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An Assessment of the Factors behind Disparities in Health Status of EU- and former Soviet Union countries

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Abstract

There is considerable variation in the health status of the populations across the "old" and the "new" EU member states, and former Soviet Union countries. The explanation for these differences is investigated by scrutinizing three different groups of factors: 1. Socio-economic factors; 2. Lifestyle factors; 3. Health care resources. The analysis is based on a regression analysis of health production functions (HPF) calculated from cross-country estimations for 2011. Health status is represented by the mortality rate of the working age population.

The explanatory variables of the health production function can explain 83-87% of the cross-country differences in mortality rates. The most important contribution comes from the past economic and political system represented by historical structure of production and the present level of development. Economic and lifestyle disadvantages turn out to be more harmful for men than women. The effects of health expenditure and the geographical location of the country are similar for the two genders. The effects of the relative prices of alcohol- and tobacco products, the consumption of spirits and tobacco, and the share of the hidden economy are significant explanatory factors for men, but non-significant for women.

Introduction[1]

The study looks at the health status of the working-age populations of various countries in 2011. Health status is represented by the mortality rate of the working age population (the probability of dying between the ages of 15 and 60 for men and women). The countries included in our international cross-sectional analysis are 46 European states and successor countries of the Soviet Union.[2,3] The substantial variation in mortality rates across the countries is well illustrated by the fact that in 2011 the mean mortality rate among working-age men was 158.5 with the smallest value of 69 measured in Switzerland and the largest value of 351 in Russia. The corresponding indicators for women are substantially smaller (mean: 73.5, min: 38, Cyprus, max: 156, Tajikistan.) The 46 countries vary in their geographical location, level of development, and economic system and culture (post-socialist versus long-established market economy) in 2011. The latter dimension gives rise to enormous differences in mortality: the mean mortality rates were 210 for men and 92 for women in the post-socialist countries; while the corresponding figures were 91 and 49 in long-established market economies (see also Figure 1, where the countries are divided into three groups, long-established market economies, Central and East European countries and former Soviet Union countries).

In an overview of adult mortality trends in Europe, Luy, Wegner & Lutz (2011) have shown that current levels and the trends over the past half-century were clustered geographically: "Western Europe with the most favorable health conditions, Eastern Europe with the least favorable, and Central Europe falling in between" (p. 76). The authors also emphasize that "the

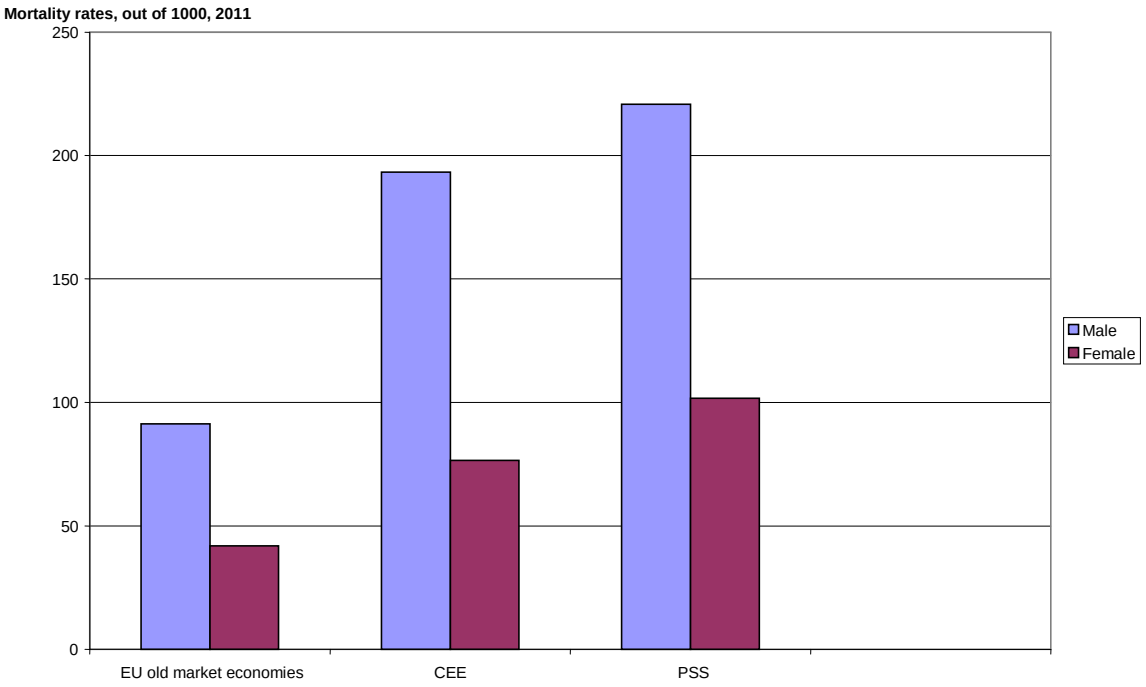
[1] Definition of all the variables and indicators used in the paper as well as sources of data are listed in the Appendix.

[2] The countries included are 26 post-socialist countries: Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Estonia, Georgia, Hungary, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Macedonia, Moldova, Montenegro, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, Tajikistan and Ukraine; and 20 Western European economies: Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Ireland, Israel, Italy, Malta, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey and Great Britain.

[3] To demonstrate the relevance of the question let us note that the world famous medical journal *The Lancet* published a series of articles in 2013 with the title of "Health in Europe," which were concerned with population health and factors determining variation in mortality and morbidity in the European and post-Soviet states.

example of Europe shows political systems can significantly affect health and mortality conditions."

Figure 1: Mortality rates among working-age men and women by country group, 2011



where

EU old market economies: Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Ireland, Israel, Italy, Malta, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey and Great Britain;

CEE (Central and East European) countries: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Hungary, Macedonia, Montenegro, Poland, Romania, Serbia, Slovakia, Slovenia;

PSS (Post Soviet Union states): Estonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Russia, Tajikistan, Ukraine.

Our detailed analysis in this study is based on a regression analysis of Health Production Functions (HPFs) calculated from cross-country estimations for 2011. The explained variable of HPF is the mortality rate of the working age population. The explanation for the differences in mortality rates is investigated by scrutinizing three different groups of factors:

1. Socio-economic factors: geographical position of the country, current level of economic development, and the political and ideological system determining the economy in the past.

2. Lifestyle factors: alcohol and tobacco consumption represented by their relative prices, consumption of spirits as a particularly damaging of these consumption products, overwork in the hidden economy in the past and present, all of which are, to some extent, associated with socio-economic factors.

3. Health care resources: health expenditure as a percentage of GDP.

Sections 1 – 3 look at the possible effects of the various factors including theoretical and empirical considerations and analyze pair-wise correlations of the individual factors and mortality rates. Section 4 discusses the results of multivariable regression models incorporating all the factors discussed earlier.

1. **The effects of the level of development**

Based on the sample of 45 countries, Figure 2 displays the negative but, especially for the post-socialist countries, fairly weak correlation between the level of development of the selected economies and the mortality of working-age men in these countries. Some post-socialist countries, mostly those in the south, appear below the regression line, while the other countries are well-above the line.

Figure 3 shows the relationship between the level of development and mortality among working-age women revealing a stronger negative correlation, than that observed for men.

Figure 2: Mortality rate among working-age men and GDP per capita (natural logarithm)

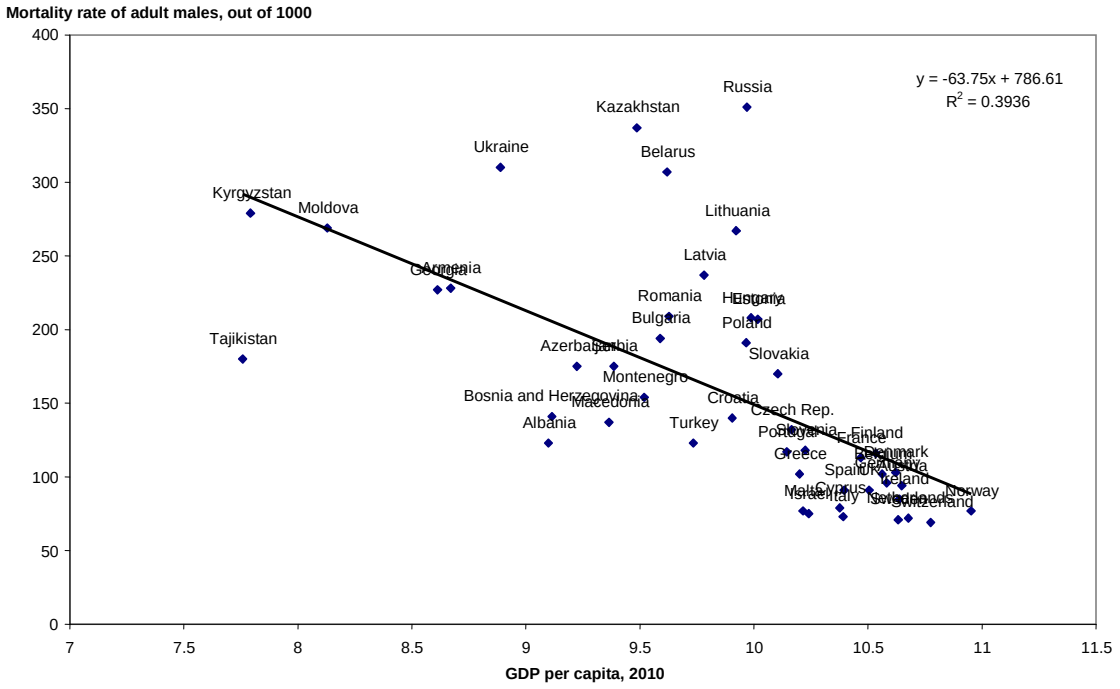
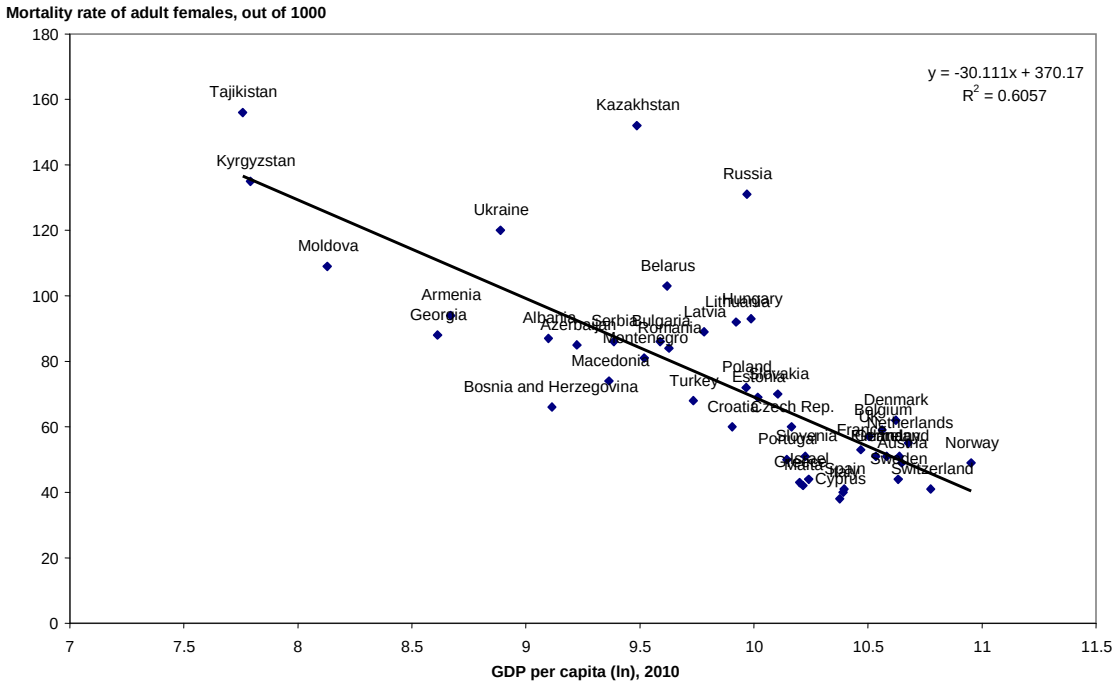


Figure 3: Mortality rate among working-age women and GDP per capita (natural logarithm)



The weak correlations between the level of development and mortality reflected by Figures 2 and 3 as well as the great divide between mortality rates according to different past political systems reflected by Figure 1 suggest that current mortality rates are affected not only by the current state of economic development but also by a combination of various factors accumulated over a long period of time. In the subsequent sections of this study we will show that these factors are: the geographical location, past economic, social and political environment characterizing these countries and the lifestyle behaviors following from them, and direct and indirect indicators of health care expenditures.

