



CPB Netherlands Bureau for Economic
Policy Analysis



Early-warning indicators for debt sustainability

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Our main message in the words of Rudi Dornbusch

Think of someone who has made a great expertise of drunk driving, regularly drives drunk, tells you that he never has a problem, and one day there is a terrible, terrible accident. And he'll say, "Well, it was the red light. It wasn't my being drunk. Normally that light is green."



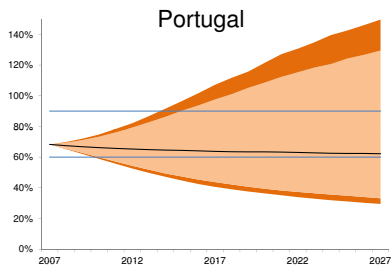
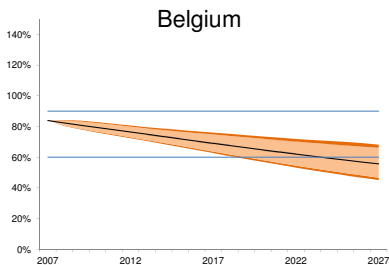
How to assess debt sustainability?

- A sustainable fiscal policy can be continued without losing control over the debt level
- Towards stochastic analysis
 - ▶ macro-volatility of interest and growth (economic uncertainty)
 - ▶ response of fiscal policy to setbacks (policy maker)
- Indicator captures upward risk of the debt level
 - ▶ Expected debt increase which happens every 40 years
 - ▶ In 2007, indicator identifies countries with sustainability issues
 - ▶ Complements SGP (3%, 60%) and ageing (S1, S2) indicators



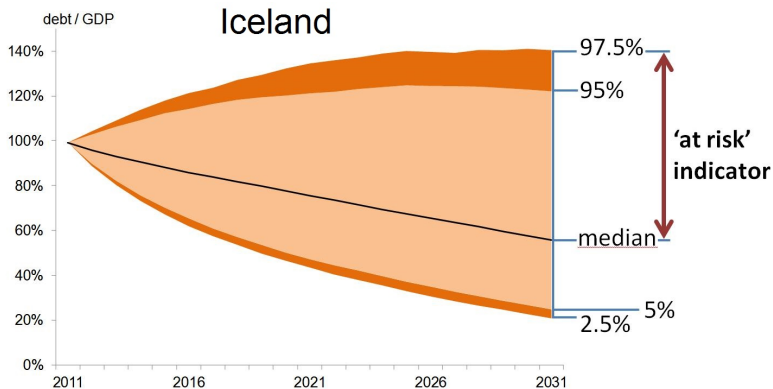
Stochastic analysis

Which government is more 'in control of its debt level'?





'at risk' indicator captures upward risk





Rest of the presentation

1. What drives the debt level?
2. Theoretical debt sustainability: Modified Aaron condition
3. Stochastic simulations
4. The added value of the indicator



What drives the debt level?

- Accounting equation for the debt level:

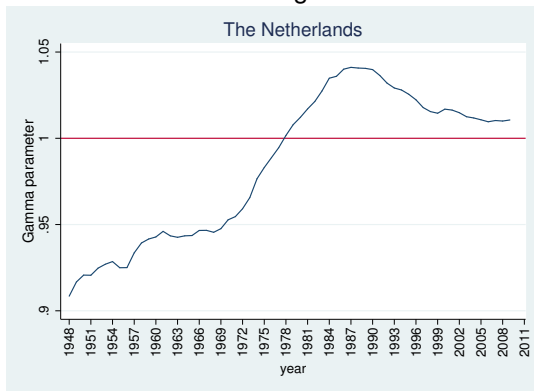
$$\text{debt}_{t+1} = \frac{1 + \text{interest}_t}{1 + \text{growth}_t} \times \text{debt}_t - \text{primary surplus}_t.$$

- Contributing channels
 - Growth
 - Interest
 - Surplus (fiscal response)



Autonomous debt reduction till 80s

Interest minus growth rate





What drives the debt level?

