

Original Research Article**Economic stress and the secondary sex ratio: Ireland, Iceland, Greece and Latvia.****Abstract****Introduction**

Male live births occur slightly in excess of female live births at a ratio of 0.515 (male/total births). Stress has been shown to reduce M/F, including stress engendered by contracting economies. This study was carried out in order to ascertain whether the economic depression caused by the Eurozone recession at the end of the previous decade influenced M/F in the European countries most heavily affected, namely Iceland, Ireland, Greece and Latvia.

Methods

Annual data on male and female live births were obtained directly from the World Health Organisation except for Latvia which was obtained from Eurostat. Quarterly data for Ireland was obtained from the Irish Central Statistics Office.

Results

There were no significant changes in M/F except in Ireland which showed a sharp and highly significant dip in 2007 due to a fall in M/F in the last quarter only ($p < 0.0001$).

Discussion

Darwinian evolution should encourage species to adapt to changing circumstances by altering the odds of having a child of a specific gender. Parents without stress and in good condition should produce sons since these are theoretically capable of producing more offspring, and vice-versa. The findings for Ireland support the contention that economic stress is also capable of depressing M/F.

27

28 **Introduction**

29 *The male:female ratio at birth*

30 Male births occur slightly in excess of female births and the ratio of live births is
 31 generally expressed as the ratio of male live births divided by total live births.
 32 Although this would be more accurately abbreviated as M/T (male births divided by
 33 total births), it is widely (albeit technically incorrectly) abbreviated as M/F, and this
 34 will be used throughout. M/F is expected to approximate 0.515, with 3% more males
 35 born than females.(1) The reasons for this discrepancy are multifactorial, and the
 36 relevant influence are legion.(1,2)

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38 In utero, the male fetus is more susceptible to morbidity and mortality from external
 39 influences than the female fetus, as well as being at higher risk for all obstetric
 40 complications.(3) Factors that typically reduce M/F due to spontaneous termination of
 41 pregnancy (while male losses outnumbering female losses) include toxins and stress.
 42 (4)

43

44 *Economic downturns*

45 Before the Great Depression in the 1930s, economists regarded the capitalist
 46 economic up-down cycle as an inevitable consequence of this financial system. Since
 47 then, recession and (even more so) depression have been feared. (5)

48

49 A country's economic growth is measured by changes in goods produced and services
 50 provided with time. It is conventionally cited as the annual percentage rate of

51 increase/decrease in real gross domestic product (GDP), which is adjusted for
52 inflation.

53

54 In economics, recession is defined as a business cycle contraction with a slowdown in
55 economic activity that produces negative GDP values for at least two consecutive
56 quarters. A depression is a sustained and severe recession that is accompanied by an
57 increase in unemployment levels, a decrease in the availability of credit and of all
58 economic activities in general, with large numbers of ensuing bankruptcies. (5)

59

60 The ongoing Eurozone crisis was triggered by a global economic recession. Several
61 European countries were heavily affected, with economic recession leading to
62 outright depression. (5) These were Iceland, (6) Ireland, (7)
63 Greece, (8) and Latvia. (9)

64

65 It has been proposed that M/F could serve as a surrogate health indicator, (10)
66 or as an indicator of contracting economies in that secular trends in M/F that
67 demonstrate a decline in the expected excess of male births may indicate adverse
68 population condition/s. This has been shown for the former East Germany after
69 reunification in 1991, when the region's economy collapsed, accompanied by a sharp
70 drop in M/F. (4)

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72 This study was carried out in order to ascertain whether M/F was affected by
73 economic circumstances in Iceland, Ireland and Greece. The null hypothesis was that
74 M/F remained unaffected by the financial downturn.

75

76 **Material and Methods**

77 Annual data on male and female live births were obtained directly from the World
78 Health Organisation (Health for All (HFA) database) for Iceland, Greece and Ireland.
79 Latvian data was obtained from the World Health Organisation Statistical Information
80 System (WHOSIS).

81

82 For Ireland, quarterly data was downloaded from the website of the Irish Central
83 Statistics Office, from the database section Births and Deaths Registered by Sex,
84 Statistical Indicator and Quarter (/StatBank/Births Deaths and Marriages/VSQ01).

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86 Annual GDP data for each country was downloaded as an Excel sheet from the
87 website of the World Bank.

