

Article

Socioeconomic Impact of Academic Research and Higher Education on Peripheral Development: the Case of Israel

Gad Degani^{1,2}, Dan Levanon², Gregory Yom Din^{1*}

¹ Tel-Hai Academic College, Upper Galilee, Israel;

² MIGAL, Galilee Research Institute, POB 831, Kiryat Shmona, Israel;

Gad Degani - gad@migal.org.il;

Dan Levanon - Danl@migal.org.il

* Correspondence: gregoryyd@gmail.com;

Abstract: MIGAL – Galilee Research Institute is a regional R&D center in the northeast peripheral region of Israel. An internationally recognized applied research institute, MIGAL specializes in biotechnology and computational sciences, plant sciences, precision agriculture and environmental sciences, as well as food, nutrition and health. Most of MIGAL's researchers serve as the core faculty at Tel Hai Academic College (TH). Despite the country's small surface area, socioeconomic inequality in Israel is high by OECD standards, with wage differences between rich and poor regions reaching up to 400%. The aims of this study are to identify possible socioeconomic impacts of MIGAL–TH on the peripheral northeast's development. We discuss the effects of academic research and institutions of higher education on mitigating differences between the center and periphery of the country. Data for MIGAL, TH and the northeastern peripheral region were collected from the yearly reports of the two institutions and the Israel Central Bureau of Statistics. MIGAL was found to serve as a link between research, academic teaching and socioeconomic development in the northeast periphery. Several variables related to this link and describing MIGAL–TH and northeastern periphery development were analyzed over time: MIGAL's budget, total number of employees and number of employees with PhDs; number of TH graduate students; socioeconomic index (SEI) of the northeastern periphery and its position on the Israeli list of regional SEIs. The signs and significance levels of their trends indicate a potential socioeconomic impact of academic research and higher education on peripheral development in the northeast of the country. Research budgets and the creation of jobs for academics living in the region are just a few examples of this impact.

Keywords: regional development; periphery; socioeconomic index; academy; university

1. Introduction

MIGAL – Galilee Research Institute Ltd., established in 1979, is a regional R&D center of the Israeli Ministry of Science and Technology, owned by the Galilee Development Company Ltd. An internationally recognized and multidisciplinary applied research institute, MIGAL specializes in biotechnology and computational sciences, plant sciences, precision agriculture and environmental sciences, as well as food, nutrition and health. MIGAL employees include more than 90 PhDs and 190 researchers deployed across 44 research groups and operating as an innovative research ecosystem that encourages collaboration across scientific, industrial, agricultural, academic and technological specializations (Levanon, 2020) (Fig. 1).

Most of MIGAL's researchers serve as the core academic and administrative staff of the Faculty of Sciences and Technology at Tel Hai Academic College (TH). Many of TH's graduate students are supervised by MIGAL scientists and conduct their research in MIGAL's laboratories. Since 1994, TH has been an independent academic institution that offers Bachelor and graduate degrees in the faculties of Social Sciences and Humanities,

and Science and Technology. TH pioneered the integration of practical, hands-on experience into college studies, providing students with valuable skills and knowledge, and invigorating the local economy with youthful energy and ideas that challenge thinking and serve to formulate innovative approaches to science, engineering, design and analysis (Levanon, 2020; Tel-Hai College, 2021) (Fig. 1).