- Accounting equation for the debt level:

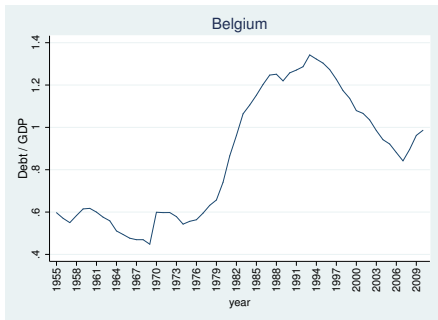
$$\text{debt}_{t+1} = \frac{1 + \text{interest}_t}{1 + \text{growth}_t} \times \text{debt}_t - \text{primary surplus}_t.$$

- Contributing channels
 1. Growth
 2. Interest
 3. Surplus (fiscal response)

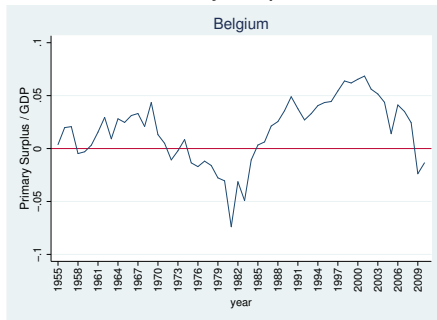


When Belgian debt increased, government budget responded

Debt ratio



Primary surplus

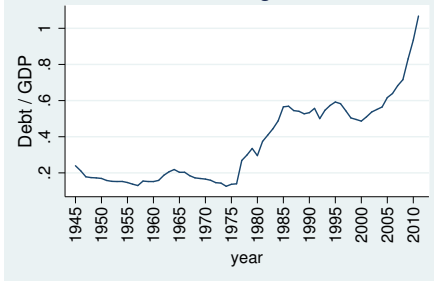




When Portuguese debt increased, government budget did not respond

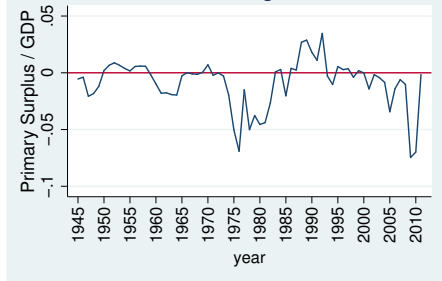
Debt ratio

Portugal



Primary surplus

Portugal





Theoretical debt sustainability: Modified Aaron condition

Modified Aaron condition: **interest** — **growth** — **fiscal response** < 0.

with fiscal response the estimated responsiveness of surplus to debt.
Then: If this condition is satisfied, debt converges to a steady state.



Data, simulation method & results



Data: long time series for fiscal response estimation

- Main results: Post-WW2 data
- Robustness: entire sample

Country	Sample	Observations
USA	1792-2011	220
GBR	1691-2011	321
NLD	1816-2011*	188
BEL	1830-2011*	160
DEU	1970-2011	42
ITA	1862-2011	150
ESP	1850-2011*	159
PRT	1852-2011	160
ISL	1908-2011	103

* = War data missing



Modified Aaron condition satisfied for all countries

Table 1 Modified Aaron condition for stability of public debt¹³

	USA	GBR	NLD	BEL	DEU	ITA	ESP	PRT	ISL
	1948-2009	1946-2011	1946-2011	1955-2011	1970-2011	1946-2011	1946-2011	1945-2011	1946-2011
Interest rate r	2.2	1.5	2.1	4.4	3.6	-1.2	-0.1	-3.6	-5.4
Growth rate g	3.2	2.2	3.7	2.8	2.5	4.4	4.2	3.8	5.3
Aaron cond. $r-g (<0)$	-0.9	-0.7	-1.6	1.6	1.0	-5.5	-4.3	-7.3	-10.7
Fiscal response b	7.8 ^{***}	4.5 ^{***}	7.7 ^{***}	3.8 ^{***}	2.6 [*]	7.1 ^{***}	0.5	-0.5	-0.2
Mod. Aaron cond. $r-g-b (<0)$	-8.7	-5.2	-9.3	-2.2	-1.6	-12.6	-4.8	-6.8	-10.5

Units are percentages; italic and grey = not significant, * = significant at 10% level, ** = significant at 5% level, *** = significant at 1% level.



