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RESEARCH PAPER

Happy PIIGS?

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Abstract This paper investigates the causality dynamics between happiness and per capita GDP growth and the impact of the recent financial crisis using a VAR–GARCH model for 10 European EMU countries divided in peripheral and non-peripheral members. The rationale of the analysis is to look at the two different dimensions (mean and variance) of economic growth and happiness within a time-series framework. The results show that GDP growth has significant positive effects on happiness in all countries considered, particularly in the PIIGS countries; happiness volatility is responsive to economic uncertainty. The size of this effect is bigger following the most recent crisis period, especially for the PIIGS countries. Our findings confirm the important role played by economic growth in determining population happiness and, most importantly, provides new evidence on the existence of causality linkages between economic uncertainty and happiness volatility.

Keywords GARCH model · GDP growth · Happiness · Volatility

1 Introduction

Economic theory has often used national income as a measure for welfare. It is widely argued that economic growth should lead to happiness and governments should therefore be targeting GDP growth in order to reach higher levels of happiness for their populations.

Interest in life satisfaction, its determinants and to what extent it is affected by economic variables can be traced back in time (Malthus 1798; Hirsch 1976). The debate remained confined within the realm of economic thought until more recently when data on

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happiness became consistently available. Such data allow economists to investigate how macroeconomic variables affect life satisfaction and happiness. New and more sophisticated measures of individual happiness have been produced at micro and macro level. Consequently, economic research on happiness has grown exponentially.

The issue of population happiness has become progressively more important, partly due to the recent economic crisis that has led to a decline in social well-being, undermining political and social stability and generating economic uncertainty. Furthermore, due to the crisis, the Eurozone has been split into core and peripheral countries that reveal different sensitivities of happiness to macro fundamentals.

Starting from these considerations, this paper investigates, at a macro level, the bidirectional causality dynamics between happiness and per capita GDP growth, focusing on the influence of the recent financial and economic crisis. Although the impact of the financial crisis on income has been widely discussed, its impact on well-being is less well known. We analyse the different effects for countries that have recently gone through economic stability pressure and for those that have not. Finally, we look at the link between GDP volatility and happiness volatility. GDP volatility can be seen as a measure of uncertainty. Huxley et al. (2013) discussed the important limitation in the assumption of a linear relationship between happiness and its co-variates. In particular, Kimball and Willis (2006) argued that happiness could be interpreted as a mix of reactions to good and bad news in a certain moment (such as changing economic environment) and a response of mood to circumstances in a longer span of time (such as macroeconomic turmoil). In this regard, post-crisis GDP has been more volatile than its pre-crisis counterpart. This is quite understandable as the former reflects the uncertainty triggered by the 2008 financial crisis. Economic instability is arguably associated with a lower level of happiness as it negatively affects people's expectations about their future position (Graham and Pettinato 2001). Still, economic uncertainty is generated by fluctuations in economic cycles reflected, amongst other macroeconomic variables, by GDP growth.

We propose an alternative method based on a time series approach using a VAR–GARCH model for ten European countries (Portugal, Ireland, Italy, Greece and Spain, hereafter PIIGS, and Belgium, Denmark, France, Germany and The Netherlands, hereafter non-PIIGS). Therefore, the rationale of this study is to look at the two different dimensions (mean and variance) of economic growth and happiness within a time-series framework.

To summarize, the contribute of the paper to the literature is threefold. First, we analysed the impact of the recent financial crisis on the linkage between happiness and income. To our knowledge no previous study has attempted to investigate this issue. Second, we extend the analysis of this effect to PIIGS and non-PIIGS countries. Third, we apply a time series methodology that allow us to investigate the link between GDP volatility and happiness volatility.

Our key results are the following: national income has a significant and positive effect on happiness for all countries considered; this is smaller in the non-PIIGS countries compared to the PIIGS. The size of the effect is strengthened by the economic crisis for all the EU country members considered. Moreover, economic uncertainty tends to increase the gap between the PIIGS and the non-PIIGS. Finally, our results show that economic instability before the crisis positively influenced happiness volatility with no substantial differences, on average, between the PIIGS and non-PIIGS. By contrast, after the crisis, PIIGS countries show on average a greater sensitivity to economic uncertainty.

The remainder of the paper is organised as follows: Sect. 2 presents the literature review, Sect. 3 outlines the methodology, data are presented in Sects. 4 and 5 discusses the empirical results, and the final section offers some concluding remarks and policy implications.

2 Literature Review

The economic growth literature suggests that an increase in income entails a higher utility. It has an impact on the monetary budget constraints of rational individuals who position themselves on a higher indifference curve. In the words of Adam Smith (1790, p. 166), "the happiness of mankind seems to have been the original purpose intended by the Author of Nature" and happiness is favoured by the wealth of nations which guarantees more goods. Amongst others, Angner (2009) stated that "the fundamental idea is that greater output makes it possible to satisfy our wants and needs, that is, our preferences, to a greater degree; on the assumption that we are rational, this implies that we will."

On the same issue, psychologists are more sceptical. Shields and Wheatley Price (2005) and Oswald and Powdthavee (2008), studying the link between well-being, health and mental health, found that there is a strong causality that goes from the health condition to well-being through the adaptation process. According to Clark and Oswald (1994) and Easterlin (2003, 2005a, b), adaptation is normally incomplete, i.e. people do not just automatically jump back to a starting-point level of happiness. Brickman and Campbell (1971) applied the theory of adaptation to the analysis of happiness. They asserted that improvements in objective circumstances of life, such as income, do not necessarily produce real effects on people's welfare. Furthermore, in high-income societies, a higher income does not make people happier and, if it does, it has a smaller impact than what would be expected. This argument has challenged economists and led to growing interest in the effects of economic conditions on happiness. The available empirical findings are mixed. In his pioneering work, Easterlin (1974, updated in 1995) stated that higher income is positively associated with people's happiness. However, over time the life satisfaction reported by individuals remains constant despite a substantial increase in the GDP.

