Short and long-run relations between capital netflows and the differential of American and Brazilian interest rates

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Capital flows: drivers

Type	Variable	Expected effect
Pull	Interest rates	Positive across different types of flows
	GDP growth	Ambiguous
	Risk	Negative across different types of flows
Push	FED short term interest rates	Negative for inflows
	American GDP growth	Usually negative, but it might assume a positive effect on inflows
	VIX	Usually negative across different types of flows

Adapted from Koepke, 2019.

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- Capital netflows vs gross flows and their relationships with the interest rates

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- We find cointegration between the two time series by using the fractionary differentiation framework
- We find that an increase of 1 p.p. in the difference between the Brazilian and American interest rates caused the netflows to increase in about US$ 700 million.
- Main innovation: cointegration is widened given that now it is more flexible than the I(1) time series with a I(0) residuals framework

Literature Review

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- Taylor and Sarno, 1997: equity flows are more susceptible to pull factors.
- Cardoso and Goldfajn, 1998: foreign interest rates are the main determinant of capital flows to Brazil.
- Forbes and Warnock, 2012: after the Global Financial Crisis, capital netflows did not alter much, however the composition of flows changed, with advanced economies receiving much more capital than developing economies

Data Analysis

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- We also create a exchange rate quotient in order to proxy the variation in exchange rate as increasing or decreasing the attractiveness of investments in a foreign country. This exchange rate quotient is given by: $\frac{e_{t-1}}{e_t}$, where e_t is the BRL/US$ exchange rate. Values higher than 1 for this quotient indicates that the Brazilian Real has appreciated in front of the dollar. Values lower than 1, on the other hand, for this quotient indicate the opposite, that is, depreciation of Brazilian real in front of the dollar.

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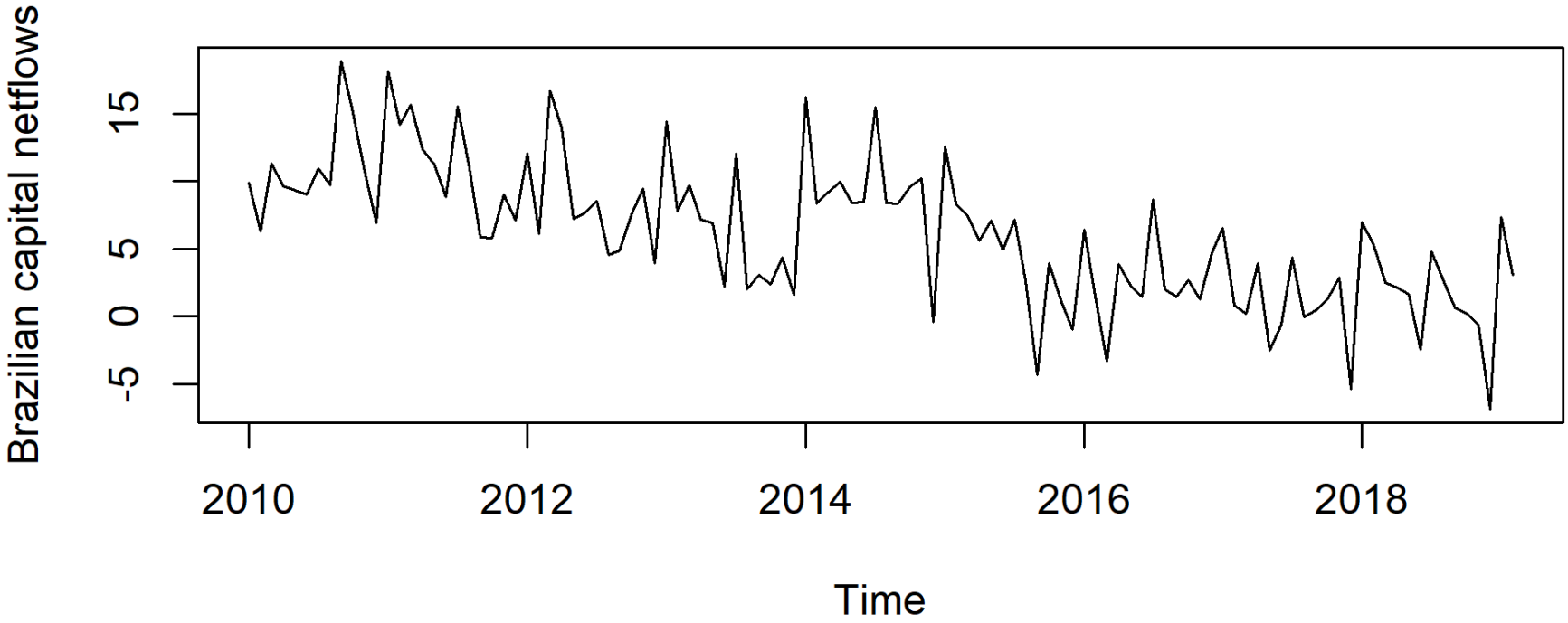
- In the following slides, we present the graphs of three series: capital netflows to Brazil, the difference between the Brazilian and American real interest rates, FX-weighted and not.

