The economic consequences of ill-health in Estonia

World Health Organization Regional Office for Europe

Ministry of Social Affairs

PRAXIS Center for Policy Studies

May 2006
Tallinn

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Figures and Tables

Acknowledgements

This report was the result of the work of many contributors and reviewers in Estonia and in the World Health Organization. The report was written by Marc Suhrcke (WHO European Office for Investment for Health and Development), Andres Võrk (PRAXIS Centre for Policy Studies), and Stefano Mazzuco (University of Padua).

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We particularly acknowledge the overall support and genuine interest of all of the staff members from the Ministry of Social Affairs, PRAXIS and other institutions who provided the necessary material quoted in this report and also revised the previous versions of the report and gave comments on the results. Administrative support and organisation by Antonella Biasotto and Kadri Kont-Kontson is also gratefully acknowledged.

This document expresses its authors' personal views and opinions, which do not necessarily reflect the views of the institutions they are affiliated with. WHO is not responsible for the outcomes and conclusions provided in this report.

The financial contribution received through the Biennial Collaborative Agreement 2004/2005 signed between the WHO Regional Office for Europe and the Ministry of Social Affairs of the Republic of Estonia is also gratefully acknowledged.

Executive summary

Research increasingly indicates that a healthy population is not an automatic by-product of economic development; it can also drive economic growth. Similarly, at the level of the individual, good health is an important determinant of economic productivity. This finding has important policy implications: policymakers interested in promoting the economic development of a country should seriously consider the role health investment could play in achieving their economic policy goals. Not much is known about the direct relevance of these recent findings for Estonia. This report sets out to fill this gap.

When looking at the health status of the Estonian population, it is not hard to imagine that there would be a substantial cost attached to the country's significant health challenges. Judged by several standard health indicators, Estonia compares very unfavourably to most of the countries it has to compete with economically, both within and outside the European Union. The relative under-performance of Estonia is particularly marked in the case of male life expectancy. Comparison of Estonian age-gender specific mortality rates with neighbouring Finland reveals that Estonian men in prime working age, 25-65, experience up to three times higher mortality rates. Since the mid 1990s, the health behaviour of young people has deteriorated considerably. The cumulative effects of increasing rates of alcohol consumption, smoking and use of illicit drugs among teenagers suggest that the health of today's teenagers upon reaching adulthood could be even worse than that of today's adults. Moreover, the poorer health of adolescents may also have potential indirect economic effects via reduced learning capacity at school.

The main contribution of the present report is to go beyond a description of the health status per se and to provide a direct quantitative assessment of the economic consequences of ill-health in the specific case of Estonia. In particular, we begin to answer two important questions:

1) What effect has adult ill-health, in particular chronic disease, had on the Estonian economy and the economic outcomes of the people living in the country?
2) If the substantial burden of adult ill-health in Estonia were reduced, what economic benefits could result?

The overarching message from our findings is unambiguous: poor adult health negatively affects economic well-being at the individual and household level in Estonia; and, if effective action were taken, improved health could play an important role in sustaining high economic growth rates.

More precisely, our findings relating to the first question demonstrate that in Estonia, ill-health has been a significant and sizable factor in workers' decision to retire from the labour force. Ill-health has also had a significantly negative impact on the probability of participation in the labour market, on the amount of hours worked per week, as well as on the monthly salaries received.

The second part of this report assesses the macroeconomic benefits that would accrue by reducing adult mortality rates in Estonia according to plausible scenarios. The main conclusion is that these benefits would be substantial for the Estonian economy, despite the significant caution that has to be exercised in evaluating results from growth forecasts by the relatively simple means used for the present purpose. Applying cross-country empirical econometric evidence, we would find (in one estimate) that a reduction of adult mortality rates by 1.5% per annum over 25 years could generate an approximately 14% higher per capita GDP at the end of the 25-year period compared to the scenario with no adult mortality reduction. This despite the fact that we assess only the effect of mortality reductions, setting aside morbidity reduction, which would likely attend mortality improvement and almost certainly also be sizable.

Evidence-based policy interventions exist that can help overcome the health challenges faced by the country in a cost-effective manner. In addition, the recent Estonian burden of diseases and risk factors analysis offers a solid scientific baseline from which to determine priorities as well as to select the best interventions in Estonia. As it has not been the task of this report to provide a comprehensive assessment of the actual policies to be pursued, we do conclude at a rather general level that the most cost-effective measures to reduce the burden would be those oriented at the entire population, e.g. by raising the excise tax rates for alcohol and tobacco, banning alcohol advertising and restricting access to alcohol sales. Within the health sector the continuity of care, including preventive and promotion services, should be improved further.

1. Introduction

A growing body of research on developing (WHO Commission on Macroeconomics and Health, 2001) and developed countries in the European Union (Suhrcke et al., 2005) has shown that health is not just a by-product of economic development, but can also directly impact economic outcomes. This finding has important policy implications: national and international policymakers interested in promoting the economic development of a given country should seriously consider the role that health investment could play in achieving their economic policy goals.

A superficial inspection of basic health indicators already suggests that Estonia could reap considerable potential economic gains from improving health. In terms of health status, there is much scope for catching up with Estonia's close economic competitors in the European Union. And there is much evidence from other countries demonstrating that improving health is good for the economy. If this evidence from other countries also holds for Estonia, then investing in health in Estonia is very likely to translate into significant economic gains.

While there might be little doubt that what applies for many other countries would in general also be true for Estonia, it is nevertheless important to develop first hand evidence with nationally relevant data from Estonia on the relationship between health and economic development. This is the main purpose of the present report – to the best of our knowledge the first comprehensive effort to provide a more precise quantitative picture of the economic consequences of ill-health in Estonia, and about the potential economic gains that could be reaped from achieving a reduction in mortality.

In the Estonian political agenda the potential contribution of health to economic development has so far received little attention. The lack of comprehensive, Estonia-specific empirical evidence may well have been a reason for such political neglect.

This report aims at raising the level of awareness of the economic importance of health, and at stimulating policy to act upon the evidence that improving health of the Estonian population can play an important role in sustaining economic growth over the medium and longer term.

While the EU's official economic development and competitiveness strategy ("Lisbon Strategy"), agreed upon in 2000, says very little indeed about health, the European Commission is examining ways to incorporate public health in the Lisbon Strategy (European Commission, 2004). Health is also mentioned in Estonia's national action plan to implement the Lisbon Strategy (Republic of Estonia, 2005). Under the macroeconomic objectives to ensure the long-term sustainability of fiscal policy, the health sector is highlighted with specific measures aiming at guaranteeing both the long-term sustainability of the health insurance system and people's financial security in case of health risks. The national action plan also highlights the role of the health sector in improving the health of the population in order to increase the labour supply and to insure a better working environment.

In its Communication on *Policy Challenges and Budgetary Means of the Enlarged Union 2007-2013,* published in February 2004, the European Commission stresses the need for greater investment in health and recognises that health is a precondition for economic prosperity, as it contributes to longer, better and more productive lives (European Commission, 2004). In addition, the European Commission's key financial assistance mechanism for promoting economic and social development – the Structural Funds – are starting to be used for investment in health, too (GVG, 2005). Parallel to the current study, WHO, jointly with Estonian partners, has been preparing an analytical overview of the Estonian health system to inform the allocation of investments from EU funds.

The report is structured as follows. Section 2 starts by providing a brief snapshot of health in Estonia. Section 3 introduces the general framework to conceptualise the impact of health on the economy. It also reviews relevant evidence from other countries. Section 4 constitutes the core of the report, presenting the evidence on the impact of health on economic outcomes in Estonia. It is subdivided into four parts: the description of the data at hand to analyse the link between health and economic outcomes, the synthesis of previous studies, the results of the impact of ill-health on labour market outcomes, and the potential gains from future mortality reductions. Section 5 briefly discusses some policy implications for Estonia, based on international and domestic evidence. The final section 6 concludes the report.

2. Health in Estonia

This section provides a brief assessment of the health status and trends of the Estonian population. Evaluating whether a given level of health (measured by various indicators) is 'low' or 'high' depends on the criteria applied. In what follows the 'benchmark' is defined as the 8 Central and Eastern European countries (CEE-8), including Estonia, that have joined the EU in 2004, as well as the 15 EU members before May 2004. We consider this comparison justified because it is these countries that Estonia has to primarily compete with in economic terms. Table 1 illustrates the comparative performance of Estonia according to a small set of aggregate population health indicators.

Table 1: Estonian health performance in comparison with EU countries (2002)

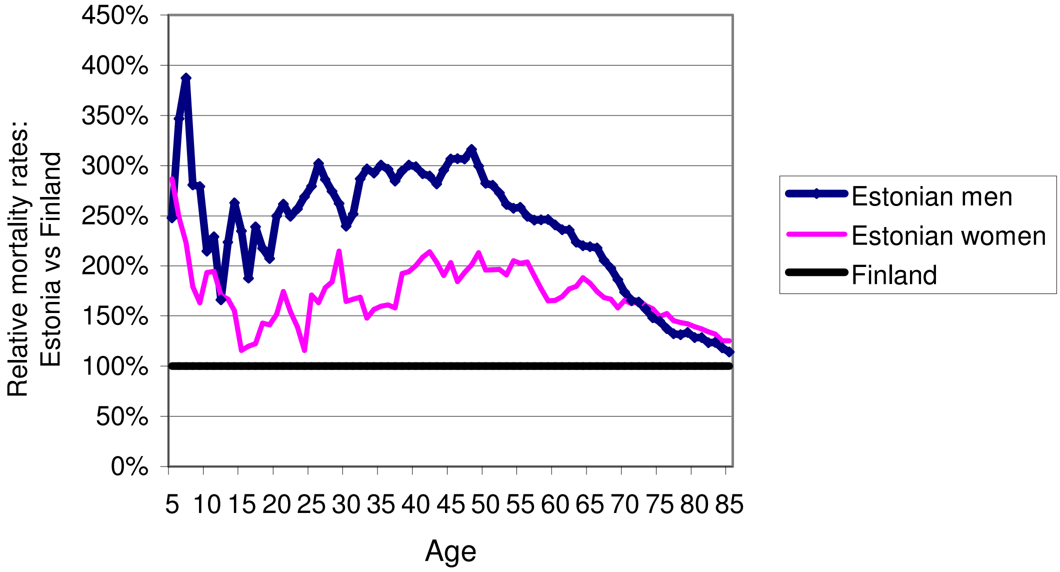
		Life expectancy at birth (male)	Life expectancy at birth (female)	Life expectancy at 45 (male)	Life expectancy at 45 (female)	Under 5 mortality rate	Infant mortality rate
EU before 5/2004	Worst	73.82	80.70	31.98	37.00	6.64	5.23
	Average	75.86	81.72	33.04	37.96	5.26	4.29
	Best	77.85	83.36	34.40	39.57	3.61	2.97
CEE-8	Worst	64.76	76.08	25.02	33.57	13.18	9.85
	Average	68.72	77.98	27.34	34.74	8.42	6.72
	Best	72.67	80.66	30.13	36.80	4.88	3.83
	Estonia	***65.29***	***77.14***	***25.31***	***34.06***	***7.64***	***5.69***

Source: WHO/EURO (2005) European health for all database (HFA-DB), version January 2006
Note: The table uses 2002 figures to ensure consistency across all countries, given that mortality data is relatively scarce in the EU before May 2004 for 2003.

