Machine Learning in Economics
(458657)

replication paper

Early Warning System of Fiscal Stress

**comparing the traditional logistic regression approach versus a
random forest algorithm**

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Contents

1 Introduction

DEFINITION OF EWS. This paper aims to design an early warning system which signals increased risk of a fiscal stress event in the near future.

test ob zitierung funktioniert Jarmulska (2020).

2 Literature Review

3 Model Describtion

3.1 Performance Metrics

3.2 Logit Model with LASSO penalisation

Hastie et al. (2009)

$$\hat{\beta}^{lasso} = \underset{\beta}{\operatorname{argmin}} \sum_{i=1}^{N} (y_i - \beta_0 - \sum_{j=1}^{p} x_{ij}\beta_j)^2 \quad \text{subject to} \quad \sum_{j=1}^{p} |\beta_j| \leq t \tag{1}$$

Lagrangian form

$$\hat{\beta}^{lasso} = \underset{\beta}{\operatorname{argmin}} \left\{ \frac{1}{2} \sum_{i=1}^{N} (y_i - \beta_0 - \sum_{j=1}^{p} x_{ij}\beta_j)^2 + \lambda \sum_{j=1}^{p} |\beta_j| \right\} \tag{2}$$

3.3 Random Forest

Gini index

$$g(w) = \sum_{k \neq j} p_{wk} p_{wj} = \sum_{k} p_{wk}(1 - p_{wk}) \tag{3}$$

4 Data Describtion

4.1 Dependent Variable

definition of a fiscal stress event

empirical/historical data about fiscal stress events

4.2 Explanatory Variables

5 Empirical Results

5.1 Performance

|	Logit LASSO		Random Forest	
	advanced dummy	GDP per capita	advanced dummy	GDP per capita
% of correctly classified stress episodes	85.18	78.17	87.69	88.61
% of correctly classified tranquil episodes	55.86	66.21	67.64	68.89
Average	70.52	72.19	77.66	78.75
AUROC	0.83	0.85	0.88	0.89

Table 1: Average prediction accuracy of early warning models for years 2009-2018 (all observations used)