Data Analysis

Figure: Brazilian net capital flows



Note: Authors' own elaboration.

Data Analysis

Figure: Difference between the Brazilian and American real interest rates

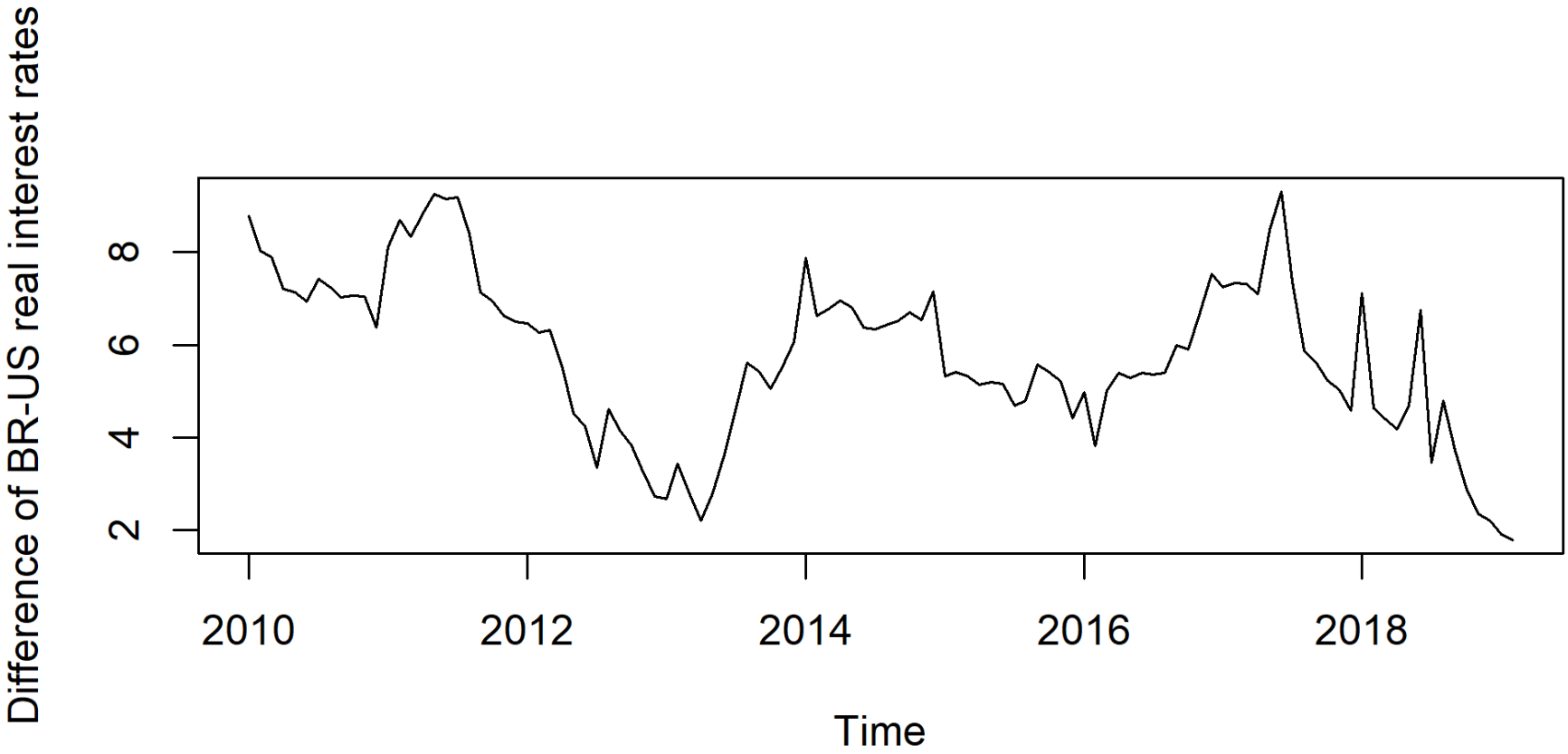


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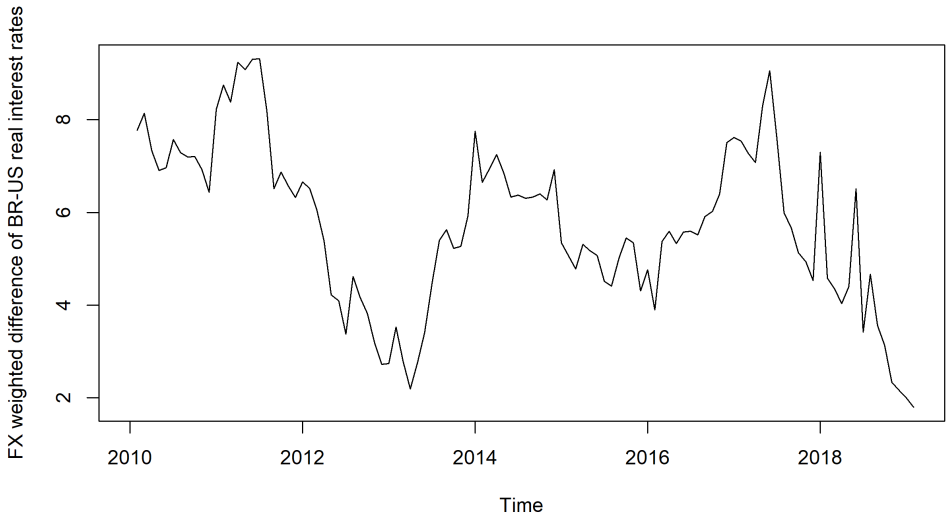
Figure: FX weighted difference between the Brazilian and American real interest rates



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Methodology

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- Geweke and Porter-Hudak, 1983 (GPH estimator) for the order of cointegration of a time series. We can compare the order of cointegration between two series with a simple t test and we can also test whether the order of cointegration of a time series is null or unity with a simple t test.

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- The t test in this case has an statistic of:

$$t = \frac{d - d*}{sd.as}$$

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$$0 < \kappa_{xy}^2(\omega) = \frac{|f_{xy}(\omega)|^2}{f_x(\omega) f_y(\omega)} < 1$$

- Where $f_{xy}(\omega)$ is the cross-spectrum and $f_z(\omega)$ is the spectrum of the time series Z.