Life expectancy at birth and child or infant mortality are the most commonly used health indicators in international comparisons. Child mortality obviously accounts for a large share in life expectancy at birth. To also capture more specifically the health status of the working age and the elderly population, we have included the indicator life expectancy at 45. The data presented in Table 1 – in particular the four indicators on life expectancy – shows fairly consistently that the average health status of the Estonian population is (a) always significantly below the average performance of the other new EU members and (b) even much further away from even the worst performer among the EU countries before May 2004. It is also obvious that the relative under-performance of Estonia is particularly marked in the case of *male* life expectancy (at birth and at age 45) – see for instance the 8.5 years of difference from the worst EU country for male life expectancy at birth, compared to 3.6 years for female life expectancy at birth. As far as child and infant mortality are concerned, Estonia appears to be less far behind than on the various life expectancy indicators.

To gauge the economic impact of ill-health it is instructive – as a first approximation – to take a look at the age profile of mortality. Which are the age groups primarily affected, compared to other countries with a more favourable health profile? Figure 1 shows the relative difference of mortality rates in each age group between Estonia and Finland as the neighbouring reference country. From the figure at least one result stands out that bears immediate economic implications: there are two peaks indicating a particularly high mortality disadvantage of Estonians – one in the age group 5-10 (which is mainly influenced by the very tiny absolute numbers of death in this age group), and another in the prime working age 25-65 (which applies predominantly to males). This is already highly indicative of a disproportionate loss in potentially productive life years.

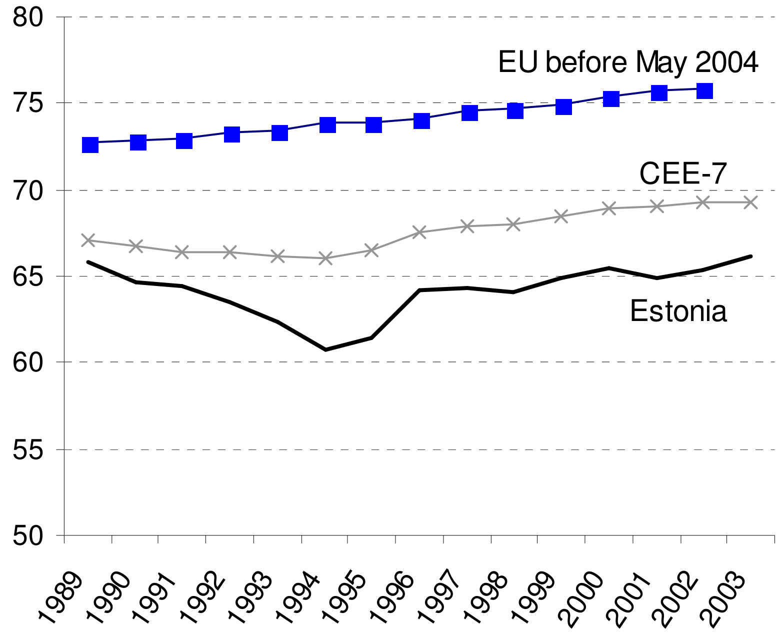
Figure 1: Age-specific mortality rates in Estonia in 2003 in percent of Finnish mortality in 2002 (by gender)



Note: 100% would mean that Estonian and Finnish mortality rates are equal in that age group.
Source: Eurostat, on-line database, table Probability of dying by sex and age, http://europa.eu.int/comm/eurostat/ accessed 11 Oct 2005

The above data only looks at one point in time, and did not include any information about longer-term trends that could have given some indication about potential future trends. As Estonia – just like most other Eastern European transition economies – is facing a particularly strong adult male health problem, figure 2 chooses male life expectancy at birth to illustrate the evolution over time.

Figure 2: Life expectancy at birth for males, 1989-2003



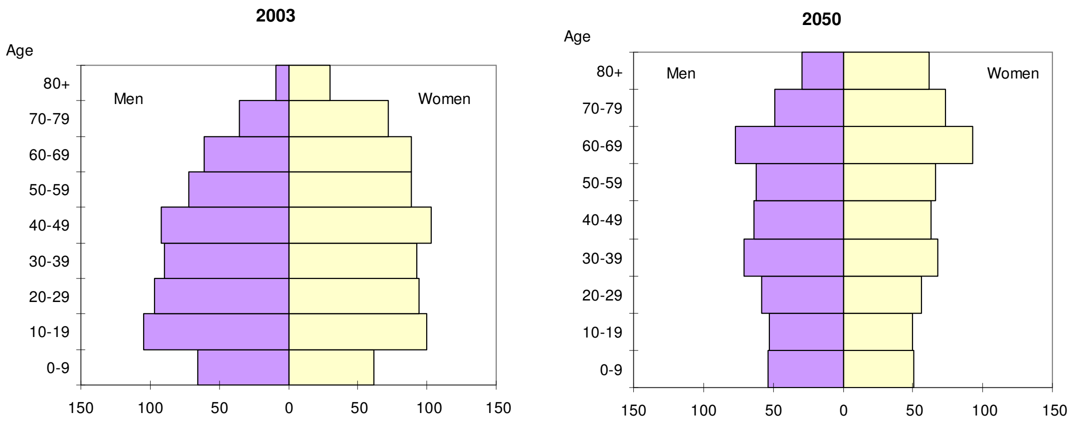
Source: WHO/EURO (2006) Health for all database, version January 2006
Note: CEE-7 is all new Central and Eastern European EU members except Estonia. Averages are not population-weighted.

Figure 2 shows that while the member countries of the EU before May 2004 have on average seen a steady increase in male life expectancy over the entire period – and the CEE-7 countries (i.e., the CEE-8 expect Estonia) on average since 1994 – the level of Estonian male life expectancy in 2003 is only marginally above the 1989 level, with only a hardly recognisable upward trend in recent years. This adds up to an increasing gap in male life expectancy between the EU and Estonia. There also remains a sizeable gap of between 3 and 4 years with respect to the average of the other new EU members from Central and Eastern Europe.

Declining life expectancy in the 1990s was accompanied by a drastic drop in fertility (see Figure A 1 in Annex 1), which has had a permanent impact on the population age structure. In the coming decades the population of Estonia is predicted to diminish further. According to Eurostat baseline projections without migration[1] the Estonian population will decrease from 1.4 million in 2003 to 1.1 million in 2050. The share of elderly people will increase and the share of working-age population will decrease (Figure 3). With a declining population and workforce the health of working-age people (and the health of the elderly) becomes crucial for economic development. If the health status continues to stagnate, this may become a barrier to sustained economic growth, as the international evidence suggests (Leeder et al., 2004).

[1] Eurostat baseline projections for Estonian population assume that the total fertility rate will increase from 1.37 in 2003 to 1.60 in 2030 and stay constant thereafter, whereas by 2050 male life expectancy will increase from the current 65.5 to 74.9, and female life expectancy will increase from the current 76.9 to 83.1.

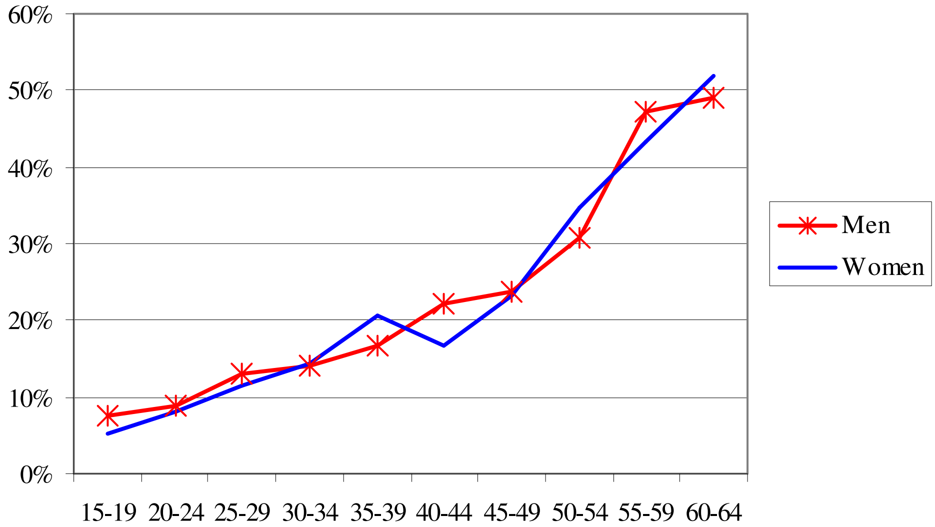
Figure 3: Estonian population structure in 2003 and 2050 (thousands)



Source: Eurostat, online database, table Population projections, no migration variant, accessed 11 October 2005

Mortality data only captures one part of the overall disease burden. Morbidity data usefully complements the picture on health in Estonia. Perhaps even more so than the mortality data, a look at morbidity shows that there is likely to be a significant cost associated with the health burden observed in Estonia. Disabilities and chronic diseases have a direct impact on a person's work ability. According to the Estonian Labour Force Survey 2002, about 21% of men and 23% of women in the age group 15-64 report having a chronic health disorder (defined as a long-term illness, impairment or disability which has lasted or will probably last for 6 months or longer). The prevalence of a health disorder obviously increases sharply with age. In the age group 60-64, nearly half of men and women have a health disorder (Figure 4). It is interesting to observe the almost identical pattern of self-reported chronic disease among men and women. This might not have been expected, given the substantial male-female mortality gaps noted previously. It suggests that the poor health status does not solely affect men, but also women, even though the outcomes of ill-health in women appear less likely to be fatal.

Figure 4: Self-reported chronic disease prevalence in Estonia (2002), by age and gender



Source: Estonian Labour Force Survey 2002, authors' calculations
Note: 'Chronic disease' is defined as 'a long-term disease, impairment or disability that has lasted or will probably last for 6 months or longer'.

What are the main health challenges faced by the Estonian population?

Again this question may be looked at in terms of mortality and morbidity data. The availability of the Estonian Burden of Disease Study 2004 (Ministry of Social Affairs & University of Tartu, 2004)) serves as a rather unique source of epidemiological information that allows both mortality and morbidity to be captured. The study finds that the total number of years of life lost of the Estonian population was about 338 thousand in 2002, of which 140 thousand was lost due to morbidity and 198 thousand years due to early mortality. It is important to note that more than one-half of the disease burden of the Estonian population occurs in the population of productive age (aged 20–64); in the case of men this percentage is as high as 58%.

The major causes for the loss in years of life are cardiovascular diseases, which contribute 33% of the total disease burden. Neoplasms come second (20%), and the third place is taken by external causes (12%). The three main disease groups that cause health loss contribute 65% of the total burden (see Table 2).

Table 2: Distribution of total life years lost (DALY) by gender and diseases in 2002

	Men	Women	Total
Cardiovascular diseases	31.3%	35.1%	33.2%
Neoplasms	17.5%	22.0%	19.7%
External causes	18.0%	5.8%	11.9%
Other non-infectious diseases	6.3%	9.0%	7.7%
Joint and muscle diseases	4.6%	8.6%	6.5%
Pulmonary diseases	6.7%	5.0%	5.8%
Psychiatric diseases	3.8%	4.3%	4.1%
Neurological diseases	3.8%	3.3%	3.6%
Diseases of digestive system	3.9%	3.0%	3.5%
Genitourinary diseases	1.2%	2.0%	1.6%
Malformations	1.6%	1.0%	1.3%
Infectious diseases	1.4%	0.7%	1.1%
Total	100.0%	100.0%	100.0%

Source: Ministry of Social Affairs, University of Tartu (2004). Tables 3-1, 3-2, 3-3, 3-4.

