



**BANCO CENTRAL DO BRASIL**

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**BANCO CENTRAL DO BRASIL**

# **Volatility Risk Premium of Commodities Currencies**

Assessing the Predictive Ability

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The views expressed in this work are those of the authors and do not necessarily reflect those of the Banco Central do Brasil or its members.

Can volatility risk premium of the commodities currencies predict commodities and other assets returns?

Volatility Risk Premium: difference between an implied volatility and a realized volatility

# What we did since last year

- We included a new block of dependent variables (bonds)
- Conducted a “differential analysis”, using the VoRP of CC – non CC as a regressor
- Performed a pseudo-out-of-sample assessment of our predictors against a random walk
- Focus on one-week ATM volatilities (monthly model-free volatilities moved to the appendix)

- On equity markets, Variance Risk Premium (VRP) can predict future equity returns (Bollerslev et al, 2009)
  - Intuition: when risk aversion sentiment increases (decreases), equity prices are quickly discounted, resulting in high (low) futures returns.
- Commodities Currencies VRP also predict well future currency and other assets returns
- Chen et al (2010): the so-called commodities currencies returns are able to predict many commodities
  - Intuition: exchange rates are more forward-looking than commodities prices

- Our results: High Volatility Risk Premium (VRP) from commodities currencies leads to positive future returns for most commodities
  - Results extended for other asset classes
- Intuition: when risk aversion sentiment increases, the market quickly *discounts* the risky asset (**commodity**), and later this discount is *accrued*, leading to positive returns

- Commodities are treated as risky asset in this case:
  - Financialization of commodity markets
  - The BCB itself has been trading commodities with international reserves
- Risk aversion sentiment:
  - We do not use an emerging market VoRP on equity index due to data unavailability

- Commodities prediction and Exchange rate
  - Chen, Rogoff, Rossi (2010): so-called commodities currencies are able to predict many commodities prices
  - Chen, Jackson, Kim, Resiandini (2014): first common factor of commodities is inversely linked to the US nominal exchange rate
- VRP and future returns - Equity:
  - Bollerslev, Tauchen and Zhou (2009): S&P500
  - Bollerslev, Marronez, Xu and Zhou (2014): developed equity markets
- VRP and future returns - Currencies:
  - Ornelas (2015), Londono & Zhou (2016): time-series
  - Della Corte et al (2016): cross-section

# Sample

	Sample	Appendix
<b>Source of option data</b>	JP Morgan	Bloomberg
<b>Type of implied volatility</b>	ATM	Model-free
<b>Time to maturity of Option data</b>	One-week	One-month
<b>Source of realized volatility data</b>	Gain Capital broker	Bloomberg
<b>Frequency of returns for realized volatility calculation</b>	5-minute	30-minute returns
<b>Overlapping</b>	No	Yes, on a daily basis
<b>Time period</b>	Feb 2003 to Dec 2014	Oct 2007 to Aug 2014

# Sample

Currency	ATM Volatility	Realized Volatility	Volatility Risk Premium
AUD	12,02	12,80	-0,78
CAD	9,50	10,13	-0,63
CHF	10,45	10,63	-0,18
EUR	10,04	9,62	0,41
GBP	9,09	9,25	-0,16
JPY	10,65	10,28	0,37
<b>Overall Mean</b>	<b>10,29</b>	<b>10,45</b>	<b>-0,16</b>

Sample  
Feb 2003 to Dec 2014

Currency	ATM Volatility	Model-free Volatility	Realized Volatility	Volatility Risk Premium
AUD	13,25	18,87	14,03	4,96
CAD	10,32	14,61	10,56	4,14
CHF	11,03	15,66	11,17	4,52
DKK	9,86	13,93	10,15	3,71
EUR	10,90	15,47	10,16	5,34
GBP	9,96	14,16	9,89	4,31
JPY	11,44	16,40	10,95	5,55
NOK	13,23	18,55	13,74	4,71
NZD	13,96	19,90	14,92	5,13
SEK	13,47	18,95	13,83	5,01
<b>Overall Mean</b>	<b>11,74</b>	<b>16,65</b>	<b>11,94</b>	<b>4,74</b>