Historically debt was sustainable

- High growth and low real interest contributes to sustainability
- Fiscal response significant and positive for USA, GBR, NLD, BEL, DEU and ITA not significant for ESP, PRT and ISL
- Fiscal response robust when pre-WWII years are included
⇒ measures persistent institutional characteristic



Since mid 80s: fiscal response required

Table 2 Aaron condition ($r-g < 0$) no longer satisfied in many countries after 1987

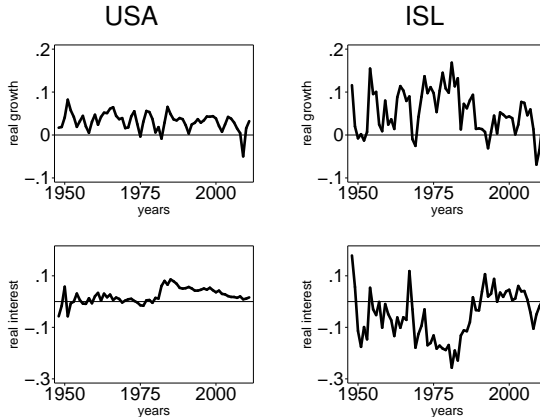
	USA	GBR	NLD	BEL	DEU	ITA	ESP	PRT	ISL	Average
Aaron condition before 1987	-2.2	-2.0	-3.2	0.9	0.0	-7.3	-8.8	-9.7	-15.2	-5.3
Aaron condition after 1987	1.1	1.3	2.0	2.1	2.4	2.0	4.1	-2.6	-2.7	1.1

Units are percentages.

- growth > interest prior to 1987 and interest > growth afterwards
⇒ fiscal response required for sustainability
- How *bad* is it?
⇒ Simulation needed



Volatility much higher in Iceland





Stochastic simulation

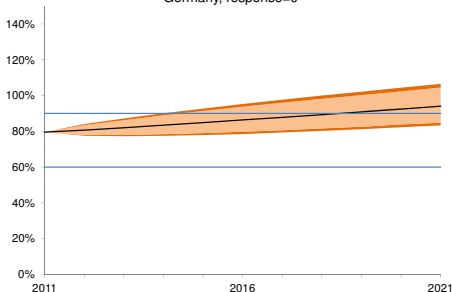
Simulate debt going forward:

1. Estimate the fiscal response
2. Simulate volatility in interest and growth rates (Budina and van Wijnbergen, 2008) using a VAR
3. Simulate debt at time $t + 1$ from time t debt, simulated volatility in interest and growth and estimated fiscal response

