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Investigating the Dynamics of Lending and Money Market Interest Rates in Brazil: A closer look to disaggregated data

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Emerson Fernandes Marçal
Pedro L. Valls Pereira

Investigating the Dynamics of Lending and Money Market Interest Rates in Brazil: A closer look to disaggregated data.*

Emerson Fernandes Marçal†

Pedro L. Valls Pereira‡

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Abstract

This paper aims to investigate if and how the dynamics of lending rates are related to money market rate in Brazilian data. In order to do this we organise a daily data set collected directed from Brazilian Central Bank that contains information on interest rate for different types of loans. The data is available for each financial institution. We investigate whether there is existence of co-integration between lending rates of different financial institutions and between lending rates and money market rates. Moreover, we test if co-integrated vector is equal to unity. Finally we investigate whether or not there is evidence of non-linearity in Data Generator Process. Our results suggest that the shocks in money market rates tend to affect lending rate, i.e. they are co-integrated but not necessarily in a one-to-one basis in the long run. We also collect evidence in favour of non linearity in the Data Generator Process. This implies that similar shocks may have different effects according to different scenarios. This conclusion has important implications, for example, for monetary policy.

JEL Codes: E52; L13; C50.

Keyword: Spreads, money market rate, lending rates, co-integration, monetary policy

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†CEMAP and Sao Paulo School of Economics - FGV

‡CEQEF and Sao Paulo School of Economics - FGV

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1 Introduction

Monetary policy is a important tool for macroeconomic stability. Policy rate is the key instrument that drives the effect on the economy. Changes in policy rates generate direct effects on bonds and lending rates with different maturities and then affect the decision of economic agents. One important channel to propagate changes in monetary policy is the interest rate channel. Lending and deposit rates should react, although not instantaneously, to changes in policy rates. If this channel is full effective, a one-to-one change reaction of lending rates to policy rate is expected at least in the long run.

Many works in international literature investigate whether or not this channel is effective using different methodologies. Recently, many papers started to use highly disaggregated data to better understand how this transmission channel works.

This paper aims to investigate if and how the dynamics lending rates are related to money market rate in Brazilian market. In order to do this we organise daily frequency data set collected directed from Brazilian Central Bank that contains information on interest rate for different types of loans and banks. The data is available for each financial institution.

We investigate the hypothesis of completeness, i.e., one-to-one transmission of policy rate to interest rate. Our methodology is to test for cointegration between policy rate and lending rates and whether or not the cointegrated vector is equal to unity. Moreover, we investigate whether or not there is evidence of non-linearity given that asymmetric adjustment can be related to market imperfections such as market power and industry specific issues. As far as the authors are aware this database has not been explored to test this type of hypothesis.

The paper is organised in the following way. Next section presents the motivation and briefly reviews the literature. Section three presents the methodology used in this paper. Section four the data set is described and section five the results are presented. The last two sections present the limitation and possible extensions of this paper as well as in the last section the final remarks. There are also six appendices where all detailed results of the tests are reported.

2 Motivation and Literature Review

Gambacorta and Leonardo [9] reviews the literature of how banks set their interest rate. Generally, scholars assume that banks operate under oligopolistic market condition. Banks are not seem as price takers, but lending rates depends on demand for loans and deposits. Macroeconomic factors drive demand for loans and deposits. Real GDP growth and inflation affect positively the demand for loans and negatively the demand for deposits.

The costs of intermediation such as screening, monitoring, branching costs, among others have a positive effect on the interest rate on loans and a negative effect on that of deposits. The risk of credit portfolio of the banks affects positively the lending rate. A high volatility in the money market rate may increase lending and deposit rates.

Monetary policy can affect banking interest rates as well throughout different channels. A monetary policy easing increases the available reserves to the banks and then the reduction of lending rate. This is a direct effect of monetary easing and named as interest rate channel.

The banking lending channel relies on existence of markets imperfections. A monetary policy tightening restricts deposits and small low-liquid and low-capitalised banks may have to pay higher rates on deposits and reduce the supply of funds and rise interest rate more intensively.

The banking capital channel is based on lending and deposit maturity mismatch and presence of market imperfections. If it is difficult for a bank to issue equities to circumvent the higher cost of deposits, bank will tend to reduce the supply of credit and rises the lending rate.

Finally the effect of level of concentration in the industry on spreads is uncertain. One part of the literature stress that higher concentration tends to induce an oligopolist behaviour of the banks whereas other part of the literature suggest that efficiency gains may reduce the risk and the cost of lending.

Many empirical papers addressed how monetary policy affects lending rates. We now present a brief and no exaustive review of this literature.

Stein and Kashyap [16] investigated the relevance of banking channel using a unique data set that contains information on balance sheets of the banks in the United States. They show that liquidity constrained banks are those most affected

by monetary policy.

DeGrave et al.[11] investigated the lending channel in Belgian market. They investigated whether or not there is a long run one-to-one pass-through (completeness hypotheses). They also investigated possible causes for different and low responses of lending rates to policy rate. They collect evidence that these changes can be associated to market power issues. Higher deviations from equilibrium mark-ups tends to be corrected faster than shorter ones.

Holton et al. [12] investigated interest rate pass-through in Euro area after the crisis. They also investigated how pass-through can be impacted under different market conditions. They show that sovereign bond yields and market concentration indicators help to explain incomplete pass-through.

Aspergi et al. [1] suggest that the presence of nonlinearity may indicate that market is not fully competitive. Asymmetric responses to equal shocks of different signs may also be an indication of lack of competition.

Gambacorta et al. [10] collect evidence of asymmetric response of money market to lending rate for Italy. De Graeve, De Jonghe and Vander Vennet [5] studied the existence of heterogeneity in pass-through response in Belgian loan and deposit markets. Existence of heterogeneity in pass-through can be linked to the existence of a banking channel in monetary policy and existence of market power. Their results suggest that corporate loans segment is more competitive than consumer loans.