2. The effects of geographical location

The literature on European mortality clearly shows that there is a factor characteristic at one end of Mediterranean countries, where heart disease is a rare cause of death and at the other end of the north-eastern regions, where it is a frequent cause of death. Researchers are, however, divided on what mortality causes lie behind the effect of geographical position.

The *Mediterranean paradox* is investigated by Gjonca & Bobak (1997) through Albania, one of the poorest countries in Europe. The authors find that in Albania the age-standardized heart disease mortality among 0-64 year-old men is half as high as in the United Kingdom, and as high as in Italy. The study concludes that the key to the *Albanian paradox* are eating habits: low consumption of total energy, meat and dairy products combined with high consumption of fruit, vegetables and carbohydrates. Grimes, Hindle & Dyer (1998) question Gjonca & Bobak's claims arguing that geographical location predicts the frequency of coronary heart disease in itself. The authors explain the effect by the hours of sunshine determined by the Mediterranean latitude, which would have a beneficiary effect on human metabolism and protect the immune system thanks to increased vitamin D production. The real question is whether the effects of latitude are exerted directly by sunlight affecting human metabolism or indirectly through the dominance of agriculture and diet. It is not clear, the authors argue, whether olives (Albania's most important produce) are simply the embodiment of a climate or it is olive consumption *per se* that has a protective effect against coronary heart disease. Grimes, Hindle & Dyer prefer the former possibility reasoning that the globalization of diet makes it unlikely that olive consumption could be the protector. They also note that although researchers like to explain the development of heart disease citing lifestyle factors and people's health damaging behaviors, there are too many paradoxes by now. Besides the Albanian paradox, other cases featuring in several studies are the *French paradox*, where the harmful eating habits in the south of the country are coupled with low mortality, and the *Italian paradox*, where heart disease mortality remains low in spite of a rather high rate of smokers. "It is undoubtedly true that a life in Mediterranean countries is protective against coronary heart disease, but we believe that geographical location is directly responsible rather than lifestyle and behavior. Too many paradoxes means that time is right for a major paradigm shift." (p. 836).

In Figures 1 and 2 we have seen that GDP per capita and geographical location[4] are rather important factors explaining the differences in mortality rates. We also noticed, however, that the post-socialist countries show some outlier characteristics in terms of these relationships. Below, as a first approach, we summarize and analyze the impact of the mentioned factors in a few regression functions. This exercise is carried out on a sample of 45 countries, working age mortality rate is used as the explained variable, and the level of economic development (GDP per capita), a dummy for the past political and socio/economic system, and geographical location (latitude)are the explanatory variables.

Table 1: Functions explaining the variation in working-age mortality in 2011, 45 countries

	[1] lnmortm	beta	[2] lnmortf	beta	[3] lnmortm	beta	[4] lnmortf	beta	[5] lnmortm	beta	[6] lnmortf	beta
GDP per capita (ln)	-0.53**	-0.82	-0.45**	-0.91	-0.22**	-0.34	-0.32**	-0.64	-0.23**	-0.36	-0.28**	-0.56
	[-6.92]		[-10.97]		[-2.77]		[-4.93]		[-2.01]		[-3.05]	
Latitude	0.027**	0.40	0.02**	0.38	0.016**	0.24	0.015**	0.29	0.016**	0.25	0.015**	0.29
	[4.24]		[4.85]		[3.14]		[3.99]		[3.13]		[4.01]	
Dummy for socialism					0.55**	0.59	0.24**	0.33				
					[4.78]		[2.59]					
Dummy for CEE									0.56**	0.49	0.23**	0.26
									[5.03]		[2.54]	
Dummy for PSS									0.53**	0.53	0.31*	0.4
									[2.50]		[1.92]	
Constant	8.91**		7.76**		6.05**		6.52**		6.16**		6.13**	
	[10.9]		[19.26]		[7.66]		[10.54]		[5.13]		[6.66]	
R2	0.61		0.73		0.75		0.77		0.75		0.78	
RMSE	0.305		0.197		0.2464		0.1826		0.2493		0.1829	
Number of obs.	45		45		45		45		45		45	

Table 1 clearly shows that geographical location affects male and female mortality in similar ways. The mortality reducing effect of the level of development is more pronounced for women. The dummy variable representing past political and socio-economic systems (with a value of 1 for post-socialist countries, and 0 otherwise) has a statistically significant detrimental effect on the health of both men and women, but this effect is far greater for male health than for female health. The results of the model suggest that geographical location does not reflect lifestyle differences. If it did, there should be greater gender differences in the regression coefficients of the latitude variable (allegedly containing differences in diet) since women tend to have considerably more health conscious eating habits than men. Importantly, the gender difference in the regression coefficients of the dummy variable of past socialist regime, in contrast, is likely

[4] Regression estimations the results of which are presented in Tables 1, 5, 6, and 7 were performed with the OLS method. For each calculation the necessary tests for specification (ovtest, linktest, robust) were applied. These tests found no respective errors in the calculations; the values of the tests are not reported.

to follow from lifestyle differences: this variable has a far greater effect on men than on women (see Columns 3 and 4). A similar pattern can be observed for the dummy variable of CEE while the gender difference in the mortality effect of the regime is much smaller in former Soviet Union countries.

3. Economic and social structure and working-age mortality

3.1. Explanations invoking the transformation of socialist economies

The relationship between the sectoral structure of the economy and working-age mortality was first noted by studies in the 1980s. These studies endeavored to analyze the unusual, rapidly increasing mortality trends observed in the second half of the 20th century in Eastern Europe (Cooper and Sempos, 1984, Giersdorf and Schuler, 1984, Bourgeois-Pichat, 1985, Józan, 1989). Since this phenomenon only appeared in state socialist countries, the authors termed it the *State Socialist Mortality Syndrome* (Okolski, 1987, Forster and Józan, 1990, Hoehn and Pollard, 1991, Shkolnikov et al. 1998a).

The first attempts to explain State Socialist Mortality Syndrome focused on health care systems, population lifestyle and alcohol and tobacco consumption. Ivanov and Echenique's (2000) study provided evidence that the health care system alone could not be responsible for the development of the syndrome. Lifestyle appeared to be a more plausible explanation (Cockerham, 1997) but this hypothesis was difficult to corroborate; specifically, it was difficult to find out what could have changed people's lifestyle such a way that mortality was increased as a result. Cornia and Paniccia (2000) observed that behaviors increasing the risk of mortality in Eastern European countries were manifestations of social chaos and stress. Cockerham et al. (2002) add that lifestyle and health may be related to passivity and other attitudes arising from socialist ideology.

The micro-analyses in Kopp et al. (2007) and the volume edited by Kopp (2008) reveal that the rapid increase in adult male mortality starting in the early 1970s in Hungary could not be attributed to the factors causing standard cardiovascular diseases (high intake of fats, smoking, excessive alcohol consumption or obesity), nor could it be explained by inadequate access to medical care. Kopp et al. (2007) and Kopp (2008) claim, instead, that the main explanatory factor behind the rapid increase in adult male mortality is an increase in *chronic stress* and various psychosocial factors. The studies by Maria Kopp and her research group, most of which were made in the period following the political and economic transition, identify low educational attainment, undervalued social status, low personal and family incomes, unavailability of secure jobs, unskilled work, depression, a feeling of lack of purpose in life and a lack of spousal support as the major factors predicting premature death in Hungarian men. These remain statistically significant explanatory factors even if their effects are corrected for the variables representing lifestyle (smoking, alcohol consumption and being overweight). Of the above factors, Kopp (2008) views chronic stress (characterized by the indicator of depression) as some kind of invisible hand having a decisive role in men's premature death. At

the same time, Kopp et al. (2006, 2007) also emphasize extensive engagement in the second economy and voluntary weekend overtime as important explanatory factors in premature cardiovascular disease related deaths.

Józan (2002) also focuses on excessive alcohol consumption in connection with the State Socialist Mortality Syndrome. His touching empirical observations come from Hungary: "Alcoholism has always been a problem in Hungary but the kind of heavy drinking currently haunting the country emerged in the 1950s and 1960s: in part as a Soviet-Russian 'import' and in part with the socialist industrialization and as a result of the milieu inherently linked to the nature of the Hungarian version of the Soviet type socialist society. Daily boundless alcohol consumption became the social norm at the great construction works of the 1950s especially among the undereducated unskilled workers recruited from agriculture. Working days were lived through under the influence of alcohol and at the weekends, without their families (when they did not have the Saturday off) or travelling on the shuttling "black trains" playing cards in their vulcanized fiber suitcases, these weary men drank beer and cheap liquor to oblivion. Alcoholism did not jeopardize their jobs as in the aggressively downward trending, performance curbing economy, society had a permissive attitude towards alcohol abuse. This is how the first generation of the Hungarian unskilled working class travelled from the newly erected Leninváros (Lenintown) or Sztálinváros (Stalintown) straight to an alcohol paradise. Down in the depths of society, this is a genesis of that particular drinking habit, which still continues to be a heavy burden on the entire society" (p. 437).

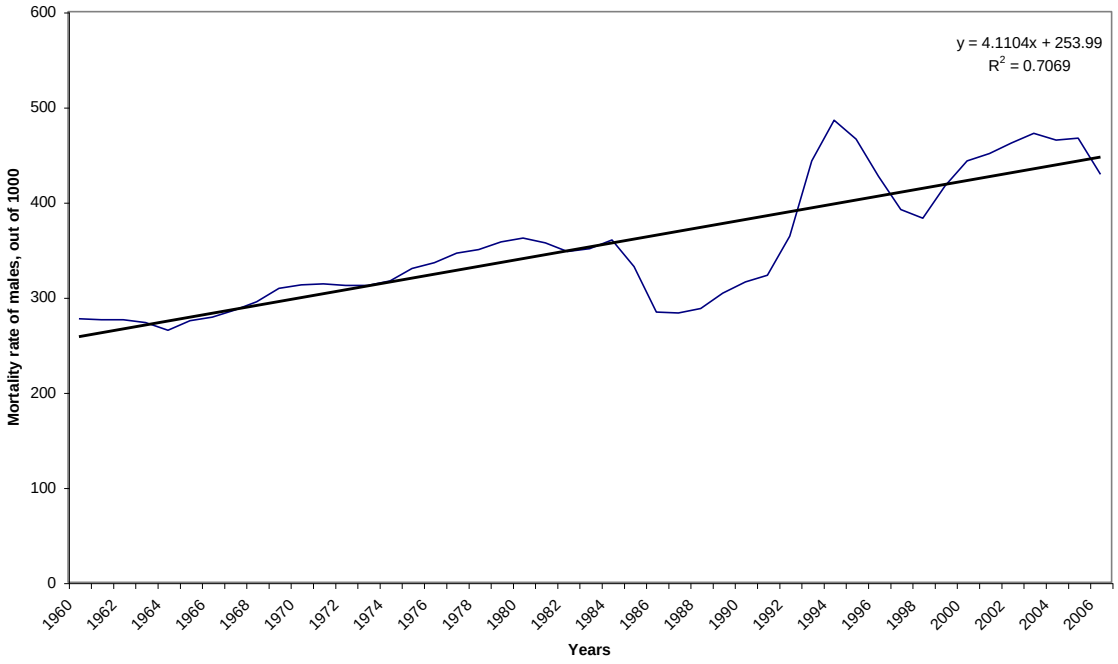
Józan's (2009) macro-analysis also points to the socio-economic environment and the harmful lifestyle it gives rise to as the main explanation for increased male mortality starting in the mid 1960s in Hungary. "Between the mid 1960s and the early 1990s [...] there emerged a dead-end modernization process and, as a result of the shock of the change of regimes, a *chronic epidemiological crisis* [...]. An epidemiological crisis is a phenomenon resting on a foundation of an aggressively forced change to a peaceful socio-economic system, the extortion of a non-organic 'development,' the stopping of evolution by a revolution turning into anarchy: almost complete nationalization, collectivization, pro-military industrialization without investment capital, and as a consequence of all that, the methodical destruction of the super construction of the existing system and its transformation modeled on the Soviet system. The virtual universality of the typical addiction of a psychosocial crisis – smoking – among the working-age male population, and the unrestrained consumption of alcohol mainly among undereducated manual workers were built on this foundation" (Józan, 2009, p. 1240).