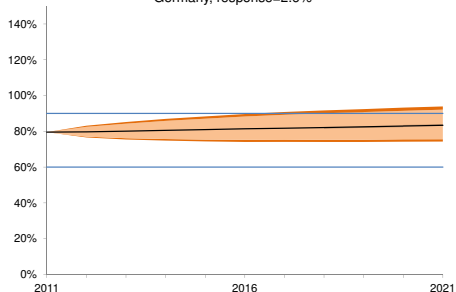


Fiscal response reduces debt levels and volatility

Germany, response=0



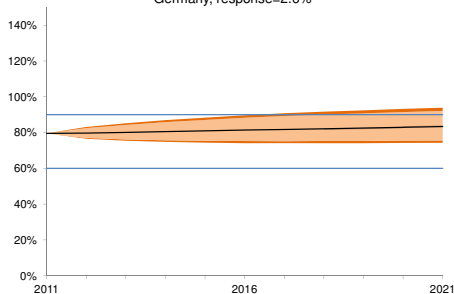
Germany, response=2.6%



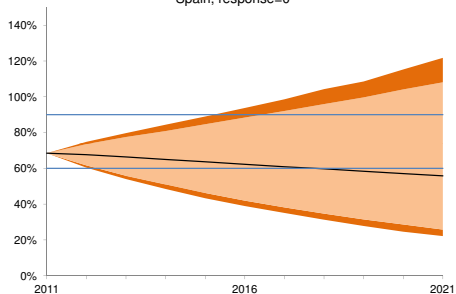


Volatility in interest and growth increase debt volatility

Germany, response=2.6%



Spain, response=0



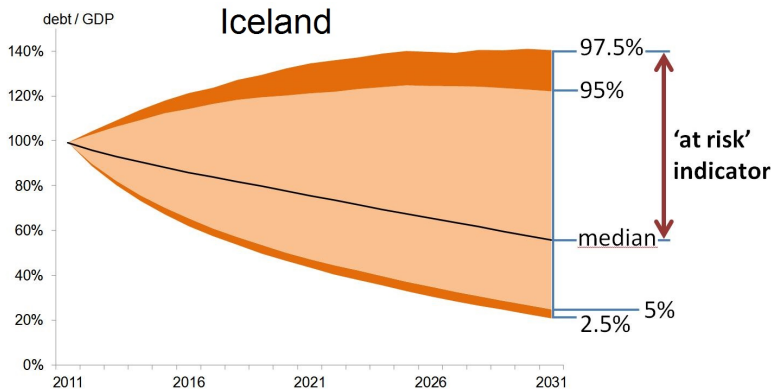


Simulation outcomes

- Larger fiscal response reduces debt levels
- Larger fiscal response and smaller interest and growth rate volatility reduce debt volatility
- Define 'at risk' indicator: debt level that is higher than 97.5% of the debt levels minus median debt level after 10 years.
Remaining 2.5% \approx once every 40 years



'at risk' indicator





2011 indicator

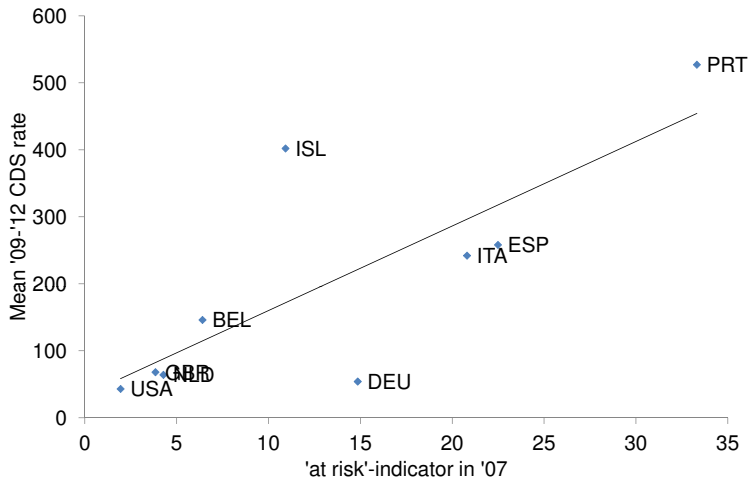
	2011 Initial debt	2021 Median debt	2021 'At risk'
USA	102	89	6
GBR	82	73	9
NLD	65	50	8
BEL	99	83	6
DEU	80	83	11
ITA	120	137	33
ESP	68	56	59
PRT	107	199	167
ISL	99	78	54

Note: Debt levels and indicators in percent of GDP.



Early-warning indicator

- '07 indicator value is highly correlated with '09-'12 sovereign spreads.
- '07 sovereign spreads are not correlated with '09-'12 sovereign spreads





Discussion



How to use the indicators?

- Assess whether fiscal response is sufficient to sustain medium term debt levels when other instruments are absent
- NOT: Ability to refinance or probability of liquidity crisis

Complements current set of indicators:

- Debt-level (SGP norms)
- Structural balances
- Ageing study sustainability indicators



Take aways

- Medium term debt sustainability depends on macro-volatility
⇒ Stochastic simulation required
- And country specific response of fiscal policy
- Our framework first step towards full stochastic analysis
- The 'at risk'- indicator distinguishes countries with sustainability issues (ITA, ESP, PRT) from countries without (USA, GBR, NLD, BEL)



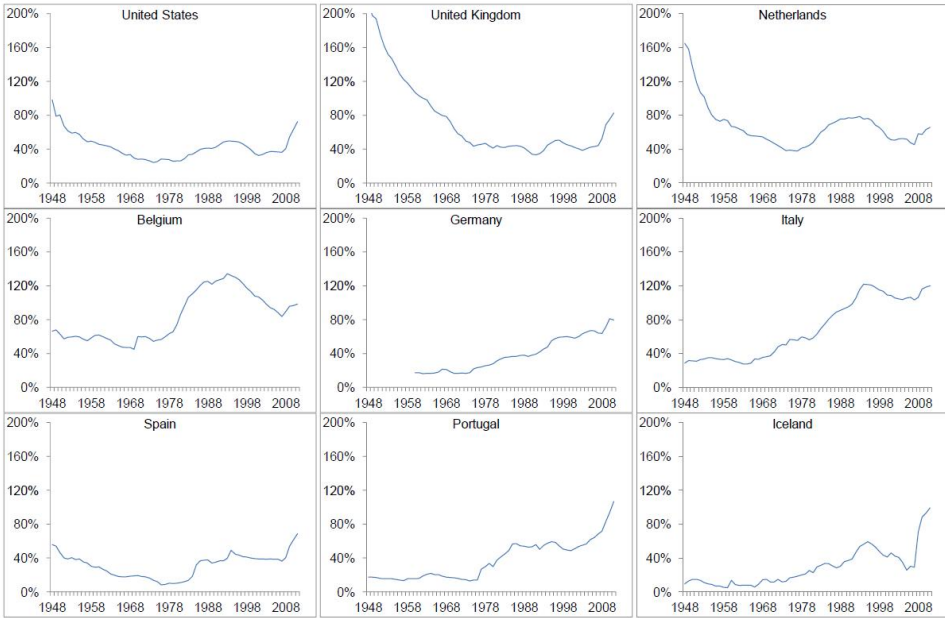
Thank you for your attention!



