The Uncovered Interest Rate Parity Condition (UIPC) Puzzle

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What is the Uncovered Interest Rate Parity Condition?

Suppose Country A’s interest rate < Country B’s interest rate - is there an arbitrage opportunity?

We have that $R_A < R_B$, so we can…

1. Borrow in Country A at R_A
2. Convert to Country B’s currency
3. Buy bonds in Country B with interest rate of R_B
4. When bonds mature, convert money back to Country A’s currency
5. Settle loan in Country A
6. Infinite Profit 🤑🤑🤑 - because interest earning in Country B > interest paid on loan in Country A

What will happen as a result of this arbitrage opportunity?

As investors exercise the arbitrage opportunity…

1. Demand for Currency B increases
2. Supply of Currency A increases
3. Currency A will depreciate relative to Currency B $\rightarrow P_{A/B}$ will decrease

Currency A will keep depreciating until the initial interest rate difference is offset and the arbitrage opportunity is eliminated.

This equilibrium yields UIPC...

$$\text{Interest Rate Differential} = \text{Expected Currency Appreciation}$$

$$\implies R_A - R_B = \frac{E[P'_{A/B}] - P_{A/B}}{P_{A/B}}$$

Does UIPC hold empirically?

1. *How can we check?*
2. *US Dollar - Russian Ruble*
3. *US Dollar - GBP*

We can check with a simple regression...

Run a regression between the left hand side, and right hand side of UIPC $\rightarrow$ $R_A - R_B = \frac{E[P'_{A/B}] - P_{A/B}}{P_{A/B}}$

If UIPC holds, we expect...

$$\frac{E[P'_{A/B}] - P_{A/B}}{P_{A/B}} = \alpha + \beta \cdot (R_A - R_B)$$

$$\implies \alpha = 0 \text{ and } \beta = 1$$

What data do we use?

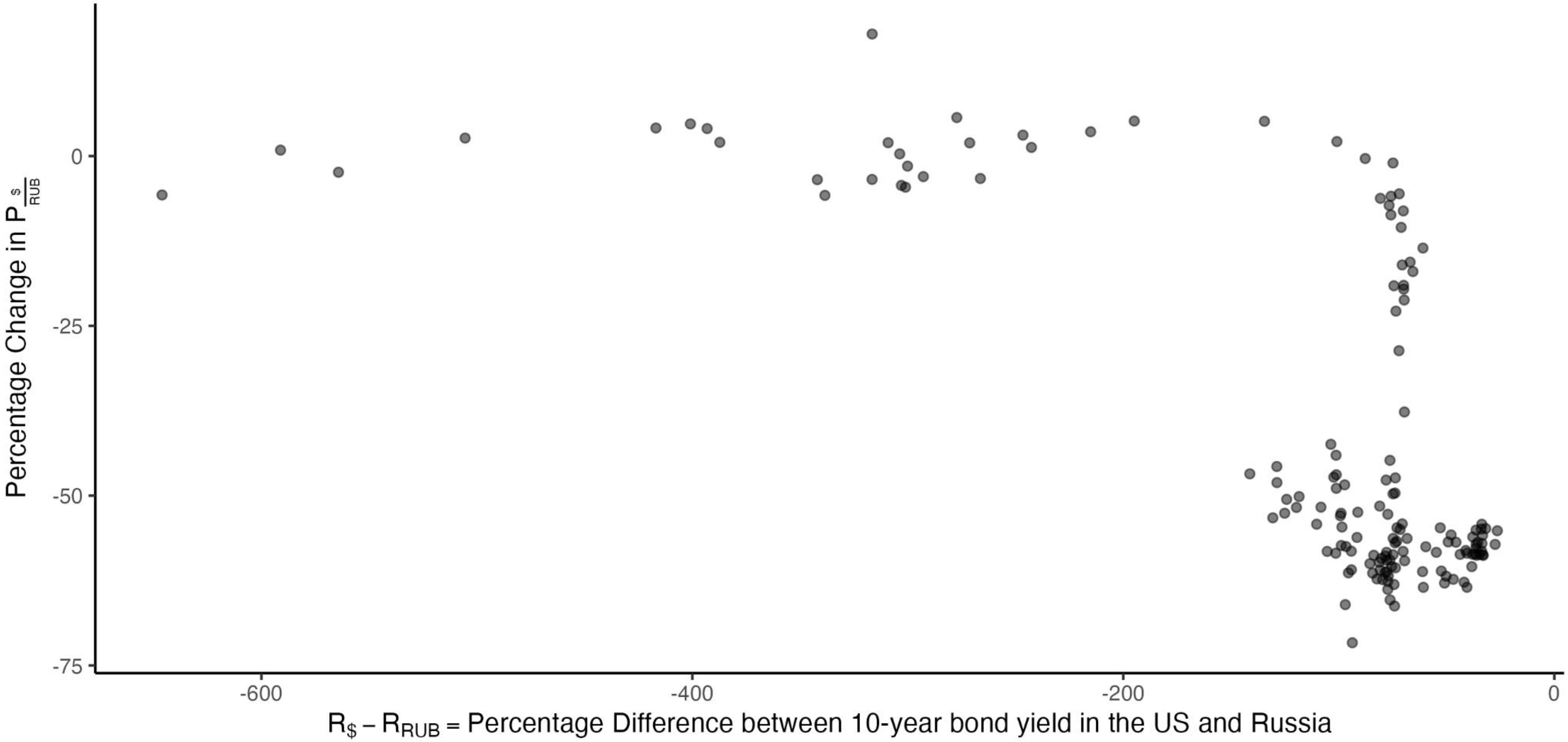
$$\frac{E[P'_{A/B}] - P_{A/B}}{P_{A/B}} = \alpha + \beta \cdot (R_A - R_B)$$

