Assessing the effect of 2008 crisis on Brazilian Economy.

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Talking points

Motivation

Objectives

Literature Review

Methodology

Preliminary Results

Preliminar Conclusions

Motivation

- *"September and October of 2008 was the worst financial crisis in global history, including the Great Depression." - Ben Bernanke*
- Economists agree that it was an unexpected, severe and global incident;
- We will try to estimate the effects of 2008 event on Brazilian real activity;

Objectives

- Estimate and analyse the effect of 2008 crisis in Brazilian Industrial Production;
- Investigate if the magnitude of effects is inline, below or above expected;

Econometric Challenge:

- 2008 crisis had a global effect.
- It's hard to find a untreated unit

Econometric Challenge:

- 2008 crisis had a global effect.
- It's almost impossible to find a untreated unit

Literature Review

- Assessing the effect of a policy:
  - The microeconometric evaluation approach (Imbens and Wooldrigde (2009) for a survey of this literature);
  - The macroeconometric evaluation approach: rarely addressed and subject to the Lucas Critique (Lucas, 1976);
- Counterfactual:
  - Synthetic control method (Abadie and Gardeazabal, 2003), Abadie at al., 2012);
  - Artificial Counterfactual (Carvalho at al., 2016);
  - Tests of Policy Ineffectiveness in the context of DSGE model with Rational Expectations (Pesaran and Smith, 2014) and ARDL (Pesaran and Smith, 2016);
    - Both methods avoid Lucas Critique.

Tests of Policy Ineffectiveness (Pesaran and Smith, 2014)

Assume the economy follows the RE model:

$$A_0 \boldsymbol{q}_t = A_1 E_t(\boldsymbol{q}_{t+1}) + A_2 \boldsymbol{q}_{t-1} + A_3 \boldsymbol{s}_t + \boldsymbol{u}_t, \quad (1)$$

- where $\boldsymbol{q_t} = (y_t, z_t')'$ is the $(K_s + 1)x1$ vector of endogenous stationary variables, y_t is the target variable affected by the variables z_t, $E_t(\boldsymbol{q_{t+1}}) = E(\boldsymbol{q_{t+1}} | I_t)$ is the future expectation of the given the information set till time period t, I_t, and $\boldsymbol{s_t} = (x_t, w_t')'$ is the $(1 + K_w)x1$ vector of exogenous variables that includes the policy variable x_t and the non-policy variables w_t which are invariant to changes in x_t.
- The structural shocks, u_t, have $E(u_t) = 0$, are serially uncorrelated with constant variance matrix, typically diagonal, $E(u_t u_t') = \Sigma_u$.

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Tests of Policy Ineffectiveness (Pesaran and Smith, 2014)

- Assuming that RE model satisfies all the stationary conditions, it has the unique solution given by

$$\boldsymbol{q}_t = \Phi(\theta)\boldsymbol{q}_{t-1} + \Psi_x(\theta)x_t + \Psi_w(\theta)w_t + \Gamma(\theta)\boldsymbol{u}_t, \tag{2}$$

- where $\theta = vec(A_0, A_1, A_2, A_3)$.

Tests of Policy Ineffectiveness (Pesaran and Smith, 2014)

- Assume that the policy intervention occurs at time $t = T_0$, the pre-intervention sample that runs from $t_0 = M, M+1, ..., T_0$ and the post intervention period, $t_1 = T_0 + 1, T_0 + 2, ..., T_0 + H$:

$$\boldsymbol{q}_t = \Phi(\theta^i)\boldsymbol{q}_{t-1} + \Psi_x(\theta^i)x_t + s\Psi_w(\theta^i)w_t + \Gamma(\theta^i)\boldsymbol{u}_t, \qquad (3)$$

- for $i = \{t_0, t_1\}$.
- Thus, the policy change shifts one or more elements of θthat will affect the mean outcome through$\Phi(\theta)$ and$\Psi(\theta)$ and variance through$\Gamma(\theta)$.

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Tests of Policy Ineffectiveness (Pesaran and Smith, 2014)

The null hypothesis of no effect of the crisis can be defined by$H_0 : \theta_0 = \theta_1$;

- The estimated policy effect are given by

$$\hat{d}_{T_0+h}(\hat{\theta}_T^{t_0}) = s' \boldsymbol{q}_{T_0+h} - s' \left[\Phi(\hat{\theta}_T^{t_0})\right]^h \boldsymbol{q}_{T_0}, \qquad (4)$$

where $s = (1,0,0,...)$ is a $(k_z+1)x1$ vector.

- Thus, the policy ineffectiveness test statistic is given by

$$\tau_{d,H} = \frac{\sqrt{H}\bar{\hat{d}}_H(\hat{\theta}_T^{t_0})}{\sqrt{\hat{\omega}^2_{t_0 q} + \hat{\omega}^2_{t_0 x}}}, \qquad (5)$$

- where $\bar{\hat{d}}_H(\hat{\theta}_T^{t_0})$ is the the mean policy effect, $\sqrt{\hat{\omega}^2_{t_0 q} + \hat{\omega}^2_{t_0 x}}$is variance as function of the uncertainties related to the estimators of $\Phi(\hat{\theta}_T^{t_0})$ and$\Psi_x(\hat{\theta}_T^{t_0})$.
- Assuming that the error $u_{\cdot T_0+h}$ for h=1,2,...,H are normally distributed, then as $T \to \infty$, $\tau_{d,H} \to_d N(0,1)$.

