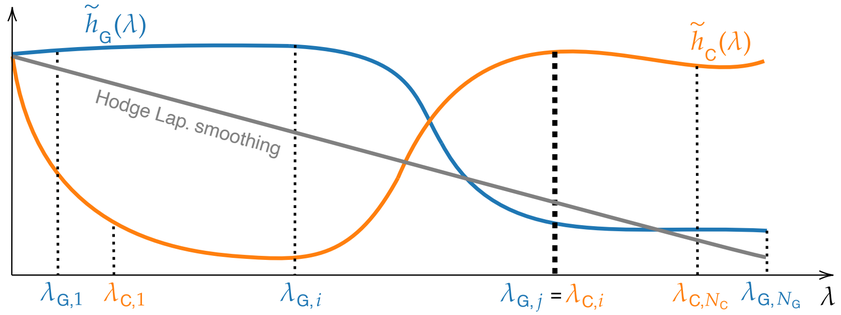
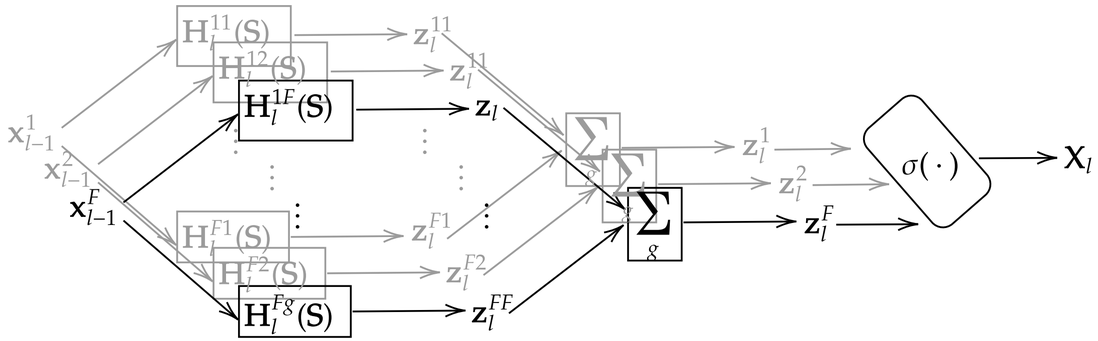
Convolutional Learning on SCs

Linear

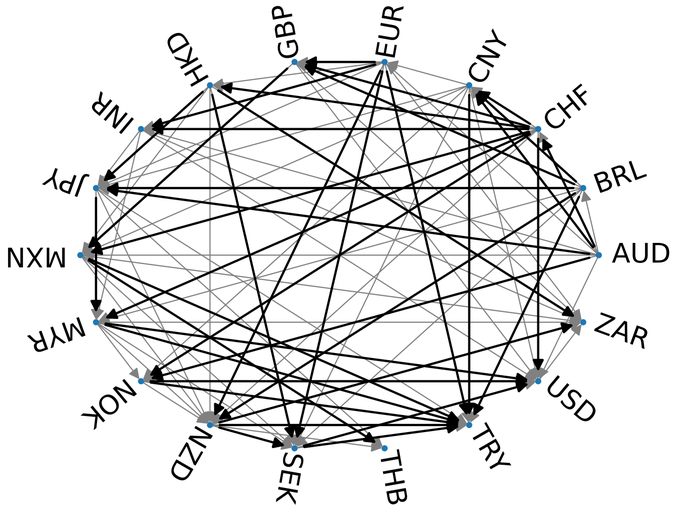
$$\mathbf{H} := \mathbf{H}(\mathbf{L}_{\mathrm{d}}, \mathbf{L}_{\mathrm{u}}; \boldsymbol{\alpha}, \boldsymbol{\beta}) = \sum_{k=0}^{K_{\mathrm{d}}} \alpha_k \mathbf{L}_{\mathrm{d}}^k + \sum_{k=0}^{K_{\mathrm{u}}} \beta_k \mathbf{L}_{\mathrm{u}}^k$$

