

Innovation as a Challenge for Peripheral Regions: An Israeli Case

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Abstract: Peripheral regions are now confronted with the worldwide prominence of innovation and high technology driving economic growth. It is crucial that they integrate the new trends for their economic sustainability and for the narrowing of social gaps. Research has focused on factors influencing the concentration of technology in metropolitan areas. Other analyses have highlighted the advantages for peripheral or rural regions if they integrate into this process. In our article, we aim to contribute to the discourse by suggesting a unique approach, testing it empirically with a peripheral region in Israel. Our approach contains the following elements: First, instead of considering innovation as knowledge creation or practical implementation (as generally considered), we prefer the indicator of a knowledge-based economy, as a better proxy for advanced economic growth. Second, we make a distinction between the changes in the economy of the periphery as indicated by prevailing types of occupations, and the changes in the economy of the resident's workers as indicated by their actual occupations, working in or out of the region (as in the distinction between GDP and GNP). Using time series for the last two decades, we compare the southern region of Israel and its main central region, using a classification of occupation types into three levels. The results showed a positive response of the peripheral region to the technological trend challenge. They improved skills and reacted to public policy measures. The economic structure of the periphery improved, providing occupations at higher wage levels. However, such improvement did not sufficiently respond to the improvement in labor supply by resident workers, leading to an increase in dependence on employment of high-level workers from other regions. We also detected an increase of internal gaps within the periphery.

Keywords: innovation, region, knowledge, periphery, core-periphery gaps, labor market

1. Introduction

The contribution of technological innovation to economic growth is well established in economic literature (Wong et al. 2005), and it is often found to be one of the fundamental drivers of both economic development and human progress (Sheehan et al. 2014). These innovation trends include the introduction of new products and services and the demise of old ones, which often leads to an increase in demand for skilled workers (Bosetti et al. 2015) and changes in economic structures (Bar-El and Maymoni 2022). Due to this, innovation differs significantly for different regions, depending on their abilities to adapt and absorb such intense transformation in their economic environment (Agrawal et al. 2014). In this article, we offer empirical evidence on the integration of the Israeli periphery into the national innovation trend. We further suggest a government policy to distribute the innovation process to the peripheral areas reducing the core-periphery gaps.

It has been well-documented that poorer regions' lower level of technology adoption is a rational response of firms to a range of challenges, such as weaker infrastructures, lower skills and low managerial capabilities (Varsakelis 2006; Filippetti and Peyrache 2011). Accordingly, wealthier regions provide a fertile ground for innovative activities since they embody innovative firms capable of a high level of adaption and resilience.

In spatial terms, metropolitan regions are often considered to have higher innovation potential in comparison to peripheral areas. This is mainly due to geographical proximity, which offers a variety of benefits such as exchange of goods or work (Krugman 1991), transfer of knowledge (Feldman and Massard 2012), as well as psychological or sociological reasons, motivated by a desire for social interaction (Ota and Fujita 1993). As a result, the core-periphery social gaps have threatened to widen, emphasizing the need for the oversight of an effective government policy.

This article aims to identify and analyze the process of the integration of the periphery into the innovation-led economic growth. We use the example of Israel for an empirical analysis. It has experienced significant technological growth in the last two decades, affecting labor market structure and employment opportunities both in the core metropolitan and peripheral regions. We use secondary data obtained from Israeli Central

Bureau of Statistics (CBS) to construct and compare regional trendline regressions of relevant variables in these two regions.

2. Literature review

The location trends of innovation activity: spatial concentration

The relevant literature assumes that the tendency to innovate is very geographically oriented and unevenly distributed between regions. This is partly due to industry clustering, social capital networks and knowledge spillover. Porter (1998) defines clusters as a geographical concentration of specialized suppliers and service providers, organizations like universities and commercial unions, as well as interconnected enterprises. These compete with each other and only collaborate in particular and related industries. Geographical proximity causes easier communication and value creation through networks (Mercan and Goktas 2011), as well as the tendency of funding and research support to be directed into areas where there have already been innovation success stories (Morgan 2007).

