Interrelations between Education, Health, Income and Economic Development in Europe with Emphasis on New Members of European Union

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Abstract:
This study looks at how health, education, and economic development are inter-related in the case of Europe. Factorial analyses besides econometric models, implemented on a panel data from EUROSTAT show that the included variables are interrelated. The new members of the European Union are found to be investing in education, research and development and health care. Furthermore, they have high economic growth and high improvements in education and health state indicators. However, the instability and economic risks that have appeared during the transition process do affect the level of social protection. The existing social protection system increases poverty rates and slows the convergence towards developed economies. Two main directions for enhancing human development in EU new member economies are identified. They include the strengthening of the social protection system to target the vulnerable members affected by the transition process besides increasing expenditure on research and development.

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1. Introduction

This study aims at analyzing the interdependencies existing between health, education and poverty as preliminary steps towards an analytical focus on human development policies. Previous research already demonstrated the role of knowledge and education in driving economic performance (Driouchi, A. et al, 2006). The paper deals with how other variables such as health, that are directly related to human development, interact and affect economic and social development.

Insights into these inter-related issues have been building with the development of both theoretical and empirical studies focusing on interdependencies and with the identification of new challenges facing policy-makers regarding the magnitude and the scope of sector inter-relations.

As developed in different empirical reports and studies, human development policies do have important interdependencies that should be better identified. These identifications help in refining the knowledge and the direction of policy actions that could enhance the level of attainment of the EU aims, as well as the enhancement of the living conditions of populations in general.

This research has two inter-related objectives. The first one is to show how health, education, and income poverty are inter-related in the context of the European Union countries. The second objective is to identify which are the main directions to be followed in Europe to enhance human development.

To achieve the above objectives, the most recent studies are reviewed and used to support the empirical investigations pursued in this paper. Most of the studies contributed in depicting various facets of the interdependencies existing between health, education, and economic development but the majority of them explored these interdependencies at the individual level. This paper suggests another path to check for the existence of these interdependencies on more aggregate macroeconomic data.. This approach allows a broader cross-country analysis and comparison (New Members of EU and EU15) which offers the opportunity to check for whether or not the existence and the working of the interdependencies can be generalized across countries and regions.

The empirical results are based on Eurostat data for the 27 European Union Countries as well as 3 candidate countries: Croatia, the Former Yugoslav Republic of Macedonia and Turkey. Because the last decade is a particular one for the European countries we have analyzed the interrelations between health, education and income for three important years of the decade 2000, 2004 and 2007. The empirical analysis begins with a descriptive analysis of health, education and income for all European Union Countries included in the analysis. Then, using factorial methods we analyze the interrelations between these variables and we create four new independent variables. Finally, the main directions to be pursued by new member states of EU and by candidate countries are identified and discussed in order to reduce the gap and then to catch up the old EU member states in economic and human development terms.

2. Literature review on interdependencies of health, education and wealth

In an earlier contribution, Driouchi A. et al. (2006) presented the relationship between knowledge and economic performance using panel data on both developed and developing economies. Among the results attained, human capital and mainly education demonstrated promising roles in the determination of economic performance. However, other human capital related variables, such as health components, were not included given the methodological framework used in the study.

Insights into the likely relationships of health, education and economic performance have been explicitly discussed in a series of social science and public health publications and reports. Different approaches have been used to tackle the extent and magnitude of these relationships. It is obvious that these linkages are well known, but their magnitude and extent of their usefulness for economic and social policies are not often emphasized. This review deals with the importance of interdependencies and the major findings accumulated in the socioeconomic literature.

In advocating the establishment of a panel survey of life-course dynamics (PSLD) as a support for social development public policies in Canada, Bernard et al. (2006) explain the importance of adopting a holistic approach to development which takes into consideration the complexity of the interactions between education, health and economic welfare. According to the authors individuals' welfare essentially depends on the extent to which they are enabled to enjoy appropriate levels of health, of knowledge, and of economic security. The latter three types of resources should be viewed as both causes and consequences of one another throughout the individuals' lifetime. They as well identify social capital which could be

considered as an additional important factor because individuals can accumulate other useful resources for themselves, their families and their communities through social networks. The idea expressed by Bernard et al. (2006) relates directly to the aim of this paper being the depiction of the strong interdependency between variables related to health, education and economic activity.

Adams et al. (2003) examined a population of elderly Americans aged seventy and older using causality tests to investigate causal paths between socioeconomic status and health condition. The results obtained suggest that for the category of acute, sudden onset health conditions the socioeconomic status gradient is not significant yet it is it in case of mental, chronic, and degenerative conditions.

Lee and Kim (2007) conducted a longitudinal analysis to detect the long-term effect of health shocks on wealth in comparison with its short-term effect on the elderly in the U.S., which is consistent with the previous studies including that of Adams et al. (2003). New health events appeared to have negative impacts on wealth but disappeared over time (Lee and Kim, 2007). The results also verified that severe health conditions (existing and new) significantly influenced wealth depletion mainly when shocks happen later in life. Furthermore, the study confirmed that health capital (existing severe chronic conditions) has a persistent negative impact on wealth changes over time. These results are subject to variation with the level of education, the family status, and other factors. Longer term effects were also investigated using panel data by P. Adams et al (2002) and by Cutler et al. (2007). However, limited evidence has been proven; the same results were found through the study of Cutler, Miller and Norton (2007). Mayer-Foulkes (2004) addressed the long-term impact of health by including the intergenerational and life-long dimensions. The relationships between health and each of the components that define the wealth of an individual, a group, and a country are examined below using a variety of publications.

Cutler David M, Adriana Lleras-Muney and Tom Vogl (2008) presented the existence of a clear link between socioeconomic status and health, which are identified by a number of studies covering both the United States and European Countries. For example, mortality risk rises when individuals do not reach upper secondary education in the United States and in some European Countries. Each of the measures of socioeconomic status influences health through different mechanisms. This has important implications for the choice of public policies aiming at improving the health of individuals under specific conditions.