How can this contradiction be explained? There are several possible psychological and economic explanations. The hedonic treadmill (Brickman and Campbell 1971), or hedonic adaptation, is one of the possible psychological explanations for which the distinction between the expected and the experienced utility of happiness is the key element. It shows that as a person becomes wealthier, expectations and desires rise accordingly, which results in a non-increasing perception of happiness.

At a macro level, economists, on the other hand, focusing on economic variables (mainly income, wealth, employment and consumption), aim to identify the often neglected important factors impacting on people's happiness and well-being. Clark and Oswald (1994) and Di Tella et al. (2003) found that people's subjective well-being is related to the high level of unemployment and inflation in the country. In general, the focus is on the relationship between happiness and income. Without going into depth into the rich economic-psychological literature, these factors can be identified as working status (Frey and Stutzer 2001), social aspirations (Easterlin 2000), formal institutions (Bjornskov et al. 2010), freedom (Veenhoven 2000), diminishing of altruism (Phelps 2001), inequality (Alesina et al. 2004) and a decrease in associational life and social capital (Putnam 2000).

As mentioned above, Easterlin (1974) provided an early study of the effect of income on happiness, setting out (provocatively) the 'paradox' of a substantial real income growth in Western economies, over the last 50 years, but without any corresponding rise in reported happiness levels. He used cross section and time series data for a number of selected countries and found two unexpected results. First, when making cross-country comparisons he found little correlation between the two variables of interest. For instance, Cuba and Egypt had higher average life satisfaction than West Germany in 1960, even if the GDP per

capita was respectively one-third and one-ninth. Second, time series data on average life satisfaction and GDP per capita show that over the post-World War II decades, for advanced countries like the United States, it is evident that "money does not buy happiness". Indeed, average well-being remained almost unchanged in spite of the fact that national income had grown by several times (Castriota 2006). This paradox has symbolic relevance as it invalidates the prevailing assumption whereby an increase in economic growth leads to a rise in life satisfaction. Related studies have also been conducted by psychologists (Diener et al. 1995) and political scientists (Inglehart 1996).

Easterlin (2000, 2005a, b) and Clark et al. (2008) emphasise relative income comparisons, suggesting that what matters for the satisfaction of any individual is her/his relative position with respect to a reference group she/he aspires to. Di Tella et al. (2003) also emphasise the potential role of reference groups and hence estimate a regression that controls for income quantiles and country average income per capita.

According to the World Happiness Report 2015, the 10 happiest countries are Switzerland, Iceland, Denmark, Norway, Canada, Finland, Netherlands, Sweden, New Zealand and Australia, while the 10 unhappiest countries are all in Saharan or sub-Saharan Africa. Asia, however, confirms the old adage that money does not necessarily buy happiness. The region's richest countries are not the happiest. On this basis, it might be thought that happiness and human well-being for Asian countries are not necessarily closely related to GDP. However, Sawangfa (2007) studied happiness in several East Asian countries. The results show that, despite cultural, political and economic differences with Western countries, they are consistent with the consolidated literature on more developed countries.

Nevertheless, as Coulmas (2012) pointed out, we have often met with difficulties applying to an Asian context theories of subjective well-being that originated in Western thought. For instance, in Europe and the United States, happiness is something to pursue, but does this hold for Asian societies too? In particular, Easterlin (1995) and Frey and Stutzer (2002) both showed that for Japan, there was no evidence of a rise in life satisfaction despite the rapid increase in real per capita GDP from World War II. Brockman et al. (2009) pointed out a decline in life satisfaction in China between 1990 and 2000 when there was a substantial increase in living standards. Furthermore, using data for South Korea, Veenhoven (2010) showed that life satisfaction did not increase in the period 1990–2005 although real per capita GDP doubled during the same period. More recently Guriev and Zhuravskaya (2009) analyzed the relation between happiness and per capita GDP in transition countries using data from multiple sources including a recent survey in 28 post-communist countries. Happiness in transition countries is associated with income and public good provision, very much like in other countries. Their results also imply that the ongoing growth in these countries will eventually increase life satisfaction.

Cross section analyses tend to show the existence of a positive, though weak, relationship between life satisfaction and GDP growth (Layard et al. 2010; Deaton 2008; Inglehart et al. 2008). In particular, Frey and Stutzer (2002), using data from the World Bank's World Value Survey, find for most countries analysed a positive relation, although the effect of GDP on well-being seems to be stronger for low levels of income, within and across countries. Diener et al. (1995) provide evidence that, on average, people living in wealthy countries are happier than those living in poor ones, with an extensive study covering 55 economies. Furthermore, Bjornskov et al. (2010) found that a high quality of governments lead to a greater level of happiness. Using data from the European Social Survey, Caporale et al. (2009) examined the link between income and subjective well-being and found that, for the whole sample of 19 European countries, although income is

positively correlated with both happiness and life satisfaction, the reference income exerts a negative effect on individual well-being.

Time series empirical studies, however, give very mixed, ambiguous results. Blanch-flower and Oswald (2004), using an ordered logit methodology, confirmed the paradox for the United States and Great Britain over the period running from the early 1970s to 1998.[1] Although both countries enjoyed a steady increase in GDP growth, reported levels of well-being declined over the last quarter of the 20th century in the United States and ran approximately flat in Great Britain. Veenhoven (1993) obtained similar results for Japan, finding that average subjective well-being was stable over the period 1958–1987, although the real GDP per capita increased more than fivefold during the same period. In his more recent study, Easterlin (2013 and 2015) found that long-term trends in happiness and income are not related while short-term fluctuations are positively associated. The evidence for this is found in time series data for developed countries, transition countries, and less developed countries. However, in some low income countries there is no evidence that income growth increases the level of happiness "up to some point", beyond which growth has no further effect.