Main factors influencing the location of innovation activities: national and regional ecosystem factors

Literature mentions that one of the most critical factors driving firms to enter into clusters, is the need for talented employees. Their skills, capabilities, and productivity are closely related to available human capital (Justman and Teubal 1991; Breschi et al. 2010). The proportion of the population with post-secondary education is a good indicator of the qualities of human capital (Hollanders et al., 2014). Ciccone and Papaioannou (2009) argued that there is a positive relationship between education and structural change in knowledge-intensive activity. Knowledge-intensive activities or services based on the knowledge inherent in people is critical for transferring or exchanging knowledge and information in the innovation process.

The region's scientific and technological resources (universities, technology centers, etc.) are another key factor for regional innovation. They provide direct services to companies and facilitate interaction and collaboration between local actors and external knowledge networks (Inkinen and Suorsa 2010).

Another factor mentioned in the literature is the public subsidy for research and development (R&D), which stimulates innovation activities at the firm level (Herrera et al. 2008). Many governments provide public funding for R&D projects with the potential to generate externalities. Almus and Czarnitzki (2003) suggested that the level of R&D investment of companies receiving government support is significantly higher compared to companies not receiving government support. However, Wallsten (2000) claims that subsidies do not increase investment in R&D, but rather act as substitutes for those that are firm-financed.

Culture is a major factor in the explanation of innovation advance, although it is hardly measurable (Mercan and Goktas 2011; Turbiner, Schwartz and Bar-El 2016).

Periphery in the context of innovation

Innovation in the periphery is an issue that still receives relatively little attention compared to innovation in the core areas. However, recently there has been many theoretical developments and much empirical work on issues related to the innovation potential of remote regions (Eder 2019). Some studies point to the potential benefits of the periphery from innovation activities (Grabher 2018; Simmie 2012; Bar-El and Felsenstein 1990). Innovation in the periphery can be a major component of growth, as these firms provide employment for highly skilled workers, and even attract other highly qualified workers from outside the region (Meili and Shearmur 2019).

An empirical study conducted in southern Norway showed that firms in the periphery could overcome difficulties and innovate by establishing regional centers and strong ties to international-innovative networks (Fitjar and Rodríguez-Pose 2011).

3. An alternative approach

While the literature is quite clear on the factors that influence the innovation process both at a national and at a regional level—the issue of balance between core and peripheral regions remains inexplicit. For our analysis

of the integration of the periphery into the innovation process, we interrogate the three main approaches that prevail.

First we question whether the variety of definitions used for innovation are appropriate for the analysis of innovation in a peripheral context. Indicators such as knowledge creation (such as R&D activity or patents creation), or practical implementation (such as manufacturing of high-tech products) may not be the most valid indicators. We propose the use of the knowledge-based indicator as a more appropriate proxy for the level of integration of the periphery into the innovation process (Cooke and Schwartz 2008; Bar-El and Felsenstein 1989). The concept of the knowledge-based economy focuses on the level of skills required in various occupations, as evaluated by education or wage levels.

Second, we do not prioritize consider our objective function as the optimization of the innovation level in the periphery. We rather consider the objective of diminution of the core-periphery gap. This is in terms of the relative increase of higher levels of knowledge-based activities (with higher wage levels in the periphery).

Third, we do not consider the periphery as a single issue; we make a distinction between the economy of the periphery (in terms of the occupations in the economic activities installed there), and the economy of the resident workers of the periphery (in terms of their occupations, either in the periphery or in other regions). This may be considered as the balance between labor supply and labor demand. Labor supply for any given occupation is evaluated as the number of resident labor force in each region employed in this occupation, in the same region or outside the region (with some bias caused by the exclusion of unemployed labor force, for which there is no viable statistical data about the desired occupation). Labor demand is evaluated as the number of workers in each occupation with each given region. To some extent, labor supply may be considered as a parallel to gross national product (GNP), while labor demand may be considered as a parallel to gross domestic product (GDP). Therefore labor supply is used as a proxy for the economic level of the labor force in a given region, while labor demand is more a proxy of the level of the economy of a given region.