Inequalities in mortality and the higher mortality of lower social classes within a country are not exclusive to Eastern Europe; they are also well-known in Western Europe where inequalities have shown an increasing tendency in the last three decades of the 20th century (Mackenbach, 2006). Mackenbach (2006) identifies three groups of factors as the likely causes of the phenomenon: property and income related factors, psychosocial factors and health related behavioral factors. In Western Europe, the difference between the mortality rate data of the various social classes manifests itself that the mortality of lower classes decreases more slowly

than the mortality of higher social classes. The faster decrease among the upper classes is due to a fall in the incidence of cardiovascular diseases. This is explained in part by more health conscious behaviors (less smoking, more physical exercise and better diet) and in part by the introduction of effective medical interventions (diagnosis and treatment of high blood pressure, surgical interventions, treatment of thrombosis).

A special case of State Socialist Mortality Syndrome is the mortality crisis in Russia. As shown in Figure 4, Russia was characterized by an evenly increasing trend in mortality among working-age men from 1960 to 1985, which was followed by a relatively sharp fall thanks to Gobachev's anti-alcohol campaign. After the campaign, mortality rates increased very rapidly – this period is termed the *Russian mortality crisis* in the literature.

Figure 4: Working-age male mortality in Russia, 1960-2006



The search for the causes of the mortality crisis led to a heated debate. Since the sharp rise in mortality coincided in time with the regime change from plan to market, several researchers tried to explain it with reference to the post-socialist transition. The hypotheses related to the post-socialist transition included the following factors as explanations for the Russian mortality crisis:

1. Decline in output and employment (Cornia, Paniccia, 2000, Brainard, 2001),
2. Rapid privatization (Stuckler, King, and McKee 2009),
3. Physiological and psychological stress (Shapiro, 1995, Bobak, Marmot, 1996, Kennedy, Kawachi, Brainard, 1998, Gavrilova et al, 2001),
4. Increase in inequalities (Lynch, Smith, Kaplan, House, 2000, Denisova, 2010),

5. Decrease in the relative price of vodka (Treisman, 2010),
6. Decline of the health care system (Ellmann, 1994).

Excessive alcohol consumption as a direct cause appeared in all theories since this was also suggested by the most common direct causes of deaths during the period: alcohol poisoning, violent death, heart failure and stroke.

In contrast with the theories attributing the phenomenon solely to post-socialist factors, Bhattacharya, Gathmann & Miller (2011) show that the termination of the Gorbachev Anti-Alcohol Campaign itself (which happened just before the regime change) created a "period of reconstruction", which could bear about half of the responsibility for the Russian mortality crisis. The authors emphasize that their analysis indicates that the transition from socialism to capitalism and democracy was not at all as lethal as others had previously suggested.

Kesteloot, Sans and Kromhout (2006) compared *cardiovascular disease related deaths* and all deaths from 1970 to 2000 in Western and Eastern Europe. These authors also note the vast difference in mortality rates during this period between the two regions of Europe. Their results suggest that one of the most important causes of the high mortality in Eastern Europe was the frequent consumption of foods rich in saturated fats before 1990. Their data reveal that the decrease in cardiovascular deaths observed since 1994 is primarily related to changes in eating habits in these countries.

Carlson and Hoffmann (2010, 2011) and Mihályi (2010) observe a link between the characteristic *structure of economic sectors in socialist economic systems* and the increase in mortality in Easter Europe: the forced growth in industry, and heavy industry in particular, and the suppression of the service sector created a norm-defying, anomic environment for men transferred from agriculture to industry, especially to heavy industry. Carlson and Hoffmann compared the employment structures in capitalist countries on the peripheries of Europe[5] to the employment structures in Eastern European countries[6] in 1930, 1950 and then every five years from 1960 to 2005. While in 1930 and 1950 there was no major difference between European periphery capitalist countries and the socialist countries in the ratio of industry to service sector workers, in socialist countries this ratio gradually increased from 1960 all the way to 1995 when it finally began to fall. Comparing these trends with working-age male mortality, the authors conclude that the increase in mortality rates follows excessive industrialization effected by state socialist policies by a lag of about ten years. The social and behavioral consequences of this development policy had accumulated over a period of time and directly led to the increase in mortality. The authors support their hypothesis by econometric analyses: a fixed effects panel regression model confirms their claims.

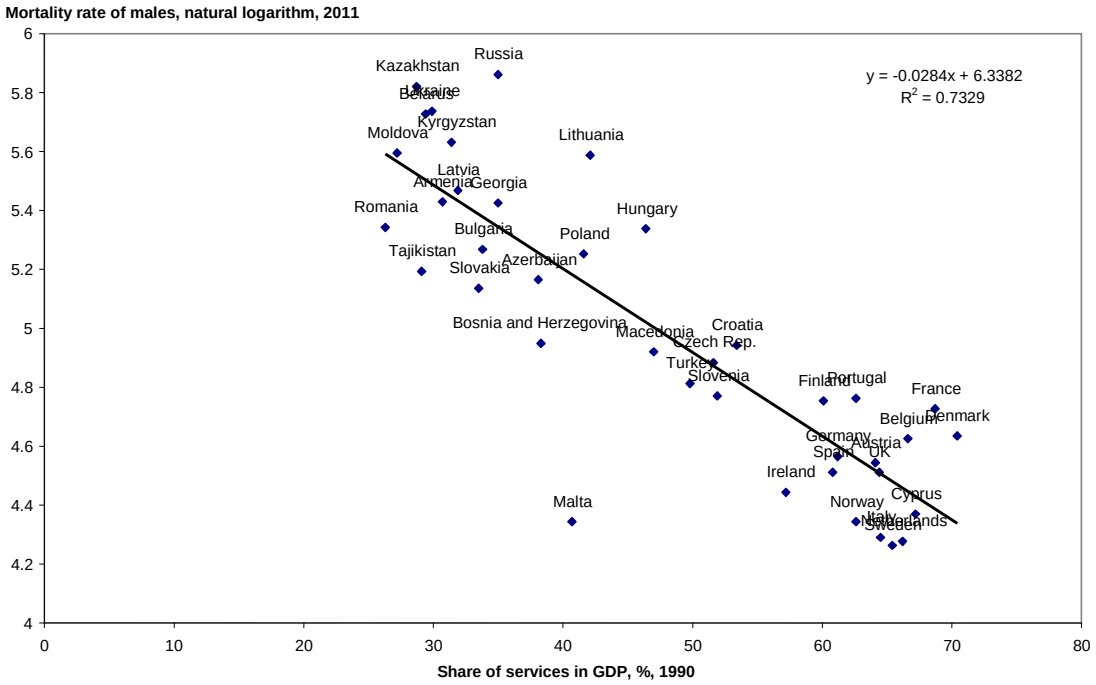
Mihályi's (2010) study also blames over-industrialization and employment in the simultaneously emerging informal economy for the self-destructive lifestyle that led to exceptionally high

[5] Finland, Greece, Ireland, Italy, Norway, Portugal and Spain.
[6] Bulgaria, Czechoslovakia (subsequently Czech Republic and Slovakia), Hungary, Poland, Romania and Yugoslavia (subsequently Serbia, Croatia and Slovenia).

mortality among the working-age population in Hungary. The author shows that a self-destructive life-style is also "encouraged" by the low relative price of alcohol and tobacco products.

For our data, Figures 5 and 6 reveal a strong association between the past production structure of an economy and current working-age mortality. The figures display the relationship between the share of services in GDP in 1990[7] and working age male and female mortality in 2011. We can see a strong negative correlation: a higher past service sector share in GDP is associated with lower mortality. In this and later models the lag in the effects is explained by the factors determining a mortality rate (population health) measured at a given point in time exerting their effects during the life course of the individuals living or deceased at that time, i.e., in the past and typically over a few decades. Table 2, where the correlation coefficients calculated for the different groups of countries are given, also reveals that the share of the service sector in 2010 shows a weaker relationship with the mortality rates of 2011 than its share at the time of the regime change, back in 1990, especially for the former socialist countries.

Figure 5: The share of services in GDP in 1990 and working-age male mortality in 2011 (natural logarithm)



[7] It would have been better to look at the share of service sector workers but this was not practicable for this broad international comparison because of data availability problems; the share of services in the GDP was the next best indicator.

Figure 6: The share of services in GDP in 1990 and working-age female mortality in 2011 (natural logarithm)

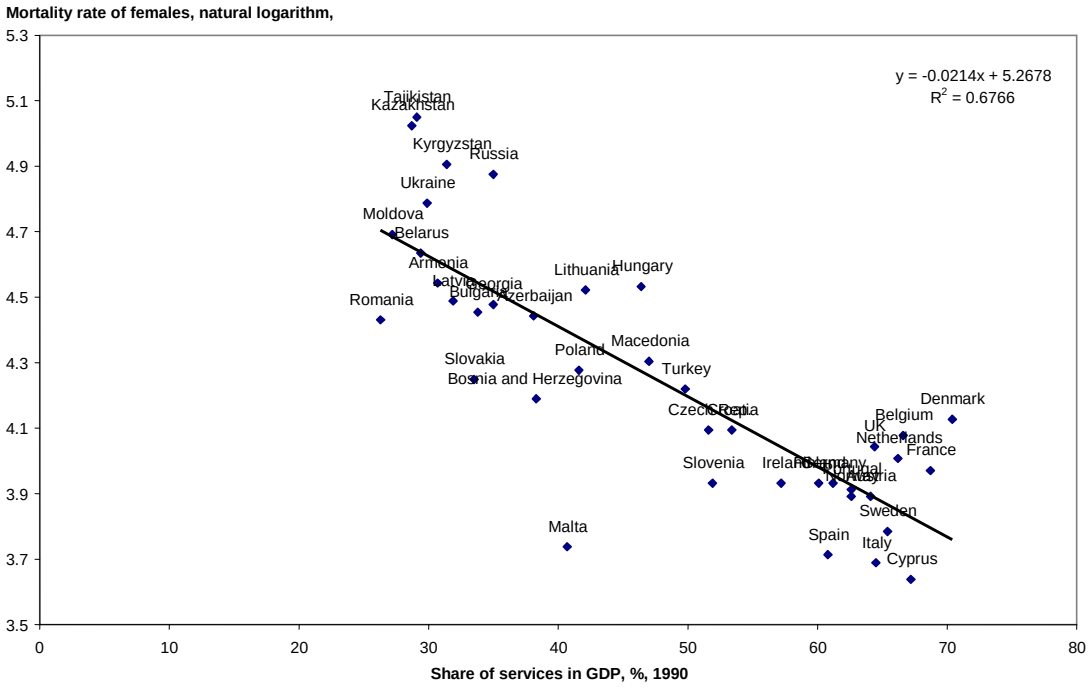


Table 2: Cross-sectional correlation coefficients for mortality rates in 2011 and the share of the service sector in 1990 and 2010

	Mortality rate male	Mortality rate female
Total sample, 38 countries		
GDP per capita (ln)	-0.63	-0.75
Share of services, 1990	-0.85	-0.82
Share of services, 2010	-0.45	-0.52
Post socialist countries, 21 countries		
GDP per capita (ln)	-0.16	-0.54
Share of services, 1990	-0.68	-0.72
Share of services, 2010	-0.08	-0.22
Old market economies, 17 countries		
GDP per capita (ln)	-0.49	-0.19
Share of services, 1990	-0.01	0.07
Share of services, 2010	0.11	0.02

Figures 5 and 6 and Table 2 all provide convincing evidence for the relationship between over-industrialization i.e. suppressing services in the past and increased mortality in Eastern Europe in recent decades.

3.2. The relative size of the hidden economy

Over-industrialization in socialist economies exerts its health damaging effects both directly and indirectly. It does so directly by tipping the balance towards industries detrimental to human health (heavy industry, mining, etc.), and indirectly by giving rise to low-level and poor-quality services in the formal economy and to health damaging behaviors caused by the norm-defying (anomic) social environment. Under socialism and during the transition to market-economies, the low-level and poor-quality services at the same time generated an economy of informal services hidden from the taxation system. This hidden economy may also be detrimental to health both directly and indirectly thus contributing to the high mortality observed in these countries (see Mihályi, 2010). The bad-quality spirits circulating in the black market, for instance, have a direct negative effect on health, while indirect effects include the self-exploitative labor under bad and often dangerous working conditions with no health insurance in the hidden economy.

