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A NOTE ON THE IMPACT OF HOURS WORKED ON MORTALITY IN THE OECD

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ABSTRACT: In this note we investigate whether an increase in hours worked per employed person raises the total mortality rate in a sample of 23 OECD countries during 1960-1997. We use the same basic research design and data as Gerdtham & Ruhm (2002). This implies that the total mortality rate is modelled to depend on economic conditions, demographic characteristics, year effects, country effects, and country-specific time trends. We extend the analysis by allowing the mortality rate to depend on, in addition, the number of hours worked per employed individual. Surprisingly, we find that an increase in the number of hours worked actually has a negative and statistically significant effect on the total mortality rate, even when controlling for income. Although one possible explanation may be that fluctuations in hours of work in fact is, in this setting, more a measure of the capacity utilisation rate of the economy than a measure of how stressful work is for individuals who are actually working, more research on the topic is needed in order to find a plausible explanation for the observed phenomenon.

KEYWORDS: Mortality, Business Cycles, Health

JEL: E32, I12

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TIIVISTELMÄ: Tässä artikkelissa tutkitaan, onko työntekijäkohtaisten tehtyjen työtuntien kasvulla kuolleisuutta lisäävä vaikutus 23 OECD-maassa 1960-1997 välisenä aikana. Tarkastelussa käytetään Gerdthamin ja Ruhmin (2002) kehittämää mallia, ja suurilta osin myös samaa aineistoa. Tämä tarkoittaa, että taloudellisen suhdannetilanteen, demografian, kiinteiden vuosi- ja maaefektien, sekä maakohtaisten aikatrendien oletetaan vaikuttavan kuolleisuuteen. Alkuperäistä mallia laajennetaan siten, että edellä mainittujen muuttujien lisäksi myös tehtyjen työtuntien vaikutus otetaan huomioon. Tuloksien mukaan kuolleisuus ei näytä kasvavan tehtyjen työtuntien myötä vaan kuolleisuus näyttää yllättäen laskevan tehtyjen työtuntien määrän kasvaessa. Tämä tulos pätee, vaikka tarkastelun kohteena olevien maiden tulotaso otetaan huomioon. Tutkimuksen tulos saattaa johtua siitä, että tehdyt työtunnit kuvaavat itse asiassa talouksien käyttöastetta enemmän kuin työn kuormittavuutta. Tämän havainnon selvittämiseksi tarvitaan kuitenkin lisää tutkimusta.

AVAINSANAT: Kuolleisuus, Suhdanteet, Terveys

JEL: E32, I12

1 Introduction

Recent research (Ruhm 2000, Ruhm 2003a, Gerdham & Ruhm 2002, Neumayer 2002, Tapio Granadas 2002) has put the view that an economic downturn worsens individuals' health into completely new light. For example, Ruhm (2000), using a sample of U.S. states for the years 1972 - 1991 reports that an one percentage point rise in the unemployment rate actually *lowers* the overall mortality rate by 0.5 to 0.6%. In terms of cause-specific mortalities, an one percentage point increase in the unemployment rate was found to reduce mortality from heart disease by 0.5%, mortality from influenza/pneumonia by 0.7%, and mortality from vehicle accidents by 3%. In Gerdham & Ruhm (2002), the exercise is repeated for a sample of 23 OECD countries for the 1960 to 1997 time period. They find that a one percentage point rise in the unemployment rate lowers the overall mortality rate by 0.4%, mortality from heart disease by 0.4%, mortality from influenza/pneumonia by 1.1 %, and mortality from motor vehicle accidents by 1.8%.

These papers all have in common that they use, instead of a pure time series analyses which was the case in many earlier studies, e.g. Brenner (1973, 1975, 1979), fixed effects models. In these models the within state or region variation in the unemployment rate is, together with other control variables used to explain the within state or region variation in various measures of health, such as mortality rates. As can be guessed, the major problem with earlier time-series analyses is that they do not properly control for confounding factors, and that a positive relationship between the unemployment rate and mortality may be spurious.

In this context it is important to make a distinction between a transitory strengthening of the economy and permanent economic growth. The key here is that a transitory strengthening of the economy will likely lead to a more intense use of existing stock of health, human and physical capital, whereas permanent growth results from improvements in technology that pushes the production possibility frontier out[1]. It is likely that the above mentioned results are due to the impact of a transitory strengthening of the economy. Indeed, Ruhm (2000) report that a sustained deterioration in economic conditions is associated with larger short-run than permanent reductions in mortality.