Furthermore, recent time series studies document a positive relationship between income and life satisfaction. Diener and Oishi (2000) found only a marginal increase in reported happiness associated to a selected group of high real per-capita GDP growth rates countries, namely Denmark, Germany and Italy, in the 1960s and 1970s. Similar results, using Eurobarometer data, were obtained for Italy by Castriota (2006). Hagerty and Veenhoven (2003), using aggregated survey data from the Eurobarometer for EU-8 countries, weighted by population size, found a weak but positive relationship. More recently, Stevenson and Wolfers (2008), using data from the Eurobarometer Survey for EU countries, showed a positive causality effect running from GDP growth to well-being over time. The recent literature clearly shows that the relationship, over time, between well-being and GDP still remains unclear.

Studies on happiness and its determinants are based, in most cases, on data collected from large-scale surveys in which people are asked to report on their happiness, or life satisfaction, expressed on a numerical scale. Several authors have expressed their scepticism about the use of cross-country survey data as a valid proxy for people's sentiments (Bertrand and Mullainathan 2001; Wilkinson 2007). Moreover, the different meanings given to the terms "happiness" and "life satisfaction", which also relate, amongst other things, to the cultural background and nationality of respondents, suggest that international surveys should be treated with caution. However, despite the limitations associated to the ability of these surveys to control for such differences, their use is undoubtedly widely accepted.

The 2008 global financial crisis and the deep recession triggered in the United States and most European economies had a widespread adverse effect. However, it gave the opportunity to examine whether, and to what extent, this event affected the standards of living and life satisfaction. Surprisingly, very few studies have focused on this issue. Deaton (2012) examined the well-being of Americans using daily data on self-reported well-being and analysed pre-2008 and post-2008 crisis levels of life satisfaction. The US interviewees reported a sharp decline in their life satisfaction, increasing concerns and a general decline in positive sentiments. Interestingly, despite the persistence of high unemployment rates, reaching its peak in 2010, the 2011 measure of self-reported well-being increased.

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[1] They used data extrapolated from the General Social Surveys of the United States and the Eurobarometer Surveys.

In its report entitled "How's Life? (2013)", the OECD found that the global economic crisis lowered people's satisfaction in the industrialised world. The study measured factors such as material living conditions and quality of life in an attempt to gauge true sentiments beyond economic indicators. The report stated that "the global economic crisis has had a profound impact on people's well-being, reaching far beyond the loss of jobs and income, and affecting citizens' satisfaction with their lives and their trust in governments". Furthermore, the results of the analysis show that in the period 2007–2012, reported average life satisfaction declined by more than 20% in Greece, 12% in Spain, and 10% in Italy. This is indicative of the impact of austerity measures following the Eurozone sovereign debt crisis.

3 The Model

We propose an alternative way of detecting the causality dynamics between happiness and GDP growth. The bivariate VAR–GARCH(1, 1)-in-mean process allows us to investigate the causality effects in two dimensions: mean and variance. The model is based on the GARCH(1, 1)-BEKK representation proposed by Engle and Kroner (1995). The BEKK–GARCH model was chosen for two main reasons: (1) it models jointly the time varying dynamics of GDP and happiness and yet it returns, by construction, a positive definite variance covariance matrix and (2) it allows causality to be tested for in mean and variance simultaneously, within the same framework. Furthermore, in order to control for the possible effects of the 2008 financial crisis, we include a dummy variable (denoted by *) with a switch on 2008:4 (i.e. 15 September 2008 was the day of the collapse of Lehman Brothers). The dummy aims to capture the shift in the causality dynamics running from GDP and unemployment into happiness. It controls for potential structural breaks in the parameters of interest rather than the variables themselves. The second subsample therefore also includes the public debt crisis which started in 2009 but whose seeds can be found in the banking crisis dating back to 2008. The model has the following specification:

$$x_t = \alpha + \beta x_{t-1} + \theta h_{t-1} + \gamma f_{t-1} + u_t \tag{1}$$

where $x_t = (Happiness_t, Growth_t)$ and x_{t-1} is a corresponding vector of lagged variables. We control for monetary policy shocks and unemployment rate, including in the mean equation the domestic 90-day Treasury Bill rate and unemployment rate, $f_{t-1} = (Unemp_{t-1}; T\text{-}bill_{t-1})$, respectively. The residual vector $u_t = (e_{1,t}, e_{2,t})$ is bivariate and normally distributed $u_t|I_{t-1} \sim (0, H_t)$ with its corresponding conditional variance–covariance matrix given by:

$$H_t = \begin{bmatrix} h_{11t} & h_{12t} \\ h_{12t} & h_{22t} \end{bmatrix}. \tag{2}$$

The parameter vector of the mean return Eq. (1) is given by the constant $\alpha = (\alpha_1; \alpha_2)$ and the autoregressive term, $\beta = (\beta_{11}, \beta_{12} + \beta_{12}^*|\beta_{21} + \beta_{21}^*, \beta_{22})$ which allows for happiness effects (β_{12}) from GDP growth changes, and in the opposite direction (β_{21}); the GARCH-in-mean parameter $\theta = (\theta_{12} + \theta_{12}^*|0)$ which measures the effect of GDP growth volatility on happiness. Furthermore, $\gamma = (\gamma_{11}, 0|0, \gamma_{22})$ is the vector of monetary policy shock and unemployment control parameters. In particular, γ_{11} measures the effect of unemployment on happiness and it is included only in the happiness equation, whereas γ_{22} captures monetary policy shocks and is therefore included only in the growth equation. The parameter matrices for the variance Eq. (2) are defined as C_0, which is restricted to be

upper triangular, and two unrestricted matrices A_{11} and G_{11}. Therefore, the second moment will take the following form:

$$
\begin{aligned}
H_t = C_0'C_0 + \begin{bmatrix} g_{11} & g_{12} \\ g_{21} + g_{21}^* & g_{22} \end{bmatrix}' H_{t-1} \begin{bmatrix} g_{11} & g_{12} \\ g_{21} + g_{21}^* & g_{22} \end{bmatrix} \\
+ \begin{bmatrix} a_{11} & a_{12} \\ a_{21} + a_{21}^* & a_{22} \end{bmatrix}' \begin{bmatrix} e_{1,t-1}^2 & e_{2,t-1}e_{1,t-1} \\ e_{1,t-1}e_{2,t-1} & e_{2,t-1}^2 \end{bmatrix} \begin{bmatrix} a_{11} & a_{12} \\ a_{21} + a_{21}^* & a_{22} \end{bmatrix}.
\end{aligned}
\tag{3}
$$