Sommestad (2001) emphasized the role of investment in human capital, with health being the major engine of economic growth. Based on the empirical evidence, "a 5-year gain in life expectancy resulted in 0.3 to 0.5 per cent economic growth". Poverty and poor health penalize economic growth (Bloom and Canning, 1999). In The Health and Wealth of Nations, Bloom & Canning (2000) acknowledged the relationship between health and income, which indicates that higher income leads to a longer life expectancy. A healthier population works more efficiently with higher chances of improving its skills, generates and attracts more investments, and benefits from a higher resource allocation. This causality between health and income lead to health improvement and, then to further income increase. Various examples of this "Virtual Spiral" are from East Asia and Ireland (Bloom & Canning, 2000). In another publication, the same authors (2004) stressed that investing in health leads to higher economic and social performance under sound macroeconomic policies and governance. The same study illustrated that initial beneficiaries of health improvements are often the most vulnerable groups (children), with healthier children having better school attendance and improved performance. This shows how health and income have been identified to be highly related.

Hurd and Kapteyn (2005) also analyzed the relationship between health and income. They noticed (found) that, in some countries, a large variation in wealth is associated with a large variation in health. Further techniques and analysis have shown the importance of the link between health and expenditures. Xu et al. (2003) demonstrated the existence of an overall positive relationship between the proportion of households with catastrophic health expenditures and the share of out-of-pocket payments in total health expenditures. Gerdtham and Thgren's (2002), in a cross-country study that covered 25 OECD countries, found out that health expenditure and GDP are co-integrated around linear trends.

Knapp (2007) dealt with the links between nutrition, labor productivity and a health variable, height. The net role of nutrition on labor productivity was shown to be highly significant. Muysken et al. (1999) showed that when physical capital, relative to health, is scarce, optimal expenditures for health and consumption are lower. Also, consumption is no longer likely to be negatively related to population growth because it enhances the percentage of health workers.

Wichmann (1995) investigated the nutrition-productivity relationship at low levels of income and showed the existence of a strong relationship between the state of nutrition or health and labor productivity. The dynamic version demonstrated that better nutrition increases the productivity of the learning by doing

process. The empirical evidence gathered confirmed the above findings, but revealed that children with good nutrition and health start school at an earlier age, progress further, and repeat fewer grades (Yamauchi, 2006). However, the analysis of a long panel of data (11 years) suggests that good health may discourage further investments in schooling at the stage of transition from primary to secondary school and that better health status may reinforce incentives to go to work.

A further series of publications produced major inputs into how interdependencies could be used to support more realistic policies. Anderson et al. (2004) illustrated how to account for evidence about early childhood socioeconomic conditions, which have long-term health consequences on health disparities over the life course, in relation to early investments in education. Aging populations in the developed world are currently posing a serious threat to the cost of pensions and health care. Anderson et al. (2004) explained why countries cannot expect to grow themselves out of the problem using measures such as increasing immigration, raising the retirement age, and encouraging households to have more children.

According to Farrell et al. (2005), the only effective measures are for households and governments to increase their savings rates and to allocate capital more efficiently in order to earn higher returns on the assets they have. Grimm and Harttgen (2007) looked at the role of the dependency ratio, in relation to population growth, in relation to health. They also found that a low life expectancy substantially reduces welfare, despite the related economic feedback effects.

All of the above studies contributed in depicting various facets of the interdependencies existing between health, education, and economic development. The majority of these papers explored these interdependencies at the household level in specific country using household survey data. This paper suggests another path to check for the existence of these interdependencies and this following the basic assumption their existence at the household level should reflect on more aggregate macroeconomic data. For instance, the analysis of general macroeconomic data on the general health conditions and education level in a given country should as well reveal interdependency paths if the interdependencies demonstrated at the household level are true. This approach allows a broader cross-country analysis and comparison (New Members of EU and EU15) which offers the opportunity to check for whether or not the existence and the working of the interdependencies can be generalized across countries and regions.

3. Empirical investigation

3.1. Data description

The results introduced in this section are based on Eurostat data for the 27 European Union Countries as well as 3 candidate countries: Croatia, the Former Yugoslav Republic of Macedonia and Turkey. During the last decade European Union was characterized by a continuous geographic expansion and development: on 1st January 1999 the EURO became the common currency of more than 300 million Europeans and on 1st January 2002 the EURO notes and coins are introduced; 1st May eight countries of central and eastern Europe (Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Slovenia and Slovakia), Cyprus and Malta join the EU; 1st January 2007 two other East European Countries (Bulgaria and Romania) join the EU.

Because this last decade is a particular one for the European countries we have analyzed the interrelations between health, education and income for three important years of the decade 2000, 2004 and 2007. The empirical analysis begins with a descriptive analysis of health, education and income for all European Union Countries included in the analysis. Then, using factorial methods we analyze the interrelations between these variables and we create four new independent variables. Finally, we analyze which are the main directions to pursue by new member states of EU and by candidate countries in order to reduce the gap and then to catch up the old EU member states.

Education indicators

The education indicators used relate to all main fields: education outcomes, participation in education, education costs and mobility. School expectancy shows the overall level of development of an educational system in terms of the number of years of education that a child is expected to achieve. Special attention is required in the interpretation as long as relatively higher school expectancy indicates greater probability for children to spend more years in education but also, higher overall retention within the education system. The EU15 mean of school expectancy increases with 0.5 years (from 17.03 years to

17.53 years) during the period 2000-2007 while the New Member States of EU mean of school expectancy increases with 1.5 years (from 15.31 years to 16.83 years) during the same period.

The average number of foreign languages learned per pupil in secondary education (ISCED 2 and 3) is the second indicator chosen to characterize the education outcomes. School is the main opportunity for the majority of people to learn foreign languages. The countries where the average number of foreign languages learned per pupil is grater then two are: Luxemburg (with 2.5 languages learned per pupil in 2007), Malta and Finland (with 2.2 languages learned per pupil in 2007), and Cyprus, Estonia, Denmark, Netherlands, Romania, Portugal (with 2 languages learned per pupil in 2007).