Results

Figure: Periodogram of the Brazilian net capital flows

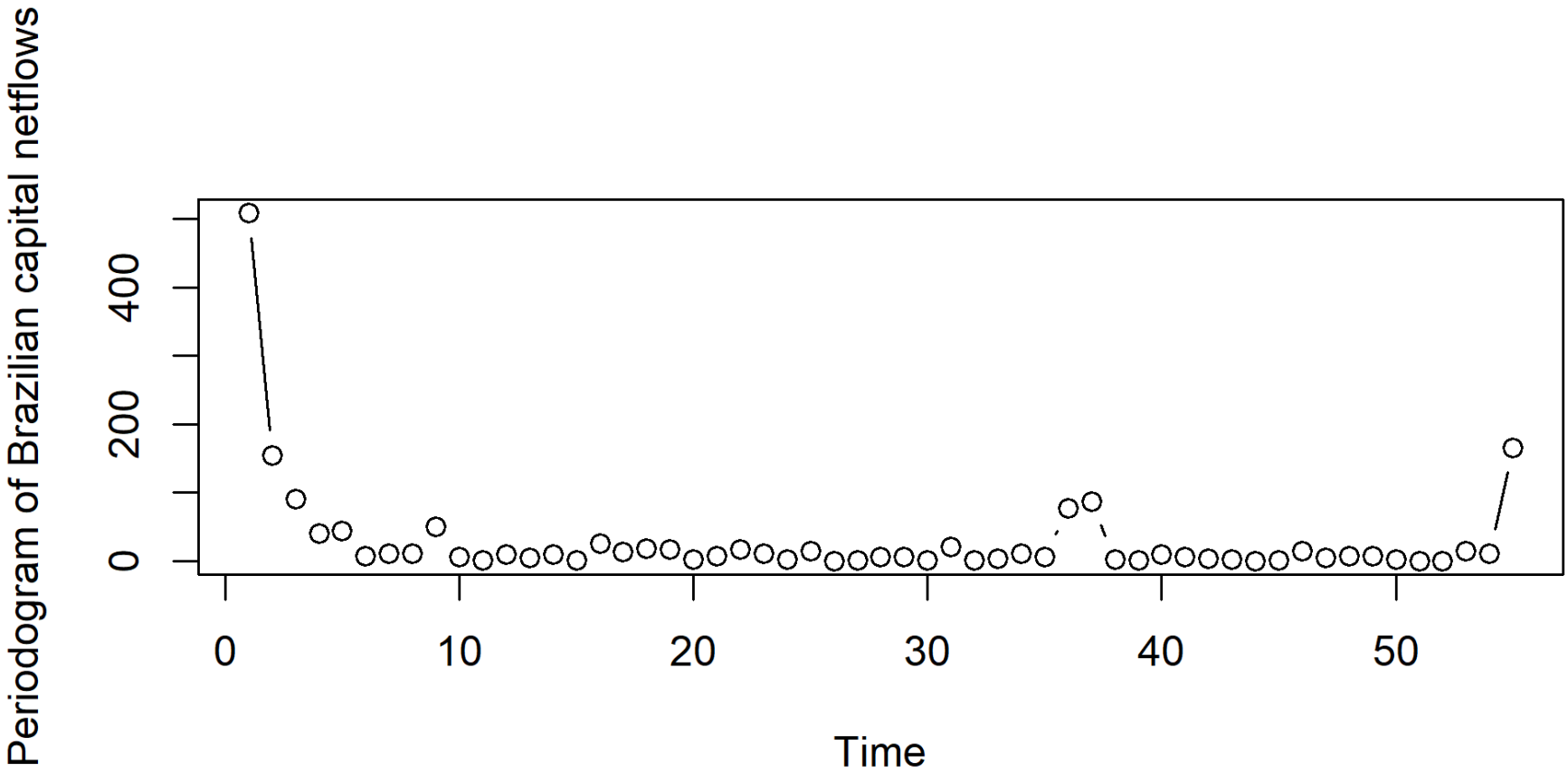

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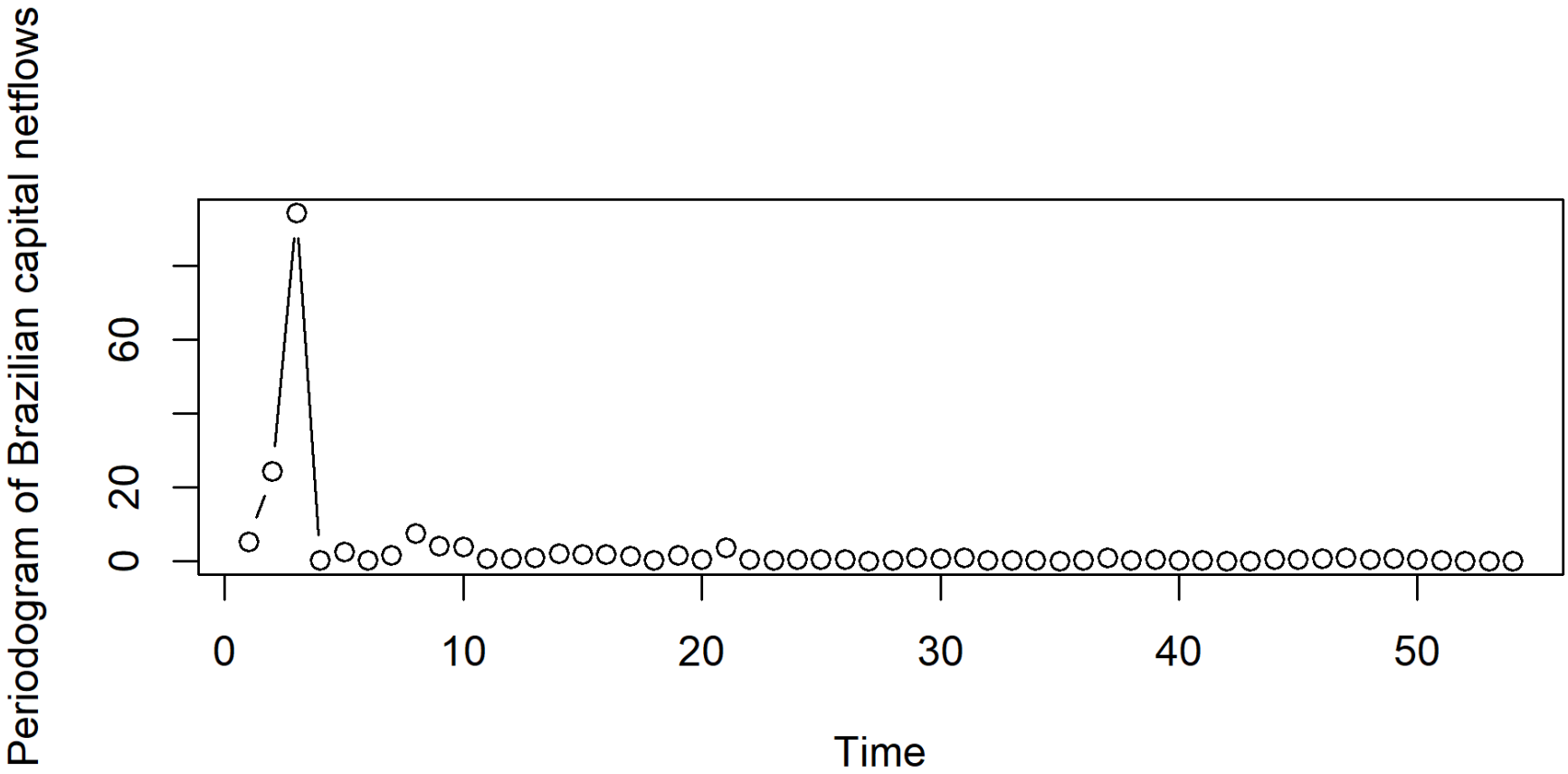
Figure: Periodogram of the difference of BR-US real interest rates



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- We choose to remove the cycle corresponding to the frequency 55 (1 month) in the Brazilian capital netflows series. The other significant frequencies in the three series are of shorter frequencies, that is, longer cycles.

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- We next present the order of the integration of the three series and we also test whether this order of integration is null or unity.

Results

TABLE 1: Fractionary order of the three series of the Brazilian capital netflows, the normal and FX weighted difference between the Brazilian and American real interest rates

Band	Brazilian capital netflows	Difference between BR-US real interest rates	FX weighted difference between BR-US real interest rates	Number of observations
0.7	0.6830942	0.5709853	0.5709853	27
	(0.1575502)	(0.1575502)	(0.1576357)	
	[0.1284298]	[0.1884278]	[0.1494902]	
0.8	0.54253	0.6720247	0.66899151	43
	(0.1226056)	(0.1226056)	(0.1227746)	
	[0.1125998]	[0.1395457]	[0.123876]	