Iacoviello, Matteo and Minetti, Raoul [13] investigate the existence of bank lending and balance sheet effect of monetary policy in housing markets. They collect evidence that monetary policy generate effects on house prices and consequently important wealth effects on consumption and investment. Econometric methodology of this paper is based on VAR modelling.

In the Brazilian case, Mello et al. [6] investigate the existence of lending channel in Brazil for the period from 1996 up to 2008 using a Vector Error Correction Model (VECM). They find evidence in favour of the existence of a lending channel. Takeda [20] investigate the existence of lending channel. They focus on the effect that reserve requirements generates on credit. Their results suggest that reserves has impact on higher loans.

3 Methodology

In this section a briefly description of the techniques used in this paper is presented. A non technical review of cointegration and unit root tests are presented. A section about non linearity is presented in order to test where there is evidence of this feature given that asymmetric adjustment can be related to market power and industry specific issues.

3.1 Cointegration

The definition of cointegration is presented in Engle and Granger [8] and it is given below.

Definition 3.1. Cointegration: Two series y_t and z_t of order $I(d)$ with $d > 0$ are said to be cointegrated, denoted by, $CI(d, d-k)$ if there is a linear combination $W_t = y_t - \theta z_t$ with $\theta \neq 0$ and W_t is order $I(d-k)$ with $0 < k \leq d$.

Assuming that lending rates and money market rate are integrated of order one and if the spread, the difference between the lending and money market rate, is integrated of order zero due to an economic mechanism, then lending and money market rate are cointegrated. In our notation, $CI(1, 0)$.

Engle and Granger [8] were the first to develop a cointegration test. In the seminal paper five different procedures are suggested but one of those became the most popular one. They suggest to test cointegration by the following procedure:

1) Test if the series are integrated of order one using a ADF test (Dickey and Fuller [7]). If the null of unit root is not reject for all series goes to step 2.

2) If the null of unit root is not reject, run a static regression of one variable in the other (no leads and lags) plus a constant and/or a time trend and save the residuals.

3) Test unit root for the residuals. If the null is rejected then the conclusion is that the series are cointegrated. If the null is not rejected, then the series do not cointegrated.

The authors show that the ADF critical values must be adapted in this context and provide them by simulation.

3.2 Unit Root Tests

There are many unit roots test in the literature. Maddala et al. [17] revise the literature up to late nineties.

Unit roots tests can be used to test if lending, money and spreads are stationary or not. If lending rates and money market rates have the same order one of integration and spread is stationary then there is cointegration.

In this work we opt to run unit root tests developed by Dickey and Fuller (ADF) [7] and Phillips and Perron (PP) [18]. These tests assume that the Data Generator Process is linear. Given that there might be some type of non-linear dynamic in our case, we opt to run a complementary analysis based on the test of Kapetanios et. al. [15].

3.3 Non linearity

Shin et. al. [19] develops a non-linear autoregressive distributed lag model (NARDL). The model is a generalisation of linear autoregressive distributed lag model (ARDL).

Their starting point is given by the following partial sums:

$$x_t = x_0 + x_t^+ + x_t^- \tag{1}$$

$$x_t^+ = \sum_{n=1}^{t} max(\Delta x_n, 0) \tag{2}$$

$$x_t^- = \sum_{n=1}^{t} min(\Delta x_n, 0) \tag{3}$$

Definition 3.2. Nonlinear ARDL: A series y_t follows an NARDL(p,q) if the Data Generator Process is given by

$$y_t = \sum_{j=1}^{p} \phi_j y_{t-j} + \sum_{k=0}^{q} (\theta_k^+ x_{t-j}^+ + \theta_k^- x_{t-j}^-) + \varepsilon_t \tag{4}$$

where ε_t is identically and independently distributed (i.i.d.) with zero mean and variance given by σ_ε^2

The case where $\theta_k^+ = \theta_k^-$ for all k is the traditional Linear ARDL.

The model (1-3) can be rewritten in the following form:

$$\Delta y_t = \rho v_{t-1} + \sum_{j=1}^{p-1} \eta_j \Delta y_{t-j} + \sum_{k=0}^{q-1} (\psi_k^+ \Delta x_{t-j}^+ + \psi_k^- \Delta x_{t-j}^-) + \varepsilon_t \tag{5}$$

$$v_{t-1} = y_{t-1} - \gamma^+ x_{t-1}^+ - \gamma^- x_{t-1}^- \tag{6}$$

where $\rho = \sum_{j=1}^{p} \phi_j - 1$, $\eta_j = -\sum_{i=j+1}^{p} \phi_i$ for $j = 1, \ldots, p-1$, $\psi_0^+ = \theta_0^+$, $\psi_j^+ = -\sum_{i=j+1}^{q} \theta_i^+$ for $j = 1, \ldots, q-1$, $\psi_0^- = \theta_0^-$, $\psi_j^- = -\sum_{i=j+1}^{q} \theta_i^-$ for $j = 1, \ldots, q-1$, and $\gamma^+ = \frac{1}{\rho}\sum_{j=0}^{q} \theta_j^+$ and $\gamma^- = \frac{1}{\rho}\sum_{j=0}^{q} \theta_j^-$ are the associated asymmetric long-run parameters.

By estimating the model given by (5) and (6) and imposing proper restrictions, it is possible to test the following hypotheses:

1) the coefficients of cointegrated relationship are equal ($\gamma^+ = \gamma^-$); and

2) the coefficients are equal to one.

The first hypothesis imposes the same cointegration relationship on both regimes whereas the second hypothesis also imposes the same unitary rate of adjustment over the long run.

4 Our data set

We collect the data set in Brazilian Central Bank from first working day of 2012 to October 2018 in a daily frequency. A code in R was designed to download the data by financial institutions and type of credit at Brazilian Central Bank website. We collect more than one million interest rates cells. With this information we organise time series for types of credits and financial institutions. Not all financial institutions operate in all types of credits all the time. We opt to work with time series that are not too short in relation to the time span of the sample.

