Is the sustainable life the longest-lived? An Analysis for OECD Economies

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Outlines

- Topic and purpose
- Context
- Data and descriptive analysis
- Methodology
- Results
  - Time series properties
  - Panel data estimation
- Extensions and discussion
- Conclusions

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Topic and Purpose:

- Determine if air pollution has an impact on health
- Analyse whether the possible relationship between health outcomes, growth and air pollution has changed after the Great Recession, and its implications

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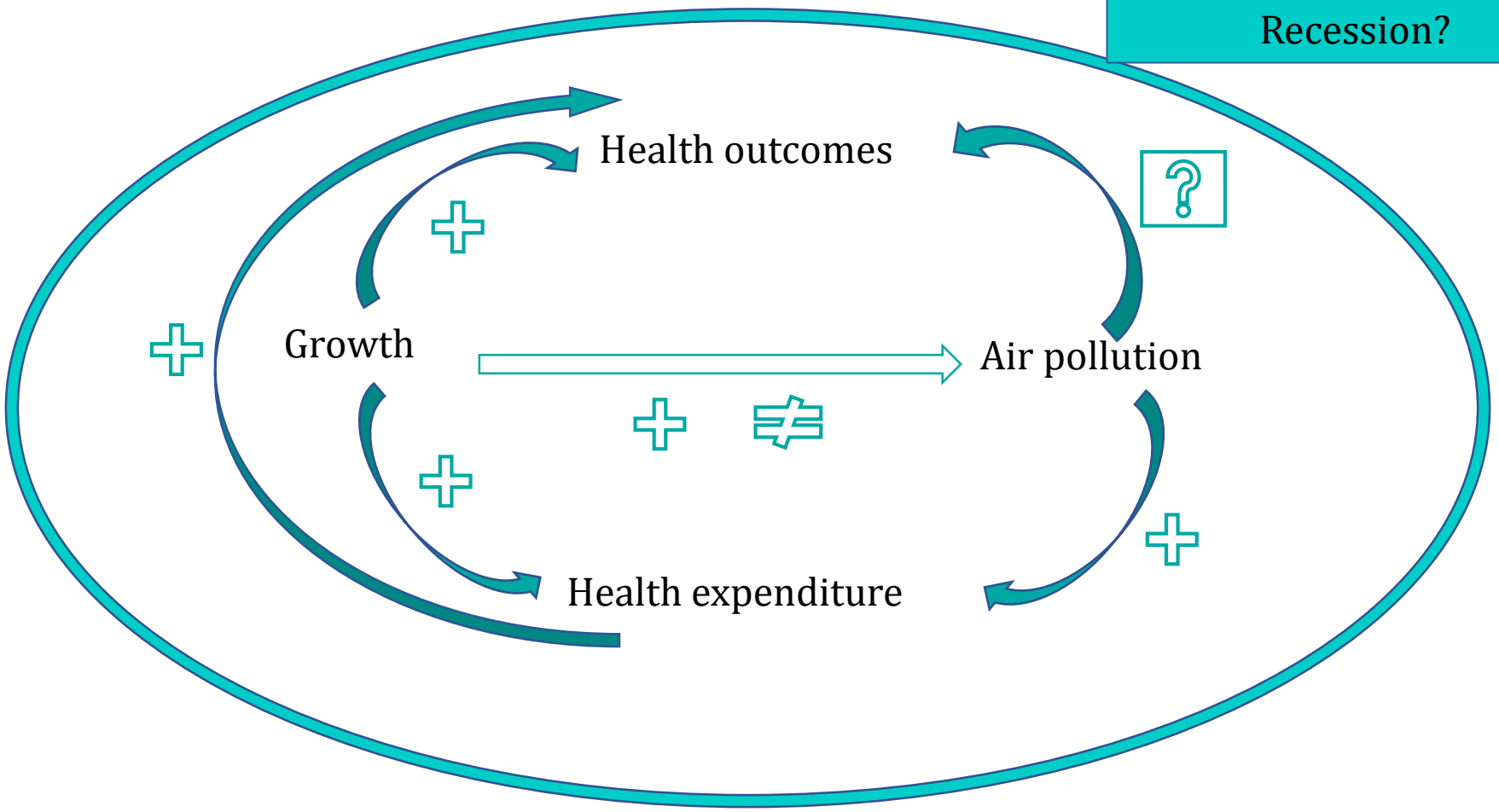
Context

¿Interrelationship between the four areas in a context of Great Recession?