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[1] In economic models of the demand for health, e.g. Grossman (1972) individuals maximise a utility function with health and other consumption as arguments subject to time and budget constraints. In such a model permanently higher incomes will be associated with better health as the budget constraint is shifted out.

But what may the reasons be then, that economic hardship, in the form of higher unemployment rates, actually may improve health on average in the economy? Some answers are provided in Ruhm (2000) First, it is possible that during an economic expansion, non-market "leisure time" becomes more costly, which makes it less worthwhile for the individual to undertake time-consuming health investments in exercise. Second, health may be an input to the production process. Hours of work may be lengthened in order to cope with increased demand, which may increase the risk of accidents. It is also likely that stress increases. Third good times may increase the prevalence of risky activities, for example driving or drinking. Indeed Evans and Graham (1988), Ruhm (1995), and Freeman (1999) find evidence in favour of drinking and vehicle accidents increasing in good economic times.

The reasons for why health may worsen in good economic times have also been empirically examined in more detail. In Ruhm (2003a) the dependent variable is not mortality, but other measures of health. He finds that a one percentage point increase in the unemployment rate predicts a 1.5% fall in the prevalence of medical problems, a 3.9% decline in acute morbidities, and a 1.6% reduction in reports of "bed-days" during the prior two weeks. Some chronic conditions also become less common. For instance, an one percentage point increase in the unemployment rate was associated with a 4.3% decrease in ischaemic heart disease, and an 8.7% reduction in intervertebral disk disorders. (Ruhm 2003b) goes one step further, and asks whether the effects on health may be explained by changes in individual behaviour. The answer appears to be yes. Individual data for adults for the years 1987-2000 from the *Behavioural Risk Factor Surveillance System* indicate that smoking, height-adjusted weight, and leisure-time physical inactivity decline when economic conditions worsen. Most interestingly, it is also found that a reduction of hours worked has a positive impact on health amongst the American population. Specifically, Ruhm (2003b) reports that working one hour less per week is associated with a 0.011 percentage point reduction in smoking, a 0.017 percentage point decline in severe obesity, a 0.036 percentage point decrease in physical inactivity, and a 0.044 percentage point decrease in multiple health risks.

Although, as seen above, there has been some research in this field to date, there is clearly a need for more research, particularly regarding the causes of why a temporary rise in the unemployment rate may improve health. As already mentioned, one of the most striking results in the literature so far is the positive effect on health owing to a reduction in the number of hours worked per week.

A natural step in this field of research is to ask whether the result that a reduction in working hours improves health also can be seen in other than US datasets. In this note we do precisely this by examining whether a lower number of working hours improves health in a sample of OECD countries.

In order to make the research presented in this note as comparable as possible to earlier research, we use exactly the same dataset as Gerdham & Ruhm (2002), apart from the fact that we add another regressor in the form of a measure of average hours worked per employee in the OECD countries.

2 Estimation Strategy and Data

As in Gerdham & Ruhm (2000) we estimate regressions of the following form:

$$M_{tj} = \alpha_t + \overline{X}_{jt}\beta + E_{jt}\gamma + C_j + \varepsilon_{jt} \tag{1}$$

where M is the natural log of the mortality rate, E is the unemployment rate, X is a vector of regressors controlling for the age and gender distribution of the population, α is a year specific intercept, C is country fixed effect and ε is a disturbance term. Subscript *j* indicates country and subscript *t* indicates year.

By including year and country fixed effects, it is possible to control for factors that vary uniformly across countries over time (e.g. the effect of oil shocks) and for factors that differ across locations but are time-invariant (such as some country-specific institutions). In this way, the effect of the macroeconomy is identified by within-country variations in unemployment rates, relative to changes occurring in other nations.

Further following Gerdtham & Ruhm (2002) we also consider models with country-specific linear time-trends $(C_j * T)$. By doing this we control for factors that vary over time within nations, such as the level of education. This implies regressions of the form:

$$M_{ij} = \alpha_t + \overline{X}_{jt}\beta + E_{jt}\gamma + C_j + C_j * T + \varepsilon_{jt} \tag{2}$$

In some regressions we also include a control for per capita income, in order to check whether the effect of the unemployment rate on mortality to some extent reflects changes in incomes. In all regression we account for potential heteroscedasticity by correcting the standard errors using the Huber-White estimator.