Table 1 shows the description of all operations analysed in this work whereas Table 3 contains the names of financial institutions that are part of the sample. We collect Brazilian money market rate in daily frequency at Brazilian Central Bank as well.

Descriptive Statistics of the data is provided in Table 2. Higher interest rates are charged to consumer loans compared to corporate loans. Export Exchange Contracts (ACC) have on average the lowest interest rate and lowest amplitude. Overdraft loans have a highest level of interest rate on average.

Table 1: Types of Loans

Identifier	**Segment**	**Type of Loan**
Op01	corporate	Export Exchange Contracts (ACC) -In foreign currency - Post Fixed
Op02	corporate	Antecipation Credit Card receivables loans - Prefixed
Op03	corporate	Working Capital Loans up to 365 days - Post Fixed with floating interest rate
Op04	corporate	Working Capital Loans up to 365 days - Pre Fixed interest rate
Op05	corporate	Working Capital Loans longer than 365 days - Post Fixed Floating interest rate
Op06	corporate	Working Capital Loans longer than 365 days - Pre Fixed Floating interest rate
Op07	corporate	Overdraft Loan - Pre-fixed
Op08	corporate	Secured Loans - Post Fixed with floating interest rate
Op09	corporate	Secured Loans - Pre Fixed
Op10	corporate	Cashier Check Receivables Loan - Pre Fixed
Op11	corporate	Receivables Loans - Pre Fixed
Op12	corporate	Vendor Financing - Pre Fixed
Op13	Consumer	Goods Acquisition Loan- Pre Fixed
Op14	Consumer	Vehicles Acquisition Loans - Pre Fixed
Op15	Consumer	Vehicles Leasing - Pre Fixed
Op16	Consumer	Credit Card Refinancing Loan - Pre Fixed
Op17	Consumer	Credit Card Loan - Pre Fixed
Op18	Consumer	Overdraft Loan - Pre Fixed
Op19	Consumer	INSS Consumer Secured Loan - Pre Fixed
Op20	Consumer	Private Consumer Secured Loan - Pre Fixed
Op21	Consumer	Public Consumer Secured Loan - Pre Fixed
Op22	Consumer	Public Consumer Non Secured Loan - Pre Fixed
Op23	Consumer	Cashier Receivable Loans - Pre Fixed

Table 2: Descriptive Statistics

Interest Rate - % per month				
Type	Minimum	Mean	Maximum	Amplitude
Op01	0.0%	0.5%	5.6%	5.6%
Op02	0.1%	2.0%	6.5%	6.4%
Op03	0.1%	1.6%	12.7%	12.6%
Op04	0.0%	2.2%	20.8%	20.8%
Op05	0.0%	1.5%	14.0%	14.0%
Op06	0.0%	1.9%	6.5%	6.5%
Op07	0.9%	7.8%	19.3%	18.4%
Op08	0.1%	2.0%	11.8%	11.7%
Op09	0.2%	3.1%	78.1%	77.9%
Op11	0.0%	2.5%	15.8%	15.8%
Op12	0.2%	2.1%	17.0%	16.8%
Op19	0.0%	6.4%	17.1%	17.1%
Op22	0.5%	3.7%	19.4%	18.9%

Amplitude=Maximum-Minimum

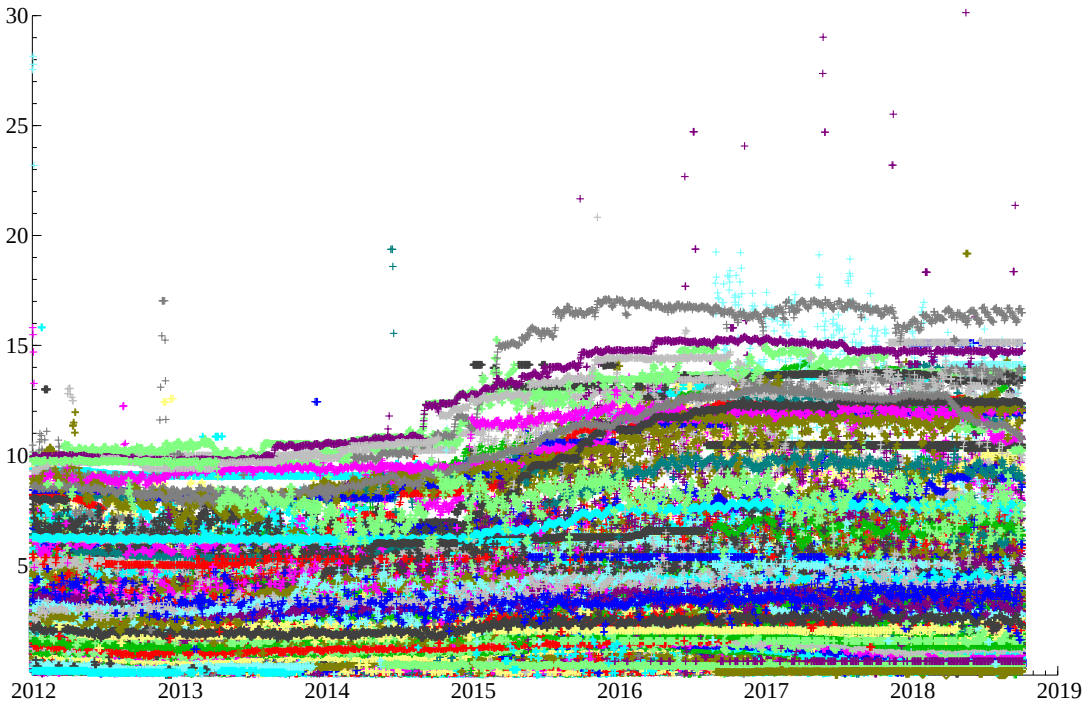

Figure 1: Plot of interest rate for all types of loans and banks - % per month.