Hidden economies are not restricted to socialist and post-socialist countries, of course: they are present also in long established capitalist countries, although different reasons and conditions have given rise to them (e.g., high service prices or unemployment), and they are of a much smaller scale, than in the socialist and post-socialist countries. Schneider (2012) estimates the share of the hidden economy in 22 former socialist countries to be on average 37.4% of GDP between 1999 and 2007, while the corresponding figure for 17 long-established capitalist countries is estimated to be 19.8%.

Figure 7: The share of the hidden economy (1999-2007) and working-age male mortality in 2011

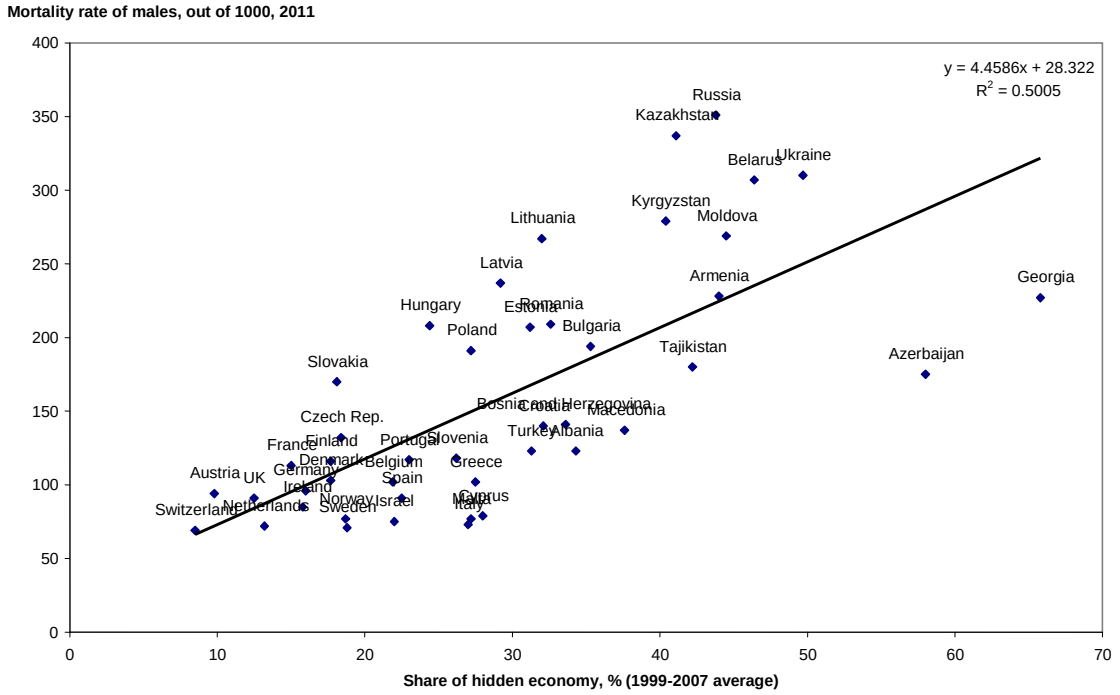
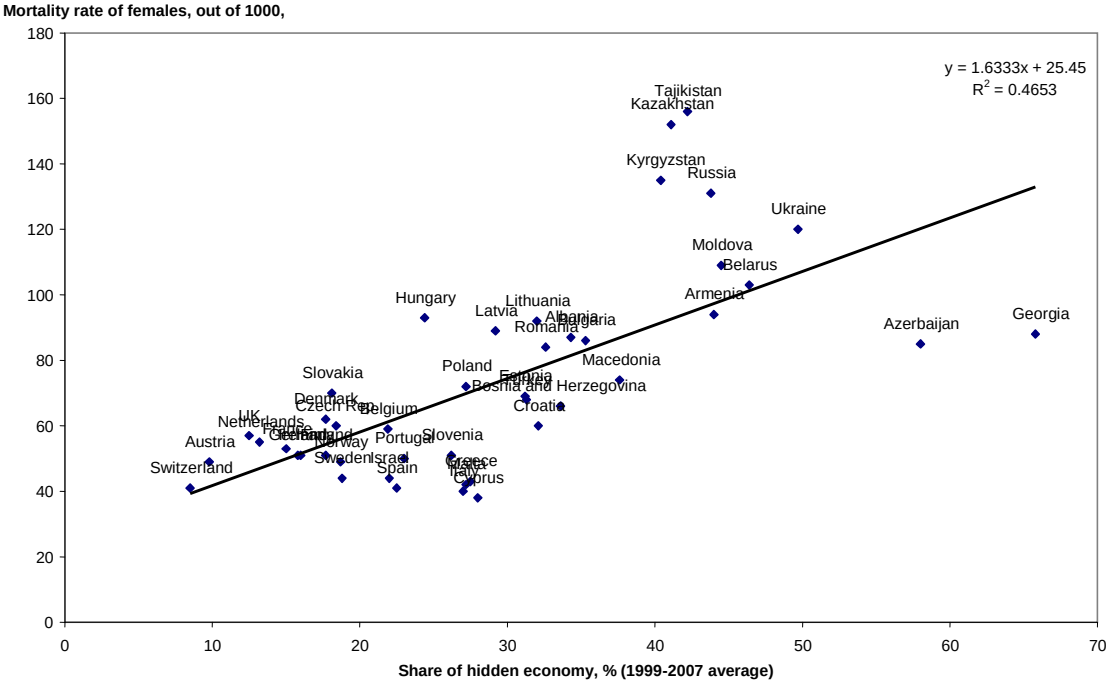


Figure 8: The share of the hidden economy (1999-2007) and working-age female mortality in 2011



Figures 7 and 8 display these values against the mortality rates for 2011. There is a clear positive correlation for both genders: a prolonged higher share of the hidden economy in the past is associated with higher mortality among the countries in our sample. The figures also reveal that the impact of the share of the hidden economy in the 2000s on mortality appears with less elasticity for women than for men.

3.3. The price and consumption of alcohol and tobacco products

An important basic relationship in micro-economics holds both for socialist and capitalist economies: alcohol and tobacco consumption strongly correlate with the prices of consumer goods and within that, with the own prices of these products and the prices of other consumer products. There is mostly consensus in the literature that relatively low prices of harmful consumer goods (alcoholic beverages, tobacco, etc.) lead to extra consumption and thus to a decline in health.

Wagenaar, Salois and Komro (2009) carried out a meta-analysis of studies (1003 publications were included) looking at the relationship between alcohol consumption on the one hand and the price of alcohol and taxes on alcohol on the other. Every study finds a negative correlation between prices and consumption although the strength of the correlation varies by type of alcohol and consumer group.

Treismann (2010) and Mihályi (2009) argue that the relatively low prices of alcoholic beverages and cigarettes make a substantial contribution to poor population health and the consequent increased mortality observed in Eastern European countries through excessive drinking and smoking. Denisova (2009, 2010), however, reaches the opposite conclusion: the author finds a weak positive correlation between the relative price of alcoholic beverages (vodka) and risk of mortality in Russia. The explanation for this pattern is that empirical experience shows that with a rise in the *official price* of vodka, there is an accompanying increase in the purchase of vodka in the informal market, and this poor quality beverage is harmful to health and leads to increased mortality.

Figure 9: Price level index of alcohol, tobacco products and narcotics (world average=100, 2005) and working-age male mortality, 2011 (natural logarithm)

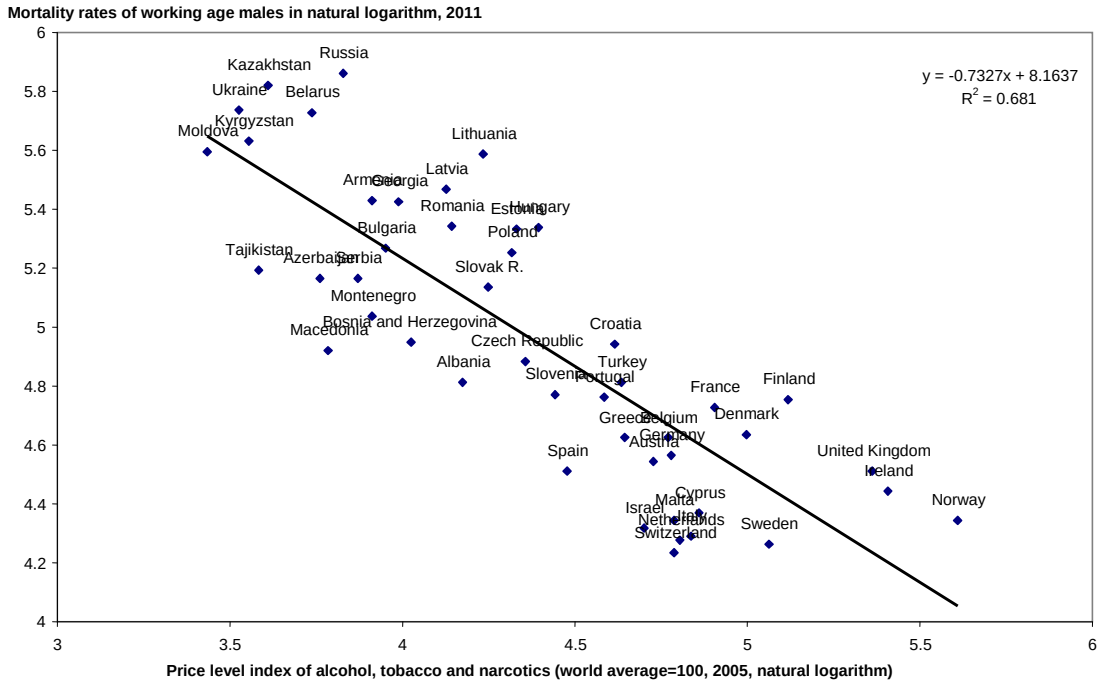
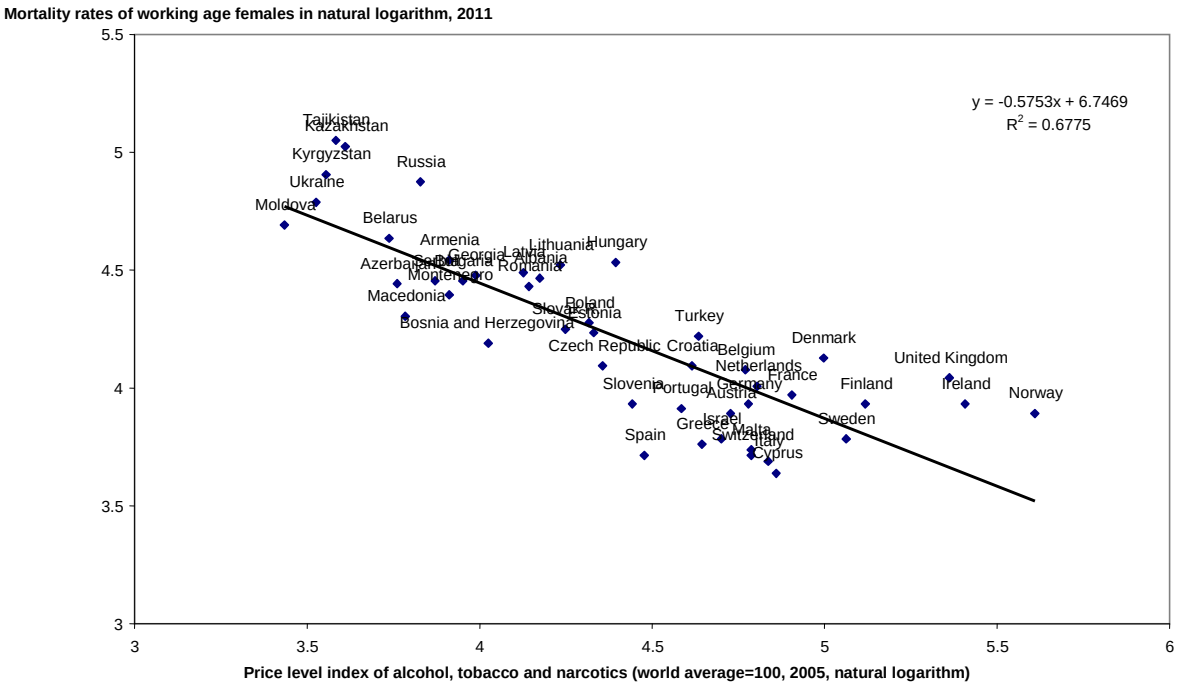
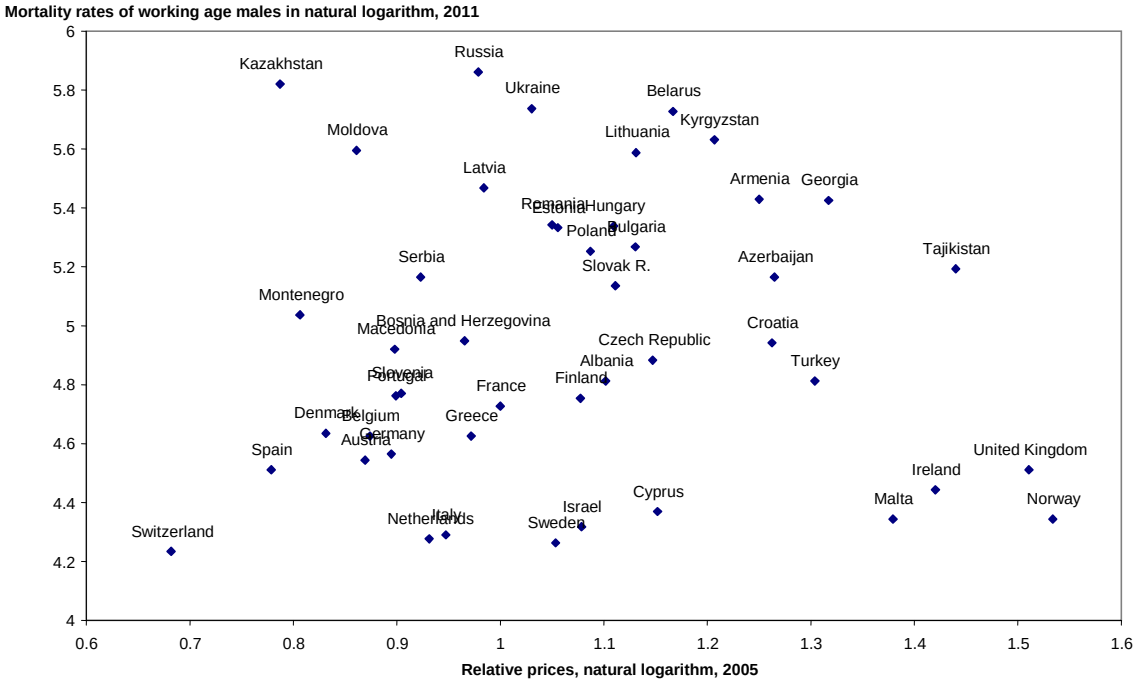


