

Maag, Thomas

Working Paper

Economic correlates of suicide rates in OECD countries

KOF Working Papers, No. 207

Provided in Cooperation with:

KOF Swiss Economic Institute, ETH Zurich

Suggested Citation: Maag, Thomas (2008) : Economic correlates of suicide rates in OECD countries, KOF Working Papers, No. 207, ETH Zurich, KOF Swiss Economic Institute, Zurich, <https://doi.org/10.3929/ethz-a-005666772>

This Version is available at:

<https://hdl.handle.net/10419/50448>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

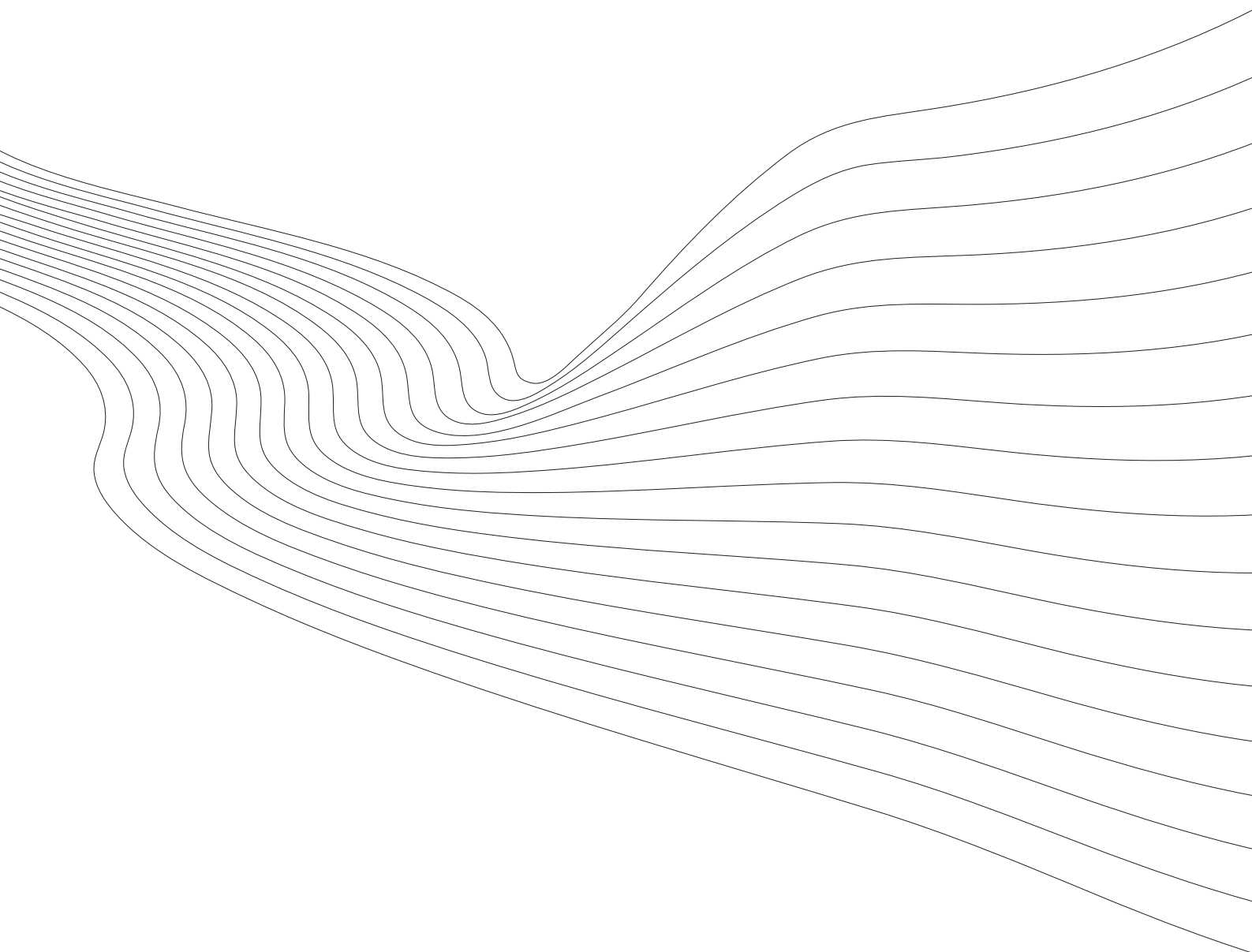
You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

KOF Working Papers

Economic Correlates of Suicide Rates in OECD Countries

Thomas Maag



KOF

ETH Zurich
KOF Swiss Economic Institute
WEH D 4
Weinbergstrasse 35
8092 Zurich
Switzerland

Phone +41 44 632 42 39
Fax +41 44 632 12 18
www.kof.ethz.ch
kof@kof.ethz.ch

Economic Correlates of Suicide Rates in OECD Countries*

Thomas Maag[†]

September 2008

Abstract

This paper investigates how economic conditions are associated with age-sex group specific suicide rates in a panel of 28 OECD countries over the period 1980-2002. We consider the trend and cyclical components of income, unemployment, income inequality, inflation, as well as various socio-demographic control variables. Results depend on whether stationarity properties are adequately accommodated or not. Estimating models in first differences we find that the cyclical component of income is negatively associated with suicide rates of men, while unemployment primarily affects suicide rates of women. Moreover, our estimations show that the effects of the cyclical component of income and unemployment are most pronounced in OECD countries with low public social security spending.

JEL classification: D60, H51, I10

Keywords: suicide, happiness, welfare, health

*I thank Gebhard Kirchgässner for stimulating my interest in the topic and for helpful discussions, and Martin Gassebner, Michael Lamla, and participants of the 2007 Conference on New Developments in Political Economy, Boldern, Switzerland, for valuable feedback.

[†]KOF Swiss Economic Institute, ETH Zurich, CH-8092 Zurich, Switzerland, E-mail: maag@kof.ethz.ch

1 Introduction

In the OECD more than 120'000 people (as of 2001) die from self-inflicted injuries every year. The worldwide number of annual suicide deaths is estimated to lie above 800'000, with suicide being the forth leading cause of death in the age group 14-44 years (WHO 2002). This paper sheds some light on how age-sex specific suicide rates (suicide deaths per 100'000 people) are related to economic conditions in a panel of 28 OECD countries. We investigate the effects of income, unemployment, income inequality, and inflation.

Apart from the interest in describing and understanding suicide rates as such, suicide deaths can also be regarded as an indicator for subjective happiness. Unsurprisingly, it has been shown that suicide and subjective well-being are strongly related at the individual level.¹ This association is even noticeable at the aggregate level. Figure 1 depicts suicide rates and average life satisfaction taken from the World Values Survey for women in the age-group 45-54 years.² In a population weighted regression suicide rates are significantly related to average life satisfaction, a result that generalizes to other age-sex-groups and over time. Moreover, suicide data might elude some common problems of survey data on self-reported well-being. Cognitive factors that affect subjective responses, such as the ordering of questions, wording, or the ranking scale are irrelevant for suicide data.³

Empirical correlates of suicide rates have been investigated by a large, mainly sociological literature.⁴ But only few contributions focus on economic variables. An early study is provided by Hamermesh and Soss (1974). To corroborate an economic theory of suicide, these authors examine how income and unemployment are related to suicide rates in U.S. time series and state cross-sectional data. Hamermesh and Soss (1974) find the expected negative relation with income and positive relation with the unemployment rate.

¹A seminal study is Koivumaa-Honkanen et al. (2001). These authors investigate the relation of self-reported life satisfaction and suicide employing a unique data-set that covers 30'000 Finnish adults. Koivumaa-Honkanen et al. (2001) find that self-reported life satisfaction in 1976 has a significant negative effect on the risk to commit suicide in the subsequent 20 years. After controlling for age, sex, health, and alcohol use, the suicide risk of a dissatisfied individual is more than twice the risk of a satisfied subject.

²Responses to World Values Survey question A170 range from 1 (dissatisfied) to 10 (satisfied), see the Appendix for details.

³See Bertrand and Mullainathan (2001) for a critical discussion of self-reported subjective data.

⁴A review by Stack (2000a, 2000b) lists more than 200 studies.

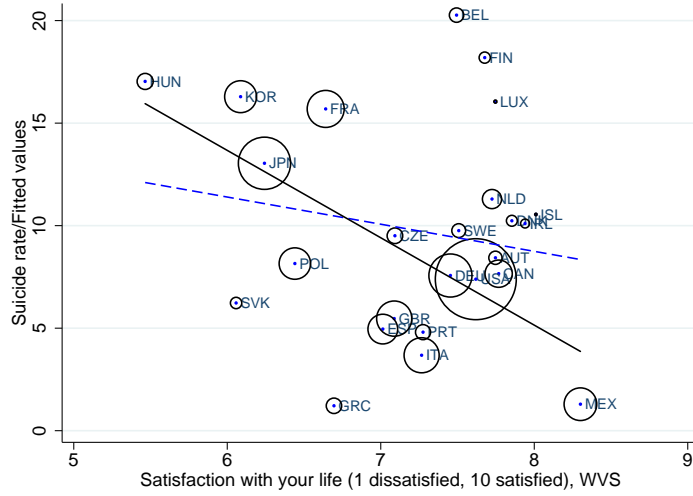


Figure 1: Suicide rates and life satisfaction for women at ages 45-54 in OECD countries, 2000 (N=25). Life satisfaction is computed as the average response to WVS question A170. Circular areas are proportional to cell population. Regression lines are based on population weighted OLS (solid) and unweighted OLS (dashed).

More recent studies mainly use country-level panel data. Neumayer (2003) examines the effects of income, income growth, unemployment, and various social and cultural variables in an unbalanced panel of 68 countries over the period 1980 to 1999. His estimates consistently indicate that GDP has a nonlinear effect on male and female suicide rates, while GDP growth is not significant. Moreover, Neumayer (2003) finds that male suicide rates are positively related to unemployment. Rodríguez-Andrés (2005) uses a panel of 15 European countries from 1970 to 1998 and presents separate results for three age-groups. Unlike Neumayer (2003), Rodríguez-Andrés (2005) reports that income, income inequality, and unemployment rate are insignificant for both sexes and all age groups in country fixed-effects models. The only economic variable that is found to be negatively associated with suicide rates in some age-sex groups is income growth. Gerdtham and Ruhm (2006) investigate the effects of per capita income and unemployment on mortality rates in 23 OECD countries over the period 1960 to 1997. The authors estimate two-way fixed effects models and find that mortality is generally positively related to cyclical fluctuations. Suicide rates however are not found to be associated with any of the economic variables.

Using state level data, Neumayer (2004) investigates the effect of unemployment on various mortality rates between 1980 and 2000 in Germany. He finds that depending on the specification, unemployment is highly significant for the female and overall suicide rate. Ruhm (2000) investigates a panel of U.S. states spanning 1972 to 1991 to find that suicide rates are positively related to unemployment and negatively related to income. Fischer and Rodríguez-Andrés (2008) examine institutional determinants of suicide in a panel of Swiss cantons over the period 1980 to 1998. The only economic control variable that is reported to be significantly associated with the suicide rate is unemployment. Two recent studies working with cross-sectional data are provided by Jungeilges and Kirchgässner (2002) and Huang (1996). Jungeilges and Kirchgässner (2002) find that income and income growth are positively related to suicide rates in a cross-section of 30 countries, 1975. Huang (1996) confirms the unexpected positive association between income and the overall suicide rate in a cross-section of 42 countries in 1990.

Apart from Rodríguez-Andrés (2005) only few studies include measures of income inequality. Leigh and Jencks (2007) investigate the effect of income and income inequality on population health in a panel of 12 developed countries over the period 1903 to 2003. Estimating a two-way fixed effects specification Leigh and Jencks (2007) do not find significant effects of income and income inequality on the suicide rate. Fernquist and Cutright (1998) investigate a panel of 21 developed countries in 5 year intervals ranging from 1955 to 1989. The authors confirm that income inequality is insignificant.

In sum, the literature provides ambiguous results on how economic conditions are related to suicide rates. Of all economic variables considered income growth appears to be the most relevant, but several studies find it to be insignificant. Meanwhile, results with regard to sociodemographic control variables are more robust. In particular family integration is mostly reported to be negatively associated with suicide rates, while alcohol consumption and the divorce rate are positively related to suicide rates. This pattern is consistent with Durkheim's (1897/2006) seminal theory of suicide, which emphasizes the importance of societal integration.