The two single diseases that account for most years of life lost are the same for women and men – cardiac ischemia and stroke, 16% and 9% of the total loss of life years, respectively. Amongst the less frequent conditions, there are causes that are characteristic for certain gender groups – lung cancer, suicides, and traffic accident-related injuries among men, and osteoarthritis and breast cancer among women. As for women, no external causes rank at the top of the list of total health loss, whereas in the case of men, among 20 causes on the top list, as many as five are external causes. HIV/AIDS does not enter the figures yet, but it is suggested in the Estonian Burden of Disease Study that by 2012 the total number of years of life lost due to AIDS mortality might be of the same magnitude as due to cardiovascular disease mortality in 2002 (see Ministry of Social Affairs & University of Tartu (2004)).

In light of the above-mentioned excessive working-age mortality (especially among men), it is instructive to compare the three most important cause-specific death rates in working age men in Estonia to those in, for instance, Finland, to develop a more concrete idea of the diseases that produce the greatest relative loss of life. As table 3 shows, the biggest relative disadvantage is circulatory disease, followed by a very small margin by external causes. For both causes Estonian prime-age males face an almost three times higher probability of dying of these three diseases, compared to their Finnish counterparts.

Table 3: Main causes of death of Estonian males and Finnish mortality, males age 25-64

	Estonia	Finland	Ratio Estonia/Finland
Neoplasms	207	99	2.1
Diseases of the circulatory system	422	145	2.9
External causes of injury and poisoning	340	119	2.8

Note: standardized death rates per 100,000
Source: World Health Organization Regional Office for Europe, European mortality indicator database, updated January 2005

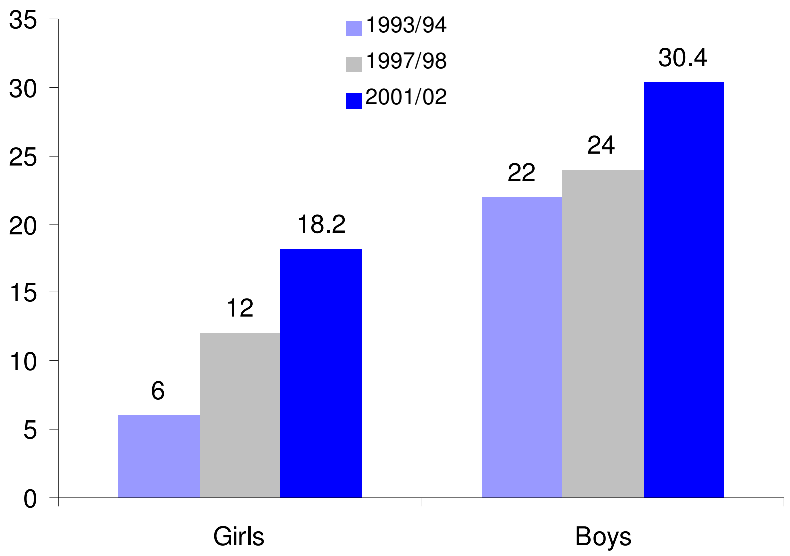
Morbidity data derived from the national Labour Force Survey 2002 confirms the importance of cardiovascular disease: heart, blood pressure or circulation disorders were reported as the most important health problems (see Table A 1 in Annex 1). Health disorders were attributed first and foremost to a disease not related to the respondent's work (see Table A 2 in Annex 1).

Young people's health

As expected, among Estonian young people mortality is generally low, and severe chronic diseases are rare among persons in their teens and 20s. Health among young people should therefore be considered in a wider sense: much illness in later life has its origin during the transition from childhood to adulthood. (Investing in child and adolescent health may well be seen as the most effective way of improving the health of future adults.) Deteriorating adolescent health therefore has an economic impact through its effect on adult health and adult productivity. However, poorer health among adolescents also has potential economic effects via reduced learning capacity and 'productivity' at school.

It is during adolescence that people first confront choices related to intoxicating and potentially addictive substances: tobacco, alcohol and drugs. As Figure 5 shows, the consumption of tobacco by Estonian youth has increased significantly among both girls and boys. This is a predictor of both an increase in adult smoking rates and an increase in premature deaths, hence, substantial economic costs.

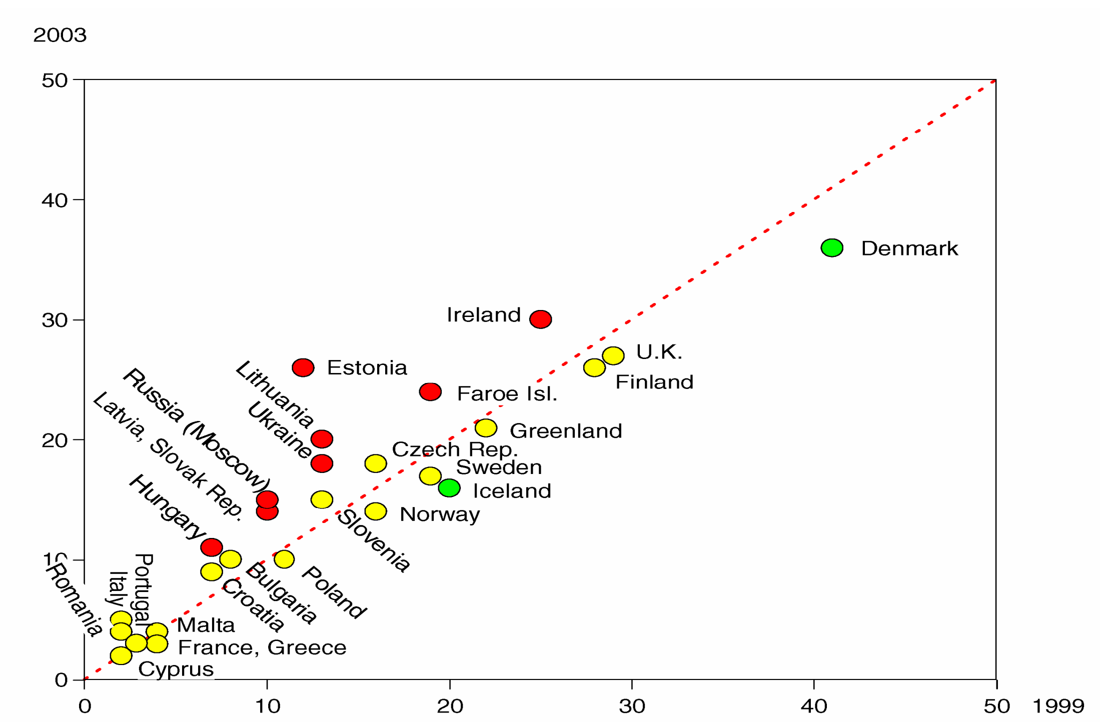
Figure 5: Estonian 15-year-olds who smoke at least once a week, %



Source: Currie et al (various years)

Data from the 1999 and 2003 ESPAD surveys show an exceptionally sharp increase in the share of adolescents regularly consuming alcohol, in Estonia far more so than in any other of the countries included in the survey (Figure 6).

Figure 6: Being drunk over 20 times in a lifetime, percent in 1999 and 2003



Source: ESPAD survey results as reported on http://www.espad.org/changes.asp (accessed 10 May 2006)

The cumulative effects of increasing rates of alcohol consumption, smoking and use of illicit drugs among teenagers suggest that the health of today's teenagers upon reaching adulthood may become even worse than that of today's adults.

In sum, there is much that suggests that the health of the Estonian population offers much scope for improvement, in particular when compared to the health of its current economic competitors. This is very obvious in the case of the working age population and young people. It was also shown that there exists reliable information on the epidemiological patterns in the country. This should serve as an important basis for informing policy interventions in the future.

3. Conceptual framework and evidence from other countries

This section introduces the conceptual framework used to analyse the relationship between health and economic development, and briefly reviews selected evidence from other high-income countries on the economic benefits of health (or the costs of ill-health).

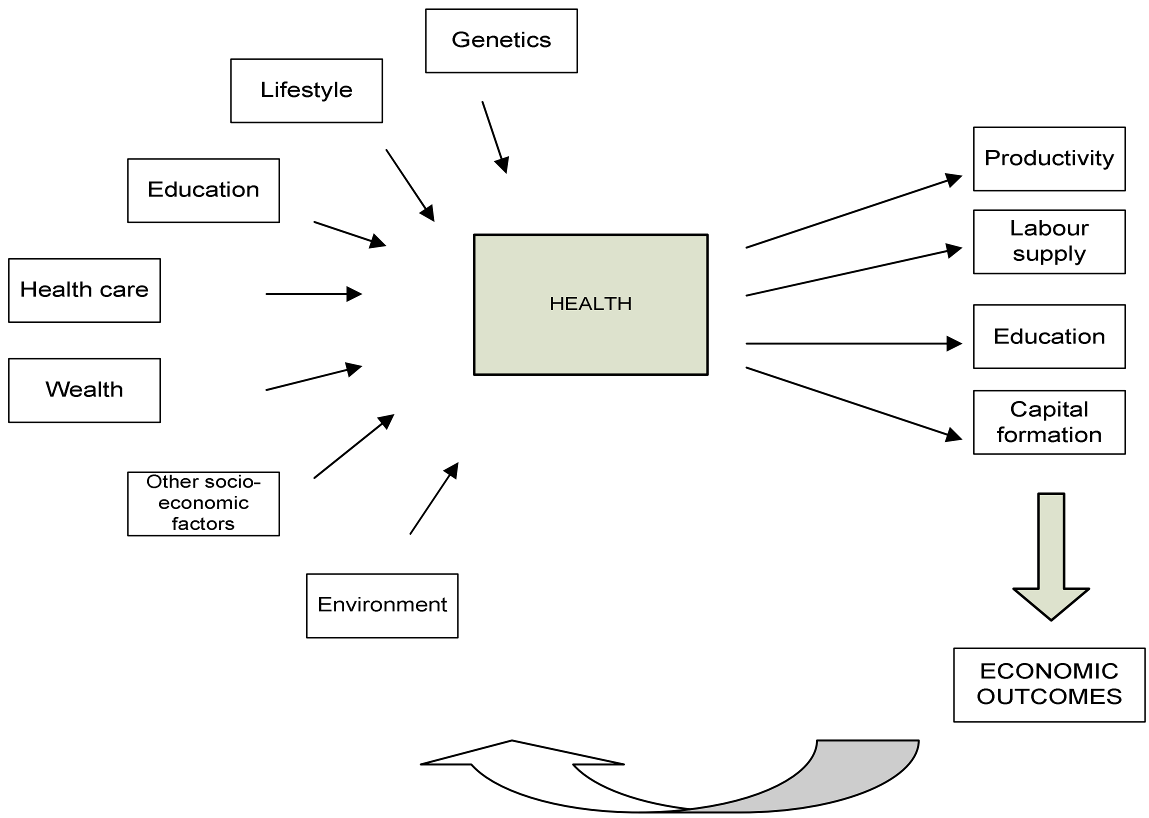
Conceptual framework

Health is determined by genetic, economic, social, cultural and environmental factors. But the health of a population may also, in return, influence the economic context. As Figure 7 illustrates in a simplified manner, health contributes to economic outcomes (at both the individual and the country level) in high-income countries mainly through four channels: higher productivity, higher labour supply, higher skills as a result of greater education and training, and more savings available for investment as physical and intellectual capital. These four channels are represented in the right-hand side of Figure 7.

