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Equilibrium Interest Rates in Brazil: A Laubach and Williams Approach

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Brazil: Equilibrium Interest Rate

- Worldwide downward trend of interest rate
- Real rates in Brazil: Convergence at last
- For the first time in the history of the country, we have a loose monetary policy and a more restrictive fiscal policy.
- Equilibrium rate is falling as fast as the effective real interest rate?
- Is Brazil going to zero real rate as Developed Countries or it is only a temporary phenomenon?

Brazil: Equilibrium Interest Rate

- Laubach and Williams (2003) focus their work in estimating the real interest rate
  - the real interest rate consistent with output equalizing potential and stable inflation –
  - based on the definition of the natural rate of interest considering deviation of output from potential.
  - the natural rate of interest estimation entails finding the potential output as well.
- Moreira and Portugal (2019) found that neutral rate at 1.8% in 19Q2.

O modelo:

IS Curve Estimates

- Output gap as dependent variable and real interest gap on the right hand side.

$$h_t = \beta_1 h_{t-1} + \beta_2 [r_t - (sv_t + \beta_3 \Delta GDP^*_{4t} + r_t^{US} + CDS_t^{5y})] + \beta_4 FCI_{t-1} + \beta_5 \Delta g_t + \beta_6 X_t + \beta_7 D_t^{08} + \varepsilon_t \qquad (1)$$

$$sv_t = sv_{t-1} + \vartheta_t \qquad (2)$$

$$r_t^* = (sv_t + \beta_3 \Delta GDP^*_{4t} + r_t^{US} + CDS_t^{5y}) \qquad (3)$$

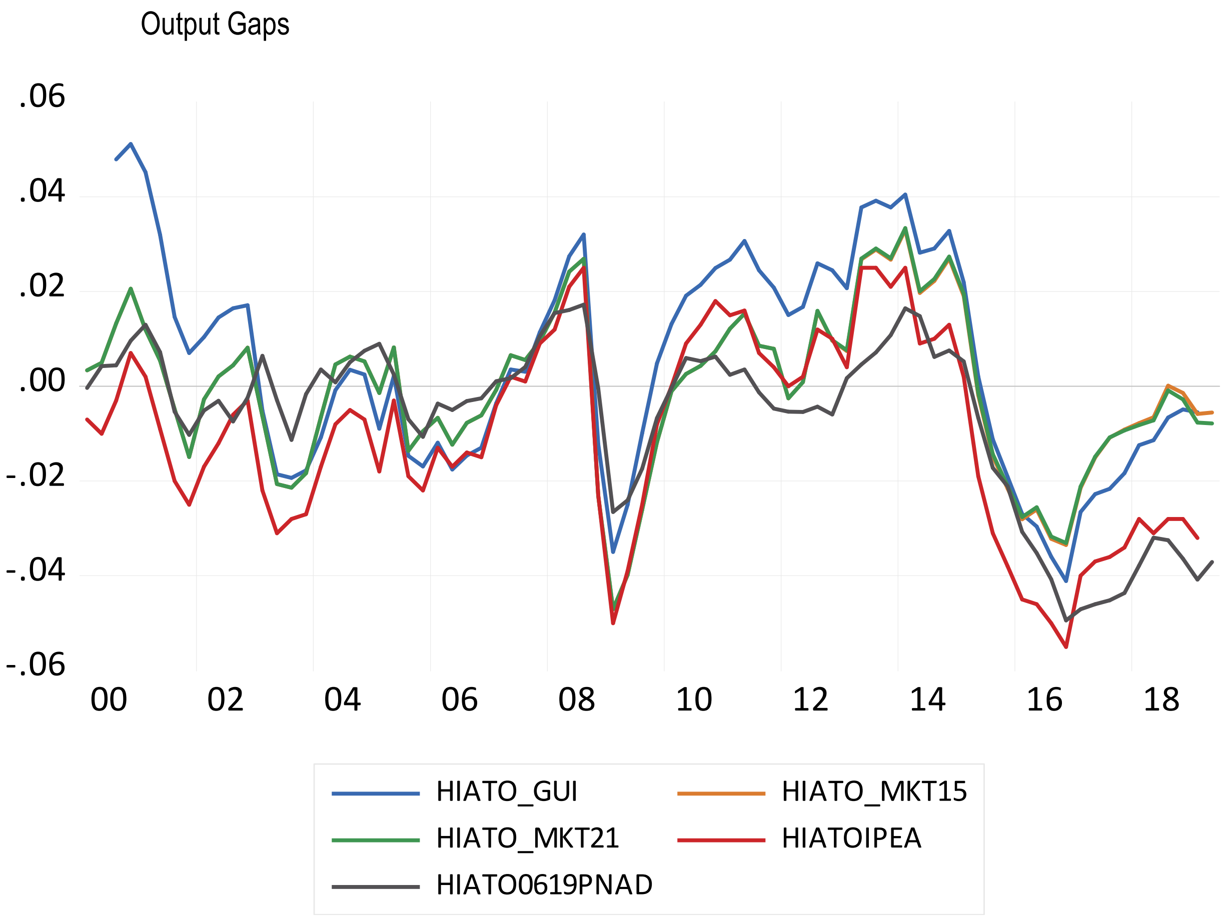
- Two additional terms – Government expenditure and credit