88

89 Contingency tables were analysed for annual male and female live births using chi
90 squared and chi squared for trend. These were performed using the Bio-Med-Stat Excel
91 add-in for contingency tables. (11) 95% confidence intervals for ratios by obtained
92 using the quadratic equations of Fleiss equations. (12) $P < 0.05$ was taken as significant.

93

94 **Results**

95 There were no significant changes in M/F when this was compared with the periods
96 before and during depression years for all four countries studied (figure 1 and table 1).

97

98 Ireland exhibited a sharp dip in M/F in 2007 (table 2). This dip was highly significant
99 when compared with the previous (chi=17.2, $p<0.001$) and with the following years
100 (chi=15.7, $p<0.001$).

101

102 Inspection of quarterly data for Ireland country showed that this dip was caused by a
103 sharp fall in M/F in the final quarter of 2007 (figure 2). This dip was highly
104 significant when compared with the previous (chi=18.1, $p<0.001$) and with the
105 following quarters (chi=27.0, $p<0.001$).

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117 **Discussion**

118 The Trivers-Willard hypothesis suggests that Darwinian evolution should encourage
 119 species to adapt to changing circumstances by altering the odds of having a child of a
 120 specific gender. Parents in good condition who find themselves in a time of plenty
 121 should tend to produce sons as these have higher reproductive potential than
 122 daughters. Conversely, parents in poor condition during times of scarcity would be
 123 better off having daughters than sons as daughters are likelier to survive to
 124 reproductive age and do not have to compete to the levels that males face for mating
 125 rights. (13)

126

127 The Trivers-Willard hypothesis therefore suggests that under stress, M/F drops. This
 128 has been witnessed under different circumstances. For example, the stress engendered
 129 by the September 11 attacks on the Twin Towers in the United States in 2001 caused
 130 a drop in M/F in New York three months later which rapidly recovered. (14)

131 The events were also associated with an increase in premature births in the region.
 132 (15)

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134 These findings have led to the theory that population stress induced by a recession
 135 also reduces the human sex ratio. This was shown in East Germany when M/F fell
 136 sharply in 1991 after the region's economic collapse following Germany's
 137 reunification. (4)

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139 Overall, economic depression followed by recession failed to produce any significant
 140 long-term effects on M/F in Iceland, Ireland and Greece. The possibility of a type 2
 141 error cannot be excluded due to the relatively small number of births. Alternatively,

142 Ireland may have been harder hit than the other countries and hence only Ireland
143 would have exceeded the threshold for a significant M/F dip. Yet another possibility
144 is that M/F dips in the three other countries may have been short lived but quarterly or
145 monthly data was only available for Ireland.

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147 The onset of the economic downturn had a sharp and non-sustained effect on Irish
148 M/F in 2007. Prior to this time, the Irish economy was widely viewed as one of the
149 most successful models worldwide. Economic growth had commenced in the mid-
150 1990s to the early 2000s and was caused by catch-up expansion after years of lagging
151 behind Europe's other economies. Growth was fuelled by favourable demographics
152 which produced an increase not only in number of available workers but also ones
153 with a higher level of education. This instigated a second and more precarious growth
154 phase based on credit expansion and an increase in individual personal indebtedness
155 that caused property prices to soar to unsustainable levels, buoyed by unwise bank
156 lending. (16,17)

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158 The international financial crisis was precipitated on the 9th August 2007 when BNP
159 Paribas, one of the world's largest banks, acknowledged the impact of a looming poor
160 debt crisis by closing two funds. It was at this point that the world's financial services
161 tacitly acknowledged that tens of trillions of dollars of financial derivatives were of
162 dubious security, leading to a seizure in the global banking system. (18)

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164 Irish banks were not immune and were highly vulnerable and exposed. Property
165 prices fell and banks took huge losses. (16,17) The onset of the crisis was associated
166 with a drop in M/F in the fourth quarter of 2007 only. M/F recovered rapidly

167 thereafter and the phenomenon appears similar to that seen in the former East
 168 Germany when M/F fell sharply in 1991 following reunification, but recovered by the
 169 following year. (4)

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171 Stress of any nature appears capable of reducing M/F. Even relatively mundane
 172 events such as democratic parliamentary elections and other similar events may
 173 impinge on M/F.(19) The Irish data in this study further supports the hypothesis that
 174 economic recession reduces M/F.

