



IMF-lending programs and suicide mortality

Eleftherios Goulas^{a,*}, Athina Zervoyianni^b

^a Department of Banking & Finance, Bursa Orhangazi University, Turkey

^b Department of Economics, University of Patras, Greece



ARTICLE INFO

Article history:

Received 9 July 2015

Received in revised form

20 January 2016

Accepted 25 January 2016

Available online 28 January 2016

Keywords:

IMF lending

Suicide

Developing & transition countries

Structural adjustment

GMM estimation

ABSTRACT

While the economic consequences of IMF programs have been extensively analyzed in the literature, much less is known about how key welfare indicators, including suicide-mortality rates, correlate with countries' participation in such programs. This paper examines the impact of IMF lending on suicide mortality, using data from 30 developing and transition countries that received non-concessionary IMF loans during 1991–2008. Our results support the hypothesis of a positive causal relationship between suicide mortality and participation in IMF programs but reveal no systematic suicide-increasing effect from the size of IMF loans. This holds after accounting for self-selection into programs, resulting from the endogeneity of a country's decision to resort to the IMF for funding, and after controlling for standard socio-economic influences on suicidal behaviour. In particular, we find a positive aggregate suicide-mortality differential due to IMF-program participation of between 4 and 14 percentage points. We also find that the positive association between suicides and program participation is stronger and more robust among males. Comparing age groups, individuals belonging to the age group 45-to-64 exhibit the highest increase in suicide due to program-participation, which amounts to over 18 percentage points. Overall, our results imply that when countries are exposed to IMF programs in an attempt to resolve their economic problems, social-safety nets need to be designed to protect the adversely-affected part of the population.

© 2016 Elsevier Ltd. All rights reserved.

1. Introduction

Over the years, IMF-lending programs have been heavily criticized both for failing to resolve participating countries' economic problems and for generating adverse social consequences. Recently, there has been renewed attention to the social consequences of Fund programs as a result of the financial crisis of 2007–2009 and the European debt crisis thereafter, which led to recessions and forced several countries to resort to the IMF for funding. Prompted by this situation, a number of papers have stressed aspects of the negative side-effects of austerity programs, like those of the IMF, including greater inequality, increased impoverishment and decreased provision of health services (Stuckler et al., 2008, 2010; Stuckler and Basu, 2009; Barr et al., 2012; Chang et al., 2013; Karanikolos et al., 2013). In this paper we focus on an aspect of the social consequences of IMF programs that has not yet been examined systematically in a cross-country context, their effect on

suicides. With respect to suicides, a bold case in recent years is Greece, which was the first Eurozone member-state to turn to the IMF for financial assistance, making from 2010 front-page news across the globe. The Greek program was designed in an environment of low growth, significant market rigidities and a serious gap in competitiveness. Economic activity dropped further thereafter, as austerity measures and extensive structural reforms were implemented, leading to a severe economic depression that lasted six years, wiping out more than twenty-five percent of GDP and raising the official unemployment rate to over 27%. As Antonakakis and Collins (2014), Economou et al. (2011) and Kentikelenis et al. (2011) point out, even more important was the shock that hit people in Greece. In a country with one of the lowest rates of suicide mortality worldwide, the number of people resorting to suicide increased dramatically in the aftermath of the 2009–2011 crisis, leading to a rise in total suicides by almost 40%. Another bold case was observed during the Asian financial crisis of the late 1990s, when Indonesia, South Korea and Thailand, faced with a loss of market confidence and pressures on their currencies, resorted to the IMF for funding. These countries experienced a substantial rise in suicides (Chang et al., 2009; Kim et al., 2010).

* Corresponding author.

E-mail addresses: eleftherios.goulas@bou.edu.tr (E. Goulas), athina@upatras.gr (A. Zervoyianni).

To what extent do countries systematically experience the same pattern? To what extent is there an underlying positive relationship linking IMF programs to suicide-mortality rates across countries and over time? This paper seeks to investigate whether there is a causal association between suicides and IMF programs in participating countries, using data from 30 transition & developing countries that received non-concessional IMF-funding under the SBA (Stand-By Arrangement) and EFF (Extended-Fund) facilities during 1991–2008. Our regression results point to a robust positive relationship between suicide-mortality rates and participation in IMF programs but reveal no systematic suicide-increasing effect from the size of IMF loans. This holds after accounting for self-selection into programs, resulting from the endogeneity of countries' decision to participate in IMF-loan agreements, and after controlling for standard socio-economic influences on suicidal behaviour.

Overall, our results suggest that while IMF-supported policies may have long-run benefits, raising economic efficiency and restoring competitiveness, suicide mortality should be seriously considered as one of the potential short-term, or even medium-term, negative side-effects of participation in IMF-lending agreements. Our estimates indeed imply a positive aggregate suicide-mortality differential due to IMF-program participation of between 4 and 14 percentage points, while individuals belonging to the age group 45-to-64 exhibit the highest differential, amounting to over 18 percentage points.

The structure of the paper is as follows. In Section 2 we identify possible channels through which IMF-loan programs might influence suicide rates in recipient countries. Section 3 describes the empirical methodology and data, while Section 4 reports the estimation results. Section 5 reports on robustness controls and Section 6 follows with concluding comments.

2. IMF programs and suicides

A country's signing of an IMF-loan agreement may affect suicides both through the resources involved and through the terms and conditions of IMF lending. The resource element of programs can be expected to have no suicide-increasing effect and may even lead to a decline of suicide rates, to the extent that the extra liquidity provided can prevent a domestic economic or financial crisis, thus helping countries move forward and making their population more hopeful. However, the terms and conditions of IMF lending may result in a higher rate of suicide mortality. There are several channels involved. First, IMF programs usually require demand-restraining measures, which, at least in the short run, can lead to higher unemployment and lower growth. As the sociological literature of suicide suggests, increased unemployment or lower growth can raise the probability of suicidal behaviour by causing a decline in expected life-time income.

Second, IMF-loan agreements often involve a large number of structural conditions, requiring reforms in many areas, which typically include reduced regulation of product markets, deregulation of labour markets and a fall in employment protection, restructuring or privatization of public enterprises and other institutional or legislative measures to increase market forces in the economy. As non-compliance with IMF conditionality can result in suspension or termination of programs, governments are often forced to carry out the required structural reforms fast and despite adverse domestic macroeconomic conditions. This can lead to abrupt deterioration in the socio-economic position of certain groups in participating countries, raising socio-economic inequalities and resulting in increased poverty and insecurity. Badly hit groups, realizing that their socio-economic status has suddenly changed and are no longer able to achieve what has previously

been expected may then be led to resort to suicide.

Third, signing an IMF-lending agreement often reduces the flexibility of governments to respond to the adverse social consequences of economic change with appropriate policies. For example, IMF-induced fiscal constraints can make it difficult for governments to fund services or programs that prevent social isolation, and thus potentially reduce suicide risk during periods of economic change, such as family-support systems, active labour-market policies, educational programs for early-school leavers and financial-assistance programs for small-scale businesses. IMF-induced budgetary cuts can also weaken the capacity of governments to provide special health-support services to individuals with higher-than-average suicide propensities, including those suffering from mental disorders or from chronic-psychical illness.