Dados

- Output gap (h):
  - Hodrick-Prescott filter extending the sample until 2022
  - weighting average between labor market and industrial capacity utilization slackness
- Real Rate (r) **–** it is the Selic rate deflated by 12-month ahead inflation expectation.
- ΔGDP_{4t}^{*} 4-quarter increasing in our default potential output growth
- r_t^{US} 3-month US Treasury rates
- CDS_t^{5y} Brazilian risk premium measured by Credit Defaut Swaps (with 5 year mature). residual of the risk premium against the output gap.
- FCI financial condition index. This variable is year over year household credit growth controlled by output gap and Selic rate as well**.**
- Δg_t is the first difference in central government expenditures measured in BRL terms.

Different Methodologies for Output Gap

The Hodrick Prescott has a problem to bend towards zero at the end of the sample. The Hiato 0619 is a weighted average between the lag in unemployment and the lag in capacity utilization .



Sources: IBGE and MK4

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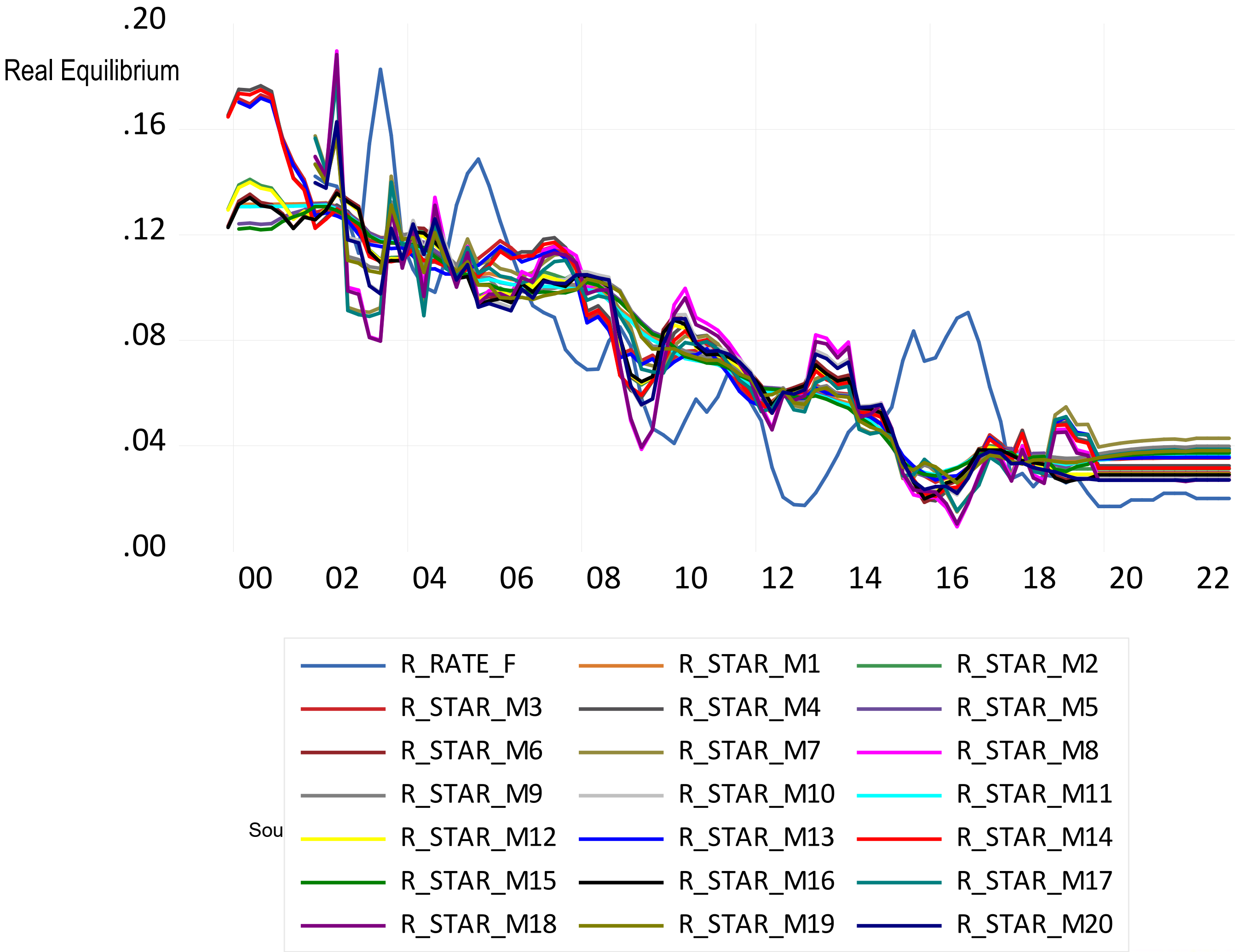
IS Estimations