Figure 10: Price level index of alcohol and tobacco products and narcotics (world average=100, 2005) and working-age female mortality, 2011 (natural logarithm)



Figures 9 and 10 uses internationally comparable prices for the product group of alcoholic beverages, tobacco and narcotics (the latter is not being in the focus in our investigation) for the year 2005 and mortality data for our sample of countries in 2011. The scatter points and the adjusted regression clearly show that in line with most studies there is negative correlation between working-age male and female mortality on the one hand and alcohol and tobacco prices on the other: low prices, presumably because of higher consumption, are associated with higher mortality. The figures also reveal that the former socialist countries tend to have substantially lower prices for these health detrimental products than do long-established capitalist countries. The length of the lag between price indices (2005) and mortality data (2011) is accidental; it was dictated by data availability. We assume that the relationship of prices of alcohol and tobacco products across countries have been stable for a long time, and low and high prices had their effect on consumption and on health through many years.

Figure 11: Relative prices of alcohol and tobacco products and male mortality



It should be noted that in our sample there is a strong correlation between the indicator of economic development (GDP per capita) and both the internationally comparable prices of the harmful substances discussed above and the prices of all consumer goods at internationally comparable prices (price level index). To be more realistic, we should conjecture that the consumption of harmful substances is in fact encouraged by their low *relative prices* (the prices of harmful substances relative to the prices of all consumer goods) rather than by their prices

compared to the world average. The effects of these relative prices of harmful substances on working-age male mortality are shown in Figure 11. The relationship between the two variables is not at all as clear here as it was on Figures 9 and 10 using prices compared to the world level.

Now from prices we turn to direct consumption of alcohol and tobacco products. In their study, Hawkes and Buse (2013) analyzed gender differences in mortality and life expectancy, which have been observed worldwide in the past 40 years. Citing Lim et al.'s (2012) analysis of 67 health-detrimental risk factors, the authors find that the 10 most damaging factors in the ranking of factors harmful to health are considerably more frequent among men than women. Of these ten factors, Hawkes and Buse (2013) focus on alcohol consumption. For the world, alcohol consumption comes third in the above ranking following smoking and high blood pressure, but it is the first factor in Eastern Europe. The authors emphasize that while there are physiological gender differences in the effects of alcohol consumption (because of specific features of alcohol absorption and metabolism in women), a larger part of the difference is rooted in "gender-determined" behaviors: men drink larger quantities of alcohol and more frequently. The authors' view is in agreement with Wilsnack et al.'s (2005) in that alcohol consumption is a culturally determined behavior dictated by gender norms, where it is an expression of the positive side of masculinity. Female heavy drinkers are at the same time despised by society. Men therefore drink a lot more than women throughout the world.

Based on the evidence provided in the literature, our analysis should have a special look at the consumption of spirits, since it has been shown to be the alcohol product most detrimental to health, especially in the former socialist countries. Recently, a number of micros-studies have been carried out endeavoring to show the correlation between the consumption of spirits and mortality, especially in the successor states of the Soviet Union. A recent paper published in *The Lancet* (Zaridze D. et al., 2014) summarized the results of a longitudinal investigation of 151.000 adults with the aim of disclosing the effects of vodka consumption on mortality in Russia. The analysis of factors affecting vodka consumption gave interesting results: vodka consumption to some extent correlates with low educational attainment and manual labor, but shows the strongest correlation with smoking. While this was a very important observation, it presented an obstacle to demonstrating that high vodka consumption increased mortality. Nevertheless, the authors succeeded in providing convincing evidence that vodka consumption increases mortality risk.

Returning to our cross-sectional analysis, we find that the relationship discussed above appears in our sample: while the regression coefficient showing the direct relationship between working-age male mortality and all alcohol consumption per capita is only –0.08, the strength of the correlation with the consumption of spirits is 0.62. Figures 12 and 13 display the effects of spirit consumption on male and female mortality. As has been repeatedly observed in the literature, male mortality shows a substantially stronger correlation with spirit consumption than does female mortality.

Figure 12: Spirit consumption per capita (liters) in 2005 and working-age male mortality per 1000 people in 2011

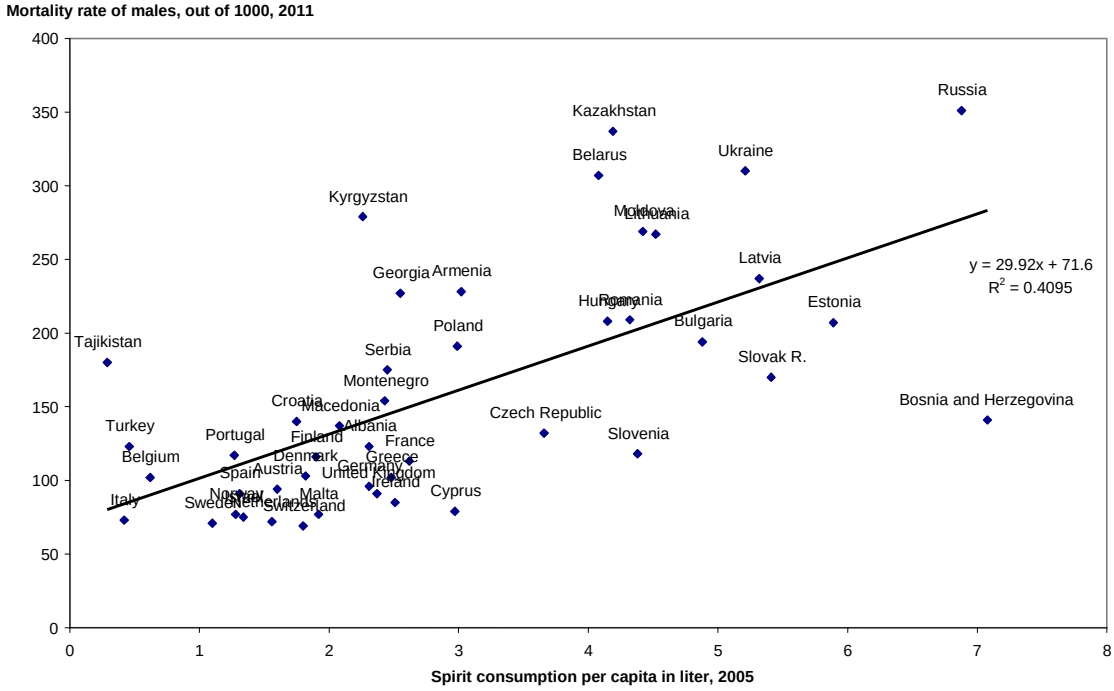
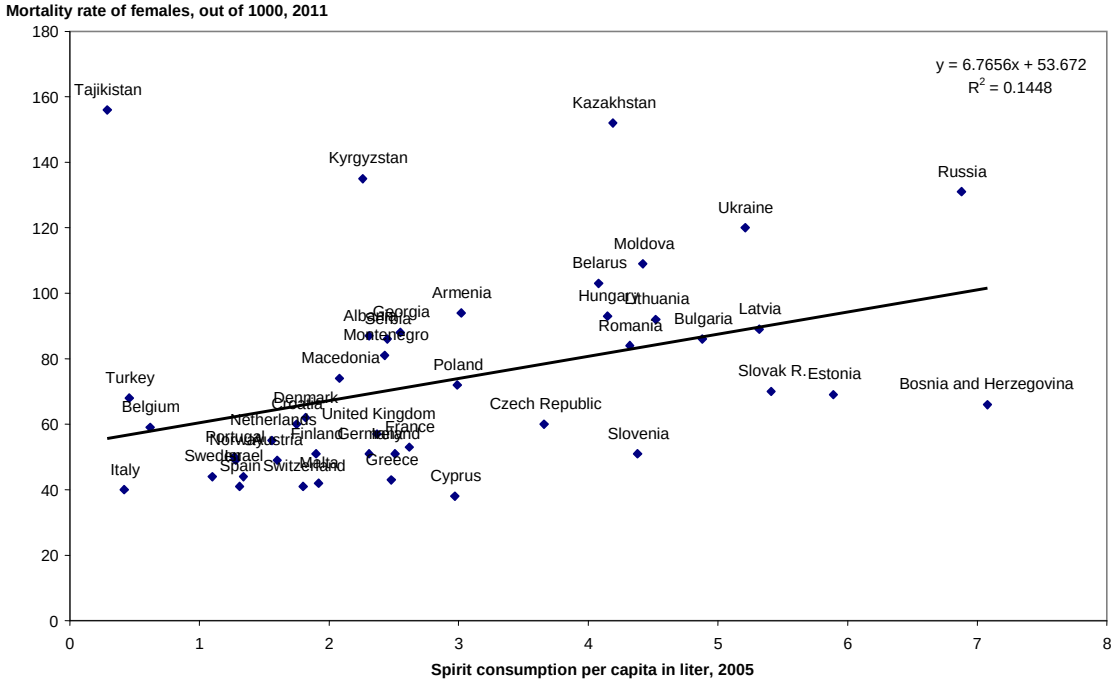