Table 3: Names and identifiers of financial institution of our sample

Identifier	**Financial Institution**
B001	AGIBANK FINANCEIRA
B002	AGORACRED S/A SCFI
B003	ALFA AM S.A.
B004	AMAGGI S.A. CFI
B005	ATRIA S.A. - CFI
B006	AVISTA S.A. CFI
B007	AYMORÉ CFI S.A.
B008	BANCO AZTECA DO BRASIL S.A.
B009	BANCO BRADESCARD
B010	BANCO BTG PACTUAL S.A.
B011	BANCO CBSS
B012	BANCO CIFRA

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Identifier	**Financial Institution**
B013	BANCO CNH INDUSTRIAL CAPITAL S.A
B014	BANCO CREDICARD
B015	BANCO FIDIS
B016	BANCO IBM S.A.
B017	BANCO INBURSA
B018	BANCO INTER
B019	BANCO ITAÚ CONSIGNADO S.A.
B020	BANCO JOHN DEERE S.A.
B021	BANCO MONEO S.A.
B022	BANCO NEON S.A.
B023	BANCO ORIGINAL
B024	BANCO PAN
B025	BANCO PORTO REAL DE INVEST.S.A
B026	BANCO RANDON S.A.
B027	BANCO SEMEAR
B028	BANCO TOPÁZIO S.A.
B029	BANCO VIPAL
B030	BANCOOB
B031	BANIF BRASIL BM S.A.
B032	BANIF INVESTIMENTO
B033	BB-LEASING S.A. AM
B034	BCO A.J. RENNER S.A.
B035	BCO ABC BRASIL S.A.
B036	BCO ABN AMRO S.A.
B037	BCO AGIBANK S.A.
B038	BCO ALFA DE INVESTIMENTO S.A.
B039	BCO ALFA S.A.
B040	BCO ANDBANK S.A.
B041	BCO ARBI S.A.
B042	BCO BANESTES S.A.
B043	BCO BARIGUI INV FIN S/A

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Identifier	Financial Institution
B044	BCO BMG S.A.
B045	BCO BNP PARIBAS BRASIL S A
B046	BCO BOCOM BBM S.A.
B047	BCO BRADESCO CARTOES S.A.
B048	BCO BRADESCO FINANC. S.A.
B049	BCO BRADESCO S.A.
B050	BCO BRJ S.A.
B051	BCO BS2 S.A.
B052	BCO BVA S.A.
B053	BCO CACIQUE S.A.
B054	BCO CAIXA GERAL BRASIL S.A.
B055	BCO CAPITAL S.A.
B056	BCO CARGILL S.A.
B057	BCO CATERPILLAR S.A.
B058	BCO CCB BRASIL S.A.
B059	BCO CEDULA S.A.
B060	BCO CETELEM S.A.
B061	BCO CITIBANK S.A.
B062	BCO CLASSICO S.A.
B063	BCO CRÉDIT AGRICOLE BR S.A.
B064	BCO CREDIT SUISSE (BRL) S.A.
B065	BCO CREFISA S.A.
B066	BCO CRUZEIRO DO SUL S.A.
B067	BCO CSF S.A.
B068	BCO DA AMAZONIA S.A.
B069	BCO DA CHINA BRASIL S.A.
B070	BCO DAYCOVAL S.A
B071	BCO DE LAGE LANDEN BRASIL S.A.
B072	BCO DES. DE MG S.A.
B073	BCO DES. DO ES S.A.
B074	BCO DO BRASIL S.A.

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Identifier	**Financial Institution**
B075	BCO DO EST. DE SE S.A.
B076	BCO DO EST. DO PA S.A.
B077	BCO DO ESTADO DO RS S.A.
B078	BCO DO NORDESTE DO BRASIL S.A.
B079	BCO FATOR S.A.
B080	BCO FIBRA S.A.
B081	BCO FICSA S.A.
B082	BCO FORD S.A.
B083	BCO GMAC S.A.
B084	BCO GUANABARA S.A.
B085	BCO HONDA S.A.
B086	BCO INDUSCRED DE INVESTIM. S/A
B087	BCO INDUSTRIAL DO BRASIL S.A.
B088	BCO INDUSVAL S.A.
B089	BCO INTERCAP S.A.
B090	BCO ITAÚ BBA S.A.
B091	BCO ITAÚ VEÍCULOS S.A.
B092	BCO ITAUCARD S.A.
B093	BCO ITAUCRED FINANC S.A.
B094	BCO ITAULEASING S.A.
B095	BCO J.P. MORGAN S.A.
B096	BCO KDB BRASIL S.A.
B097	BCO KEB HANA DO BRASIL S.A.
B098	BCO KOMATSU S.A.
B099	BCO LA NACION ARGENTINA
B100	BCO LA PROVINCIA B AIRES BCE
B101	BCO LOSANGO S.A.
B102	BCO LUSO BRASILEIRO S.A.
B103	BCO MÁXIMA S.A.
B104	BCO MAXINVEST S.A.
B105	BCO MERCANTIL DE INVS S/A