	Output -1	R-rate	Potential GDP	Credit	CG Expend	Dum Crises	US inter	cds	sv1
	b(1)	b(2)	b(3)	b(4)	b(5)	b(6)	b(7)	b(8)	
Model 1	**0.74**	**-0.14**	0.73		**0.1**	**-0.04**			**0.028**
	0.03	0.02	0.46		0.014	0.002	0		0.013
Model 3	**0.74**	**-0.132**	0.33		**0.1**	**-0.039**	-1		**0.037**
	0.03	0.021	0.46		0.013	0.0027			0.014
Model 5	**0.75**	**-0.137**	0.93		**0.11**	**-0.042**	-0.25		**0.026**
	0.034	0.025	0.53		0.014	0.0038	0.49		0.014
Model 7	**0.74**	**-0.12**	**1.21**		**0.1**	**-0.041**	-1	-1	**0.04**
	0.034	0.018	0.45		0.014	0.0028			0.015
Modelo 9	**0.74**	**-0.14**	**1.19**		**0.1**	**-0.042**	-0.075	**0.52**	**0.031**
	0.035	0.026	0.53		0.015	0.002	0.49	0.24	0.014
Model 11	**0.76**	**-0.13**	0.63	0.03	**0.1**	**-0.04**			**0.027**
	0.03	0.019	0.51	0.018	0.014	0.003			0.013
Model 13	**0.76**	**-0.12**	0.24	0.03	**0.1**	**-0.039**	-1		**0.035**
	0.035	0.021	0.52	0.018	0.014	0.003			0.015
Model 15	**0.77**	**-0.13**	0.86	0.03	**0.11**	**-0.041**	-0.29		0.024
	0.03	0.024	0.57	0.019	0.014	0.003	0.55		0.014
Model 17	**0.76**	**-0.11**	**1.04**	**0.035**	**0.1**	**-0.04**	-1	-1	**0.039**
	0.034	0.017	0.52	0.017	0.015	0.003			0.015
Model 19	**0.76**	**-0.127**	**1.13**	0.031	**0.1**	**-0.041**	-0.1	**0.55**	**0.028**
	0.035	0.025	0.57	0.018	0.015	0.003	0.55	0.26	0.014

Different Methodologies for Interest Rate

The Hodrick Prescott has a problem to bend towards zero at the end of the sample. The Hiato 0617 is a weighted average between the lag in unemployment and the lag in capacity utilization .



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Sensitivity Analysis

	Equilibrium Real Interest Rate			
	Average		Model 19	
	2019Q3	2022Q4	2019Q3	2022Q4
Normal	3.5	3.3	3.4	3.8
High CDS	3.9	3.8	3.8	4.4
Low CDS	3.3	3	3.1	3.2
Hiato IPEA	0	0.5	neg	neg
Hiato Pnad	0.7	0.7	0.3	0.6
Hiato_gui	3.5	3.6	2.9	3.8
Hiato21	3.3	3.1	3.2	3.5

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The Brazilian Reaction Function

The estimated Taylor rule has coefficients with expected value and also statistically significantly.