4. Hypotheses

- Both the local labor force and the business sector respond positively to the challenges of the innovation trend (with the support of public policy), with the integration into higher knowledge-based activities and higher wages.
- The improvements in peripheral supply (of improved labor force, improved local ecosystem factors) are not met by sufficiently appropriate demand of knowledge-based activity.

5. Methodology

We use Israel as a case study, and compare two regions: a core region defined as the metropolitan region of Tel-Aviv (including the district of Tel Aviv and the central district, and the peripheral region defined as the southern district). We used data from the Central Bureau of Statistics on the percentages of employed persons by occupations from 2003 to 2019. Occupations were classified into 3 levels of knowledge-based activities, based on wage levels of detailed occupations:

LO—Low-level occupations: unskilled, services, and sales workers.

MO—Mid-level occupations: skilled, clerical workers, engineers.

HO—High-level occupations: academics and managers.

We compared the relative weight of each occupational level in the periphery and in the core, when the demand (the “region”) side is the share of each occupational level out of total employment within the periphery (or core), when variable:

LOD(p), LOD(c): the share of workers in low level occupations out of total employment within the periphery (p) and within the core (c),

MOD(p), MOD(c): the parallel share of workers in medium level occupations,

HOD(p), HOD(c): the parallel share of workers in high level occupations.

The supply (the “people”) side is the share of each occupational level out of total employment of the resident labor force of the periphery (or core):

Using those variables, we define the relative share of each occupation level in the periphery in relation to the core:

Eq 1: $LOD(p/c) = \frac{LOD(p)}{LOD(c)}$: the percent of labor demand for low level occupations out of total labor demand in the periphery, divided by the same percent in the center.

Eq 2: $MOD(p/c) = \frac{MOD(p)}{MOD(c)}$: as above for labor demand for medium level occupations.

Eq 3: $HOD(p/c) = \frac{HOD(p)}{HOD(c)}$: as above for labor demand for high level occupations.

Eq 4: $LOS(p/c) = \frac{LOS(p)}{LOS(c)}$: the percent of labor supply for low level occupations out of total labor supply in the periphery, divided by the same percent in the center.

Eq 5: $MOS(p/c) = \frac{MOS(p)}{MOS(c)}$: as above for labor supply for medium level occupations.

Eq 6: $HOS(p/c) = \frac{HOS(p)}{HOS(c)}$: as above for labor supply for high level occupations.

We performed an analysis of time series changes in the economic structure, in the periphery and the center. This was in terms and occupational levels, using estimation of regression trendline, using a “best fit” regression procedure. On the supply side, we identify the trends of adaptation of the local labor force to improved occupational levels, and on the demand side, we identify trends of change in the structure of the economy in the periphery.

6. Findings

Labor supply:

The relative changes of labor supply at the three levels of occupations in Table 1 demonstrate a clear increase of the share of workers employed on high level occupations, both in the core region and in the peripheral region. The sudden increase in 2012 is attributed to the changing classification of occupations by the Israeli Central Bureau of Statistics (CBS). This technical distortion is attenuated by the calculation of the ratio of the share of peripheral labor force and of core labor force residents ($HOS(p/c)$). A most interesting finding is the quite continuous increase of this indicator (after a decrease at the beginning of the period), testifying to an adaptation of the residents of the periphery to innovation changes, at a higher share than that of the core residents (who were apparently already better prepared at the beginning of the period).

The decrease of the share of labor force residents in middle level and low level occupations is met by a higher decrease amongst the core labor force residents.