Source: Authors' own elaboration. The asymptotic standard deviation is reported inside the parentheses, while the regression standard deviation is reported inside the brackets.

Results

TABLE 2: Nullity and Unity test of the fractionary order of integration of the Brazilian capital netflows and normal and FX weighted Difference between BR-US real interest rates

Test	Brazilian capital netflows	Difference between BR-US real interest rates	FX weighted difference between BR-US real interest rates
Nullity ($d = 0$)	4.425001	5.48119	5.619361
	(4.818214)	(4.815804)	(5.569402)
Unity ($d = 1$)	-3.731232	-2.675043	-2.525643
	(-4.062795)	(-2.350308)	(-2.503189)

Source: Authors' own elaboration. The test statistic with the asymptotic standard deviation is reported in the line, while the test statistic with the regression standard deviation is reported insides the parentheses.

Results

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TABLE 3: Regression of the Brazilian capital flows on the the difference of Brazilian and American real interest rates, normal and weighted by FX quotient

Variable	Coefficient	Coefficient of weighted difference by FX quotient
Constant	3.7675*	-3.7790**
	(1.9867)	(1.9795)
Difference on BR-US real interest rates	0.9346***	0.9519***
	(0.2464)	(0.2475)

Source: Authors' own elaboration. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The standard deviations are reported insides the parentheses.

