DOI:10.17951/h.2023.57.2.137-156

A N N A L E S
UNIVERSITATIS MARIAE CURIE-SKŁODOWSKA
LUBLIN – POLONIA
VOL. LVII, 2 SECTIO H 2023

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Investment Activity and Technological Opportunities for Human Capital Development. The Case of the "Pszukaj" Application for Ukrainian Refugees in Poland

Keywords: human capital; investment optimization model; optimal value of investments; mobile application; refugee

JEL: M39; J24; C51; C61

How to quote this paper: Stepanok, N., Kaczmarek, P.T., & Kholodenko, A.M. (2023). Investment Activity and Technological Opportunities for Human Capital Development. The Case of the "Pszukaj" Application for Ukrainian Refugees in Poland. *Annales Universitatis Mariae Curie-Skłodowska, sectio H – Oeconomia*, *57*(2), 137–156.

Abstract

Theoretical background: Human capital is one of the key factors in the development of entrepreneurship, production and services. The goal of each enterprise is to make a profit, the realization of which requires investment. When developing investment projects, it is crucial to choose the most promising ones, at the same time, it is necessary to take into account the existence of "bottlenecks", and investment activity should be directed to liquidate them. So, the optimal values of the enterprises' investments in the situation of sufficient and insufficient levels of human capital are found and the factors influencing them are analyzed. The study of the issue of human capital today cannot bypass the question of refugees. As a result of the war in Ukraine, a large wave of migration processes is taking place in Poland, and, therefore, there is a problem and need for adaptation of people fleeing from the war. The social problem that arose due to the large number of refugees in Poland requires a comprehensive solution that would aim not only to help the refugees, but also the Polish economy. The best possible solution to the problem of refugees, both for themselves and for the host countries, is to involve them in an egalitarian society and equal economic life. The study highlights the possibility of using technical capabilities for the development of human capital on the example of a mobile application "Pszukaj" developed by the authors.

Purpose of the article: The aim of this paper is to build and analyze optimization models of investments in the field of production of goods and provision of services and in the development of human capitalin the situation of sufficient and insufficient levels of human capital development. The practical research question of this study is to consider the case of the "Pszukaj" mobile application as a communication tool for refugees wishing to function independently in Polish society.

Research methods: The role of human capital in the enterprises' activities will be evaluated based on constructed investment optimization models. The importance of technological opportunities for human capital development will be evaluated based on the case of the "Pszukaj" mobile application.

Main findings: This study contributes to the existing research by offering the analysis of constructed investment optimization models in situation of sufficient and insufficient levels of human capital. The dependence of the optimal values of investments in the development of the sphere of production of goods and provision of services and in human capital on both efficiency indicators of investments in the corresponding directions is shown and analyzed. From the practical perspective, the value of technological opportunities for human capital on the example of "Pszukaj" is shown.

Introduction

The development of the economic environment has always been based on a human, whose labor and intellectual abilities created the conditions and opportunities for the formation of a modern economy. The uniqueness of contemporary realities lies in the fact that robotization processes are simultaneously taking place, displacing a human as a labor factor, and the predominance of the role of a human and his abilities in comprehending economic benefits.

These complex processes are interrelated and complement each other. In connection with the emergence of such heterogeneous phenomena in our days, enterprises in the formation of their management decisions need to carefully weigh their strategies and areas of investment. A comprehensive study by Alan and Köker (2021) emphasizes the relevance of the issues of "human capital", "knowledge management" and "innovation" among management topics.

It should be noted that it is man who is the creator of both technological and economic progress. Human intellectual capital is precisely that "organizational ad-

vantage" that improves performance (Nahapiet & Ghoshal, 1998). And it was man who created the prerequisites for digitalization and robotization, which affects all spheres of economic and social life of the population. And, therefore, the issue of investing in a person and his potential comes to the fore, which makes the problem of human capital particularly relevant.

An exceptional feature of a human is that he is able to use his creativity, emotional state, and mood for economic purposes. Akgün et al. (2007) note that the emotional abilities that firms use for their purposes contribute to increasing the effectiveness of their activities due to the increase in the level of learning and innovativeness. Therefore, it will be appropriate to consider how human capital affects on the enterprise's operation under different conditions and the state of its development and to find optimal investment options.

So, the aim of this paper is to build and analyze optimization models of investments in the field of production of goods and provision of services and in the development of human capital in the situation of sufficient and insufficient levels of human capital development. The practical research question of this study is to consider the case of the "Pszukaj" mobile application as a communication tool for refugees wishing to function independently in Polish society.