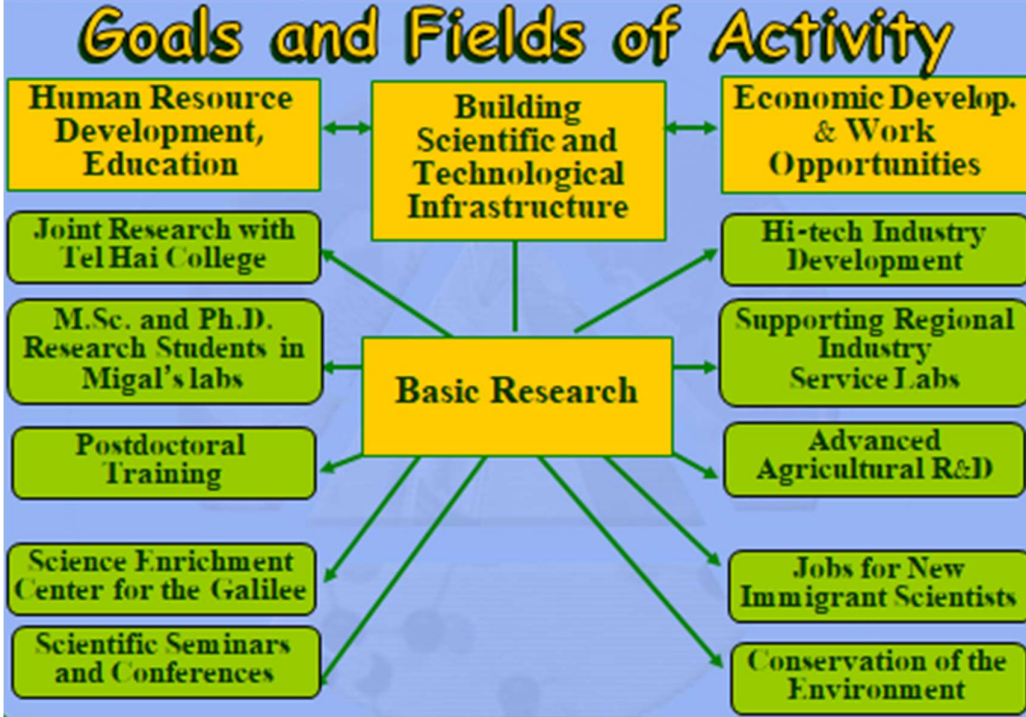


Fig. 1. MIGAL’s goals upon its establishment in 1979.

In this article, we discuss the possible impact of academic research and education institutions on mitigating differences between the center and periphery of the country. We study the case of MIGAL and TH, located in a peripheral region in northeastern Israel. We explore this potential impact quantitatively, using data on regional development in Israel from the establishment of MIGAL and TH until today.

Currently, most low-productivity sectors with low-quality and low-wage jobs are located in the peripheral regions of Israel. Despite the Encouragement of Capital Investments Law, the country’s small surface area, and the availability of investment grants for the periphery, socioeconomic inequality in Israel is high by OECD standards.

The difference in monthly wage between the rich and poor regions can reach up to 400% (Machlica, 2020). The center of the northeastern Galilee region of Israel, the focus of this article, is the town of Kiryat Shmona. MIGAL and TH are located near this peripheral town, where historically, education and employment opportunities have been low, similar to other “development” towns established to support the absorption of new immigrants (Tel Hai Innovation Center Team, 2020).

The problem of developing peripheral regions through university–industry–government relations has been studied widely in the published research. The question is even more pertinent today, in a modern social environment characterized by the processes of innovation and migration. In the present empirical research, the significant features of this approach are analyzed. The aims of this study are to identify the ways in which MIGAL–TH might have a socioeconomic impact in the peripheral northeast’s development, and to estimate this impact statistically.

We suggest using a new type of dataset for this purpose; specifically, we examine the socioeconomic indices (SEIs) of the northeastern region relative to other peripheral

regions of Israel. We check the multiyear relationship between these indices and variables reflecting the development of MIGAL and TH—institutional budgets, staff, and number of graduate students. This research may serve to inform policy recommendations for knowledge-driven regional development aimed at equalizing socioeconomic conditions in the center and periphery of developed countries.

Background and Literature Survey

The medieval universities were sources of basic knowledge, separated from the rest of society. In the nineteenth century, the universities began to play a more active role, particularly through experimentation and more applied research. The first technological university in Israel, the Technion, was established in 1924 in Haifa. Its first departments were architecture, civil engineering and energy, later supplemented with high-tech fields such as computer science, biotechnology, stem cell research, space research and nanotechnology. After World War II, funding for universities' basic and applied research grew substantially the world over, contributed by governments and commercial firms. In the US, for example, university R&D expenditures grew higher than the economy as a whole. With time, universities evolved from providing conventional research and teaching activities to being a knowledge hub that promotes innovation (Youtie and Shapira 2008).