The left-hand side of Figure 7 shows the multiple factors that health is determined by: genetic endowments, lifestyle, living and working conditions (access and use of healthcare, education, wealth, housing, occupation) and the more general socioeconomic, cultural and environmental conditions. Several of these determinants of health can be influenced by public policies.

In assessing the contribution that health can make to economic growth, it is important to keep in mind the positive feedback from income to health. There are two ways in which income can influence health: through a direct effect on the material conditions that have a positive impact on biological survival and health; and through an effect on social participation, the opportunity to control life circumstances, and the feeling of security. Above a certain threshold of material deprivation, income may be more important because of its link with these social and psychological factors, particularly in societies where social participation depends heavily on individual income (Marmot, 2002).

Figure 7: Health inputs and health outputs



Source: Suhrcke et al. 2005

The main interest of the present study is to review the evidence on the positive effect of health on the economy, not the reverse pathway, which has been widely documented elsewhere (Marmot, 2002). Four channels that link health to economic outcomes are shown, though others may exist: enhanced labour productivity, greater labour supply, education and training fostering higher skills, and more savings available for investment in physical and intellectual capital. Each channel is described in turn below.

Labour productivity. Healthier individuals could reasonably be expected to produce more per hour worked. On the one hand, productivity could be increased directly by enhanced physical and mental activity. On the other hand, more physically and mentally active individuals could make a better and more efficient use of technology, machinery, and equipment. A healthier labour force could also be expected to be more flexible and adaptable to changes (e.g., changes in job tasks and the organisation of labour), reducing job turnover with its associated costs (Currie & Madrian, 1999).

Labour supply. Somewhat counter-intuitively, economic theory predicts a more ambiguous impact of health on labour supply. The ambiguity results from two effects working to offset each other. If the effect of poor health is to reduce wages through lower productivity, the substitution effect would lead to more leisure and therefore lower labour supply as the return for work diminishes. On the other hand, the income effect would predict that as lifetime earnings are reduced through lower productivity, the individual would seek to compensate by increasing the labour supply. The income effect is likely to gain importance if the social benefit system fails to cushion the effect of reduced productivity on lifetime earnings. The net impact of the substitution and income effects ultimately becomes an empirical question (Currie & Madrian, 1999).

Education. Human capital theory suggests that more educated individuals are more productive (and obtain higher earnings). If children with better health and nutrition attain higher education and suffer less from school absenteeism and dropping out of school early, then improved health in youth would contribute to future productivity. Moreover, if good health is also linked to longer life, healthier individuals would have more incentive to invest in education and training, as the rate of depreciation of the gains in skills would be lower (Strauss & Thomas, 1998).

Savings and investment. The health of an individual or a population is likely to impact not only the level of income but also the distribution of income among consumption, savings, and investment. Individuals in good health are likely to have a wider time horizon so their savings ratio may be higher than that of individuals in poor health. Therefore, a population experiencing a rapid increase in life expectancy may be expected, other things being equal, to have more savings. This should also contribute to a propensity to invest in physical or intellectual capital (Bloom, Canning & Graham, 2003).

Microeconomic evidence: the economic effect of health at the individual level

In the high-income country context, most of the existing empirical evidence relates to the effect of health on labour supply and labour productivity. As these are the two areas that the Estonian evidence will focus on in section 4, we limit ourselves here to a brief review of the empirical evidence in this area alone. In a recent synthesis of the existing evidence on the impact of health on the economy in the European Union, Suhrcke et al (2005) have summarised a significant number of studies that examined the impact of health on various labour market outcomes in a number of EU countries[2] and in other high-income countries, along the lines suggested by the above theoretical considerations. The report cites European evidence of a significant effect of ill-health on labour force participation for instance in Ireland (Gannon & Nolan, 2003), Spain (Pagán & Marchante, 2004), Sweden (Lindholm et al., 2001), Germany (Riphahn, 1998; Lechner & Vazquez-Alvarez, 2004), and the Netherlands (Van de Mheen et al., 1999). The effect of ill-health as a factor that anticipates retirement has been shown for several EU countries by Jiménez-Martin et al. (1999), for Germany by Siddiqui (1997) and for the UK by Disney et al (2003). The effect on earnings or wages has been shown for instance by Contoyannis and Rice (2001) and Gambin (2004) for the UK. Brunello and d'Hombres (2005) have demonstrated a wage depressing effect for obesity in several EU countries, especially for women.

[2] See also Currie and Madrian (1999) for a review on the labour market effect of health in developed countries.

Macroeconomic evidence: the effect of health on economic growth

Recent worldwide empirical evidence strongly suggests that health is a robust determinant of economic growth (Bloom, Canning & Graham, 2003; Kalemi-Ozcan, Ryder & Weil, 2000; Thomas 2001; Alsan, Bloom & Canning, 2004; Barro, 1996; Bhargava, Jamison & Murray, 2001; Bloom, Canning & Seville, 2001; Jamison, Lau & Wang, 2005, and many more). Studies examining the impact of health on income levels or income growth differ substantially in terms of country samples, time frames, control variables, functional forms, data definitions and configurations, and estimation techniques. Nevertheless, parameter estimates of the effects of life expectancy on economic growth have been remarkably comparable and robust across studies (Levine & Renelt, 1992; Sala-I-Martin & Doppelhofer, 2004). In some studies, initial health status, typically proxied by life expectancy or adult mortality, proved to be a more significant and more important predictor of subsequent growth than the education indicators employed (Barro, 1997). Bhargava, Jamison and Murray (2001), for instance, show in the context of a panel regression that the 5-year growth rate of GDP per capita depends on a country's adult mortality rate, among other factors. They also show that the direction of causality runs unambiguously from adult mortality to growth. Section 4.3 will apply a parsimonious version of this worldwide empirical relationship in order to project different future pathways in GDP per capita, conditional on plausible future mortality scenarios.

4. Empirical evidence on the economic consequences of health in Estonia

This section contains the core contribution of the report. Section 4.1 gives an overview of studies that have started to explore the issue in the Estonian context. Section 4.2 presents our own analysis on the impact of health on labour market outcomes. Section 4.3 takes a macroeconomic perspective and assesses the potential future macroeconomic benefits that would result from various, plausible future population health improvements, here proxied by reductions in adult mortality rates.

4.1 Previous studies

Given the very dramatic and highly intertwined social, political and economic changes that have occurred in Estonia's transition, the attempt to use recent macroeconomic time series data to assess the past impact of health on economic growth would be of limited use. Therefore, most of the previous studies in Estonia have used various available micro-level data sets to evaluate the impact of health on the economy (see Table A 3 in Annex 1 for an overview of the data available). In principle, regional county level data could also be used, as they display some variation both in health status and economic activity, but given the large differences in industrial structure, labour demand, ethnic composition etc, it is almost impossible to disentangle the effects of health on the level of economic activity.

Several studies have also applied versions of the cost-of-illness methodology in an attempt to quantify the aggregate costs of certain diseases or of ill-health at the country level.

Table 4 presents a summary of those studies. Most of the studies have estimated the effect of lost workdays or life years on output using either gross labour earnings or GDP per employee as a relevant measure.

As expected, the results vary markedly, given different methods and assumptions. Estimates on indirect costs due to current and future lost output from ill-health range between 6-15% of GDP. There are some studies that have looked at one particular disease or risk factor. Uusküla (2001) estimated that discounted lost gross labour earnings due to annual fatal injuries in Estonia are about 3% of GDP in 2000. Economic costs of traffic accidents in Estonia are estimated to be around 2-3% of GDP in the period 1998-2004 (Tallinna Tehnikaülikool; 2005). Taal et al (2004) showed that, for the state budget, the total costs of smoking considerably outweigh the revenue from tobacco taxes.

Table 4: Studies on the effects of health on the Estonian economy

Author, year, topic	Data	Method	Result
Tallinna Tehnikaülikool (2005) Economic costs of traffic accidents	Combining different registry and statistical information	Direct material and health care costs, plus indirect current and future costs of output – discounted GDP per employee	Economic costs due to traffic accidents in Estonia were on average 2.4% of GDP in 1998-2004.
Ministry of Social Affairs (2005a) Economic costs of accidents at work	Combining different registry information	Discounted lost gross labour earnings due to accidents at work	0.5% of GDP in 2004
Ministry of Social Affairs (2005b) Economic costs of illness	Combining different registry information	-Direct health care costs of illness -Indirect current and future costs of output – discounted GDP per employee	15.3% of GDP in 2003 (of which 5.4% absenteeism from work, and 9.9% early retirement)
Reinap (2004) Economic costs of illness	Health Insurance data, Social insurance data 2002	-Direct health care costs -Indirect current and future costs of output – discounted lost gross labour earnings	Indirect discounted costs about 7 bln EEK or about 6% of GDP (approx. 1/2 due to mortality, 1/3 due to disability, 1/6 due to illness) Direct health care costs about 6 bln EEK (about 5.2% of GDP)
Kaldaru, Kerem, Võrk (2004) Economic costs of illness	Labour Force Survey 2001, Household Budget Survey 2000-2001	-Average number of absent days from work due to illness generalized to macro level using earlier studies on the production function - The effects of self-assessed health on employment (probit) and net wages (Mincerian wage regression, simultaneity not considered)	1-2% of GDP per year lost because of sick days Self-assessed health has a strong effect on wages and employment probability; a person with very poor self-assessed health has about a 45% lower hourly wage and 63% lower employment probability compared to a person with very good self-assessed health
Leetmaa, Võrk, Kallaste (2004) Effects of ill-health on labour market	Labour Force Survey 2002, Social insurance data 2004	Simple cross-tabulations of characteristics of health and labour market outcomes; respondents self-assessed effect of health on labour market behaviour	Ill-health is main reason why people retire from labour before normal retirement age About 40 000 people inactive due to ill-health. Poor health influences the type and amount of work
Taal et al (2004) Costs of smoking	National trade and health care statistics, Household Budget Surveys and Health Behaviour Among Estonian Adults	Direct medical costs, indirect costs of lost production and other aspects (costs of health promotion, tax revenues, losses due to smoking-related fires) are used to calculate the private and public costs of smoking	In 1998, tobacco cost the Estonian government 200 mln EEK more than excise revenues; household members lost 6.8 mln of their expected family income because of premature deaths attributed to smoking of family members.
Uusküla (2001)	Injury data	Discounted lost gross	Economic costs (direct and

Economic costs of fatal injuries	Special survey on injuries 2000 and 2001	labour earnings due to fatal injuries	indirect) due to fatal injuries are about 3% of GDP.
Bačkaitis (2000) Economic costs of traffic accidents	The economic costs of traffic accidents in the Baltic countries in 1998	Based on indicators of National Highway Traffic Safety Administration (NHTSA) of the U. S. Department of Transportation	Economic costs due to traffic accidents in Estonia are about 1.5% of GDP.