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Data and descriptive analysis:

Data used:

- Health outcomes → Premature mortality (Potential years of life lost →PYLL)
  - Measured in years lost per 100,000 inhabitants (total), aged 0-69
  - Source: OECD Data

- Economy → per capita GDP
  - US dollars per capita (current PPPs)
  - Source: OECD Data

- Environmental degradation → per capita CO2 emissions
  - Measured in metric tons per capita
  - Source: World Data Bank

- State of the health system → per capita Health Expenditure
  - Measured in USD per capita (using economy-wide PPPs)
  - Source: OECD Data

Data and descriptive analysis:

Data used:

- 24 OECD countries →Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Korea, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, United Kingdom and United States

- Period → 1990 to 2017

Table 1a: Descriptive analysis of PYLL and per capita GDP

	PYLL			GDPpc		
	90-17	90-08	08-17	90-17	90-08	08-17
Australia	-2.23%	-2.60%	-1.49%	3.95%	4.61%	2.64%
Austria	-2.50%	-2.72%	-2.04%	3.87%	4.27%	3.06%
Belgium	-2.06%	-1.91%	-2.37%	3.75%	4.01%	3.23%
Canada	-1.68%	-2.06%	-0.93%	3.28%	3.91%	2.01%
Czech Republic	-2.82%	-3.06%	-2.33%	4.23%	4.47%	3.76%
Denmark	-2.70%	-2.37%	-3.36%	4.20%	4.64%	3.31%
Finland	-2.50%	-2.30%	-2.91%	3.64%	4.50%	1.92%
France	-2.10%	-2.14%	-2.04%	3.48%	3.90%	2.66%
Germany	-2.25%	-2.69%	-1.36%	3.78%	3.85%	3.65%
Greece	-1.51%	-1.77%	-0.98%	2.90%	4.82%	-0.84%
Iceland	-2.27%	-3.26%	-0.26%	3.50%	3.86%	2.78%
Ireland	-2.80%	-2.49%	-3.42%	6.63%	6.68%	6.51%
Italy	-2.57%	-2.81%	-2.08%	3.05%	3.61%	1.94%
Japan	-1.89%	-1.61%	-2.45%	2.75%	3.22%	1.83%
Korea	-3.66%	-3.60%	-3.77%	6.06%	7.35%	3.54%
Netherlands	-2.04%	-2.17%	-1.79%	3.99%	5.04%	1.92%
Norway	-2.69%	-2.53%	-3.01%	4.72%	6.94%	0.41%
Poland	-2.26%	-2.15%	-2.48%	5.97%	6.20%	5.53%
Portugal	-2.79%	-2.95%	-2.48%	3.90%	4.65%	2.41%
Spain	-2.67%	-2.66%	-2.69%	4.06%	5.13%	1.96%
Sweden	-2.12%	-2.35%	-1.66%	3.52%	4.11%	2.35%
Switzerland	-2.78%	-2.96%	-2.42%	3.38%	3.67%	2.82%
United Kingdom	-1.91%	-2.00%	-1.72%	3.77%	4.36%	2.59%
United States	-0.96%	-1.47%	0.08%	3.47%	4.03%	2.37%

Table 1b: Descriptive analysis of per capita CO2 emissions and per capita Health Expenditure

