Fiscal Stress Index

Stressing the General Governments

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Definition of fiscal stress [Baldacci et al., 2011]

Fiscal stress is indicated if any of following criteria is satisfied:

- IMF-supported programme in country
- Hyperinflation ($>=35\%$)
- Public debt default, restructuring or rescheduling
- Significant sovereign bond yield spreads (two standard deviations above country-specific mean)

Signalling window

Core of early warning indicator is that it should generate signals with considerable advance. Due to this reason two scenarios of stress episodes were analysed and compared:

- Observed stress episodes (Scenario 1)
- Stress episodes "moved" two quarters earlier (lead stress) before actual event. Stress period data is omitted based on fact that during crisis, behaviour of economics is systematically different. (Scenario 2)
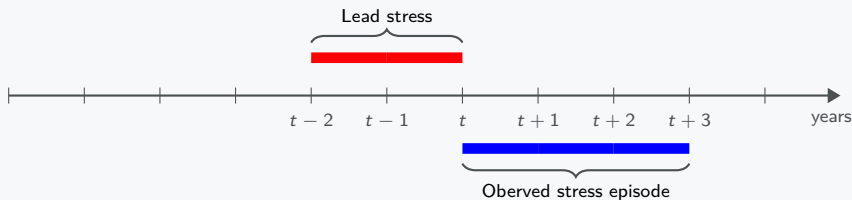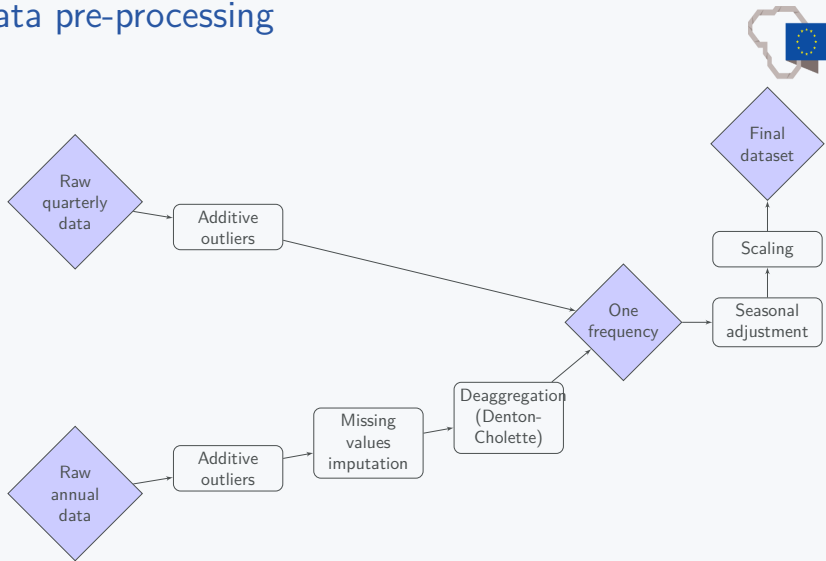
Methods

Based on the literature, three most common approaches are concluded, to obtain fiscal stress level:

- Signal extraction
- Binary choice models
- Fiscal reaction functions

Signalling approach	✓
Binary regression	✓
FRF	To be added

Table: Progress

Data pre-processing

Data overview

- 25 European Union countries
- Quarterly data from 2000 Q1 until 2018 Q4 (76 quarters)
- 28 candidate predictors (various transformations considered)

Country	BE	BG	CZ	DK	DE	EE	IE	EL	ES	FR	IT	CY	LV	LT
Stress	2	12	2	3	3	6	13	5	4	0	4	1	13	4
Country	MT	NL	AT	PL	PT	RO	SI	SK	FI	SE	UK			
Stress	0	4	3	16	13	36	2	2	3	0	1			

Table: Number of quarters when stress was observed by country

Signalling approach

Main literature:

- Hernandez et al. "An early-detection index of fiscal stress for EU countries" [3]
- Baldacci et al. "Measuring Fiscal Vulnerability and Fiscal Stress; A Proposed Set of Indicators" [1]
- Berti et al. "An early-detection index of fiscal stress for EU countries" [2]

Method overview:

- Firstly, optimal threshold for every variable is calculated, by minimizing type I and II errors:

$$t_i^* = argmin\left(\frac{FN_i(t_i)}{Fs} + \frac{FP_i(t_i)}{Nfs}\right),$$

$i = 1, ..., n$, $n-$ number of variables.

- Secondly, weights are assigned:

$$z_i = 1 - \left(\frac{FN_i(t_i)}{Fs} + \frac{FP_i(t_i)}{Nfs}\right)$$

Thresholds

Top 5 indicators in both scenarios

| **Scenario 1**	Threshold		Signalling power	False alarms ratio	Missed crisis ratio
Balance, % GDP	-3.38	<	0.43	0.29	0.28
S80-S20	4.45	>	0.40	0.48	0.12
GINI	28.97	>	0.35	0.50	0.15
Current account, 1Y MA, % GDP	-1.09	<	0.35	0.41	0.24
Primary balance, % GDP	-1.64	<	0.35	0.25	0.40
Scenario 2					
Balance, % GDP	-3.64	<	0.40	0.27	0.29
Real GDP growth	-0.41	<	0.36	0.12	0.45
Current account, % GDP	-1.50	<	0.35	0.39	0.26
Primary balance, % GDP	-1.05	<	0.32	0.35	0.33
Change in gross debt, % GDP	1.36	>	0.31	0.21	0.48