We extend the previous literature in several respects. First, we disentangle effects

associated with long-term income growth from short-term fluctuations in income. Second, we focus on the effects of economic conditions while considering a broad set of variables. Third, we investigate unit root properties of all series involved and estimate appropriate models with stationary variables. Given the ambiguous findings of the previous literature we put emphasis on careful statistical modeling. Fourth, we examine whether public social expenditures affect the identified associations of economic variables and suicide rates.

The next section briefly presents some hypotheses on the effects of economic conditions. These are mainly motivated by sociological and psychological literature. Section 3 presents the empirical strategy and data. Sections 4 and 5 discuss estimation results for models in levels and first differences. Section 6 investigates the effect of public social expenditures, while Section 7 concludes.

2 Hypotheses

The classical work about societal suicide rates is without doubt Durkheim's (1897/2006) "On Suicide". Based on a careful empirical investigation, Durkheim (1897/2006) theorizes that suicide as a social phenomenon is determined by two social conditions: social integration and social regulation. Social integration measures the extent to which members of a society have shared beliefs, common goals and interact with each other. Social regulation describes the extent to which a society has control over emotions and motivations of individuals. Durkheim's theory has subsequently been simplified. Johnson (1965) argues that social integration and regulation cannot be discerned empirically. His simplified theory states that "the more integrated (regulated) a society, group, or social condition is, the lower its suicide rate" (Johnson 1965). As Sennett (2006) emphasizes, economic conditions play a particularly important role in Durkheim's framework for suicide caused by low levels of social integration and regulation (so called anomic suicide). The theory predicts that sudden economic changes such as changes in unemployment and per capita income (in both directions) affect social integration by confusing and disorienting people. Lower levels

of social integration will then be reflected in higher suicide rates.⁵ Another sociological theory that allows predictions with respect to economic variables is the Henry and Short theory. According to Lester (1989) this theory emphasizes frustration caused by variations in the status ranking of individuals. According to the theory of Hendry and Short suicide rates should be particularly high in social groups that suffer most in economic downturns.⁶

Empirical sociological studies focus on effects of social integration, which is typically measured by marriage and divorce rates, fertility rates, average household size, alcohol consumption, or ethnical heterogeneity.⁷ These variables are generally found to be associated with suicide rates as predicted by Durkheim's theory.⁸ Of course, the sociological literature has identified various further determinants of suicide rates. These include suicide prevention programmes (Mann, Apter, and Bertolote 2005, Morrell, Page, and Taylor 2007), availability of means to commit suicide (Stack 2000a), or reports in mass media and imitation (Stack 2000a, Lester 1989).

Overall, the sociological literature clearly suggests to control for social integration. Predictions with regard to economic variables remain ambiguous. According to Durkheim (1897/2006) any change in economic variables, independently of its direction, lowers social integration and therefore should be associated with higher suicide rates. Meanwhile, the Hendry and Short theory suggests an anticyclical pattern in suicide rates.

As it turns out, individual level evidence is more helpful in setting up hypotheses on economic associations of suicide rates. A large empirical psychological literature investigates effects of measurable micro-level factors on suicide. Further indirect evidence can be drawn from the literature on happiness and economics.⁹ Possibly the most comprehensive study

⁵In other words, suicide rates are expected to be high among people who are moving up or down economically. Durkheim's theory does not relate suicide to absolute levels of income. Durkheim (1897/2006) even claims that deprived social groups show lower suicide rates since social integration is higher in these groups.

⁶Other theories, but with weaker empirical support, include the Gibbs and Martin status integration theory (Lester, 1989) or the cohort size hypothesis of Easterlin (1987).

⁷See, e.g., Neumayer (2003) for a paper controlling for social integration.

⁸Thorough reviews are provided by Stack (2000a, 2000b) and Lester (2000).

⁹We will focus on empirical literature since in psychology, unlike in sociology, no dominant theory of suicide exists. An economic theory of suicide is provided by Hamermesh and Soss (1974) and extended by Marcotte (2003). In essence, the economic theory suggests that an agent commits suicide if net discounted

using micro-data is provided by Qin, Agerbo, and Mortensen (2003). The authors investigate the complete set of over 21'000 suicides that occurred in Denmark between 1981 and 1997. Using the unique personal identifier assigned to each person living in Denmark they link entries in the death registry to annual information from the Integrated Database for Labor Market Research. Qin, Agerbo, and Mortensen (2003) estimate logistic regressions and control for socioeconomic factors, ethnicity, area of residence, sickness, and psychiatric admission. They find that suicide risk of individuals in the lowest income quartile is significantly higher compared to the highest quartile. The effect is more pronounced for men than for women. These results are confirmed by Agerbo, Sterne, and Gunnell (2007). Relying on the same data-set from Denmark, the authors additionally report that income is most relevant in the age group 25-40. Kposowa (2000) confirms these findings for the U.S. using data from the National Longitudinal Mortality Study.

Empirical results on the effect of unemployment on suicide risk are also fairly unambiguous. Lewis and Sloggett (1998) use data from a record linkage study that covers 1% of the population of England. The authors focus on the effect of economic factors in 1981 on suicide risk between 1983 and 1992. Lewis and Sloggett (1998) find that individual unemployment is associated with a significantly higher suicide risk. The results are in line with findings of Qin, Agerbo, and Mortensen (2003) and Blakely, Collings, and Atkinson (2003). Agerbo, Sterne, and Gunnell (2007) report that unemployment is most relevant for men in the age group 25-40 years.

Patterns identified by the psychological literature are consistent with results from happiness economics. A robust finding of this literature is the positive association of self-reported subjective well-being and individual income in a cross-section of individuals (Frey and Stutzer 2002, Easterlin 2001). According to Easterlin (2001) well-being depends on the gap between actual material conditions and aspirations. The latter are formed by social comparison (e.g. relative income) and past experience (family background and peer comparisons in childhood). At a given income, experienced utility is higher the lower income

lifetime utility falls below a certain threshold. But again, how individual utility should be specified is an empirical question.

aspirations are.¹⁰ Regarding unemployment, Di Tella, MacCulloch, and Oswald (2001) find that individual unemployment reduces life-satisfaction by 0.33 points on a scale from 1 to 4 in a sample of 12 European countries and the U.S. Meanwhile a 1% increase in the unemployment rate decreases average happiness by 0.02 points. The highly significant and negative association of unemployment and happiness has been confirmed by other studies (see Frey and Stutzer 2002).

Moreover, happiness research has examined the effects of income distribution, the inflation rate, and political institutions on subjective well-being. Relevance of reference group conditions on self-reported well-being at the individual level is well documented, both with respect to income and unemployment (see Frey and Stutzer 2002). In contrast, results regarding aggregate income inequality and inflation rate are ambiguous. Alesina, Di Tella, and MacCulloch (2004) find that aggregate income inequality negatively affects subjective well-being in a panel of 13 developed countries between 1975 and 1996. Using a similar sample, Di Tella, MacCulloch, and Oswald (2001) report that the inflation rate exerts a significant negative effect on average well-being. Both results are inconsistent with findings of Bjørnskov, Dreher, and Fischer (2008). These authors aim at identifying robust determinants of subjective well-being by employing extreme bounds analysis. Using World Values Survey data for 70 countries, Bjørnskov, Dreher, and Fischer (2008) conclude that both income inequality and the inflation rate are not robustly associated with self-reported well-being. Findings with regard to political institutions are also mixed. Frey and Stutzer (2000) show that direct democratic rights are positively related to subjective well-being in Switzerland. Dorn et al. (2007) do not confirm this result for Switzerland, but document a positive association in a cross-section of 28 countries. Meanwhile, Bjørnskov, Dreher, and Fischer (2008) report that measures of democratic institutions are not significantly associated with subjective well-being.

Regarding socio-demographic control variables, findings from psychological literature

¹⁰Consistent with the aspiration level theory is the empirical finding that well-being is fairly constant over an individual's life cycle, whereas income and wealth peak at retirement age. Moreover, individuals typically report that they are happier now than in the past and that they expect to be even happier in the future than today (see Easterlin 2001).

are unambiguous. Suicide risk of married individuals is found to be lower than suicide risk of divorced or single individuals (Kposowa 2000, Agerbo, Sterne, and Gunnell 2007, Qin, Agerbo, and Mortensen 2003, Blakely, Collings, and Atkinson 2003). As with income the effects are more pronounced for men than for women.¹¹ Other relevant risk factors include occupation (Stack 2001, Kposowa 1999), stressful life events, family history of suicidal behavior and psychiatric illness (Qin, Agerbo, and Mortensen 2003, Cheng et al. 2000), and imitation after media reports on suicide (McKenzie et al. 2005).

In light of the individual level evidence on life satisfaction we expect that income is negatively and the unemployment rate positively related to suicide rates. The effect of income and unemployment can be expected to be more important for men than for women. Moreover, changes in income are likely to be more relevant for suicide than the level of income, as suggested by sociological theories and consistent with aspiration level theory. Results from happiness research further indicate that inflation and social inequality might be positively associated with suicide rates. Both sociological and psychological literature suggest to control for social integration, which should exert a negative effect on societal suicide rates.

3 Data and Empirical Strategy

This paper uses data from the WHO mortality database which contains number of deaths by year, country, sex, age group, and cause.¹² Table A.3 summarizes availability of suicide rates for OECD member states. Among this group of countries detailed suicide rates are available for 47 years on average. Since demographic structures vary over time and across

¹¹Qin, Agerbo, and Mortensen (2003) additionally control for children and conclude that the negative effect of marriage on suicide risk for women is partially due to having children and being a parent.

¹²The WHO mortality database is based on reports of civil registration systems of member countries. Causes of death are registered according to the International Classification of Diseases and Causes of Death (ICD). Since the introduction of the first ICD in 1903 suicide has always been a separate category and has been reported by all participating countries (see the Appendix). The database also contains population numbers which allows to compute group specific suicide rates from one single source.

countries we compute suicide rates based on a population with a standard age structure.¹³

Reported suicide rates in the OECD vary considerably across countries, as Table A.3 shows. In 2001, Greece, Italy, and Portugal report age-adjusted suicide rates of below 7 suicides per 100'000 people, while Japan, Finland, and Hungary report suicide rates of above 20. Table A.1 indicates that suicide rates are generally increasing in age. The highest absolute number of suicide deaths occurs in the age group 25-54, both for men and women. Across all countries, men are about three times more likely to commit suicide than women.

Among the set of explanatory variables are income, unemployment, income inequality, inflation rate and controls for socio-demographic and cultural factors. As a measure of income we use per capita real gross domestic product in year 2000 international dollar (chain weighted) taken from Penn World Tables. This variable is decomposed into a trend and cyclical component using the Hodrick-Prescott filter.¹⁴ We expect the trend component of GDP to be associated with a variety of long-term developments, such as improvements in health care infrastructure or changes in social security institutions.¹⁵ In contrast, the cyclical component of GDP will be more closely related to shocks in personal income. This reasoning has been similarly employed by van den Berg, Lindeboom, and Portrait (2006) who investigate how economic conditions in early life are related to individual mortality later in life.

Income inequality is measured in terms of Gini coefficients taken from the UNU/WIDER World Income Inequality Database (WIID). This is an extended and substantially revised version of the widely used data-set provided by Deininger and Squire (1996).¹⁶ Unemploy-

¹³We use the European standard population distribution as adopted by the WHO, see e.g. Ahmad et al. (2001). This population distribution puts more weight on older age groups than the widely used WHO World Standard. Details on the procedure can be found in the Appendix.

¹⁴Following Ravn and Uhlig (2002), the HP parameter value is set to 6.25. The resulting trend should be very close to the trend produced with quarterly data and a parameter value of 1600. As suggested by Baxter and King (1999) 3 data points at both ends of the sample are dropped.

¹⁵Long term growth is also related to globalization, which again entails various changes in the political, social, and cultural dimension. See, e.g., Dreher (2006).

¹⁶International comparability of the UNU/WIDER income inequality data has been questioned, see the critical review by Atkinson and Brandolini (2001). We have therefore tested robustness of our results by employing Gini coefficients taken from the Estimated Household Income Inequality Data Set (UTIP-EHII)

ment rates are taken from the ILO Laborsta database. Inflation is measured in terms on annual change in consumer prices and is taken from the Worldbank Development Indicators database.