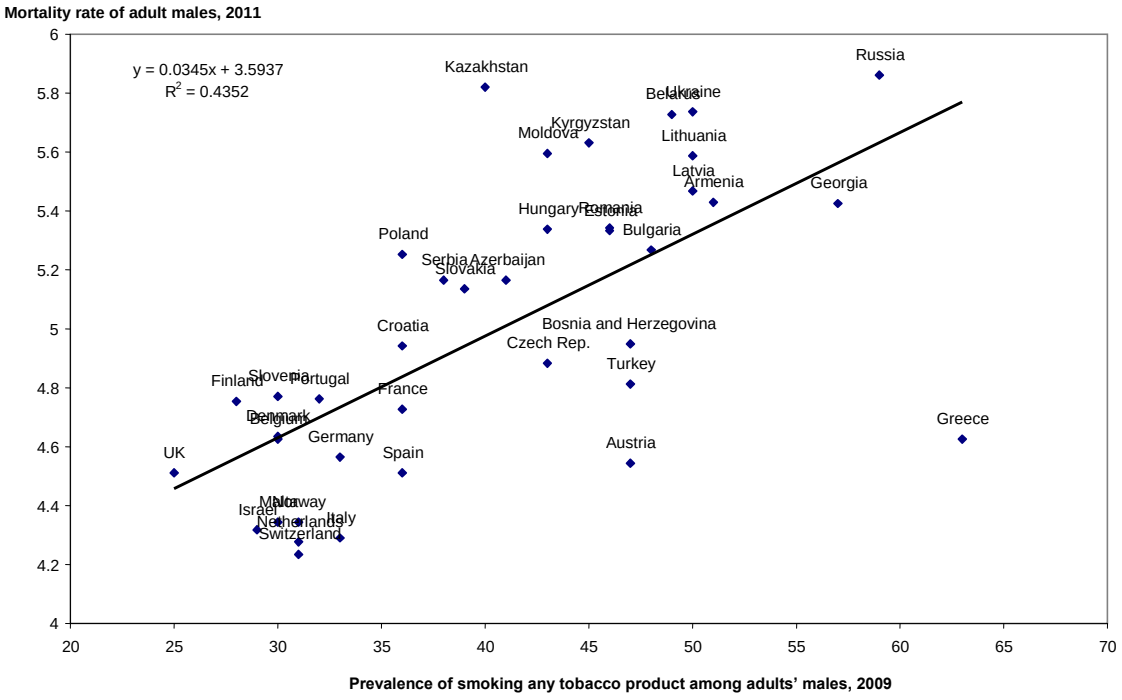
Figure 13: Spirit consumption per capita (liters) in 2005 and working-age female mortality per 1000 people in 2011



We also looked at the direct effects of smoking on mortality. The basic indicator in this case is the percentage of smokers in the male and female populations over the age of 15; this kind of data was available for 38 countries in our sample for 2009.[8]

The data reveal that the lowest frequency of smokers was observed in the United Kingdom (25%) and the highest in Greece (63%) and Russia (60%). As shown in Figure 14, male mortality increases with the share of smokers among men. In the diagram of the relationship between smoking and mortality, Greece is a real outlier, which is a typical manifestation of the Mediterranean paradox discussed above: in spite of the fact that over 60% of adult men smoke here, working-age male mortality is about the same as in Germany, which is not only considerably more advanced than Greece but also has half as many male smokers relative to the population than does Greece.

Figure 14: Share of adult male smokers and mortality



Looking at women (data not presented here), there is no direct positive correlation between the percentage of smokers and mortality; in fact, the relationship appears to be negative.

[8] This indicator is different from the one that we use for spirits for several reasons: it does not indicate the volume of consumption, but offers information about the two genders separately and has the potential of indicating consumption from the black market as well. The indicator for spirit brings information about actual consumption of two genders together, but hides data about utilization of the black market.

Table 3 lists across the different country groups the average of the percentage of smokers among men and women in the sample countries in 2009. It is clear that for the whole sample, smoking is about twice as common among men than among women. Men are most likely to smoke in the former Soviet Union countries, while the women in this same region have the lowest percentage of smokers. The average prevalence of female smokers in long-established capitalist countries is equal to the frequency of female smokers in the CEE countries, and both are substantially higher than their frequency in former Soviet Union countries (PSS).

Table 3: Prevalence of smoking in adult males and females, %

				of which	
	Total sample	Old market economies	Post socialist economies	CEE	PSS
Prevalence of smoking adult males, 2009	40.5	34.8	44.8	43.1	46.3
number of countries	39	17	22	10	12
Prevalence of smoking adult females, 2009	22.3	24.6	20.5	24.8	17
number of countries	39	17	22	10	12

3.4. Education

The relationship between health and mortality on the one hand and education on the other is widely studied in the literature. Every European country has to face the fact that there are great inequalities in health and mortality among their population: those having lower educational attainment, those with lower employment status and those having lower incomes die younger and become ill with higher frequency. Research suggests that premature death in these social strata is caused by a long series of unfavorable financial conditions (lower income, poorer quality housing, lower employment status), psycho-social factors (higher levels of stress, less rest and physical exercise) and risk behaviors (smoking and alcohol consumption) (Mackenbach, 2006). These three groups of factors are not independent of each other: the higher frequency of financial disadvantages among people having lower social status, for instance, partly explains a higher frequency of psycho-social stress or less rest and physical exercise, and higher levels of smoking and alcohol consumption. Mackenbach et al. (2008) analyze the above groups of factors using data from 22 countries. The authors find that mortality inequality is substantially greater in the population of Eastern European and Baltic states than in those of Western European countries. They attribute this pattern mostly to more smoking and alcohol consumption among people of lower socio-economic status, but also note inequalities in access to good medical services.

In an overview of the literature, Lochner (2011) considers the various channels through which education leads to a healthier lifestyle and lower mortality. Education improves decision-making skills and may thus lead to better decisions on one's own health and more efficient utilization of health inputs (productive efficiency). Educated people also tend to be more efficient in collecting and interpreting information from physicians, others or the Internet (allocative efficiency). Schooling is further associated with better health because it increases earnings, which in turn increases the demand for better health encouraging people to spend more on keeping healthy. (They buy better health insurance and take more valuable treatments.)

Education helps to manage and alleviate stress. Educated people choose healthier and safer occupations and healthier lifestyles, they are less likely to smoke or drink alcohol, and they have healthier diets and get more physical exercise. Educated people tend to move to healthier regions with more expensive housing, and maintain close contact with educated friends and colleagues, from whom they may acquire more health related information through regular communication.

In our international comparative analysis we attempt to analyze the direct relationship of education and mortality with the help of two rudimentary indicators of educational attainment. We calculate the coefficients for simple direct correlations between mortality rates and the share of enrolment in tertiary education among all secondary school graduates in 2010 [edu3][9] and the share of individuals with low educational attainment among the 25-64 year-old population in 2010 [lowedu]. The coefficients were calculated for a sample of 37 and respectively 27 countries.

Table 4: Correlation coefficients for mortality rates for men and women (mortm, mortf) in 2011, and the share of tertiary education enrolments among all secondary school graduates (edu3) and the share of individuals with low educational attainment among the 25-64 year-old population (lowedu10), 2010

	mortm	mortf	edu3
Total sample (27 countries)			
edu3	-0.05	-0.22	
lowedu10	-0.4	-0.19	-0.38
Post socialist countries (11 countries)			
edu3	0.06	-0.12	
lowedu10	-0.32	-0.02	-0.57
Old market economies (16 countries)			
edu3	0.2	-0.29	
lowedu10	0.26	0.71	-0.53

	mortm	mortf
Total sample (37 countries)		
edu3	-0.11	-0.3
Post socialist countries (21 countries)		
edu3	0.2	-0.08
Old market economies (16 countries)		
edu3	0.2	-0.29

[9] It is reasonable to expect a long lagged effect for this indicator as well. Our data for 1990 are, however, incomplete and in some sense distorted: the 1990 figures were much higher for the post-Soviet republics than for the long-established market economies, which probably reflect differences in the interpretation of tertiary education in the sample.

Table 4 reveals that there is a mostly negative but rather weak relationship between the edu3 indicator and mortality. It is quite possible that the weakness of the direct relationship is due to the nature of the education indicator used here.

We selected the other education indicator and calculated its relationship to the mortality data just to test this hypothesis. Unfortunately data availability problems only allowed an analysis of a smaller sample (27 countries in total, 16 of which are long term capitalist and 11 post-socialist). For this indicator [lowedu10] we expect a positive correlation with mortality: a higher share of undereducated people is predicted to be accompanied by higher mortality. (For comparison, the calculation for the smaller sample also includes the edu3 indicator.) Table 4 shows only one statistically significant direct relationship: there is a strong positive correlation between the share of undereducated persons and working-age female mortality in the group of old market economies.

We may conclude that we received only weak results for the expected direct relationships. The reason may be that the utilized educational indicators were too rudimentary as it is very difficult to find a macro-level education indicator that accurately represents the actual schooling of the working-age populations in the countries in our sample.[10]

3.5. Health expenditure as a percentage of GDP

Since 1960, in the developed economies in Europe, the health of the population has continuously improved at the macro-level – measured in mortality or life expectancy. Health expenditure, the total spending on health relative to GDP, has similarly been increasing. The cause and effect relationship between the two processes is, however, complicated since health expenditure is only one of several quantitative and qualitative factors contributing to health outcomes. Similarly to many other studies, this paper considers health expenditure as a percentage of GDP to be exogenous.[11]

A large share of studies analyzing health outcomes in terms of macro-level Health Production Functions mostly use a sample of OECD countries and occasionally developing market economies (see an overview by Nixon and Ulmann, 2006). The general conclusion of these studies (including that of Nixon and Ulmann, 2006) is that health expenditure and its in-kind, indirect indicators (e.g., the density of physicians) are statistically significant explanatory variables, and their expansion, *ceteris paribus,* increase life expectancy. The size of the effect is, however, typically found to be marginal with the exception of infant mortality as an outcome. Our cross-country analysis (see Figures 15 and 16) reveals a clear correlation between health

[10] Similar problems have been repeatedly raised in the literature. For this reason, on the macro level education is often represented by GDP per capita as an approximation.

[11] For an analysis of the factors influencing health expenditure and its system-specific characteristics, see Kornai and McHale (2000).

expenditure and mortality: higher health expenditure is accompanied by a lower level of mortality.

Figure 15: Health expenditure as a percentage of GDP in 2010 and working-age male mortality in 2011

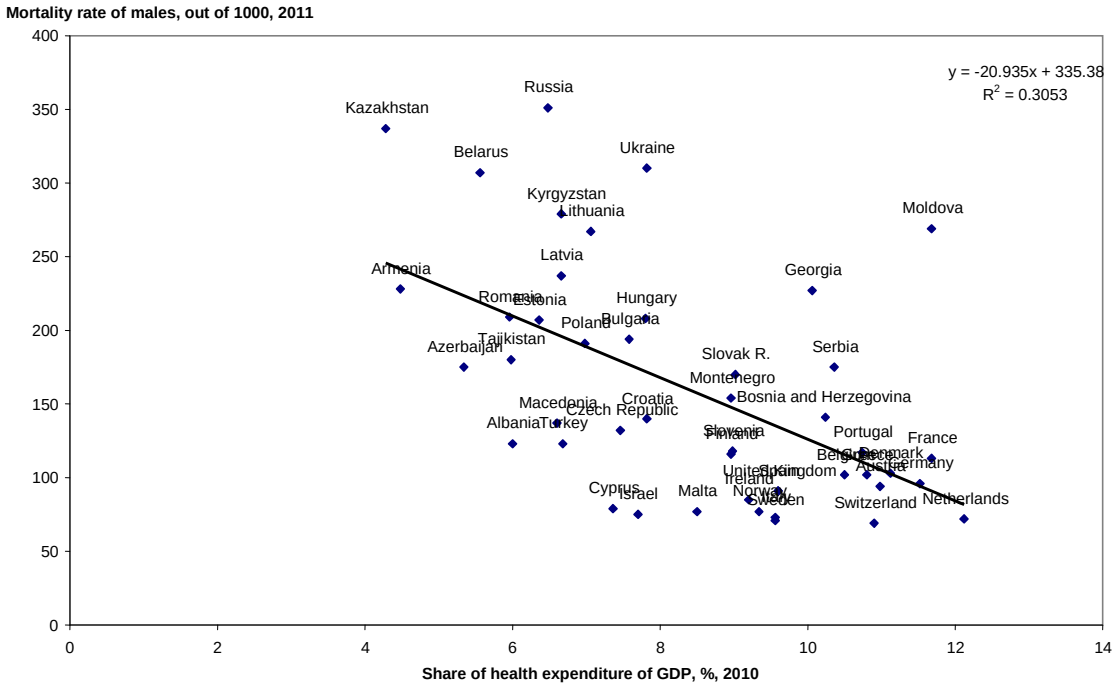
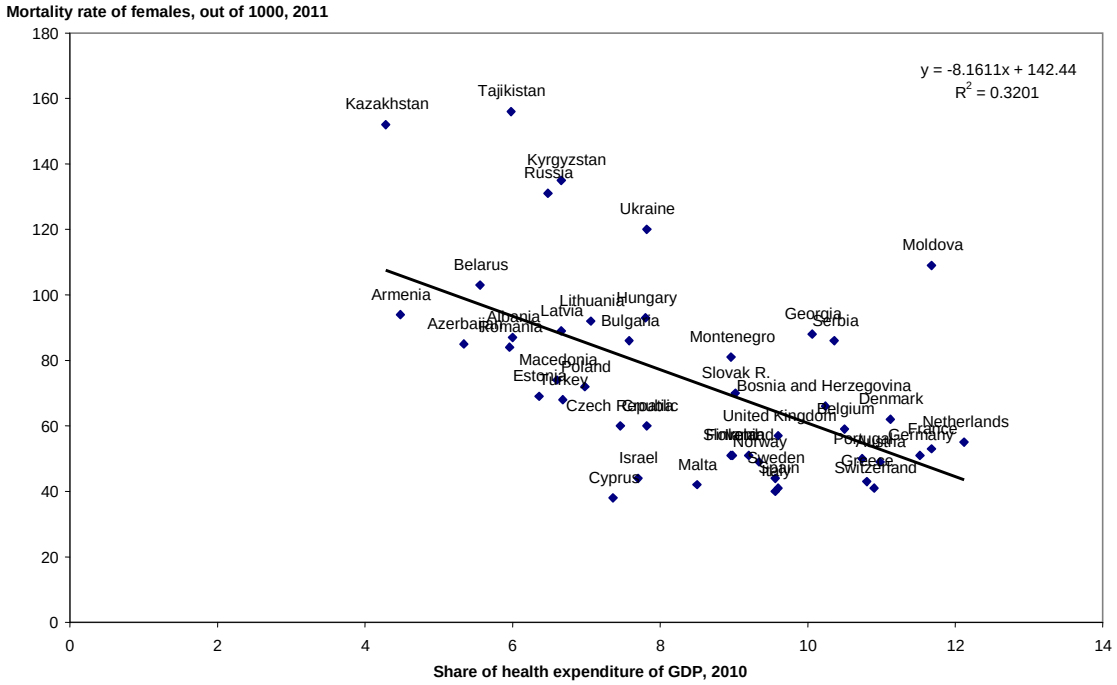