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Identifier	**Financial Institution**
B106	BCO MERCANTIL DO BRASIL S.A.
B107	BCO MERCEDES-BENZ S.A.
B108	BCO MIZUHO S.A.
B109	BCO MODAL S.A.
B110	BCO MORGAN STANLEY S.A.
B111	BCO MUFG BRASIL S.A.
B112	BCO OLÉ BONSUCESSO CONSIGNADO S.A.
B113	BCO ORIGINAL DO AGRO S/A
B114	BCO OURINVEST S.A.
B115	BCO PAULISTA S.A.
B116	BCO PINE S.A.
B117	BCO PROSPER S.A.
B118	BCO PSA FINANCE BRASIL S.A.
B119	BCO RABOBANK INTL BRASIL S.A.
B120	BCO RCI BRASIL S.A.
B121	BCO RENDIMENTO S.A.
B122	BCO REP ORIENTAL URUGUAY BCE
B123	BCO RIBEIRAO PRETO S.A.
B124	BCO RODOBENS S.A.
B125	BCO RURAL S.A.
B126	BCO SAFRA S.A.
B127	BCO SANTANDER (BRASIL) S.A.
B128	BCO SOCIETE GENERALE BRASIL
B129	BCO SOFISA S.A.
B130	BCO SUMITOMO MITSUI BRASIL S.A.
B131	BCO TOYOTA DO BRASIL S.A.
B132	BCO TRIANGULO S.A.
B133	BCO TRICURY S.A.
B134	BCO VOLKSWAGEN S.A
B135	BCO VOLVO BRASIL S.A.
B136	BCO VOTORANTIM S.A.

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Identifier	**Financial Institution**
B137	BCO VR S.A.
B138	BCO WOORI BANK DO BRASIL S.A.
B139	BCO YAMAHA MOTOR S.A.
B140	BCO. J.SAFRA S.A.
B141	BCV
B142	BECKER FINANCEIRA SA - CFI
B143	BI CREDIT SUISSE (BRASIL) S.A.
B144	BIORC FINANCEIRA - CFI S.A.
B145	BMG LEASING S/A-AM
B146	BMW FINANCEIRA S.A. - CFI
B147	BMW LEASING DO BRASIL - AM
B148	BNC BRAZIL LTDA.
B149	BOFA MERRILL LYNCH BM S.A.
B150	BR PARTNERS BI
B151	BRADESCO LEASING S.A. AM
B152	BRASIL PLURAL S.A. BCO.
B153	BRB - BCO DE BRASILIA S.A.
B154	BRB - CFI S/A
B155	BRK S.A. CFI
B156	BV FINANCEIRA S.A. CFI
B157	BV LEASING AM S A
B158	CAIXA ECONOMICA FEDERAL
B159	CARUANA SCFI
B160	CCB BRASIL AM S.A.
B161	CCB BRASIL S.A. - CFI
B162	CENTROCRED S.A. CFI
B163	CETELEM BRASIL S.A. CFI
B164	CIA CFI RCI BRASIL S.A.
B165	CIFRA S.A. CFI
B166	COMMERZBANK BRASIL S.A. - BCO MÚLTIPLO
B167	CREDIARE CFI S.A.

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Identifier	**Financial Institution**
B168	CREDIFIBRA S.A. - CFI
B169	CREDITÁ S.A. CFI
B170	CREFISA S.A. CFI
B171	DACASA FINANCEIRA S/A - SCFI
B172	DEUTSCHE BANK S.A.BCO ALEMAO
B173	DIRECAO S.A. CFI
B174	ESTRELA MINEIRA
B175	FACTA S.A. CFI
B176	FIN. ITAÚ CBD CFI
B177	FINAMAX S.A. CFI
B178	FINANC ALFA S.A. CFI
B179	FINANSINOS S.A. CFI
B180	GAZINCRED S.A. SCFI
B181	GOLCRED S/A - CFI
B182	GOLDMAN SACHS DO BRASIL BM S.A
B183	GRAZZIOTIN FINANCIADORA SA CFI
B184	HAITONG BI DO BRASIL S.A.
B185	HIPERCARD BM S.A.
B186	HS FINANCEIRA
B187	ICBC DO BRASIL BM S.A.
B188	ING BANK N.V.
B189	INTESA SANPAOLO BRASIL S.A. BM
B190	ITAÚ UNIBANCO FINANCEIRA S.A. - CFI
B191	ITAÚ UNIBANCO BM S.A.
B192	JBCRED S.A. SCFI
B193	JSL A.M. S.A.
B194	KIRTON BANK
B195	KREDILIG S.A. - CFI
B196	LEBES FINANCEIRA CFI SA
B197	LECCA CFI S.A.
B198	LUIZACRED S.A. SOC CFI

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Identifier	**Financial Institution**
B199	MERCANTIL BRASIL FIN S.A. CFI
B200	MERCANTIL BRASIL LEASING SA AM
B201	MERCEDES-BENZ AM S.A.
B202	MIDWAY S.A. - SCFI
B203	NATIXIS BRASIL S.A. BM
B204	NEGRESCO S.A. - CFI
B205	NOVO BCO CONTINENTAL S.A. - BM
B206	OMNI BANCO S.A.
B207	OMNI S.A. AM
B208	OMNI SA CFI
B209	PAN AM
B210	PARANA BCO S.A.
B211	PARATI - CFI S.A.
B212	PERNAMBUCANAS FINANC S.A. CFI
B213	PORTOCRED S.A. - CFI
B214	PORTOSEG S.A. CFI
B215	REALIZE CFI S.A.
B216	SAFRA LEASING S/A AM
B217	SANTANA S.A. - CFI
B218	SANTANDER FINANCE AM
B219	SANTANDER S.A. AM
B220	SANTINVEST S.A. - CFI
B221	SAX S.A. CFI
B222	SCANIA BCO S.A.
B223	SCOTIABANK BRASIL
B224	SENFF S.A. - CFI
B225	SINOSSERRA S/A - SCFI
B226	SOCINAL S.A. CFI
B227	SOROCRED CFI S.A.
B228	STANDARD CHARTERED BI S.A.
B229	STARA FINANCEIRA S.A. - CFI

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Identifier	**Financial Institution**
B230	TODESCREDI S/A - CFI
B231	VIA CERTA FINANCIADORA S.A. - CFI

5 Results

Now we start to discuss the results of the work. Three hypothesis are investigated and Table 4 presents the results for the every test. In the first case we test whether interest rates of one particular bank react to changes in other banks' rates. And if this reaction is a one-to-one in the long run. The second hypothesis to be investigated is whether interest rate of one bank reacts to movements in money market and if this reaction is a one-to-one in the long run. Finally we investigated existence of non linear dynamics in Data Generator Process of the series.