Fourth, fast IMF-induced structural adjustments involving privatizations of state-owned enterprises in key sectors, like energy and telecommunications, or reduced government subsidies for basic public services, like healthcare and education, can result in preventing access to these sectors or services for a certain segment of the population, particularly low-income groups, thus raising the likelihood of suicidal behaviour by making relative deprivation more noticeable.

Fifth, a lower level of employment protection or cutbacks in unemployment benefits, again typical components of IMF conditionality, can induce suicidal behaviour through increased insecurity and anxiety among workers about losing jobs. IMF-induced lower pensions or increases in VAT on basic goods can also raise suicidality among older-age groups and other already disadvantaged families through increased impoverishment.

Lastly, the requirement to rapidly liberalize trade, which is a typical IMF condition, can result in reduced effectiveness of a country's effort to control drug-trafficking and domestic drug-use or alcoholism, which are factors likely to be associated with higher suicide risk.

Indeed, a growing literature finds adverse social consequences of IMF programs, including negative effects on labour, greater inequalities, increased impoverishment, lower health expenditures and worsened health outcomes, which may lead to increased suicide risk through the channels discussed. For example, [Vreeland \(2002\)](#), based on data from 110 countries, has found evidence of a significant decline in labour's share of output after receipt of IMF loans, which can be related to suicide risk through increased impoverishment and a deterioration of socio-economic position, while [Garuda \(2000\)](#) has found a sizable drop in the income of the poorest 20% of the population in 88 countries following program participation. The estimates of [Nooruddin and Simmons \(2006\)](#) show that the presence of an IMF program reduces the positive impact of democracy on social and other pro-poor policies, while [Weisbrot and Jorgensen \(2013\)](#), examining the Fund's recommendations to EU governments during the crisis period of 2008–2009, confirms the emphasis of the IMF on policies that tend to reduce labour's share of national income or increase poverty and socio-economic inequalities. At the same time, many studies suggest negative effects of programs on health-care expenditures and health outcomes. [Kentikelenis et al. \(2015\)](#), [Stuckler and Basu \(2009\)](#) and [Stuckler et al. \(2010\)](#), among others, find evidence indicating that, at least in richer developing countries, Fund programs are associated with significant health-spending cuts, a factor that can lead to suicides through decreased health services. [Graybill \(2013\)](#) finds a positive association between compliance with IMF conditions and infant mortality for a group of 36 developing countries during 1980–2010. [Shandra et al. \(2010\)](#), using data from 65 countries for 1980–2003, present evidence supporting the hypothesis that IMF-type of structural adjustments are associated with increased maternal mortality. [Stuckler et al. \(2008\)](#) find a

positive relationship between tuberculosis-mortality rates and IMF-loan agreements in 21 countries, with their estimates suggesting that each extra year of remaining under a program can lead to up to four-percent increase in tuberculosis incidents.

These findings open up the possibility of effects of IMF programs on suicides. To what extent, then, is there a causal relationship between programs and suicide rates in participating countries? And to what extent the conditionality effect of programs on suicides can be offset by the resource effect? In an attempt to separate the resource effect of programs from the conditionality effect, in our empirical analysis we use two IMF variables as potential influences on suicides. The first is a program-participation dummy reflecting the presence of a program. This takes the value of 1 if a country has been exposed to an active program for at least 5 months in any given year. The second is a loan-size variable, measured as loan-amount disbursed per year as a share of GDP. The loan-size variable can be taken to capture the resource effect of programs. On the other hand, once the resource effect on suicides through loan size has been accounted for, the program-participation variable can be taken to reflect the conditionality effect of programs.

3. Methods and data

We proceed to test for a causal relationship between suicide-mortality rates and IMF-programs by applying a two-step approach. In a first step, we use a larger sample of 120 transition and developing countries that were or were not under a program during 1991–2008 in order to predict program-participation and loan-size (see Appendix A for the countries included). Then, we estimate a suicide model for a smaller sub-sample consisting of 30 countries under programs, using predicted values from the first stage to instrument the actual IMF variables. This is necessary to avoid the possibility of selection bias. Selection bias may arise from the fact that the decision to participate in an IMF-program is not random, as countries usually seek IMF assistance when they face economic difficulties. These economic difficulties forcing countries to enter Fund programs may have an independent, unaccounted for, effect on suicides, in which case including actual IMF-related variables in a model can produce biased estimates of program impacts. Due to data unavailability for the suicide and the other control variables, the second-step sample is restricted to 30 countries.

3.1. IMF-lending determinants

To predict program-participation and loan-size we use pooled-probit and pooled-tobit models. Since program participation is a binary-choice variable, a pooled-probit regression is required. For loan-size we use a pooled-tobit model to take account of the censoring of the dependent variable at zero. Explanatory variables in the program-participation and loan-size determination models are standard, consisting of a set of political, institutional and macroeconomic factors commonly used in the existing IMF-literature (Barro and Lee, 2005; Dreher, 2006; Moser and Sturm, 2011; Dreher and Sturm, 2012). These variables include: (i) IMF quotas; (ii) political and economic proximity to the US, measured, respectively, by the degree of voting similarity with the US at the UN General Assembly and the volume of bilateral trade with the US (% of GDP); (iii) domestic regime type, proxied by a freedom-of-speech indicator or a civil-rights-suppression index; (iv) political stability, measured by a regime-durability index; (v) the external-value of a country's currency vis-a-vis the US\$ as a proxy for competitiveness; (vi) liquidity needs, measured by domestic credit to private sector (% of GDP); (vii) the fiscal-policy stance, proxied by

government consumption (% of GDP); and (viii) per-capita real GDP. Appendix B provides data-sources and variable-definitions.

We focus on IMF facilities that are non-concessionary, not covering very low-income countries, and involving a lot of conditionality, namely programs under the SBA (Stand-By-Arrangement) and EFF (Extended-Fund) facilities. Fig. 1 shows, for the sample of the 120 countries considered in this first-stage, the percentage distribution of SBAs and EFFs that were in effect for at least five months in a given year during 1991–2008. Programs exhibit variability across years, with the percentage of countries under programs increasing from 13.33 in 1991 to 25.83 in 1996 and then falling again after 2001. The figure also shows loan-amounts disbursed by year, again indicating considerable variability during 1991–2008. Overall, there were a total of 202 programs during 1991–2008 (164 SBAs and 38 EFFs) for this country-sample.