Bibliography I

- Bohn, H. (2007). “Are Stationary and Cointegration Restrictions Really Necessary for the Intertemporal Budget Constrainting?”, *Journal of Monetary Economics* 54(7): 1837–1847.
- Budina, N. and van Wijnbergen, S. (2008). “Quantitative Approaches to Fiscal Sustainability Analysis: A Case Study of Turkey since the Crisis of 2001”, *World Bank Economic Review* 23(1): 119–140.

Figure 1 Debt-to-GDP ratios in the post-war period





Estimating the fiscal response

- Estimation:

$$\text{primary surplus}_t = \alpha + \text{fiscal response} \times \text{debt}_t + \beta \text{ other}_t + \varepsilon_t.$$

- 'Other' corrects for:
 - ▶ Business cycle
 - ▶ Temporary government spending
- Fiscal response:
 - ▶ Measures long-term response of fiscal policy to government debt
 - ▶ Indicates whether governments reduce their debt over time



Stationarity conditions

From Bohn (2007) we know:

$\delta < 1$ Debt stationary, steady state $-\gamma\alpha/(1 - \delta)$

$1 < \delta < \rho$ Debt explosive but consistent with the IBC

$1 < \delta$ and $\rho < \delta$ Debt explosive

For $\delta = \frac{1+r}{1+y}(1 - \rho)$



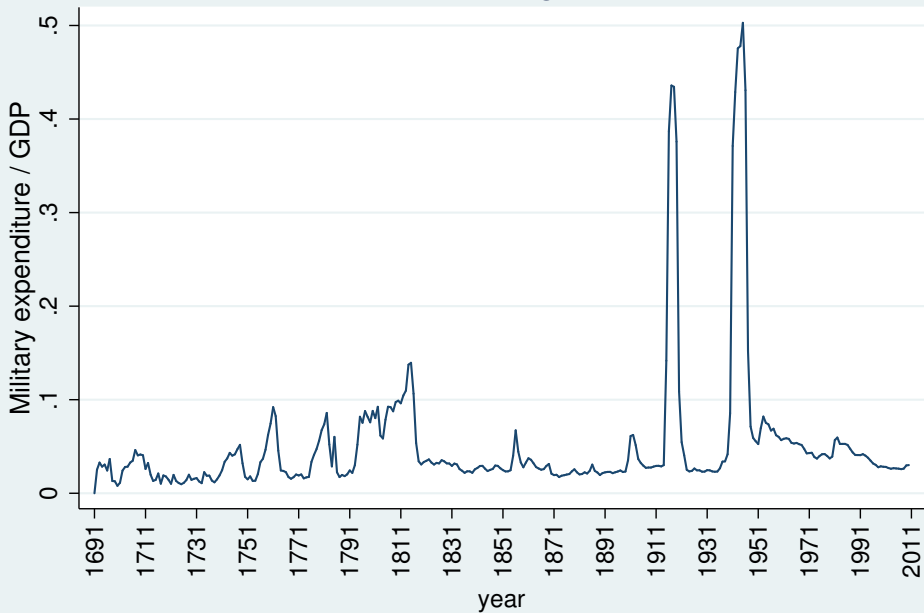
Fiscal response

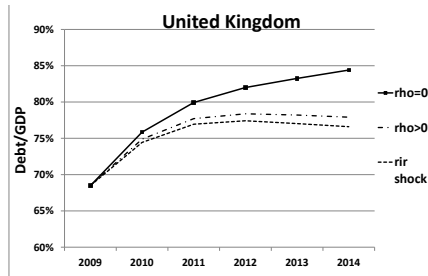
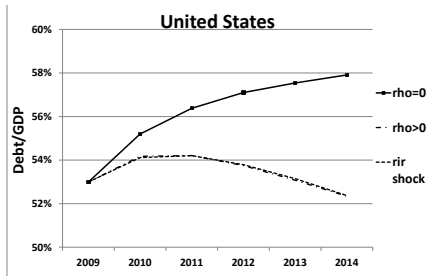
- Estimation:

$$s_t = \alpha + \rho d_t + \beta \mathbf{Z}_t + \varepsilon_t.$$

- With \mathbf{Z}_t :
 - ▶ Business cycle
 - ▶ Temporary government spending
-

United Kingdom







Empirical procedure

1. Estimate the fiscal response:

$$s_t = \alpha + \rho d_t + \beta \mathbf{Z}_t + \varepsilon_t.$$

2. Estimate a VAR for interest and growth rates (Budina and van Wijnbergen, 2008):

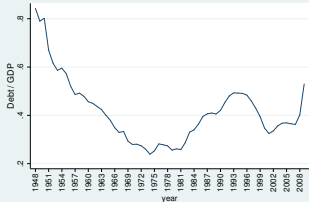
$$\begin{pmatrix} r_t \\ y_t \end{pmatrix} = \alpha_0 + \sum_{j=1}^{\infty} A_j \begin{pmatrix} r_{t-j} \\ y_{t-j} \end{pmatrix} + \eta_t, \quad \text{var}(\eta_t) = \Sigma.$$

3. Simulate debt at time $t + 1$ from time t data:

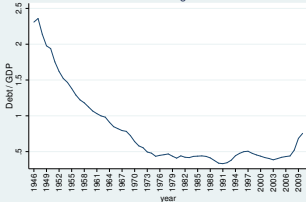
$$d_{t+1} = \frac{1 + r_t}{1 + y_t} (1 - \rho) d_t - \gamma \alpha,$$

using the VAR shocks and the fiscal response coefficients.

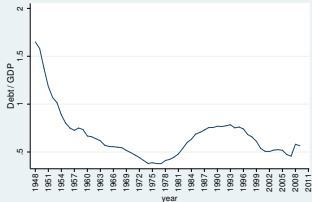
United States



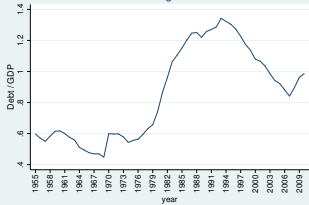
United Kingdom



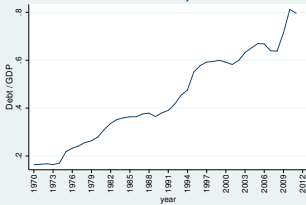
The Netherlands



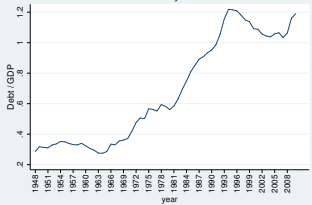
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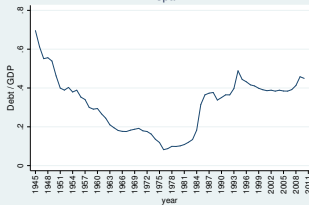
Germany