In this article, we show that with an increase in the efficiency of investment in human capital, the optimal amount of investment in the development of the sphere of production of goods and the provision of services always increases, which indicates the primary expediency of investing in human capital. The development of human capital contributes to the improvement of the sphere of production and provision of services. The problem of human capital is very broad and multifaceted, and also affects various aspects of economic activity. Modern challenges in connection with the war in Ukraine and the problems of refugees affect the Polish labor market, as well as the economic situation in general. The results obtained regarding the feasibility of developing human capital show the need to create an approach to refugees as potential human capital, and notonly as temporary protected guests of Poland. Understanding the complexity, versatility and interdisciplinarity of this issue, we claim that an important step towards attracting refugees to the composition of the human capital of the Polish national economy is the need to know the Polish language, which can be helped by the use of technical capabilities such as themobile application "Pszukaj" developed by the authors.

Empirical data obtained through the survey among refugees in the Tricity, as well as students of Polish language courses, helped to confirm the positive impact of the use of the mobile application "Pszukaj" on the adaptation to the Polish environment and job search opportunities of refugees among the respondents.

This study contributes to the existing research by offering the analysis of constructed investment optimization models in situation of sufficient and insufficient levels of human capital development. The originality of the article lies in microeconomic approach to the problem of investing in human capital under different initial

conditions of its development, as well as a macroeconomic approach that addresses the aspect of the need to reformat the refugee problem in the possibility of replenishing human capital. The structure of the subsequent sections of the article contains the theoretical part, results, conclusions and a list of cited literature sources.

Literature review

Human capital is one of the key factors in the development of entrepreneurship, production and services. Previous studies of the issue have shown that "human capital development plays a vital role in promoting equitable income distribution" (Managi et al., 2021, p. 268). The state of human capital at the macroeconomic level affects the possibilities of industrialization of the national economy (De la Cruz Prego, 2021). At the level of enterprise management, both human and social capital are important, but to increase the efficiency of their activities, it is more appropriate to focus on the acquisition of additional human capital (Andersen et al., 2022; Inkpen & Tsang, 2005; Lin, 1999). As Predygier and Zalesna (2021) note, the level of development of human capital affects the development of each cluster. This is due to the fact that "knowledge productivity appears twofold, i.e. organizational innovation, and professional ability for future innovation" (Ehlen et al., 2014, p. 54). Smuda-Kocoń (2022) also emphasizes the importance of intellectual capital, which is inextricably linked with human capital, in today's unstable environment.

The stimulating effect of human capital on the activity of enterprises indicates the expediency of deepening research into this issue, which is multifaceted and complex. The problem of human capital is also of a macroeconomic nature and should be taken into account when developing appropriate macroeconomic strategies. So, Wajnbrener et al. (2022) note the serious economic consequences of such a phenomenon as the aging of the population, which indicates the need for a competent pension policy. The situation in the labor markets depends on many challenges, among which Bukowska et al. (2021) and Dudek (2021) single out the COVID-19 pandemic. Gulski and Gorzym-Wilkowski (2022) emphasize the relevance of the study of the category of stakeholders in conjunction with public values, which allows a balanced achievement of the goals of public administration. Hanushek and Woessmann (2008) note the need to take care of the level of human capital development starting from the school bench and with quality schooling for overall economic well-being. According to Squicciarini and Voigtländer (2015), it is the level of knowledge and literacy that is decisive in the study of human capital issues. According to Demirgüç-Kunt and Torre (2022), obtaining higher education and improving the qualifications of adults are more important for improving the productivity of human resources. Specific areas of investment should correspond to the specialization of activity, because "human capital is most important if it is task-related and if it consists of outcomes of human capital investments rather than human capital investments" (Unger et al., 2011, p.

341). Larkin and Leider (2012) point out that the productivity of the enterprise is influenced by the self-confidence and level of motivation of employees, and, therefore, among the directions of investment, it is advisable to develop incentive schemes that will adapt employees according to their behavioral characteristics. Also, the empirical results of a study by Al-Amin et al. (2021) show that "many organizations are morally accepted by their workforce because of their societal concern and formulation of HR policies and practices to stimulate them toward eco-friendly behavior".

In a broad sense, the state of development of human capital is influenced by many factors, both personal and social. In today's global world, migration is an important factor that also affects the overall state of human capital in the national economy.

As a result of the war in Ukraine, a large wave of migration processes is taking place in Europe, and, therefore, there is a problem and need for adaptation of people fleeing from the war. The best possible solution to the problem of refugees, both for themselves and for the host countries, is to involve them in an egalitarian society and equal economic life. It should be noted that, along with various problems of a large-scale influx of refugees, the prospects for replenishing the active working-age population at their expense are simultaneously opening up for the host countries. Effective programs of adaptation of refugees to an active social and working life can positively influence their decision to stay in the country, renewing its human capital (Biglari et al., 2022; Zhatkanbaeva et al., 2012).