To control for social integration we follow the literature and employ female labor force participation (female labor force in % of total labor force), crude birth rate, marriage rate, and divorce rate. Some specifications also include alcohol consumption (estimated amount of pure ethanol consumption per capita). Religious culture is accounted for by adding dummy variables for the historically predominant religious culture as identified by Norris and Inglehart (2004). Indicator variables control for protestant (d_prot), catholic (d_cath), islamic (d_islamic), orthodox (d_orthodox), and sinic/confucian (d_sinic) countries, Central Europe (d_centraleurope), Latin America (d_latinam), and Japan (d_japan). We additionally consider suicide acceptability, which is computed as the average response to World Values Survey (WVS) question F123 on suicide justifiability (see Appendix for details). Finally we control for civil liberties and political rights by including the Freedom House index of political rights.¹⁷

We estimate the association of economic variables and age-sex-group specific suicide rates in an unbalanced panel of 28 OECD countries over the period 1980-2002. In a first step we run population weighted pooled regressions in which observations are multiplied with the inverse of age-sex-group specific population. We estimate the following equations:

$$y_{it,as} = x'_{it}\beta_{as} + \mu_{as} + \gamma_{t,as} + u_{it,as} \quad (1)$$

where $y_{it,as}$ is the log suicide rate of age-group (a) and gender (s).¹⁸ The vector of ex-

provided by Galbraith and Kum (2005). These authors predict Gini coefficients from fixed effects models that explain Deininger and Squire (1996) Gini coefficients based on internationally comparable data on payroll inequality in manufacturing. Using the UTIP-EHII income inequality data does not change our results however.

¹⁷The index for political rights (rights and freedoms to participate in the political process) is highly correlated with the index for civil liberties (freedoms of expression and belief, rule of law, personal autonomy, etc.) but more volatile across countries and over time. We therefore only include the index of political rights. The Freedom House index ranges from 1 (highest degree of rights) to 7 (least amount of rights). Since variation over time is very small we do not include the index in fixed effects estimations.

¹⁸Suicide probabilities $y_{it,as}$ are fractional variables that are bounded within $y_{it,as} \in [0, 1]$. Therefore

planatory variables x_{it} is identical for all age-sex groups. Subscripts t and i denote time and country. All specifications will include time dummy variables $\gamma_{t,as}$. The model is estimated by pooled OLS (POLS).¹⁹ The appeal of this specification is that it explains cross-country variation in mean suicide rates. Consistent estimation requires in particular that any country specific constants (random effects) are uncorrelated with the explanatory variables. In response we employ a broad set of control variables.

Due to the restrictive conditions required for consistent estimation of the above model, our preferred specification accounts for country specific fixed effects $\mu_{i,as}$:

$$y_{it,as} = x'_{it,s}\beta_{as} + \mu_{i,as} + \gamma_{t,as} + \epsilon_{it,as} \quad (2)$$

This model can be consistently estimated with the within-estimator even if the country specific effect $\mu_{i,as}$ is correlated with the regressors. As the within-estimator is based on deviations from country-specific means this of course implies that country specific means in suicide rates are not explained anymore. Employing fixed effects is also motivated by national differences in quality of mortality data, which may be related to economic conditions.²⁰

4 Level of Suicide Rates across Countries

To start we consider a descriptive specification that includes the most complete set of control variables. The economic variables considered are trend and cyclical component of per capita GDP, income inequality, unemployment rate, and inflation rate. We employ

marginal effects in a linear model cannot be constant for all x . Also, the variance of $y_{it,as}$ will depend on the conditional mean $E[y_{it,as}|X]$ since for $E[y_{it,as}|X] \rightarrow \{0,1\}$ we must have that $Var[y_{it,as}|X] \rightarrow 0$. To account for these problems we use natural logarithms of suicide probabilities. Since suicide probabilities are close to 0, this transformation is an approximation to the logit transformation (log-odds ratio, see e.g. Papke and Wooldridge, 1996).

¹⁹Note that system estimation would not be more efficient than POLS because of identical regressors across age-sex groups.

²⁰National differences in quality of WHO mortality data are documented by Mathers, Ma Fat, Inoue, Rao, and Lopez (2005). A discussion of suicide data is provided by De Leo, Burgis, Bertolote, Kerkhof, and Bille-Brahe (2004) or Stack (2000a).

similar controls as Rodríguez-Andrés (2005) and Neumayer (2003): female labor force participation rate (FLP), birth rate, marriage rate, divorce rate, and alcohol consumption. In addition we control for cultural factors by including attitudes on suicide acceptability, average self-reported life-satisfaction, and indicator variables for religion. Political factors are accounted for by using the Freedom House index for political rights. The resulting sample consists of 458 country-year observations and covers 28 OECD countries.²¹

Tables 1 and 2 show population-weighted POLS estimation results. The estimations include annual indicators and country specific linear trends which are highly significant. Of all economic variables only the cyclical component of income is negatively associated with overall suicide rates both of men and women. For men the association is significant at the 10% level in age groups 25-34, 35-44, 45-54, and 55-64, while for women the effect is significant in age groups 15-24, 25-34 and 45-54. In these groups an increase in income characterized by a one percentage point increase in the cyclical component of income is associated with a 1% to 2% decrease in suicide rates. The remaining economic variables are insignificant for overall suicide rates, except for the negative association of income inequality and suicide rates of women. These results hold independently of whether the model includes time fixed effects and country specific linear trends.

Regarding controls, the estimates indicate that divorce rates are positively associated with overall suicide rates of men. Results for marriage and birth rates are mixed, while female labor force participation has a highly significant positive association with overall suicide rates. Also, alcohol consumption is significantly positively related to suicide in the oldest age group of both sexes. The findings with regard to female labor force participation and alcohol consumption are in line with earlier results of Rodríguez-Andrés (2005) and Neumayer (2003). Furthermore, the mean responses on acceptability of suicide is significant and positive in several age-sex groups. This indicates that suicide rates are higher if suicide acceptability is higher. Religious indicator variables are mostly insignificant. Relative to

²¹Not included are Iceland and Turkey. No inequality data is available for Iceland, while for Turkey no suicide rates are available. Only 2 complete observations for Ireland are included because divorce rates have only been recorded since 2000.

Men	Overall	15-24	25-34	35-44	45-54	55-64	65-74	75plus
Income, trend	0.0000227	0.0000230	0.0000432	0.0000142	0.00000493	0.00000776	0.0000385	0.0000352
Income, cyclical	-0.0159**	-0.00998	-0.0171**	-0.0172*	-0.0260***	-0.0158**	-0.00329	-0.0112**
Unemployment	-0.0175	-0.0267	-0.0145	-0.0237	-0.0212	-0.0155	-0.00748	-0.0110
Gini coeff.	-0.00833	-0.00117	-0.0103	-0.0109	-0.00931	-0.00853	-0.00726	-0.00592
Inflation rate	-0.000577	-0.000339	-0.000233	-0.000836*	-0.000679	-0.000423	-0.000835*	-0.000876*
Political rights	0.0831	0.0571	0.0638	0.0950	0.0790	0.115	0.0819	0.0877
Divorce rate	118.5*	166.4*	108.5	142.7*	117.3	113.0*	82.06	108.4
Marriage rate	-44.91	-29.67	-24.52	-51.21	-67.42	-47.35	-30.91	-7.540
Birth rate	0.0306	0.113**	0.0420	0.0316	0.0198	0.0147	0.00830	-0.0141
FLP	0.0467***	0.0250	0.0543***	0.0602***	0.0570***	0.0389***	0.0430***	0.0406***
Alcohol cons.	0.0190	-0.0179	0.0107	0.00370	0.0158	0.0227	0.0237	0.0839**
Acceptability	0.134*	0.131	0.230**	0.223**	0.150	0.122	0.0738	0.117
d_cath	0.451	0.434	0.314	0.416	0.413	0.404	0.650**	0.541
d_orthodox	-0.365	-0.303	0.523	-0.833	-0.498	-1.032**	-0.471	0.531
d_centraleurope	0.538	-0.0644	0.755	0.717	0.554	0.348	0.788	0.553
d_latinam	-0.782	-2.788**	-0.657	-0.800	-0.432	-0.671	-0.212	0.244
d_sinic	-0.135	0.324	0.389	-0.168	-0.324	-0.596	0.0381	-0.443
d_japan	0.680***	0.424	0.574***	0.643***	0.733***	0.520***	0.721***	1.369***
Country FE	no	no	no	no	no	no	no	no
Time FE	yes***	yes***	yes***	yes***	yes***	yes***	yes***	yes***
Country trends	yes***	yes***	yes***	yes***	yes***	yes***	yes***	yes***
N	458	458	458	458	458	458	458	458
R-squared	0.95	0.93	0.93	0.95	0.95	0.94	0.94	0.95

Table 1: Population weighted POLS estimation, unbalanced panel of 28 OECD countries, 1980-2002. Dependent variable: log suicide rate of men, age adjusted. Joint significance of annual indicators and linear trends is assessed using Wald tests. Constant is not reported. Panel robust standard errors are not printed to save space. One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level.

Women	overall	15-24	25-34	35-44	45-54	55-64	65-74	75plus
Income, trend	0.0000285	-0.00000936	0.0000516	0.0000507	0.0000317	0.0000266	0.0000109	-0.00000526
Income, cyclical	-0.0132**	-0.0162*	-0.0219***	-0.0108	-0.0178**	-0.00267	-0.0110	-0.00699
Unemployment	-0.00996	-0.0324*	-0.0124	-0.0148	-0.0130	-0.00139	-0.00590	-0.00536
Gini coeff.	-0.0154*	-0.000923	-0.0113	-0.0176*	-0.0170*	-0.0171**	-0.0224***	-0.0165**
Inflation rate	-0.000689	-0.000587	-0.000752	-0.00102	-0.000553	-0.000475	-0.00110	-0.000534
Political rights	-0.00317	0.00461	0.0292	-0.00300	-0.0263	0.0222	-0.00879	-0.0281
Divorce rate	47.58	108.2	19.25	56.58	59.43	52.92	-3.496	40.76
Marriage rate	-23.09	20.09	-5.614	-22.74	-53.44	-43.50	-0.869	-12.19
Birth rate	-0.0367*	0.0295	0.0201	-0.0168	-0.0391*	-0.0520**	-0.0696***	-0.0930***
FLP	0.0511***	0.0468**	0.0552***	0.0648***	0.0548***	0.0414***	0.0441***	0.0420***
Alcohol cons.	0.0251	0.0277	0.0106	0.00916	0.0297	0.0129	0.0292	0.0695*
Acceptability	0.267***	0.203	0.327***	0.275***	0.237***	0.256***	0.331***	0.376***
d_cath	0.178	0.236	0.195	0.263	-0.00817	0.188	0.300	0.287
d_orthodox	-1.274***	-0.764	-0.338	-3.247***	-1.754***	-0.187	-0.0104	-1.902***
d_centraleurope	0.662	-0.156	0.764	1.090*	0.494	0.684	0.706	0.590
d_latinam	0.120	-1.026	-0.425	0.0386	0.306	-0.379	-0.0889	1.349*
d_sinic	0.0520	0.209	0.481	0.488	-0.225	-0.384	-0.326	-0.335
d_japan	0.874***	0.944***	0.745***	0.605***	0.501***	0.569***	1.150***	2.184***
Country FE	no	no	no	no	no	no	no	no
Time FE	yes***	yes***	yes***	yes***	yes***	yes***	yes***	yes***
Country trends	yes***	yes***	yes***	yes***	yes***	yes***	yes***	yes***
N	458	452	458	456	457	457	456	458
R-squared	0.97	0.92	0.95	0.95	0.96	0.96	0.97	0.97

Table 2: Population weighted POLS estimation, unbalanced panel of 28 OECD countries, 1980-2002. Dependent variable: log suicide rate of women, age adjusted. Joint significance of annual indicators and linear trends is assessed using Wald tests. Constant is not reported. Panel robust standard errors are not printed to save space. One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level.

the reference group of protestant countries, suicide rates are higher in Japan. Suicide rates are lower in orthodox countries, in particular for women. Finally, political rights are insignificant.

These results change once we allow for country-fixed effects. Tables 3 and 4 summarize two-way fixed effects estimation results. Again, the cyclical component of income is negatively related to suicide rates. Moreover, the trend component of GDP now is significantly negatively associated with male suicide rates, suggesting that suicide rates decline in trend income. Similar relations are present for women, but less pronounced. Unemployment rate and Gini coefficient are insignificant. Unclear is why inflation is highly significant and negatively associated with suicide rates in most male and female age groups. The estimated effect is very small though, an increase in inflation by 10 percentage points decreases suicide rates by about 0.5%. Estimated parameters and coefficients of determination do not significantly change if we exclude inflation. Regarding control variables, female labor force participation is not significant anymore in the country fixed-effects specification.