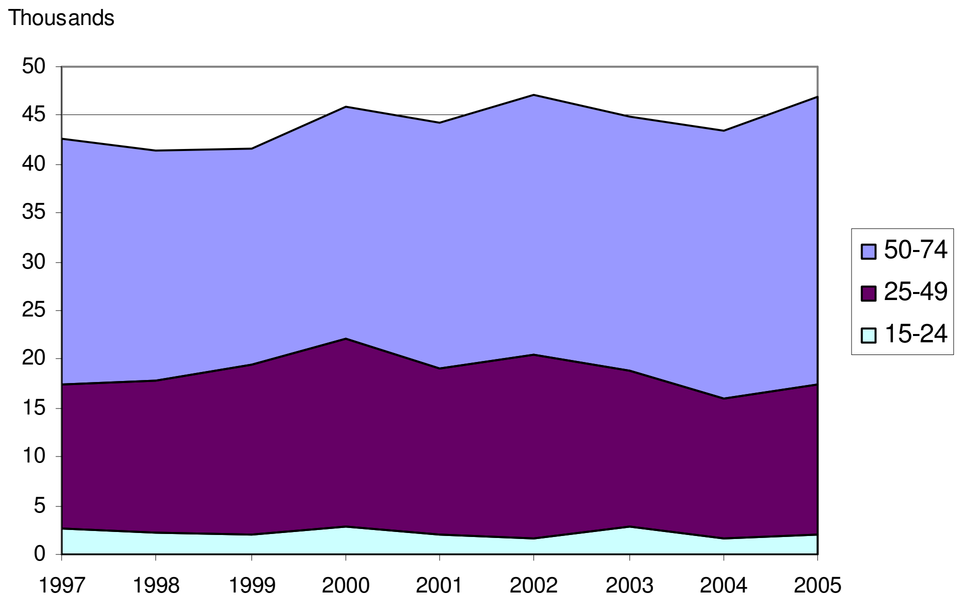
4.2 The impact of health on labour market outcomes

Poor health may negatively affect individual labour market outcomes by reducing the number of people who actively participate in the labour force, by reducing working hours of those employed and by reducing the productivity (commonly approximated by the wage rate) of those working. In this section, we begin with a descriptive analysis of the potential economic magnitude of ill-health as it is immediately visible in the Estonian labour market, based on recent data. Subsequently we proceed to a more structural analysis, which tries to establish some causal mechanisms, taking into account also other potential determinants of labour market outcomes.

Descriptive analysis

In Estonia, about 40 to 50 thousand people, i.e., 6-7% of the labour force (aged 15-74), report being inactive due to illness or disability (figure 8). The number has been relatively stable since 1997, with a slight upward trend. Unsurprisingly, the highest share is accounted for by the age group 50-74.

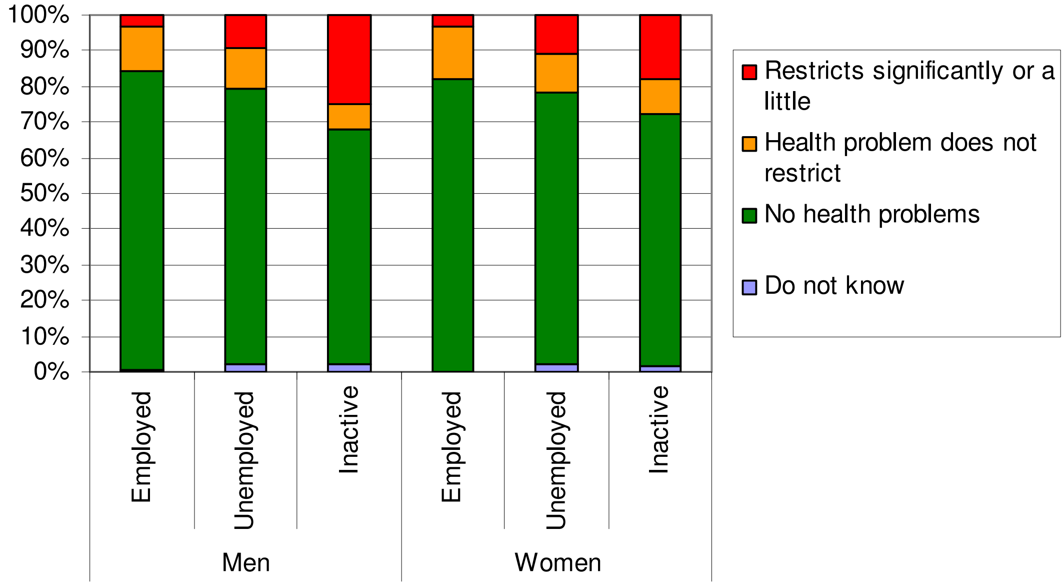
Figure 8: Number of inactive people because of illness or disability in 1997-2005 (thousands)



Source: Statistical Office of Estonia database, accessed 8 May 2006

According to the Estonian Labour Force Survey 2002, about 21% of men and 23% of women in the age group 15-64 were experiencing a health disorder at the time they were surveyed. Among the employed the percentage is 17%, among the unemployed 24% and among the inactive people 31%. Overall, the health disorder "*restricts significantly or a little*" the type and amount of work in about 3% of the employed, 9% of unemployed and 21% of the inactive (Figure 9).

Figure 9: How much does (or "would" in case of non-working persons) the health disorder restrict the type of work done, in 2002



Source: Estonian Labour Force Survey, 2002, authors' calculations

These data are illustrative, and there are obvious limits as to how far they can be interpreted as causal evidence of the effect of ill-health on labour market outcomes. For this purpose, a more structural analysis is required.

Structural analysis

Measuring the impact of ill-health on labour market outcomes is not a trivial exercise. Some econometric challenges have to be tackled in order to arrive at sufficiently reliable estimates of a causal impact. Some of these challenges are described in Annex 2. Here we present the main results of the estimations carried out using data from the Estonian Labour Force Survey.[3] The presentation is separated into two parts (as the method proposed to overcome the econometric challenges differs between the two): first, the results assessing the impact of health on retirement, and second, the impact of

[3] To check robustness of the results we have also carried out analysis using the Estonian Household Budget Survey. However, this survey offered fewer possibilities for tackling the econometric problems, so we only present results on the impact of health on retirement (see Annex 2). Qualitatively, they are very similar to the results based on the labour force survey and are presented in Table A 4.

health on the three outcomes: labour force participation, working hours and salaries. For the sake of improved readability, we relegate the complete set of econometric results to Annex 2.

Early retirement

Ill-health turns out to play an important role in anticipating the decision to retire in Estonia. Both men and women reporting a chronic illness or disability[4] are more likely to have retired in the two years prior to the survey. The effect is statistically highly significant. We can develop an idea of the average extent of the effect of ill-health by looking at the marginal effects reported in Table A 5. **For men (women), ill-health increases the probability of retiring in the following year by 6.4 percent (5.6 percent), compared to those who do not report a chronic illness or disability**.

As further explanatory variables in addition to health status, we included age, the amount of hours usually worked in a week, the number of members in the household of the respondent, ethnicity, marital status, educational attainment, and selected job characteristics (i.e. whether the respondent was an employee and, if so, whether the contract was permanent or a fixed-term one).

Data from the 2002 round of the Estonian Labour Force Survey was used for the estimates. The survey captures the working-age population (here defined as the age group 15 to 74) living in Estonia. In order to exclude the possibility that the relationship between health and retirement reflects reverse causality, we assessed the effect of health on retirement only for individuals who were working before 2000. Then we constructed the dependent variable, assigning a value of 1 if the individual left the job between 2000 and the survey year (2002), and 0 otherwise.

Labour force participation, labour supply and salaries

We applied the methodology proposed by Stern (1989) – and briefly described in Annex 2 – to explicitly test the impact of ill-health on three labour market outcomes given in the Estonian LFS: labour force participation, actual weekly working hours and monthly salaries.

In all specifications, the same general result obtains: ill-health is consistently bad for all three labour market outcomes. Individuals with a predicted "fair" health status are less likely to participate, to have worked fewer hours, and have gained lower salaries than those with good health status. Those with a "poor" health status are even worse off for all three outcomes.

The extent of the impact can again be illustrated by the marginal effects, as is done in Table 5 for the impact on labour force participation. Men in "poor health" are almost 40 percent more likely not to participate in the labour force compared to those in "good health". For women the corresponding number is almost 30 percent.

[4] Ill-health is here defined as the affirmative answer to the question "Do you suffer from a lasting disease or disability which has lasted or is likely to last for 6 months or longer?".

Table 5: Reduction in the probability to participate in the labour force, compared to self-reported "good health" (marginal effects)

	Male	Female
Fair health	-10%***	-15%***
Poor health	-39%***	-29%***

Source: Authors' calculation
Note: See Annex 2 for details. * significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level

The negative impact of ill-health is confirmed for the two other labour market outcomes that were examined, i.e., weekly working hours (see Table 6), and monthly salaries (see Table 7). Being in poor health reduces weekly working hours by more than 12 hours for men and by about 8 hours for women, compared to being in good health. Poor health also reduced monthly salaries by almost 1,300 Estonian kroons (approximately 30% of the mean male salary) and about 621 kroons (approximately 20% of the mean female salary), respectively for men and women. These are rather substantial effects.

Table 6: Reduction in weekly working hours, compared to self-reported "good health"

	Male	Female
Fair health	-2.7***	-3.0***
Poor health	-12.4***	-8.1***

Source: Authors' calculations.
Note: See Annex 2 for details. Numbers are derived from a transformation of the model coefficient as explained in Wooldridge (2002). * significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level

Table 7: Reduction in monthly salaries in response to fair and poor health, compared to self-reported "good health"

	Male		Female	
	Estonian kroons	% of mean salary of working men	Estonian kroons	% of mean salary of working women
Fair health	-205*	-4.8%	-130*	-4.2%
Poor health	-1,290***	-30.2%	-621***	-20.0%

Source: Authors' calculations.
Note: See Annex 2 for details. Numbers are derived from a transformation of the model coefficient as explained in Wooldridge (2002). * significant at the 10% level, ** significant at the 5% level, ***

significant at the 1% level. Mean after-tax monthly salary for working men is 4266 Estonian kroons, and for women 3111 kroons in the estimation sample.

The microeconomic results presented in this section paint a remarkably robust picture: ill-health negatively impacts labour market outcomes in Estonia. The macroeconomic dimension of this negative labour market effect could not be assessed within the limited scope of the study. The following section assumes a macroeconomic perspective by looking ahead and asking: what would be the macroeconomic benefits if Estonia succeeded in reducing its adult mortality rate according to plausible scenarios?

4.3 The potential macroeconomic gains from future mortality reductions

As mentioned above, recent worldwide empirical evidence strongly suggests that health is a robust determinant of economic growth. Bhargava, Jamison and Murray (2001), for instance, show in the context of a panel regression that the 5-year growth rate of GDP per capita depends on a country's adult mortality rate, among other factors. They also show that the direction of causality runs *unambiguously* from adult mortality to growth. This section replicates a more parsimonious version of their empirical model and then uses this worldwide empirical relationship (assessed for a panel from 1960 to 2000) to project different future pathways in GDP per capita specifically for Estonia, subject to assumptions about the evolution of future adult mortality rates and of the other growth determinants of the model (see Annex 3 for technical details).