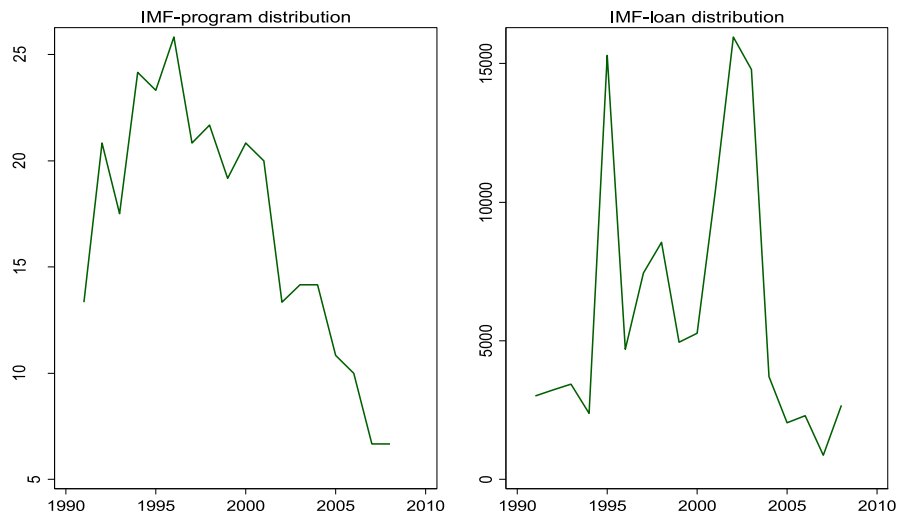
Estimation results from the program-participation and loan-size determination models are presented in Table 1. To avoid potential simultaneity bias, all factors considered as potential determinants of program-participation and loan-size are lagged 1-year. Time dummies are included to account for common effects across countries resulting from external factors, including changes in global macroeconomic conditions. In the final specification appearing in Table 1, only determinants that are significant at least at the 10 percent level are included and the coefficients on all explanatory variables carry the expected sign.

3.2. Modeling the relationship between suicide and IMF lending

In the second-step we use predicted values based on the probit/tobit models from Table 1 in order to test for a relationship between suicide mortality and IMF programs, using the restricted sample of 30 countries under programs (Albania; Armenia; Azerbaijan; Belarus; Bulgaria; Costa Rica; Croatia; Czech Republic; Egypt; Arab Rep.; Estonia; Georgia; Guatemala; Hungary; Kazakhstan; Kyrgyz Republic; Latvia; Lithuania; Macedonia, FYR; Mexico; Moldova; Panama; Peru; Poland; Romania; Russian Federation; Slovak Republic; Tajikistan; Turkey; Ukraine; Uruguay). We employ the following model, which is estimated using both total and disaggregated suicide-mortality data by sex and age-groups:

$$s_{it} = z'_{it}\delta_k + x'_{it}\beta_k + ns_{it-1} + \gamma_t + \alpha_i + u_{it} \quad (1)$$

The subscripts i and t denote, respectively, country and time, the δ_k 's and β_k 's are vectors of parameters to be estimated, γ_t is a set of year dummies, α_i reflects time-invariant country-specific characteristics and u_{it} is an error term. s_{it} is the suicide rate, measured as the number of suicide deaths per 100,000 population, while the lagged dependent variable, s_{it-1} , is included to capture cumulative effects on suicidal behaviour, as individuals may respond with some delay to changes in socio-economic conditions. z'_{it} is the vector of the two IMF-related variables, based on their predicted values. Further, x'_{it} is a vector of control factors, consisting of a set of socio-economic variables, commonly used in the literature to explain suicidal behaviour (Durkheim, 1951; Neumayer, 2003; Navarro, 2009; Van Orden et al., 2010; Milner et al., 2012). Thus, the probability of suicidal behaviour can be expected to be inversely related to per-capita economic growth, as a higher growth rate is likely to be associated with better occupational or financial prospects. In contrast, higher unemployment can be expected to increase suicides by lowering expected life-time income. A higher divorce rate or a lower fertility rate may further increase suicide risk through reduced family ties, by contributing to social isolation, while educational attainment can be seen as a proxy for human capital, and, as such, it can be connected to expectations of higher future earnings or reduced income inequality and poverty, thus



Notes: IMF-program distribution: percentage of countries in the sample with an IMF program (SBA or EFF) in effect for at least five months in a certain year. IMF-loan distribution: sum of the amounts disbursed in millions of SDRs. Both graphs are based on the 120 country-sample.

Fig. 1. The distribution of IMF programs and loans, 1991–2008.

Table 1

Probit and Tobit regressions for IMF program-participation and loan-size.

IMF program-participation (probit regression)		IMF loan-size (% GDP) (tobit regression)	
UN voting in line with USA, logarithm	0.801*** (7.65)	UN voting in line with USA, logarithm	3.021** (1.99)
IMF quota share, logarithm	0.200*** (6.80)	IMF quota share, logarithm	1.072*** (2.72)
Freedom of Speech, index	0.138** (2.15)	Real GDP per capita	-0.0004* (-1.88)
Domestic credit to private sector (% of GDP)	-0.008*** (-4.82)	Civil-liberties-suppression, index	-0.384* (-1.86)
Exchange rate, ratio	-0.397*** (-3.26)	Regime-durability, index	-0.049* (-1.70)
Bilateral trade with the USA, logarithm	0.104*** (3.00)	Government consumption expenditure (% GDP)	0.064*** (3.18)
R ² - pseudo	0.16	R ² - pseudo	0.08
Number of Countries	120	Number of Countries	120
Observations	1786	Observations	1940

Notes: All explanatory variables are expressed in their first lag. Numbers in parentheses denote z-scores and t-statistics for the probit and the tobit regression respectively. Single, double, and triple asterisks denote statistical significance at the ten percent, five percent, and one percent level respectively. Both models allow for robust standard errors. Time dummies are included.

lowering suicide risk.

Expected signs for the IMF variables follow from the channels, discussed in Section 2, through which programs can be expected to exert an impact on suicides, holding all other factors constant. To the extent that loan-size measures the extra liquidity provided, it can be taken to capture the resource effect of IMF lending. And, once the resource effect of IMF lending through loan-size has been accounted for, the program-participation variable can be taken to reflect IMF-conditionality effects. Accordingly, when both loan-size and program-participation are included in the set of regressors, we can expect a non-positive coefficient for the loan-size variable, reflecting impacts from the resources involved, and a non-negative coefficient for the program-participation variable, reflecting impacts connected to the terms and conditions of IMF lending. On the other hand, we expect to find differences in the impact of programs on suicides between genders and across age groups. With respect to gender, the effect can be expected to be stronger for males than females for at least two reasons. First, program-induced abrupt loss

of socio-economic status is likely to be more detrimental for men than for women, given that socio-economic position is a particularly significant element of self-respect for men (Stack, 2000; Chen et al., 2012). Second, program-induced policies that lead to worsened employment position, increased financial insecurity and greater fear of job loss can be expected to produce more psychological pressure on men than on women, to the extent that men are on average the primary household-income providers (Navarro, 2009; Van Orden et al., 2010). At the same time, given the channels through which a country's participation in an IMF program is likely to affect suicidal behaviour, we can expect the program-participation variable to have a larger impact on suicides among age groups that have strong ties with the economy, namely individuals aged 25–44 and 45–64. Nevertheless, older-age groups may also be adversely affected, to the extent that programs often involve spending cuts in traditional social-welfare areas, such as health-care and pensions, which can be expected to be particularly harmful for the fraction of the population over 65 years

(Antonakakis and Collins, 2014, 2015).