A study by Peri and Sparber (2009) showed that in the USA large inflows of immigrants did not make significant changes in the overall level of employment and the level of wages due to the predominantly lower level of education and qualifications among immigrants compared to local workers. A study by Cortés and Tessada (2011) showed a positive effect of an increase in the supply of low-skilled immigrants on the possibility of rational use of time of highly skilled women due to the reduction of the housework they delegate to immigrants. At the same time, Docquier and Rapoport (2012) note that "high-skilled emigration does not necessarily deplete the country's human capital reserves and can create positive external network effects". Thus, for the economies of countries hosting refugees, the optimal solution would be the gradual transition of refugees to the positions of emigrants, their assimilation into public life, the achievement of which requires appropriate tools. People affected by the consequences of war need special social and economic care, and targeted assistance programs should facilitate their adaptation to new realities (Blattman et al., 2016; Naidoo et al., 2018).

Research methods

The goal of each enterprise is to make a profit, the realization of which requires investment, in the process of which it is necessary to take into account various aspects of the enterprise's activity and external factors. During the development

of investment plans and their management, it is important to take into account the actual state of the enterprise, find "bottlenecks" that block its improvement and reveal the potential that carries advancement prospects. Therefore, when developing investment projects, it is advisable to carry out a preliminary analysis of the need for investments in operational activities, namely in our model, we will consider the state of the sphere of production of goods and provision of services and the state of human capital development, which will give us the opportunity to compare investments in these areas.

When developing investment projects, on the one hand, it is necessary to choose the most promising ones, at the same time, it is necessary to take into account the existence of "developmental boundary", and investment activity should be directed to liquidate them. Human capital is not only a mechanical work (as in the modern world it becomes more and more automated), but also a source of innovation, characterized by the unique features of creativity and the idea generation. At the same time, human capital is a complex category in the process of planning and management, since it requires taking into account the emotional, mental, motivational and other characteristics that are particular to a person. Thus, the return on investment in case of sufficient development of human capital in the operational area can be more predictable, and the implementation of such an investment project is more clear and understandable.

In our work, we construct and examine models for two situations:

– the situation of the need to invest in expanding the sphere of production of goods and the provision of services without the need for additional investments in the development of human capital,

– the situation of investing jointly in the expansion of the sphere of production of goods and the provision of services and in the development of human capital.

The practical value of the mobile application "Pszukaj" developed by the authors is assessed using an anonymous survey among refugees in the Tricity, as well as students of Polish language courses. Based on the data obtained, a regression model is built between the indicators of the level of salary and the individual assessment of the level of knowledge of the Polish language.

Results

The situation of initially sufficient level of human capital development

First, we will consider the project of investing in the expansion of the sphere of production of goods and provision of services without the need for additional investments in the development of human capital, and we will find the optimal value of the investment.

The investment optimization model in the field of production of goods and provision of services would look like:

$$F = \sum_{t=t_0}^{T} \frac{p \cdot Q_1}{(1+i)^t} - I_1 \rightarrow \max_{I_1 \geq 0}, \tag{1}$$

where: F is the net present value of the investment project for the development of the sphere of production of goods and provision of services; p – net income from a unit of manufactured products and services; Q_1 – the volume of production and services; i – discount rate; T – planning horizon; t_0 – is the value of the lag; I_1 – the amount of investments in the sphere of production of goods and provision of services.

As a result of the implementation of investment activities, the volume of production of goods and services will increase, but due to the effect of the law of diminishing returns, this growth will slow down, and the function corresponding to this circumstance will be monotonically increasing and convex upwards:

$$Q_1 = Q_1^0 + e_1\sqrt{I_1}, \tag{2}$$

where: e_1 is an indicator of the efficiency of investments in the sphere of production of goods and provision of services; Q_1^0 – the basic value of the volume of production of goods and provision of services.

When implementing an investment project, it is important to take into account the investor's expectations regarding the value of current money compared to future money, which is what the discount factor is for

$$K = K(i, T, t_0) = \sum_{t=t_0}^{T} \frac{1}{(1+i)^t}. \tag{3}$$

The degree of value of future money is affected by the discount rate i, which is inversely proportional to the discount factor K, and, therefore, the higher it is, the less preference is given to future money compared to the present.

We would apply the introduced dependencies to (1)

$$F = K \cdot p \cdot Q_1 - I_1 = K \cdot p\left(Q_1^0 + e_1\sqrt{I_1}\right) - I_1 \rightarrow \max_{I_1 \geq 0} \tag{4}$$

and we find the optimal value of investments in the sphere of production of goods and provision of services under the condition of a sufficient level of human capital development, equating to zero the first derivative of (4):

$$F'_{I_1} = \frac{K \cdot p \cdot e_1}{2\sqrt{I_1}} - 1 = 0. \tag{5}$$

Here, from

$$\sqrt{I_1} = \frac{K \cdot p \cdot e_1}{2}. \tag{6}$$

We find the optimal value of investments in the sphere of production of goods and provision of services under the condition of a sufficient level of human capital development I_1^*:

$$I_1^* = \left(\frac{K \cdot p \cdot e_1}{2}\right)^2 \tag{7}$$

and the optimal volume of production of goods and provision of services Q_1^*:

$$Q_1^* = Q_1^0 + \frac{K \cdot p \cdot e_1^2}{2}. \tag{8}$$

Analysis (7) and (8) shows that the optimal value of investment in the field of production of goods and provision of services and the optimal volume of production of goods and provision of services increase with the increase in the investment efficiency indicator e_1, what is more, in proportion to the square of this value. An increase in net income p and the discount factor K also leads to an increase in the optimal values of investments and the optimal volume of production of goods and the provision of services, but the optimal volume of production of goods and the provision of services grows linearly, and the optimal value of investments grows proportional to the square of the values of these indicators.