Appendix sample  
Oct 2007 to Aug 2014

# Volatility Calculation

- Tick-by-tick quotes provided by Gain Capital on their website
- Calculation of 5-minute log returns
- Realized volatility calculated based on 5-minutes returns each week
- Data consists of 12 years of non-overlapping weekly volatilities (Feb. 2003 to Dec. 2014)
- Implied volatility: OTC exchange rate options (from JP Morgan's data query application)

# VRP Calculation

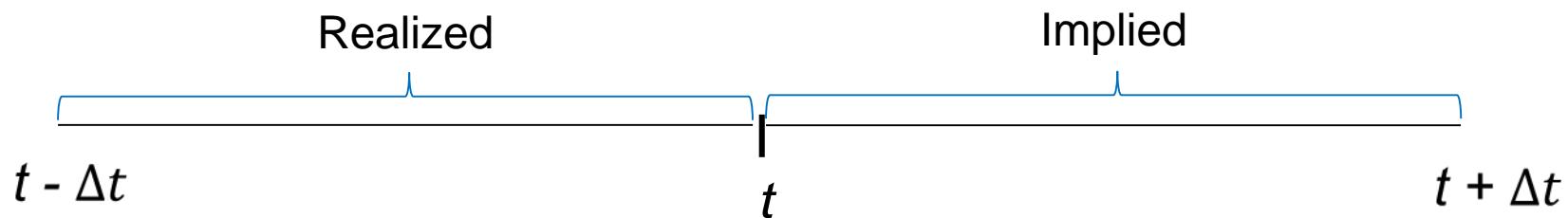
- The traditional way: current (date  $t$ ) implied volatility and past realized volatility ( $t - \Delta t$  to  $t$ )

- Another approach: implied volatility and realized volatility for the same period of the forecast.

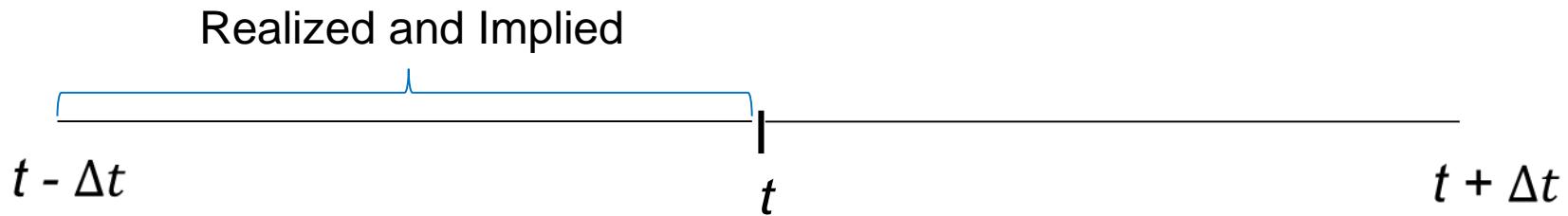
$$VRP_{fwd} = E^{\mathbb{Q}}[\sigma_{t-\Delta t, t}] - E^{\mathbb{P}}[\sigma_{t-\Delta t, t}] = \underbrace{E^{\mathbb{Q}}[\sigma_{t-\Delta t, t}]}_{\text{Implied or Risk-neutral}} - \underbrace{\sigma_{t-\Delta t, t}}_{\text{Realized or physical}}$$

- Assumptions on risk-neutral or Q-measure:
  - The current value of financial assets is equal to their expected payoffs in the future discounted at the risk-free rate
  - Absence of arbitrage
  - All financial assets have the same expected rate of return (risk-free)

- The traditional way: current (date  $t$ ) implied volatility and past realized volatility ( $t - \Delta t$  to  $t$ )



- Our approach: implied volatility and realized volatility for the same period of the forecast.