5.2 Interpretability

5.2.1 Variable Importance and Shapley Values

Breiman's Variable Importance

Shapley Values

4
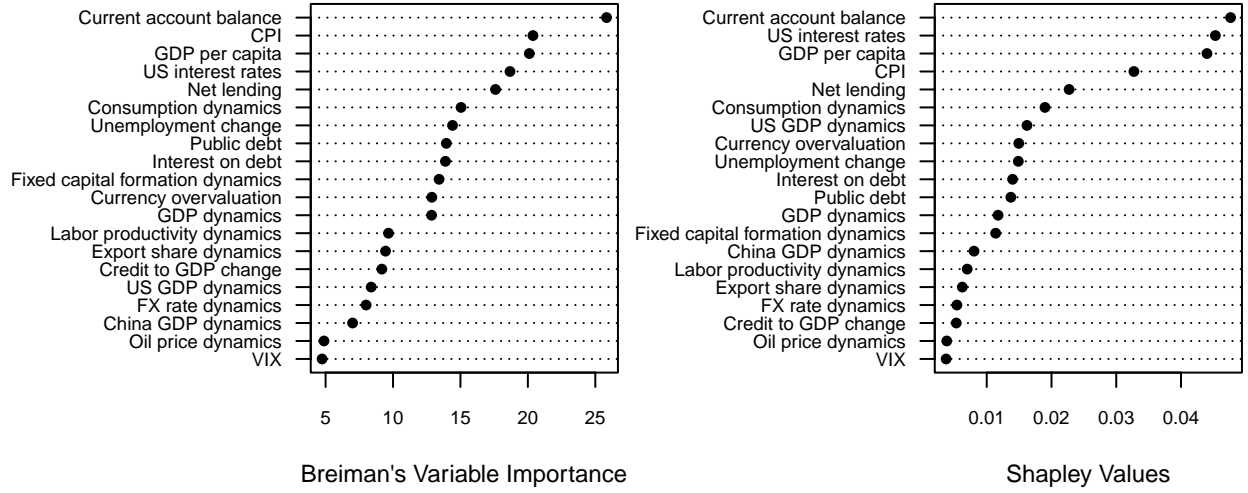
5.2.2   Partial dependence plots and Accumulated local effects plots
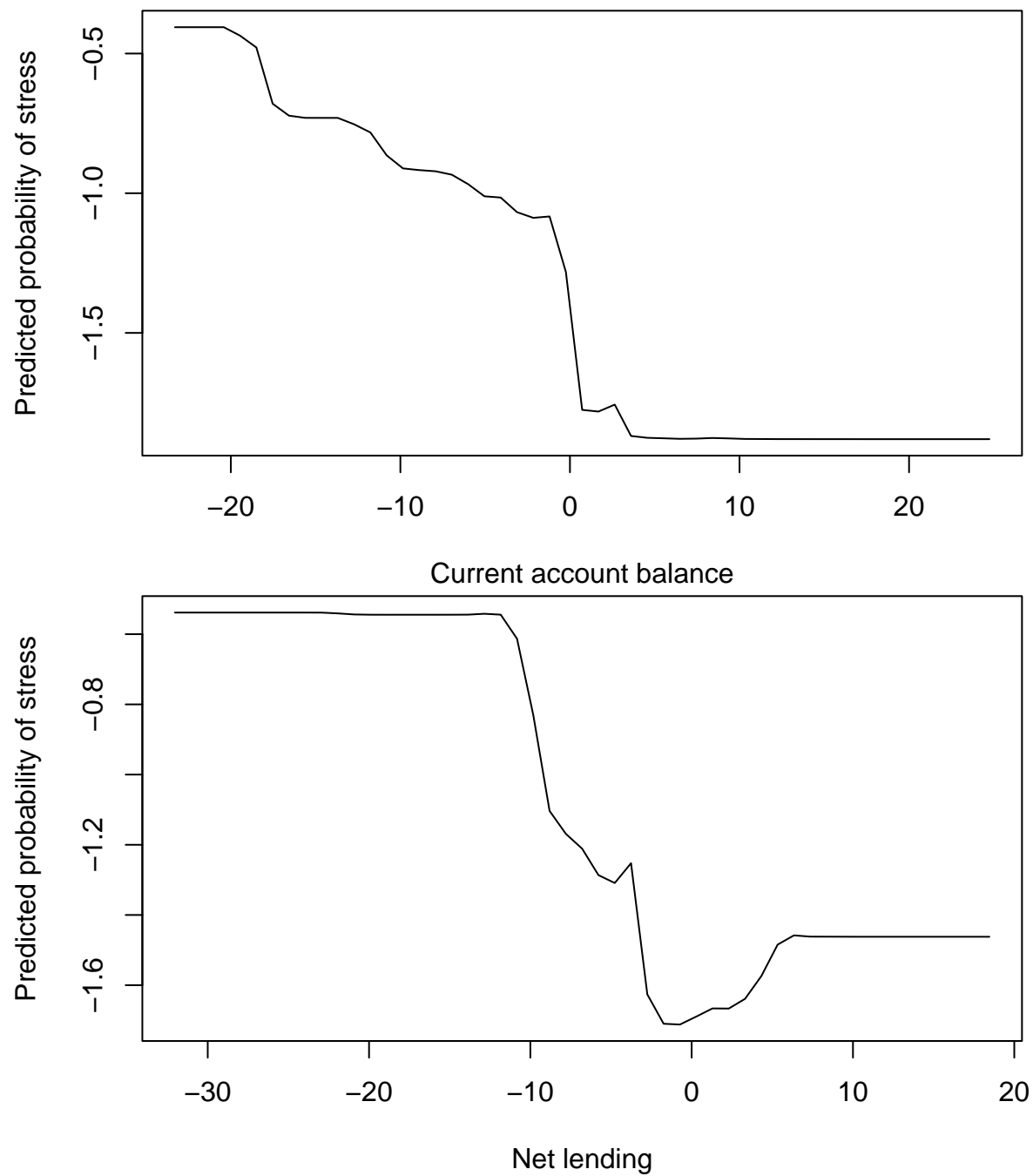

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## NULL
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6   Conclusion

7 References

Hastie, Trevor, Robert Tibshirani, Jerome H Friedman, and Jerome H Friedman. 2009. *The Elements of Statistical Learning: Data Mining, Inference, and Prediction.* Vol. 2. Springer.

Jarmulska, Barbara. 2020. "Random Forest Versus Logit Models: Which Offers Better Early Warning of Fiscal Stress?" *ECB Working Paper Series No 2408 / May 2020.*