Table 1: Share of occupation levels by regions of residence, 2003–2019: Labor Supply

year	Core			Periphery			Share Periphery/Core		
	LOS	MOS	HOS	LOS	MOS	HOS	Low supply	Middle supply	High supply
							LOS(p/c)	MOS(p/c)	HOS(p/c)
2003	27%	50%	23%	30%	55%	15%	1.15	1.09	0.64
2004	28%	49%	23%	30%	56%	14%	1.11	1.13	0.60
2005	28%	49%	23%	32%	56%	13%	1.13	1.13	0.56
2006	28%	49%	23%	31%	55%	13%	1.13	1.12	0.58
2007	27%	49%	24%	31%	55%	14%	1.14	1.13	0.58
2008	27%	48%	25%	31%	55%	14%	1.16	1.13	0.57
2009	27%	49%	25%	32%	54%	14%	1.20	1.11	0.57

year	Core			Periphery			Share Periphery/Core		
	LOS	MOS	HOS	LOS	MOS	HOS	Low supply	Middle supply	High supply
							LOS(p/c)	MOS(p/c)	HOS(p/c)
2010	27%	47%	26%	32%	52%	15%	1.20	1.11	0.59
2011	27%	48%	26%	33%	51%	16%	1.23	1.08	0.61
2012	24%	36%	40%	30%	41%	28%	1.26	1.14	0.71
2013	25%	36%	39%	30%	42%	28%	1.23	1.15	0.72
2014	24%	36%	40%	31%	39%	30%	1.28	1.10	0.75
2015	23%	35%	42%	30%	40%	30%	1.28	1.15	0.73
2016	23%	34%	43%	29%	40%	31%	1.27	1.17	0.72
2017	24%	34%	43%	28%	41%	31%	1.20	1.21	0.72
2018	23%	33%	44%	29%	40%	31%	1.25	1.19	0.72
2019	23%	34%	43%	29%	41%	30%	1.28	1.18	0.70

Source: Calculated on the basis of data from the labor force surveys of the CBS

Labor demand:

The changing structure of the economy of the core and of the periphery regions (labor demand) shows an increasing adaptation to the innovation national trend: in both regions we identify an increase (in spite of changing classifications by the CBS) of the share of high level occupations. However, the share of low level occupations in the periphery is quite stable, against its diminution in the core region.

Table 2: Share of occupation levels by regions of work, 2003–2019: Labor Demand

	Core			Periphery			Share Periphery/Core		
	LOD	MOD	HOD	LOD	MOD	HOD	Low demand	Middle demand	High demand
							LOD(p/c)	MOD(p/c)	HOD(p/c)
2003	27%	50%	23%	30%	54%	16%	1.14	1.07	0.69
2004	28%	50%	22%	31%	54%	15%	1.10	1.09	0.67
2005	28%	50%	22%	32%	54%	15%	1.11	1.07	0.68
2006	28%	50%	22%	31%	54%	15%	1.12	1.07	0.70
2007	27%	49%	23%	31%	54%	15%	1.12	1.10	0.64
2008	27%	49%	24%	32%	53%	16%	1.16	1.09	0.64
2009	27%	49%	24%	32%	52%	16%	1.17	1.06	0.68
2010	27%	48%	25%	33%	51%	17%	1.19	1.06	0.67
2011	27%	48%	25%	33%	50%	17%	1.20	1.04	0.70
2012	25%	37%	38%	31%	41%	28%	1.24	1.12	0.73

	Core			Periphery			Share Periphery/Core		
	LOD	MOD	HOD	LOD	MOD	HOD	Low demand	Middle demand	High demand
							LOD(p/c)	MOD(p/c)	HOD(p/c)
2013	25%	37%	38%	31%	41%	28%	1.25	1.11	0.74
2014	24%	36%	40%	31%	39%	30%	1.26	1.07	0.77
2015	24%	35%	41%	30%	39%	31%	1.25	1.10	0.76
2016	23%	35%	42%	30%	39%	31%	1.28	1.12	0.74
2017	24%	34%	42%	29%	40%	31%	1.23	1.17	0.73
2018	23%	34%	43%	30%	39%	32%	1.27	1.14	0.74
2019	23%	35%	42%	30%	41%	30%	1.32	1.15	0.70

Source: Calculated on the basis of data from the labor force surveys of the CBS

7. Analysis: Demand vs. supply

We use best fitted trendlines of the ratio of the share of periphery and of the core regions for the three levels of occupations, for demand (HOD (p/c), MOD(p/c), LOD (p/c)) and for supply (HOS(p/c), MOS(p/c), LOS(p/c)).