- RHS: Interest Rate delta computed using 10 year bond yield data for the two countries
- LHS: Expected currency appreciation is the % change in the currency between now and 10 years from now

All this data is on FRED… But, why 10 years?

- R_A - R_B is higher, so less likely to have UIPC hold due to random chance
- Reaching equilibrium necessary for UIPC may take time

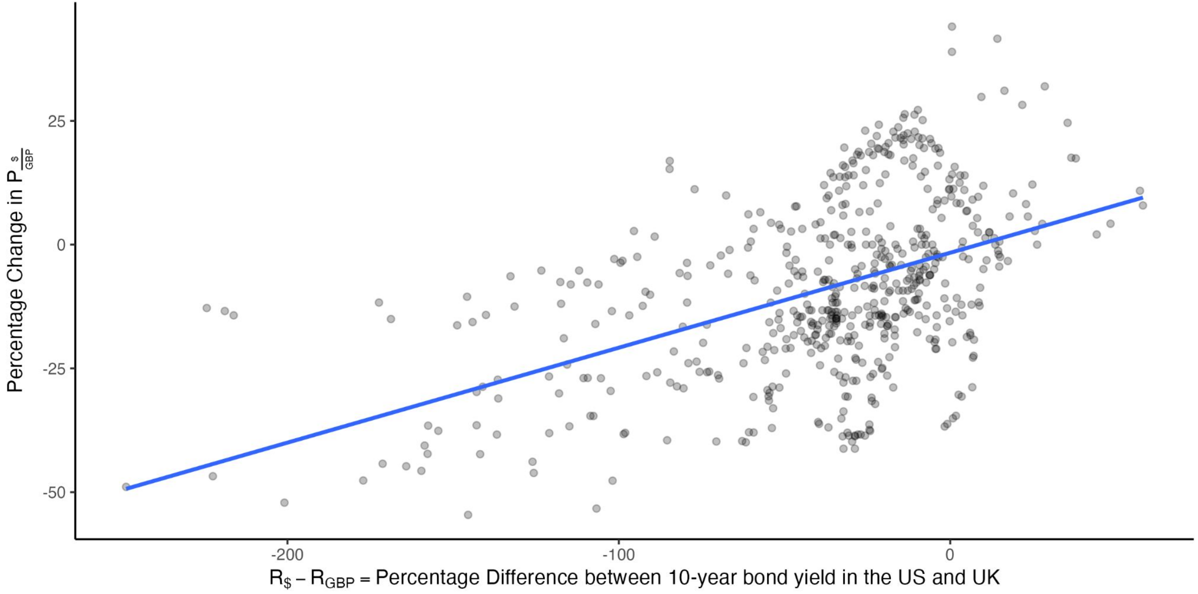
Figure 1 - UIPC doesn't hold for Russia due to Lack of (1) Floating Exchange Rate and (2) Perfect Capital Mobility