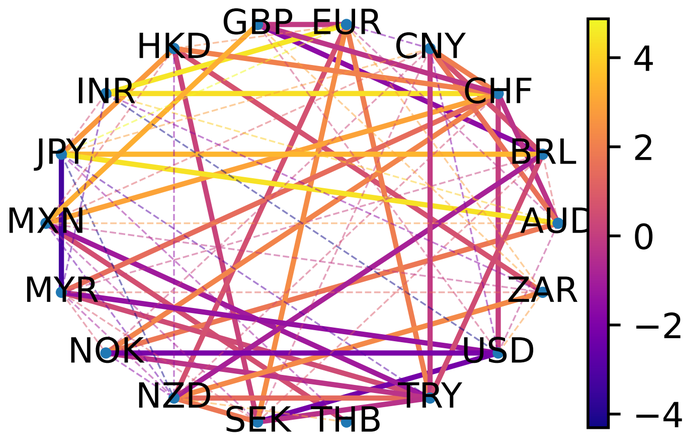


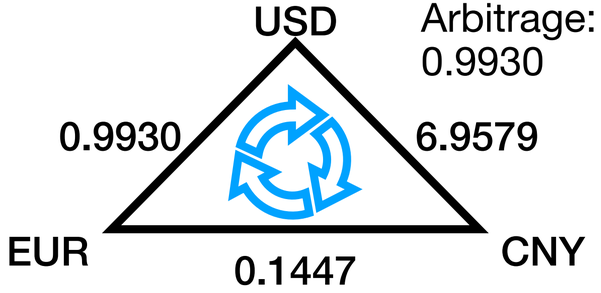
Non-Linear



Learning for Forex







$$r^{a/b} r^{b/c} = r^{a/c}$$ Arbitrage-free

$$f_{[a,b]} + f_{[b,c]} - f_{[a,c]} = 0$$ Curl-free

Table 1: Forex results (nmse|total arbitrage, ↓).

Methods	Random Noise	Curl Noise	Interpolation
Input	$0.119_{\pm 0.004}$|$29.19_{\pm 0.874}$	$0.552_{\pm 0.027}$|$122.4_{\pm 5.90}$	$0.717_{\pm .030}$|$106.4_{\pm 0.902}$
Baseline (ℓ_2 regularization)	$0.036_{\pm 0.005}$|$2.29_{\pm 0.079}$	$0.050_{\pm 0.002}$|$11.12_{\pm 0.537}$	$0.534_{\pm 0.043}$|$9.67_{\pm 0.082}$
SNN (Ebli et al., 2020)	$0.110_{\pm 0.005}$|$23.24_{\pm 1.03}$	$0.446_{\pm 0.017}$|$86.95_{\pm 2.20}$	$0.702_{\pm 0.033}$|$104.74_{\pm 1.04}$
PSNN (Roddenberry et al., 2021)	$0.008_{\pm 0.001}$|$0.984_{\pm 0.170}$	$0.000_{\pm 0.000}$|$0.000_{\pm 0.000}$	$0.009_{\pm 0.001}$|$1.13_{\pm 0.329}$
MPSN (Bodnar et al., 2021b)	$0.039_{\pm 0.004}$|$7.74_{\pm 0.88}$	$0.076_{\pm 0.012}$|$14.92_{\pm 2.49}$	$0.117_{\pm 0.063}$|$23.15_{\pm 11.7}$
SCCNN, id	$0.027_{\pm 0.005}$|$0.000_{\pm 0.000}$	$0.000_{\pm 0.000}$|$0.000_{\pm 0.000}$	$0.265_{\pm 0.036}$|$0.000_{\pm 0.000}$
SCCNN, tanh	$\mathbf{0.002_{\pm 0.000}}$|$\mathbf{0.325_{\pm 0.082}}$	$0.000_{\pm 0.000}$|$0.003_{\pm 0.003}$	$\mathbf{0.003_{\pm 0.002}}$|$\mathbf{0.279_{\pm 0.151}}$