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Data

- Monthly variables from January 1996 till June 2009;
- Brazilian variables: Industrial production growth (pibra), the base interest rate Selic (rate) and the Public Sector Deficit (psd);
- The exogenous policy variable is the American adjusted industrial production (piusa) and T-bill rate (fed);

Pre-Treatment Period

- We follow NBER dates for US Business Cycles that estimates the decline of the US economy due to Subprime financial crisis from December 2007 till June 2009;
- In the NBER definition, a recession is a significant decline in economic activity that spread across all sectors and it lasts more than a few months.
- It is effect is visible in real income, employment, real GDP, industrial production and wholesale-retail sales.

Model

- In order to implement the counterfactual analysis, we propose the following VAR model:

$$\begin{pmatrix} pibra_t \\ rate_t \\ psd_t \end{pmatrix} = \sum_{k=1}^{K_2} \Phi_{2k} \begin{pmatrix} pi_{t-k} \\ rate_{t-k} \\ psd_{t-k} \end{pmatrix} + \sum_{k=0}^{K_3} \Psi_{3k} \begin{pmatrix} piusa_{t+k} \\ fed_{t+k} \end{pmatrix} + \Gamma \boldsymbol{u}_t, \tag{6}$$

- We apply Autometrics (Doornik, 2009) to select the optimally number of lags and exogenous variables including Impulse-indicator Saturation and Seasonal Dummies.

Model

Table: VAR model

Variables	pibra Coef.	pibra P-value	rate Coef.	rate P-value	psd Coef.	psd P-value
$pibra_{t-1}$	-0.351	0.000	0.008	0.189	-9101	0.525
$pibra_{t-7}$	-0.340	0.000	0.006	0.389	21903	0.165
$rate_{t-1}$	-3.035	0.000	0.823	0.000	34274	0.832
$rate_{t-2}$	2.206	0.000	-0.092	0.180	-97732	0.527
psd_{t-1}	0.000	0.184	0.000	0.051	-1.074	0.000
psd_{t-2}	0.000	0.191	0.000	0.727	-1.138	0.000
psd_{t-3}	0.000	0.396	0.000	0.292	-0.882	0.000
psd_{t-4}	0.000	0.245	0.000	0.391	-0.676	0.000
psd_{t-5}	0.000	0.657	0.000	0.146	-0.398	0.000
$piusa_{t-8}$	1.155	0.000	-0.002	0.937	-157731	0.002
$piusa_{t-9}$	-0.309	0.091	0.011	0.621	243858	0.000
$piusa_{t-12}$	-0.515	0.058	0.099	0.004	-116366	0.128
$Constant$	0.013	0.003	0.002	0.000	361	0.759
AR 1-7 test:	2.404	0.025	1.266	0.274	1.784	0.098
ARCH 1-7 test:	0.696	0.676	0.793	0.594	1.705	0.113
Normality test:	0.911	0.634	3.687	0.158	3.340	0.188
Hetero test:	1.199	0.247	0.921	0.591	1.169	0.275

Vector

	Coef.	P-value
AR 1-7 test:	1.299	0.081
Normality test:	7.675	0.263
Hetero test:	1.031	0.389
RESET23 test:	2.130	0.051

Note: Seasonal Dummy and Impulse-indicator saturation included.

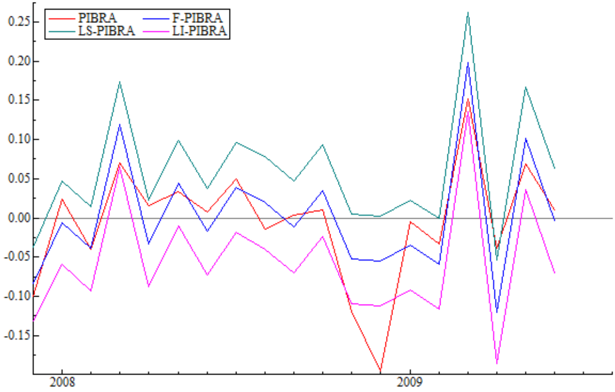
Testing the effect of the crisis

Table: τ statistic

Date	τ	P-value
2008(9)	0.105	0.458
2008(10)	-0.065	0.474
2008(11)	-0.645	0.259
2008(12)	-2.096	0.018
2009(1)	-2.144	0.016
2009(2)	-2.179	0.015
2009(3)	-3.550	0.000
2009(4)	-2.764	0.003
2009(5)	-5.023	0.000
2009(6)	**-7.260**	**0.000**

Testing the effect of the crisis

Figure: Forecast and Actual Industrial Production Growth



Preliminary Conclusions

- Brazilian Industrial Production lost nearly 9.34% a.a. from 2007M12 till 2009M6;
- Rejecting the null hypothesis means that there was significant effect;

Next Step:

- Test whether or not Brazilian economy was affect abnormaly.
- Tentative test would be a Chow or CUSUM test?
- Brown, Durbin and Evans (1975), Journal of Royal Statistical Society.