Based on data from 2001-2013. Source: FRED

Doesn't seem to hold for the UK either...

Figure 2 - $/GBP Exchange Rates don't move as much as expected by UIPC



Based on data from 1960-2007. Source: FRED

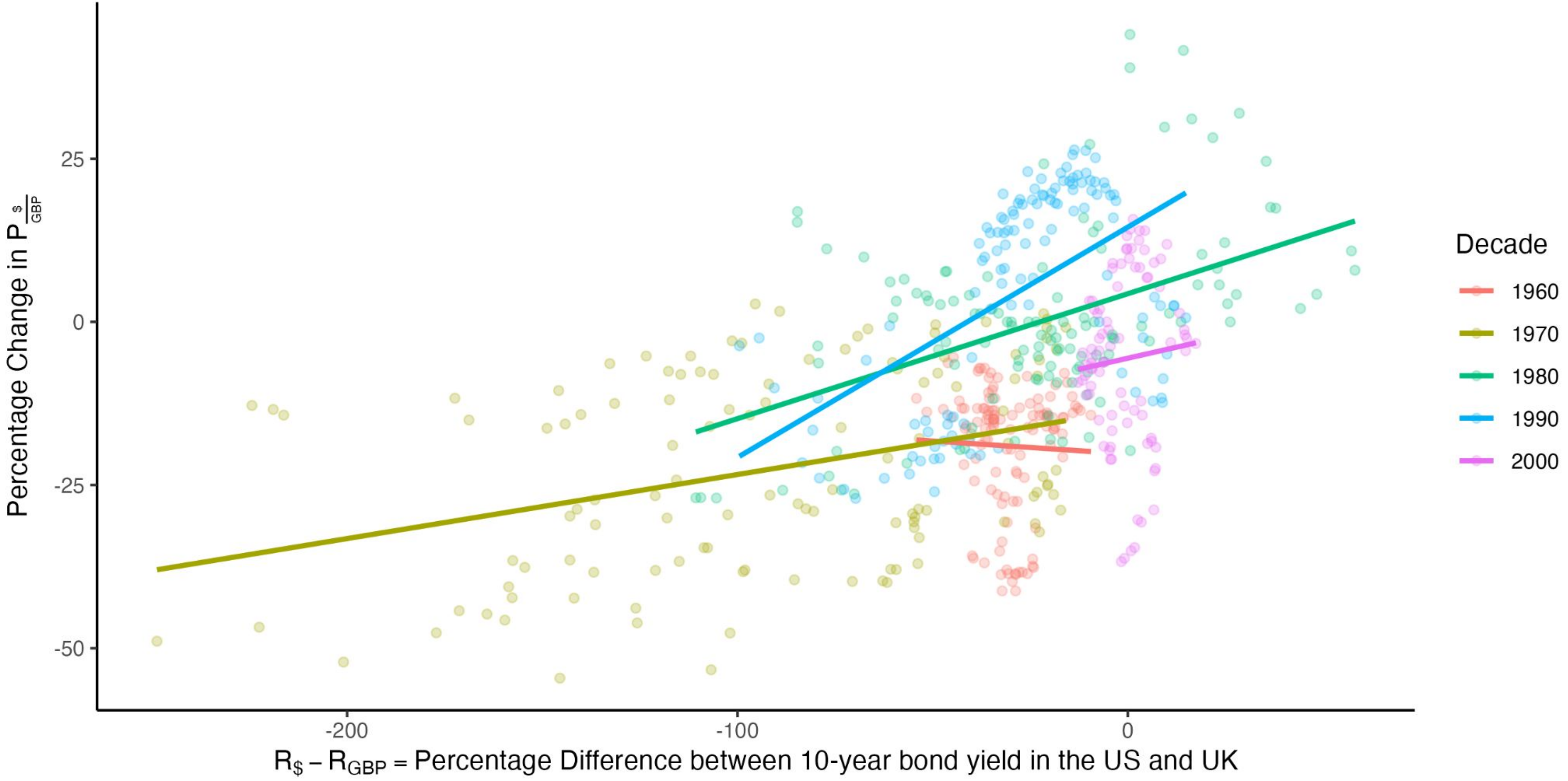
Table 1: Regression Results

	Dependent variable:
	Pct.Diff.Exch.Rate
β	0.192^{***}
	(0.015)
α	-1.643^{*}
	(0.853)
Observations	565
R^2	0.228
Adjusted R^2	0.226
Residual Std. Error	15.544 (df = 563)
F Statistic	166.050^{***} (df = 1; 563)
Note:	*p<0.1; **p<0.05; ***p<0.01

Statistically different than 1 at 5% level!

Why is $\beta \ll 1$? Can we crack this UIPC Puzzle?

Figure 3 - Agreement with UIPC differs by Decade for $/GBP



Based on data from 1960-2007. Source: FRED

Can past trends in the currency explain the deviation we see between decades?

Let’s try this approach by adding an interaction variable that captures the past trend in $P_{\$/£}$

$$\frac{E[P'_{\$/£}] - P_{\$/£}}{P_{\$/£}} = \alpha + \gamma_0 \cdot (R_\$ - R_£) + \gamma_1 \cdot \underbrace{\frac{dP_{\$/£}}{dt}} + \gamma_2 \cdot \underbrace{\frac{dP_{\$/£}}{dt}} \cdot (R_\$ - R_£)$$