As indicated above, the novelty in this paper is the addition of the number of hours worked. In terms of regressions we add this explanatory (*HW*) variable as follows:

$$M_{ij} = \alpha_t + \overline{X}_{jt}\beta + E_{jt}\gamma + HW_{jt}\delta + C_j + C_j * T + \varepsilon_{jt} \qquad (3)$$

In terms of data we use the same data as Gerdham & Ruhm (2002). However, there are two exceptions. First, while they use data on mortality from the *OECD Health Data 2000,* we use the newer *OECD Health Data 2003*. Second*,* as this newer data set does not contain information on per capita disposable income, and so we obtain these data directly from the *OECD Economic Outlook*. For the data on hours worked we use data from the *Total Economy Data Base* of the *Groningen Growth and Development Centre* at the University of Groningen[2]. In all other respects, our data set is identical to that of Gerdtham & Ruhm (2002), and further description are therefore not included in this note.

Before going to the results it is however worth studying some descriptive statistics (shown in table 1) of the sample of hours worked. The Japanese on average has worked the longest hours, with an average of some 1949 hours per year per person employed. The Dutch has worked the fewest hours per employed person, with only 1449 hours on average per person employed. In the OECD as a whole, the average number of hours worked per person employed during this period was 1765.

The number of hours worked has trended downwards In the OECD as a whole, the average annual hours worked per employed person has decreased by 4 hours per year. However, in some countries, the number of hours worked decreased much more quickly. In Ireland, Switzerland, West Germany, Austria, Belgium, and the Netherlands, the number of hours worked per person employed has decreased by more than 10 hours per year on average during 1979-1997. On the other hand, the number of hours worked per employee did hardly change on average in the US, Australia, and Canada. In Sweden, the number of hours worked per person employed rose by on average 5.9 hours per year during this period.

2 see http://www.eco.rug.nl/ggdc/homeggdc.html

The development of hours worked per employee in some countries was similar to the trend in the OECD as a whole[3]. For Belgium, Finland, West Germany, Ireland, Italy, Netherlands, Norway, Portugal, Switzerland, and in the UK, the squared correlation coefficient between the OECD hours worked data and the country data was larger than 0.75. For Austria, Japan, Spain, and Sweden, the squared correlation coefficient was between 0.5 and 0.75. For Australia, Canada, Denmark, and the US, the squared correlation coefficient was smaller than 0.5.

As the analysis in this note relies on within-country variations in economic conditions to explain changes in mortality, there needs to be sufficient variation across countries, if the fixed-effect models is to have potential to improve upon a mere time-series analysis. Although some of the countries' hours worked series correlate to quite an extent with the OECD series, three still seems to be a reasonable amount of correlation between countries.

3 Results

To start with we scrutinise some of the results presented in Gerdtham & Ruhm (2002) (table 2). In their study, a one percentage point increase in the unemployment rate leads to a 0,4% increase in the mortality rate (column a). As can be seen from column b), the inclusion of earnings, measured as real disposable income per capita, does not qualitatively alter the result. In fact, the effect of the unemployment rate becomes larger.

In order to make our estimation to resemble as closely as possible that of Gerdtham & Ruhm (2002), we start by trying to replicate their results. Our version of their results is presented in table 3. As can be seen from the table, our results are very close to those of G&R. There are some small differences, and it is possible that they are due to the fact that we are using data from the OECD *Health Data 2003*, instead of the earlier OECD *Health Data 2000*, which is used by G&R.

Our next step is to run a new regression with the same explanatory variables, but this time to restrict the sample only to observations where we can observe hours of work (see column "years" in table 1). This exercise is done in order to verify that later results, where we control

[3] Aggregate OECD hours worked per employed person is a GDP-weighted average of Australia, Austria, Belgium, Canada, Denmark, Finland, France, West Germany, Ireland, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, U.K., USA.

for hours of work, are not due to changes in our sample. As can be seen from table 4, this operation does decrease the number of observations somewhat, but the results remain essentially the same. A one percentage point increase in the unemployment rate is now found to decrease the mortality rate by 0.34%, instead of the earlier 0.4%, and is still statistically significant.

The final step is to include the log of annual hours worked per person as an additional regressor. A priori, we expect that this variable, as in Ruhm (2003b), would have a positive effect on mortality. This because longer working hours, ceteris paribus, should increase stress, the occurrence of accidents etc.