The public sector is still a major provider of education in all countries. Public expenditure on education expressed as a percentage of GDP increased by 0.4% in New Member States of EU (in mean) during the analyzed period (2000-2007) reaching the level of 5.05% of GDP very close to EU15 mean (5.41% of GDP).

European Union encourages mobility of students, teachers and researchers within Europe by special programs. The indicator Mobility of Students presents the number of students (ISCED 5-6) studying in another EU-27, EEA or Candidate country divided by 1000. The average number of students from New Member States studying in another European country increase by 8500 students during the analyzed period (2000-2007). Even so, the average mobility of students in New Member States is still much lower than the average mobility of students in EU15 countries (13180 students in average for New Member States compared to 21970 students in average for EU15 countries in 2007).

All the candidate countries (Croatia, Former Yugoslav Republic of Macedonia, and Turkey) have the education indicators below the average for the European countries. One exception can be observed for Turkey which has a very high level of the mobility of students (37700 students studying in another EU-27, EEA or Candidate country). One explanation for this level could be the country dimension (the population of Turkey is 14.07% of EU27 population - the second country by population in Europe, after Germany).

Table 1: Education Indicators

	School Expectancy (years)			**Public expenditure on education (% of GDP)**			**Mobility of Students (/1000)**			**The average number of foreign languages learned per pupil**		
	2000	*2004*	*2007*	*2000*	*2004*	*2007*	*2000*	*2004*	*2007*	*2000*	*2004*	*2007*
EU15	17.03	17.65	17.53	5.31	5.40	5.41	17.91	18.20	21.97	1.63	1.63	1.65
New Members	15.31	16.54	16.83	4.68	4.97	5.07	4.72	9.82	13.18	1.49	1.49	1.56
Croatia	-	14.6	15.2	-	3.9	4.11	7.6	9.3	9.2	-	-	-
Former Yugoslav Republic of Macedonia	12.9	13.1	13.7	-	-	-	2.4	5.4	6.7	1.3	1.3	1.7
Turkey	10.4	12.9	-	2.59	3.12	2.86	34.4	36.8	37.7	-	-	-

Health indicators

Health measurements are related to two main areas: mortality and health care. Life expectancy at birth is a measure of a population's state of general health. It is calculated as the mean number of years that a newborn child can expect to live if subjected throughout his life to the current mortality conditions (age specific probabilities of dying). Life expectancy rose rapidly in last century due to improvements in public health, nutrition and medicine. In Western European countries it reached 80 years in 2007 with very small regional variation (from 78.4 in Denmark compared to 81.21 in France, in 2007). The regional variation in New Members of European Union is much more important. It is known that this indicator is highly dependent on life style. One example is Cyprus which being a Mediterranean country has habits that increase life expectancy. Actually Cyprus was the country with higher value of life expectancy at birth in 2007 (80.05 years). Another interesting fact is that life expectancy had not an increasing trend during the last decade for some countries in Eastern Europe. For example, life expectancy in Lithuania has an oscillatory evolution (reaching the smallest value in 2007 of 70.92 years).

The infant mortality rate represents the number of children dying before their first year out of 1,000 live births within a year. The infant mortality rate varies widely between countries. One reason is the method of defining a live birth and how many premature infants are born in the country. The World Health Organization (WHO) defines a live birth as any born human being who demonstrates independent signs of life, including breathing, voluntary muscle movement, or heartbeat while many countries, including certain

European states and Japan, only count as live births cases where an infant breathes at birth, which makes their statistics on Infant Mortality lower. Therefore, in Western European countries the Infant mortality rate in 2007 was 3.49 infant deaths per 1,000 births compared to 6.24 infant deaths per 1,000 births for New Members of European Union. As for life expectancy at birth, infant mortality varies much more between New Members of European Union (2.8 in Slovenia to 12.0 in Romania) then between EU15 countries (from 1.8 in Luxembourg to 4.8 in United Kingdom).

Since both indicators on mortality are highly dependent on health care services, two other indicators are considered for health: practicing physicians and curative care (or acute care) beds in hospitals. Practicing physicians are physicians who provide services directly to patients. Because of lack of data for some countries (Ireland, Italy, Malta, Netherlands) we have estimated the missing values with the data from licensed physicians who are practicing physicians, professionally active and economically active physicians as well as all physicians being registered and entitled to practice as health care professionals. This indicator varies a lot for Western European countries from 249 practicing physicians per 100 000 inhabitants in UK to 652 practicing physicians per 100 000 inhabitants in Italy, in 2007 with a mean of 365.9 practicing physicians per 100 000 inhabitants for all EU15 countries. As for Eastern European countries it could be observed a greater homogeneity with the average of 290.8 practicing physicians per 100 000 inhabitants for all New Member States in 2007 (the smallest value is found in Poland – 219.1 practicing physicians per 100 000 inhabitants while the highest value is found in Lithuania – 371.1 practicing physicians per 100 000 inhabitants in 2007). In all European countries could be observed an increasing tendency of this indicator during the analyzed period (2000-2007).

Curative care (or acute care) beds in hospitals (per 100 000 inhabitants) are beds that are available for curative care. Despite the fact that the number of practicing physicians is increasing, the number of curative care beds in hospitals is decreasing during the analyzed period. One explanation could be that European Union aim to improve public health, prevent human illness and diseases, and identify sources of danger to human health. Therefore, more and more physicians work in preventive health care services while the number of curative care beds in hospitals decreases. Because Eastern Europe was in poorer health than Western Europe at the beginning of the 20th century, the number of curative care beds in hospitals was much higher in New Member countries of EU than in EU15 countries (532.7 beds in mean per 100 000 inhabitants in New Members compared to 373.1 beds in mean per 100 000 inhabitants in EU15 in 2000). Because of the improving health in New Members of EU and increasing measures of preventive health, the decrease of the number of curative care beds in hospitals is more important then in Old Member countries of EU (the mean number of curative care beds in hospitals decrease from 532.7 to 290.8 beds per 100 000 inhabitants in New Members of EU compared to the decrease from 373.1 to 251.4 beds per 100 000 inhabitants in EU15 countries).