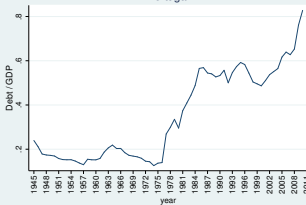
Italy



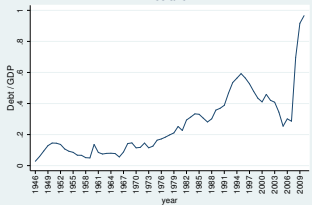
Spain

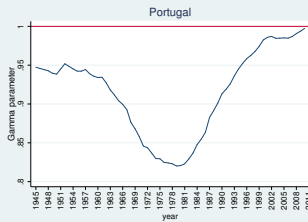
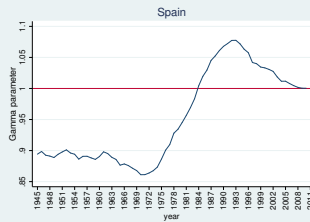
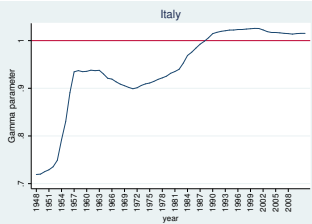
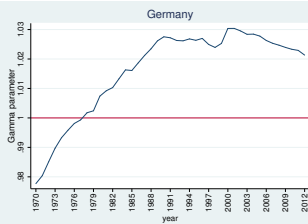
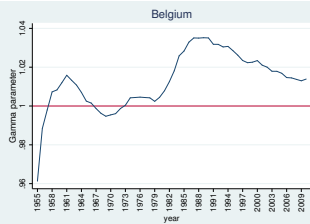
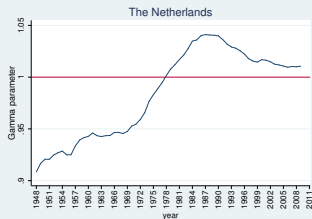
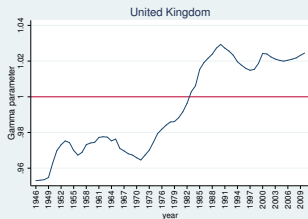
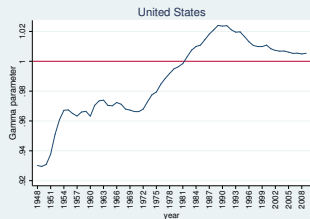


Portugal

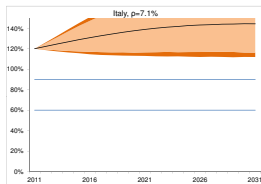
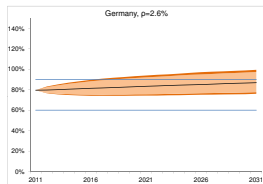
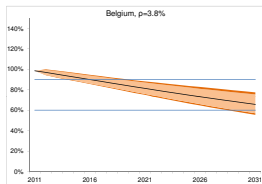
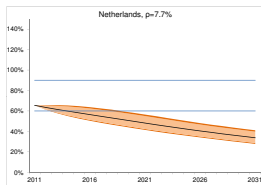
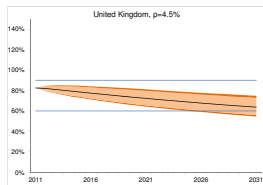
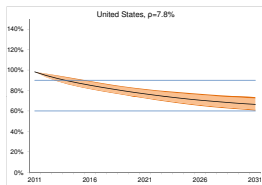


Iceland

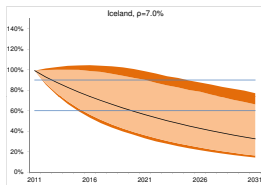
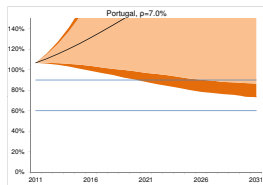
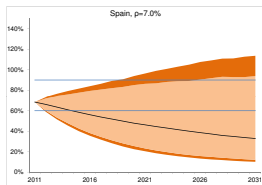




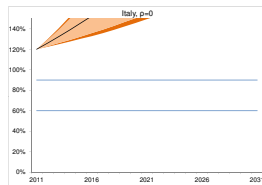
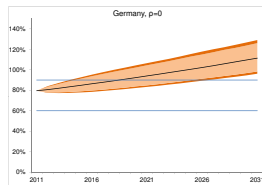
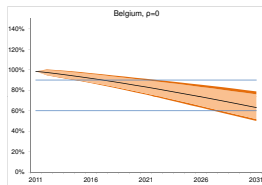
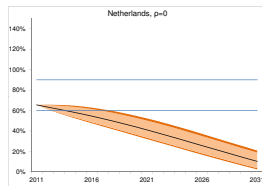
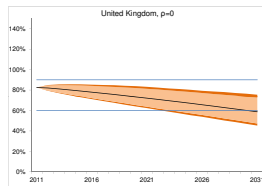
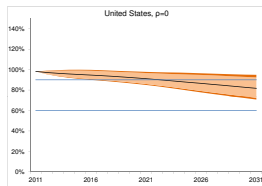
Countries with ρ significant



Countries with ρ not significant, $\rho = 0.07$ assumed



Countries with ρ significant, $\rho = 0$ assumed



Countries with ρ not significant, $\rho = 0$