Data on reported suicide deaths by country, year, sex and age group are obtained from the *WHO Mortality Database*, while population data are obtained from the UN database. Figs. 2–3 show the evolution of suicide rates from 1991 to 2008 by gender and age group for the group of the 30 countries considered in the second stage. Male suicide rates in our sample are on average about 4 times higher than female suicide rates, which is in line with the typical observation in the sociological literature of suicide that males are behaviorally more prone to suicide than females (Chang et al., 2009). Suicide rates in our sample are also in general lower among younger individuals, in line with the theoretical predictions of Durkheim (1951) and the subsequent literature. Age groups of 45–64 and 65–89 year-old show the highest suicide-mortality rates, for both men and women. On the other hand, suicides in Figs. 2–3 show a downward trend for both men and women, consistent with the existing pattern worldwide (Kim et al., 2010), while the notable rise in suicides during 1991–1993 coincides with an increase in the number of countries with IMF programs (Fig. 1).

The statistical properties of the variables in the suicide model, including descriptive statistics for total, male and female suicide rates by age group for our 30 countries, are reported in Tables 2 and 3. Detailed data-sources and variable-definitions are reported in Appendix B.

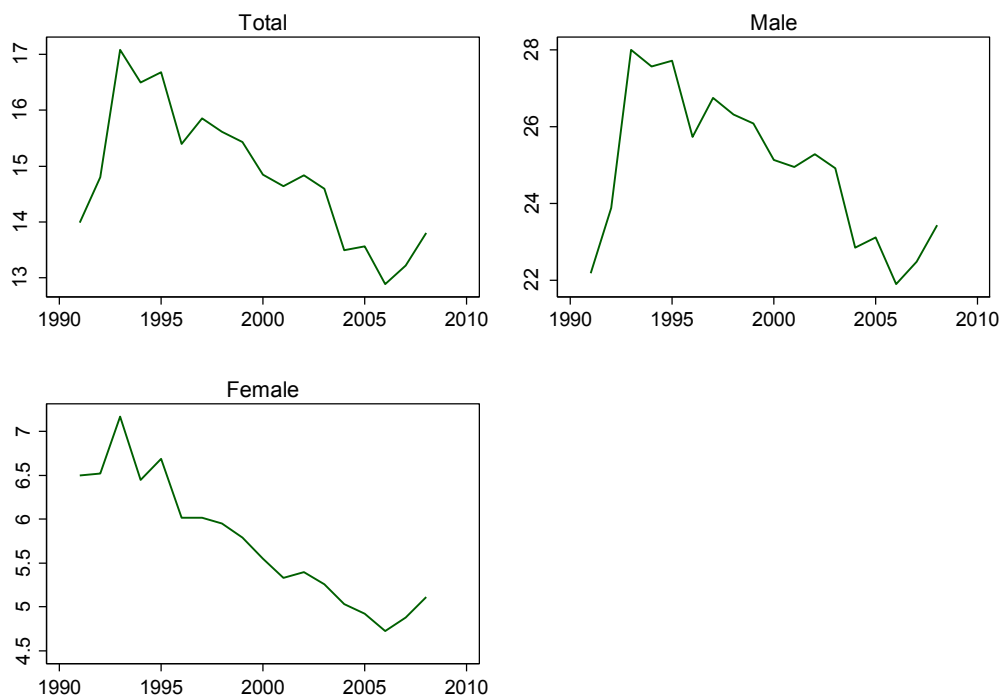
4. Results

Equation (1) has been estimated by applying the Arellano and Bond (1991) generalized-method-of-moments technique (GMM). Actual estimation is based on a difference-transformation that eliminates the unobserved individual-country characteristics, while regressors that are considered not to be strictly exogenous are instrumented by their lags. The statistical adequacy of the model is established when the generated residuals do not exhibit

second-order autocorrelation, a property checked by the m_2 statistic, and when the over-identifying restrictions are not rejected, a condition checked by applying the Sargan test. For potentially endogenous variables, valid lags in the transformed-difference equation (i.e. not correlated with the current error term), are lags 2 or more. Since a large number of instruments can over fit endogenous variables and bias the coefficient estimates, we use only lags 2–4 to keep the number of instruments manageable. On the other hand, given that we deal with an unbalanced panel with gaps, we resort to using a forward orthogonal transformation instead of first-differencing (see e.g. Arellano and Bover, 1995). By this transformation, instead of the previous observation, the average of all available future observations is subtracted from the current value of a variable. This transformation can therefore be computed even in the presence of gaps in a panel, thus minimizing data loss, while lagged observations of a variable are valid as instruments since they do not enter the transformation formula. GMM further deals with the presence of a lagged dependent variable among the regressors, which can produce dynamic-panel bias in fixed-effects ordinary-least-squares estimation. This can inflate the coefficient of the lagged-dependent variable by attributing to it predictive power that actually belongs to the fixed-effects (see e.g. Roodman, 2009).

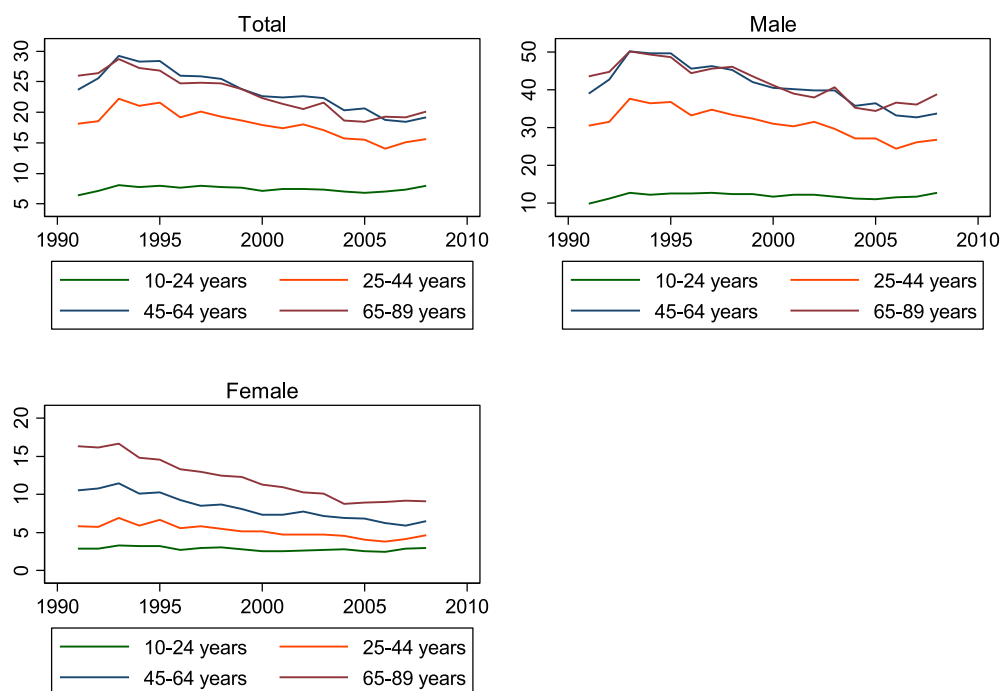
Results are reported in Tables 4–7. All regressions satisfy the insignificance of second-order autocorrelation in the residuals, while the Sargan test of over-identifying restrictions suggests that the model is well specified. At the same time, the lagged dependent variable is highly significant throughout the tables, indicating slow adjustment of suicidal behaviour to changes in the socio-economic environment. The signs of the control variables are also, in most cases, in accordance with our priors.