However, as can be seen from table 5, the effect is not the expected, but the opposite. Longer working hours implies lower mortality! Also, the other results i.e. on unemployment and disposable income are still present, although the magnitudes have become somewhat smaller.

4 Discussion and concluding remarks

This is a surprising result, and it is not straightforwardly clear what the explanation may be. One possible explanation may be that fluctuations in hours of work in fact is, in this setting, more a measure of the capacity utilisation rate of the economy than a measure of how stressful work is for individuals who are actually working. If this is the case, the hours of work is in some way proxying income, and that is then the reason for why the coefficient is negative and not positive. Some indication of this may be found in table 6. In this table, we present regressions that are otherwise identical to those presented in table 5, but the sample is restricted to 1979-1997. From those results we can see, that the coefficient for hours worked and the unemployment rate are still negative and significant, but that the effect of income is now insignificant.

A second explanation may be that the hours variable is conditional on employment, is such a away that in bad times work fewer hours. In order to investigate this aspect, we used a measure of average hours of work per capita (i.e. the whole population). In this way, we thus also control for the employment to population ratio. The result of these regressions can be found in table 7. As can be seen, the coefficients for the hours variable are clearly smaller in this case than in table 6, implying that hours worked and employment are correlated. However, the general message is still there, i.e. more hours per person decreases mortality.

A third explanation may be that the effect is non-linear. In order to explore this possibility, we performed some preliminary regressions involving a squared hours worked term. However, the results of that regression was that none of the hours worked terms were anywhere close to be significant.

A fourth explanation is of course that average hours of work are poorly measured. And particularly when fixed effect models are used, this could lead to severe problems. However, we have no knowledge of whether measurement errors are likely to bias our results in any particular direction. Furthermore, for a study like this, there are, as far as we know, no alternative data sets that could be used instead of what we presently use.

Thus, as a summary, it is fair to say that our explanations for why hours worked per employed or hours worked per capita should have a negative effect on total mortality when we also control for income are not particularly convincing. It is very hard to come up with a good explanation for the observed result, particularly taking into account that we control for disposable income. Perhaps it is the case that aggregate hours worked per employee is correlated with some unobserved and by yet undiscovered factor that also affects health in a positive way. Judging from the results of this study, further investigations into this aspect is clearly needed.

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Table 1. Annual hours worked per person employed

	Min	Max	Mean	Stdev	Trend	R^2	Years
Australia	1779	1816	1802	11.5	1.1	0.01	60, 73, 79-97
Austria	1516	1764	1681	65.1	-13.1	0.64	60, 73, 79-97
Belgium	1610	1840	1697	64.3	-11.2	0.92	60, 73, 79-97
Canada	1763	1856	1809	23.2	-2.2	0.24	60, 73, 79-97
Czech Republic	1974	1996	1992	7.2	0.3		90-97
Denmark	1469	1645	1537	47.6	-2.2	0.40	60, 73, 79-97
Finland	1654	1790	1708	33.8	-5.1	0.78	60, 73, 79-97
France	1536	1704	1581	52.0	-8.4	0.74	60-97
West Germany	1471	1708	1596	80.6	-12.4	0.88	60-90
Ireland	1797	2065	1907	69.0	-14.1	0.87	60, 73, 79-97
Italy	1631	1724	1669	31.3	-4.1	0.77	60-97
Japan	1823	2015	1949	70.0	-9.3	0.73	60-97
Netherlands	1365	1578	1449	71.6	-11.2	0.84	60, 69-97
Norway	1401	1513	1454	35.0	-5.9	0.76	60, 73, 79-97
Poland	1974	1997	1993	6.9	0.2		89-97
Portugal	1760	1939	1854	53.1	-9.4	0.90	60, 69-97
Spain	1810	2003	1862	59.9	-6.3	0.64	60, 73, 79-97
Sweden	1495	1628	1548	41.4	5.9	0.60	60, 73, 79-97
Switzerland	1587	1831	1703	91.6	-12.9	0.84	60, 73, 79-97
U.K.	1646	1779	1706	39.8	-6.5	0.97	60-97
USA	1799	1848	1821	15.2	0.2	0.01	60-97
OECD	1729	1814	1765	26.1	-4.0		

Notes: R^2 is the squared correlation coefficient between hours worked for the country and the OECD series of hours worked. Calculations of R^2 based on a balanced panel for the years 1979-1997 (excluding Poland and the Czech Republic). Trend is the average growth of annual hours worked per employed person per year measured in hours. Annual hours worked for the OECD is calculated by using GDP weights. Column "years" refers to the observations on hours worked per employee available for analysis. Data source: University of Groningen and The Conference Board, GGDC Total Economy Database, July 2003, http://www.eco.rug.nl/ggdc.