All things considered, estimations in levels suggest that the cyclical component of income is negatively related to suicide rates. Trend income is negatively related to suicide rates in fixed effects models. This is a strong result given that the model accounts for time fixed effects and country specific linear trends. In both cases the associations are particularly significant for men. This again is consistent with evidence from empirical psychological studies. Unemployment rate and inequality are generally insignificant however.

5 First Differences in Suicide Rates across Countries

To account for deterministic trends the above estimations include country specific time trends. In this section we investigate whether the series contain stochastic trends. We assess unit-root properties of suicide rates by first examining country specific series over a time horizon only restricted by data availability. For most countries the series span from 1950 to 2002. The null-hypothesis of a unit-root is tested using the augmented Dickey-

Men	Overall	15-24	25-34	35-44	45-54	55-64	65-74	75plus
Income, trend	-0.0000467* (0.000024)	-0.0000792* (0.000045)	-0.0000160 (0.000049)	-0.0000682*** (0.000022)	-0.0000596** (0.000028)	-0.0000495* (0.000025)	-0.0000143 (0.000027)	-0.0000202 (0.000027)
Income, cyclical	-0.00836*** (0.0029)	-0.00235 (0.0048)	-0.00700 (0.0051)	-0.0110*** (0.0033)	-0.0197*** (0.0041)	-0.00811 (0.0053)	-0.00126 (0.0055)	0.00334 (0.0074)
Unemployment	-0.00481 (0.0059)	-0.0114 (0.011)	-0.000404 (0.012)	-0.0101* (0.0054)	-0.00538 (0.0069)	-0.00388 (0.0079)	0.00191 (0.0072)	-0.00346 (0.0077)
Gini coeff.	0.00287* (0.0014)	0.00538 (0.0034)	-0.00686 (0.0063)	0.00216 (0.0023)	0.00362 (0.0033)	0.00405 (0.0058)	-0.000893 (0.0022)	0.0114 (0.0074)
Inflation rate	-0.000332*** (0.000089)	-0.00000693 (0.00015)	0.0000324 (0.00012)	-0.000592*** (0.000098)	-0.000502*** (0.00010)	-0.000229 (0.00015)	-0.000405*** (0.00012)	-0.000511*** (0.00015)
Divorce rate	120.9* (63.0)	91.06 (71.8)	115.6 (82.2)	184.2** (73.2)	149.7** (63.9)	146.3* (84.2)	21.43 (83.7)	62.91 (78.5)
Marriage rate	12.05 (9.41)	33.65* (16.9)	25.57 (15.2)	11.02 (9.96)	10.58 (8.04)	-0.376 (20.1)	0.718 (8.00)	13.33 (15.4)
Birth rate	-0.0123 (0.017)	-0.0126 (0.027)	-0.0352 (0.032)	-0.00286 (0.010)	-0.0128 (0.022)	-0.0216 (0.019)	-0.00545 (0.018)	0.00218 (0.013)
FLP	0.00176 (0.018)	-0.0121 (0.043)	0.0178 (0.030)	-0.0129 (0.024)	-0.000174 (0.030)	0.00701 (0.019)	-0.0238 (0.023)	0.0152 (0.021)
Country FE	yes	yes	yes	yes	yes	yes	yes	yes
Time FE	yes***	yes***	yes***	yes***	yes***	yes***	yes***	yes***
Country trends	yes***	yes***	yes***	yes***	yes***	yes***	yes***	yes***
N	467	467	467	467	467	467	467	467
R-squared	0.72	0.44	0.59	0.64	0.63	0.56	0.58	0.52

Table 3: Unbalanced panel of 28 OECD countries, 1980-2002. Dependent variable: log suicide rate of men, age adjusted. Two-way fixed effects specification including country specific linear trends. Panel robust standard errors in brackets. Joint significance of annual indicators and linear trends is assessed using Wald tests. One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level.

Women	Overall	15-24	25-34	35-44	45-54	55-64	65-74	75plus
Income, trend	-0.0000548 (0.000030)	-0.0000312 (0.000035)	-0.0000590 (0.000037)	-0.0000397 (0.000036)	0.0000565 (0.000048)	-0.0000176 (0.000045)	-0.0000512* (0.000028)	-0.0000151 (0.000028)
Income, cyclical	-0.00813* (0.0045)	-0.0162 (0.010)	-0.0191 (0.012)	-0.00683 (0.0059)	-0.0196* (0.010)	0.0197 (0.014)	-0.00316 (0.0089)	-0.0177 (0.014)
Unemployment	0.00413 (0.0065)	-0.0205* (0.011)	-0.00341 (0.011)	0.00137 (0.0093)	0.00521 (0.010)	0.0186* (0.0100)	0.00430 (0.012)	-0.00919 (0.016)
Gini coeff.	-0.00153 (0.0027)	0.00397 (0.0075)	-0.00324 (0.0033)	-0.00172 (0.0051)	0.000463 (0.0042)	0.00128 (0.0040)	-0.00885 (0.0073)	-0.00352 (0.0083)
Inflation rate	-0.000166** (0.000076)	-0.000452** (0.00017)	-0.000418* (0.00021)	-0.000485*** (0.00013)	0.0000459 (0.00014)	0.000229 (0.00017)	-0.000516*** (0.00015)	-0.000164 (0.00025)
Divorce rate	63.05 (53.8)	123.8 (75.9)	30.18 (70.0)	56.66 (71.1)	48.03 (70.6)	-6.158 (76.8)	86.41 (73.2)	100.3 (70.8)
Marriage rate	8.603 (7.46)	43.83*** (10.3)	12.43 (15.6)	21.03 (14.1)	-28.15** (13.4)	8.752 (14.9)	26.46** (11.9)	-17.83 (20.4)
Birth rate	-0.0219 (0.022)	-0.0148 (0.027)	-0.00481 (0.034)	-0.0311 (0.023)	0.00157 (0.034)	-0.0500 (0.030)	-0.0238 (0.025)	-0.0251 (0.032)
FLP	0.0127 (0.017)	0.0479 (0.033)	0.0492 (0.042)	-0.0495 (0.050)	-0.00701 (0.023)	0.0751 (0.080)	0.0466 (0.034)	0.0375 (0.039)
Country FE	yes	yes	yes	yes	yes	yes	yes	yes
Time FE	yes***	yes***	yes***	yes***	yes***	yes***	yes***	yes***
Country trends	yes***	yes***	yes***	yes***	yes***	yes***	yes***	yes***
N	467	461	467	465	466	466	465	467
R-squared	0.79	0.49	0.57	0.52	0.57	0.58	0.68	0.39

Table 4: Unbalanced panel of 28 OECD countries, 1980-2002. Dependent variable: log suicide rate of women, age adjusted. Two-way fixed effects specification including country specific linear trends. Panel robust standard errors in brackets. Joint significance of annual indicators and linear trends is assessed using Wald tests. One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level.

Fuller (ADF) test.²² The null hypothesis of stationarity is tested using the KPSS test of Kwiatkowski, Phillips, Schmidt, and Shin (1992). Tables A.5 and A.6 in the Appendix summarize results for overall suicide rates of men and women. The null hypothesis of a unit root in male (female) suicide rate can only be rejected for 5 (4) countries. The KPSS test fails to reject the null hypothesis of stationarity only in 2 (1) cases. Meanwhile both tests clearly indicate that first differences of suicide rates are stationary.

In a second step we investigate unit root properties in a balanced panel that covers the period 1970-1997 using the Im, Pesaran, and Shin (2003) (IPS) panel unit-root test. The test assesses the null hypothesis of a unit-root in all cross-sectional series against the alternative that at least one series is stationary. We allow for country-specific drift terms and deterministic trends. Table 5 shows the test results. The null hypothesis of a unit root in suicide rates is not rejected. We conclude that (log) suicide rates are integrated of order 1.

Table 6 summarizes IPS test results for the set of explanatory variables. Cross-sectional correlation is accounted for by first subtracting period specific sample means. Since underfitting may lead to considerable size distortions we again choose lag orders that are higher than those indicated by the SBC and verify results for different lag orders. The IPS test results for Gini coefficient, marriage rate, and female labor force participation rate are robust with respect to lag order and suggest that these series are nonstationary in all countries. Meanwhile, the null hypothesis of a unit root in the birth rate is clearly rejected. We additionally test against the alternative hypothesis that birth rate is stationary in all countries using the Levin, Lin, and Chu (2002) (LLC) test. This test never rejects the null hypothesis, independently of specification and lag structure. We conclude that birth rates are stationary only in a subset of OECD countries. The IPS test results for divorce rate are not robust with respect to the lag order, with the IPS test rejecting at lag lengths 2 and 3. For these lag orders, the LLC test also rejects the null, suggesting that divorce rates are stationary across all countries in the sample.

For completeness Table 6 additionally summarizes results for unemployment, inflation

²²We apply the sequential procedure suggested by Perron (1988) to find a correct model specification.

	<i>all series</i>				<i>I(1) series only</i>			
	m, ct	m, c	w, ct	w, c	m, ct	m, c	w, ct	w, c
<i>levels</i>								
W_{tbar}	-1.178	1.227	0.797	-0.107	-0.518	1.831	0.804	0.162
p-value	0.119	0.89	0.787	0.457	0.302	0.966	0.789	0.564
Lags	2	2	2	2	2	2	2	2
<i>first differences</i>								
W_{tbar}	-7.724	-9.745	-8.318	-9.066	-7.32	-5.405	-7.149	-8.292
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Lags	2	2	2	2	2	2	2	2
N	625	625	625	625	475	475	475	475
I	25	25	25	25	19	19	19	19
Period	70-97	70-97	70-97	70-97	70-97	70-97	70-97	70-97
T	28	28	28	28	28	28	28	28

Table 5: IPS panel unit root tests, log of overall suicide rates of men (m) and women (w). Results are reported for the specification with deterministic trend and constant (ct), and for the specification with constant only (c). The all series sample covers a balanced panel of 25 countries. Not included due to lack of observations are CZE, KOR, MEX, SVK, TUR. The I(1) series only sample additionally excludes countries for which ADF-tests indicate stationarity, i.e. AUS, ISL, LUX, POL, PRT, NEZ. Lag order is identical across countries. W_{tbar} is asymptotically standard normal, see Im et al. (2003).

and income. Stationarity of unemployment and inflation has been controversially discussed and empirical findings are ambiguous.²³ Using the IPS test we cannot reject the null hypothesis for inflation, while the results for unemployment largely depend on the lag order.

Unit-root tests strongly indicate that suicide rates, Gini coefficients, marriage rate, and female labor force participation are I(1) processes. Results for the other variables are ambiguous, clearly however all differentiated processes are stationary. Possible cointegration

²³See e.g. Camarero, Carrion-i Silvestre, and Tamarit (2006) or Henry and Shields (2004). Regarding unemployment recent studies support the natural rate hypothesis (as opposed to the hysteresis hypothesis). Using a panel setting that incorporates multiple structural breaks Camarero, Carrion-i Silvestre, and Tamarit (2006) reject the null hypothesis of nonstationarity for most OECD countries. Gustavsson and Österholm (2006) test against the alternative of a nonlinear smooth transition autoregressive process and reject the null hypothesis of a unit root for 4 out of 5 OECD countries. Similarly, allowing for nonlinearities in inflation Henry and Shields (2004) reject the unit root hypothesis for inflation in 2 out of 3 investigated OECD countries.

	HP6S	HP6R	Gini	UR	INFL	RDIV	RMAR	BR	FLP
<i>levels</i>									
W_{tbar}	-0.208	-12.262	0.466	-0.165	-0.462	1.287	0.067	-1.291	-0.327
p-value	0.418	0.000	0.679	0.434	0.322	0.901	0.527	0.098	0.372
Lags	5	3	3	2	3	4	4	4	3
<i>first differences</i>									
W_{tbar}	0.286	-13.835	-4.683	-3.989	-10.034	-7.499	-4.071	-4.898	-4.820
p-value	0.613	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Lags	5	3	3	2	3	4	4	4	3
N	675	729	462	540	850	462	600	870	609
I	27	27	22	20	25	21	24	29	29
Period	71-00	71-01	75-98	76-05	72-05	72-98	70-99	70-04	81-05
T	30	31	25	30	34	27	30	35	25

Table 6: IPS panel unit root tests. All models include constant and time trend. HP6S and HP6R denote trend and cyclical component of GDP. Gini, UR, INFL, RDIV, RMAR, BR, FLP denote UNU/WIDER Gini coefficient, ILO unemployment rate, CPI inflation rate, divorce rate, marriage rate, crude birth rate, and female labor force participation rate. Lag structure is identical across countries. W_{tbar} is asymptotically standard normal, see Im et al. (2003).

is not further investigated because we cannot think of a plausible theoretical foundation. Instead we move on to reexamine the correlates of suicide among stationary variables. To remain consistent we take first differences of all variables.