Gradient of exchange rate over the last <u>four years</u>

The model seems to be better

$$\text{Partial } F \approx 58.911$$

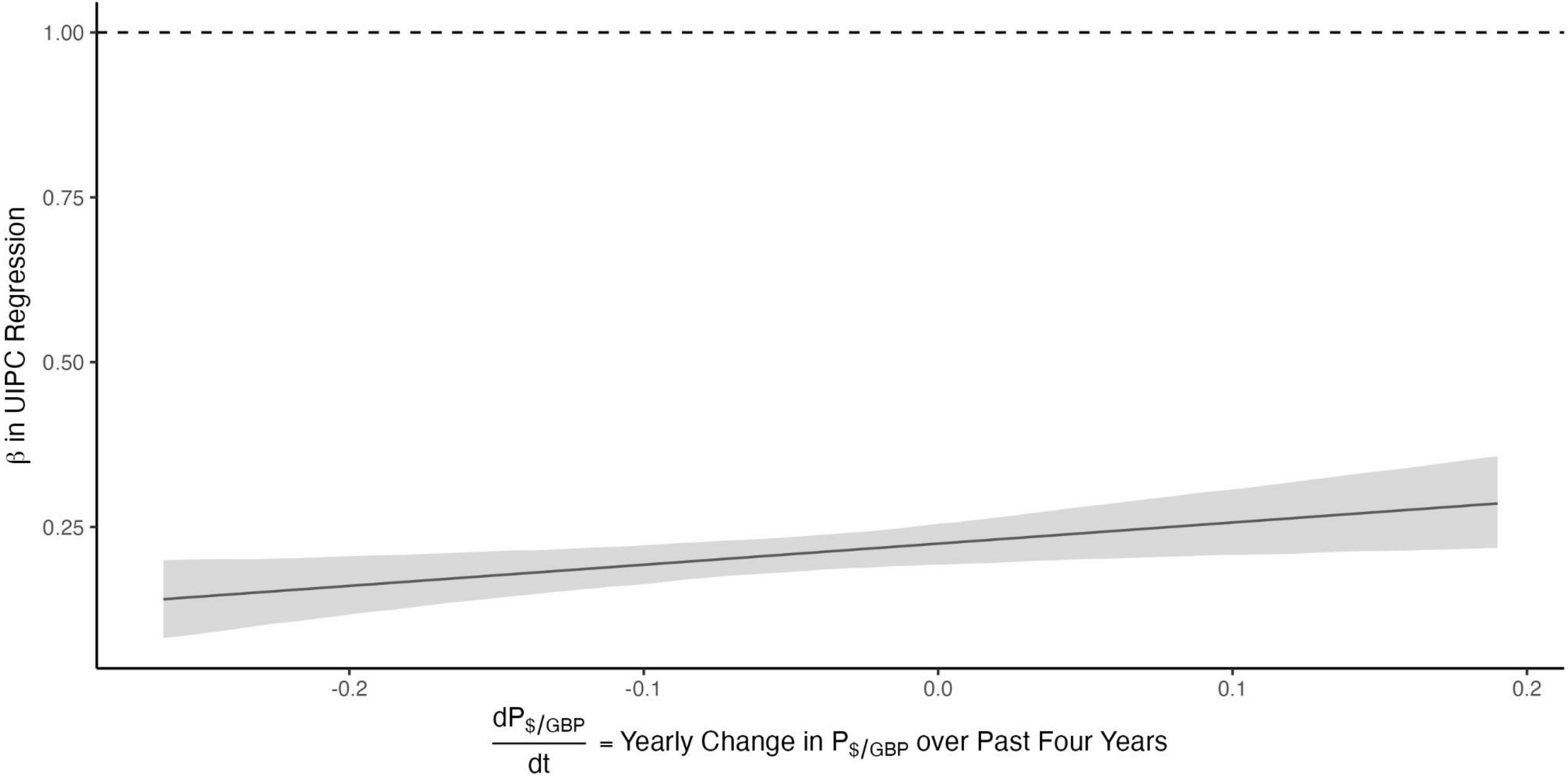
Statistically Significantly
Explains Variability in Data

Accounting for the yearly gradient of exchange rate for the last 4 years is a better predictor of beta than holding beta constant.

New model

$$\beta = \gamma_0 + \gamma_2 \cdot \frac{dP_{\$/£}}{dt}$$

Figure 4 - UIPC is more likely to hold if GBP Appreciated in the Past Four Years



Based on data from 1960-2007. Source: FRED

Why do Gradients Explain β so well

- We assume that the currency is expected to appreciate if it appreciated in the past 4 years.
- This is might be due to the **availability bias**: people believe that the readily available information is more representative of fact than is the case. This means that agents in the market believe that trends from the past will continue in the future.
- However, this does not hold for 6-month gradients, or even 1-year gradients - availability bias takes longer to set in?

Conclusion - There is so much scope!

- We found out UIP does not hold, even for countries with free trade like the the US and UK, but for some decades it does.
- Can perform multiple regression models by adding in potential factors like inflation, trade between the two countries, past trends, etc. to see how they influence the percent change in exchange rates.
- Can also explore further reasons as to why investors do not usually exploit the failure of UIP: Behavioral biases? Risk Aversion? Government Intervention? Market frictions?