Today, besides providing traditional education and performing research, academic education and research institutions (hereafter academic institutions) perform other functions that are important for regional development. For instance, they provide knowledge-intensive services and technical expertise for business R&D activities (Grossman et al., 2001), and operate as global pipelines for international academic research networks (Bathelt et al., 2004).

Their role extends beyond the mere transfer of technology at the regional level and can, in fact, attract talent from other areas to the region. There is growing evidence that excellent universities, together with a regional innovation system that promotes inter-firm collaboration and business–university interactions, can boost regional competitiveness (Garcia-Alvarez-Coque et al., 2021). Published research examining the relationship between academic institutions and regional competitiveness has shown a strong relationship between research achievements and regional industrial development. In peripheral regions, one of the functions of universities is to cover deficits in the R&D infrastructure (Garcia-Alvarez-Coque et al., 2021). The effectiveness of academic research and higher education from a regional standpoint, and universities' influence on regional development have been assessed using various analytical models. One such model, the Triple Helix model of University–Industry–Government relations, describes the enhanced role of the university in processes of innovation in knowledge-based societies. This model is used in one form or another in government and academic initiatives for knowledge-based economic development in the USA, European countries and many others. It states that the university (and in our case, research institute and academic college) can play an enhanced role for the purpose of innovation in increasingly knowledge-based societies, specifically, in the social context (Etzkowitz and Leydesdorff, 2000).

In another—Quadruple Helix—model, researchers assume that society also plays an important role in the innovation process, along with science, business and state, and impacts the creation of knowledge and technology at different levels of institutional, regional and operational functionality. Research from Russia for the period of 2008–2014 confirmed the indirect impact (through the development of a “knowledge space”) of academic education on the level of socioeconomic development, and on the relationship between the index of scientific–technological potential of the region and the size of the gross regional product per capita (Kurbatova and Kagan, 2017).

In a study from Spain covering the period 2003–2015, a moderately positive relationship was found between the level of university–firm collaboration (UFC) and most regional development indicators in that country. UFC was shown to strengthen industrial knowledge management and innovation capacity, indirectly having a positive effect on the regional economy and human capital. UFC can also generate positive effects on social

life and serve a base of regional entrepreneurship in the context of the Triple Helix Model (Manrique, 2019).

Significant features of these models are used in the current research to examine a case study of the Upper Galilee region of Israel, one of the peripheral regions in the north of the country. We employ the “research–academic education–regional development” model in our research based on the socioeconomic index (SEI) used in Israel. This MIGAL–TH model is implemented for the Upper Galilee region with a focus on academic and industrial aspects of biotechnology.

2. Methodology

Data

Data on MIGAL and TH were collected by the authors from these institutions' yearly reports. Table 1 shows an excerpt of these data for MIGAL, and Table 2 for TH.

Table 1. An excerpt of MIGAL data used in this study.

item	2011	2012	2013	2014
budget, mln. NIS	47.7	54. 1	61.3	57.6
workers	180	180	180	220
PhD workers	42	44	53	60

Table 2. An excerpt of TH data used in this study.

item	2017	2018	2019	2020
MA students	28	28	54	55
PhD students	6	6	7	6

The SEI data of the northeastern region for the researched period were collected from the Israel Central Bureau of Statistics (Table 3).

Table 3. An excerpt of SEI data for the northeastern peripheral region used in this study.

item	2006	2008	2013	2015
SEI	0.241	0.225	0.423	0.550
position on list of regional SEIs for Israel	31	36	26	13

Data were not always available for all years of the researched period. Nevertheless, we were able to examine possible increasing trends in MIGAL's budget and number of researchers, as well as in TH's number of students. The SEI data (Table 3) were related to the values over time for the northeastern periphery (a possible positive trend was examined), and to the position of this region on the Israeli list of regional SEIs (a possible rising trend of moving up toward the top of this list, was examined).