Figure 16: Health expenditure as a percentage of GDP in 2010 and working-age female mortality in 2011



4. A cross-sectional analysis with multiple regression functions

In this section of the paper the individual factors affecting mortality are combined in a Health Production Function model. The model includes the 38 countries for which data are available for each of the factors discussed in the previous sections.

The explained variable of the function is working-age male and female mortality in 2011 (in natural logarithm).

The following explanatory variables are included:

1. GDP per capita, in US dollars at PPP, (natural logarithm), 2010

2. Latitude of the countries

3. Share of service sector in GDP, %, 1990

4. Per capita consumption of spirits, liter, (natural logarithm), 2005

5. Share of the hidden economy in GDP, %, 1999-2007 average

6. Relative prices of alcohol and tobacco products and narcotics, 2005

7. Share of adult male and female smokers, 2010

8. Health expenditure as a percentage of GDP, %, 2010

Before we show our regression functions, we have to refer back to Table 1, in which some initial mortality functions were already defined on the sample of 45 countries. In Table 1 it was shown that mortality rates are strongly affected by the level of development, the latitude and a dummy variable of past political and economic system of the investigated countries. One of the main results emerging from that analysis was that mortality in 2011 is still strongly dependent on the economic and political system existing 20 years before that year. In Table 5 this dummy of the past economic and political system is defined (or in other words, replaced) by a number of other explanatory variables characteristic of the socialist countries compared to developed capitalist countries. Past socialist countries had – beside a much lower level of GDP per capita, and a lower share of health expenditure in GDP – a much lower *share of the service sector with a long term impact*, a much higher *share of the hidden economy*, much higher *consumption of spirits*, and a higher *share of smokers*, especially among men. After adding these lifestyle and policy related variables, the contribution of the dummy of socialist regime used in Table 1 ceases to be statistically significant for both men's and women's mortality models (see columns 1 and 2 in Table 5).

Table 5: Regression models of working-age male and female mortality I

(lnmortm and lnmortf)

	[1] lnmortm	beta	[2] lnmortf	beta	[3] lnmortm	beta	[4] lnmortf	beta
GDP per capita (ln), 2010	-0.25** [-3.90]	-0.39	-0.36** [-4.8]	-0.73	-0.18* [-2.01]	-0.29	-0.29** [-3.13]	-0.59
Latitude	0.019** [3.15]	0.27	0.020** [3.60]	0.37	0.019** [3.09]	0.27	0.019** [3.79]	0.36
Dummy for socialism	0.11 0.86]	0.12	0.0048 [0.36]	0.065				
Share of service sector in GDP, 1990 %					-0.009* [-1.74]	-0.29	-0.0068* [-1.73]	-0.27
Consumption of spirit, 2005 (ln)	0.17** [3.28]	0.27	0.023 [0.41]	0.05	0.14** [2.57]	0.23	-0.006 [-0.12]	-0.01
Share of hidden economy in GDP (1999-2007 average), %	0.0087** [2.85]	0.24	0.0005 [0.12]	0.016	0.008** [3.05]	0.23	0.00023 [0.06]	0.08
Relative price of alcohol, tobacco, and narcotics (ln), 2005	-0.49** [-3.44]	-0.19	-0.3 [-1.61]	-0.15	-0.52** [-3.52]	-0.2	-0.32* [-1.75]	-0.16
Share of health expenditure in GDP. %	-0.066** [-3.55]	-0.29	-0.058** [-2.45]	-0.33	-0.055** [-2.86]	-0.24	-0.047** [-2.50]	-0.27
Constant	6.64** [8.85]		7.23** [7.21]		6.42** [8.44]		6.91** [7.37]	
R2	0.869		0.812		0.877		0.822	
RMSE	0.1958		0.1807		0.1894		0.1759	
Number of obs.	38		38		38		38	

When looking at further results of regression calculations in Table 5 there is a striking difference between the mortality models of men and women in the effects of certain lifestyle variables (Models 3 and 4 in Table 5): in contrast to men's mortality neither spirit consumption nor the share of the hidden economy has a statistically significant effect on women's mortality. The contributions of the relative prices of health damaging substances approach significance for women with a coefficient with substantially larger *t* values than for the previous two lifestyle variables. (The same pattern is suggested by the beta coefficients, which show the relative sizes of the effects of the variables in the models.) The mortality reducing effect of economic development (GDP per capita) is just as substantial in these models as in Models 3 – 6 in Table 1. The two versions are also similar in that the same level of economic development has a stronger mortality reducing effect for women than for men. Part of the explanation for this phenomenon is that in a society with a developed economy women tend to be engaged in lighter, physically less demanding jobs. A second reason is that health-technological developments reach a higher proportion of women than of men (e.g. mammography). Finally, the higher educational

attainment and more health-conscious behaviors of women allow them to access medical care and treatment using appropriate technology sooner, than men.

In Models 3 and 4 in Table 5, the dummy variable of socialist regime used in Table 1 is replaced not only by the lifestyle variables that our previous analyses have shown to vary greatly between post-socialist and long-established capitalist countries but also by a variable of the share of services 20 years before as a characteristic system-specific indicator of socialist and developed capitalist economies. The latter variable is, *ceteris paribus,* statistically significant at the 10% level and has a negative effect on both male and female mortality: male and female mortality are higher in 2011 with a lower share of the service sector in 1990 even if we control for both the level of economic development and the different lifestyle variables.

Results in columns 3 and 4 also indicate that after controlling for the level of development, for the direct effects of the lifestyle variables and for the indirect effects of the past share of services, health expenditure as a share of GDP shows a statistically significant effect to decrease mortality for both men and women. The effect is of a similar relative size for the two genders.

Table 6 displays further calculations with the aim of finding an equation that is more satisfactory then Models 3 and 4 in Table 5.

Table 6 Regression models of working age male and female mortality II

:

	[1] lnmortm	beta	[2] lnmortf	beta	[3] lnmortm	beta	[4] lnmortf	beta	[5] lnmortm	beta	[6] lnmortf	beta
GDP per capita (ln), 2010	-0.29** [-5.25]	-0.46	-0.37** [-5.04]	-0.77								
Latitude	0.02** [3.18]	0.28	0.02** [3.82]	0.37	0.016** [2.60]	0.23	0.015** [2.70]	0.28	0.02** [3.22]	0.27	0.02** [3.87]	0.35
Share of service sector in GDP, 1990 %					-0.016** [-4.53]	-0.49	-0.018** [-3.50]	-0.71				
Interaction between GDP per capita,2010 and the share of service sector, 1990 (ln)									-0.24** [-6.22]	-0.51	-0.29** [-5.67]	-0.82
Spirit, 2005 (ln)	0.20** [4.18]	0.32	0.035 [0.76]	0.07	0.11* [1.94]	0.17	-0.067 [-0.8]	-0.14	0.17** [3.80]	0.27	-0.001 [-0.03]	-0.003
Share of hidden economy in GDP (1999-2007 average), %	0.009** [2.97]	0.24	0.005 [0.15]	0.02	0.012** [4.32]	0.34	0.007* [1.92]	0.24	0.008** [3.01]	0.22	0.0002 [0.07]	0.008
Relative price of alcohol, tobacco (ln), 2005	-0.51** [-3.60]	-0.19	-0.31 [-1.79]	-0.15	-0.53** [-2.95]	-0.2	-0.31 [-1.40]	-0.15	-0.51** [-3.65]	-0.19	-0.31* [-1.76]	-0.15
Share of health expenditure in GDP, 2010 %	-0.075** [-4.96]	-0.33	-0.062** [-3.50]	-0.35	-0.039** [-2.51]	-0.17	-0.021 [-1.31]	<<<	-0.064** [-4.22]	-0.28	-0.048** [-2.82]	-0.27
Constant	7.12** [11.35]		7.43** [8.53]		4.87** [12.22]		4.42** [8.57]		7.46** [4.22]		7.76** [9.26]	
R2	0.866		0.811		0.863		0.762		0.875		0.825	
RMSE	0.1947		0.1781		0.1965		0.2		0.1881		0.1717	
Number of obs.	38		38		38		38		38		38	

Models 1 and 2 in Table 6 include current GDP per capita as an indicator for the level of economic development but drops the variable of share of the service sector, while Models 3 and 4 include the share of services in 1990, while leaves out GDP per capita in 2010. In Models 5 and 6 the interaction of current GDP per capita and the relative size of the service sector with a 20-year time lag is taken into account. We were particularly curious of the effect of this interaction because in the last two columns of Table 5 the effect of the share of the service sector with a long time lag was statistically significant at only the 10% level when GDP per capita was included in the model at the same time. As it turns out in Table 6, the model with the interaction term shows the best fit.

The results in Models 5 and 6 in Table 6 also reflect that a higher health expenditure as a percentage of GDP is associated with a reduction in mortality for both men and women. A 1 percentage point increase in the share of health spending is accompanied by 5-6% decrease in mortality. This means that if in Hungary, for instance, health expenditure as a percentage of GDP increased to the Austrian level (from 8% to 10%), male mortality would fall by about 13% from 208 to 181 per 1000 men. This is a really strong effect. But if, alternatively, per capita spirit consumption in Hungary moved to the Austrian level, from 4.15 liters to 1.6 liters, the model indicates a 16% drop in Hungarian men's mortality in 2011, that is, from 208 to 175 per 1000 men [(ln(4.15)-ln(1.6))*0.17=0.16]. This latter, Austria oriented effect therefore surpasses even

the effect of the hypothetical increased health expenditure. Similar calculations can be made for the share of the hidden economy: if the long-term average share of the hidden economy in Hungary had been 9.8%, as in Austria, rather than 24.4%, male mortality would have been 11.7% lower in Hungary in 2011, that is, 184 rather than 208 deaths per 1000 men.

As for gender differences the models in Table 6 also suggest that working-age female mortality is not significantly affected by the different lifestyle factors (spirit consumption, share of the hidden economy), but the relative prices of the health damaging products have a significant moderate effect. Once again, the level of development and/or the past share of the service sector make a far greater relative contribution to the mortality of women compared to that of men. The relative contribution of health expenditure is similar in the mortality models for the two genders, while the effect of latitude is once again the same for men and women as it was in the models shown in Tables 1 and 5.