The situation of insufficient level of human capital development

Let us now consider the situation when the sphere of production of goods and provision of services has the potential for development, but the inappropriate state of development of human capital, the inadequacy of its level of qualifications and skills restrains this development, limits it, and, therefore, it is necessary to jointly invest in the development of the sphere of production of goods and provision of services, and in the development of human capital, increasing the level of its productivity and qualification. So, let us consider the case when the basic value of the state of human capital development Q_2^0 does not correspond to the optimal volume of production of goods and services Q_1^*, and there is a need to invest in the development of human capital.

Investing in workforce development can have different characteristics that must be considered according to the specifics and needs of each explicit case. We consider the general nature of investment in the development of human capital, as a result of which its return Q_2 will increase, but according to economic laws more slowly, because the opportunities for improving skills and productivity will gradually be exhausted, so the function Q_2 will be monotonically increasing and convex upwards:

$$Q_2 = Q_2^0 + e_2\sqrt{I_2}, \tag{9}$$

where: e_2 is an indicator of the effectiveness of investments in human capital.

So let us present a model of optimization of investment jointly in the development of the sphere of production of goods and provision of services and in the development of human capital:

$$F = K \cdot p \cdot Q_1 - I_1 - I_2 \rightarrow \max_{I_1, I_2 \geq 0} \tag{10}$$

$$Q_1 \leq Q_2,$$

where: I_2 is investment in human capital.

Let us construct the Lagrange function for the solution of model (10)

$$F(I_1, I_2, \lambda) = K \cdot p \cdot Q_1 - I_1 - I_2 + \lambda(Q_2 - Q_1) \rightarrow \max_{I_1, I_2, \lambda \geq 0}. \tag{11}$$

Let us substitute (2) and (9) into (11) and write the Lagrange function in expanded form:

$$F(I_1, I_2, \lambda) = K \cdot p \cdot \left(Q_1^0 + e_1\sqrt{I_1}\right) - I_1 - I_2 + \lambda\left(Q_2^0 + e_2\sqrt{I_2} - Q_1^0 - e_1\sqrt{I_1}\right) \rightarrow \max_{I_1, I_2, \lambda \geq 0}.$$

and we equate all three of its partial derivatives to zero

$$F_{I_1}' = \frac{K \cdot p \cdot e_1}{2\sqrt{I_1}} - 1 - \frac{\lambda e_1}{2\sqrt{I_1}} = 0, \tag{12}$$

$$F_{I_2}' = -1 + \frac{\lambda e_2}{2\sqrt{I_2}} = 0, \tag{13}$$

$$F_\lambda' = Q_2^0 + e_2\sqrt{I_2} - Q_1^0 - e_1\sqrt{I_1} = 0. \tag{14}$$

Let us solve this system with three unknowns I_1, I_2, λ:
from (12) we get

$$\sqrt{I_1} = \frac{(Kp - \lambda)e_1}{2}, \tag{15}$$

from (13) we have

$$\sqrt{I_2} = \frac{\lambda e_2}{2}, \tag{16}$$

now let us substitute (15) and (16) in (14):

$$F_\lambda' = Q_2^0 + \frac{\lambda e_2^2}{2} - Q_1^0 - \frac{(Kp - \lambda)e_1^2}{2} = 0, \tag{17}$$

Here, from

$$\lambda = \frac{Kpe_1^2+2\left(Q_1^0-Q_2^0\right)}{e_1^2+e_2^2}, \tag{18}$$

we substitute (18) in (15) and (16), we get

$$\sqrt{I_1} = \frac{\left(Kp-\frac{Kpe_1^2+2\left(Q_1^0-Q_2^0\right)}{e_1^2+e_2^2}\right)c_1}{2} = \frac{\left(Kpe_2^2-2\left(Q_1^0-Q_2^0\right)\right)e_1}{2\left(e_1^2+e_2^2\right)}, \tag{19}$$

$$\sqrt{I_2} = \frac{\left(Kpe_1^2+2\left(Q_1^0-Q_2^0\right)\right)e_2}{2\left(e_1^2+e_2^2\right)} \tag{20}$$

and we find optimal investment values

$$I_1^* = \left(\frac{\left(Kpe_2^2-2\left(Q_1^0-Q_2^0\right)\right)e_1}{2\left(e_1^2+e_2^2\right)}\right)^2, \tag{21}$$

$$I_2^* = \left(\frac{\left(Kpe_1^2+2\left(Q_1^0-Q_2^0\right)\right)e_2}{2\left(e_1^2+e_2^2\right)}\right)^2. \tag{22}$$

The obtained results show the dependence of the optimal values of investments in the development of the sphere of production of goods and provision of services and in human capital on both efficiency indicators of investments in the corresponding directions.