Model

To examine possible trends in the data described in the previous subsection, we used ordinary least squares (OLS) regression:

$$y_{kt} = \alpha_k + \beta_k x_t$$

(1)

where t is the year of the researched period 1996–2020; k is a number indicating the variable being examined: (1) MIGAL’s budget, (2) workers and (3) PhD workers, (4) TH’s is graduate students, and the northeast region's (5) SEI and (6) position on the Israeli list

of regional SEIs, for a total of six time series ($k = 1$ to 6); y_{kt} is the value of time series k in year t ; and α_k, β_k are the sought-after coefficients of the model for each time series k .

3. Results

The Microsoft Excel Analysis ToolPak was used for model (1) estimation. The periods of available data for the six times series all differed slightly.

MIGAL's budget and number of employees have increased significantly over the years. MIGAL has proven to be an important institution that employs more than 200 academics in the region, many of whom (more than 80) are PhD researchers. MIGAL is a workplace where postgraduate students, PhD students and postdoctoral fellows can carry out their research, and this enables them to live in northeast, making up a strong population. It is also an important option for citizens living in the region to apply their knowledge and experience without having to go to the center of the country where most of the academic research institutions are located.

All three MIGAL time series - for budget, number of employees and number of PhD employees - showed positive trends, and the R^2 measures were relatively large: from 0.87 to 0.92 (Figs. 2, 3).

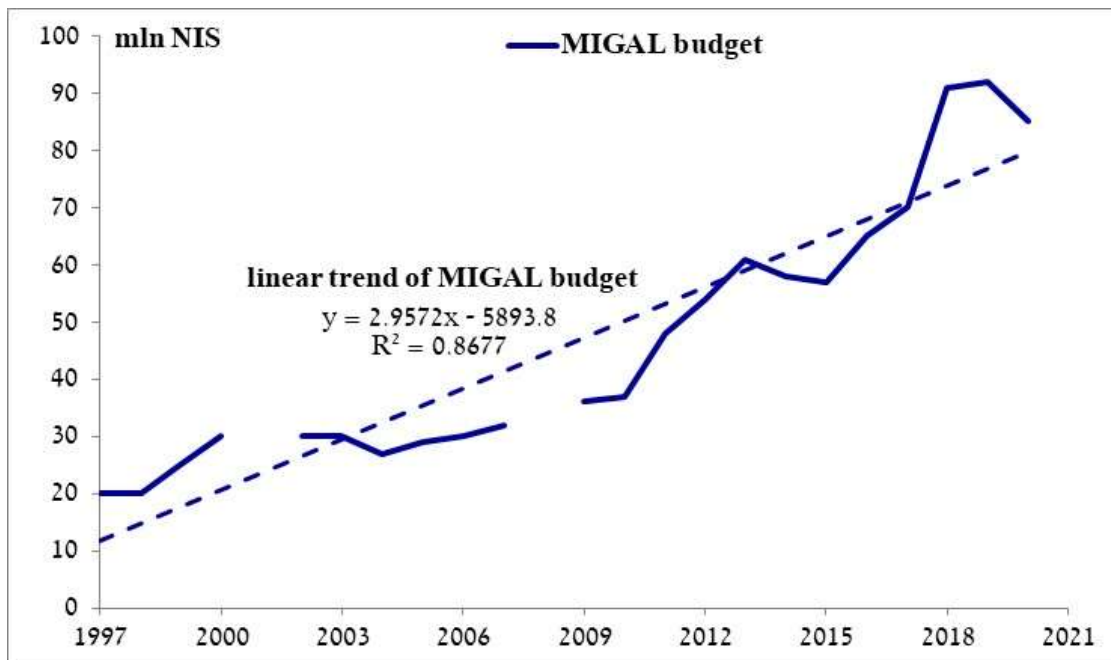


Fig. 2. MIGAL budget, in nominal prices.