All the candidate countries (Croatia, Former Yugoslav Republic of Macedonia, and Turkey) have the values of health care indicators and life expectancy at birth very similar to EU countries. One exception could be observed for infant mortality rate which was much higher in Turkey then in other EU countries in 2000 but on descending trend to the values observed in EU countries.

Table 2: Health Indicators

	Life expectancy at birth (years)			**Infant mortality (1,000 live births)**			**Practicing physicians (per 100 000 inhabitants)**			**Curative care beds in hospitals (per 100 000 inhabitants)**		
	2000	*2004*	*2007*	*2000*	*2004*	*2007*	*2000*	*2004*	*2007*	*2000*	*2004*	*2007*
EU15	78.19	79.36	80.00	4.9	4.1	3.5	318.5	347.1	365.9	373.1	347.7	251.4
New Members	73.83	74.46	75.03	8.8	7.4	6.2	282.6	300.5	290.8	532.7	464.4	290.8
Croatia	-	75.45	75.82	7.4	6.1	5.6	235.2	249.6	266.0	373.4	344.0	342.2
Former Yugoslav Republic of Macedonia	73.2	73.58	73.78	11.8	13.2	10.3	-	-	-	329.8	317.9	-
Turkey	-	-	-	28.9	24.6	15.6	129.6	-	-	218.0	231.1	-

Income indicators

The European Union combines the economies of 27 member states and accounts for about 31% of the world's total economic output according to the IMF. The current map of EU economic development is one of huge regional variation. The disparity between old and new Member States remains very

pronounced, although some of the relatively poorer countries are indeed catching up. The GDP per capita in 2007 was 10880 euro in average for New Member countries compared to 34010 euro in average for EU15 countries. The twelve new member states of Central and Eastern Europe have enjoyed a higher average percentage growth rate compared to their Western European counterparts (in 2007 the average of growth rate for New Member States was 6.66% compared to an average of 3.33 % growth rate for EU15 countries). Notably the Baltic States have achieved massive GDP growth, with Slovakia and Latvia topping 10% in 2007. Reasons for this massive growth include government commitment to stable monetary policy, export-oriented trade policies, the utilization of relatively cheap labor, foreign direct investments, etc. The very high growth rate of GDP could overheat the economy of a country with negative consequences even in terms of non-economic crisis.

The second indicator chosen to explain the income of a country is At-risk-of-poverty rate after social transfers (%) which is calculated as the share of persons with an equivalent disposable income below the risk-of-poverty threshold, which is set at 60 % of the national median equivalent disposable income (after social transfers). With respect to this indicator there are some disparities between countries, but the means levels of poverty for new and old members are comparable (16.55 % for New Members compared to 15.33 for EU15 Countries in 2007). The poverty rate for the New Members is increasing during the analyzed period (from 14.75% in 2000 to 16.5% in 2007) due to the transition process which affected some families and peoples (especially the old peoples who have difficulties of adaptation to the new and dynamic economy).

Total expenditure on social protection per head of population (PPS) provides detailed information on the performance of national social protection schemes. They are designed to reduce poverty and vulnerability against hazards and interruption/loss of income. Effective social protection contributes to fair growth, social stability and enhanced productivity. In old European countries the expenditure on social protection is much higher then in new members (an average of 7880 PPS for EU15 countries versus 2780 PPS for New Members, in 2007) even if there are important increases of social protection in all 12 new members of European Union.

Research and development expenditure include all expenditures for R&D performed within the business enterprise sector (BERD) on the national territory during a given period, regardless of the source of funds, shown as a percentage of GDP. Research and development is necessary due to continuous technology change and development, to changing preference of customers and to the competition on the market. The mean level of research and development expenditure is much higher for EU15 countries than for New Members (1.95% in GDP for EU15 compared to 0.79% in GDP for New members in 2007). The absolute level of R&D expenditure is even higher that is shown by this indicator, because in old members of EU the GDP is higher than in new members.

Table 3: Income Indicators

	GDP per capita (euro per inhabitant)			**Total expenditure on social protection per head of population (PPS)**			**Research and development expenditure (% in GDP)**			**At-risk-of-poverty rate after social transfers (%)**		
	2000	*2004*	*2007*	*2000*	*2004*	*2007*	*2000*	*2004*	*2007*	*2000*	*2004*	*2007*
EU15	25320	29190	34010	5880	7080	7880	1.78	1.87	1.95	15.33	15.5	15.33
New Members	5933	7758	10880	1930	2420	2780	0.67	0.7	0.79	14.75	17.66	16.54
Croatia	5200	7400	9700	-	-	-	-	1.05	0.81	-	18	18
Former Yugoslav Republic of Macedonia	1900	2100	2800	-	-	-	-	-	-	14	-	-
Turkey	4500	4600	6700	-	-	-	0.48	0.52	0.72	-	-	-

3.2. How education, health and income are interrelated in European Union context?

In order to identify which are the interrelations between education, health and income, a principal component analysis is applied (see appendix 1 for a brief description of the method) using the variables described previously. The method is applied three times on all EU countries: on 2000 database, on 2004 database and on 2007 database in order to prove the stability of interrelations during the analyzed period of time.