Elucidation of the nature of the influence of investment efficiency indicators

To clarify the nature of the influence of investment efficiency indicators in the development of the sphere of production of goods and provision of services and in human capital, consider the derivative of the expression of the optimal value of investment in the development of production and service provision (21) by the investment efficiency indicator e_1.

$$\begin{aligned}(I_1^*)'_{e_1} &= \left(\frac{2e_1\left(Kpe_2^2-2(Q_1^0-Q_2^0)\right)}{2(e_1^2+e_2^2)}\right)\cdot \\ &\cdot\left(\frac{\left(Kpe_2^2-2(Q_1^0-Q_2^0)\right)\cdot 2(e_1^2+e_2^2)-4e_1^2\left(Kpe_2^2-2(Q_1^0-Q_2^0)\right)}{4(e_1^2+e_2^2)}\right)= \\ &= \frac{e_1\left(Kpe_2^2-2\left(Q_1^0-Q_2^0\right)\right)^2\cdot(e_2^2-e_1^2)}{2\left(e_1^2+e_2^2\right)^3},\end{aligned} \tag{23}$$

Therefore, the negativity or positivity of (23) depends on the ratio of investment efficiency indicators, namely

$$(I_1^*)'_{e_1} = \frac{e_1\left(Kpe_2^2-2(Q_1^0-Q_2^0)\right)^2\cdot(e_2^2-e_1^2)}{2\left(e_1^2+e_2^2\right)^3} > 0 \text{ at } e_2 > e_1, \text{ then } I_1^* \text{ increases by } e_1,$$

$$(I_1^*)'_{e_1} = \frac{e_1\left(Kpe_2^2-2(Q_1^0-Q_2^0)\right)^2\cdot(e_2^2-e_1^2)}{2\left(e_1^2+e_2^2\right)^3} < 0 \text{ at } e_2 < e_1, \text{ then } I_1^* \text{ decreases with } e_1.$$

Therefore, with a higher efficiency of investments in the development of the sphere of production of goods and provision of services than the efficiency of investments in the development of human capital, under the conditions of its (e_1) further growth, investments in the development of the sphere of production of goods and provision of services decrease; and with a lower one, on the contrary, they grow.

Now, in order to study the effect of the efficiency indicator of investments in human capital e_2 on the optimal value of investments in the development of the sphere of production of goods and provision of services, we take the corresponding partial derivative:

$$(I_1^*)'_{e_2} = \frac{e_1^2e_2\left(Kpe_1^2+2(Q_1^0-Q_2^0)\right)\cdot\left(Kpe_2^2-2(Q_1^0-Q_2^0)\right)}{4\left(e_1^2+e_2^2\right)^3} = \frac{e_1\sqrt{I_2}\sqrt{I_1}}{e_1^2+e_2^2} > 0 \qquad (24)$$

Analyzing (24), we conclude that with an increase in the efficiency of investments in human capital, the optimal volume of investments in the development of the sphere of production of goods and provision of services always increases, which testifies the primary expediency of investment activity in human capital, the development of which encourages the improvement of the sphere of production and provision of services.

Let us investigate the impact of the efficiency indicator of investments in human capital e_2 on the optimal volume of investments in the corresponding direction. Let us take the derivative of the expression of the optimal value of investment in human capital (22) by the investment efficiency indicator e_2:

$$(I_2^*)'_{e_2} = \frac{e_2\left(Kpe_1^2+2(Q_1^0-Q_2^0)\right)^2\cdot(e_1^2-e_2^2)}{2\left(e_1^2+e_2^2\right)^3}. \qquad (25)$$

The negativity or positivity of (25) depends on the ratio of investment efficiency indicators, namely

$$(I_2^*)'_{e_2} = \frac{e_2\left(Kpe_1^2+2(Q_1^0-Q_2^0)\right)^2\cdot(e_1^2-e_2^2)}{2\left(e_1^2+e_2^2\right)^3} > 0 \text{ at } e_1 > e_2, \text{ then } I_2^* \text{ increases by } e_2,$$

$$(I_2^*)'_{e_2} = \frac{e_2\left(Kpe_1^2+2(Q_1^0-Q_2^0)\right)^2\cdot(e_1^2-e_2^2)}{2\left(e_1^2+e_2^2\right)^3} < 0 \text{ at } e_1 < e_2, \text{ then } I_2^* \text{ decreases with } e_2.$$

Thus, if the efficiency of investments in human capital is higher than in the development of the sphere of production of goods and provision of services, then with its (e_2) further increase, investments in human capital decrease; and if it is lower, then they grow.