The regression estimation for high level occupations is best fitted using a 3 level polynomial estimation:

$$HOD(p/c) = 2058616 - 3071.09Year + 1.5272Year^2 - 0.0003Year^3, \quad R^2 = 0.805^{***}$$

$$HOS(p/c) = 3162792 - 4717.67Year + 2.3456Year^2 - 0.0004Year^3, \quad R^2 = 0.877^{***}$$

*** p<0.01

As shown in Figure 1, regarding the supply, there is a lower share of high-level occupations in the periphery, but a decreasing gap with the center after a short increase. Regarding the demand of local activities, we see a decreasing periphery/core gap, but at a slower intensity; the increasing relative supply of high-level workers of the periphery is not met by a sufficient response of local activities.

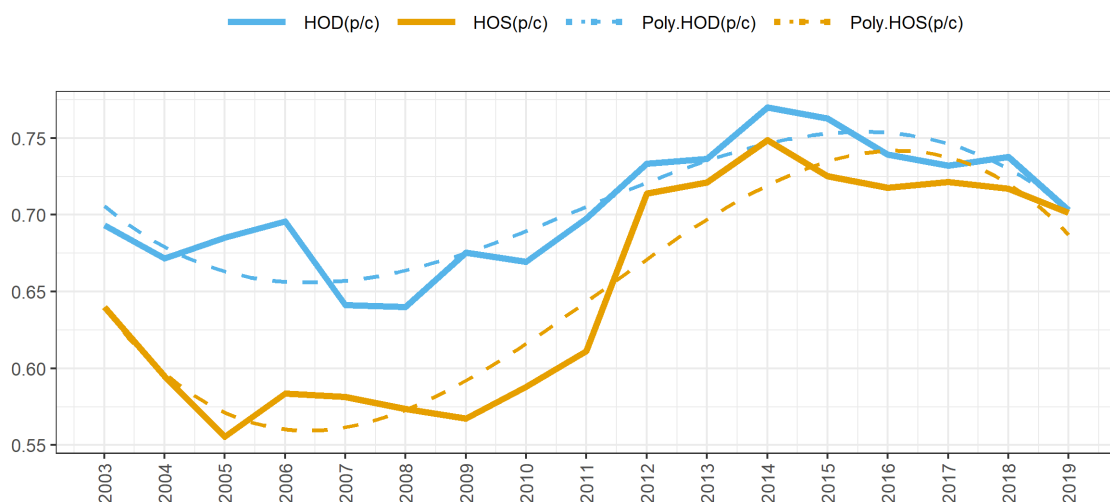


Figure 1: High level occupations: trends of the periphery/core gap of supply and demand

The consequence regarding the ability of high-level labor force to find occupations in the periphery is shown by the following indicator:

HOB(d/s)- high occupational level balance in the periphery=
workers employed in high level occupations in the periphery/
workers resident in the periphery employed in high level occupations

The trend of the balance is presented in Figure 2, and estimated by the following regression:

$$HOB(D/S) = 19.6283 - 0.0093Year, R^2 = 572^{***}$$

*** $p < 0.01$

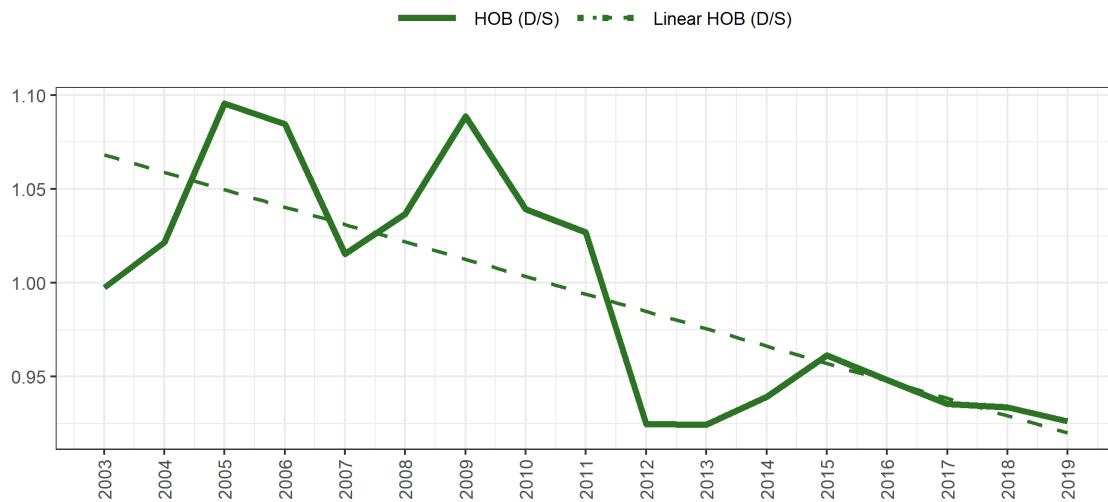


Figure 2: High level occupations balance

We find a clear decreasing demand/supply balance: the increasing supply of high-level workers in the periphery is not met by a parallel increasing demand.

The parallel results for low level occupations are shown in the following regressions results and graphs:

$$LOD(p/c) = -410.14 + 0.396Year - 0.0001Year^2, R^2 = 0.893^{***}$$

$$LOS(p/c) = -2131.29 + 2.110Year - 0.0005Year^2, R^2 = 0.817^{***}$$

$$LOB(D/S) = -0.743 + 0.0008Year, R^2 = 0.175^*$$

*** $p < 0.01$ * $p < 0.10$

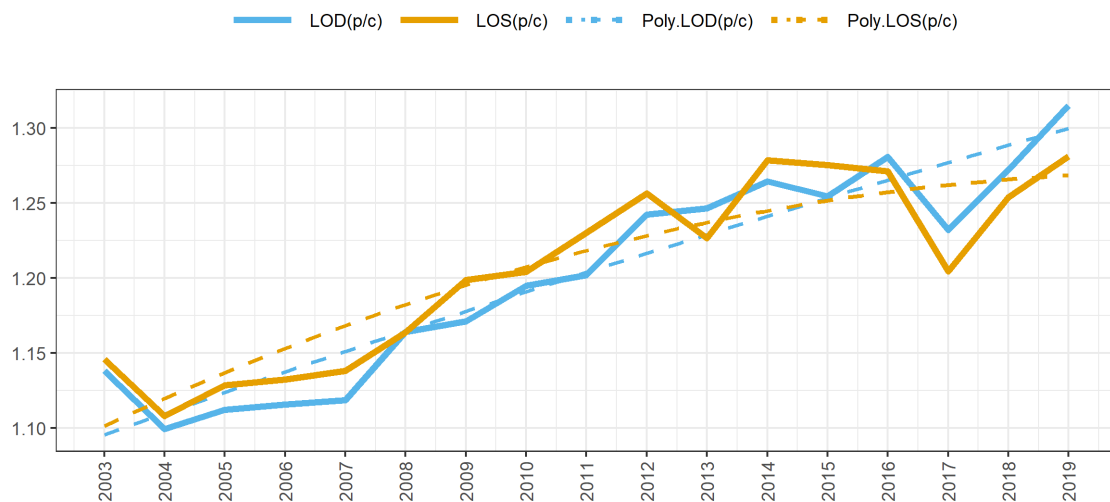


Figure 3: Low level occupations: trends of the periphery/core gap of supply and demand