Equation (3) models the dynamic process of H_t as a linear function of its own past value H_{t1} and past values of the squared innovations ($e_{1,t-1}^2$, $e_{2,t-1}^2$). The BEKK model guarantees by construction that the covariance matrix in the system is positive definite. Given a sample of T observations, a vector of unknown parameters θ and a 2×1 vector of variables x_t, the conditional density function for model (1) is[2]:

$$
f(\mathbf{x}_t|I_{t-1};\theta) = (2\pi)^{-1}|H_t|^{-1/2}\exp\left(-\frac{\mathbf{u}_t'(H_t^{-1})\mathbf{u}_t}{2}\right)
\tag{4}
$$

The log-likelihood function is:

$$
L = \sum_{t=1}^{T} \log f(\mathbf{x}_t|I_{t-1};\theta)
\tag{5}
$$

Standard errors are calculated using the quasi-maximum likelihood methods of Bollerslev and Wooldridge (1992), which is robust to the distribution of the underlying residuals.

4 Data

Quarterly data for real GDP per capita (Gross Domestic Product based on purchasing-power-parity), 3-month Treasury Bills and unemployment rates (percent of total labour force) were obtained from the International Monetary Fund World Economic Outlook Database for ten European countries, namely Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal and Spain over the period 1980–2013 (for a total of 133 observations). The countries were grouped into peripheral and non-peripheral members in order to investigate whether or not the causality dynamic running from unemployment and GDP into happiness has a similar pattern for countries with different economic fundamentals. The VAR–GARCH model enabled us to test for causality in mean and variance within the same model specification.

Annual data for the happiness index were collected from Veenhoven database.[3] The index is based on survey questions such as "How satisfied are you with the life you live?" with answers ranked from 1 (not satisfied) to 4 (very satisfied) on a scale from 0 to 10. Since the main aim is to improve comparison of happiness measures across countries, Veenhoven (1993) restricted the questions to those used in studies of general populations in

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[2] The parameter (a_{21}) in Eq. (3) measures the causality effect running from GDP growth volatility to happiness volatility, whereas ($a_{21} + a_{21}^*$) measures the possible effect of the 2008 financial crisis.

Please note that, for the nature of the model, we cannot investigate whether the effects are positive or negative but rather only whether the magnitude of the effects has increased/decreased after the crisis.

[3] Veenhoven (2013) Happiness in Nations, World Database of Happiness, Erasmus University Rotterdam, The Netherlands. This dataset was preferred to the Eurobarometer for the uniform time series length across the countries considered.

nations. In order to produce indices consistent across different countries, they were homogenised through expert-transformation methodology.

In chapter 7 Veenhoven (1993) maintained that "These scores will be used to recalculate the means and standard deviations from distributional findings on happiness in nations already available in the section 'Happiness in nations' of this database. The question then is will these weighted averages provide a more accurate estimate of happiness in nations than the currently used 'naive' method, which assumes equidistance and absence of language differences? To answer that question we will compare the performance of the calibrated and uncalibrated means in a cross-national analysis, to find out if objective country characteristics such as income per head correlate stronger with the former than with the latter". For instance, "…the response options with three response options were rated as follows in the Dutch language: 8.5 for 'very happy', 5.7 for 'fairly happy' and 2.5 for 'not too happy' (study dutch1). When used in a survey in The Netherlands in 1985 the frequency of responses to these options was respectively 71, 27 and 2%. The values obtained were then used to compute a weighted average from the following frequencies: $0.71 \times 8.5 + 0.27 \times 5.7 + 0.02 \times 2.5 = 7.6$".

Annual data on happiness were converted into quarterly by means of average quadratic polynomial interpolation methodology, allowing the average of the high frequency points to match the low frequency data by means of a linear system with Gaussian elimination, Marsden (1974).

The descriptive statistics, presented in Table 1, show that the post-crisis level of happiness increased for all the non-PIIGS countries, whereas it decreased for the five PIIGS countries. The standard deviation of happiness, in the pre-crisis period, was on average around 0.24. A marked increase is observed in the post-crisis period for most of the countries. Notably, Greece shows an appreciable shift from 0.29 to a value of 0.64, the highest value among all countries. In the pre-crisis period, the happiness distribution is platykurtic for Denmark, Italy and Spain.

GDP growth averages show a decrease in the post-crisis sample, and become negative in the cases of Greece (-1.54) and Ireland (-0.41). In the pre-crisis period, Ireland shows the highest growth rate (7.27) followed by Portugal (5.58). The standard deviation of GDP growth is on average around 2.25. In both samples, GDP growth distributions are symmetric. The distribution of GDP growth is platykurtic with values close to 2 in the post-crisis period.

The happiness index and GDP growth are shown in Figs. 1 and 2, respectively. Shaded areas highlight the post-2008 sample. In the pre-crisis period, the happiness index clearly reflects the social and economic country-specific conditions. However, in the post-2008 period two different paths are identified. As regards the PIIGS countries, happiness shows a marked downward shift. On the contrary, for non-PIIGS countries the trend remains positive.

5 Empirical Results

In order to test for the adequacy of the model, Ljung–Box portmanteau tests were performed on standardised residuals and standardised squared residuals. Overall, the results indicate that the VAR–GARCH(1, 1)-in-mean specification satisfactorily captures the persistence in the first and second moment of all the series considered.

The estimated VAR–GARCH(1, 1)-in-mean models with the associated robust standard errors and likelihood function values are presented in Tables 3 and 4.[4] We select the

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[4] Summary results are presented in Table 2 in order to facilitate results comparison across different countries and parameters.