Table 4: Summary of the tests

	Non Linear Index Test	Johansen Cointegration tests - CDI and Lending Rate	Johansen Cointegration tests - Lending Rate Pairs	Cointegration test - between lending rates	Cointegration with CDI	Testing Spread is the cointegrated vector (with symmetry)	Spread Unit Root Tests		Intrabank Spread Unit Root test	
		(1)	(1)	(2)	(3)	(3)	ADF (2)	PP (2)	ADF (2)	PP (2)
Op01	10%	35%	0%	0%	9%	100%	41%	45%	0%	0%
Op02	40%	0%		60%	33%	80%	33%	33%	0%	10%
Op03	43%	43%	0%	0%	29%	89%	26%	27%	0%	0%
Op04	27%	41%	25%	20%	31%	100%	31%	31%	20%	20%
Op05	40%	20%	100%	0%	30%	89%	27%	28%	0%	0%
Op06	22%	39%	0%	29%	39%	90%	39%	40%	20%	20%
Op07	33%	14%	50%	33%	59%	100%	59%	59%	24%	24%
Op08	36%	36%	0%	9%	14%	89%	17%	17%	9%	11%
Op09	27%	13%	0%	18%	21%	75%	31%	29%	14%	14%
Op10	25%	25%	0%	36%	33%	88%	28%	28%	18%	25%
Op11	36%	20%	0%	31%	20%	89%	15%	14%	7%	13%
Op12	30%	30%	0%	7%	28%	100%	24%	24%	0%	0%
Op13		25%		50%	43%	75%	36%	36%	0%	17%
Op14				62%	50%	100%	45%	49%	24%	29%
Op15				0%	36%	100%	40%	36%	0%	0%
Op16				57%	40%	57%	35%	35%	71%	67%
Op17				50%	34%	75%	42%	42%	50%	32%
Op18				33%	59%	100%	59%	59%	24%	24%
Op19	20%		0%	42%	40%	90%	56%	62%	20%	29%
Op20				47%	35%	89%	25%	32%	3%	17%
Op21				86%	44%	88%	57%	58%	47%	47%
Op22	29%	29%		40%	41%	90%	34%	35%	22%	18%
Op23				36%	35%	88%	28%	28%	18%	25%

Note: Percentage of the result (based on a 5% significance test)

(1): Percentage of tests returning rank = 1;

(2): Percentage of tests returning the rejection of the null hypothesis

(3): Percentage of tests returning acceptance of the null hypothesis

5.1 Do lending rates move together?

If we have a fully integrated market, interest rates among banks will tend to react to each other and possibly at one-to-ones basis. This is the hypothesis we test using cointegration and unit root techniques.

5.1.1 Cointegration tests between lending rates

We first discuss the results on co-integration between lending rates. Column 4 of the Table 4 contains Engle and Granger [8] cointegration tests results for all possible pairs for the same type of credit where data is available. We obtain good evidence in favour of cointegration hypothesis. These results suggest that changes in one bank interest rate leads to change in other banks interest rate changes. These results are

expected given they operate in the same market.

In order to investigate whether or not this reaction leads to a one-to-one long run response, we need to test if the cointegrated vector coefficients is $(1, -1)$.

5.1.2 Unit roots tests on Spreads

In order to investigate the presence of a one-to-one long run response of lending rates, we test whether spreads between banks are stationary. We collect evidence that the null of unit root can be rejected for most of pairs analysed, therefore the Spreads are $I(0)$. Columns 9 and 10 of table 4 contains results for all banks and types of loans. For the majority of spreads the null of unit root can be reject by ADF and PP test, confirming the hypothesis that Brazilian credit market is integrated in all branches.

5.2 Do lending rates react to money market rate?

For Brazilian monetary policy is effective throughout the lending channel lending rates should react to change in money market rate. If the pass-through is fast and one-to-one basis, this is a good evidence in favour of a strong lending channel.

5.2.1 Cointegration tests between lending and money market rates

Similar to previous section we investigate existence of cointegration but now between money market rate and lending rates. Column 5 of table 4 reports Engle and Granger [8] cointegration tests' results for lending rates and money market rates. The results reported in these tables suggest good evidence in favour of the hypothesis of cointegration.

One should note that if all lending rates cointegrate with money market, then lending rates must cointegrate among themselves. Results of this section and previous sections are complementary in one aspect but evidence of cointegration between lending rates and money market allows us to conclude that monetary policy has effects on lending rates.

5.2.2 Spreads are stationary?

We also investigate if spreads between lending rates are stationary. This is important to evaluate not just if monetary policy affect lending rates but also if there is a one-

to-one pass-through. These testes are quite important to evaluate the strength of monetary policy. Results can be seen in detail in the appendices in columns 7 and 8 of Table 4. Although there might be some important exceptions for loans of some of leading banks in particular branches, it seems reasonable to conclude in favour of good support for one-to-one hypothesis, suggesting that the lending channel is operative. It is not reasonable to conclude that monetary policy does not operate throughout this channel for Brazil.

5.3 Evidence of Non linearity

The existence of the lending channel in Brazil does not mean it is near an ideal standard. Non linearity is seen in the literature that lending rate channel contains some type of imperfections. Castle and Hendry [2] develops a test to detect presence of non linearity of unknown form. We run the test for monthly data.

We run the test for the spreads between lending rate and money market rate. The null of linearity is rejected for some of types of credit and banks. The results are shown on column 6 of table 4.

The rejection of the null is higher than a nominal value of tests, suggesting that non linearity should be present. Modelling the dynamics of lending interest rate response to shocks in money market needs more refined models than the linear ones.