The projections reach from 2000 (as this is when the underlying panel regression ends) to 2025. The main inputs into the projections are the future adult mortality rates (see Annex 3 for technical details). As such they should be seen as projections that broadly indicate the overall magnitudes that could be involved, rather then a literal prediction. Caution should also be exercised for some of the general concerns relating to economic growth regressions.[5]

While in principle any future scenario regarded as relevant by policymakers can be considered, for illustrative purposes we assume three different scenarios:

1) The status quo scenario in which adult mortality rates remain constant throughout the period.
2) The intermediate scenario in which adult mortality rates are reduced by 1.5% per annum.
3) The optimistic scenario in which adult mortality rates are reduced by 3% per annum.

It is hard to judge whether 2) and 3) would be realistic scenarios. However, they are broadly in line with the recent goals set out by WHO for the reduction of chronic

[5] Cross-country regressions for identifying the determinants of growth have numerous drawbacks, including the difficulty of disentangling symptoms from causes, wide divergence from more robust microeconomic analyses, and the limited utility of inferring country-specific lessons from results based on cross-country averages (see Pritchett (2006) for a more complete discussion of the limits of the growth regression approach).

disease mortality (much of which would occur in adult age) worldwide. Based on historical epidemiological assessments of what has been feasible in the past, the objective of an annual 2% reduction of chronic disease mortality rates is postulated. The arbitrary scenarios chosen for the present exercise are within the range of this WHO objective (WHO 2005).

To further illustrate what scenarios 2) and 3) would mean, we draw again the comparison to Finland. In 2000 – which is where our "predictions" had to start – the crude adult mortality rate (age group 15-64) in Estonia was 641 (per 100,000 population), compared to 307 in Finland. With a 1.5% p.a. reduction in adult mortality, it would take 49 years for Estonia to reach the 2000 Finnish level – not exactly an excessively optimistic scenario. In the case of an annual reduction by 3%, the Finnish level would be reached by 2025.

Applied to the specific Estonian context, the economic benefits of improving adult health are substantial and growing over time. Figure 10 illustrates the predicted path of GDP per capita under the three scenarios, using the growth estimates calculated on the basis of the fixed effects estimation. The area between the lowest and highest lines indicates the economic benefit of the optimistic scenario. The estimates indicate that while in 2005 the difference in the per capita GDP between the status quo scenario and the most optimistic scenario is only US $114–291 (depending on the estimation methodology used), by 2025 this difference would have grown to US $1,504–3,490 (see Table 8 for the projected GDP per capita path and Table 9 for the economic benefits of the two superior scenarios compared to the status quo scenario).

Table 8: Projected Estonian GDP per capita, US $ (based on fixed effects-estimation)

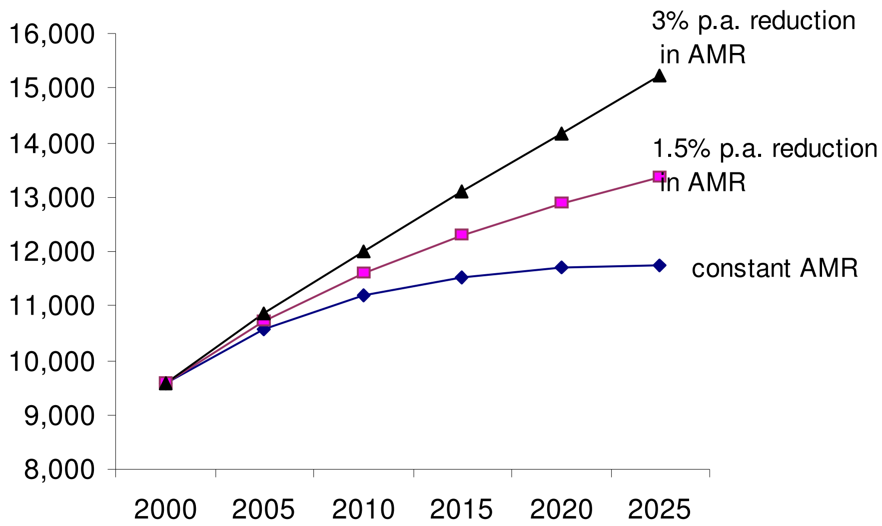
	No change	1.5% p.a. reduction	3% p.a. reduction
2000	9,588	9,588	9,588
2005	10,573	10,716	10,864
2010	11,181	11,587	12,015
2015	11,526	12,282	13,101
2020	11,700	12,868	14,172
2025	11,749	13,368	15,239

Table 9: Projected gains compared to the status quo scenario (based on fixed effects estimation)

	1.5% p.a. reduction		3% p.a. reduction	
	Absolute gain	Percentage gain	Absolute gain	Percentage gain
2000	0	0%	0	0%
2005	143	1%	291	3%
2010	406	4%	834	7%
2015	756	7%	1,575	14%
2020	1,167	10%	2,472	21%
2025	1,618	14%	3,490	30%

Note: The absolute gain is calculated as the same-year difference in GDP per capita of the 1.5% or 3%-scenario compared to the status quo scenario. The percentage gain is the absolute gain expressed as a share of the GDP per capita in the status quo scenario in the same year.

Figure 10: Projected GDP per capita (US $) path for Estonia (based on fixed effects estimation) conditional on three future adult mortality scenarios



Source: authors' calculations; see Annex 3 for details.

In Figure 10 it is particularly interesting to observe the projected decline in the slope of the GDP per capita path, which indicates a declining growth rate, if adult mortality rates stay at the currently unnecessarily high level. This provides a quantitative illustration of the point that sustained growth cannot occur unless population health keeps pace with economic progress.

The findings presented in this section bear an obvious implication for economic policymakers in Estonia: investing in the health of the Estonian adult population should be seriously considered as one (of several) means by which to achieve economic policy goals. These conclusions hold despite the fact that we assess only the effect of mortality reductions, setting aside morbidity reduction, which would likely attend mortality improvement and almost certainly also be sizable.

5. What should be done?

The natural next step is to ask what should be done to promote health and reduce negative consequences of poor health on Estonian economic development and wellbeing. Although it would be beyond the scope of the current paper to provide detailed policy recommendations, some general, evidence-based conclusions can be drawn. At an international level, there is abundant evidence on effective interventions that could be drawn on in deciding what needs to be done[6]. In addition, the recent Estonian analysis of the burden of disease, its risk factors, and the cost-effectiveness of interventions (Ministry of Social Affairs, University of Tartu 2004) offers a unique means of basing the policy discussion on sufficiently solid scientific ground.

According to the burden of disease study, the three major disease groups that account for most of the loss in years of life are: cardiovascular diseases, tumours and external causes. Further, the burden of HIV/AIDS is set to increase considerably in the near future. Out of the five risk factors analysed in this study – smoking, overweight, low consumption of fruits and vegetables, physical inactivity and consumption of alcohol – the biggest damage on the health of the population of Estonia is caused by smoking, followed by physical inactivity and consumption of alcohol. Combining that information with the increasing rates of alcohol consumption, smoking and use of illicit drugs among teenagers clearly indicates the importance of combating smoking and alcohol consumption. Another group of avoidable deaths and injuries are those due to external causes, which is the second most important cause of loss in life years among men. Part of this can be attributed to alcohol abuse.

The analysis carried out in the burden of disease study indicates that the most cost-effective measures would be those targeted at the entire population, not all of which are indeed within the scope of health sector alone, e.g., raising the excise tax rates for alcohol and tobacco, banning alcohol advertising and restricting access to sales of alcohol.

Also within the health sector there is a need for wider actions to tackle the main causes of loss of healthy years of life that include promotion, prevention, diagnosis, treatment and rehabilitation available through personal and non-personal health services. A recent study (Atun et al 2005) has assessed the strengths and weaknesses of the Estonian health system, the main results of which are briefly summarised hereafter:

First of all, a strength of the Estonian health system is its clear vision for the health sector, as it is set forth in various strategic documents and action plans, both for public health and health care services. Furthermore, transparency in the system is improving, a well developed primary health care and rationalised hospital sector is in place, and public health services are under review. In addition, there is a balanced health financing system in place where the allocations take place in parallel to all health sectors. In most areas a high number of qualified staff is available for treating patients and managing the health system.

[6] See e.g. WHO (2005). Chronic disease: a vital investment. WHO: Geneva.

Still there are certain weaknesses in the system as well. First,, even if there are different health services available, the individual can get lost in the system and the continuity of care (but also preventive and promotion services) is not well developed. In addition there are poor links to the social sector. Even though health financing has relatively fair allocations, there is a question of sustainability as the revenue base in the aging society is one of the weaknesses (see Couffinhal and Habicht 2005, Võrk et al 2005). In addition there has been a shift to put more responsibility to the individuals that has resulted from the rising cost sharing for health care. With regard to human resources the system has difficulties retaining the professionals due to their migration to other countries or sectors. In addition there is an unfavourable ratio of different competences available and a lack of sustainable training. In particular, there is a lack of human resources for public health functions.

To improve the health of the population the primary health care needs to be developed further and closer to the patient to improve the access and continuity of care. Further prevention and promotion services should be available using both personal and non-personal service models in an integrated way in the health system. Recent evidence from international comparison (Newey et al 2004) shows that even when the avoidable mortality has decreased in Estonia there is a considerable role for both treatment and prevention to reduce mortality. The avoidable mortality from treatment still accounts for about one-fourth and from prevention about one-tenth of the whole mortality in Estonia. Both health care and public health need increased allocations from the health sector budget, but in a transparent way. The whole health financing system is fair and accountable, but the issue of sustainability needs to be tackled in the near future to secure the development of the sector in the long term.

The increased financing cannot be the sole objective but rather a tool to achieve better health, if it can be measured and linked to the cost-effective interventions selected for delivery. There is a need to strengthen the stewardship role in the health sector to develop a clear vision and to allow different parties to act in the agreed regulatory framework, and to monitor and evaluate the development. In addition, the health sector should start to act more as a steward for other sectors as well (economy, environment, education etc) to promote governance that is good for health and share available findings from studies that were conducted recently but have not always led to pro-health decisions. Also it should be noted that the investments to health system are currently more complex and the whole health system should be managed in a good manner to get value for money.

6. Conclusions

Estonia is currently experiencing a remarkable rate of economic growth that is impossible to sustain if the health status of the population remains lower than in most of Estonia's competitors in the enlarged EU. A growing body of research has recently demonstrated the potential contribution of health to economic growth or to economic outcomes more generally. In the present study we have examined the relevance of this work for the Estonian situation, by analysing original Estonian data. It was shown that ill-health has a statistically solid and robust negative impact on various labour market outcomes (both supply and productivity) at the individual level. Moreover, we have shown that if health can be markedly improved in Estonia as a whole, then the country would stand to gain substantially in terms of future economic wealth. This is entirely consistent with evidence on the contribution of health to the economy in other countries. Investing in health in Estonia should therefore bring tangible economic returns for its people and for the economy as a whole. Policymakers interested in sustaining the remarkable rates of economic growth would be likely to profit from incorporating health into their portfolio of investment strategies.

Given the limited scope of this work, we have focused on highlighting the economic costs of ill-health as well as the economic benefits that will accrue from improving health. We have only touched upon the issue of what type and mix of interventions exactly would be appropriate, given the existing health challenges and the resources at hand. A true "investment" approach would involve some sort of economic evaluation of the recommended interventions and policy measures. This would clearly be the next step in the preparation of a complete economic argument that ultimately would facilitate the insertion of health into the national economic development strategy by comparing directly the return to investment in health with those in other areas of public policy.