In our last analysis, the above mortality models are expanded by an additional explanatory variable representing tobacco consumption directly, in a single dimension: the percentage of smokers in the adult population. This function is shown in Table 7, mostly for only 33 countries.

Table 7: Regression models of working-age male and female mortality III

	[0] lnmortm	beta	[1] lnmortm	beta	[2] lnmortm	beta	[3] lnmortm	beta	[4] lnmortm	beta	[5] lnmortf	beta
GDP per capita (ln), 2010					-0.24**	-0.32	-0.20**	-0.29				
					[-3.23]		[-2.66]					
Latitude	0.019**	0.25	0.018**	0.24	0.020**	0.28	0.018**	0.24	0.016**	0.2	0.018**	0.32
	[3.22]		[3.33]		[5.00]		[3.67]		[2.58]		[3.03]	
Share of service sector in GDP, 1990 %									-0.006	-0.17		
									[-0.99]			
Interaction between GDP per capita and the share of service sector (ln)	-0.18**	-0.36	-0.16**	-0.32							-0.16**	-0.43
	[-2.76]		[-2.88]								[2.04]	
Spirit, 2005 (ln)	0.18**	0.27	0.16**	0.24	0.17**	0.25	0.18**	0.27	0.17**	0.27	0.07	0.16
	[2.76]		[2.90]		[3.53]		[3.54]		[2.19]		[1.11]	
Share of hidden economy in GDP (1999-2007 average), %	0.01**	0.29	0.009**	0.24	0.009**	0.24	0.008**	0.23	0.013**	0.37	0.006*	0.25
	[2.76]		[2.62]		[2.35]		[2.28]		[4.64]		[1.72]	
Relative price of alcohol, tobacco (ln), 2005	-0.54**	-0.2	-0.51**	-0.19	-0.42**	-0.16	-0.52**	-0.19	-0.53**	-0.2	-0.37*	-0.19
	[-3.84]		[-3.56]		[-2.70]		[-3.85]		[-2.95]		[-1.85]	
Share of health expenditure in GDP. %	-0.07**	-0.33	-0.07**	-0.3	-0.073**	-0.32	-0.076**	-0.34	-0.056**	-0.26	-0.05**	-0.31
	[-5.3]		[-4.62]		[-5.02]		[-5.06]		[-2.60]		[-3.12]	
Tobaccom09			0.008**	0.15	0.006**	0.13	0.008**	0.15	0.009**	0.17	-0.0009	-0.02
			[2.31]		[2.31]		[2.33]		[2.04]		[-0.30]	
Constant	6.71**		6.18**		6.39**		6.09**		4.12**		5.71**	
	[6.89]		[7.88]		[7.35]		[7.19]		[10.83]		[5.54]	
R2	0.9037		0.9137		0.908		0.9141		0.9025		0.8319	
RMSE	0.167		0.1611		0.167		0.1606		0.1711		0.1618	
Number of obs.	33		33		37		33		33		33	

Column [0] shows the results of the model shown in Column [5] of Table 6 for this smaller sample of 33 countries. This is taken as our standard of comparison for the subsequent regression calculations that take into account the direct mortality effects of smoking habits (columns [1]-[5]). The comparison reveals that while there is no significant difference in mortality effect between the variables present in both functions [0] and [1]-[5], the new variable, the share of smokers among adult men has a significant positive effect but its relative contribution is not especially great (see the beta coefficient), while the new variable of share of smokers among adult women does not bring a statistically significant coefficient (see column [5] in Table 7).

Summary

There is considerable variation in the health status of the populations across the "old" and the "new" EU member states, and the former Soviet Union countries. The explanation for these differences was investigated by scrutinizing three different groups of factors:

1. Socio-economic factors: the geographical location of the country, current level of economic development and the political and ideological system of the economy in the past.

2. Lifestyle factors: alcohol and tobacco consumption represented by their relative prices as well as by consumption of spirits and tobacco in the past, overwork in the hidden economy in the past and present. These are, in fact, not independent of the socio-economic factors listed above.

3. Health care resources: health expenditure as a percentage of GDP.

The analysis was based on pair-wise relationships of the individual factors and health status also calculated as correlations, as well as on regression analysis of health production functions (HPF) calculated from cross-country estimations for 2011. Health status, the explained variable of HPF was represented by the mortality rate of the working age population.

For the countries (20 "old" EU countries and 26 post-socialist countries) included in the analysis, the explanatory variables of the health production function could explain 83-87% of the cross-country differences in mortality rates of the working age population in 2011.

The most important contribution to the differences comes from the past economic and political system represented by the structure of production (the share of the service sector in 1990) and the present level of development (GDP per capita in 2010).

Our results give support to the theory of state socialist mortality syndrome. According to this theory, in the communist countries the forced growth in industry, and heavy industry in particular, and suppression of the service sector had created a norm-defying, anomic environment for working age population transferred from agriculture to industry. The social and behavioral consequences of this development policy accumulated over a period of time and directly led to the increase in mortality. Over-industrialization in socialist economies exerts its health damaging effects both directly and indirectly. It does so directly by tipping the balance towards industries detrimental to human health (heavy industry, mining, etc.), and indirectly by

giving rise to low-level and poor-quality services in the formal economy and to health damaging behaviors caused by the norm-defying (anomic) social environment.

Under socialism and during the transition to market-economies, the low-level and poor-quality services at the same time generated an economy of informal services hidden from state control and the taxation system. Our results also reflect that this hidden economy could be also detrimental to health both directly and indirectly thus contributing to the high mortality observed in these countries. The bad-quality products and services from the black market could have a direct negative effect on health, while indirect effects includes the self-exploitative labor under bad and often dangerous working conditions with no health insurance in the hidden economy.

Economic and lifestyle disadvantages turn out to be more harmful for men than women. The effects of the relative prices of alcohol- and tobacco products, the consumption of spirits and tobacco, and the share of the hidden economy are significant explanatory factors for men, but non-significant for women. The effects of health expenditure and the geographical location of the country are similar for the two genders.

Our assessment of the factors behind disparities in the health status revealed the long lasting impact of economic and social institutions of the past. This suggests that reducing high mortality rates in the post-socialist countries is not an easy, short term task for policy makers. The structure of these economies have already gone through radical changes in the past 25 years; to achieve changes in social behavior, in life-style, and the emergence of new social norms, however, need more time and targeted policies.

A less hectic, more predictable economic and social environment, better pricing policies for health damaging consumer goods, crowding out of the black market, and better education about health – all these may contribute to the reduction in consumption of alcohol and tobacco products as well as cutting back activities in the informal economy. The latter needs further efforts in reforming the regulatory and tax systems. A faster catching up in incomes would mean better working environment for the employees, higher technological level both in manufacturing production and in a wide range of services, including medical services. Increasing the share of expenditures in health services and improving education about healthy lifestyle are further factors that could help the post-socialist countries to catching up with the developed market economies in the health status of their population.

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Appendix: Definitions, sources and the names of the variables used

Adult male mortality, per 1000 [**mortm**] [lnmortm=ln(mortm), natural logarithm]

Adult mortality is the probability of dying between the ages of 15 and 60--that is, the probability of a 15-year-old dying before reaching age 60, if subject to current age-specific mortality rates between those ages. World Bank code: SP.DYN.AMRT.MA

Adult female mortality, per 1000 [**mortf**]] [lnmortf=ln(mortf), natural logarithm]

Adult mortality rate is the probability of dying between the ages of 15 and 60--that is, the probability of a 15-year-old dying before reaching age 60, if subject to current age-specific mortality rates between those ages. World Bank code: SP.DYN.AMRT.FE

GDP per capita, PPP, dollar, **[gdpcap]**

GDP expressed in purchasing power parity (PPP) is adjusted to the relative domestic purchasing power of the national currency as compared to the US dollar rather than using the official exchange rate. Multipliers (PPPs) are estimated periodically, using the cost of the standard basket of goods. (WHO/EURO uses World Bank World Development indicators, indicator NY.GDP.PCAP.PP.CD as the common source. http://data.euro.who.int/hfadb/

Share of services in GDP, %, 1990 [service90], 2010 [service10]

Services correspond to ISIC divisions 50-99 and they include value added in wholesale and retail trade (including hotels and restaurants), transport, and government, financial, professional, and personal services such as education, health care, and real estate services. Also included are imputed bank service charges, import duties, and any statistical discrepancies noted by national compilers as well as discrepancies arising from rescaling. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The industrial origin of value added is determined by the International Standard Industrial Classification (ISIC), revision 3. World Bank code: NV.SRV.TETC.ZS

Education 1 [edu3], %

Share of enrollment in tertiary education according to the gross enrollment concept. Gross enrollment ratio is the ratio of total enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Tertiary education, whether or not to an advanced research qualification, normally requires, as a minimum condition of

admission, the successful completion of education at the secondary level. World Bank code: SE.TER.ENRR

Education 2, % [lowedu]

Share of low educational attainment among 25-64 year olds, %

(http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do?dvsc=0)

Geographical position: latitude [lat]

www.mapsofworld.com/lat_long/europe.html

Alcohol consumption per capita in the population aged 15 years or over, litres, in 2005 [alc05]

Recorded alcohol consumption per capita is defined as the recorded amount of alcohol consumed per adult (15+ years) over a calendar year in a country, in litres of pure alcohol. The indicator only takes into account consumption recorded from production, import, export, and sales data often via taxation. Associated terms Pure alcohol: 100% ethanol,European Health for all database (HFA-DB)

http://data.euro.who.int/hfadb/tables/tableA.php?w=1024&h=768

Spirit consumption per capita in the population aged 15 years or over, expressed in pure alcohol, litres, in 2005-ben [spirit05] .

Spirits consumed measured in pure alcohol, litres per capita.European Health for all database (HFA-DB))

http://data.euro.who.int/hfadb/tables/tableA.php?id=tbla_291555001395242145&ind=3051

Health expenditure as a percentage of GDP in 2010 [hegdp10], European Health for all database (HFA-DB)

http://data.euro.who.int/hfadb/tables/tableA.php?id=tbla_291555001395242145&ind=6711

The total collective price of tobacco, alcohol and narcotics products relative to the world average, 2005, world average=1, [relprice], WORLD BANK [2008*a*]: Global Purchasing Power Parities and Real Expenditures – 2005, International Comparison Program, The World Bank, Washington, D.C.

http://siteresources.worldbank.org/ ICPINT/Resources/icp-final.pdf.

WORLD BANK [2008*b*]: Tables of Results. Global Purchasing Power Parities and Real Expenditure. The World Bank, Washington, D.C.

Prevalence of smoking any tobacco products among adults aged ≥15 years, 2009 [males: tobacm09, females: tobacof09]

Smoking at the time of the survey of any form of tobacco, including cigarettes, cigars, pipes, bides, etc. and excluding smokeless tobacco. These figures represent age-standardized prevalence rates for smoking tobacco and should only be used to draw comparisons of prevalence between countries, and between men and women within a country. World Health Statistics 2013:109-120.

The share of the hidden economy in GDP, 1999-2007 average [hidden],Schneider, F. (2012) pp. 61-64, http://ftp.iza.org/dp6423.pdf

Table: Descriptive statistics of the variables used in the calculations

Variables	Number of observation	Mean	Std. Deviation	Min	Max
mortm	46	159	79	69	351
mortf	46	74	30	38	156
gdpcap	46	23014	13493	2147	56976
service90	39	48	15	26	70
hidden	44	29	13	9	66
spirit05	46	2.8	1.7	0.3	7.1
hegdp10	46	8.4	2.1	4.3	12.1
relprice	46	1.1	0.2	0.7	1.5
latitude	45	46.9	7.1	32	60.2
edu3	44	58.2	17	19	94
tobacom05	39	40.5	9.4	25	63
tobacof05	39	22.4	10.1	2	45

Ols: Ordinary least squares method

R2: indicator of fit

RMSE: root mean square error

Robust: Huber-White estimates of standard errors

Ovtest: Ramsey regression specification-error test (RESET) for omitted variables.

Linktest: Specification link test for single-equation models

Beta: Standardized beta coefficients. The beta coefficients are the regression coefficients obtained by first standardizing all variables to have a mean of 0 and a standard deviation of 1.

No.: Number of observations