# VRP Calculation

- Forecast error:
$$e_{t-\Delta t,t} = E^{\mathbb{P}}[\sigma_{t-\Delta t,t}] - \sigma_{t-\Delta t,t}$$
$$e_{t,t+\Delta t} = E^{\mathbb{P}}[\sigma_{t,t+\Delta t}] - [\underbrace{\sigma_{t,t+\Delta t} - \sigma_{t-\Delta t,t}}_{\Delta\sigma_{t-\Delta t,t+\Delta t}}] - \sigma_{t-\Delta t,t}$$

Ideally

$$VRP = E^{\mathbb{Q}}[\sigma_{t,t+\Delta t}] - E^{\mathbb{P}}[\sigma_{t,t+\Delta t}]$$

Implied or Risk-neutral      Realized or physical

$$VRP_{fwd} = E^{\mathbb{Q}}[\sigma_{t-\Delta t,t}] - \sigma_{t-\Delta t,t} - e_{t-\Delta t,t}$$
$$VRP_{back} = E^{\mathbb{Q}}[\sigma_{t,t+\Delta t}] - \sigma_{t-\Delta t,t} - \Delta\sigma_{t-\Delta t,t+\Delta t} - e_{t,t+\Delta t}$$

- We do not use the whole information set (implied volatility is lagged)
- Volatility forecast error and VRP are probably positively correlated
- Not possible to separate this effect on the prediction analysis
- Performance might be better due to forecast error
- Despite that, we do not have to assume that volatility has a unit autocorrelation

# Results – Baseline Regressions

## Commodities and Currencies

$$R_t = \alpha + \beta_1 R_{t-1} + \beta_2 VRP_{t-1} + \varepsilon_t$$

Dependent Variables	Coefficients				HH t-stats				Adjusted $R^2$			
	VoRP		VaRP		VoRP		VaRP		VoRP		VaRP	
	CC	non CC	CC	non CC	CC	non CC	CC	non CC	CC	non CC	CC	non CC
	Panel A - Commodities											
Broad Spot	14,5	8,8	22,3	22,6	4,03***	2,02**	6,06***	1,55	5,5%	1,3%	4,6%	1,1%
Energy	14,8	8,7	24,8	20,3	2,44**	1,35	3,76***	0,99	2,2%	0,5%	2,2%	0,4%
Agriculture	13,5	9,2	19,8	25,4	3,51***	1,82*	4,46***	1,51	3,5%	1,1%	2,7%	1,1%
Indust Metals	18,8	15,4	28,7	41,0	3,87***	2,28**	5,17***	1,81*	5,1%	2,1%	4,3%	1,9%
Prec. Metals	11,4	2,7	12,8	2,8	3,39***	0,53	2,58***	0,18	2,3%	0,1%	1,0%	0,0%
Crude Oil	20,4	9,4	34,9	12,6	2,62***	1,11	3,61***	0,45	3,6%	0,7%	3,7%	0,4%
Panel B - Currencies												
Dollar Index	-4,5	-2,5	-6,9	-9,2	-3,36***	-1,05	-9,93**	-1,27	2,6%	0,5%	2,2%	0,9%
EM Currency Index (JPM)	10,6	9,5	17,1	26,4	5,78***	3,53***	11,58***	3,05***	15,9%	7,9%	14,5%	7,9%
Latam FX Index	11,9	11,5	20,6	33,1	4,27***	3,11***	9,28***	2,49**	15,1%	8,7%	15,6%	9,1%
Asia FX Index	2,9	2,4	4,4	7,4	4,54***	2,10**	7,04***	1,98**	7,0%	3,2%	5,8%	3,7%