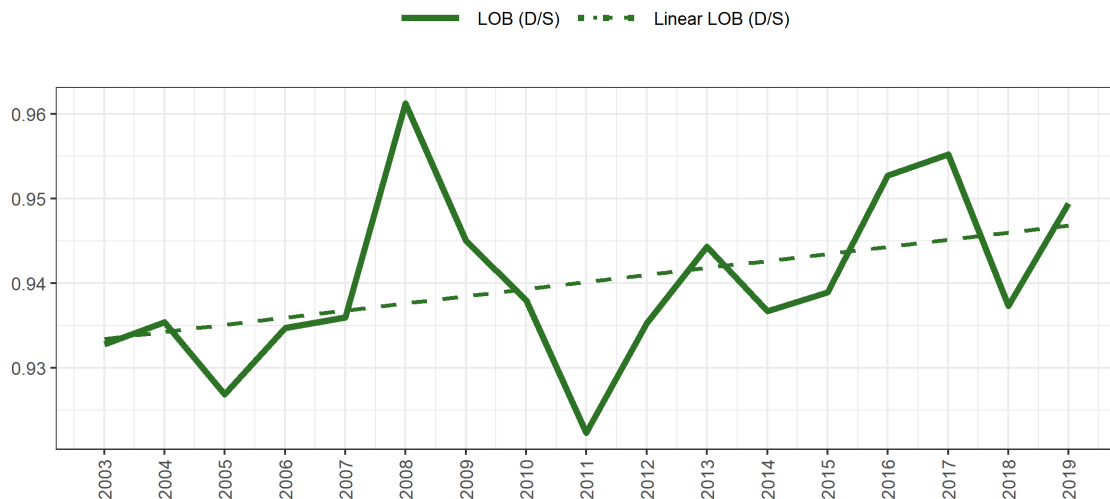


Figure 4: Low level occupations balance

On the supply side, the share of low-level occupations of local workers in the periphery is quite constant (about 30%), but that of the core decreases over the time period. This increase of the relative frequency of low-level workers leads to a decrease of the relative attractiveness of the periphery (Figure 3).

This is met on the demand side of local activities with an increasing periphery/core gap, adapting to the relatively higher frequency of low-level workers in the periphery.

Consequently, we identify in Figure 4 an increasing excess of low-level job opportunities in the periphery (yet not statistically significant).

8. Conclusion

We found that advances in innovation and high-tech activities do actually impact the regional system. This article focused on the impact on the economic balances between a core region and a peripheral region, from the aspect of the labor market. Prevailing literature related to the regional issue in the context of innovation, but the conclusions were not explicit. This is due to a large extent to the fact that there is no real agreement about the definition of innovation and its measures, and to the fact that core and periphery or remote regions may have varying facets.

We chose to consider the integration of innovation by peripheral areas in terms of absorption of knowledge-based activities with higher wage levels (instead of knowledge creation or production of innovative products). We considered improved occupation types with higher income levels to be a better indicator of the objective function of the peripheral area.

Using the Israeli case, we found that the innovation process impacts the economic situation of the labor force population in the periphery, and to a lesser extent the economic situation of the periphery itself. In a sense, the gap between the peripheral labor force and that of the core region is reduced, but not the gap between the economic structure of both regions. This may be attributed to the lower response flexibility of a region's economy, that depends mainly on more rigid factors, such as infrastructures or agglomeration.

The adaptation of the labor force of the periphery to the innovation trends is also expressed by a decrease of the share of workers in low level occupations. However, the decrease of such workers in the core region was even higher, which can be attributed to a higher advance of the innovation process there. This imbalance naturally leads to a higher relative attractiveness of low-level occupations to the periphery.

The bottom line is a better adaptation of local labor force of the periphery (supply) to the innovation national process than that of the local economy (demand). This increasing gap between supply and demand may lead to increased commuting of skilled labor force, or to emigration to core regions.

The findings of this study should be considered under a few heavy limitations, and therefore can be used as a base for much further research. One important limitation is the validity of the measures of the knowledge base level of each occupation: the wage level provides an important and quite reliable measure, but other variables should be considered, such as the educational level. A second important limitation is the time series of two decades: much more interesting results may be achieved with longer time series (which could not be done here because of heavy technical limitations, changing definitions, and changing classifications of occupations).

Further research is also required to identify the implications of these results in terms of welfare and spatial structures, and for the introduction of appropriate policy measures.

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