Composite indicator

$$S0_{jt} = \sum_{i=1}^{n} \frac{z_i}{\sum\limits_{k=1}^{n} z_k} d_{jt}^i,$$
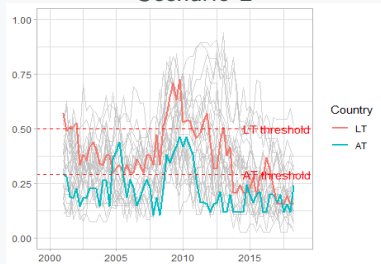
where j − country, t − time, i − variable.

Scenario 1
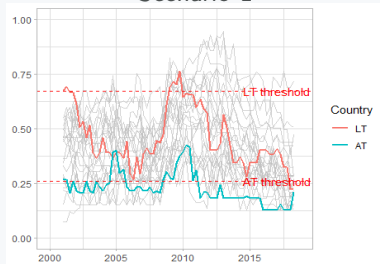
Signalling power 71 %
Missed episodes 15 %
False alarms 13%

Scenario 2

Signalling power 69 %
Missed episodes 14 %
False alarms 14%

Binary response model

Main literature:

- Manasse et al. "Predicting Sovereign Debt Crises" [4]
- Berti et al. "A Complementary Tool to Monitor Fiscal Stress in European Economies" [5]

Method overview:

Applied logistic regression for panel data using Elastic Net algorithm.

$$p\left(stress_{t,i}\right) = \phi\left(\Delta debt_{(t-4,t-1)}; Controls_{i,t}\right)$$

Pooled and Fixed effects variations of regression was estimated and compared.

Model results

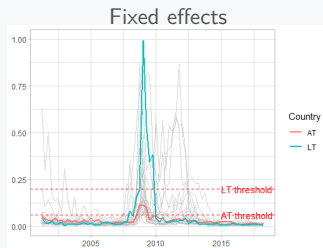|	Scenario 1		Scenario 2	
	Pooled	FE	Pooled	FE
Intercept	-4.11	-4.48	-3.69	-4.26
Change in debt$_{(t-4,t-1)}$	1.68	2.71	2.21	6.11
Short-term debt, % GDP	-0.99	-7.81		
Change in final consumption, % GDP	-1.30	-0.44		
Final consumption, % GDP	-3.77			
Nominal interest rate		-33.95		
Current account, 1Y MA, % GDP			-0.01	-0.02
Nominal unit labour cost		-0.02	0.01	0.02
Non-financial corp. debt,% GDP		0.55		
Part of non-employed		-1.95		
S80-S20	0.17	0.05		
GINI	0.02			
Real GDP growth	-2.91	-7.77	-8.75	-28.52
Inflation		-0.02	0.02	0.05
Interest rate	0.19	0.39	0.05	0.12
Primary balance, % GDP	-7.54	-4.96	-0.76	-2.17
Gross debt$_{t-1}$,% GDP		1.34		

Probability to be in stress

Scenario 1
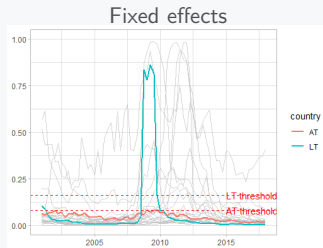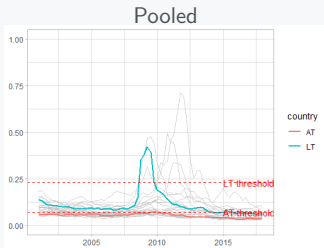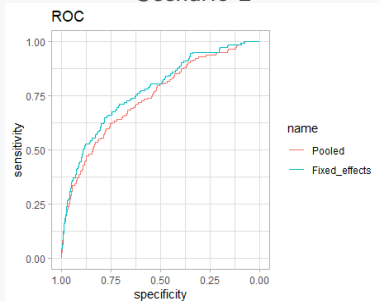

Scenario 2
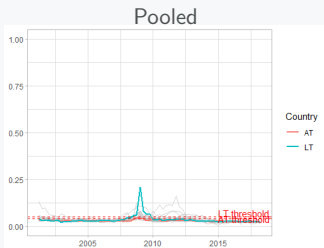
Model performance

Scenario 1
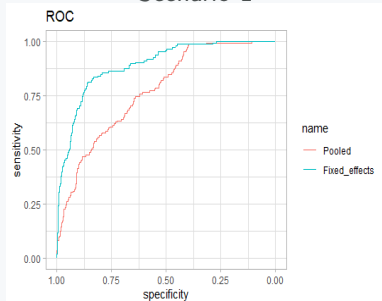
Model	SomersD	AUC
Pooled	0.62	0.80
FE	0.85	0.92

Scenario 2

Model	SomersD	AUC
Pooled	0.49	0.74
FE	0.55	0.78

Conclusions

- Highest precision is achieved with Fixed Effects regression modelling original stress episodes.
- Scenario 2 is less efficient in terms of model performance. In regression case higher number of false alarms is sent.
- Country effect significantly improves classification for both methods.

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