- Strong significance for CC VoRP in this specification

# Results – Baseline Regressions

## Equities and Bonds

$$R_t = \alpha + \beta_1 R_{t-1} + \beta_2 VRP_{t-1} + \varepsilon_t$$

Dependent Variables	Coefficients				HH t-stats				Adjusted R <sup>2</sup>			
	VoRP		VaRP		VoRP		VaRP		VoRP		VaRP	
	CC	non CC	CC	non CC	CC	non CC	CC	non CC	CC	non CC	CC	non CC
<b>Panel C - Equities</b>												
MSCI World	23,2	18,7	41,8	51,6	<b>3,60***</b>	<b>2,60***</b>	<b>7,04***</b>	<b>1,91*</b>	14,7%	6,0%	16,5%	5,8%
MSCI EM	31,3	25,9	51,8	70,0	<b>5,41***</b>	<b>3,36***</b>	<b>10,17***</b>	<b>2,71***</b>	15,7%	6,7%	15,0%	6,2%
Russell 2000	18,7	14,9	33,5	37,0	<b>3,08***</b>	<b>2,02**</b>	<b>5,08***</b>	1,41	6,0%	2,5%	6,7%	2,0%
MSCI Energy	30,4	22,4	52,7	62,1	<b>3,69***</b>	<b>2,74***</b>	<b>6,28***</b>	<b>2,02**</b>	13,6%	4,8%	14,2%	4,7%
SP500	19,4	15,2	36,1	40,1	<b>3,07***</b>	<b>2,34**</b>	<b>5,50***</b>	1,63	11,0%	4,5%	13,2%	4,1%
<b>Panel D - Bonds</b>												
10-year T-Bond - US	-0,3	-0,8	-0,3	-2,4	-1,35	<b>-1,85*</b>	-1,20	<b>-2,14**</b>	0,5%	1,2%	0,4%	1,4%
10-year T-Bond - Germany	-0,2	-0,6	-0,2	-1,7	-1,48	<b>-1,97**</b>	-1,05	<b>-2,07**</b>	1,2%	1,7%	1,0%	1,9%
10-year T-Bond - Japan	-0,1	-0,3	-0,2	-0,7	<b>-1,91*</b>	<b>-2,37**</b>	<b>-3,38**</b>	<b>-2,29**</b>	0,5%	0,9%	0,4%	0,8%
10-year T-Bond - Australia	-0,3	-0,8	-0,6	-2,7	-1,43	<b>-1,81*</b>	<b>-2,31**</b>	<b>-2,06**</b>	1,4%	2,1%	1,4%	2,5%
10-year T-Bond - Canada	-0,0	-0,4	-0,0	-1,3	-0,23	-1,44	-0,10	<b>-1,79*</b>	0,3%	0,8%	0,3%	0,9%
US Corporate Spreads (A)	-0,7	-0,5	-1,4	-1,5	<b>-2,55**</b>	<b>-2,10**</b>	<b>-6,43***</b>	<b>-1,82*</b>	15,6%	11,8%	19,4%	12,4%
US Corporate Spreads (BBB)	-0,4	-0,4	-1,0	-1,3	<b>-2,14**</b>	<b>-2,36**</b>	<b>-9,54***</b>	<b>-3,37***</b>	9,8%	8,9%	11,5%	9,5%

- For bonds, dependent variable is  $\Delta y$

# Results – Differential Analysis

$$R_t = \alpha + \beta_1 R_{t-1} + \beta_2 (CC\ VRP_{t-1} - non\ CC\ VRP_{t-1}) + \varepsilon_t$$

Dependent Variables	Coefficients		HH t-stats		Adjusted R <sup>2</sup>	
	VoRP		VoRP		VoRP	
	CC - non CC	CC	CC - non CC	CC	CC - non CC	CC
<b>Panel A - Commodities</b>						
<b>Broad Spot</b>	17,1	14,5	<b>6,11***</b>	<b>4,03***</b>	4,1%	5,5%
<b>Energy</b>	17,8	14,8	<b>3,29***</b>	<b>2,44**</b>	1,7%	2,2%
<b>Agriculture</b>	14,7	13,5	<b>4,30***</b>	<b>3,51***</b>	2,2%	3,5%
<b>Indust Metals</b>	17,7	18,8	<b>4,96***</b>	<b>3,87***</b>	2,4%	5,1%
<b>Prec. Metals</b>	18,3	11,4	<b>3,34***</b>	<b>3,39***</b>	3,2%	2,3%
<b>Crude Oil</b>	27,6	20,4	<b>3,92***</b>	<b>2,62***</b>	3,5%	3,6%
<b>Panel B - Currencies</b>						
<b>Dollar Index</b>	-5,6	-4,5	<b>-3,01***</b>	<b>-3,36***</b>	2,2%	2,6%
<b>EM Currency Index (JPM)</b>	9,3	10,6	<b>4,26***</b>	<b>5,78***</b>	6,5%	15,9%
<b>Latam FX Index</b>	9,5	11,9	<b>3,15***</b>	<b>4,27***</b>	5,0%	15,1%
<b>Asia FX Index</b>	2,8	2,9	<b>3,80***</b>	<b>4,54***</b>	3,6%	7,0%