Results based on 2000 data

Running Principal Component Analysis in SPSS on 2000 data, 75.82% of the information is preserved by projection of the variables on the first four principal components. Each of the components is determined by the variables with the coefficients in absolute value close to one on the corresponding column. On the first principal component Total expenditure on social protection, GDP per capita, Research and development expenditure, Life expectancy at birth have positive representation while Infant mortality have a negative representation. Therefore income and mortality are interrelated. Moreover, the variable related to general welfare, Total expenditure on social protection is related to income and mortality too. The rich countries have higher expenditure on social protection, improving the population living conditions and as a consequence the general health of the population. On the second principal component are well represented the variables related to health care and poverty. Therefore the countries with high poverty rate, have a small the number of curative care beds. This relation must be interpreted with caution: on the first principal component is found a positive relation of them and on the second principal component is found a negative relation of them. Therefore, analyzing them in interrelation with GDP per capita and Expenditure on social protection, they have a positive correlation and by analyzing them alone, they have a negative correlation. It means that rich countries with low level of poverty rate have small number of Curative care beds in hospitals because the population is in good health while the countries with high poverty rates have small number of Curative care beds in hospitals because they don't have money to finance them. On the third principal component the best represented variables are related to education. On the first principal component is found a positive relation of Public expenditure on Education and School expectancy with Mobility of students in Europe while on the third principal component is found a negative relation of them. It means that rich countries invest in education and the mobility of students is high to improve knowledge while in countries with high poverty rates the mobility of students has principally economic reasons.

Table 4. Rotated Component Matrix, year 2000

	Component			
	1	2	3	4
Total expenditure on social protection per head of population. PPS	**.924**	-.112	.071	-.010
GDP per capita	**.883**	.027	.095	-.192
Research and development expenditure	**.836**	-.163	.203	.015
Life expectancy at birth	**.770**	***.454***	.013	.101
Infant mortality	**-.758**	-.200	-.245	-.208
At-risk-of-poverty rate after social transfers	-.341	**.815**	-.152	.032
Curative care beds in hospitals	**-.405**	**-.694**	-.274	.103
Public expenditure on education	.328	.036	**.720**	-.230
School expectancy	.384	.184	**.702**	.386
Mobility of students in Europe	.385	.371	**-.611**	.311
Foreign languages learned per pupil	.225	.105	-.023	**-.842**
Practicing physicians	.169	.072	-.133	**.699**

Note: Extraction Method: Principal Component Analysis; Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 7 iterations; b. Only cases for which UE/NON UE = UE are used in the analysis phase; c. Year = 2000

Results based on 2004 data

Running Principal Component Analysis in SPSS on 2004 data, 76.81% of the information is preserved by projection of the variables on the first four principal components. Each of the components is determined by the variables with the coefficients in absolute value close to one on the corresponding column. The main difference in the interpretation of the principal components for 2004 compared to 2000 is that the sign of the relationships between variables remains the same on different components. It means that the income, health and education variables interrelate in poorer countries of EU (New Members) as in rich countries. Therefore the students have now knowledge reasons and not economically reasons to study

in another country and the small number of Curative care beds in hospitals appears because of the improvements in health state of the population and not because of the lack of financial support.

Table 5. Rotated Component Matrix, year 2004

	Component			
	1	2	3	4
Total expenditure on social protection per head of population. PPS	**.940**	.045	.145	.136
GDP per capita	**.873**	-.017	.282	.041
Research and development expenditure	**.741**	***.538***	.114	.005
At-risk-of-poverty rate after social transfers	**-.669**	***-.434***	.325	.317
Infant mortality	**-.524**	-.274	***-.470***	-.294
School expectancy	.041	**.868**	.212	.099
Public expenditure on education	.353	**.710**	.168	-.293
Curative care beds in hospitals	-.071	-.216	**-.877**	.147
Life expectancy at birth	***.556***	.065	**.694**	.303
Foreign languages learned per pupil	.337	-.350	.266	**-.697**
Practicing physicians	.178	-.015	.053	**.676**
Mobility of students in Europe	.083	-.353	.111	**.625**

Note: Extraction Method: Principal Component Analysis; Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 10 iterations; b. Only cases for which UE/NON UE = UE are used in the analysis phase; c. Year = 2004

Results based on 2007 data

Running Principal Component Analysis in SPSS on 2007 data, 74.29% of the information is preserved by projection of the variables on the first four principal components. Each of the components is determined by the variables with the coefficients in absolute value close to one on the corresponding column. For the year 2007, it is found a further distinction between components. The first component is mainly explained by variables related to income and health (mortality). High income and high social protection means better health and low poverty rates. The second component is mostly related to education and health care. High levels of education mean better health and a lower need of health care.

Table 6. Rotated Component Matrix, year 2007

	Component			
	1	2	3	4
Total expenditure on social protection per head of population. PPS	**.932**	-.108	.190	.005
Infant mortality	**-.852**	-.088	-.045	-.085
GDP per capita	**.840**	-.233	.248	-.133
Research and development expenditure	**.750**	***.441***	.063	-.009
Life expectancy at birth	**.717**	.152	*.377*	.244
At-risk-of-poverty rate after social transfers	**-.676**	-.311	*.349*	.199
School expectancy	.182	**.780**	-.079	.111
Public expenditure on education	.160	**.746**	*.346*	-.197
Practicing physicians	.283	**-.454**	.043	.196
Curative care beds in hospitals	-.236	-.209	**-.827**	-.150
Foreign languages learned per pupil	.088	-.250	**.670**	***-.571***
Mobility of students in Europe	.017	-.192	.073	**.886**

Note: Extraction Method: Principal Component Analysis; Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 8 iterations; b. Only cases for which UE/NON UE = UE are used in the analysis phase; c. Year = 2007

Analyzing the results obtained previously by applying Principal components method on 2000 data, on 2004 data and on 2007 data (Table 4, 5 and 6) we found that all variables except At risk at poverty rate, Infant mortality and Curative care beds in hospitals have a positive representation on it. This means that there is a negative correlation between these three variables and all the others. The first principal component tells us about whether a country is rich (high values of GDP per capita) then it has a population in good health (high values of Life expectancy, low level of Infant mortality and small number of Curative care beds in hospitals), educated (high values of School expectancy, Foreign languages learned per pupil), it protects their inhabitants against poverty risks (Total expenses on social protection are high, At risk at poverty rate is low) and it makes investments in the development of human quality (high levels of Public expenditure on education, R&D expenditure, mobility of students, practicing physicians). The second component is related to education and prevention. It tells us about whether a country invests in education (high values of Public expenditure on education, R&D expenditure) then it improves the quality of life and the health of population (high values of School expectancy, of life expectancy and low levels of At risk at poverty rate, of Curative care beds in hospitals, of Practicing physicians).