The estimates in Table 4 for total and gender suicide suggest that participation in IMF programs has systematic suicide-increasing effects, even after controlling for standard social-economic



Notes: Numbers denote averages per 100,000 population for the sample covering 30 countries from 1991 to 2008.

Fig. 2. The evolution of suicide rates, 1991–2008.



Notes: Numbers denote averages per 100,000 population for the sample covering 30 countries from 1991 to 2008.

Fig. 3. Suicide rates by age group, 1991–2008.

Table 2

Statistical properties of variables in the suicide model.

Variable	Obs.	Mean	Std. Dev.	Min	Max
Suicide rate (per 100,000 population), total	493	14.88	12.39	0.04	47.78
Suicide rate (per 100,000 population), male	493	24.96	21.65	0.06	83.68
Suicide rate (per 100,000 population), female	493	5.74	4.59	0.02	20.63
Real GDP per capita, growth rate	499	3.03	7.31	−31.18	33.03
Unemployment rate	540	10.60	6.32	1.30	37.30
Total fertility rate (births per woman)	540	2.11	0.92	1.09	5.53
Divorce rate (per 1000 population)	511	1.82	1.28	0.06	5.87
School enrollment, tertiary	467	36.16	16.60	8.20	80.40
IMF program-participation, predicted	455	0.31	0.15	0.00	0.78
IMF loan-size, predicted	480	0.49	0.43	0.00	2.54

Notes: Variables correspond to the sample covering 30 countries from 1991 to 2008.

Table 3

Suicide rates by gender and age-group.

Gender	Age group	Obs.	Mean	Std. Dev.	Min	Max
Total	10–24 years	485	7.44	5.84	0.06	24.22
	25–44 years	485	18.08	15.38	0.06	61.67
	45–64 years	485	23.55	19.76	0.02	87.57
	65–89 years	484	23.03	17.20	0.00	79.81
Male	10–24 years	485	11.89	9.88	0.05	41.09
	25–44 years	485	31.20	27.40	0.10	111.61
	45–64 years	485	41.38	36.35	0.04	159.79
	65–89 years	484	42.05	31.95	0.00	123.19
Female	10–24 years	485	2.85	2.00	0.00	12.29
	25–44 years	485	5.21	3.93	0.00	17.90
	45–64 years	485	8.29	6.82	0.00	29.25
	65–89 years	484	12.02	10.24	0.00	53.59

Notes: Suicide rates per 100,000 population correspond to the sample covering 30 countries from 1991 to 2008.

variables. In columns (i) and (iii), where only the IMF participation variable has been included, the corresponding coefficient is

significantly positive for both total and male suicide. In column (v), although the estimates suggest a gender difference in terms of magnitude, in line with our priors, i.e. females are less prone compared to males to suicide due to IMF programs, the program-participation variable is still positive at 10 percent level of significance. Including the loan-size variable in columns (ii), (iv), (vi) does not alter this result. The loan-size variable enters with a negative coefficient, reflecting the resource element of IMF programs, which, by removing the probability of an economic or financial crisis, enables participating countries to move ahead. This makes their populations more optimistic, reducing suicides. However, the insignificance of this coefficient at conventional levels throughout [Table 4](#) suggests only weak suicide-reducing effects from the extra resources involved, with the impact on suicides of the program-participation variable remaining positive and statistically significant. Indeed, the program-participation coefficient is highly significant in the case of total and male suicide in columns (ii) and (iv), and it retains its significance at 10 percent for female suicide in column (vi). This suggests adverse side-effects of IMF-lending agreements through conditionality, via the channels discussed in

Table 4
Suicide rates and IMF lending. GMM estimation results.

Regressor	Both Sexes		Males		Females	
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Suicide rate, lagged	0.657*** (15.91)	0.670*** (17.22)	0.656*** (15.80)	0.662*** (16.21)	0.550*** (8.93)	0.559*** (9.19)
Real GDP per capita, growth rate	-0.040** (-2.29)	-0.044** (-2.27)	-0.070** (-2.17)	-0.075** (-2.06)	-0.009 (-1.00)	-0.010 (-1.10)
Unemployment rate	0.117** (2.39)	0.095** (2.26)	0.167** (2.07)	0.148** (2.06)	0.069*** (3.15)	0.057*** (2.99)
Total fertility rate	-2.263*** (-3.02)	-2.277** (-2.56)	-4.277*** (-3.39)	-4.296*** (-2.99)	-0.813 (-1.23)	-0.927 (-1.26)
Divorce rate	0.737** (2.20)	0.769*** (2.64)	1.391** (2.22)	1.575*** (2.81)	0.231 (1.42)	0.185 (1.21)
School enrollment, tertiary	-0.035** (-2.24)	-0.032* (-1.90)	-0.061** (-2.09)	-0.058* (-1.82)	-0.016* (-1.91)	-0.016* (-1.83)
IMF program-participation, predicted	4.118*** (2.62)	4.381*** (2.88)	7.556** (2.46)	8.041*** (2.71)	1.223* (1.74)	1.523* (1.74)
IMF loan-size, predicted		-0.398 (-0.66)		-0.703 (-0.62)		-0.221 (-0.82)
Observations	286	286	286	286	286	286
m_1 [p-value]	-3.34 [0.00]	-3.38 [0.00]	-3.25 [0.00]	-3.29 [0.00]	-3.06 [0.00]	-3.02 [0.00]
m_2 [p-value]	1.88 [0.06]	1.90 [0.05]	1.61 [0.10]	1.60 [0.10]	-0.74 [0.45]	-0.74 [0.45]
Sargan [p-value]	238.39 [0.37]	268.26 [0.28]	239.98 [0.34]	267.50 [0.29]	259.46 [0.10]	280.27 [0.14]

Notes: Numbers in parentheses denote z-scores, m_1 and m_2 are residual first and second order serial correlation tests, while Sargan stands for the over-identifying restrictions test. Single, double, and triple asterisks denote statistical significance at the ten percent, five percent, and one percent level respectively. All models allow for robust standard errors. Time dummies are included in all specifications. The instruments used in each model correspond to the t-2 to t-4 lags of the right-hand side variables.

Table 5
Total suicide rates and IMF lending by age group. GMM estimation results.