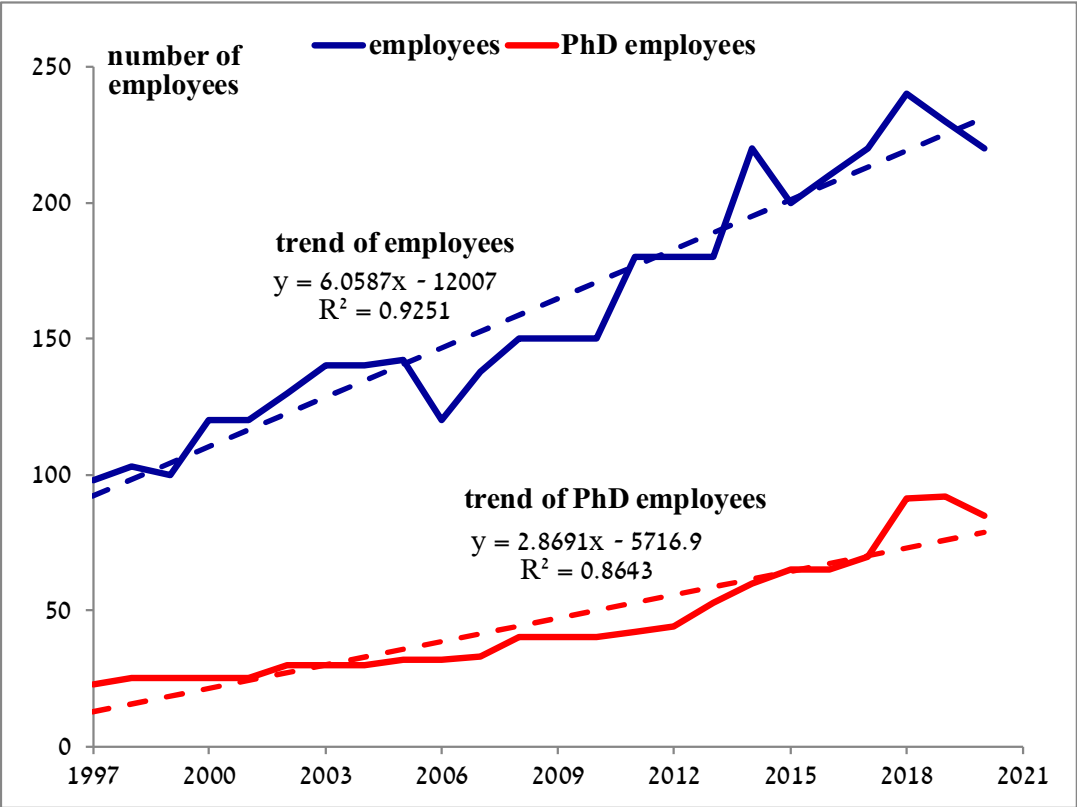


Fig. 3. Number of MIGAL employees – total and with PhD degree.

The number of undergraduate and graduate students has increased at TH. Some of this increase is due directly to MIGAL’s influence, and some of it is related to the academic development of TH, which operates like a university for certain disciplines. The time series graduate students showed a positive trend, but the R2 measure was relatively small, 0.25 (Fig. 4).