	CO_2pc emissions			HEXPpc		
	90-17	90-08	08-17	90-17	90-08	08-17
Australia	0.07%	0.94%	-1.65%	5.26%	6.04%	3.73%
Austria	-0.05%	0.63%	-1.41%	4.85%	5.69%	3.18%
Belgium	-1.09%	-0.52%	-2.22%	5.22%	5.75%	4.16%
Canada	0.06%	0.50%	-0.81%	4.18%	4.65%	3.26%
Czech Republic	-1.46%	-1.34%	-1.70%	6.75%	7.54%	5.19%
Denmark	-2.06%	-0.58%	-4.94%	4.78%	5.51%	3.35%
Finland	-1.24%	-0.14%	-3.40%	4.57%	5.39%	2.95%
France	-0.95%	-0.53%	-1.79%	4.67%	5.36%	3.30%
Germany	-1.13%	-1.24%	-0.91%	4.70%	4.72%	4.66%
Greece	-0.65%	1.12%	-4.11%	4.03%	7.12%	-1.89%
Iceland	-0.71%	-0.60%	-0.92%	3.64%	4.73%	1.51%
Ireland	-0.45%	0.88%	-3.06%	7.01%	9.17%	2.83%
Italy	-1.01%	0.32%	-3.60%	3.68%	4.75%	1.58%
Japan	0.10%	0.13%	0.04%	5.33%	5.41%	5.19%
Korea	2.78%	3.32%	1.70%	7.94%	8.54%	6.75%
Netherlands	-0.32%	0.07%	-1.10%	5.03%	6.55%	2.05%
Norway	0.06%	0.68%	-1.17%	5.80%	7.01%	3.42%
Poland	-0.40%	-0.71%	0.21%	7.37%	8.07%	5.98%
Portugal	0.86%	1.51%	-0.43%	5.83%	7.84%	1.93%
Spain	0.08%	1.36%	-2.43%	5.31%	6.78%	2.45%
Sweden	-1.81%	-1.21%	-2.98%	4.76%	4.73%	4.83%
Switzerland	-1.27%	-0.52%	-2.76%	4.43%	4.74%	3.81%
United Kingdom	-2.06%	-0.86%	-4.41%	6.33%	8.15%	2.77%
United States	-1.00%	-0.33%	-2.32%	5.03%	5.78%	3.54%

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Methodology

- Time series properties in data panel

  → Cross-section independence CD statistic (Pesaran, 2004)

  → CIPS* statistic for unit roots (Pesaran, 2007)

  → Z, P_m and P statistics (Bai and Carrión-i-Silvestre, 2009)

- Structural breaks in panel data

  → Statistics proposed by *Dizten et al.* (2021)

- Panel data estimation

  → Estimation using fixed effects (log-log models)

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Results: *Time series properties*

Table 2. Testing for cross-sectional independence

	P=0	P=1	P=2
PYLL	7.76***	7.74***	7.85***
GDPpc	36.04***	35.52***	35.32***
CO_2pc	16.06***	15.89***	16.08***
HEXPpc	16.48***	15.47***	14.80***

This Table presents the values of the CD statistic proposed by Pesaran (2021) for testing the null hypothesis of cross-sectional independence. The statistics have been obtained from the OLS residuals obtained using a panel of Augmented Dickey-Fuller equations estimated with fixed effects and employing p lags.

*** means rejection 1%.

Results: *Time series properties*

Table 3. Panel data unit root tests

	CIPS*				Bai and Carrion-i-Silvestre		
	P=0	P=1	P=2	P=3	Z	P_m	P
YPLL	-4.64***	-0.50	-0.40	-1.86**	-1.37	4.18**	88.93**
GDPpc	3.60	3.10	3.18	2.98	1.78**	3.64**	83.71**
CO_2pc	-3.83***	-2.84***	-0.81	-1.32*	-1.58*	5.60**	102.8**
HEXPpc	2.51	0.98	1.67	3.73	1.28	3.68**	84.02**

This table presents the statistics CIPS* (for p lags, with p=0, 1, … ,3) proposed by Pesaran (2007), and the simplified Z, P_m and P statistics proposed by Bai and Carrión-i-Silvestre (2009). Both statistics test for the panel data unit root null hypothesis. Critical values at the 1% and 5% levels for rejecting the hull hypothesis of unit root are 2.326 and 1.645 respectively for both Z and Pm. For P test, chi-square critical values are obtained by using 2N degree of freedom with the corresponding significance levels.