Regressor	10–24 years	25–44 years	45–64 years	65–89 years
	(i)	(ii)	(iii)	(iv)
Suicide rate, lagged	0.369*** (4.40)	0.579*** (9.17)	0.616*** (14.99)	0.500*** (5.31)
Real GDP per capita, growth rate	-0.019 (-0.96)	-0.043 (-1.45)	-0.110*** (-2.94)	0.006 (0.16)
Unemployment rate	0.041* (1.82)	0.158** (2.37)	0.246** (2.17)	0.148*** (3.38)
Total fertility rate	-0.598 (-0.46)	-2.723** (-2.08)	-4.933*** (-3.22)	-5.961*** (-2.77)
Divorce rate	0.400 (1.62)	1.131** (2.45)	2.055*** (3.48)	0.896* (1.65)
School enrollment, tertiary	-0.032 (-1.65)	-0.088** (-2.53)	-0.078* (-1.78)	-0.015 (-0.42)
IMF program-participation, predicted	0.192 (0.16)	7.409*** (2.92)	11.186*** (3.47)	0.641 (0.24)
IMF loan-size, predicted	-0.365 (-0.60)	-0.522 (-0.51)	-1.138 (-1.16)	0.096 (0.09)
Observations	284	284	284	281
m_1 [p-value]	-3.01 [0.00]	-3.32 [0.00]	-2.90 [0.00]	-3.29 [0.00]
m_2 [p-value]	1.70 [0.08]	1.36 [0.17]	1.29 [0.19]	0.94 [0.34]
Sargan [p-value]	272.98 [0.19]	278.76 [0.13]	274.83 [0.17]	274.39 [0.18]

Notes: see Table 4.

Section 2. Given the coefficient estimate of the program-participation variable in column (ii), it follows that an increase in the probability of being exposed to a Fund program by one-standard deviation, which from Table 2 equals 0.15, leads, holding everything else constant, to 0.66 ($=0.15 \times 4.381$) additional suicide-deaths per 100,000 population per year. Dividing by the sample's mean of 14.88 from Table 2, this implies a rise in the yearly total suicide-mortality rate by 4.44%. In column (iv), given the program-participation coefficient, the corresponding effect for males is 1.21 ($=0.15 \times 8.041$) additional male-suicide deaths per 100,000 population per year, or, dividing by the sample's mean from Table 2, a rise of 4.85% in the yearly male-suicide rate. In column (vi), given the program-participation coefficient, the effect for females is 0.23 ($=0.15 \times 1.523$) additional female-deaths per 100,000 population per year, or, dividing by the sample's mean

from Table 2, a rise of 4.01% in the yearly female suicide-mortality rate. The long-run impact of an increase in the program-participation probability by one standard deviation ($=0.15$) is larger. From columns (ii), (iv) and (vi), setting $S_{it} = S_{it-1}$ and dividing the program-participation coefficient by one minus the coefficient of the lagged dependent variable, this long-run effect amounts to a positive suicide-mortality rate differential for countries under programs of 13.37% for overall suicides, of 14.30% for male suicides, and of 9.06% for female suicides, which corresponds, respectively, to 1.99, 3.57, and 0.52 additional suicides per 100,000 population. As in our sample the mean total population is 21.40 million while the mean male and female population is 10.32 and 11.08 millions respectively, these long-run effects translate into 425 more suicide-deaths due to IMF-program participation, of which 368 are among males and 57 among females.

Table 6
Male suicide rates and IMF lending by age group. GMM estimation results.

Regressor	10–24 years	25–44 years	45–64 years	65–89 years
	(i)	(ii)	(iii)	(iv)
Suicide rate, lagged	0.304*** (3.88)	0.543*** (7.29)	0.640*** (16.44)	0.331*** (4.58)
Real GDP per capita, growth rate	–0.004 (–0.14)	–0.081 (–1.43)	–0.192** (–2.56)	0.011 (0.13)
Unemployment rate	0.060* (1.81)	0.276** (2.25)	0.454** (2.07)	0.255** (2.25)
Total fertility rate	–1.705 (–0.91)	–5.901** (–2.43)	–8.300*** (–2.88)	–12.392*** (–3.67)
Divorce rate	0.891** (2.28)	2.402*** (2.77)	4.015*** (3.13)	1.793* (1.74)
School enrollment, tertiary	–0.048 (–1.60)	–0.166** (–2.37)	–0.138* (–1.68)	–0.088 (–1.20)
IMF program-participation, predicted	0.738 (0.35)	14.949*** (3.05)	17.627*** (3.07)	2.492 (0.39)
IMF loan-size, predicted	–0.700 (–0.69)	–1.031 (–0.55)	–1.445 (–0.79)	–0.404 (–0.18)
Observations	284	284	284	281
m_1 [p-value]	–2.93 [0.00]	–3.03 [0.00]	–2.86 [0.00]	–3.71 [0.00]
m_2 [p-value]	1.76 [0.07]	0.57 [0.57]	1.33 [0.18]	–0.85 [0.39]
Sargan [p-value]	272.98 [0.19]	278.83 [0.13]	274.71 [0.17]	271.24 [0.21]

Notes: see Table 4.

Table 7
Female suicide rates and IMF lending by age group. GMM estimation results.

Regressor	10–24 years	25–44 years	45–64 years	65–89 years
	(i)	(ii)	(iii)	(iv)
Suicide rate, lagged	0.254*** (3.46)	0.446*** (7.28)	0.291*** (5.19)	0.428*** (3.82)
Real GDP per capita, growth rate	–0.024* (–1.78)	0.007 (0.69)	–0.037** (–2.00)	0.001 (0.03)
Unemployment rate	0.033 (1.52)	0.082*** (2.97)	0.122** (2.54)	0.116** (2.13)
Total fertility rate	0.546 (0.56)	–0.158 (–0.21)	–3.524*** (–3.38)	–4.870** (–2.53)
Divorce rate	–0.009 (–0.05)	0.193 (0.77)	0.802*** (2.63)	0.953* (1.88)
School enrollment, tertiary	–0.023 (–1.61)	–0.038*** (–3.34)	–0.040*** (–2.90)	–0.011 (–0.27)
IMF program-participation, predicted	–1.119 (–1.38)	1.074 (1.01)	6.264*** (3.42)	1.988 (1.03)
IMF loan-size, predicted	0.050 (0.15)	–0.236 (–0.68)	–0.822 (–1.30)	–0.018 (–0.02)
Observations	284	284	284	281
m_1 [p-value]	–3.25 [0.00]	–3.68 [0.00]	–3.78 [0.00]	–3.23 [0.00]
m_2 [p-value]	–0.80 [0.42]	–0.79 [0.43]	–1.56 [0.11]	0.63 [0.52]
Sargan [p-value]	280.44 [0.12]	274.33 [0.18]	278.84 [0.13]	280.26 [0.12]

Notes: see Table 4.