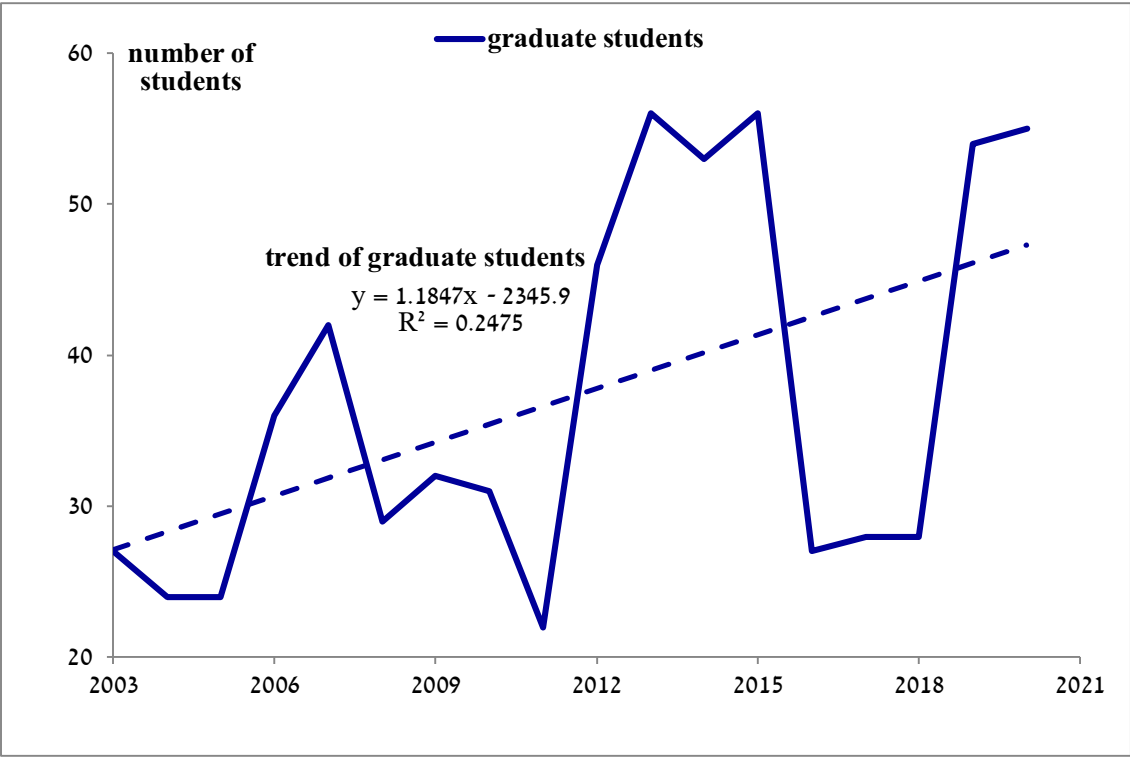


Fig. 4. Number of graduate students at TH over time.

The SEI of the northeastern periphery increased during the research period (1999–2015) with $R^2 = 0.42$. The position of the region on the Israeli list of all regional SEIs rose, from 33rd in 1999 to 13th in 2015, moving toward the top of the list with a relatively large $R^2 = 0.59$ (Fig. 5).