Tables 7 and 8 report estimation results for two-way fixed effects models that include first differences of cyclical component of income, unemployment rate, Gini coefficient, and inflation rate. First differences of divorce rate, marriage rate, birth rate, and female labor force participation rate are included to control for social integration. Among men, the cyclical income component is significantly negatively associated with suicide rates in age groups 35-44 and 45-54. All coefficients on unemployment are positive but never significant. Meanwhile, the cyclical component of income is never significant for suicide rates of women, while unemployment is positively associated at the 10% level in the age group 35-44. Since the sample correlation coefficient of the change in cyclical income and unemployment is -0.496 we have additionally estimated models that only include one of the two variables.

Men	Overall	15-24	25-34	35-44	45-54	55-64	65-74	75plus
Income, cyclical	-0.00353 (0.0057)	-0.000232 (0.0074)	-0.00514 (0.0079)	-0.00684* (0.0040)	-0.0127*** (0.0035)	0.000698 (0.013)	-0.00531 (0.0051)	0.0127 (0.012)
Unemployment	0.00659 (0.0050)	0.00226 (0.0091)	0.00679 (0.0076)	0.00337 (0.0044)	0.00816 (0.0052)	0.00924 (0.014)	0.00470 (0.0076)	0.0150 (0.0099)
Gini coeff.	0.00126 (0.0025)	-0.000580 (0.0028)	-0.00549 (0.0044)	-0.0000398 (0.0037)	0.00132 (0.0050)	0.000156 (0.0064)	-0.00390 (0.0042)	0.0119 (0.0090)
Inflation rate	-0.000131* (0.000065)	0.0000548 (0.000096)	0.000210 (0.00013)	-0.000258*** (0.000091)	-0.000285*** (0.00011)	-0.00000777 (0.00017)	-0.000248** (0.00011)	-0.000363*** (0.00013)
Divorce rate	46.26 (46.8)	75.34 (85.6)	-47.17 (66.5)	76.47 (73.5)	104.0 (69.9)	59.26 (51.1)	-63.19 (83.5)	29.87 (65.1)
Marriage rate	7.252** (2.66)	11.18 (15.4)	14.98 (12.6)	6.417 (7.77)	10.11 (6.22)	-2.842 (10.4)	-2.930 (11.1)	14.45 (10.6)
Birth rate	0.0161 (0.023)	0.0414 (0.042)	-0.00708 (0.025)	0.0119 (0.017)	0.0172 (0.034)	-0.00147 (0.028)	0.0215 (0.034)	0.00199 (0.023)
FLP	-0.00776 (0.015)	-0.0314 (0.041)	0.0213 (0.045)	-0.0482* (0.025)	0.00528 (0.027)	0.0370 (0.030)	-0.0777** (0.037)	0.0457 (0.052)
Country FE	yes	yes	yes	yes	yes	yes	yes	yes
Time FE	yes***	yes***	yes***	yes***	yes***	yes***	yes***	yes***
Country trends	no	no	no	no	no	no	no	no
N	434	434	434	434	434	434	434	434
R-squared	0.10	0.08	0.08	0.13	0.09	0.04	0.07	0.11

Table 7: First differences, unbalanced panel of 27 OECD countries, 1980-2001. Dependent variable: first difference of log suicide rate of men, age adjusted. Two-way fixed effects estimation. Panel robust standard errors in brackets. Joint significance of annual indicators is assessed using a Wald test. One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level.

Women	Overall	15-24	25-34	35-44	45-54	55-64	65-74	75plus
Income, cyclical	-0.0131 (0.0081)	-0.0132 (0.010)	-0.0206 (0.020)	0.00108 (0.0086)	-0.0304 (0.021)	0.00608 (0.0092)	-0.00618 (0.0082)	-0.0450 (0.033)
Unemployment	0.00593 (0.0071)	-0.00453 (0.012)	0.0108 (0.015)	0.0159* (0.0090)	-0.00363 (0.016)	0.0138 (0.0094)	0.0164 (0.011)	-0.0235 (0.029)
Gini coeff.	0.000788 (0.0027)	0.00782 (0.0086)	-0.00390 (0.0053)	0.00356 (0.0066)	0.00115 (0.0051)	-0.00135 (0.0073)	0.00119 (0.0068)	0.00397 (0.0095)
Inflation rate	0.0000447 (0.000086)	-0.000107 (0.00023)	0.0000430 (0.00024)	-0.000126 (0.00014)	0.0000391 (0.00018)	0.000386* (0.00021)	-0.0000381 (0.00019)	-0.000132 (0.00050)
Divorce rate	14.96 (47.7)	113.3 (81.2)	-55.37 (83.1)	-47.42 (67.2)	17.69 (70.6)	76.62 (115)	-23.32 (58.0)	-36.01 (111)
Marriage rate	-2.441 (5.09)	50.88*** (7.61)	-10.98 (20.5)	-2.780 (15.9)	-37.14*** (12.6)	-7.303 (7.20)	39.53** (17.4)	-0.218 (17.8)
Birth rate	-0.0263 (0.030)	0.123 (0.087)	-0.0278 (0.052)	-0.0335 (0.026)	0.0179 (0.034)	-0.0525* (0.029)	-0.0281 (0.042)	-0.0419 (0.093)
FLP	0.0571 (0.036)	0.0297 (0.046)	0.0623 (0.069)	-0.0739 (0.094)	0.0824 (0.051)	0.199 (0.18)	-0.0233 (0.080)	0.0873 (0.089)
Country FE	yes	yes	yes	yes	yes	yes	yes	yes
Time FE	yes***	yes***	yes***	yes***	yes***	yes***	yes***	yes***
Country trends	no	no	no	no	no	no	no	no
N	434	423	434	431	433	433	431	434
R-squared	0.12	0.12	0.05	0.07	0.10	0.11	0.06	0.10

Table 8: First differences, unbalanced panel of 27 OECD countries, 1980-2001. Dependent variable: first difference of log suicide rate of women, age adjusted. Two-way fixed effects estimation. Panel robust standard errors in brackets. Joint significance of annual indicators is assessed using a Wald test. One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level.

Estimates can be found in Table A.7 in the Appendix and confirm that the suicide rate of women is rather affected by unemployment than by the cyclical component of income.

As in estimations in levels, Gini coefficients are insignificant, while inflation rate is highly significant in all male age groups. For women inflation is only significant in the age group 55-64. Again, all results are robust to the exclusion of inflation. Also, excluding inflation leaves the coefficients of determination virtually unaffected.

Summing up, estimations in first differences confirm that male suicide rates are significantly related to cyclical fluctuations in income. Suicide rates of women are rather affected by the unemployment rate. The identified dependence of suicide rates on economic conditions is weak however. In general, significant effects are only present in some age-sex groups, while overall societal suicide rates remain largely unaffected by economic conditions. The effects become more distinct if we split the sample into countries with high and low public social security expenditures, which is done in the next section.

6 The Effect of Public Social Expenditures

Similar to Gerdtham and Ruhm (2006) we investigate whether the observed association of suicide and economic variables depend on public expenditures for social security. A common hypothesis would be that public social security spending softens the impact of cyclical fluctuations on individuals and should render associations of cyclical variables and suicide rates insignificant. We examine this hypothesis by splitting the sample in two groups ranked by average total public social expenditures as a fraction of GDP between 1980 and 2002. Public social expenditures are taken from the OECD social expenditures database.²⁴ The group with high social expenditures spends on average 25.1% on social security, as opposed to a expenditure ratio of 14.9% in the low expenditure group.

We estimate two way fixed effects models in first differences covering the period 1980-2002. Table 9 contrasts estimates in the high and low spending group for men. Estimation results from the full OECD sample have been discussed above and are provided in Table 7.

²⁴Due to a lack of observations Hungary is dropped from the sample.

Men	Overall	15-24	25-34	35-44	45-54	55-64	65-74	75plus
<i>high spending</i>								
Income, cyclical	0.00697 (0.0088)	0.0175 (0.013)	0.00723 (0.013)	0.000813 (0.0037)	-0.0107 (0.0073)	0.0201 (0.016)	-0.00325 (0.0092)	0.0355* (0.018)
Unemployment rate	0.00490 (0.0055)	-0.0135 (0.014)	0.0100 (0.011)	0.0000263 (0.0047)	0.00183 (0.0035)	0.0171 (0.021)	0.00831 (0.012)	0.0138 (0.014)
Gini coeff.	0.00109 (0.0034)	-0.00256 (0.0037)	-0.0102* (0.0052)	-0.00136 (0.0049)	0.00104 (0.0066)	-0.000260 (0.0079)	-0.00299 (0.0053)	0.0162 (0.011)
Inflation rate	-0.0000741 (0.000062)	-0.0000695 (0.00016)	0.000311* (0.00016)	-0.000184 (0.00012)	-0.000272* (0.00014)	0.000262 (0.00018)	-0.000192 (0.00012)	-0.000381** (0.00014)
N	263	263	263	263	263	263	263	263
I	14	14	14	14	14	14	14	14
R-squared	0.15	0.17	0.14	0.20	0.11	0.10	0.12	0.19
<i>low spending</i>								
Income, cyclical	-0.0134** (0.0053)	-0.00609 (0.0082)	-0.0145* (0.0075)	-0.00952 (0.0089)	-0.0145*** (0.0033)	-0.0237 (0.015)	-0.00504 (0.0084)	-0.0160* (0.0073)
Unemployment rate	0.00865 (0.0053)	0.0276** (0.0092)	0.00811 (0.0089)	0.00546 (0.0096)	0.0191*** (0.0049)	-0.00558 (0.017)	0.0000377 (0.011)	0.0107 (0.011)
Gini coeff.	0.00325 (0.0032)	0.00193 (0.0092)	0.0101 (0.010)	0.0103** (0.0044)	0.00643* (0.0031)	0.000103 (0.0076)	-0.0000332 (0.0065)	-0.0104* (0.0056)
Inflation rate	-0.00182 (0.0045)	0.00540 (0.011)	0.00340 (0.0075)	0.00193 (0.0075)	-0.00525 (0.0053)	-0.00375 (0.0092)	-0.00377 (0.0051)	-0.00430 (0.0100)
N	159	159	159	159	159	159	159	159
I	12	12	12	12	12	12	12	12
R-squared	0.28	0.22	0.24	0.22	0.34	0.21	0.15	0.26

Table 9: Association with public social security expenditures, 1980-2002. Dependent variable: first difference of log suicide rate of men, age adjusted. High expenditures group includes AUT, BEL, CHE, DEU, DNK, FIN, FRA, GBR, ITA, LUX, NLD, NOR, POL, SWE. Low expenditure group includes AUS, CAN, CZE, ESP, GRC, IRL, ISL, JPN, KOR, MEX, NZL, PRT, SVK, TUR, USA. Two-way fixed effects estimation. Constant, divorce rate, marriage rate, birth rate, and FLP are included but not reported. Panel robust standard errors in brackets. One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level.

