Nonperforming Loans and Rules of Monetary Policy
preliminary and incomplete draft: any comment will be welcome

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Outline

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Goal and scope of the analysis

- Aim of the paper: to assess the empirical reliability of the "Taylor Rule" (TR), when compared with alternative central bank’s behaviour for interest rate setting
- An alternative framework, rooted in Post-Keynesian economics: different foundations with respect to the TR
- e.g.: endogenous money challenges the equilibrating role of the interest rate → transmission mechanism to investigate the complex effects on economic activity. Hence, the equation of the so called "Solvency Rule" (SR): direct relation between the interest rate and the average solvency condition of firms\(^1\)

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Two different views on monetary policy

- **TR → neoclassical economics**: the interest rate set to ensure the stability of inflation around the target rate, and the convergence of income towards its natural equilibrium.

- **SR → post-keynesian economics**: uncertain and largely undetermined effects of Central Banks’ decisions on growth and (un)employment. The decisions on the rate of interest will mainly concern the *socially acceptable rate of firms’ insolvencies in the economic system*. 
Causal nexus

The TR relies on the supposed existence of a dual causal relation:

- From the gap between target variables and their actual values \(\Rightarrow\) to the values assumed by the instrumental variables of monetary policy
- The instrumental variables \(\Rightarrow\) shall affect that gap

These links need to be tested, especially after the Great Recession: doubts on the effectiveness of monetary policy (e.g. QE policies).
Methodology

- Structural Vector Autoregressive Model (SVAR) technique
- Study of causal relations through **Indipendent Component Analysis (ICA)**\(^2\) and **LiNGAM algorithm**\(^3\)
- The approach is entirely **data-driven**: restrictions are retrieved from the data, not the results of theoretical assumptions.


Methodology cont.

- Key element: **nonperforming loans (NPL)** introduced into the analysis → *proxy for the general solvency condition of firms within the system*: introducing NPL enables to investigate the causal links relevant to both TR and SR
- The system of equations in our model acts as a sort of *stereogram*: different conclusions in economic analysis and policy depending on the viewpoint from which the equations are examined: apparently marginal changes in assumptions can lead to completely different deductions
- VAR technique with the use of ICA is well suited to this type of analysis
The model

Equation 1 is suitable for testing both a TR augmented with NPL and a SR. Equation 2 captures the key determinants of the trend of NPL. Equation 3 can be seen as an IS relation, whilst the last equation of the system is residual and gives the inflation of the next period in relation with the output gap.

\[ i_t = r^* - \alpha(\Delta \pi) + \beta(\Delta y) + \gamma(\Delta NPL) \]  \hspace{1cm} (1)

\[ (\Delta NPL) = \epsilon[(i_t - r^*) - \Delta \pi - \Delta y)] \]  \hspace{1cm} (2)

\[ \Delta y = \sigma - \omega(i_t - \pi_t) \]  \hspace{1cm} (3)

\[ \pi_{t+1} - \pi_t = \rho \Delta y \]  \hspace{1cm} (4)
United States FRED data from 1988Q1 to 2016Q4 (quarterly series).

- Federal Funds Rate ($FFR$)
- Real interest rate ($RFFR$), i.e. $FFR - PI$
- Real GDP in logarithm ($GDP$)
- Price inflation as GDP deflator ($PI$)
- Total nonperforming loans for commercial banks in logarithm ($NPL$)

All series are non-stationary.
The reduced form model:

\[ y_t = \mu_t + A_1 y_{t-1} + \ldots + A_p y_{t-p} + u_t^4 \]  

(5)

It is an approximate description of the unobserved data generating process (DGP): adequacy can be checked with the typical criteria. But it omits the mutual influences among the contemporaneous variables (within the period of observation) (among \( y_{1t}, \ldots, y_{kt} \)).

\[ y_t = (y_{1t}, \ldots, y_{kt})' \] = vector of \( k \) time series variables; \( A_i \) \( (i = 1, \ldots, p) \) = \((k \times k)\) coefficient matrices; \( u_t = (u_{1t}, \ldots, u_{kt})' \) = \( k \)-dimensional zero mean white noise process; vector \( \mu_t \) = deterministic part (can be a trend).
Structural VAR analysis cont.

We move to **Structural VAR analysis**: it attempts to identify structural, i.e. causally meaningful, relations among the variables.

\[
\Gamma_0 y_t = \nu_t + \Gamma_1 y_{t-1} + \ldots + \Gamma_p y_{t-p} + \varepsilon_t \tag{6}
\]

Let \( B = I - \Gamma_0 \). Thus equation (6) can be rewritten as

\[
y_t = \nu_t + By_t + \Gamma_1 y_{t-1} + \ldots + \Gamma_p y_{t-p} + \varepsilon_t \tag{7}
\]

It cannot be directly estimated by linear regression: some elements of \( y_t \) may cause within the period other elements of \( y_t \).

\(^5\Gamma_0 = (k \times k)\) matrix reflecting the instantaneous relations; \( \Gamma_i \) \((i = 1, \ldots, p)\) = coefficient matrices of the lagged structural relations, reflecting causal influences present in the DGP.
Indipendent Component Analysis

Structural VAR analysis is focused on imposing restrictions on $\Gamma_0$ so that it can be retrieved from the data.

- Restrictions on $\Gamma_0$ usually derived from theoretical or institutional knowledge
- Instead, we apply an identification method inferring the contemporaneous causal structure on the basis of the study of the reduced-form residuals.
- Our approach is based on ICA (designed for non-Gaussian variables): the statistical properties of the residuals drive the identification procedure.
- We also check the robustness under different approaches, e.g. the method of graphical causal models
Two estimations: nominal and real interest rate

- Variables $I(1)$ in levels and thus $I(0)$ in their first-order differences. The presence of cointegrating relation not rejected (Johansen test)
- With two lags the information criteria of SchwarzBayesian (BIC) and HannanQuinn (HQC) are minimised
- Model estimated with Least Absolute Deviation (LAD) estimation
- Residuals of the reduced-form VAR non-normally distributed: normality (Shapiro-Wilk, Shapiro-Francia, and Jarque-Bera test) is rejected at 0.05 level of significance
Causal structure

We identify the causal structure among the contemporaneous variables (matrix $B$) with LiNGAM algorithm: results robust to both models. **An important determinant of immediate monetary policy actions is NPL:** not only caused by indicators of macroeconomic activity and inflation, but also by NPL.
Impulse response functions (1 std deviation)
Forecast Variance Decomposition

Variance Decomposition of GDP

Variance Decomposition of NPL

Variance Decomposition of PI

Variance Decomposition of FFR
Main results

- The policy instrument responds to immediate change of all the variables relevant to both rules: GDP, inflation, and NPL.
- Effect of a monetary policy shock on GDP is significant only after about two years.
- Effect of a shock on inflation is ambiguous and insignificant for all the periods.
- Effect of a contractionary shock on NPL is positive and significant after about 1 year and for about 4 years.
Main results cont.

The empirical analysis sheds new light on the causal role of NPL: insolvencies a crucial outcome of monetary policy. We do not find causal relations that confirm the ability of the monetary authority to move inflation to its target level and stabilise output in the short-run.

- \( FFR \Rightarrow PI \): no impact
- \( FFR \Rightarrow GDP \): extremely low impact
- \( GDP \Rightarrow FFR \): positive only short run impact
- \( FFR \Rightarrow NPL \): significant and long lasting
- \( NPL \Rightarrow FFR \): negative short run impact