Table 2. Econometric estimates of the determinants of total mortality rates (Gerdtham & Ruhm, 2003a)

	(a)	(b)	(c)	(d)
Country unemployment rate	-0.0040* (0.0009)	-0.0067* (0.0010)	-0.0026* (0.0009)	-0.0043* (0.0011)
Natural log of income		-0.1660* (0.0290)		
Year effects	Yes	Yes	Yes	No
Country-Specific Trends	Yes	Yes	No	Yes
N	525	525	525	525

Note: The analysis includes 23 OECD countries for the 1960-1997 time period. The dependent variable is the natural log of the total mortality rate. Observations are weighted by the square root of the country population. All specifications also include vectors of country dummy variables and controls for the for the percentage of the country population who are: men, 15-64 years old, 65 to 74 years old, and 75 years and over. Year dummy variables and country specific time trends are also controlled for, except where noted. Income refers to net national disposable income per capita in thousands of US$ PPP (1990). Standard errors in parentheses.

Table 3. Replication of table 2

	(a)	(b)	(c)	(d)
Country unemployment rate	-0.0040* (0.0006)	-0.0071* (0.0010)	-0.0032* (0.0007)	-0.0041* (0.0007)
Natural log of income		-0.1774* (0.0405)		
Year effects	Yes	Yes	Yes	No
Country-Specific Trends	Yes	Yes	No	Yes
N	546	546	546	546

Note: See table 2.

Table 4. Replication of table 2, with smaller sample

	(a)	(b)	(c)	(d)
Country unemployment rate	-0.0034* (0.0007)	-0.0068* (0.0010)	-0.0026* (0.0008)	-0.0029* (0.0008)
Natural log of income		-0.1940* (0.0433)		
Year effects	Yes	Yes	Yes	No
Country-Specific Trends	Yes	Yes	No	Yes
N	467	467	467	467

Note: Sample size determined by the availability of data for annual hours worked.
See http://www.eco.rug.nl/ggdc/homeggdc.html. Otherwise, see notes to table 2.

Table 5. Econometric estimates of the determinants of total mortality rates (augmented model)

	(a)	(b)	(c)	(d)
Country unemployment rate	-0.0028* (0.0007)	-0.0056* (0.0009)	-0.0036* (0.0007)	-0.0031* (0.0008)
Natural log of income		-0.1552* (0.0381)		
Natural log of annual hours	-0.6232* (0.1434)	-0.5723* (0.1375)	-0.4188* (0.0623)	-0.1930* (0.0629)
Year effects Country-Specific Trends	Yes Yes	Yes Yes	Yes No	No Yes
N	467	467	467	467

Note: Sample size determined by the availability of data for annual hours worked. See Table 1. Otherwise, see notes to table 2.

Table 6. Econometric estimates of the determinants of total mortality rates (augmented model)

	(a)	(b)	(c)	(d)
Country unemployment rate	-0.0032** (0.0007)	-0.0042** (0.0009)	-0.0036** (0.0007)	-0.0028** (0.0009)
Natural log of income		-0.0614 (0.0455)		
Natural log of annual hours	-0.4406** (0.1539)	-0.4204** (0.1554)	-0.3775** (0.1016)	-0.3106* (0.01613)
Year effects Country-Specific Trends	Yes Yes	Yes Yes	Yes No	No Yes
N	336	336	336	336

Note: Sample limited to 1979-1997. Otherwise, see table 2.

Table 7. Econometric estimates of the determinants of total mortality rates

	(a)	(b)	(c)	(d)
Country unemployment rate	-0.0058** (0.0011)	-0.0083** (0.0013)	-0.0053** (0.0010)	-0.0040** (0.0010)
Natural log of income		-0.1824 (0.0435)		
Natural log of hours per capita	-0.1618** (0.0654)	-0.1130** (0.0642)	-0.1450** (0.0411)	-0.0686* (0.0653)
Year effects Country-Specific Trends	Yes Yes	Yes Yes	Yes No	No Yes
N	467	467	467	467

Note: see table 2.

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