5.4 Robustness check

In order to check the robustness of our conclusion to our frequency choice and techniques we opt to run multivariate Johansen's cointegration test ([14]) for the pair lending rates and with these and money market rates. We were able to collect evidence of cointegration particular between lending rates and money market rates. Column 2 of table 4 contains the results. Evidence in favour of cointegration are not as strong as suggested by results of Engle and Granger test at higher frequency. Column 3 of table 4 contains cointegration test for pairs.

5.5 Specific Banks Analysis

In this section we take a closer look to some specific banks. We choose Brazilian private and public leading banks to analyse. Among private bank, we choose two local banks and one foreign bank. Given that we are analysing leading banks in

Brazilian credit market, it is expected that completeness hypothesis is fulfilled if lending channel is working properly.

Tables 5, 6, 7, 8 and 9 contain a summary of all tests results for five of the leading Brazilian banks: Bradesco, Banco do Brasil, Caixa Econômica Federal (CEF), Itaú and Santander. Excepting CEF, for most majority of credit types loans it is possible to find evidence in favour of cointegration between lending rates and money market rates, confirming the hypothesis that at least an imperfect pass-through from money market rate to lending rate exist.

This picture changes when the one-to-one hypothesis for the cointegration vector is tested. For the case of loans to corporate clients there is good evidence of a one-to-one pass-through whereas for consumer loans evidence is mixed. This results is in line with international results as stated in literature review. Finally for some types of loans there is evidence of non-linearity.

6 Limitations, Extensions and possible policy implications

One natural limitations of study is the time span of our sample. Although the data is available at daily frequency, we are investigating a long run relationship and longer time series is always desirable.

Another possible refinement of this work is related to the database. More disaggregated data, particularly on deposit rate of each bank, should give information on how monetary policy works in Brazil. Unfortunately this type of data is not public in Brazilian case.

Data Generator Process at daily frequency may have heteroscesdatic errors and non normality. Cavaliere and co-authors [3] [4] show that unit root and cointegration tests may suffer size distortions under this scenario. They construct procedures to overcome this problems but they are computational demanding and it is left for future research to use these techniques. We opt to run test in a lower frequency to assess robustness of our results and circumvent this problem.

Another line of investigation has to do with the type of non linearity the Data Generator Process may have and what explains these non-linearities.

Our results suggest that credit channel may not work at its full potency in

Table 5: Summary of tests results for Banco do Brasil (Public Bank)

Identifier	Cointegration		Unit Root			Non-Linearity
	Engle-Granger	Johansen	ADF	PP	KSS	Index Test
Op01			I(1)	I(1)	NO	Linear
Op02	NO	NO	I(1)	I(1)	NO	Linear
Op03	COINT	COINT	I(0)	I(0)	NO	Linear
Op04	COINT	COINT	I(0)	I(0)	NO	Linear
Op05	COINT	COINT	I(0)	I(0)	COINT	Non-Linearity
Op06	COINT	COINT	I(0)	I(0)	NO	Non-Linearity
Op07	NO	NO	I(1)	I(1)	COINT	Non-Linearity
Op08	COINT	COINT	I(1)	I(1)	NO	Non-Linearity
Op09	NO	NO	I(1)	I(1)	NO	Linear
Op10	NO	NO	I(0)	I(1)	NO	Linear
Op11	COINT	COINT	I(1)	I(1)	NO	Linear
Op12	COINT	COINT	I(1)	I(1)		Linear
Op13	NO	NO	I(0)	I(0)		
Op14	NO	NO	I(0)	I(0)		
Op15						
Op16	NO	NO	I(0)	I(0)		
Op17	NO	NO	I(0)	I(0)		
Op18	NO	NO	I(1)	I(1)		
Op19	NO	NO	I(1)	I(1)	NO	Linear
Op20	COINT	COINT	I(1)	I(1)		
Op21	NO	NO	I(0)	I(0)		
Op22	NO	NO			NO	Linear
Op23	NO	NO	I(0)	I(1)		

Note: Dashed line separates Corporate and Consumer lendings (respectively)

Table 6: Summary of tests results for Caixa Econômica Federal (Public Bank)

Identifier	Cointegration		Unit Root			Non-Linearity
	Engle-Granger	Johansen	ADF	PP	KSS	Index Test
Op01	COINT		I(1)	I(1)		
Op02						
Op03	COINT		I(0)	I(0)		
Op04	COINT	COINT	I(0)	I(0)	I(1)	Linear
Op05	COINT	COINT	I(0)	I(0)	I(1)	
Op06	NO	COINT	I(0)	I(0)	I(1)	Non Linear
Op07	COINT	NO	I(1)	I(1)		Linear
Op08	COINT	NO	I(0)	I(0)	I(0)	Linear
Op09						
Op10	COINT	COINT	I(1)	I(1)	I(1)	Non Linear
Op11	NO	COINT	I(1)	I(1)	I(1)	Non Linear
Op12						
Op13	COINT		I(0)	I(0)		
Op14	COINT		I(0)	I(0)		
Op15						
Op16	COINT		I(1)	I(1)		
Op17	NO		I(1)	I(1)		
Op18	COINT		I(1)	I(1)		
Op19	NO	NO	I(1)	I(1)	I(1)	Non Linear
Op20	NO		I(0)	I(0)		
Op21	NO		I(1)	I(1)		
Op22	NO		I(0)	I(0)		
Op23	NO		I(1)	I(1)		

Note: Dashed line separates Corporate and Consumer lendings (respectively)

Table 7: Summary of tests results for Itaú (Local Private Bank)