Women	Overall	15-24	25-34	35-44	45-54	55-64	65-74	75plus
<i>high spending</i>								
Income, cyclical	-0.0113 (0.016)	-0.0164 (0.018)	-0.0328 (0.038)	0.0160 (0.0099)	-0.0415 (0.040)	0.0241 (0.017)	0.0129 (0.0089)	-0.0840 (0.071)
Unemployment rate	0.00634 (0.010)	-0.0248 (0.022)	-0.00404 (0.021)	0.0204 (0.014)	-0.00345 (0.018)	0.0158 (0.022)	0.0139 (0.016)	-0.00745 (0.028)
Gini coeff.	0.000542 (0.0029)	0.00831 (0.012)	-0.000893 (0.0054)	-0.00209 (0.0088)	0.00679 (0.0054)	-0.00600 (0.010)	0.00394 (0.0075)	0.00855 (0.013)
Inflation rate	0.0000498 (0.00011)	-0.000229 (0.00029)	-0.0000559 (0.00035)	0.0000519 (0.00017)	-0.0000574 (0.000095)	0.000286 (0.00033)	-0.0000532 (0.00031)	0.00000318 (0.00049)
N	263	252	263	260	262	262	260	263
I	14	14	14	14	14	14	14	14
R-squared	0.16	0.13	0.11	0.15	0.15	0.24	0.14	0.18
<i>low spending</i>								
Income, cyclical	-0.0114 (0.0065)	-0.0241* (0.013)	0.00657 (0.018)	-0.0123 (0.016)	-0.0157 (0.011)	0.00869 (0.013)	-0.0313** (0.013)	-0.0332 (0.023)
Unemployment rate	0.0126 (0.0078)	0.0199 (0.027)	0.0301 (0.025)	0.0180 (0.013)	0.0232** (0.0087)	0.0240 (0.020)	0.00953 (0.016)	-0.0475 (0.057)
Gini coeff.	0.000223 (0.0065)	0.000681 (0.013)	-0.0148 (0.017)	0.0109 (0.017)	-0.00716 (0.0079)	0.00496 (0.017)	-0.0122 (0.016)	-0.00801 (0.023)
Inflation rate	0.00465 (0.0061)	0.00442 (0.013)	-0.00964 (0.0092)	0.00399 (0.011)	0.0189 (0.014)	0.000603 (0.0052)	0.00778 (0.0099)	0.00209 (0.0049)
N	159	159	159	159	159	159	159	159
I	12	12	12	12	12	12	12	12
R-squared	0.20	0.32	0.14	0.18	0.21	0.25	0.25	0.18

Table 10: Association with public social security expenditures, 1980-2002. Dependent variable: first difference of log suicide rate of women, age adjusted. High expenditure group includes AUT, BEL, CHE, DEU, DNK, FIN, FRA, GBR, ITA, LUX, NLD, NOR, POL, SWE. Low expenditure group includes AUS, CAN, CZE, ESP, GRC, IRL, ISL, JPN, KOR, MEX, NZL, PRT, SVK, TUR, USA. Two-way fixed effects estimation. Constant, divorce rate, marriage rate, birth rate, and FLP are included but not reported. Panel robust standard errors in brackets. One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level.

In the high spending group the negative association of the cyclical component of income and suicide rates in the age groups 35-44 and 45-54 disappears. Instead, the cyclical component of income is positively associated with suicide in the oldest age group, but only on the 10% level. Unemployment is not significantly related to suicide. This pattern is substantially different in the sample of countries with low social security spending. In this group the cyclical component of income has a significant negative impact on suicide rates in 3 age groups as well as on the overall suicide rate. Additionally, in 2 age groups the association of unemployment and suicide is positive and highly significant. Furthermore inequality as measured by Gini coefficients is positively related to suicide in the low-spending group (except for the oldest age group), while estimates indicate a weak negative association in the high spending group. This pattern is also present in suicide rates of women. Table 10 summarizes estimates for the two groups of countries. In the high-spending group all coefficients are insignificant. Meanwhile, in the low-spending group the cyclical component of income is negatively associated with suicide in 2 age groups, while unemployment rates are positively related to suicide rates in one age group.

7 Conclusion

This paper investigates how economic conditions are associated with age-sex group specific suicide rates in a panel of 28 OECD countries over the period 1980-2002. We report results for estimations in levels and first differences. Estimations in levels should be interpreted with care, since unit root tests clearly signal that suicide rate, Gini coefficient, marriage rate, and female labor force participation rate contain stochastic trends. Also, our results suggest to opt for models that include country fixed effects. In particular the conclusions about income trend, inflation, and female labor force participation are substantially altered once country fixed effects are accounted for.

Two-way fixed effects estimations in first differences show that the cyclical component of income (output-gap) is negatively associated with suicide rates of men, but only in the age group 35-44 and 45-54. In contrast, suicide rates of women are affected by unemployment,

again only in the age-group 35-44. We do not find a significant association of suicide and inequality. Inflation is negatively associated with male suicide rates in all age-groups. Estimates however are robust to the exclusion of inflation. The associations of cyclical variables and suicide rates are more pronounced in a group of OECD countries with low public social security expenditure ratios. In these countries, cyclical component of income and unemployment are significant in several age-groups of both genders. This result is consistent with the notion that the impact of cyclic fluctuations is softened by social security institutions. Also the findings for men indicate that the association of suicide and income inequality might depend on social insurance, with the association being positive in countries with low public social expenditures.

In general however, identified dependence of suicide rates on economic conditions is weak. Typically, significant effects are only present in some age-sex groups, while overall societal suicide rates are unaffected by economic conditions. This result is consistent with Rodríguez-Andrés (2005) and Gerdtham and Ruhm (2006). Both studies report that economic variables are insignificant once country fixed effects are accounted for. We can think of two primary explanations to reconcile this result with psychological literature that robustly identifies significant associations at the individual level. First and perhaps most importantly, the link between macro variables and individual level conditions is ambiguous.²⁵ The incidence of a decline in aggregate income, e.g., will differ across social groups and may not necessarily affect suicide rates if it hits individuals that otherwise attain high levels of well-being. Second, aggregate level relations may be too minor to be significantly identified. In this case our results indicate that one should proceed by increasing sample size and by reducing the level of aggregation, and rather not by imposing more restrictive models that do not allow for trends or country fixed effects.

²⁵See King, Rosen, and Tanner (2004) for a recent discussion of the ecological inference problem.

References

- AGERBO, E., J. S. STERNE, AND D. J. GUNNELL (2007): “Combining Individual Level and Ecological Data to Determine Compositional and Contextual Socio-Economic Risk Factors of Suicide,” *Social Science & Medicine*, 64, 451–461.
- AHMAD, O. B., C. BOSCHI-PINTO, A. D. LOPEZ, C. J. MURRAY, R. LOZANO, AND M. INOUE (2001): “Age Standardization of Rates: A New WHO Standard,” *World Health Organization, GPE Discussion Paper Series, No. 31*.
- ALESINA, A., R. DI TELLA, AND R. MACCULLOCH (2004): “Inequality and Happiness: Are Europeans and Americans Different?,” *Journal of Public Economics*, 88(9-10), 2009–2042.
- ATKINSON, A. B., AND A. BRANDOLINI (2001): “Promise and Pitfalls in the Use of “Secondary” Data-Sets: Income Inequality in OECD Countries as a Case Study,” *Journal of Economic Literature*, 34, 771–799.
- BAXTER, M., AND R. G. KING (1999): “Measuring Business Cycles: Approximate Band-Pass Filters For Economic Time Series,” *The Review of Economics and Statistics*, 81(4), 575–593.
- BERTRAND, M., AND S. MULLAINATHAN (2001): “Do Peple Mean What They Say? Implications for Subjective Survey Data,” *The American Economic Review*, 91(2), 67–72.
- BJØRNSKOV, C., A. DREHER, AND J. FISCHER (2008): “Cross-Country Determinants of Life Satisfaction: Exploring Different Determinants Across Groups in Society,” *Social Choice and Welfare*, 30(1), 119–173.
- BLAKELY, T. A., S. C. D. COLLINGS, AND J. ATKINSON (2003): “Unemployment and Suicide. Evidence for a Causal Association?,” *Journal of Epidemiology and Community Health*, 57, 594–600.

- CAMARERO, M., J. L. CARRION-I SILVESTRE, AND C. TAMARIT (2006): “Testing for Hysteresis in Unemployment in OECD Countries: New Evidence Using Stationarity Panel Tests with Breaks,” *Oxford Bulletin of Economics and Statistics*, 68(2), 167–182.
- CHENG, A. T., T. H. H. CHEN, C.-C. CHEN, AND R. JENKINS (2000): “Psychosocial and Psychiatric Risk Factors for Suicide,” *British Journal of Psychiatry*, 177, 360–365.
- DE LEO, D., S. BURGIS, J. M. BERTOLETE, A. KERKHOF, AND U. BILLE-BRAHE (2004): “Definitions of Suicidal Behaviour,” in *Suicidal Behaviour: Theories and Research Findings*, ed. by D. De Leo, U. Bille-Brahe, A. Kerkhof, and A. Schmidtke, chap. 3, pp. 17–40. Hogrefe & Huber Publishers.
- DEININGER, K., AND L. SQUIRE (1996): “A New Data Set Measuring Income Inequality,” *The World Bank Economic Review*, 10(3), 565–591.
- DI TELLA, R., R. J. MACCULLOCH, AND A. J. OSWALD (2001): “Preferences over Inflation and Unemployment: Evidence from Surveys of Happiness,” *The American Economic Review*, 91(1), 335–342.
- DICKEY, D. A., AND W. A. FULLER (1981): “Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root,” *Econometrica*, 49(4), 1057–1072.
- DORN, D., J. FISCHER, G. KIRCHGÄSSNER, AND A. SOUSA-POZA (2007): “Is It Culture or Democracy? The Impact of Democracy and Culture on Happiness,” *Social Indicators Research*, 82(3), 505–526.
- DREHER, A. (2006): “Does Globalization Affect Growth? Evidence from a New Index of Globalization,” *Applied Economics*, 38(10), 1091–1110.
- DURKHEIM, E. (1897/2006): *On Suicide*. Penguin Books.
- EASTERLIN, R. A. (1987): “Easterlin Hypothesis,” in *The New Palgrave: A Dictionary of Economics*, ed. by J. Eatwell, M. Milgate, and P. Newman, pp. 1–4. Macmillan.

- (2001): “Income and Happiness: Towards a Unified Theory,” *The Economic Journal*, 111(473), 465–484.
- FERNQUIST, R. M., AND P. CUTRIGHT (1998): “Societal Integration and Age-Standardized Suicide Rates in 21 Developed Countries, 1955-1989,” *Social Science Research*, 27, 109–127.
- FISCHER, J., AND A. RODRÍGUEZ-ANDRÉS (2008): “Political Institutions and Suicide: A Regional Analysis of Switzerland,” Research Paper Series 33, Thurgau Institute of Economics at the University of Konstanz.
- FREY, B. S., AND A. STUTZER (2000): “Happiness, Economy and Institutions,” *The Economic Journal*, 110, 918–938.
- (2002): “What Can Economists Learn From Happiness Research?,” *Journal of Economic Literature*, 40(2), 402–435.
- GALBRAITH, J. K., AND H. KUM (2005): “Estimating the Inequality of Household Incomes: A Statistical Approach to the Creation of a Dense and Consistent Global Data Set,” *Review of Income and Wealth*, 51(1), 115–143.
- GERDTHAM, U.-G., AND C. J. RUHM (2006): “Deaths Rise in Good Economic Times: Evidence from the OECD,” *Economics and Human Biology*, 4(3), 298–316.
- GUSTAVSSON, M., AND P. ÖSTERHOLM (2006): “Hysteresis and Non-Linearities in Unemployment Rates,” *Applied Economics Letters*, 13, 545–548.
- HAMERMESH, D. S., AND N. M. SOSS (1974): “An Economic Theory of Suicide,” *Journal of Political Economy*, 82, 83–98.
- HENRY, O. T., AND K. SHIELDS (2004): “Is There a Unit Root in Inflation?,” *Journal of Macroeconomics*, 26, 481–500.
- HUANG, W.-C. (1996): “Religion, Culture, Economic and Sociological Correlates of Suicide Rates: A Cross-National Analysis,” *Applied Economic Letters*, 3, 779–782.

- IM, K. S., M. H. PESARAN, AND Y. SHIN (2003): “Testing for Unit Roots in Heterogeneous Panels,” *Journal of Econometrics*, 115, 53–74.
- JOHNSON, B. D. (1965): “Durkheim’s One Cause of Suicide,” *American Sociological Review*, 30(6), 875–886.
- JUNGEILGES, J., AND G. KIRCHGÄSSNER (2002): “Economic Welfare, Civil Liberty, and Suicide: An Empirical Investigation,” *The Journal of Socio-Economics*, 31, 215–231.
- KING, G., O. ROSEN, AND M. A. TANNER (2004): “Information in Ecological Inference: An Introduction,” in *Ecological Inference: New Methodological Strategies*, ed. by G. King, M. A. Tanner, and O. Rosen, pp. 1–13. Cambridge University Press.
- KOIVUMAA-HONKANEN, H., R. HONKANEN, H. VIINAMKI, K. HEIKKIL, J. KAPRIO, AND M. KOSKENVUO (2001): “Life Satisfaction and Suicide: A 20-Year Follow-Up Study,” *The American Journal of Psychiatry*, 158(3), 433–439.
- KPOSOWA, A. J. (1999): “Suicide Mortality in the United States: Differentials by Industrial and Occupational Groups,” *American Journal of Industrial Medicine*, 36, 645–652.
- (2000): “Marital status and suicide in the National Longitudinal Mortality Study,” *Journal of Epidemiology and Community Health*, 54, 254–261.
- KWIATKOWSKI, D., P. C. B. PHILLIPS, P. SCHMIDT, AND Y. SHIN (1992): “Testing the Null Hypothesis of Stationarity Against the Alternative of a Unit Root: How Sure are We That Economic Time Series Have a Unit Root?,” *Journal of Econometrics*, 54(1-3), 159–178.
- LEIGH, A., AND C. JENCKS (2007): “Inequality and Mortality: Long-Run Evidence from a Panel of Countries,” *Journal of Health Economics*, 26, 1–24.
- LESTER, D. (1989): *Suicide from a Sociological Perspective*. Charles C Thomas.
- (2000): *Why People Kill Themselves: A 2000 Summary of Research on Suicide*. Charles C Thomas.