Now let us determine the effect of the indicator of efficiency of investments in the development of the sphere of production of goods and provision of services e_1 on the optimal volume of investments in human capital, so we take the corresponding partial derivative:

$$(I_2^*)'_{e_1} = \frac{e_2^2 e_1\left(Kpe_1^2+2(Q_1^0-Q_2^0)\right)\cdot\left(Kpe_2^2-2(Q_1^0-Q_2^0)\right)}{4\left(e_1^2+e_2^2\right)^3} = \frac{e_2\sqrt{I_2}\sqrt{I_1}}{e_1^2+e_2^2} > 0 \tag{26}$$

Therefore, the development of the sphere of production of goods and provision of services in conditions $\bar{Q}_1^* > Q_2^0$ (where $\bar{Q}_1^*$ – the optimal volume of production and provision of services) requires the appropriate development of human capital.

Let us now substitute (21) and (22) in (2) and find the optimal volume of production of goods and provision of services:

$$\bar{Q}_1^* = Q_1^0 + \frac{\left(Kpe_2^2-2(Q_1^0-Q_2^0)\right)c_1^2}{2\left(e_1^2+e_2^2\right)} = \frac{Kpe_2^2+2e_1^2Q_2^0+2e_2^2Q_1^0}{\left(e_1^2+e_2^2\right)}. \tag{27}$$

Let us compare (27) with the optimal volume of production of goods and provision of services in the situation of absence of investment in human capital (8):

$$\begin{aligned} Q_1^* - \bar{Q}_1^* &= \frac{1}{2}\cdot\left(Kpe_1^2 - \frac{e_1^2}{e_1^2+e_2^2}\left(Kpe_2^2-2(Q_1^0-Q_2^0)\right)\right) = \\ &= \frac{e_1^2}{2\left(e_1^2+e_2^2\right)}\left(Kpe_1^2+2(Q_1^0-Q_2^0)\right) > 0, \end{aligned} \tag{28}$$

When $I_2 > 0$. Therefore, in the case of the need to invest in human capital, optimal investments in the development of production and provision of services and the optimal volume of their production decrease compared to the situation when the level of development of human capital would be sufficiently high from the very beginning, which indicates the necessity and feasibility of investments in human capital.

Thus, the analysis of the constructed models revealed the special role of human capital in the activities of enterprises, found the optimal values of investments in the development of the sphere of production and provision of services with a sufficient level of development of human capital, and the optimal values of investments if their joint development is necessary.

The case of the "Pszukaj"application for Ukrainian refugees in Poland

According to the United Nations High Commissioner for Refugees, as a result of the war in Ukraine, the number of refugees in Europe is 6,657,918, with the largest number in Poland, more than 1.2 million people (UNHCR, 2022). According to Statistics Poland (GUS, 2022), there are also 36,000 students from Ukraine studying in Poland, which is 40.3% of all foreign students in Poland. Although they came to Poland temporarily to study, but in the realities of the war in Ukraine, the probability of their desire and need to stay in Poland is growing. The vast majority of refugees have experienced great trauma and are not labor migrants by nature of their resettlement, but their adaptation and integration into the Polish workforce has great potential for the national economy. In Poland, there is a constant increase in awareness of the introduction of the concept of social well-being and corporate social responsibility in the economic environment, and the urgent need in today's realities is the introduction of tools for solving the social problems of refugees, in the solution of which companies and the state can join (Koładkiewicz, 2009). The productivity of employees of socially responsible companies is higher compared to less socially responsible companies, and, therefore, the higher costs of these companies pay off with better results (Sun & Yu, 2015; Balon et al., 2022; Prasad et al., 2022), which confirms the positive influence of social trends on economic results. The social problem that arose due to the large number of refugees in Poland requires a comprehensive solution that would aim not only to help the refugees, but also the Polish economy.

The vast majority of refugees from Ukraine in Poland are women, and, therefore, in the formation of assistance programs, it is necessary to take into account gender characteristics, including pre-low expectations in the level of income and wages among women compared to men (Kurek & Górowski, 2020; Din et al., 2018), limited employment opportunity due to the presence of young children in need of care, etc. According to the study of Demirbağ et al. (2022), women with higher education have higher chances of business success, but even better results are achieved by women who are also aware of political activities in the country. "The higher the political skill, the higher the influence of the level of education on the performance of the firm" (Demirbağ et al., 2022, p. 40). Using these ideas regarding the issue of refugees, it should be noted that the basis for understanding business, economic and political activities in the country receiving them is mastering and understanding the language of the host country at the required level and especially special terminology. Therefore, the study of economic and financial vocabulary is the basis not only for the opportunity for refugees with specialized economic education to get a job according to their qualifications, but also a necessity for understanding the economic and political situation in Poland.