# Results – Long Term Returns

$$LTR_{t,t+n} = \alpha + \beta_1 VoRP_{t-1} + \varepsilon_t$$

<i>Dependent Variable</i>	<i>Coefficients of Commodities Currencies Volatility Risk Premium</i>						
	1 week	2 weeks	3 weeks	5 weeks	10 weeks	15 weeks	20 weeks
<b>Panel A - Commodities</b>							
Broad Spot	14,2***	8,1***	7,3***	4,5*	3,9*	2,4	2,0
Energy	14,4**	8,8***	7,6**	5,0	5,0*	4,0	3,7*
Agriculture	13,7***	7,3***	6,0**	3,2	3,1*	1,0	0,8
Indust Metals	19,2***	11,4***	10,8***	7,4**	5,9**	4,3**	3,5*
Prec. Metals	11,5***	4,9*	5,5***	3,1**	1,8***	0,6	-0,6
Crude Oil	20,2***	13,0***	8,9*	6,2	5,6	4,6	4,4
<b>Panel B - Currencies</b>							
Dollar Index	-4,6***	-1,8**	-2,3***	-1,9***	-0,7	-0,3	-0,3
EM Currency Index (JPM)	10,6***	5,0***	4,3***	2,6***	1,7**	1,2**	1,0*
Latam FX Index	12,0***	4,9***	4,4***	2,9**	2,2**	1,5**	1,2
Asia FX Index	3,1***	1,5***	1,6***	1,0***	0,6**	0,4**	0,4*

- Significance up to almost ten weeks

# Results – Adding Control Variables

$$R_t = \alpha + \beta_1 R_{t-1} + \beta_2 VRP_{t-1} + \beta_3 RFX_{t-1} + \varepsilon_t$$

	Panel A						$R^2$	
	Coefficients Estimates			HH t-statistics				
	VoRP CC	Lag Dollar Index Returns	Lag Comm Returns	VoRP CC	Lag Dollar Index Returns	Lag Comm Returns		
<b>Broad Spot</b>	14,74	0,15	-0,01	<b>4,21***</b>	1,60	-0,21	5,9%	
<b>Energy</b>	15,73	0,29	-0,01	<b>2,58***</b>	<b>1,88*</b>	-0,32	2,7%	
<b>Agriculture</b>	13,72	0,10	0,01	<b>3,71***</b>	0,97	0,24	3,6%	
<b>Indust Metals</b>	18,63	-0,07	-0,02	<b>3,71***</b>	-0,55	-0,54	5,2%	
<b>Prec. Metals</b>	11,41	0,01	-0,01	<b>2,20**</b>	0,10	-0,35	2,3%	
<b>Crude Oil</b>	20,94	0,17	-0,05	<b>2,68**</b>	0,95	-0,95	3,8%	

	Panel B						$R^2$	
	Coefficients Estimates			HH t-statistics				
	VoRP CC	Lag CC Returns	Lag Comm Returns	VoRP CC	Lag CC Returns	Lag Comm Returns		
<b>Broad Spot</b>	14,43	0,01	-0,05	<b>4,20***</b>	0,14	-0,75	5,5%	
<b>Energy</b>	14,99	-0,05	-0,03	<b>2,53**</b>	-0,40	-0,66	2,2%	
<b>Agriculture</b>	13,56	-0,02	0,00	<b>3,71***</b>	-0,22	0,07	3,5%	
<b>Indust Metals</b>	18,62	0,06	-0,03	<b>3,67***</b>	0,57	-0,60	5,2%	
<b>Prec. Metals</b>	11,31	0,02	-0,02	<b>2,16**</b>	0,14	-0,43	2,3%	
<b>Crude Oil</b>	20,82	-0,10	-0,05	<b>2,68***</b>	-0,94	-0,80	3,7%	

