was not strong enough to change the behavior of universities or other domestic companies.

All these factors influence the shift of automotive industry in Western Slovakia from imitative innovation pattern to creative innovation pattern. Table 1 summarizes the key factors influencing this shift.

However, one of main question now is question of sustainability of this development. The region remained only in imitative pattern with territorial attractiveness would be vulnerable to MNCs decisions in long term, also never able to achieve the wages of most developed regions, otherwise it will lost the attractiveness for MNCs. Also the flow of FDI based only on territorial attractiveness may become stagnant or declining over the time. This development can be partly observed in the automotive sector in Bratislava and Western Slovakia regions (Šipikal and Buček 2013). At the beginning, FDI inflow was very strong and most of the growth was achieved by the

Table 1 Main factors influencing the innovation pattern shift

Key factors for FDI inflow and upgrade	Main advantages allowing upgrade
Human capital	Quality and availability of workforce Favorable cost/productivity ratio
State policy	Very aggressive policy towards inflow of FDI Strong investment stimuli
Institutional factors	Upgrade of public institutions Membership in the European Union
External factors	Achieving critical mass of FDI Division of labour between parents and subsidiaries

Source: Own

establishment of new foreign companies. Gradually, the expansion of existing companies become more relevant compare to new entries. Currently, both processes are much less intense, mainly due to lack of adequate workforce and general increase of wage level. However, the FDI positive effects expand to neighboring regions of Slovakia, with two new final car producers KIA (in Central Slovakia) and Jaguar (in east part of Western Slovakia) established, followed by several of their sub-suppliers. Productivity increases and higher value added production look like the most probable way how to achieve sustainable future growth. However, not only territorial attractiveness is required, so needs for innovation and knowledge creation arise. The mentioned process innovation activities could be one of development path, but region must intensively seeking for other possibilities for productivity and value added improvement.

6 Spillovers to Local Economy

One of the main questions in this case study is if region or sector is able to use FDI for benefits of local economy. We discussed change of innovation pattern and the most relevant factors behind this successful innovation shift. However, nearly the whole automotive industry consists of foreign investors and most of the innovation and knowledge flows involve only foreign firms, especially large MNCs, and the empirical evidence confirm a small spillover effect to domestic companies in case of automotive sector (Lábaj 2014). This creates the danger of dual economy (Narula 2015). This suggest that the interaction between foreign companies and the local environment is crucial for local innovation performance in the future. It is also important for the ability of region to build and reinforce endogenous innovation capabilities. In other words, there are some processes whose strengthen ties between MNC's and region which will either support the embeddedness of these companies or the development of related industries of public institutions (Šipikal and Buček 2013).

Because very low presence of domestic companies within automotive sector, the inter-sectoral linkages seem to be key channels of knowledge and innovation flow to regional economy. This was confirmed also by survey done by Ferenčíková and Fifeková (2006) showed that indirect technology transfer was much more common than direct transfer. There are at least two good preconditions for it. First, The industry is one of the most innovative industries in Europe, as we already argued before. Second, automotive sector multiplier is one of the highest among industrial sector in Slovakia. Multiplier of value added had rose from 0.17 in 2000 to 0.39 in 2008. Output multiplier was 3.82 in 2011 (Luptáčik et al. 2013). Therefore, through multisectoral suppliers, these two preconditions allow possible diffusion of innovation to other sectors. As observed from interviews, process innovations already spread to other industries, mainly chemical, engineering or electronics. Some formalized cluster initiative also occurred, but usually only able to cooperate in the field

quality of labour force or vocational training, not innovation activities (Zamborsky 2012). Another diffusion possibility are knowledge intensive business services. Bratislava region is a highly urbanized and diversified region with lot of KIBS which are very active engaged in innovation activities in the region. Therefore, the automotive industry strongly influences regional development and innovativeness of the region. However, still large part of it spreads outside the country, output multiplier without export was only 1.54 (Luptáčik et al. 2013). Several interviews confirm diversification in such a way, here the one example interviewed the head R&D of company:

> We found out increasing pressure on more effective process innovation. Firstly, we used our internal R&D capacities to improve our own technologies to be more competitive for automotive sector. Later, we established the new division of industrial automatization, which was responsible for process innovation. This division becomes very successful and it's production is now oriented not only on process innovation in automotive, but also in other sectors like chemical and engineering. Now, this division counts for 50% of our turnover.

Additionally, the multinational companies pushed for the evolution and improvement of the public sector in the region. They bring world class knowledge and innovation and require the same from possible partners within the region, so this competitive pressure "forced" the public institutions to "catch up" in order to be able act as a partner of the foreign companies Several public institutions have been able to at least partly fulfill their requirements. This cooperation between all governmental levels and the higher amount of public sector organizations promotes the continuous improvement of innovation capabilities at the local level. For instance, leading technical university in Slovakia, STU in Bratislava, used EU structural funds for two projects related to automotive industry to improve its R&D capacities (Šipikal and Buček 2013). The orientation of towards innovations are for example towards green cars, weight reduction, intelligent vehicles or software components (Babeľová et al. 2010). STU has also good cooperation with automotive sector in the field of labour force education (Zamborsky 2012). As mentioned in the interview with university:

> If we want to improve our research qualities, we must concentrate on cooperation with private sector. Due to present division of labour in automotive sector—these companies are mainly interesting into cooperation in increasing the production effectiveness, so we concentrated our projects and research on these issues.