To check this interpretation we plot the data along with the projections of the original features, on to the first two components. Notice that the first component split the old by new members of EU. Finland, Denmark and Sweden are the richest countries (high levels of GDP per capita) with the most educated and healthy people. These economies are also known for their very well developed social protection system. Luxemburg has the highest level of GDP per capita, has a healthy population and invests a lot in social protection but has low levels of education. On the other side of component 1, Romania, Bulgaria and Latvia are the poorest countries of EU. However, these countries are not in the extreme side of the second component, meaning that they invest in education, research and development and health care. Furthermore they have high economic growth and high improvements in education and health state indicators. On the other hand, the instability and economic risks that appear during the transition process not covered by a well developed social protection system increase the poverty rates and slow the convergence of these economies to developed economies. The candidate countries (Croatia, Former Yugoslav Republic of Macedonia and Turkey) have the same problems as all the other new candidates. They invest in education, research and development, they improve their income, health and education indicators, but because of the economic instability and social risks they have a slow transition to developed economies.

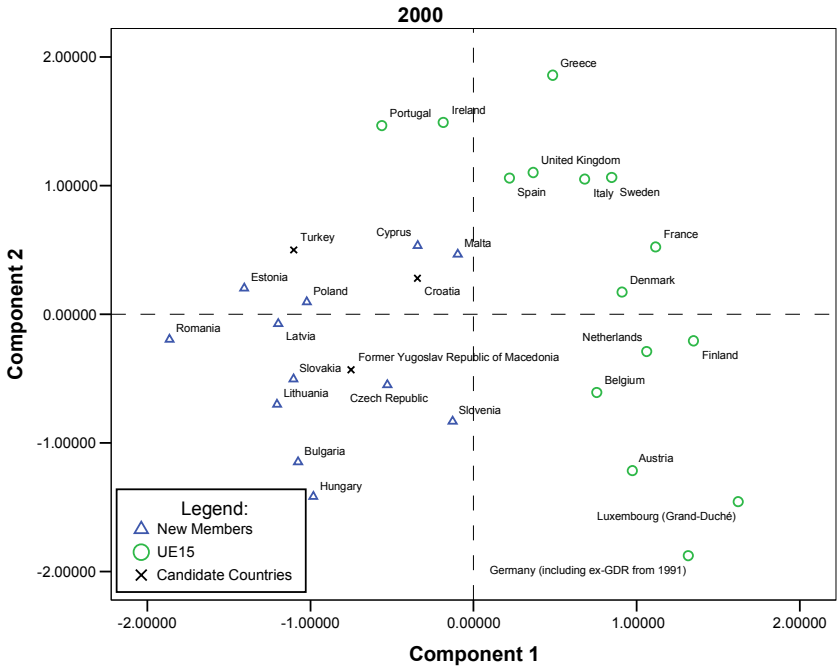

Figure 1 – Country plots on first two components, year 2000

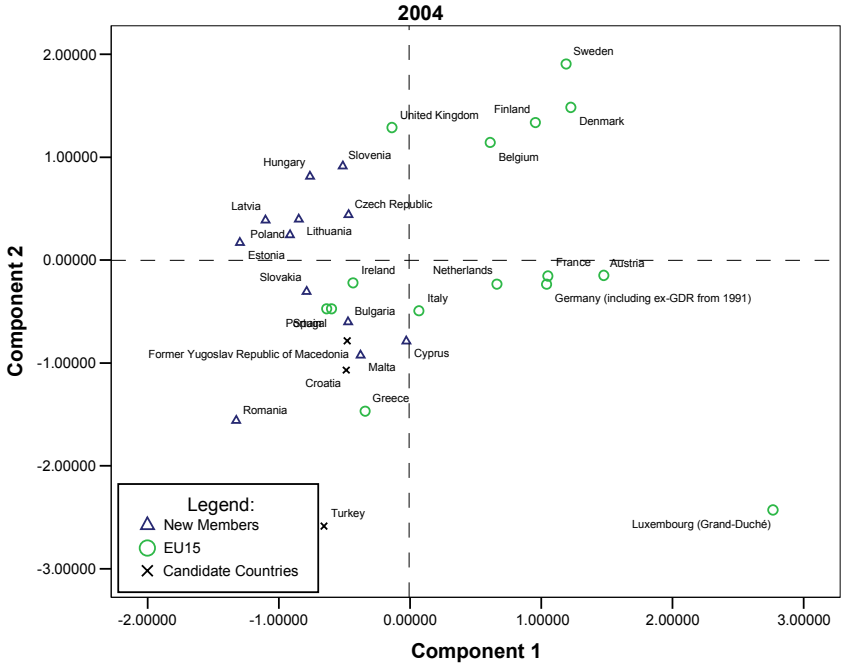

Figure 2 – Country plots on first two components, year 2004

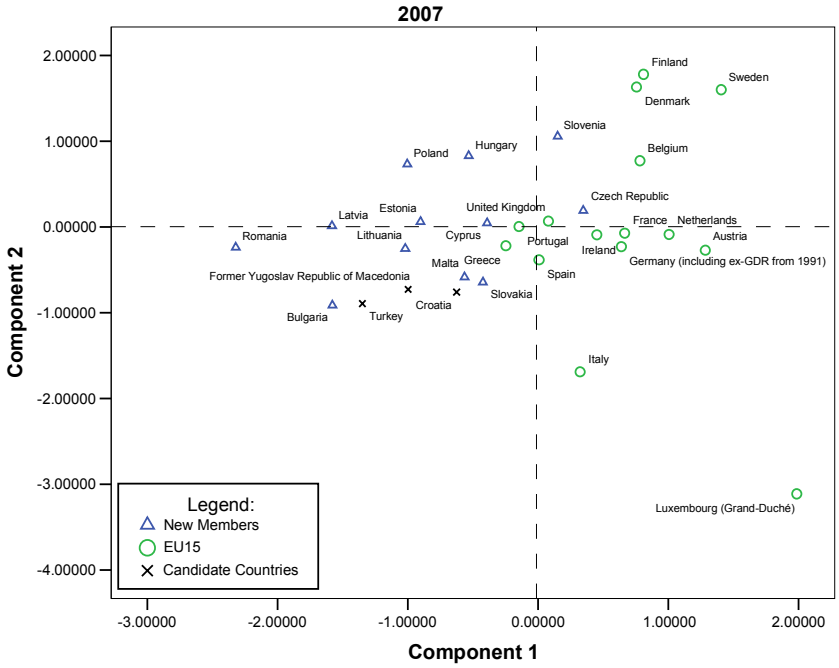

Figure 3 – Country plots on first two components, year 2007

One example to be followed is Slovenian case. During the analyzed period they succeeded to catch up with the developed economies in all aspects by investing in education, health care and prevention, like all other New Members of EU. Moreover the state implemented social measures and instruments to ensuring that individuals and groups are able to satisfy personal and social interests and act as full and equal members of the society and state.