# Results – Random Walk Comparison

$$R_t = \alpha + \beta_1 X_{t-1} + \varepsilon_t$$

Panel A - Commodities								
Weekly Returns	Differential MSE				HH t-statistics			
	VoRP CC	VoRP non-CC	Lag CC Returns	Lag Return	VoRP CC	VoRP non-CC	Lag CC Returns	Lag Return
Broad Spot	-0,46	0,02	0,11	0,10	<b>-2,07</b>	0,09	1,36	1,07
Energy	-0,45	0,14	0,34	0,10	-1,41	0,60	<b>2,62</b>	1,36
Agriculture	-0,30	0,04	0,16	0,13	<b>-2,33</b>	0,26	1,27	1,06
Indust Metals	-0,76	-0,03	0,29	0,25	<b>-2,67</b>	-0,12	1,39	<b>1,85</b>
Prec. Metals	0,07	0,27	0,14	0,12	0,17	1,00	1,61	1,24
Crude Oil	-1,03	0,20	0,40	0,18	<b>-2,47</b>	0,61	1,56	1,08
Panel B - Currencies								
Dollar Index	-0,04	0,02	0,02	0,01	-1,38	0,97	1,13	1,61
EM Currency Index (JPM)	-0,28	-0,11	0,03	0,05	<b>-3,23</b>	<b>-2,52</b>	0,98	1,21
Latam FX Index	-0,35	-0,18	0,06	0,09	<b>-2,73</b>	<b>-5,51</b>	1,07	1,09
Asia FX Index	-0,02	0,00	0,01	0,00	-1,57	-0,38	1,12	<b>1,71</b>

- VoRP CC beats Random Walk, except for Prec. Metals
- Lag CC returns are not statistically better than a random walk

# Results - Summary

- Positive and statistically significant relationship between Volatility Risk Premium of commodities currencies and future commodities indexes returns
  - Analysis using differential cc VRP – non cc VRP shows even better results
  - Forecast periods ranging from one week to twenty weeks.
  - Robust to the inclusion of control variables
  - Pseudo-out-of-sample assessment of our predictors
  - The adjusted R<sup>2</sup> ranges from around 5% for commodity indexes to around 15% in currencies and equities
- Other asset classes such as currencies, equities and bonds can also be predicted (non-commodities currencies seem to be especially adequate in predicting future returns of bonds)

# Appendix

# Comparison – Realized and Implied

- Testing realized and implied volatility separately
- Realized volatility shows more significance than implied volatility
- High significance might be explained by the short window (one week)

Dependent Variables	Coefficients			HH t-stats			Adjusted R <sup>2</sup>		
	Realized	Implied	Implied with lag	Realized	Implied	Implied with lag	Realized	Implied	Implied with lag
<b>Panel A - Commodities</b>									
<b>Broad Spot</b>	-4,02	-1,68	-1,63	<b>-2,12</b>	-0,96	-0,92	2,4%	0,4%	0,4%
<b>Energy</b>	-5,75	-3,75	-3,54	<b>-2,56</b>	<b>-1,69</b>	-1,56	1,9%	0,8%	0,7%
<b>Agriculture</b>	-2,55	-0,23	-0,23	-1,20	-0,11	-0,11	0,8%	0,1%	0,1%
<b>Indust Metals</b>	-6,31	-3,20	-3,30	<b>-2,39</b>	-1,21	-1,24	3,2%	0,8%	0,8%
<b>Prec. Metals</b>	-1,19	0,93	0,90	-0,66	0,44	0,42	0,1%	0,1%	0,1%
<b>Crude Oil</b>	-9,24	-6,39	-6,30	<b>-2,73</b>	<b>-1,80</b>	<b>-1,75</b>	4,1%	1,9%	1,8%