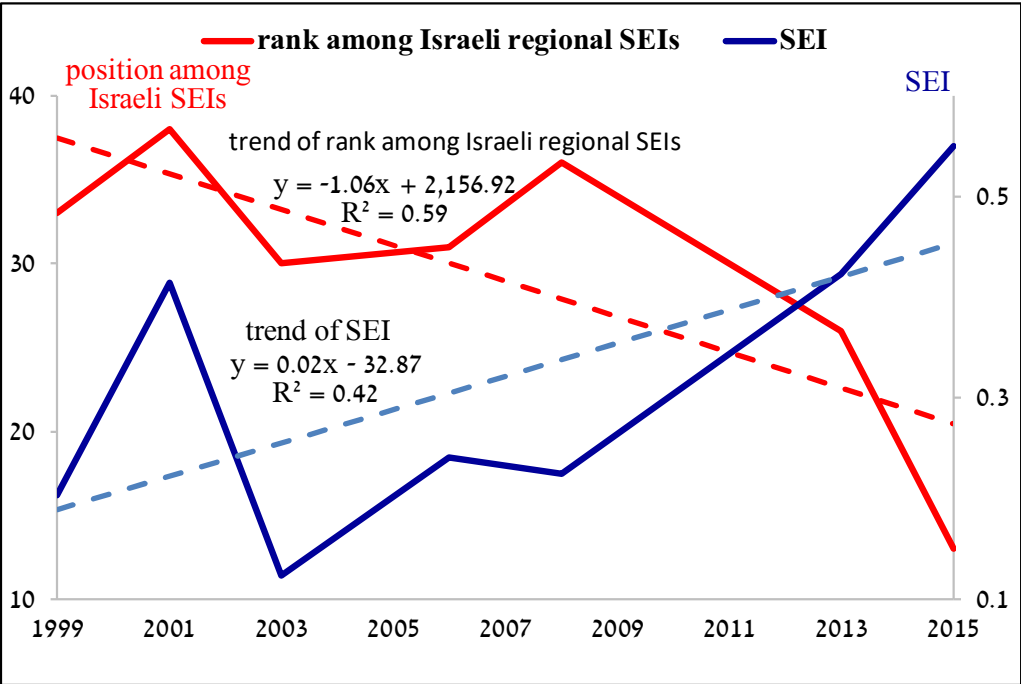


Fig. 5. SEI of northeastern periphery and position on Israeli list of regional SEIs.

The model (1) was estimated for all six time series. The significance test results are summarized in Table 4. The significance level was small ($p = 0.00$) for the time series related to the possible socioeconomic impact of academic research (MIGAL) and higher education (TH), and relatively small ($p = 0.15$ and $p = 0.08$) for the time series related to development in the periphery (SEI and position on Israeli list of regional SEIs, respectively).

Table 4. Significance of the time series trends according to model (1).

time series	trend	p-value from model (1)
MIGAL budget	rise	0.00
MIGAL employees	rise	0.00
MIGAL PhD employees	rise	0.00
TH graduate students	rise	0.04
SEI of northeast	rise	0.15
position of northeast on Israeli list of regional SEIs	rise to the top of the list	0.08

4. Discussion and Conclusions

The academic institution MIGAL serves as a link between research, academic teaching and socioeconomic development in the northeastern periphery of Israel. In this study, several time series related to this link and describing MIGAL–TH and northeast development were analyzed. For all of the studied time series, the signs and level of significance of the trends indicated the existence of a possible socioeconomic impact of academic research and higher education on peripheral development of the northeast region. Research budgets and creating jobs for academics living in the region are just one explanation for this possible impact. Our empirical findings are consistent with the paradigm of the Triple Helix model that describes the new role of academic institutions in innovation processes that are ongoing in knowledge-based societies. In this study, we used this paradigm in the context of regional development in the periphery of Israel.

In the historical context, researchers suggest an evolution in the role of universities from knowledge storehouse to knowledge factory, and on to knowledge hub. Youtie and Shapira (2008) examined this process using the case of the Georgia Institute of Technology (USA). The state efforts to shift the region from an agricultural to an industrial, and then to an innovation-driven economy were analyzed in the context of academic education and research roles.

The empirical results of our study are in line with findings of other studies in this field. Garcia-Alvarez-Coque et al. (2021) analyzed data from Spain and concluded that R&D expenditure and academic contribution are important for regional competitiveness. They found that university excellence is not crucial, and needs to be contextualized in every specific case.

Rodionov and Velichenkova (2020) studied 85 regions in the Russian Federation. They used a list of statistical socioeconomic indicators based on the regions’ performance in previous years. This is similar to the regional SEI used in our study. Rodionov and Velichenkova’s (2020) findings highlighted the importance of higher education institutions in the Russian regional innovation system, and of joint R&D and the training of qualified personnel.

One of the limitations of our empirical research was use of the OLS regression, which assumes constant coefficients of the estimated trends of socioeconomic development. Another limitation was the length of the studied period, raising the need for longer and more consistent time series in future research in this area.

Future research in this field should include additional directions for regional academic and socioeconomic development. For the case of the Israeli northeast, for example, these might include the following relevant interactions related, in part, to the neighboring Galilee regions of Carmiel, Kinneret and Golan: bio-environment services including Kinneret research centers, educational institutions including those for Ethiopian immigrants and the Arab sector, agricultural research and farmers’ organizations, and industry-based development, in particular, technology incubators and a biotech park (Fig. 6).