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230 **Table 1: M/F, GDP% and chi tests for periods before and during depression**

231 **years for Iceland, Ireland, Greece and Latvia.**

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Iceland	2004-2008	2009-2010	
M	11446	5084	chi
F	10878	4850	0.02
T	22324	9934	p
UCI	0.5193	0.5217	0.88
M/F	0.5127	0.5118	
LCI	0.5061	0.5019	
Mean GDP%	5.4	-5.3	
Ireland	2004-2006	2007-2010	
M	131865.8	115670	chi
F	125738	110123	0.09
T	257603.8	225793	p
UCI	0.5138	0.5143	0.77
M/F	0.5119	0.5123	
LCI	0.5100	0.5102	
Mean GDP%	5.2	-3.2	
Greece	2004-2007	2008-2012	
M	225842	287441	chi
F	211326	270359	1.63
T	437168	557800	p
UCI	0.5181	0.5166	0.20
M/F	0.5166	0.5153	
LCI	0.5151	0.5140	

Mean GDP%	3.9	-4.4	
Latvia	2005-2007	2008-2010	
M	35019	33890	chi
F	33689	32332	0.59
T	68708	66222	p
UCI	0.5134	0.5156	0.44
M/F	0.5097	0.5118	
LCI	0.5059	0.5079	
Mean GDP%	10.9	-7.5	

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Table 2: M/F for Ireland, 2006-2008.

	2006	2007	2008
M	33085	35574	38593
F	31152	35046	36472
T	64237	70620	75065
UCI	0.5189	0.5074	0.5177
M/F	0.5150	0.5037	0.5141
LCI	0.5112	0.5000	0.5105

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Table 3: Quarterly M/F for Ireland, late 2007-early 2008.

	2007Q3	2007Q4	2008Q1
M	9462	8515	9857
F	9092	8951	9297
T	18554	17466	19154
UCI	0.5172	0.4950	0.5217
M/F	0.5100	0.4875	0.5146
LCI	0.5027	0.4801	0.5075