Identifier	Cointegration		Unit Root			Non-Linearity
	Engle-Granger	Johansen	ADF	PP	KSS	Index Test
Op01	COINT	No			I(1)	Linear
Op02	NO	NO	I(1)	I(1)	I(1)	Linear
Op03	COINT	NO	I(1)	I(1)	I(1)	Linear
Op04	COINT	COINT	I(0)	I(0)	I(1)	Linear
Op05	COINT	NO	I(0)	I(0)	I(1)	Non-Linearity
Op06	COINT	COINT	I(0)	I(0)	I(1)	Linear
Op07		COINT	I(1)	I(1)	I(1)	Linear
Op08	COINT	NO	I(0)	I(0)	I(1)	Linear
Op09	NO	NO	I(0)	I(0)	I(1)	Linear
Op10	COINT	NO	I(0)	I(0)	I(1)	Linear
Op11	COINT	NO	I(0)	I(0)	I(1)	Linear
Op12	COINT	COINT	I(0)	I(0)	I(1)	Linear
Op13						
Op14	NO		I(0)	I(0)		
Op15	NO		I(0)	I(0)		
Op16	COINT		I(1)	I(1)		
Op17	NO		I(1)	I(0)		
Op18	NO		I(1)	I(1)		
Op19	NO	COINT	I(1)	I(1)	I(1)	Linear
Op20	NO		I(0)	I(0)		
Op21	NO		I(0)	I(0)		
Op22	NO		I(1)	I(1)		
Op23	COINT		I(0)	I(0)		

Note: Dashed line separates Corporate and Consumer lendings (respectively)

Table 8: Summary of tests results for Bradesco (Local Private Bank)

Identifier	Cointegration		Unit Root			Non-Linearity
	Engle-Granger	Johansen	ADF	PP	KSS	Index Test
Op01	COINT	NO	I(1)	I(1)	I(1)	Linear
Op02	COINT	NO	I(0)	I(0)	I(1)	Non-Linearity
Op03	COINT	COINT	I(0)	I(0)	I(1)	Linear
Op04	COINT	COINT	I(0)	I(0)	I(1)	Linear
Op05	COINT	COINT	I(0)	I(0)	I(1)	Linear
Op06	COINT	COINT	I(0)	I(0)	I(1)	Linear
Op07	NO	NO	I(1)	I(1)	I(1)	Linear
Op08	COINT	NO	I(0)	I(0)	I(1)	Linear
Op09	COINT	NO	I(0)	I(0)	I(1)	Linear
Op10	COINT	COINT	I(0)	I(0)	I(1)	Linear
Op11	NO	NO	I(0)	I(1)	I(1)	Non-Linearity
Op12	COINT	NO	I(0)	I(0)	I(1)	Linear
Op13			I(0)	I(0)		
Op14	COINT		I(0)	I(0)		
Op15	COINT		I(0)	I(0)		
Op16	COINT		I(0)	I(0)		
Op17	COINT		I(0)	I(0)		
Op18	NO		I(1)	I(1)		
Op19	COINT	NO	I(1)	I(1)	I(0)	Linear
Op20	COINT		I(1)	I(1)		
Op21	NO		I(1)	I(1)		
Op22	NO	COINT	I(0)	I(0)	I(0)	Non-Linearity
Op23	COINT		I(0)	I(0)		

Note: Dashed line separates Corporate and Consumer lendings (respectively)

Table 9: Summary of tests results for Santander (Foreign Private Bank)

Identifier	Cointegration		Unit Root			Non-Linearity
	Engle-Granger	Johansen	ADF	PP	KSS	Index Test
Op01	COINT	NO	I(0)	I(1)	I(1)	Linear
Op02	COINT		I(0)	I(0)	I(1)	Linear
Op03	COINT	COINT	I(0)	I(0)	I(1)	Linear
Op04	COINT	NO	I(0)	I(0)	I(1)	Linear
Op05	COINT	COINT	I(0)	I(0)	I(1)	Non-Linearity
Op06	COINT	COINT	I(0)	I(0)	I(1)	Linear
Op07	COINT	NO	I(0)	I(0)	I(1)	Non-Linearity
Op08	COINT	COINT	I(0)	I(1)	I(0)	Linear
Op09	COINT	NO	I(0)	I(0)	I(0)	Non-Linearity
Op10	NO	NO	I(0)	I(0)	I(1)	Linear
Op11	COINT	NO	I(0)	I(0)	I(1)	Linear
Op12	COINT	NO	I(0)	I(0)	I(0)	Linear
Op13	COINT		I(0)	I(0)		
Op14	NO		I(0)	I(0)		
Op15						
Op16	COINT		I(0)	I(0)		
Op17	NO		I(1)	I(1)		
Op18	COINT		I(0)	I(0)		
Op19	COINT	COINT	I(1)	I(1)	I(1)	Linear
Op20	NO		I(1)	I(1)		
Op21	COINT		I(1)	I(1)		
Op22	COINT	COINT	I(0)	I(0)	I(1)	Non-Linearity
Op23	NO		I(0)	I(0)		

Note: Dashed line separates Corporate and Consumer lendings (respectively)

Brazil. Changes in money rate are not fully transmitted to lending rates. This channel should be improved in other to avoid strong movement of money market rate to induce change in the lending rate.

It is unclear the reasons why this channel is not fully working in Brazil. Possible explanations are the leading role played by public banks in Brazilian market and restrictions to set interest rates and high level of directed credits programs. High level of reserves requirements compared to international standards is also an issue that may explain the results. Measures to foster competition are always welcomed particularly in markets with high level of concentration.

7 Final Remarks

Our goal was to investigate the dynamics between lending and money market rates. In perfect markets, shocks in money market rate are propagated in a one-to-one basis to lending rates and non linearity should not be presented in the Data Generator Process.

The conclusions of our paper are that lending rates and money rates are cointegrated in the long run possibly with one-to-one basis and the null of unit root in spreads is reject in our tests with few but important exceptions.

The other important conclusion is that non linearity may be presented in Data Generator Process. If this is the case, similar shocks may be propagated in different forms due to the different circumstances. This conclusion has direct implications for monetary policy. Moreover, further investigation is required to better understand the types and sources of non linearity of Brazilian data.

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