Thank you!

Appendix

Regression Output for Interaction Plot

Here, `r_delta` is basically the difference between the US interest rate for 10-year bonds and the UK interest rate.

Gradients is the 4-year yearly increase in exchange rate (for the 4-years before each Date value)

Table 1: Interaction Regression Results

	Dependent variable:
	Pct.Diff.Exch.Rate
gradients	-58.950^{***}
	(7.623)
r_delta	0.225^{***}
	(0.016)
gradients:r_delta	0.321^{**}
	(0.135)
Constant	-1.796^{**}
	(0.839)
Observations	553
R^2	0.366
Adjusted R^2	0.363
Residual Std. Error	14.242 (df = 549)
F Statistic	105.761^{***} (df = 3; 549)
Note:	$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Partial F-Statistic for Interaction Plot

The partial F-statistic for the interaction model is very high, which indicates that the interaction explains a lot of the variation observed in the percent difference in exchange rates.

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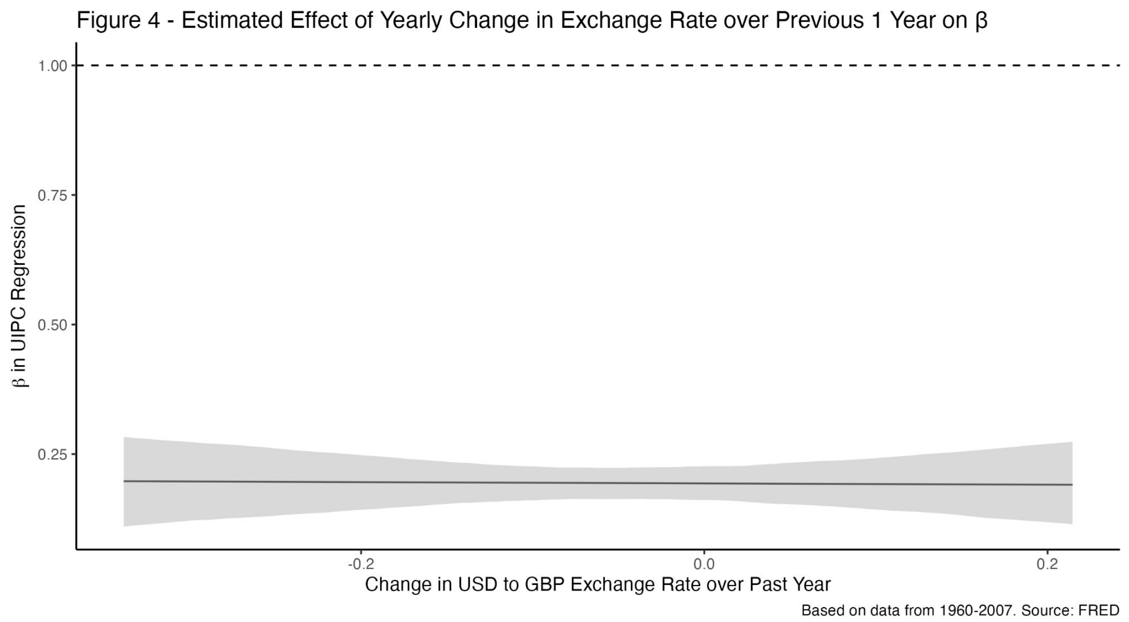
Analysis of Variance Table

Model 1: Pct.Diff.Exch.Rate ~ r_delta
Model 2: Pct.Diff.Exch.Rate ~ gradients * r_delta
  Res.Df    RSS Df Sum of Sq      F
1    551 135261
2    549 111362  2     23900 58.911
    Pr(>F)
1
2 < 2.2e-16 ***
---
Signif. codes:
  0 '***' 0.001 '**' 0.01 '*' 0.05 '.'
  0.1 ' ' 1
```

1 Year Gradients Interplot



6 Months Gradients Interplot