To what extent are there differences in the impact of IMF programs on suicides across age groups? And to what extent do these differences also apply to genders? Tables 5–7 suggest age-specific differences in the impact of IMF programs on suicidal behaviour. Starting from total suicide rates in Table 5, both program participation and loan size play no statistically significant role in suicides among young-people up to 24-year old, although the corresponding coefficient estimates have the expected signs (column (i)). One plausible explanation is that IMF-induced structural reforms are unlikely to produce strong adverse side-effects for younger groups, as young individuals are in general more flexible than older-age groups and have better chances to emigrate or to earn income from multiple sources (Antonakakis and Collins, 2014). For the 65–89-year-old group in column (iv), again the program-participation variable is statistically insignificant at conventional levels, although it enters with a positive sign, which can be taken to

reflect program-induced psychological strain due to, for example, unavailability of appropriate health services or cuts in pensions. Loan-size is also statistically insignificant. For this age group, factors other than IMF-lending programs appear to play a more important role. Indeed, variables associated with loneliness, like a lower fertility rate and a higher divorce rate, have significantly positive signs, in line with the existing empirical literature on suicides (Shah et al., 2007), while the statistical significance of the unemployment variable could be interpreted as reflecting distress among old-age persons when they see their children with no jobs, independently of the reasons for it.

On the other hand, for age groups 25–44 and 45–64, while the loan-size coefficient continues to be negative, the program-participation variable is positive and highly significant, confirming our priors that, through conditionality, any adverse side-effects of IMF lending will tend to be more pronounced among age groups

that have the strongest links with the economy. For these two age groups, the coefficient estimates in columns (ii) and (iii) of [Table 5](#) imply that an increase in the probability of program exposure by one standard deviation ($= 0.15$) leads, respectively, in the long run to 2.64 and 4.37 more suicide-deaths per 100,000 population. Given the sample's mean-suicide-rate values in [Table 3](#), this translates into a rise in the long-run suicide-mortality rate by between 14.60% (25–44 year old) and 18.56% (45–64 year old).

The age-specificity of program-participation effects also applies to gender suicide. This is shown in [Tables 6 and 7](#), which report results for age-specific male and female suicide. As far as males are concerned, the results are very similar to those for total suicide. Program participation contributes significantly to the suicidality of males who have the strongest links with the economy, namely individuals 25–44 and 45–64 year-old. For both these groups, the program participation coefficient is large in size, attaining a value of 14.94 and 17.62 respectively, while all the other explanatory variables, except loan-size and per-capita GDP growth, are always significant and with the expected signs. In terms of magnitude, the coefficients estimates in [Table 6](#) suggest that an increase in the probability of program exposure by one standard deviation raises in the long run the 25–44 year-old male-suicide rate by 15.74% and the 45–64 year-old male-suicide rate by 17.74%. Suicides among males 65–89 year-old appear to be affected mainly by factors associated with social disintegration, namely higher overall unemployment, lower fertility and a higher divorce rate. IMF-program participation and loan-size enter, respectively, with a positive and negative coefficient in accordance with our priors, but their effect is statistically insignificant at conventional levels. For males aged 10–24 years, again the effects of programs are not statistically significant, with unemployment and divorces playing a more prominent role.

Turning to female suicide in [Table 7](#), the coefficient estimates for the 65–89 year-old group suggest no statistically significant suicide-increasing effect from program-participation. Like in the corresponding age-group for males, social-integration variables (fertility, divorce rate and unemployment) seem to play a more important role. In the case of females up to 24 year-old, none of the control variables considered, except per-capita GDP growth, is individually statistically significant at conventional levels. At the same time, unlike in the case of male suicide, none of the IMF variables has a significant explanatory role among 25–44 year-old females, with unemployment and educational attainment exerting a more pronounced impact. One plausible explanation for this gender-dissimilarity is that on average females become income-earners and establish links with the economy at a later stage in their lives than men. Indeed, the group that appears to be most adversely affected by IMF programs in [Table 7](#) is females between 45 and 64 year-old, where the program-participation variable is significant at 1% (column (iii)). For this age group, the suicide-increasing effect of program-participation is quite large. The coefficient estimates imply in this case that if the probability of program entry is increased by one-standard deviation ($=0.15$), there will be 1.33 additional female suicide-deaths per 100,000 population in the long run, or, using the sample's mean from [Table 3](#), a rise in the female suicide-mortality rate by 16.04%.

Overall, our results indicate that the impact of program participation is both gender- and age-specific. Male population between 25 and 64 year-old and females between 45 and 64 year-old incur the cost of the adverse side-effects of IMF-lending agreements. Concerning the magnitude of the impact, males and females belonging to the age group 45–64 appear to exhibit the highest suicide rate relative to the other age groups due to programs, whereas the impact on males is larger.

5. Robustness controls

As a sensitivity analysis, we have repeated the estimation of the suicide model using predicted values from first-stage probit and tobit regressions for total IMF-lending, namely both non-concessionary (SBAs & EEFs) and concessionary (Extended Credit Facility (ECF) & Structural Adjustment Facility (SAF)). It could be argued, however, that pooling concessionary and non-concessionary IMF programs is inappropriate. Concessionary programs also require structural-adjustment policies, but they differ significantly from non-concessionary programs in terms of their overall objective, types of countries addressed to, and financial conditions (e.g. concessionary IMF programs are often administered together with the World Bank, involve much lower interest rates and longer repayment periods, and are usually addressed to very-low-income countries). As a result, the factors making more likely the presence of a concessionary program may differ substantially from those making more likely the presence of non-concessionary programs. In such a case, pooling together these two types of IMF facilities in first-stage program-participation and loan-size determination models could lead to insignificant coefficients with little predictive power. For this reason we do not report here results based on total IMF-lending programs, although the estimated coefficients for the two IMF variables are not very dissimilar to those reported in [Tables 4–7](#) (results are available upon request).

As a robustness control, we have also run suicide regressions using fixed-effects OLS estimation instead of GMM, despite the potential dynamic-panel bias that can arise in this case because of the possibility of correlation between the lagged-dependent variable and the fixed-effects. Again the results do not change qualitatively (results with fixed effects OLS are reported in [Appendix C](#)).

6. Concluding comments

IMF-lending programs have been heavily criticized over the years, both for failing to improve macroeconomic outcomes and for producing negative side-effects that worsen people's lives in participating countries. With respect to suicides, the sociology literature has long recognized that adverse economic conditions, particularly if accompanied by disturbances of social order, can affect a population's suicidality ([Stack, 2000](#); [Marmot and Wilkinson, 2006](#); [Van Orden et al., 2010](#)). Suicide rates can then be connected to participation of countries in IMF programs through the Fund's conditionality, to the extent that IMF agreements often require fast reforms, which, at least in the short run, are likely to result in abrupt changes in existing socio-economic structures and in wider socio-economic inequalities. In addition to their impact through fast structural reforms, IMF programs can also result in a higher rate of suicide-mortality indirectly, through weakened social-safety nets, to the extent that the constraints usually imposed on participating countries' fiscal policy often reduce the ability of governments to fund services that can mitigate some of the adverse social consequences of economic change. Indeed, recent evidence by [Antonakakis and Collins \(2015\)](#) based on Eurozone periphery dataset indicates a robust causal relationship between public-expenditure reductions and suicide deaths.

Using data on 30 transition & developing countries that received non-concessionary IMF loans during 1991–2008, our results confirm the hypothesis of an underlying positive association between suicide-mortality rates and countries' IMF-program participation. The effect is more pronounced among males. Comparing age groups, our results suggest that the suicide-increasing effect of program-participation is larger among middle-age groups. At the same time, the size of IMF loans is found to have only a weak

suicide-reducing effect, suggesting that this effect cannot offset the conditionality aspect of programs that tends to raise the probability of suicidal behaviour among participating countries' populations.