Table 1 Descriptive statistics

	Pre-crises				Post-crises			
	Mean	SD	Skew	Kurt	Mean	SD	Skew	Kurt
Happiness index								
Belgium	6.81	0.26	−0.23	2.17	7.00	0.12	0.70	2.19
Denmark	8.13	0.12	−0.63	3.31	8.33	0.08	−0.46	2.10
France	6.13	0.22	−0.18	2.16	6.43	0.26	0.56	2.62
Germany	6.13	0.22	−0.18	2.16	6.70	0.30	−0.60	1.89
Greece	5.53	0.29	−0.21	1.88	4.59	0.64	0.63	2.23
Ireland	7.03	0.24	−0.43	2.59	6.84	0.21	0.05	2.78
Italy	6.04	0.24	−1.03	4.63	5.59	0.25	0.50	1.89
The Netherlands	7.53	0.13	−0.43	2.03	7.60	0.33	−1.58	4.27
Portugal	5.44	0.28	−0.21	2.13	4.63	0.38	−0.22	1.66
Spain	6.30	0.39	−0.81	3.32	6.14	0.34	0.67	1.93
GDP per capita Growth								
Belgium	4.80	1.86	0.24	3.01	1.59	2.30	−0.56	2.97
Denmark	4.98	2.19	0.45	2.64	0.93	2.98	−1.33	3.80
France	4.57	1.97	0.92	3.84	1.62	2.28	−0.82	2.99
Germany	4.67	2.14	0.24	2.59	3.12	3.71	−0.75	2.75
Greece	4.52	2.32	−0.29	2.61	−1.54	3.86	1.01	2.83
Ireland	7.27	3.10	0.31	1.83	−0.41	3.89	−0.23	1.87
Italy	4.68	2.09	0.57	3.23	0.29	3.02	−0.52	2.57
The Netherlands	4.93	1.67	−0.19	3.53	1.67	2.98	−0.06	2.55
Portugal	5.58	3.24	0.75	3.00	1.01	2.37	0.28	1.96
Spain	5.39	1.93	−0.17	3.04	0.62	2.35	−0.48	3.14

The sample size covers the period 1980:1–2013:4 for a total of 133 observations. The post crisis sample starts on 2008:4, i.e. 15 September 2008 is the day of the collapse of Lehman Brothers. The second subsample therefore also includes the public debt crisis which started in 2009

optimal lag length of the mean equation using the Schwarz information criterion. By means of Wald tests[5] we test several hypotheses, specifically: (1) the presence of spillovers from GDP growth ($\beta_{12} = 0$) to happiness before the crisis; (2) the presence of spillovers from GDP growth to happiness after the crisis ($\beta_{12}^* = 0$); (3) the presence of spillovers from happiness to GDP growth before ($\beta_{21} = 0$) and after ($\beta_{12}^* = 0$) the crisis; (4) the effect of GDP volatility on happiness volatility before ($a_{21} = g_{21} = 0$) and after ($a_{21}^* = g_{21}^* = 0$) the crisis, and finally (5) the effect of GDP volatility on happiness before ($\theta_{12} = 0$) and after ($\theta_{12}^* = 0_{12} = 0$) the crisis. Our results suggest the following. First, coefficients measuring the causality running from GDP growth into happiness are positive and statistically significant for all countries but Belgium, France and Germany. These are higher for the PIIGS countries. Second, the economic crisis reinforces the causality effect from GDP growth into happiness ($\beta_{12} + \beta_{12}^* > \beta_{12}$); on average the gap between the PIIGS (but Portugal) and the non-PIIGS countries substantially widens, with the only exception given by The Netherlands. The average dummy coefficient for the PIIGS countries (0.19) is substantially