# Appendix

## Individual regressions

$$R_{t,t+19} = \alpha + \beta_1 X_{t-1} + \varepsilon_t$$

Dependent Variables	Comm. Curr. VoRP	Non-CC VoRP	Lag Comm Returns	Lag Dev Cur Ret	Lag CC Returns	Equity VoRP
<b>Panel A - Coefficients</b>						
<b>Broad Spot</b>	5,74	6,63	0,08	0,41	0,28	1,48
<b>Energy</b>	6,33	5,68	0,05	0,53	0,36	2,12
<b>Agriculture</b>	4,91	6,79	0,02	0,41	0,25	0,82
<b>Grains</b>	5,52	7,96	0,01	0,44	0,27	0,83
<b>Petroleum</b>	10,26	10,19	0,11	0,72	0,54	2,88
<b>Indust Metals</b>	9,27	12,00	0,09	0,59	0,41	2,14
<b>Prec. Metals</b>	2,90	3,62	-0,12	-0,07	0,04	0,99
<b>Panel B - HH t-stats</b>						
<b>Broad Spot</b>	<b>3,26</b>	<b>2,43</b>	0,58	<b>2,11</b>	<b>1,73</b>	<b>1,80</b>
<b>Energy</b>	<b>2,26</b>	1,34	0,38	1,61	1,40	<b>1,72</b>
<b>Agriculture</b>	<b>2,70</b>	<b>2,40</b>	0,24	<b>1,74</b>	1,47	1,15
<b>Grains</b>	<b>2,76</b>	<b>2,45</b>	0,07	<b>1,65</b>	1,33	1,07
<b>Petroleum</b>	<b>3,27</b>	<b>1,99</b>	0,66	<b>1,86</b>	1,63	<b>1,71</b>
<b>Indust Metals</b>	<b>4,47</b>	<b>3,83</b>	0,73	<b>2,22</b>	<b>2,01</b>	<b>2,00</b>
<b>Prec. Metals</b>	<b>1,83</b>	1,53	<b>-1,91</b>	-0,42	0,28	1,39

# Appendix

## Regressions with control variables

$$R_{t,t+19} = \alpha + \beta_1 CCV_oRP_{t-1} + \beta_2 R_{t-20,t-1} + \beta_3 CurRet_{t-20,t-1} + \beta_4 EqVoRP_{t-1} + \varepsilon_t$$

Dependent Variables	Comm. Curr. VoRP	Lag Comm Returns	Lag Dev Cur Ret	Lag Comm Curr Returns	Equity VoRP	Adjusted R <sup>2</sup>
<b>Panel A - Coefficients</b>						
<b>Broad Spot</b>	5,61	-0,13	-	0,10	0,30	12,6%
<b>Energy</b>	4,70	-0,06	-	0,10	1,01	7,9%
<b>Agriculture</b>	5,71	-0,07	-	0,11	-0,61	5,8%
<b>Grains</b>	6,56	-0,07	-	0,12	-0,82	5,6%
<b>Petroleum</b>	9,28	-0,07	-	0,09	0,77	14,8%
<b>Indust Metals</b>	9,97	-0,15	-	0,08	0,23	18,2%
<b>Prec. Metals</b>	3,34	-0,16	-	-0,05	0,49	5,1%
<b>Panel B - HH t-stats</b>						
<b>Broad Spot</b>	<b>3,29</b>	-1,17	-	0,74	0,57	-
<b>Energy</b>	<b>1,97</b>	-0,53	-	0,45	1,15	-
<b>Agriculture</b>	<b>2,87</b>	-0,70	-	0,54	-1,12	-
<b>Grains</b>	<b>2,74</b>	-0,74	-	0,47	-1,32	-
<b>Petroleum</b>	<b>3,59</b>	-0,62	-	0,38	0,77	-
<b>Indust Metals</b>	<b>3,41</b>	<b>-1,91</b>	-	0,46	0,31	-
<b>Prec. Metals</b>	<b>1,66</b>	<b>-2,38</b>	-	-0,30	0,69	-

- Equity VoRP is not significant when tested together with other variables