Overall, our results enhance the arguments, already appearing extensively in the literature on other aspects of social consequences of Fund programs, that social-safety nets need to be designed in participating countries to protect the unprivileged part of the population when countries are exposed to programs in an attempt to resolve their economic problems.

Acknowledgments

We are very grateful to three anonymous referees for their valuable comments on an earlier version of the paper.

Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.socscimed.2016.01.045>.

References

- Antonakakis, N., Collins, A., 2014. The impact of fiscal austerity on suicide: on the empirics of a modern Greek tragedy. *Soc. Sci. Med.* 112, 39–50.
- Antonakakis, N., Collins, A., 2015. The impact of fiscal austerity on suicide mortality: evidence across the 'Eurozone periphery'. *Soc. Sci. Med.* 145, 63–78.
- Arellano, M., Bond, S., 1991. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Rev. Econ. Stud.* 58, 277–297.
- Arellano, M., Bover, O., 1995. Another look at the instrumental variables estimation of error-components models. *J. Econ.* 68, 29–51.
- Barr, B., Taylor-Robinson, D., Scott-Samuel, A., McKee, M., Stuckler, D., 2012. Suicides associated with the 2008–10 economic recession in England: time-trend analysis. *Br. Med. J.* 345, 5142–5157.
- Barro, R., Lee, J., 2005. IMF programs: who is chosen and what are the effects? *J. Monetary Econ.* 52, 1245–1269.
- Chang, S.S., Gunnell, D., Sterne, J.A., Lu, T.H., Cheng, A.T., 2009. Was the economic crisis 1997–1998 responsible for rising suicide rates in east/southeast Asia? a time-trend analysis for Japan, Hong Kong, South Korea, Taiwan, Singapore and Thailand. *Soc. Sci. Med.* 68, 1322–1331.
- Chang, S.S., Stuckler, D., Yip, P., Gunnell, D., 2013. Impact of 2008 global economic crisis on suicide: time-trend study in 54 countries. *Br. Med. J.* 347, f5239.
- Chen, J., Choi, Y.J., Mori, K., Sawada, Y., Sugano, S., 2012. Socio-economic studies on suicide: a survey. *J. Econ. Surv.* 26, 271–306.
- Dreher, A., 2006. IMF and economic growth: the effects of programs, loans, and compliance with conditionality. *World Dev.* 34, 769–788.
- Dreher, A., Sturm, J.E., 2012. Do IMF and world bank influence voting in the UN General Assembly? *Public Choice* 151 (1), 363–397.
- Durkheim, E., 1951. *Suicide: A Study in Sociology*. Free Press, New York (translation from original: *Le suicide: etude de sociologie*, Paris, 1897).
- Economou, M., Madianos, M., Thelertis, C., Peppou, L.E., Stefanis, C., 2011. Increased suicidality amid economic crisis in Greece. *Lancet* 378 (9801), 1459.
- Garuda, G., 2000. The distributional effects of IMF programs: a cross-country analysis. *World Dev.* 28, 1031–1051.
- Graybill, L., 2013. Evaluating the Impact of the IMF's Programs on Infant Mortality. IRIS Working Paper No. 84. Northwestern University.
- Karanikolos, M., Mladovsky, P., Cylus, J., Thomson, S., Basu, S., Stuckler, D., et al., 2013. Financial crisis, austerity, and health in Europe. *Lancet* 381 (9874), 1323–1331.
- Kentikelenis, A., Karanikolos, M., Papanicolas, I., Basu, S., McKee, M., Stuckler, D., 2011. Health effects of financial crisis: omens of a Greek tragedy. *Lancet* 378 (9801), 1457–1458.
- Kentikelenis, A.E., Stubbs, T.H., King, L.P., 2015. Structural adjustment and public spending on health: evidence from IMF programs in low-income countries. *Soc. Sci. Med.* 126, 169–176.
- Kim, M.H., Jung-Choi, K., Jun, H.J., Kawachi, I., 2010. Socioeconomic inequalities in suicidal ideation, parasuicides, and completed suicides in South Korea. *Soc. Sci. Med.* 70, 1254–1261.
- Marmot, M., Wilkinson, R. (Eds.), 2006. *Social Determinants of Health*. Oxford University Press.
- Milner, A., McClure, R., De Leo, D., 2012. Socio-economic determinants of suicide: an ecological analysis of 35 countries. *Soc. Psychiatry Psychiatric Epidemiol.* 47, 19–27.
- Moser, C., Sturm, J.E., 2011. Explaining IMF lending decisions after the Cold War. *Rev. Int. Organ.* 6, 307–340.
- Navarro, V., 2009. What we mean by social determinants of health. *Int. J. Health Serv.* 39, 423–441.
- Neumayer, E., 2003. Are socioeconomic factors valid determinants of suicide? controlling for national cultures of suicide with fixed-effects estimation. *Cross-Cultural Res.* 37, 307–329.
- Nooruddin, I., Simmons, J.W., 2006. The politics of hard choices: IMF programs and government spending. *Int. Organ.* 60, 1001–1033.
- Roodman, D., 2009. How to do xtabond2: an introduction to difference and system GMM in Stata. *Stata J.* 9, 86–136.
- Shah, A., Bhat, R., McKenzie, S., Koen, C., 2007. Elderly suicide rates: cross-national comparisons and association with sex and elderly age-bands. *Medicine. Sci. Law* 47, 244–252.
- Shandra, J., Shandra, C., London, B., 2010. Debt, structural adjustment, and non-governmental organizations: a cross-national analysis of maternal mortality. *Am. Sociol. Assoc.* 16, 217–245.
- Stack, S., 2000. Suicide: a 15-year review of the sociology literature. *Suicide Life-Threatening Behav.* 30, 145–162.
- Stuckler, D., Basu, S., 2009. The International Monetary Fund's effects on global health: before and after the 2008 financial crisis. *Int. J. Health Serv.* 39, 771–781.
- Stuckler, D., Basu, S., Gilmore, A., Batniji, R., Ooms, G., Marphatia, A., McKee, M., 2010. An evaluation of the International Monetary Fund's claims about public health. *Int. J. Health Serv.* 40, 327–332.
- Stuckler, D., King, L.P., Basu, S., 2008. International Monetary Fund programs and tuberculosis outcomes in post-communist countries. *PLoS Med.* 5, 143–154.
- Van Orden, K.A., Witte, T.K., Cukrowicz, K.C., Braithwaite, S.R., Selby, E.A., Joiner Jr., T.E., 2010. The intertemporal theory of suicide. *Psychol. Rev.* 117, 575–627.
- Vreeland, J.R., 2002. The effect of IMF programs on labor. *World Dev.* 30 (1), 121–139.
- Weisbrot, M., Jorgensen, H., 2013. *Macroeconomic Policy Advice and the Article IV Consultations: A European Union Case Study*. CEPR Study No. 2013–03. Center for Economic and Policy Research.