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[5] Empirical Wald critical values are computed by means of bootstrapping.
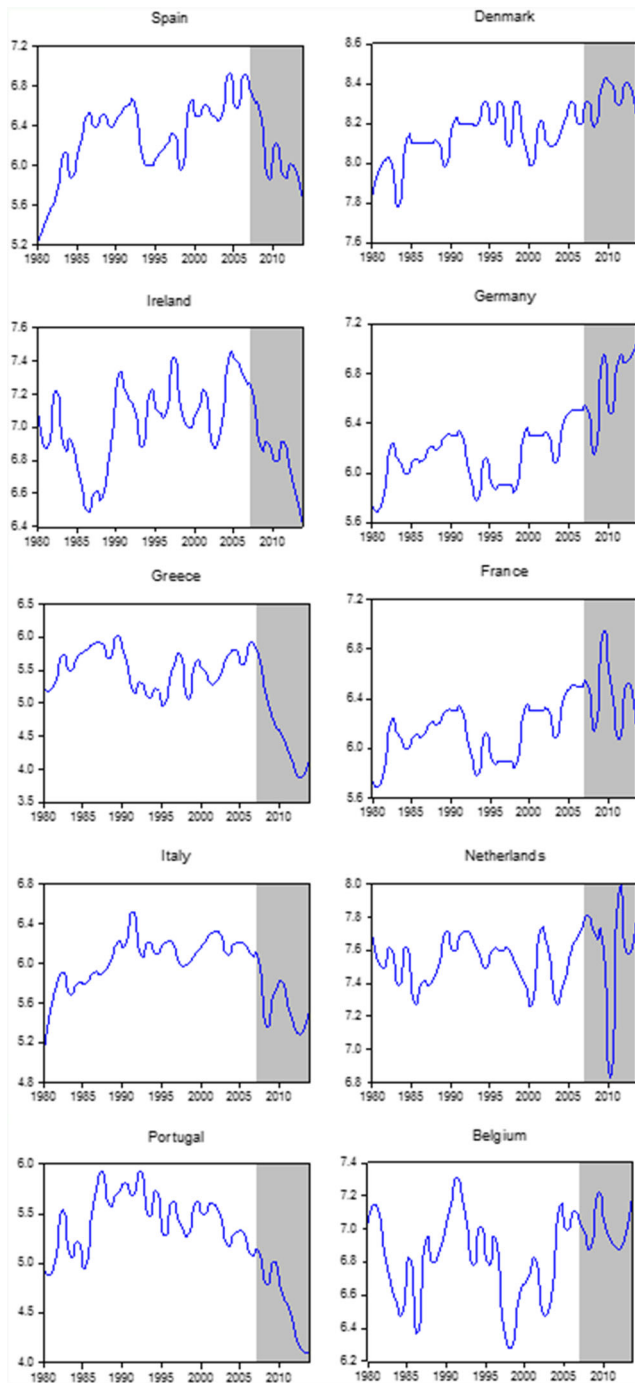
Fig. 1 The happiness index Note: The *shaded area* starts on 2008:4, i.e. 15 September 2008 is the day of the collapse of Lehman Brothers
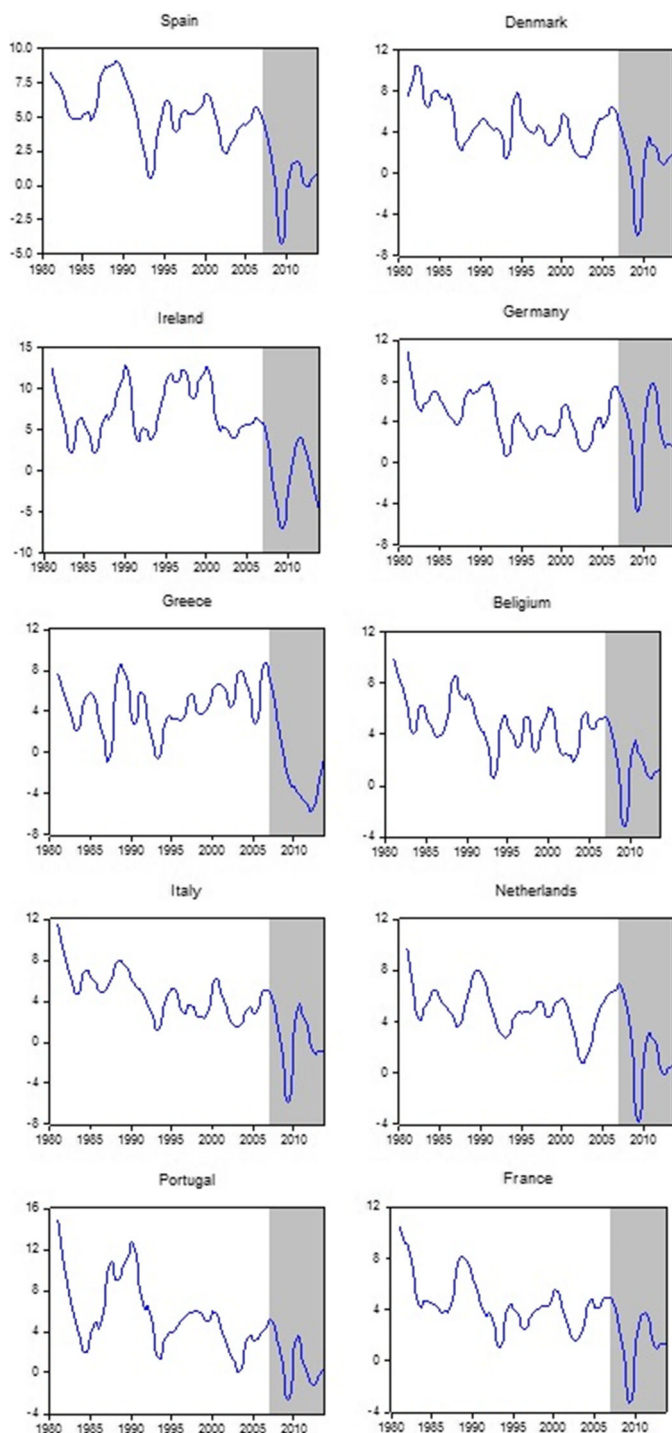
Fig. 2 The GDP growth. *See* note Fig. 1

Table 2 Summary results

	Pre-crises	Post-crises
GDP per capita growth $\rightarrow$ Happiness index		
	H_0: $\beta_{12} = 0$	H_0: $\beta_{12}^* = 0$
Belgium		
Denmark	$\times$	$\times$
France		
Germany		
Greece	$\times$	$\times$
Ireland	$\times$	$\times$
Italy	$\times$	$\times$
The Netherlands	$\times$	$\times$
Portugal	$\times$	
Spain	$\times$	$\times$
GDP per capita growth volatility $\rightarrow$ Happiness index volatility		
	H_0: $a_{21} = 0$	H_0: $a_{21}^* = 0$
Belgium	$\times$	
Denmark	$\times$	$\times$
France	$\times$	$\times$
Germany	$\times$	$\times$
Greece	$\times$	$\times$
Ireland	$\times$	$\times$
Italy	$\times$	$\times$
The Netherlands	$\times$	$\times$
Portugal	$\times$	$\times$
Spain	$\times$	$\times$
GDP per capita growth volatility $\rightarrow$ Happiness index		
	H_0: $\theta_{12} = 0$	H_0: $\theta_{12}^* = 0$
Belgium		
Denmark		
France		
Germany		$\times$
Greece		
Ireland		$\times$
Italy		
The Netherlands	$\times$	$\times$
Portugal		
Spain		$\times$

Summary results are presented in order to facilitate results comparison across different countries and parameters. $\times$ indicates rejection of the Null Hypothesis at the conventional 5% confidence level

bigger compared to the non-PIIGS (0.06). Therefore, we observe that for the former there is greater sensitivity of happiness to economic growth in reaction to economic slowdowns (post-2008).