The improvement of public institutions is an important condition for a future upgrade of the region towards endogenous innovation pattern (Šipikal 2013). As mentioned in interviews:

> Foreign companies were not very interested in cooperation with us. We need to implemented several projects that improve our technology and tried to focus the projects on very specific issues that interested them. This improves our cooperation, but still we see a lot of space for our improvement. These projects are very difficult, because MNC are very demanding.

This cooperation is vital for regional public research institutions abilities to create and acquire new knowledge or innovation as key preconditions for shift in

innovation pattern. As in previous upgrade, the critical mass is important, in this case not the FDI investment, but investment into specialised research in the public institutions (Šipikal and Buček 2013), probably connected to only certain fields as e.g. process innovation, which will allow region to perform research in these areas at the international level. This is necessary preconditions to foster cooperation with MNCs and embed existing ones in the region. This "second level of threshold" investment will be key to further upgrade of innovation pattern in the region.

The specific tacit knowledge necessary for process innovation in the automotive industry has been applied to generate new knowledge in other sectors, mainly through knowledge intensive business services (Šipikal and Buček 2013). Such spillovers are much more even more likely to occur outside the sector, specially due to the strong innovation performance of the automotive sector, which is significantly higher than for other industry sectors in the region. As one KIBS stated:

> We created a production process software support for automotive company in cooperation with this MNC. The knowledge we got during this cooperation led us to ability to successfully apply modification of this software in several non-rival sector in the region.

Without strong FDI, the KIBS will be never able to achieve that level of abilities themselves. The automotive FDI as one of most competing sectors push the local companies to the word class activities. This was one of the main differences when comparing other interviewed sectors. In them there was no such pressure from FDI, mainly because FDI were quite isolated in these sectors and domestic companies still play an important role. For example in wood processing sector, KIBS or universities cooperate mainly with domestic companies, but this cooperation lead only to incremental innovation activities compare to automotive sector, even both sides were more less satisfied with this cooperation.

However, the "embeddedness of FDI" is still much more in the way of "foreign to foreign" linkages and one of main future issues will be question if such type of embeddedness could survive possible "domino" effect if some of automotive companies will decide to leave the country or these linkages are strong enough to prevent them to do so in most of cases.

7 Conclusions

This case study investigated at the knowledge and innovation patterns that has been developed in the automotive industry in western part of Slovakia over last 15 years. Special attention was given to foreign direct investment. FDI proved to be the main channel of knowledge creation and acquisition and the one of main key factor of successful sectoral as well as regional innovation shift. Compare to some other studies (e.g. Simmie and Martin 2010), FDI play very positive role, so the crucial question is related to factors and specific context preconditions that can positively influence the role of FDI (Šipikal and Buček 2013).

We identify several main reasons for this successful upgrading innovation pattern. Firstly, FDI inflow was very much influence by human capital. At the beginning, it played decisive role in the ability of the region to attract new foreign companies. The labour force was very skilled and able to reach very good productivity comparable to costs. Human capital also influences regional ability to implement autonomously process innovations within companies. The role of process innovation, strengthening by production reduction or cancellation in the parent companies, became one of the main driving forces of the industry upgrade and lead to the clear division of tasks between the subsidiaries and parent companies and consequently, to increasing specialization in specific types of knowledge generation (Šipikal and Buček 2013). This is not only the case of Western Slovakia, similar orientation in the automotive sector was found in the Czech Republic (Pavlínek and Ženka 2010). The process innovation orientation could also help region to overcome economic crisis as importance of the efficiency of production increase during crisis. Another important factor was the achievement of a critical mass of FDI in the sector resulting in external economies of scale which improved the competitiveness of the industry. The aggressive government policies played important role in this process, especially in the beginning of whole transformation. The gradual institutionalisation of the innovation activities in all types of companies in the region, including MNCs and local suppliers, created a functioning systematic process of continuous improvement that led to sectoral and regional growth. To summarize, we showed that region used its own combination of different conditions and actions (e.g. adequate infrastructure, human capital, appropriate support policies to achieve critical mass of FDI and proximity to market) to achieve regional ability for knowledge creation and exploitation in specific part of innovation process.

This support the conceptual argument that regions like Western Slovakia could not have necessarily much worse innovative performance than Western European regions (Capello et al. 2012), as it looks when we compare traditional innovation indicators. Only because the innovation processes are divided according to the regions and sectors, they are just focused primarily on process innovation (Šipikal and Buček 2013).

Availability of universities and other public research centers, KIBS and specially extensive automotive supplier network could help to maintain the present FDI companies and sustain sector development in Western Slovakia for this moment, despite lack of developed domestic companies in the industry. However, according to the theory (Capello et al. 2012), it's only second stage and the new question arise—if the sector will able to move forward to endogenous innovation pattern. As some studies suggest (Pavlínek 2016), the conditions for this are not so favourable at this moment, especially quality and availability of skilled workforce in the field of research.

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