***, ** and * means rejection of the null hypothesis at 1%, 5% and 10% significance level, respectively.

Models

- **Model 1:**

$$\mathrm{l}PYLL_{it} = \alpha_i + \beta_i \mathrm{l}GDPpc_{it} + \delta_i \mathrm{l}CO_2pc_{it} + \varepsilon_{it}$$

- **Model 2**

$$\mathrm{l}PYLL_{it} = \alpha_i + \beta_i \mathrm{l}GDPpc_{it} + \delta_i \mathrm{l}CO_2pc_{it} + \sigma_i \mathrm{l}HEXPpc_{it} + \varepsilon_{it}$$

Where ε_{it} is the error term, with i=1,...,24 countries and t=1990,...,2017 years

Results: *Time series properties*

Table 4. Testing for structural breaks in panel data

	Model 1	Model 2
F(1/0)	6.57**	5.35*
F(2/1)	2.68	2.48
F(3/2)	2.32	1.34

This table presents the sequential statistics proposed by Ditzen *et al.* (2021). These statistics tests for the presence of multiple structural breaks at unknown breakpoints. F(n+1/n) tests for the presence of n versus n+1 breaks. Model 1 includes the log of GDPpc and the log of CO_2pc as explanatory variables, whilst model 2 also includes the log of HEXPpc.

***, ** and * means rejection of the null hypothesis at 1%, 5% and 10% significance level, respectively.

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Results: *Panel data estimation*

Table 5. Panel data estimation

	1990-2008		2009-2017	
	Model 1	Model 2	Model 1	Model 2
GDPpc	-0.51***	-0.28***	-0.43***	-0.25***
	(-16.5)	(-2.79)	(-6.23)	(-2.81)
CO_2pc	0.06	0.04	0.27***	0.26***
	(0.78)	(0.54)	(3.41)	(3.51)
HEXPpc		-0.18**		-0.21***
		(-2.49)		(-1.96)

This table presents the estimated elasticities obtained from the estimation of models 1 and 2 using fixed effects for the periods 1990-2008 and 2009-2017. The values in parenthesis are the robust t-ratios.

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Extensions

- We repeat the analysis with Life Expectancy and disaggregate by gender → The results are robustly similar

Life expectancy total

	1990-2008		2009-2018	
	Model 1	Model 2	Model 1	Model 2
GDPpc	0.06***	0.032***	0.04***	0.02***
	(19.42)	(2.87)	(5.34)	(3.25)
CO_2pc	-0.003	-0.001	-0.02***	-0.02***
	(-0.38)	(-0.09)	(-3.27)	(-3.07)
HEXPpc		0.02***		0.02*
		(3.17)		(2.12)

This table presents the estimated elasticities obtained from the estimation of models 1 and 2 using fixed effects for the periods 1990-2008 and 2009-2018. The values in parenthesis are the robust t-ratios.

Discussion:

- The most important result is that CO_2pc emissions are influencing health outcomes after 2009, but before the Great Recession there is no evidence of their influence
  - The structural break, brought about by the Great Recession, affects how variables are related
- Phenomena that might explain this change:
  - <u>cumulative effect of emissions:</u>
    - The interaction between health and pollution is prolonged in the long term (Manisalidis *et al.,* 2020)
    - Pollution levels are so high that there comes a time when the harmful effect of pollution surfaces (Mujtaba and Shahzad, 2021; WHO, 2021)
  - <u>The effect of austerity policies on health spending during the GR:</u>
    - Before the GR → the economic boom in OECD countries offset the negative effect of carbon dioxide emissions
    - After the GR → the effect of pollution on health is not offset and it is then that it becomes a key variable in the relationship between health and growth
    - The results suggest that the beneficial impact of the financial crisis on air quality is short-lived (Pacca *et al.,* 2020)

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Conclusions:

- There is a relationship between health, economics and environment, and this relationship changes after the GR.
  - Before the break year, 2009, CO_2pc emissions are not relevant for the model. However, after this event they are, which indicates that the relationship between pollution and premature mortality has changed.
- The positive effect of economic growth on health is not enough to eliminate the negative effect of emissions, which surfaces after an economic crisis.
  - To preserve this beneficial impact in the long run and avoid negative emission dynamics after the crisis, policy responses to financial crises should not forget to include stricter environmental regulations and green investments.
- Maintaining environmental sustainability, even in times of recession, is crucial for improving the health of the population and mitigating the effects of air pollution on premature mortality.

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Thank you for your attention

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