Taylor Rule

Sample (adjusted): 2002Q3 2019Q3
Included observations: 69 after adjustments
LSWAPREAL360MAY19Q = C(1)*LSWAPREAL360MAY19Q(-1) + C(2)
*(LEXPECT(2)/4-LMETA(2)/4) + C(3)*HIATO0319PNAD(0)+C(10)+C(11)
*D0304+C(12)*DUM1113+C(13)*D0204(0)+C(14)*D0804(-1)+C(15)
*D0204(1)+C(15)*D0804+C(17)*D1601(-2)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.911392	0.024614	37.02697	0.0000
C(2)	0.227431	0.079322	2.867183	0.0057
C(3)	0.035857	0.011609	3.088601	0.0031
C(10)	0.001310	0.000500	2.621023	0.0111
C(11)	-0.005221	0.001444	-3.615062	0.0006
C(12)	-0.001617	0.000545	-2.965800	0.0044
C(13)	-0.004005	0.001630	-2.456484	0.0170
C(14)	-0.002831	0.001429	-1.981667	0.0522
C(15)	-0.002538	0.001137	-2.233402	0.0293
C(17)	0.003306	0.001447	2.284594	0.0259

R-squared	0.977282	Mean dependent var	0.015982
Adjusted R-squared	0.973816	S.D. dependent var	0.008656
F-statistic	282.0029	Durbin-Watson stat	1.583743
Prob(F-statistic)	0.000000		

Source: FGV-EESP

- The expected inflation coefficient is significant at 10% the as expected by Taylor
- The output gap coefficient is significant but lower than expected in calibration exercises using the Taylor rule.
- The interest rate persistence is about in line with expectation.

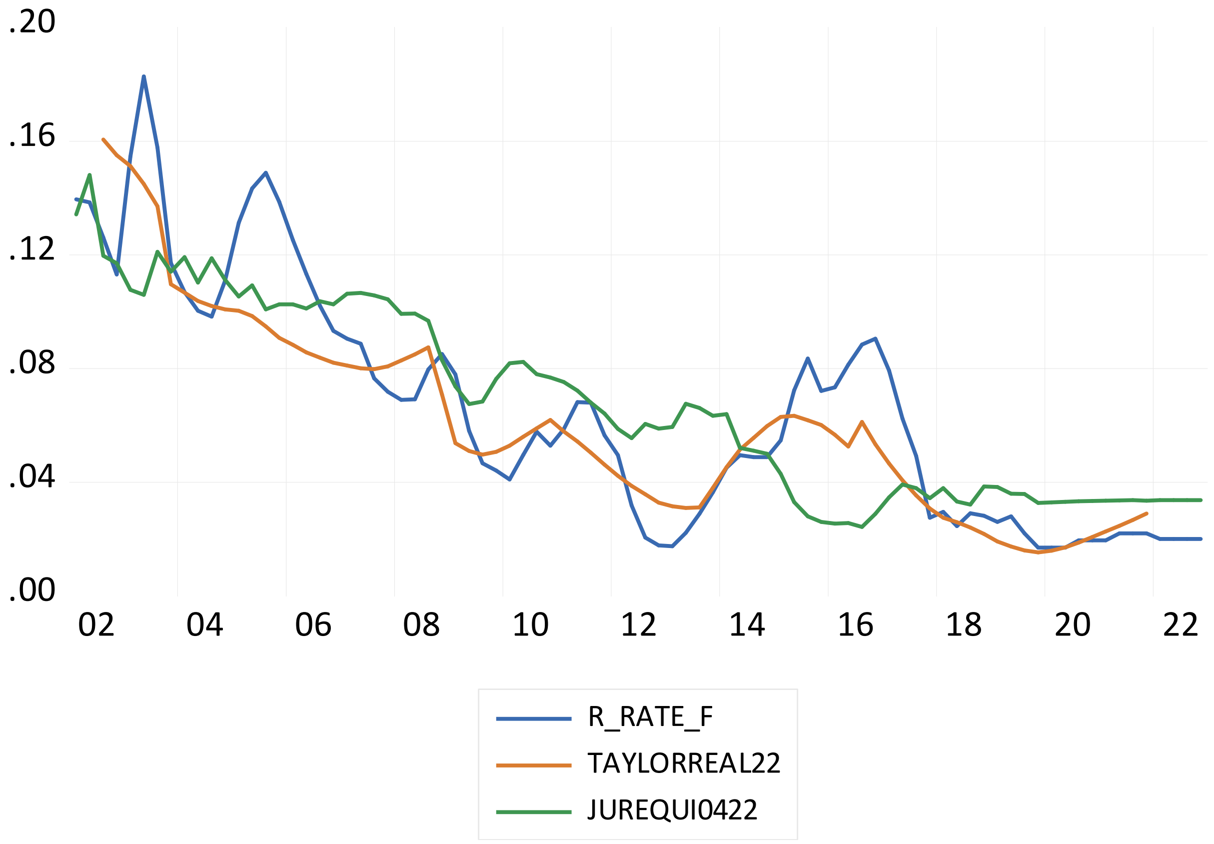
CPI Breakdown (YoY)