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TABLE 4: Order of integration of the residuals of Brazilian capital netflows regressed on the difference of the BR-US real interest rates weighted by FX and otherwise

Band	Residuals based on the difference between BR-US real interest rates	Residuals based on the FX weighted difference between BR-US real interest rates	Number of observations
0.7	0.518028	0.58218	27
	(0.1575502)	(0.1576357)	
	[0.2052273]	[0.2360694]	
0.8	0.4471052	0.4591514	43
	(0.1226056)	(0.1227746)	
	[0.1592755]	[0.1722107]	

Source: Authors' own elaboration. The asymptotic standard deviation is reported inside the parentheses, while the regression standard deviation is reported inside the brackets.

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TABLE 5: Error-corrected regression of the deseasonalized Brazilian capital netflows on the difference of Brazilian and American real interest rates

Variable	Coefficient	Coefficient of weighted difference by FX quotient
Constant	-0.11857	-0.057
	(0.37222)	(0.40378)
Difference on BR-US real interest rates	0.72780*	0.88891*
	(0.42909)	(0.44277)
Residuals	0.42240***	0.36777***
	(0.08882)	(0.09629)

Source: Authors' own elaboration. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The standard deviations are reported insides the parentheses.

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Figure: Coherence of Brazilian capital netflows and the difference of Brazilian and American real interest rates