- LEVIN, A., C.-F. LIN, AND C.-S. J. CHU (2002): “Unit Root Tests in Panel Data: Asymptotic and Finite-Sample Properties,” *Journal of Econometrics*, 108(1), 1–24.
- LEWIS, G., AND A. SLOGGETT (1998): “Suicide, Deprivation, and Unemployment: Record Linkage Study,” *British Medical Journal*, 317(7168), 1283–1286.
- MACKINNON, J. G. (1991): *Long-Run Economic Relationships: Readings in Cointegration*chap. Critical Values for Cointegration Tests, pp. 267–276. Oxford University Press.
- MANN, J. J., A. APTER, AND J. BERTOLETE (2005): “Suicide Prevention Strategies: A Systematic Review,” *JAMA - Journal of the American Medical Association*, 294, 2064–2074.
- MARCOTTE, D. E. (2003): “The Economics of Suicide, Revisited,” *Southern Economic Journal*, 69(3), 628–643.
- MATHERS, C. D., D. MA FAT, M. INOUE, C. RAO, AND A. D. LOPEZ (2005): “Counting the Dead and What They Died From: An Assessment of The Global Status of Cause of Death Data,” *Bulletin of the World Health Organization*, 83(3), 171–180.
- MCKENZIE, N., S. LANDAU, N. KAPUR, J. MEEHAN, J. ROBINSON, H. BICKLEY, R. PARSONS, AND L. APPLEBY (2005): “Clustering of Suicides Among People With Mental Illness,” *British Journal of Psychiatry*, 187, 476–480.
- MORRELL, S., A. N. PAGE, AND R. J. TAYLOR (2007): “The Decline in Australian Young Male Suicide,” *Social Science & Medicine*, 64, 747–754.
- NEUMAYER, E. (2003): “Are Socioeconomic Factors Valid Determinants of Suicide? Controlling for National Cultures of Suicide With Fixed-Effects Estimation,” *Cross-Cultural Research*, 37(3), 307–329.
- (2004): “Recessions Lower (Some) Mortality Rates: Evidence From Germany,” *Social Science & Medicine*, 58, 1037–1047.

- NORRIS, P., AND R. INGLEHART (2004): *Sacred and Secular: Religion and Politics World-wide*. Cambridge University Press.
- PAPKE, L. E., AND J. M. WOOLDRIDGE (1996): “Econometric Methods for Fractional Response Variables with an Application to 401(K) Plan Participation Rates,” *Journal of Applied Econometrics*, 11(6), 619–632.
- PERRON, P. (1988): “Trends and Random Walks in Macroeconomic Time Series,” *Journal of Economic Dynamics and Control*, 12, 297–332.
- QIN, P., E. AGERBO, AND P. B. MORTENSEN (2003): “Suicide Risk in Relation to Socioeconomic, Demographic, Psychiatric, and Familial Factors: A National Register-Based Study of All Suicides in Denmark, 1981-1997,” *American Journal of Psychiatry*, 160, 765–772.
- RAVN, M. O., AND H. UHLIG (2002): “On Adjusting the Hodrick-Prescott Filter for the Frequency of Observations,” *The Review of Economics and Statistics*, 84(2), 371–380.
- RODRÍGUEZ-ANDRÉS, A. (2005): “Income Inequality, Unemployment, and Suicide: A Panel Data Analysis of 15 European Countries,” *Applied Economics*, 37, 439–451.
- RUHM, C. J. (2000): “Are Recessions Good For Your Health?,” *The Quarterly Journal of Economics*, 115(2), 617–650.
- SENNETT, R. (2006): “Introduction,” in *Émile Durkheim: On Suicide*. Penguin Books.
- STACK, S. (2000a): “Suicide: A 15-Year Review of the Sociological Literature, Part 1: Cultural and Economic Factors,” *Suicide and Life-Threatening Behaviour*, 30(2), 145–162.
- (2000b): “Suicide: A 15-Year Review of the Sociological Literature, Part 2: Modernization and Social Integration Perspectives,” *Suicide and Life-Threatening Behaviour*, 30(2), 163–176.

——— (2001): “Occupation and Suicide,” *Social Science Quarterly*, 82(2), 384–396.

VAN DEN BERG, G. J., M. LINDEBOOM, AND F. PORTRAIT (2006): “Economic Conditions Early in Life and Individual Mortality,” *The American Economic Review*, 96(1), 290–302.

WHO (2002): *World Report on Violence and Health*. World Health Organization, Geneva.

——— (2006): *WHO Mortality Data Base Documentation*. World Health Organization, Department of Measurement and Health Information Systems.

Appendix

Suicide Deaths and Population

World Health Organization, Mortality Database, September 17, 2006.

Since the ICD had been first adopted in 1903 revised classifications have been adopted roughly all 10 years. Under ICD-7 and ICD-8 (1955, 1965) suicide is called “Suicide and self-inflicted injury/poisoning by ...”. Relevant codes are A148 (ICD 07A), B049 (ICD 07B), A147 (ICD 08A), B049 (ICD 08B). Under ICD-9 (1975) this denomination is unchanged but the items relating to suicide have been subsumed under a separate section called “Suicide and Self-Inflicted Injury” which includes “injuries in suicide and attempted suicide, self-inflicted injuries specified as intentional”. Relevant codes are B54 (ICD 09A, 09B), C102 (ICD 09C). ICD 09N is adopted by countries of the newly independent states of the former UDSSR that do not report suicide. With the adoption of ICD-10 (1993) the section was renamed “Intentional self-harm” which includes “Purposely self-inflicted poisoning or injury, suicide (attempted)”. Suicide is called “Intentional self-harm by ...” and “Intentional self-poisoning by ...”. Relevant codes are 1101 (ICD 101), X60-X84 (ICD 103), X600-X849 (ICD 104), X60-X849 (ICD 10M). See WHO (2006).

The age-adjusted all-age suicide rate is given by:

$$r_{it,s} = \sum_a \frac{d_{it,as}}{p_{it,as}} \frac{p_a^s}{\sum_a p_a^s} \cdot 100000 \quad (\text{A.1})$$

where subscripts i, t, s, a denote country, year, sex, and age-group. $d_{it,as}$ and $p_{it,as}$ denote suicide deaths and population, p_a^s is the European standard population. We also apply the standardization in computing age-group specific suicide rates. These are usually generated by aggregating data for two 5-year age groups, in the case of the age group >75 aggregation involves up to 6 age-groups.

To identify possible structural breaks associated with ICD revisions, we estimate a simple model that explains changes in suicide rates $\Delta y_{it,s}$ by time fixed-effects, country

	Overall	15-24	25-34	35-44	45-54	55-64	65-74	75plus
Men								
Rate	19.5	13.8	20.6	25.5	29.1	28.9	29.3	44.3
Deaths	96521	9119	14445	18289	19584	14255	10278	9884
Women								
Rate	5.6	3.5	5.3	7.2	8.7	8.9	8.9	11.6
Deaths	30746	2212	3703	5125	5883	4713	4016	4886

Table A.1: Average age-group specific suicide rates and absolute numbers of suicide deaths in 26 OECD countries, 2001. Not included are BEL, MEX, TUR since suicide or population numbers are not available.

specific linear trends $\gamma_{t,s}$ and an indicator variable $c_{it,s}$ that is unity in the year of transition to a new ICD revision:

$$\Delta y_{it,s} = \phi_{as} c_{it,s} + \gamma_{t,as} + \tau_{i,as} t + u_{it,s} \quad (\text{A.2})$$

Table A.2 summarizes the results. ϕ_{as} is insignificant in all but 6 specifications. Only in one age-sex group the coefficient is significant at the 5% level.

ICD9	Overall	15-24	25-34	35-44	45-54	55-64	65-74	75plus
Men	-0.0720 (0.048)	0.0173 (0.15)	-0.0582 (0.11)	-0.191 (0.13)	-0.118* (0.060)	0.0529 (0.070)	0.0620 (0.083)	-0.267** (0.11)
Women	-0.154 (0.14)	-0.207* (0.11)	-0.0832 (0.15)	-0.0671 (0.14)	0.0494 (0.11)	0.0199 (0.076)	-0.112 (0.18)	-0.0338 (0.25)
ICD10								
Men	-0.00152 (0.035)	-0.0533 (0.032)	-0.00451 (0.034)	0.0293 (0.035)	0.0634 (0.065)	-0.0514 (0.055)	0.0842* (0.044)	-0.132* (0.070)
Women	-0.0423 (0.044)	0.0654 (0.072)	-0.0961 (0.082)	-0.116 (0.078)	0.103 (0.079)	-0.123 (0.11)	0.000299 (0.090)	-0.153* (0.084)

Table A.2: Changes in suicide rates and ICD revisions, 29 OECD countries, 1980-2002, average N=600. Table only reports ϕ_{as} in 4 separate estimations (men, women, change to ICD9, and change to ICD10). POLS estimation including time indicators and country specific linear trends. Panel robust standard errors in brackets. Time indicators and linear trends are joint significant at the 5% level in all age-sex groups and specifications. One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level.

Explanatory Variables

Income

Heston, Alan, Robert Summers and Bettina Aten, Penn World Tables Version 6.2, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, September 2006.

Inequality

United Nations University (UNU) - World Institute for Development Economics Research (WIDER): World Income Inequality Database (WIID), Version 2.0a, June 2005. We use unadjusted Gini coefficients with quality levels 1 and 2 as estimated by UNU-WIDER. The results of Galbraith and Kum (2005) indicate that simple adjustments (such as adding 6.6 to the expenditure based Gini coefficients as proposed by Deininger and Squire, 1996) may be inappropriate. If multiple estimates are available for a given country and year we take averages.

Galbraith, James K. and Hyunsub Kum, University of Texas Inequality Project (UTIP): Estimated Household Income Inequality Data Set (EHII), Version 2.4 (2004).

Unemployment rate

Worldbank (2007), World Development Indicators Online (WDI).

ILO, LABORSTA Internet Database, May 31, 2007, <http://laborsta.ilo.org/>.

Inflation, Female Labor Force Participation Rate, Crude Birth Rate

Worldbank (2007), World Development Indicators Online (WDI).

Political Rights

Freedom House, Freedom in the World, Comparative Scores for All Countries From 1973-2006.

Marriage Rate, Divorce Rate

United Nations Common Database, May 18, 2007.

Alcohol Consumption

WHO (2007), Global Alcohol Database, June 4, 2007.

World Values Survey

European Values Study Group and World Values Survey Association, European and World Values Surveys Four-Wave Integrated Data File, 1981-2004, v.20060423, 2006. Aggregate File Distributor: Zentralarchiv für Empirische Sozialforschung (ZA) Cologne, Germany. Observations are weighted using weighting variable s017.

Question A170: “All things considered, how satisfied are you with your life as a whole these days? Please use this card to help with your answer.”, answers: “1 Dissatisfied, 2,3,...9, 10 Satisfied”.

Question F123: “Please tell me for each of the following statements whether you think it can always be justified, never be justified, or something in between, using this card: Suicide.”, answers: “1 Never justifiable, 2,3,...9, 10 Always justifiable”.

Public Social Expenditures

OECD Social Expenditures Database (SOCX), 2007.