The mass flow of refugees from Ukraine to Poland has led to an increased demand for Polish language courses, meeting this unexpected demand requires resources and

time. To help with physically limited resources, it is necessary to attract modern technological possibilities, for example, distance learning, the use of online translators and other applications aimed at learning the Polish language. At the same time, it should be noted that the supply of free and paid Polish language courses at a basic level for six months from the start of the war was already more or less balanced with demand, that is, should be expected an increase in demand for the need for a deeper and more specialized study of the language.

The mobile application "Pszukaj" developed by the authors is a self-tutor that aims to help users learn economic terms in Polish. The application draws definitions from a database of economic terms, and the user has the opportunity to learn concise definitions in both Ukrainian and Polish languages. The shortage of didactic and scientific tools related to the transmission of knowledge between Poland and Ukraine made it necessary to quickly develop new methods and communication tools for refugees wishing to function independently in Polish society. The "Pszukaj" application enables you to learn terms simultaneously in Polish and Ukrainian. This allows for easier and parallel assimilation of both substantive knowledge and language competences. The current version of the application contains several dozen of the most important economic terms that are generated randomly, which allows for more effective repetition of the acquired knowledge.

Despite the fact that the application is in the initial stage of development, it is available for download on Google Play. The authors are in the process of supplementing the database and extending the application with new definitions and functionalities. On the one hand, it is planned to develop the application in a horizontal manner – adding new modules regarding other scientific disciplines (so far only economic terms have been used), as well as ways to further classify data in the application. This, in turn, will enable better content management and more effective learning when using the application in the future.

The application was written in java, compiled in the .apk format for mobile devices with the Android operating system. In the future, the application is also planned to be made available for devices with the iOS operating system.

To evaluate the effectiveness and usefulness of the mobile application "Pszukaj", we conducted an anonymous survey among refugees in the Tricity, as well as students of Polish language courses, the results of which were processed using computer tools. Table 1 presents the demographic characteristics of the interviewees, which show that the majority of the interviewees are women with a high level of education.

Table 1. Demographic characteristics

Characteristics	Items	%
Gender	Female	78
	Male	22
Age	18–25	9
	26–35	16
	36–45	37
	46–55	24
	56 and older	12
Education	Elementary	11
	Middle	26
	High and higher education	63
Occupation	Student	18
	Knowledge worker	37
	Manual worker	29
	Service industry worker	16

Source: Authors' own study.

An important indicator for the study was the individual assessment of knowledge of the Polish language among the interviewees, which was classified on a scale from one to ten.

Table 2. Individual assessment of knowledge of the Polish language on a scale from 1 to 10

Scale from 1 to 10	Individual assessment of knowledge of the Polish language (%)
1	0
2	0
3	12
4	10
5	24
6	30
7	12
8	6
9	2
10	4

Source: Authors' own study.

According to Table 2, it can be seen that the majority consider their level of language proficiency at the level of average proficiency, while high and low levels of knowledge of Polish are in the minority. With the help of correlation analysis, based on empirical data obtained as a result of the survey, we will establish the relationship between such parameters as the level of salary and individual assessment of knowledge of the Polish language among the respondents. From the calculations, it was found that the value of the linear correlation coefficient between these parameters is 0.618, which indicates a noticeable and direct connection between them. Let us check the statistical significance of the obtained linear correlation coefficient using Fisher's test. Coefficient of determination $R^2 = 0.3823$.

$$F_{\text{observable}} = \frac{0.3823}{1-0.3823} \cdot \frac{50-1-1}{2} = 29.704 \tag{29}$$

At the level of significance $\alpha = 0.01$

$$F_{critic} = 7.08 \tag{30}$$

and $F_{\text{observable}} > F_{critic}$, therefore, the obtained results are statistically significant.

To analyze the dependence between parameters of the level of salary and individual assessment of knowledge of the Polish language, we construct a linear regression equation

$$y = 393.666\,x + 610.45, \tag{31}$$

where we denoted the individual assessment of knowledge of the Polish language by x, and by y the level of salary.

The regression coefficient $b = 393.666$ shows the average change in the effective indicator y with an increase or decrease in the value of the factor x per unit of its measurement. In our case,with an increase of 1 in the knowledge of the Polish language among refugees, the level of salary y increases by an average of PLN 393.666.

Empirical data obtained through the survey helped to confirm the positive impact of the use of the mobile application "Pszukaj" on the adaptation and job search opportunities of refugees among the respondents (Table 3).

Table 3. Characteristics of the relationship between the use of the mobile application "Pszukaj" and the adaptation of refugees in Poland

Characteristics	Disagree (%)	Neither agree nor disagree (%)	Agree (%)
The application is useful in everyday life	12	16	72
The application helped to acquire economic knowledge	6	0	94
The application helped to acquire knowledge of the Polish language	8	14	78
The application helped to expand vocabulary of the native language	12	24	64
The application helped to expand vocabulary of the Polish language	2	0	98
The application is more theoretical than practical	48	32	20
The application helped in finding a job	14	28	58
The application helped to find a job in the specialty	20	40	40
The application helped to adapt to society	14	8	78
The application helped to adapt to the work environment	14	8	78
The application is user-friendly	0	0	100

Source: Authors' own study.