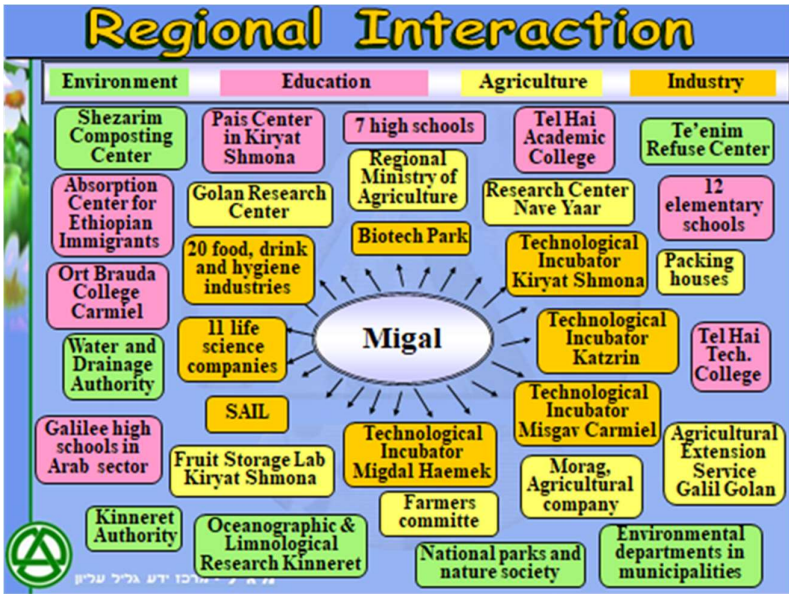


Fig. 6. The direct and indirect effects of MIGAL on development of the northeast of Israel.

Funding: This research was funded by MIGAL – Galilee Research Institute, Israel.

Conflicts of Interest: The authors declare no conflict of interest.

References

Bathelt, H., Malmberg, A., & Maskell, P. (2004). Clusters and knowledge: local buzz, global pipelines and the process of knowledge creation. *Progress in Human Geography*, 28(1), 31-56.

Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: from National Systems and “Mode 2” to a Triple Helix of university–industry–government relations. *Research Policy*, 29(2), 109-123.

Garcia-Alvarez-Coque, J.M., Mas-Verdú, F., & Roig-Tierno, N. (2021). Life below excellence: exploring the links between top-ranked universities and regional competitiveness. *Studies in Higher Education*, 46(2), 369-384.

Grossman, J.H., Reid, P.P., & Morgan, R.P. (2001). Contributions of academic research to industrial performance in five industry sectors. *The Journal of Technology Transfer*, 26(1), 143-152.

Kurbatova, M.V., & Kagan, E.S. (2017). The role of universities in the formation of scientific and technological potential and in development of Russian Federation regions. *University Management: Practice and Analysis*. DOI: 10.15826/umpa.2017.05.063

-
- Levanon, D. (2020). Establishment of MIGAL – early years 1979–1985. Unpublished (Hebrew).
- Machlica, G. (2020). Reducing socio-economic differences between municipalities in Israel. OECD Economic Department Working Paper, No. 1645. OECD Publishing, Paris.
- Manrique, S. (2019). Exploring the impact of university-firm collaboration on regional development: the Spanish case. DOI:10.3990/4.2535-5686.2019.02. Available at <https://runinproject.eu/results/working-paper-series>
- Rodionov, D., & Velichenkova, D. (2020). Relation between Russian universities and regional innovation development. *Journal of Open Innovation: Technology, Market, and Complexity*, 6(4), 118.
- Tel Hai Innovation Center Team (2020). From entrepreneurship courses to a regional innovation and entrepreneurship center: a model for innovation and entrepreneurship center at Tel Hai Academic College. Chapter 4 in *SILICE – Best Practices for Innovation Centers in Higher Education Institutions*, pp. 33-49.
- Tel-Hai College (2021). Available at <https://english.telhai.ac.il/>
- Youtie, J., & Shapira, P. (2008). Building an innovation hub: a case study of the transformation of university roles in regional technological and economic development. *Research Policy*, 37(8), 1188-1204.