Third, the spillovers from happiness to economic growth, explained by the coefficient β_{21}, are found to be not significant for all countries but Belgium ($\beta_{21} = 0.049$) and The Netherlands ($\beta_{21}^* = 0.004$), after the crisis. This result suggests that happiness is potentially

Table 3 Growth and happiness: PIIGS countries estimated VAR–GARCH (1, 1) in mean model

Param.	Greece Coef.	SE	Ireland Coef.	SE	Italy Coef	S.E.	Portugal Coef.	SE	Spain Coef.	SE
Conditional mean equation										
α_1	-0.417	(0.324)	-0.305	(0.435)	-0.695	(0.471)	-0.870	(0.917)	-0.619	(0.536)
β_{11}	0.345***	(0.008)	0.446**	(0.120)					0.539**	(0.221)
β_{12}	0.284***	(0.032)	0.068***	(0.025)	0.262**	(0.090)	0.033*	(0.016)	0.116**	(0.039)
β_{12}^*	0.336***	(0.023)	0.132***	(0.015)	0.272**	(0.081)			0.215***	(0.051)
θ_{12}										
θ_{12}^*			-0.044***	(0.011)					-0.391***	(0.064)
α_2	0.022	(0.107)	1.006***	(0.345)	-0.172	(0.199)	-0.013	(0.174)	0.236	(0.319)
β_{22}	0.756***	(0.021)	0.851***	(0.047)	0.602*	(0.333)	0.962***	(0.046)	0.924***	(0.026)
β_{21}										
β_{21}^*										
γ_{11}	-0.113***	(0.013)	-0.070***	(0.008)	-0.007*	(0.004)	-0.088**	(0.028)	-0.048**	(0.013)
γ_{22}	-0.001	(0.001)	-0.007*	(0.003)	-0.009**	(0.003)	-0.006**	(0.002)	-0.009*	(0.004)
Conditional variance equation										
c_{11}	0.820***	(0.218)	0.732***	(0.188)	1.088*	(0.507)	1.873**	(0.630)	0.585**	(0.242)
c_{12}	0.013***	(0.001)	0.027**	(0.011)	0.033***	(0.009)	0.007**	(0.002)	0.019*	(0.008)
c_{22}	0.040	(0.301)	-0.284**	(0.122)	-0.329**	(0.158)	-0.510***	(0.127)	-0.290**	(0.104)
a_{11}	-0.048	(0.071)	0.016	(0.065)	0.090	(0.193)	0.277	(0.257)	0.236**	(0.090)
a_{21}	-0.111***	(0.017)	0.416***	(0.103)	-0.265***	(0.033)	0.165*	(0.077)	0.190*	(0.083)
a_{21}^*	0.038***	(0.005)	-0.190***	(0.023)	0.407*	(0.203)	-0.407**	(0.017)	-0.234***	(0.012)
a_{12}										
a_{22}	0.822***	(0.040)	0.076	(0.088)	0.209	(0.177)	-0.090	(0.291)	0.046	(0.062)
g_{11}	1.347***	(0.117)	1.192***	(0.109)	1.039**	(0.289)	-0.919***	(0.081)	1.342***	(0.144)
g_{21}	0.131***	(0.009)	-0.050**	(0.018)	-0.091***	(0.012)	-0.253*	(0.105)	-0.504*	(0.233)

Table 3 continued

Param.	Greece Coef.	SE	Ireland Coef.	SE	Italy Coef	S.E.	Portugal Coef.	SE	Spain Coef.	SE
g^*_{21}	−0.082***	(0.004)	0.124**	(0.039)	0.089*	(0.040)	0.262***	(0.013)	0.505***	(0.004)
g_{12}										
g_{22}	0.662***	(0.147)	0.764***	(0.106)	0.364***	(0.086)	−0.337*	(0.148)	0.932***	(0.248)
LogLik	−537.4275		−461.1290		−403.5815		−513.3692		−411.4287	
LB_{hap}	4.77		3.57		5.78		6.12		4.67	
LB^2_{hap}	3.69		4.88		4.34		2.34		3.45	
LB_{grow}	4.67		4.78		6.56		4.98		5.12	
LB^2_{grow}	2.97		2.16		3.54		4.12		2.13	

Standard errors (SE) are calculated using the quasi-maximum likelihood method of Bollerslev and Wooldridge (1992), which is robust to the distribution of the underlying residuals. LB and LB^2 are respectively the Ljung-Box test (1978) of significance of autocorrelations of ten lags in the standardized and standardized squared residuals. Parameters β_{12} and β_{21} measure the causality effect of Happiness on Growth and Growth on Happiness, respectively, whereas a_{21} and a_{12} measure the causality in variance effect of Growth volatility shocks (economic uncertainty) on Happiness volatility, and Happiness volatility shocks on Growth volatility (economic uncertainty), respectively

***, **, and * reject the null at 1%, 5% and 10% respectively

Table 4 Growth and happiness: No-PIIGS countries estimated VAR–GARCH (1, 1) in mean model

Param.	Belgium Coef.	SE	Denmark Coef.	SE	France Coef	SE	Germany Coef.	SE	The Netherlands Coef.	SE
Conditional mean equation										
α_1	−0.388	(0.704)	−0.822**	(0.284)	0.176	(0.229)	0.335	(0.295)	−0.768***	(0.284)
β_{11}			0.501*	(0.237)			0.229**	(0.088)	0.618*	(0.294)
β_{12}			0.095**	(0.030)	0.024	(0.028)	0.007	(0.030)	0.214***	(0.027)
β_{12}^*			0.076**	(0.021)	0.012	(0.028)	0.015	(0.030)	0.212***	(0.007)
θ_{12}							−0.084	(0.079)	−0.110**	(0.053)
θ_{12}^*									−0.141***	(0.024)
α_2	0.354	(0.472)	0.050	(0.307)	0.222	(0.181)	0.202	(0.255)	0.681*	(0.273)
β_{22}	0.905***	(0.054)	0.955***	(0.056)	0.929***	(0.034)	0.943***	(0.043)	0.860***	(0.051)
β_{21}	0.022**	(0.008)								
β_{21}^*	0.049**	(0.016)								
γ_{11}	−0.103*	(0.048)	0.020**	(0.007)	0.021	(0.018)	0.009	(0.017)	0.030***	(0.005)
γ_{22}	−0.006*	(0.003)	−0.009***	(0.003)	−0.003	(0.002)	−0.001	(0.001)	−0.002*	(0.001)
Conditional variance equation										
c_{11}	1.149***	(0.257)	0.674***	(0.119)	0.407***	(0.091)	0.383***	(0.081)	0.599***	(0.199)
c_{12}	0.002*	(0.001)	0.012***	(0.001)	0.021**	(0.007)	0.017***	(0.004)	0.032**	(0.011)
c_{22}	0.517***	(0.080)	0.330***	(0.080)	−0.182***	(0.042)	−0.264**	(0.097)	0.219***	(0.041)
a_{11}	−0.029	(0.292)	−0.173	(0.308)	−0.291***	(0.061)	−0.256***	(0.063)	−0.160***	(0.045)
a_{21}	0.072*	(0.027)	0.246***	(0.024)	0.221***	(0.011)	0.691***	(0.015)	−0.053***	(0.008)
a_{21}^*	−0.009	(0.027)	−0.182***	(0.014)	−0.150***	(0.011)	−0.579***	(0.015)	0.096***	(0.008)
a_{12}										
a_{22}	−0.109	(0.188)	−0.700***	(0.074)	0.446***	(0.050)	0.447**	(0.149)	0.513***	(0.069)
g_{11}	1.156***	(0.189)	1.048***	(0.119)	1.353***	(0.147)	1.355***	(0.145)	1.208***	(0.156)
g_{21}	−0.082	(0.066)	0.241***	(0.027)	−0.352***	(0.008)	−0.370***	(0.010)	0.222***	(0.005)