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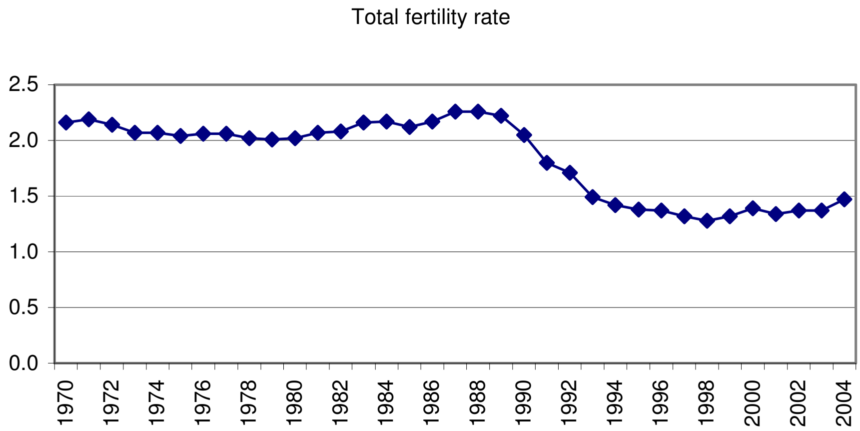
Annex 1: Descriptive figures and tables

Figure A 1: Total fertility rate in Estonia



Source: Statistical Office of Estonia, online database, accessed 8 May 2006

Table A 1: Share of health disorders in the age group 15-64 in 2002, %

Health disorder*	15-44	45-64	Total 15-64
Heart, blood pressure or circulation disorders	1.9	14.4	6.5
Problems with the back or neck (arthritis, rheumatism, injury, etc.)	2.8	10.5	5.7
Problems legs and feet (arthritis, rheumatism, injury, etc.)	2.2	10.6	5.3
Problems with arms and hands (arthritis, rheumatism, injury, etc.)	1.5	7.1	3.6
Impairments in stomach area, liver or kidney diseases, indigestion	2.0	4.9	3.1
Difficulties in seeing (also with glasses or contact lenses)	1.3	4.2	2.4
Mental, emotional problems or problems related to nerves	1.8	2.9	2.2
Respiratory or pulmonary impairments (asthma, bronchitis etc.)	1.1	2.8	1.7
Skin diseases, allergy, severe skin deformity (scars, birth marks etc., excl. tattoos)	1.5	1.2	1.3
Diabetes	0.2	2.3	1.0
Other severe diseases (cancer, AIDS, Parkinson's disease etc.)	0.3	1.3	0.7
Difficulties in hearing (also with a hearing aid)	0.4	0.8	0.6
Speech disorders	0.3	0.6	0.4
Epilepsy	0.3	0.3	0.3
Other	0.8	1.6	1.1

Source: Estonian Labour Force Survey 2002, authors' calculations
*Note: One person may have several health disorders.

Table A 2: Causes for health disorders in 2002, %

Age	15-44	45-64	Total (15-64)
Non-work-related disease	34.1	42.8	39.5
Work related disease (occupational disease etc.)	14.2	23.1	19.7
Inherent health disorder or a birth trauma	18.2	3.7	9.2
Accident at home, related to recreation or sports	7.7	4.0	5.4
Work related injury (also a traffic accident)	2.3	2.7	2.5
Non-work-related traffic accident	2.1	1.1	1.5
Not sure	21.3	22.7	22.1
Total	100	100	100

Source: Estonian Labour Force Survey 2002, authors' calculations

Table A 3: Micro-level data sources to study the effects of health on the Estonian economy

Name	Time coverage	Description	Relevant information included
Estonian Household Budget Survey	Started 1996 Since 2000 includes relevant information	Cross-section household survey data Rotating panel of 2 years since 2000	Self-assessed health, labour market activity, earnings, savings
Estonian Labour Force Survey	Since 1995	Cross-section survey data on working-age people (15-74) Rotating panel over years since 2000	Poor health as one reason for inactivity, or reduced working hours Personal characteristics related to labour market
Special annex to Estonian Labour Force Survey 2002	2002	Cross-section survey data on working-age people (15-74)	Detailed information on health and work ability
Health insurance registry data	Since 1999	Population registry data	All individual level health care costs and sickness benefits
Social insurance data	Since 1999	Population registry data	Labour earnings, social benefits (incl disability benefits)
Census data	2000	Population data	Presence of disability, labour market status
Health Behavior among Estonian Adults	Biannually since 1992	Cross-section survey data	Health status, health behaviour, household earnings
Norbalt 1994, 1999	1994, 1999	Cross-section survey data	Health status, health behaviour, household earnings, labour market status
Estonian health interview survey 1996[7]	1996	Cross-section survey data	Health status, health behaviour, household earnings, labour market status
Eesti sotsiaaluuring (Estonian Social Survey – Estonian version of EU-SILC)	2004-2007	Longitudinal survey data	Health status, main characteristics related to labour market status, earnings
European Social survey 2004 (by Estonian Centre of Behavioural and Health Sciences)	2004	Cross-section survey data	Health status, main characteristics related to labour market status

[7] The next similar full scale health survey is planned for 2006.

Annex 2: Econometric estimates of impact of health on labour outcomes

Econometric challenges in estimating the causal impact of health on labour market outcomes

There are at least two econometric challenges:

a) health and labour outcomes are usually endogenous (i.e., there is a bi-directional relationship between health and labour market outcomes) and
b) measurement problems of the variable health status.

In addition, both challenges may well interact. For example, some studies rely on questions asking respondents whether their health situation hampers their work productivity (Parsons 1980). The bias may arise if non-working individuals feel the need to find a justification for not working, and this may be an incentive for them to report a poor health status even if they do not actually suffer any impairment. But even if respondents report their true health status, the failure to participate in the labour market could by itself cause health problems. Moreover, among those actually working, health may suffer through adverse working conditions. In this case the measured effect of health on labour participation would be biased downward. Several authors have proposed ways of tackling the problem. Stern (1989), for instance, proposes a two-step approach to estimate the effect of disability. This is the approach we adopt in our estimations when we estimate the effect of health on labour force participation, working hours and the salary.

The impact of health on the probability of retirement, using household budget survey data

We take a sample of those who were working one year prior the survey, and were born between 1940 and 1980. Through this selection we limit the potential interference of a reverse effect of retirement on health. The choice of 1980 is arbitrary but is simply a reflection of the (uncontroversial) assumption that most chronic illness occurs in adult age. (Results are not sensitive to the choice of these years.) The estimates are computed separately for men and women (see Table A 4). For the purpose of our research interest, it is important to note that for both men and women the effect is significantly positive, i.e., men and women with a chronic disease or disability are more likely to have retired in the year prior to the survey.

We also find that married women are less likely to retire from work than never married women. The same holds for men. Native Estonians are also less likely to retire from their job. The effect of general education is significant only for men: those who only had a primary education are more likely to retire with respect to the reference group (basic education) whereas those who attained a secondary education level are less likely to retire. A higher education has a negative effect (on the probability to retire) even for women. Living in an urban area has a positive effect on women but not on men. We do not find a significant effect of household composition except for one thing: women living in couples are more likely to retire than singles.

Table A 4: Logit model on the probability to retire in the year prior to the survey

	Women			Men		
	Coef	St.err	t-stat	Coef	St.err	t-stat
Age	-0.452	0.073	-6.190	-0.332	0.127	-2.620
Age squared	0.005	0.001	6.140	0.004	0.001	2.760
Legal marital status (comparison group "Never married"						
Married	-0.283	0.278	-1.020	-0.071	0.352	-0.200
Divorced	-0.146	0.363	-0.400	-0.209	0.597	-0.350
Widowed	-0.485	0.493	-0.980	1.032	0.658	1.570
Estonian	-0.116	0.214	-0.540	0.258	0.387	0.670
General education (comparison group "elementary or no education")						
Basic education	-0.543	0.918	-0.590	0.480	0.779	0.620
Secondary education (no vocational)	-0.404	0.887	-0.460	0.172	0.771	0.220
Secondary education (vocational activity)	-0.804	0.932	-0.860	0.665	0.824	0.810
Higher education	-0.816	0.900	-0.910	-0.627	0.836	-0.750
Chronic illness or disability	0.652	0.248	2.630	1.630	0.329	4.960
Urban	0.445	0.216	2.070	-0.580	0.328	-1.770
Household composition (comparison group "Single adult household")						
Adult+ch.	0.242	0.772	0.310			
Couple	1.466	0.562	2.610	-0.226	0.481	-0.470
Couple +1 children	1.668	0.615	2.710	-2.773	0.877	-3.160
Couple +2 children	1.834	0.646	2.840	-1.563	0.828	-1.890
Couple +3 children	2.055	0.772	2.660	-1.405	1.024	-1.370
Other household	0.945	0.534	1.770	-0.388	0.473	-0.820
N°kids<16 in the household	0.292	0.126	2.310	0.143	0.148	0.970

Source: own calculations, based on Estonian HBS 2000-2004.
Note: The number of observations in the regressions is 5,346 for females and 5,106 for men.

The impact of health on the probability to retire, using labour force survey data

For our specific purposes the household budget survey is relatively limited in that it offers no appropriate instrumental variables that could help properly address the endogeneity problem. In contrast, the Estonian labour force survey (LFS) offers more opportunities. We have used data from the 2002 round of the LFS. The survey captures the working-age population (between 15 and 74) living in Estonia. Sampled households are interviewed quarterly with a 2-2-2 rotation plan. This means that every household is interviewed during two consecutive quarters at the beginning and after a two-quarter period they are again interviewed twice. In our analysis households are considered only once. Thus re-interviews are dropped from the sample. Moreover we only use data from the year 2002 because only for this year information on health outcomes is available. All in all 4417 households and 9370 individuals are considered.

Before carrying out the instrumental variable estimation, we try to replicate a similar approach to the one used for the household budget survey, now using the LFS. This is to test the robustness of our previous findings. We assess the effect of health on retirement only for individuals who were working before 2000. Then we construct the dependent variable taking the value 1 if the individual left his\her job between 2000 and the survey year (2002) and 0 if he\she kept the job through 2002.

The definitions of adverse health status depends on answers to the question "Do you suffer from a lasting disease or disability which has lasted or is likely to last for 6 months or longer?".

As explanatory variables, in addition to health status we include age, the amount of hours usually worked in a week, the number of members in the household of respondent, ethnicity, marital status, educational attainment, and some job characteristics (i.e. whether he\she is an employee and whether the contract is permanent or a fixed-term one).

Results are given in Table A 5. The adverse health status turns out to play an important role. Both men and women reporting a disability are more likely to have retired in the two years prior the survey.

Table A 5: Probit model on the probability to retire (LFS data)

	MEN			WOMEN		
	Coef.	Signif.	Marginal effects	Coef.	Signif.	Marginal effects
Age	-0.327	***	-0.10	-0.292	***	-0.026
Age sq.	0.004	***	0.0001	0.003	***	0.0003
N members HH	0.002		0.00006	0.010		0.0009
Adverse health status	1.334	***	0.064	0.550	***	0.056
Estonian	0.008		0.00026	-0.027		-0.0024
Married	-0.659	*	-0.021	1.032	***	0.095
Cohabit	-0.837	**	-0.020	0.696	***	0.075
Widowed	-1.336	*	-0.024	1.024	***	0.128
Divorce	-0.146		-0.004	0.452		0.045
Degree	-0.839		-0.020	-0.470		-0.037
Sec. Educ.	0.040		0.0012	-0.241		-0.021
Bas. Educ.	0.021		0.0007	0.072		0.0064
Student	1.413	***	0.0820	0.319		0.0314
Constant	2.166	***		3.183	***	

Source: own calculations, using LFS data
*, **, *** denote significance at the 10%, 5%, and 1% level, respectively.