Learning a foreign language is impossible without replenishing the vocabulary, the special feature of the "Pszukaj" application is the economic content, which will expand the base of the economic nature. The target audience of the application is both students of economic fields, who could catch up with definitions that are new to them, and specialists, who could catch up with the Polish equivalent of economic terms.

Regular use of the mobile application "Pszukaj" allows to simultaneously expand the knowledge of economics and the Polish language and apply them in everyday life, as well as in a professional and business environment. Learning the economic Polish language could create an opportunity for refugees not only to become competitive on the Polish labor market and get a job according to their qualifications, but also to understand the economic and political processes taking place in the host country.

Thus, the knowledge obtained with the help of the mobile application "Pszukaj" will help refugees to adapt to the Polish environment

– emotionally, due to the opportunity to feel confident in a new environment,

– socially, thanks to the possibility of a holistic understanding of the Polish language, which will help to freely integrate into society,

– financially, thanks to the opportunity to find decent work according to education, skills and qualifications.

For the Polish economy, a positive effect of the spread of the mobile application "Pszukaj" will be the quantitative and qualitative growth of human capital in the national economy and the gradual exit of refugees from the position of dependents. The advantage of the mobile application "Pszukaj" is its accessibility and ease of use. The financial and other living conditions of refugees do not always give the opportunity to attend courses or take lessons from teachers, and the mobile application "Pszukaj" is their free alternative, the remote use of which allows its users to individualize and optimize the time of learning the economic Polish language.

Conclusions and discussion

The study shows that when developing investment plans for the improvement of enterprises, it is necessary to take into account the state of human capital. The model of investments in the field of production of goods and provision of services in the situation of sufficient level of human capital is constructed and analyzed. The optimal value of investments in the sphere of production of goods and provision of services is found. It is shown it increases with the increase in the investment efficiency indicator in proportion to the square of this value. An increase in net income p and the discount factor K also leads to an increase in the optimal values of investments and the optimal volume of production of goods and the provision of services.

The model of investments in the field of production of goods and provision of services in the situation of insufficient level of human capital is constructed, and optimal investment values are found. The obtained results showed the dependence of the optimal values of investments in the development of the sphere of production of goods and provision of services and in human capital on both efficiency indicators of investments in the corresponding directions.

Analysis of the nature of the influence of investment efficiency indicators in the development of the sphere of production of goods and provision of services

and in human capital has shown that with a higher efficiency of investments in the development of the sphere of production of goods and provision of services than the efficiency of investments in the development of human capital, under the conditions of its (e_1) further growth, investments in the development of the sphere of production of goods and provision of services decrease; and with a lower one, on the contrary, they grow.With an increase in the efficiency of investments in human capital, the optimal volume of investments in the development of the sphere of production of goods and provision of services always increases, which testifies the primary expediency of investment activity in human capital, the development of which encourages the improvement of the sphere of production and provision of services.

Our results show that in the case of the need to invest in human capital, optimal investments in the development of production and provision of services and the optimal volume of their production decrease compared to the situation when the level of development of human capital would be sufficiently high from the very beginning, which indicates the necessity and feasibility of investments in human capital.

The study of the problem of human capital today cannot bypass the issue of refugees. The vast majority of refugees have experienced great trauma and are not labor migrants by nature of their resettlement, but their adaptation and integration into the workforce of the hosting country has great potential for its national economy. According to the data, now the largest number of refugees from Ukraine are in Poland. Our study highlights the need to learn the Polish language for their full adaptation, which can be helped by the use of technical capabilities such as themobile application "Pszukaj" developed by the authors. It is shown that new methods and communication tools should be useful for refugees wishing to function independently in Polish society.

It is marked that the basis for understanding business, economic and political activities by refugees in the host country is mastering and understanding its language at the required level and especially special terminology. Therefore, the study of economic and financial vocabulary is the basis not only for the opportunity for refugees with specialized economic education to get a job according to their qualifications, but also a necessity for understanding the economic and political situation in Poland.

Empirical data obtained through the survey among refugees in the Tricity, as well as students of Polish language courses, helped to confirm the positive impact of the use of the mobile application "Pszukaj" on the adaptation and job search opportunities of refugees among the respondents. The "Pszukaj" application enables refugees to learn terms simultaneously in Polish and Ukrainian. This allows for easier and parallel assimilation of both substantive knowledge and language competences. The application was written in java, compiled in the .apk format for mobile devices with the Android operating system. In the future, the application is also planned to be made available for devices with the iOS operating system.

For the Polish economy, a positive effect of the spread of the mobile application "Pszukaj" will be the quantitative and qualitative growth of human capital in the national economy and the gradual exit of refugees from the position of dependents.

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