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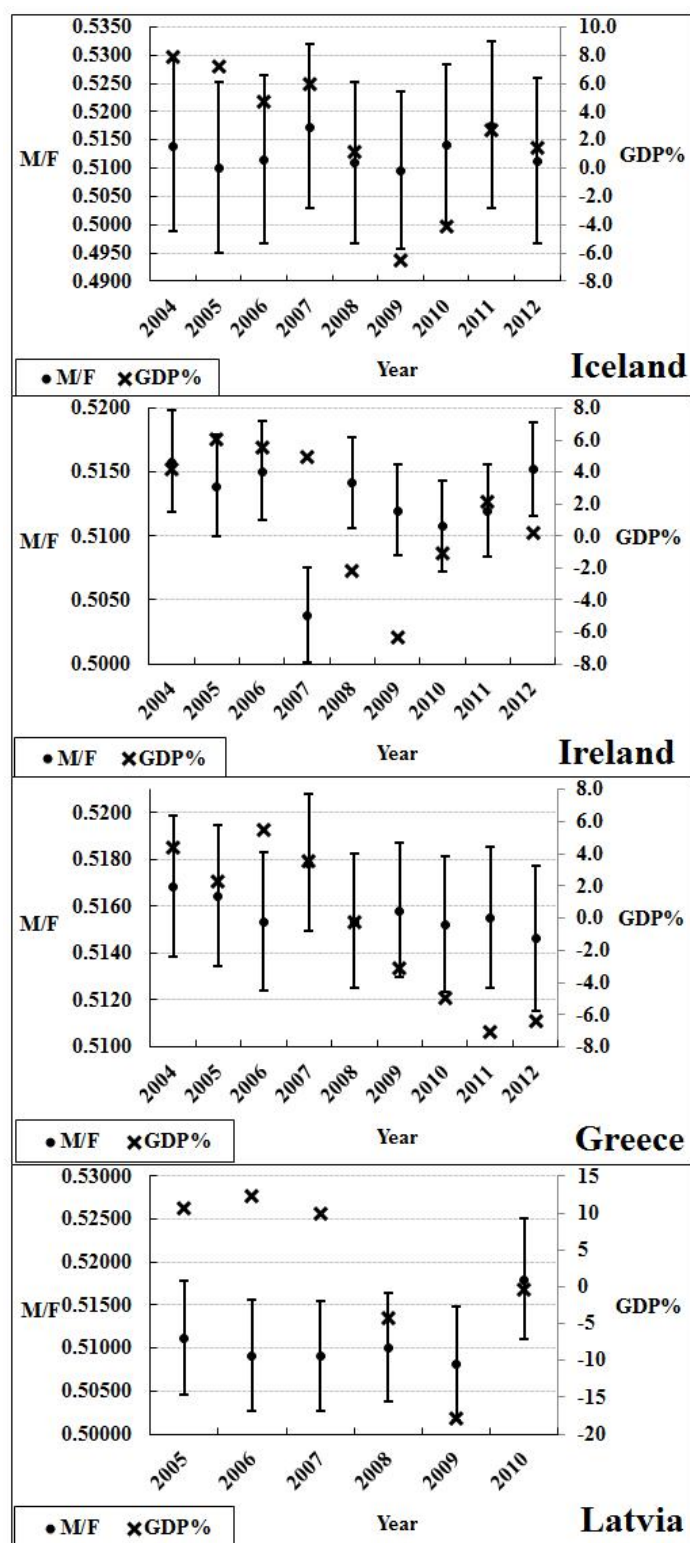
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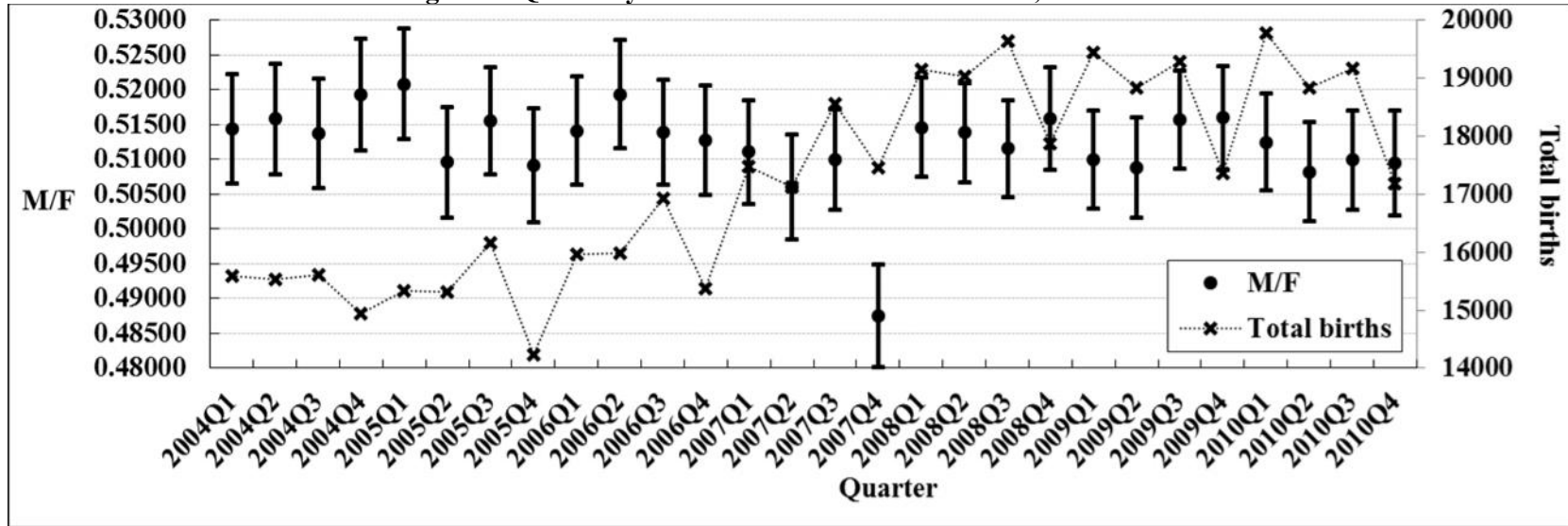
245 **Figure 1: M/F and GDP% for periods before and during depression years for**
 246 **Iceland, Ireland, Greece and Latvia.**
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Figure 2: Quarterly M/F and total births for Ireland, 2004-2010.



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