The impact of health on labour force participation, working hours and salary, using labour force survey data

Finally, we implement a model proposed by Stern (1989) to explicitly test the impact of ill-health on three labour market outcomes given in the Estonian LFS: labour force participation, actual weekly working hours and monthly salaries. As mentioned above there are several reasons as to why self-rated-health and labour market outcomes may be endogenous (see Currie and Madrian 1999). The solution suggested by Stern to tackle the endogeneity issue is to instrument the self-reported health using objective measures of disability, whereby "objective" means that they have been diagnosed by a doctor. We use data from the first quarter of the Estonian LFS in 2003 for this purpose. Respondents have been asked to self-rate their health on a five-point scale (very poor, poor, fair, good, very good). In addition they are asked explicitly about specific health problems they currently have or did have (asthma, allergy, diabetes, cataract, hypertension, heart attack, stroke, bronchitis, arthritis, osteoporosis, ulcer, tumour, headache, anxiety or depression). Information is also given as to whether these problems were diagnosed by a doctor.

The first stage of Stern's method is to regress self-rated health – aggregated into a three-point scale (good, fair, poor) – on objective measures of health and other exogenous regressors. Self-rated health is therefore modelled by an ordered probit model. The objective measures of health we use are a series of dummy variables for each health problem that has been diagnosed by a doctor. We run separate regression for men and women. Results are displayed in Table A 6. The instruments predict reasonably well the self-rated health variable. We find a particularly high predictive value of asthma or allergy, hypertension, arthritis, depression, and other problems.

Table A 6: Ordinal probit model on self reported health. First stage.

	MEN			WOMEN		
	Coef.	Std. Err.	Significance	Coef.	Std. Err.	Significance
Age	0.087	0.014	***	0.074	0.013	***
Age squared	-0.001	0.000	***	0.000	0.000	***
Estonian	-0.130	0.073	*	-0.217	0.064	***
Married	-0.468	0.106	***	-0.234	0.098	**
Cohabiting	-0.237	0.119	**	-0.054	0.117	
Widowed	-0.424	0.238	*	-0.212	0.123	*
Divorced	-0.128	0.146		-0.153	0.122	
Degree	-0.988	0.158	***	-0.791	0.149	***
Secondary education	-0.693	0.137	***	-0.446	0.129	***
Basic education	-0.493	0.124	***	-0.233	0.123	*
Student	0.747	0.158	***	0.594	0.114	***
Asthma or allergy	0.754	0.213	***	0.531	0.187	***
Diabetes	0.509	0.271	***	0.384	0.226	*
Cataract	0.693	0.102	***	0.613	0.082	***
Hypertension	1.721	0.216	***	0.868	0.192	***
Heart attack or stroke	0.293	0.193		0.376	0.173	**
Bronchitis	0.836	0.099	***	0.527	0.086	***
Arthritis	0.249	0.334		0.329	0.199	*
Osteoporosis	0.459	0.125	***	0.529	0.165	***
Ulcer	1.329	0.336	***	0.951	0.235	***
Tumour	0.758	0.214	***	0.616	0.118	***
Headache	1.501	0.233	***	0.381	0.168	**
Depression or anxiety	1.067	0.094	***	0.961	0.084	***
Other	0.087	0.014	***	0.074	0.013	***
Cutting point 1	2.125	0.250		0.000	0.000	***
Cutting point 2	3.765	0.259		-0.217	0.064	***
No. of observations		1788			2053	
Log likelihood		-1167.6			-1369.1	
Pseudo R squared		0.309			0.310	

Source: own calculations, Estonian Labour Force Survey (2003)
*, **, *** denote significance at the 10%, 5%, and 1% level, respectively.

In the second stage of the estimation strategy we use the regression of Table A 6 in order to predict self-rated health. Following Stern, we are thereby creating an exogenous health indicator for labour force participation. This indicator is used in a new probit model on participation. The results are reported in Table A 7. The same first stage regression is used to create the exogenous self-rated health variable in the second-stage regressions that examine the effect of health on weekly working hours (Table A 8) and monthly salaries (Table A 9).

This model is not entirely free from criticism. Bound (1991) shows that if the measurement error involving health status is correlated with the other covariates (i.e. marital status, education, age, etc.) Stern's procedure yields unbiased estimates of the effects of health but not for the effects of these other covariates. However this is of no concern in this study as our interest is focused on the effect of health, not on the other covariates, which are used only as control variables.

These models can also be criticised as they only consider working people at the moment of the survey or shortly prior to the survey. This selection may cause some bias, if non-workers are systematically different from workers in terms of health conditions. This is probably true, but it seems unlikely that non-workers are in better health than workers. It is more realistic (and widely confirmed in the literature) to expect that inactive individuals suffer from worse health than workers. If this is the case, then our estimates of adverse health effect are downward-biased, i.e., the “true” effect would be more severe than what we measured with these simple regressions.

Table A 7: Probit model on work participation. Second stage

	MEN		WOMEN	
	Coef.	Significance	Coef.	Significance
Age	0.205	***	0.262	***
Age squared	-0.003	***	-0.003	***
Estonian	0.184	**	0.195	***
Married	1.005	***	0.165	
Cohabiting	0.845	***	0.038	
Widowed	0.277		0.101	
Divorced	0.029		0.011	
Degree	1.091	***	1.347	***
Secondary education	0.571	***	0.905	***
Basic education	0.461	***	0.770	***
Student	0.205	***	0.262	***
Predicted health status. Reference: Good health				
Fair (predicted)	-0.252	***	-0.386	***
Poor (predicted)	-1.080	***	-0.823	***
Constant	-4.330	***	-5.958	***
No. of observations	1790		2055	
Log likelihood	-799.2		-974.8	
Pseudo R squared	0.350		0.316	

Source: own calculations, Estonian Labour Force Survey (2003)
*, **, *** denote significance at the 10%, 5%, and 1% level, respectively.

Table A 8: Tobit model on weekly working hours. Second stage.

	Men		Women	
Age	5.044	***	7.145	***
Age squared	-0.062	***	-0.081	***
Estonian	2.825		2.217	
Married	20.283	***	2.457	
Cohabiting	19.716	***	1.731	
Widowed	5.608		1.019	
Divorced	0.847		-0.538	
Degree	22.184	***	32.451	***
Secondary education	16.774	***	27.172	***
Basic education	14.775	***	23.433	***
Student	5.044	***	7.145	***
Predicted health status Reference: Good health				
Fair (predicted)	-6.51	***	-7.882	***
Poor (predicted)	-29.92	***	-21.54	***
Constant	-101.849	***	-155.382	***
No. of observations	1789		2041	
Log likelihood	-5029.75		-5148.25	
Pseudo R2	0.082		0.089	

Source: own calculations, Estonian Labour Force Survey (2003)
*, **, *** denote significance at the 10%, 5%, and 1% level, respectively.

Table A 9: Tobit model on monthly salary. Second stage.

	Men		Women	
Age	1.3		55.2	***
Age squared	-890.1	***	-792.9	***
Estonian	757.2	***	658.0	***
Married	3032.6	***	137.7	
Cohabiting	2300.1	***	45.4	
Widowed	-92.8		178.3	
Divorced	-610.0		-61.1	
Degree	5407.4	***	5084.5	***
Secondary education	2589.3	***	2796.4	***
Basic education	2155.1	***	2096.8	***
Student	1.3		55.2	***
Predicted health status. Reference: Good health				
Fair (predicted)	-621.7	*	-403.6	*
Poor (predicted)	-3904.8	***	-1930.1	***
Constant	-1731.4	**	-1177.8	*
Number of obs	1484		1824	
Log likelihood	-7038.6		-7770.5	
Pseudo R squared	0.049		0.052	

Source: own calculations, Estonian Labour Force Survey (2003)
*, **, *** denote significance at the 10%, 5%, and 1% level, respectively.

Annex 3: Technical details and results of economic growth impact estimates

We start by running a standard pooled ordinary least squares (OLS) panel growth regression for the period 1960 to 2000. The dependent variable is the annual average of the 5-year growth rate of real GDP per capita. The other explanatory variables are the 5-year time lag of GDP per capita, the lagged fertility rate, the lagged working-age mortality rate,[8] and the Warner-Sachs index of openness.[9] The fertility rate is from the World Development Indicators (World Bank 2004) and the adult mortality rate is constructed from the WHO mortality database.

Since OLS panel growth regressions yield downward-biased estimates on the projected growth rate (Trognon 1978), we also apply a fixed effect estimator (FE) on the same regression equation. The FE regression is known to yield upward-biased estimates on the projected growth rate (Nickel 1981). Hence, the unbiased growth path is bounded by the OLS and FE estimates. The regression results of the OLS and FE regressions are given in Table A 10.

Table A 10: Growth regression results

Dependent variable: GDP per capita	OLS	FE
Lagged GDP p.c.	.86*** (.02)	.65*** (.05)
Lagged fertility rate	-.05 (.03)	-.17*** (.06)
Openness	.16*** (.02)	-
Lagged adult mortality rate	-.08** (.04)	-.18*** (.06)
R^2	0.97	0.98
No. of observations	302	332

Notes: Heteroscedasticity-consistent standard errors in parenthesis. *, **, *** denote significance at the 10%, 5%, and 1% level, respectively. Constant terms are not reported. GDP data are from Penn World Data 6.0 (available at http://pwt.econ.upenn.edu/). Openness is a time-invariant dummy variable between 1965 and 1990 from Gallup and Sachs (1998), available at http://www.cid.harvard.edu/ciddata/ciddata.html. The fertility rate is from World Bank (2004) World Development Indicators.

The OLS coefficient of lagged GDP per capita indicates that the GDP growth rate over 5 years is 14% (=1-0.86) on average or roughly 3% per annum. Accordingly, the FE estimator yields an annualised growth rate of roughly 7%. The results, in Table A 11, show a convergence rate of 14% with OLS or even 35% with FE estimator, well above the 2% that is well known in the empirical growth literature. However, as Islam (1995) noted, convergence rates increase dramatically in a panel data context. The long-run

[8] Working age is assumed to be between 15 and 64.

[9] This variable is a time-invariant dummy variable with value 1 if an economy has been considered as open during 1965 and 1990. See Sachs and Warner (1995).

convergence rate is then mixed with business cycle effects. Concerning the variable of interest in this study, the lagged adult mortality rate is found to be highly significant for both estimators with a negative sign as expected. Hence, the larger the mortality rate, the lower the GDP per capita growth.

Next, these alternative growth regressions are used to predict Estonian GDP per capita up to the year 2025. This requires an assumption about the future path of the fertility rate, which was taken from Eurostat baseline population forecasts. The openness status of the Estonian economy is assumed to stay constant over the next 20 years as the key question for this study relates to different mortality scenarios. An increase in openness would not change results dramatically, although the growth path would become somewhat steeper.

As for the adult mortality scenarios, we use the same ones as those described in the main text. Based on these scenarios, a forward prediction is carried out on the FE estimates.