Further Results

iso	Name	N	Miny	Maxy	Mean m	Mean w	illdef
IRL	Ireland	56	1950	2005	10.2	3.0	7
JPN	Japan	55	1950	2004	26.5	14.7	9
NLD	Netherlands	55	1950	2004	11.9	6.6	15
NOR	Norway	54	1951	2004	16.3	5.5	12
ISL	Iceland	54	1951	2004	19.7	6.2	5
CHE	Switzerland	54	1951	2004	30.8	11.2	13
AUS	Australia	54	1950	2003	19.5	7.0	5
CAN	Canada	53	1950	2002	18.5	5.7	7
FRA	France	53	1950	2003	27.5	9.0	14
GBR	United Kingdom	53	1950	2004	12.1	5.8	7
FIN	Finland	53	1952	2004	40.2	10.1	3
ESP	Spain	53	1951	2004	9.8	2.9	11
USA	United States of America	53	1950	2002	19.6	5.6	7
DEU	Germany	53	1952	2004	25.8	10.8	14
ITA	Italy	52	1951	2002	10.2	3.6	12
NZL	New Zealand	52	1950	2001	17.9	6.5	4
SWE	Sweden	52	1951	2002	25.7	9.7	11
AUT	Austria	51	1955	2005	34.4	11.9	14
DNK	Denmark	51	1951	2001	30.2	15.3	12
HUN	Hungary	49	1955	2003	53.3	18.1	7
PRT	Portugal	49	1955	2003	15.8	4.1	21
GRC	Greece	49	1956	2004	5.2	1.9	26
BEL	Belgium	44	1954	1997	25.1	10.3	15
POL	Poland	41	1959	2004	22.6	4.3	25
LUX	Luxembourg	40	1965	2004	23.3	8.5	14
MEX	Mexico	36	1958	1995	4.4	0.7	5
KOR	Republic of Korea	20	1985	2004	20.4	7.6	14
CZE	Czech Republic	19	1986	2004	27.1	7.5	13
SVK	Slovakia	11	1992	2002	24.0	4.1	4

Table A.3: Availability of age-group specific suicide rates for OECD countries. Observations are only included if suicide rates are available for 7 age groups (WHO age group format 04 or smaller). Mean m and w denotes the average age-adjusted suicide rate of men and women over the country-specific sample period. Illdef is the percentage of "ill-defined" deaths, i.e. deaths registered under residual categories, as computed by Mathers et al (2005).

iso3	N	miny	maxy
AUS	23	1980	2002
AUT	22	1980	2001
BEL	18	1980	1997
CAN	17	1984	2000
CHE	21	1982	2002
CZE	9	1994	2002
DEU	10	1992	2001
DNK	22	1980	2001
ESP	21	1982	2002
FIN	23	1980	2002
FRA	23	1980	2002
GBR	20	1980	1999
GRC	7	1995	2001
HUN	13	1990	2002
IRL	2	2000	2001
ITA	23	1980	2002
JPN	19	1980	1998
KOR	14	1985	1998
LUX	17	1985	2001
MEX	4	1988	1995
NLD	22	1980	2001
NOR	23	1980	2002
NZL	11	1986	1996
POL	11	1990	2002
PRT	21	1980	2001
SVK	9	1994	2002
SWE	23	1980	2002
USA	19	1980	1998

Table A.4: Sample for estimating models in levels and first differences. Included explanatory variables are trend and cyclical component of per capita GDP, income inequality, unemployment rate, inflation, female labor force participation rate, birth rate, marriage rate, divorce rate.

iso3	nobs	miny	maxy	lags	$\hat{\tau}_\tau$	Φ_3	$\hat{\tau}_\mu$	Φ_1	$\hat{\tau}$	model	KPSS	model 1st diff.
AUS	54	1950	2003	1	-2.88	5.06	-3.09**	4.78*	-0.07	I(0), c	0.157**	I(0)
AUT	51	1955	2005	1	-0.32	3.16	0.82	1.12	1.27	I(1)	0.573***	I(0), ct
BEL	44	1954	1997	1	-2.22	2.46	-1.26	1.28	-1.00	I(1)	0.170**	I(0)
CAN	53	1950	2002	1	-0.52	1.67	-1.71	1.74	-0.76	I(1)	0.574***	I(0), ct
CHE	54	1951	2004	1	-0.49	0.81	0.18	1.28	1.61	I(1)	0.382***	I(0), c
DEU	53	1952	2004	1	-0.87	3.11	1.10	2.21	1.81	I(1)	0.649***	I(0)
DNK	51	1951	2001	1	-0.67	0.87	-0.19	0.78	1.24	I(1)	0.392***	I(0), ct
ESP	54	1951	2004	1	-1.80	2.33	-1.24	0.77	0.00	I(1)	0.535***	I(0)
FIN	53	1952	2004	1	-1.21	3.13	-0.95	0.54	0.41	I(1)	0.326***	I(0)
FRA	54	1950	2003	2	-1.88	1.88	-1.96	1.93	0.14	I(1)	0.178**	I(0)
GBR	55	1950	2004	1	-1.46	1.06	-1.15	1.01	0.82	I(1)	0.355***	I(0)
GRC	49	1956	2004	1	-2.43	2.96	-2.44	3.05	0.32	I(1)	0.253***	I(0)
HUN	49	1955	2003	1	-0.29	9.74***	-2.13	2.48	-0.68	I(1), ct	0.612***	I(0), ct
IRL	56	1950	2005	1	-2.32	2.70	-0.64	1.02	-1.33	I(1)	0.303***	I(0)
ISL	54	1951	2004	1	-5.46	14.92***	-5.50***	15.12***	0.02	I(0), ct	0.0432	I(0)
ITA	52	1951	2002	1	-1.95	1.94	-1.72	1.51	0.23	I(1)	0.357***	I(0)
JPN	55	1950	2004	1	-1.70	1.76	-1.88	1.76	-0.05	I(1)	0.372***	I(0)
LUX	40	1965	2004	1	-3.73**	7.03**	-3.66***	6.71**	0.02	I(0), ct	0.146**	I(0)
NLD	55	1950	2004	1	-2.10	2.37	-1.82	1.74	-0.42	I(1)	0.397***	I(0)
NOR	54	1951	2004	1	-0.78	1.24	-1.57	1.49	-0.74	I(1)	0.405***	I(0)
NZL	52	1950	2001	1	-2.44	3.05	-1.31	0.93	-0.40	I(1)	0.393***	I(0)
POL	46	1959	2004	1	-3.57**	6.57*	-1.98	2.69	-1.21	I(0), ct	0.271***	I(0)
PRT	49	1955	2003	1	-3.45*	6.40*	-2.30	2.72	0.32	I(0), ct	0.0966	I(0)
SWE	52	1951	2002	1	-1.97	3.15	-0.06	0.70	1.19	I(1)	0.545***	I(0), ct
USA	53	1950	2002	1	-1.63	1.98	-1.59	1.35	0.42	I(1)	0.304***	I(0)

Table A-5: ADF and KPSS test results for log-odds ratio of suicide rate by country, men. Notation follows Fuller (1976) and Dickey and Fuller (1981): $\hat{\tau}_\tau$ denotes t-statistic in the specification with constant and deterministic trend, Φ_3 is the F-statistic for the joint hypothesis that coefficient and time trend are zero. $\hat{\tau}_\mu$ denotes t-statistic in the specification with constant only, Φ_1 is the F-statistic for the joint test that coefficient and constant are zero. $\hat{\tau}_\mu$ denotes t-statistic in the specification without constant and trend. The model column summarizes the specification implied by the sequential procedure of Perron (1988). Lag structure is determined using the Schwarz information criterion (SBC). KPSS test allows for deterministic trend. Critical according to MacKinnon (1991), Dickey and Fuller (1981), Kwiatkowski et al. (1992). The last column summarizes ADF-test results for first differences, again based on the Perron (1988) model selection procedure. One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level.

iso3	nobs	miny	maxy	lags	$\hat{\tau}_\tau$	Φ_3	$\hat{\tau}_\mu$	Φ_1	$\hat{\tau}$	model	KPSS	model 1st diff.
AUS	54	1950	2003	1	-2.61	4.60	-1.23	0.76	0.11	I(1)	0.412***	I(0)
AUT	51	1955	2005	1	-0.62	1.96	-1.12	2.75	2.08	I(1)	0.555***	I(0), ct
BEL	44	1954	1997	2	-1.48	1.21	-1.34	1.04	-0.55	I(1)	.273***	I(0)
CAN	53	1950	2002	1	-0.81	1.10	-1.21	0.76	-0.21	I(1)	.583***	I(0)
CHE	54	1951	2004	1	-1.36	1.08	-1.25	0.92	0.50	I(1)	.442***	I(0)
DEU	53	1952	2004	1	-1.21	6.52*	-1.75	3.79	2.15	I(1), ct	.677***	I(0), ct
DNK	51	1951	2001	1	-0.14	1.90	-0.38	0.75	1.18	I(1)	.500***	I(0)
ESP	54	1951	2004	1	-2.23	3.44	-1.54	1.20	0.15	I(1)	.454***	I(0)
FIN	53	1952	2004	1	-3.02	6.54*	-3.56**	6.44***	-0.42	I(1), ct	.191**	I(0)
FRA	54	1950	2003	1	-1.01	1.65	-1.60	1.41	-0.51	I(1)	.413***	I(0)
GBR	55	1950	2004	1	-2.59	4.06	-0.01	1.04	1.46	I(1)	.431***	I(0)
GRC	49	1956	2004	1	-3.24	5.26	-1.30	1.39	1.01	I(1)	.194**	I(0)
HUN	49	1955	2003	1	-0.15	11.63***	-0.23	0.19	0.58	I(1), ct	.606***	I(0), ct
IRL	56	1950	2005	1	-2.09	2.29	-1.42	1.23	-0.75	I(1)	.312***	I(0)
ISL	54	1951	2004	1	-4.74***	11.23***	-4.77***	11.37***	-0.12	I(0), ct	.0632	I(0)
ITA	52	1951	2002	1	-0.83	1.20	-0.37	0.56	0.99	I(1)	.316***	I(0)
JPN	55	1950	2004	1	-2.55	3.25	-0.89	1.24	1.27	I(1)	.105	I(0)
LUX	40	1965	2004	1	-3.69**	7.12**	-3.83***	7.40***	0.27	I(0), ct	.234***	I(0)
NLD	55	1950	2004	1	-1.38	2.03	-1.79	1.62	-0.19	I(1)	.558***	I(0)
NOR	54	1951	2004	1	-1.52	1.26	-1.24	1.21	-0.98	I(1)	.452***	I(0)
NZL	52	1950	2001	1	-3.18*	5.47	-2.97**	4.40*	-0.02	I(0), c	.361***	I(0)
POL	46	1959	2004	1	-3.74**	8.20**	-3.75***	7.35***	-0.72	I(0), ct	.272***	I(0)
PRT	49	1955	2003	1	-2.69	3.65	-2.32	2.69	-0.01	I(1)	.284***	I(0)
SWE	52	1951	2002	1	-1.38	5.41	-0.77	0.33	0.23	I(1)	.618***	I(0), ct
USA	53	1950	2002	2	-1.72	3.89	-0.70	0.28	0.26	I(1)	.423***	I(0), ct

Table A.6: ADF and KPSS test results for log-odds ratio of suicide rate by country, women. One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level.

	Overall	15-24	25-34	35-44	45-54	55-64	65-74	75plus
<i>men</i>								
Income, cyclical	-0.00549 (0.0051)	-0.000904 (0.0067)	-0.00717 (0.0064)	-0.00784* (0.0041)	-0.0151*** (0.0034)	-0.00205 (0.011)	-0.00671 (0.0044)	0.00828 (0.011)
Unemployment rate	0.00895* (0.0044)	0.00241 (0.0084)	0.0102* (0.0053)	0.00795 (0.0052)	0.0167*** (0.0055)	0.00878 (0.0091)	0.00826 (0.0067)	0.00645 (0.0077)
<i>women</i>								
Income, cyclical	-0.0148** (0.0065)	-0.0118 (0.011)	-0.0238 (0.016)	-0.00373 (0.0070)	-0.0293* (0.017)	0.00194 (0.0081)	-0.0111 (0.0074)	-0.0380 (0.027)
Unemployment rate	0.0147*** (0.0048)	0.00420 (0.014)	0.0246** (0.0090)	0.0151** (0.0065)	0.0166** (0.0080)	0.00974 (0.0076)	0.0205* (0.010)	0.00662 (0.019)

Table A.7: Coefficient estimates in specifications excluding first difference of unemployment rate or excluding first difference of cyclical component of income. Unbalanced panel of 27 OECD countries, 1980-2001. Dependent variable: first difference of log suicide rate, age adjusted. Two-way fixed effects estimation. Panel robust standard errors in brackets. Constant is not reported. One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level.