3.3. How to enhance human development for New Members of European Union?

Human development can be viewed as the process of achieving an optimum level of health and well-being. It includes physical, biological, mental, emotional, social, educational, economic, and cultural components. Since 1990 United Nations computes **Human Development Index** (**HDI**) used to rank countries by level of "human development", which usually also implies whether a country is developed, developing, or underdeveloped. The countries are considered developed countries if they have an HDI at or above 0.900. Most of New Members of European Union are developing countries (except: Cyprus and Slovenia from 2004 and Malta and Check Republic from 2007; Figure 4 and Figure 5). All the other countries of EU are developed. Since the goal of EU is that all countries to become developed, it seems important to identify the sources of possible human development for New Members of European Union.

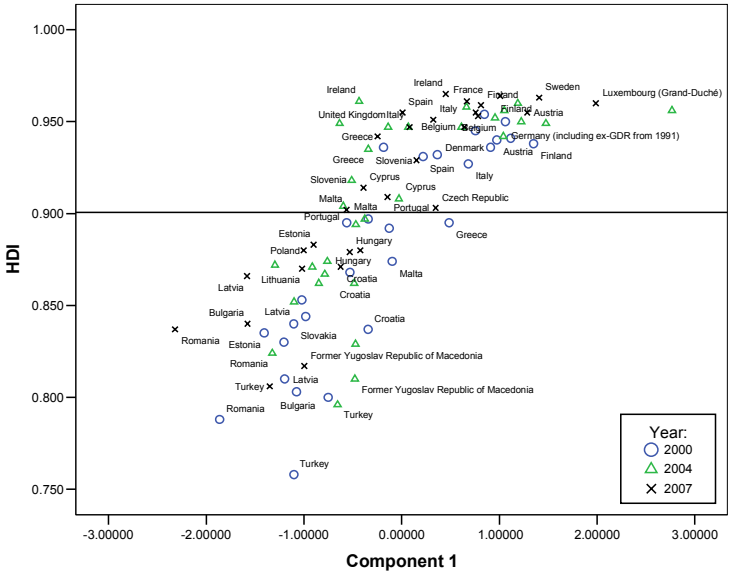

Figure 4 – HDI plots on first Principal component

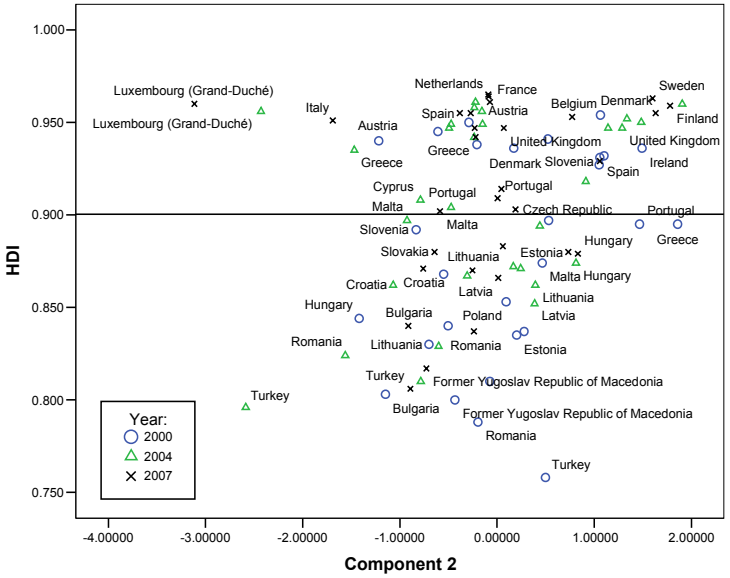

Figure 5 – HDI plots on second Principal component

In order to estimate the effect of first and second Principal Components on HDI we have used a panel data analysis. The variables HDI, First Principal Component and Second Principal Component are observed three years (2000, 2004 and 2007) for all European Union Countries. We have estimated a regression model using Pooled Least Squares Method such that to identify which is the effect of Component 1 and of Component 2 for European Union countries after the removal of fixed effect of time and including one Dummy variable for the membership of EU15 group or to New Members group. The estimated model has R^2=0.86. It could be validated with a significance level of 0.001. All the parameters are significant with a significance level lower then 0.05 (Appendix 2).