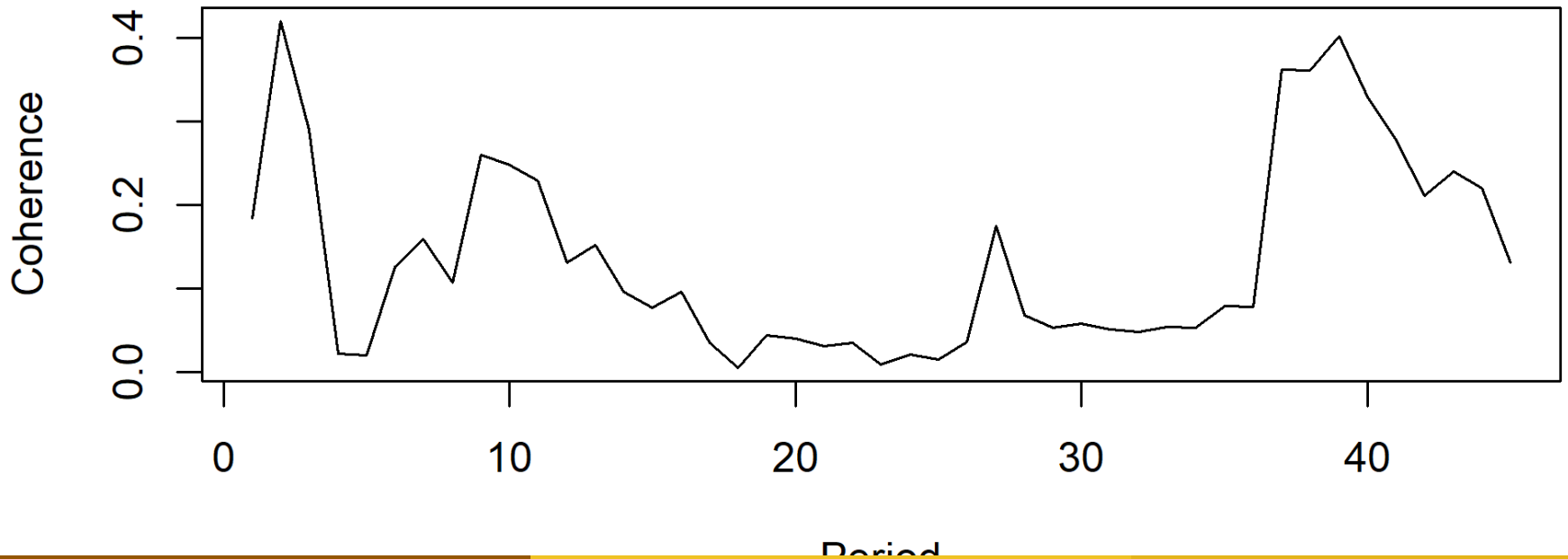

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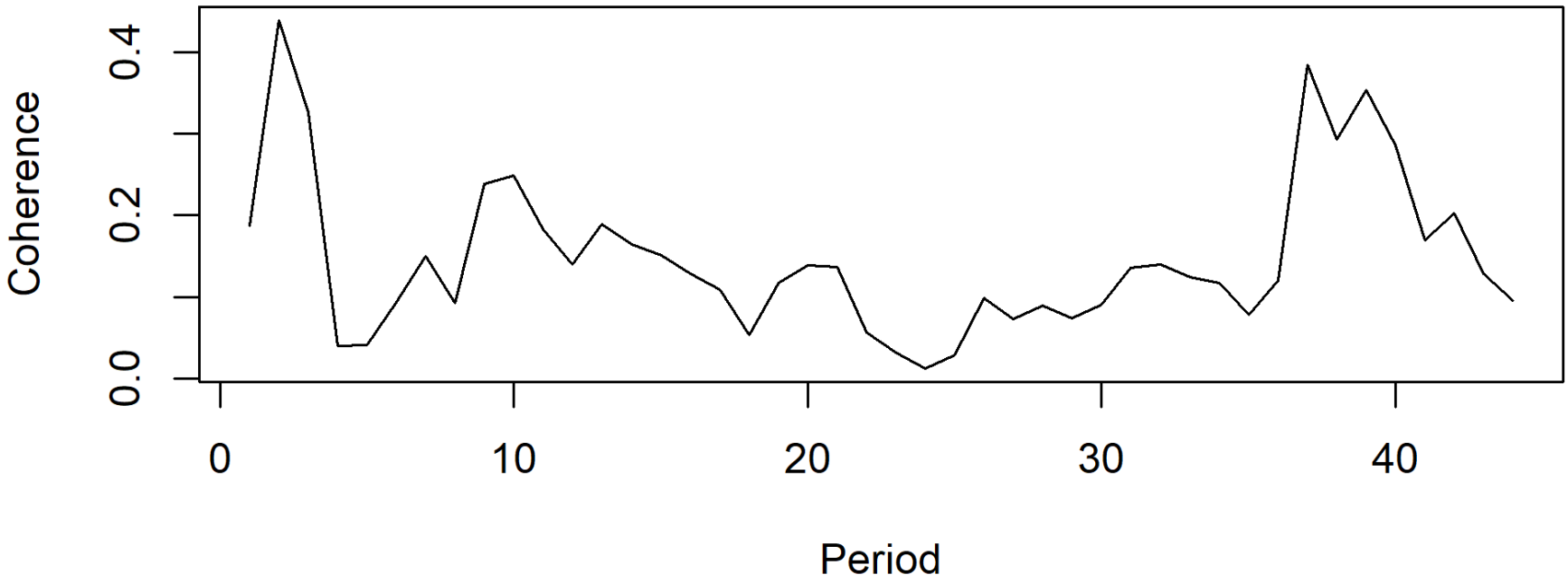
Figure: Coherence of Brazilian capital netflows and the FX weighted difference of Brazilian and American real interest rates



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- Future works might look at expanding this analysis for other countries and also look at more disaggregated components of capital flows.

References

Calvo, Guillermo A, Leonardo Leiderman, and Carmen M Reinhart (1993). "Capital inflows and real exchange rate appreciation in Latin America: the role of external factors". In: *Staff Papers* 40.1, pp. 108–151.

Cardoso, Eliana and Ilan Goldfajn (1998). "Capital flows to Brazil: the endogeneity of capital controls". In: *Staff Papers* 45.1, pp. 161–202.

Engle, Robert F and Clive WJ Granger (1987). "Co-integration and error correction: representation, estimation, and testing". In: *Econometrica: journal of the Econometric Society*, pp. 251–276.

Forbes, Kristin J and Francis E Warnock (2012). "Capital flow waves: Surges, stops, flight, and retrenchment". In: *Journal of international economics* 88.2, pp. 235–251.

Geweke, John and Susan Porter-Hudak (1983). "The estimation and application of long memory time series models". In: *Journal of time series analysis* 4.4, pp. 221–238.

Koepke, Robin (2019). "What drives capital flows to emerging markets? A survey of the empirical literature". In: *Journal of Economic Surveys*