Time	FX	Swap 360	Inflation	Output Gap
mar/19	3.74	6.81	4.60	-4.00
jun/19	3.90	6.72	3.38	-3.64
set/19	3.99	6.56	2.95	-3.28
dez/19	4.09	5.94	3.60	-2.96
mar/20	4.14	5.89	3.37	-2.65
jun/20	4.15	5.69	3.36	-2.38
set/20	4.15	5.81	3.53	-2.12
dez/20	4.15	6.03	3.67	-1.93
mar/21	4.14	6.23	3.61	-1.75
jun/21	4.15	6.45	3.75	-1.59
set/21	4.16	6.67	3.85	-1.43
dez/21	4.16	6.91	3.45	-1.29

Sources:FGV-Macro Brasil

Interest Rate: Taylor Rule and Equilibrium Rate

The red line is the effective real interest rate and the blue is the one predicted by the Taylor Rule



Sources: MK4

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Bjornland et al. (2011): Estimating the natural rates in a simple New Keynesian framework

- A teoria novo keynesiana tornou-se a estrutura principal para a análise da política monetária.
- Um ponto de referência importante para o formulador de políticas é como a economia teria se desenvolvido caso os preços fossem totalmente flexíveis
- Chamamos taxa de juros e o nível do produto sob preços flexíveis, como taxa natural de juros e produto natural
- A estratégia da política monetária é frequentemente formulada em termos de desvios dessas taxas naturais, ou seja, em termos de hiato da taxa de juros e do hiato do produto

Bjornland et al. (2011): Estimating the natural rates in a simple New Keynesian framework

- Hiato da taxa de juros:
  - Se a taxa corrente < taxa natural ➔ Política Monetária Expansionista
  - Se a taxa corrente > taxa natural ➔ Política Monetária Contracionista
- Utilização de um modelo novo keynesiano, que é mais consistente com a abordagem de otimização e expectativas racionais, deste modo as taxas naturais serão derivadas de forma a seguir a teoria econômica
- Métodos bayesianos no processo de estimação são bastante atrativos, ao se desejar estimar parâmetros estruturais em um período relativamente curto
- Estimativas plausíveis da variação temporal das taxa natural de juros e hiatos do produto correspondentes usando estimativas bayesianas

Modelo Novo Keynesiano Simplificado

- Curva IS: $\Delta \mathrm{y_t} = \frac{\sigma}{\gamma_1(\sigma - 1)} E_t \Delta \mathrm{y_{t+1}} - \frac{\gamma_2}{\gamma_1} \Delta \mathrm{y_{t-1}} - \frac{1}{\gamma_1(\sigma - 1)} (i_t - \Delta \pi_{\mathrm{t+1}} - \rho) + \frac{1}{\gamma_1} (\nu_t - E_t \nu_{t+1})$

- Choque de preferência: :$\nu_t = \rho_\nu \nu_{t-1} + \varepsilon_t^\nu$

- Curva de Phillips: $\pi_t = \mu E_t \pi_{t+1} + (1 - \mu) \sum_{i=0}^{3} \alpha_j \pi_{t-j} + \kappa x_t + \varepsilon_t$

- Produto natural é assumido ser um processo exógeno:

$$\Delta y_t^n = \nu + \omega_t \text{ e } \omega_t = \phi \omega_{t-1} + \varrho_t$$

- O hiato do produto segue o processo: $x_t = x_{t-1} + \Delta y_t - \Delta y_t^n$

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Modelo Novo Keynesiano Simplificado

- Regra de Taylor: $i_t = \psi i_{t-1} + (1 - \psi)(i_t^n + \theta_\pi(\pi_t - \pi_t^{meta}) + \theta_x x_t) + u_t$

- A meta de inflação evolui de acordo com: $\pi_t^{meta} = (1 - \rho_\pi)\pi^* + \rho_\pi \pi_{t-1}^{meta} + \zeta_t$

- Choque para meta de inflação: $\zeta_t = \rho_\zeta \zeta_{t-1} + \varepsilon_t^\zeta$

- A taxa natural de juros:

$$i_t^n = \delta + E_t\pi_{t+1} + \sigma E_t \Delta y_{t+1}^n - \gamma_1(\sigma - 1)\Delta y_t^n - \gamma_2(\sigma - 1)\Delta y_{t-1}^n + (\sigma - 1)(\nu_t - E_t\nu_{t+1})$$

- A taxa real natural de juros é definida como: $r_t^n = i_t^n - E_t\pi_{t+1}$

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Taxa Natural Real de Juros

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Taxa Natural: DSGE e LW