Table 4 continued

Param.	Belgium		Denmark		France		Germany		The Netherlands	
	Coef.	SE	Coef.	SE	Coef	SE	Coef.	SE	Coef.	SE
g_{21}^*	0.070	(0.066)	−0.199***	(0.017)	0.373***	(0.008)	0.411***	(0.010)	−0.207***	(0.008)
g_{12}										
g_{22}	0.591*	(0.245)	0.640**	(0.223)	0.633***	(0.091)	0.589**	(0.190)	0.730***	(0.125)
LogLik	−453.0259		−369.3013		−394.6802		−425.8918		−360.9663	
LB_{hap}	3.67		5.16		6.36		5.27		4.33	
LB_{hap}^2	4.01		4.34		5.02		3.34		2.99	
LB_{grow}	4.33		3.19		5.39		5.21		4.15	
LB_{grow}^2	3.02		4.55		3.99		3.87		5.62	

See notes Table 3

***, **, and * reject the null at 1%, 5% and 10% respectively

one of the factors that affects economic growth through the increase in productivity (Wright and Staw 1998), albeit marginally and only for a limited number of countries.

Fourth, we find evidence of significant spillovers running from GDP growth volatility into happiness volatility.[6] Findings on the effect of economic uncertainty on happiness volatility are on average qualitatively similar with no substantial differences between PIIGS and non-PIIGS. The positive influence is particularly evident in the case of Germany. After the crisis, the happiness volatilities of PIIGS show on average greater sensitivity to economic uncertainty.

Fifth, there is also evidence of spillovers running from economic growth volatility into happiness (measured by the GARCH-in-mean parameter) for The Netherlands before the crisis and Germany, Ireland, The Netherlands and Spain after the crisis.

Finally, the exogenous variables considered are statistically significant for all ten countries, indicating a negative interest rate effect on economic growth ($\gamma_{22} < 0$) and a negative unemployment rate on happiness ($\gamma_{11} < 0$).

6 Conclusions

In this paper, we investigated the dynamic causality link between economic growth and population happiness. Unlike previous studies, we modelled both mean and volatility spillovers, and controlled for the recent global financial crisis. Our econometric analysis was based on estimating a VAR–GARCH(1, 1)-in-mean model which is ideally suited to testing for both mean and volatility linkages between per capita economic growth and happiness. Moreover, our time series analysis overcomes the heterogeneity issues often associated with cross-section analysis.

The results suggest that economic growth has significant positive effects on happiness in seven out of eight countries. However, happiness in peripheral members of the EMU (PIIGS) is more responsive to economic growth. The pattern has straighten after the recent financial crisis. The finding that, in non-peripheral members of the EMU (non-PIIGS), an increase in GDP level does not necessarily lead to higher levels of population well-being, contrary to what we would have expected, may lie in the existence of a so-called "satiation point", as claimed, among others, by Diener and Seligman (2004) and Clark et al. (2008). Economic growth volatility has a significant impact on happiness volatility with a more pronounced effect in the PIIGS countries, especially post-2008. The crisis, and the resulting austerity policies implemented, have further strengthened such links, particularly for peripheral members of the EMU, making population well-being even more sensitive to economic uncertainty.

Overall, our findings confirm the important role played by economic growth in determining population happiness and provides new evidence for the existence of causality linkages between economic growth volatility and happiness volatility. Of particular interest is the finding that the latter has become even more responsive to the former since the recent financial crisis. These linkages have clearly become stronger, especially for the PIIGS countries, which should be taken into account in the debate on EU-wide measures aiming to sustain economic growth.

These results provide many policy implications, in terms of government expenditure, taxation and welfare policy. It is quite manifest that crises increase the level of poverty, the

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[6] Note that in the conditional variance equation the sign of parameters is not relevant and should be considered as an absolute value.

level of uncertainty and income inequality within countries. PIIGS countries experienced these negative consequences. The subsequent increase in the spillover from GDP growth to happiness shows that for those countries a greater level of income will yield a greater level of happiness.

Since policymaker decisions cannot be directly translated into population happiness, those should follow the path of improving living standard conditions. Therefore, policymakers can contribute by promoting policies which ensure that people have more confidence in a prosperous economy able to provide employment opportunities and greater growth expectations.

The results presented in this paper are a first cut and further analyses are no doubt needed to explore the linkages between the state of the economy and population happiness within a time series framework. We did not consider variables other than those of an economic nature and therefore results should be taken with due caution. Further avenues for research may include the use of non-linear models and disaggregated economic indicators, other than growth, in order to investigate whether economic growth should still be considered a primary goal for government policy aiming to improve population well-being.

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