$$HDI = 0.885 + 0.0216 \cdot Component\ 1 + 0.0046 \cdot Component\ 2 + \\ + 0.045 \cdot Dummy_{UE15} - 0.016 \cdot Dummy_{2000} + 0.0041 \cdot Dummy_{2004} + 0.011 \cdot Dummy_{2007}$$

where: - $Dummy_{UE15}$ = 1 for EU15 countries and 0 otherwise
- $Dummy_{2000}$ = 1 for Year 2000 and 0 otherwise
- $Dummy_{2004}$ = 1 for Year 2004 and 0 otherwise
- $Dummy_{2007}$ = 1 for Year 2007 and 0 otherwise

Notice that HDI has an ascending trend in time (the fixed effects of time are positive for 2004 and 2007). Moreover the first component has a higher effect on HDI then the second component. Therefore, the first direction to be followed is improving Social security system (Total Expenditure on Social Security is the best represented on the first Principal Component). Second direction to be followed is to increase the research and development expenditure such that to obtain a competitive economy. The third direction is related to improvements in health and education.

4. Conclusion

Over the last half century EU has grown from 6 to 27 nations. It has nowadays the world's third largest population after China and India. EU standards of living are among the highest in the world. However there are huge disparities between EU countries, mainly between new and old members of EU. In 2007, the poorest country in EU, Bulgaria, has GDP per capita of 3800 euro per inhabitant and the richest country, Luxembourg, has GDP per capita of 78100 euro per inhabitant. The EU is striving to narrow the gap between its rich and poor members. By analyzing the interdependencies existing between health, education and income in EU some interesting ideas arise about how to enhance human development in New Members of EU.

The New members of EU, in the early years of transition saw tremendous socio-economic hardship, with the collapse in economic activity and major changes in traditional social roles, values, and definitions of national and ethnic identity. Since then, some countries have experienced a significant economic progress – which started earlier for countries such as Poland, Slovakia, and Slovenia, than for others. Given that we are now 20 years after the break of the Iron Curtain, we can judge the successful strategy for human development. The transition economies with the fastest growth of human development were not those that most reformed their economies and polities but those that have introduced deeper social and institutional reforms. Therefore, for New members of EU countries there are two main directions for enhancing human development. The first one is the development of a social protection system in order to protect the vulnerable members of society. In many ways the transition enabled a broadening of people's choices in ways that were never possible under the old regime, but the reforms also brought huge risks for some categories of population (elderly people, employed persons in industries that have disappeared, people with a very low level of education, etc.). Therefore, these disadvantaged people will be protected and reintegrated in the society and could help the country as a whole to increase the level of human development. The second direction to be followed is the increasing expenditure on research and development, expressed as % in GDP, especially in new technology which holds the key to future economic growth and jobs.

In terms of health, Europeans are leading longer and healthier lives then most of the other nations in the world. Moreover in today's EU, the vast majority of young people have been educated to upper secondary level or upper. Therefore, health and education are important as well to enhance human development in New Members of EU but not in the same terms as it was proved in other studies for emerging and developing countries. The Europeans can do more to protect themselves against the most frequent causes of death and sickness by a healthy and active lifestyle. Furthermore some preventive

measures are considered by promoting physical exercise as recreational activity, measures against smoking in public places, regular visits to doctors, etc. Investing heavily in research and education and training and promoting lifelong learning are the key direction for improving human capital in Europe.

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Appendix 1
The principal components analysis procedure

The Principal Component Analyze is used to reduce large dimensional data sets to data sets with a few dimensions that still retain most of the information in the original data matrix. By reducing the dimensionality of the original data, principal components can often simplify many analyses.
Method description: Given a data matrix X with n cases and p variables (i.e., variables X_1, X_2, ... , X_p) a linear transformation to a new set of variables PC_1, PC_2, ... , PC_p can be calculated as:

$PC_1 = a_{11}X_1 + a_{21}X_2 + ... + a_{p1}X_p$ such that $(a_{11})^2 + (a_{21})^2 + ... + (a_{p1})^2 = 1$
$PC_2 = a_{12}X_1 + a_{22}X_2 + ... + a_{p2}X_p$ such that $(a_{12})^2 + (a_{22})^2 + ... + (a_{p2})^2 = 1$
....
$PC_P = a_{1p}X_1 + a_{2p}X_2 + ... + a_{pp}X_p$ such that $(a_{1p})^2 + (a_{2p})^2 + ... + (a_{pp})^2 = 1$

The principal components are a specific linear combination that is chosen so that the PC_i (called the principal components) have the following characteristics:
1. The p principal components are uncorrelated.
2. The first principal component explains the largest percentage of the variation in the original p-dimensional data set (and the second principal component explains the second largest percentage and so on). Typically the first few principal components account for most of the variation while the remaining principal components make a negligible contribution. As principal components are used to reduce large dimensional data sets to data sets with a few dimensions, typically only the first few principal components are preserved. If the first few principal components do not account for most of the variation, there is little advantage to using them.

Appendix 2
Panel Data Analysis – results obtained using E-View software

Dependent Variable: HDI
Method: Pooled Least Squares
Sample: 2000 2004 2007
Included observations: 3
Cross-sections included: 27
Total pool (unbalanced) observations: 81

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Component 1	0.021654	0.003242	6.679672	0.0000
Component 2	0.004620	0.002211	2.089790	0.0401
Constant	0.885095	0.004094	216.1946	0.0000
Dummy variable (for UE 15 countries)	0.044877	0.006346	7.071981	0.0000
Fixed Effects (Period)				
Constant 2000	-0.016342			
Constant 2004	0.004084			
Constant 2007	0.011047			

Effects Specification

Period fixed (dummy variables)

R-squared	0.856075	Mean dependent var	0.908911
Adjusted R-squared	0.846217	S.D. dependent var	0.046982
S.E. of regression	0.018424	Akaike info criterion	-5.077394
Sum squared resid	0.024780	Schwarz criterion	-4.897436
Log likelihood	206.5571	F-statistic	86.84171
Durbin-Watson stat	0.722768	Prob(F-statistic)	0.000000