Time Variation of Regression Coefficients related to Macroeconomic News affecting Currency Prices

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November 5, 2019

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abstract here when I'm done with the writing and have all results

1 Introduction

There exists a number of macroeconomic figures that are released on a predetermined schedule for certain countries. These include for example the Non-Farm Employment change that is released on the first friday of every month informing economists and investors alike of the status of employment in the United States.

Classic economic theory helps us understand that an increase of interest rates is warranted when economies are performing well and prices are generally increasing. Those who decide to increase national interest rates, the central banks, typically refer to measures of inflation in order to make their decisions. Because of this, investors and traders alike pay close attention to news releases (such as inflation, and also the Non-Farm-Payrolls in the case of the United States) and react according to the results. These news releases are not made public until specific times on specific days and since investors and traders react to the same news the moment it is released, the result is often a violent reaction of price in one direction or another. The common discourse is that the direction and the magnitude of the change of price depends on the difference between the expectation of the market (combined expecation of worldwide investors) and the result of the news release.

In this paper, we decide to use currency pairs to measure the price shocks. As certain news pertaining to a particular country affects its respective currency more than other ones, it makes sense to observe the currency most relevant to the news announcement. As currency prices are typically measured in pairs, the second chosen currency will be another major currency that is known for its high liquidity (EUR, USD or CHF) and does not have any other news announcements at the same time[1]. As an example, we would use the

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[1]When simultaneous news cannot be avoided, a sequence of stability tests will be applied to ensure time variation is identified on a specific news release

USD/CAD currency pair to measure the effect of the Canadian Consumer Price Index (CPI).

The paper of (Board of Governors of the Federal Reserve System et al. 2003) reveals that over the time period between 1987 and 2002 there has been little time-variation in the reaction to news. Some more recently published literature of (Ben Omrane et al. 2019) involving an analysis on euro-dollar contracts has determined that unlike the the decade(s) encompassing the "Great Moderation" where there was lower relative volatility in the financial markets, the time period between 2004 and 2014 is characterized by evolving reactions to macroeconomic news.

This paper aims to _____

2 Data

The minute-by-minute OHLC Data of 7 currency pairs were collected from the Metatrader5 platform. This represents over 4 million data points for each pair. Only a small fraction of this data is actually used since we consider only the 5 time frame from when each piece of monthly or quarterly news is released until 5 minutSes afterwards.

3 Construction of the model.

Being consistent with previous literature on the subject, the first step involves estimating the impact that each piece of news has on its respective currency assuming 1.) That the news effects are constant over time. 2.) The surprise element S_t of the regression is evaluated as:

$$S_t = \frac{A_t - E_t}{\sigma_d} \tag{1}$$

A_t is the actual result of the news at time t, E_t is the expected result aggregated from experts and σ_d is the empirical standard deviation of this difference over the entire sample. We use the expectation numbers from the ForexFactory website[2] Thereafter, we use this surprise element in a first simple OLS model.

$$R_t = \beta_0 + \beta S_t + \varepsilon_t \tag{2}$$

$$R_t = \beta_0 + \beta_t S_t + \varepsilon_t \tag{3}$$

4 Testing for instability of the news impact parameter

There exists many ways to test whether β_t is time dependent or not. We choose the methodology of the authors of (Elliott and Müller 2006) and briefly retrace their steps. In their paper, it is shown that the quasi-Local-Level (qLL) test enables one to test for many different types of persistent processes of the β_t. It is explained that many of these breaking processes can have a "temporary memory" (strictly speaking are strongly mixing) but will be well approximated by a Wiener process.[3]. This is extremely practical in our scenario as there are many possiblities for the possible variation of the β_t. The Null Hypothesis implies there is a stable parameter as in a familiar OLS regression. We obtain the likelihood under the Null assuming that the R_t observations are independently and identically distributed (and therefore so are their first differences):

$$L_{H0}(\beta_0, \beta_1, \sigma^2) = log \prod_{t=1}^{T} p(\Delta R_t | S_t; \beta_0, \beta_1, \sigma^2) \tag{4}$$

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[2]The expectations of most online sources such as "Investing.com" or "DailyFX" are very similar. The aggregation methods are not disclosed to the public.

[3]Theorem 7.30 of (White 2001) can be applied since certain assumptions are made about the process

Table 1: Asymptotic critical values of the qLL statistic

k	1	2	3	4	5
1%	-11.05	-17.57	-23.42	-29.18	-35.09
5%	-8.36	-14.32	-19.84	-25.28	-30.60
10%	-7.14	-12.80	-18.07	-23.37	-28.55

$$= -\frac{T}{2}log(2\pi) - Tlog(\sigma) - \frac{1}{2\sigma^2} \sum_{t=1}^{T}(\Delta R_t - (\Delta\beta_0 + \Delta\beta_1 S_t))^2 \tag{5}$$

Only the last term of (5) is kept as the first constants will cancel out. $\Delta\beta_0 + \Delta\beta_1 S_t$ becomes 0 as the terms do not change with time.

$$L_{H0} = \frac{1}{2\sigma^2} \sum_{t=1}^{T}(\Delta R_t)^2 \tag{6}$$

This contrasts with the alternative where instability is implied. We assume $\beta_t - \beta_0$ is approximated by the Gaussian random walk and ΔR_t is therefore a Gaussian moving average of order 1 MA(1) with the specification: $\Delta R_t \sim \eta_t + \psi_\eta \eta_{t-1}$, $\eta_t \sim iidN(0, \sigma_\eta^2)$, constant $\psi_\eta < 1$. Using the same *iid* assumption we obtain the likelihood of this alternative process:

$$L_{HA} = \frac{1}{2\sigma^2} \sum_{t=1}^{T}(\Delta\eta)^2 \tag{7}$$

The qLL statistic is obtained by subtracting L_{HA} from L_{H0}. The qLL test is therefore a monotone transformation of the Likelihood Ratio Test (LR_T), so while it does not follow a chi-square distribution exactly, it does follow a certain related distribution that has its percentiles defined by (Elliott and Müller 2006) and reported in their table, reproduced here as Table 1. The general extension to the LR_T can be made where we can reject the model related to the Null Hypothesis (the stable model) if the critical value is sufficiently negative.

In order to see this in practice and ensure it works in our case, we create some hypothetical paths and observe the result of the tests.
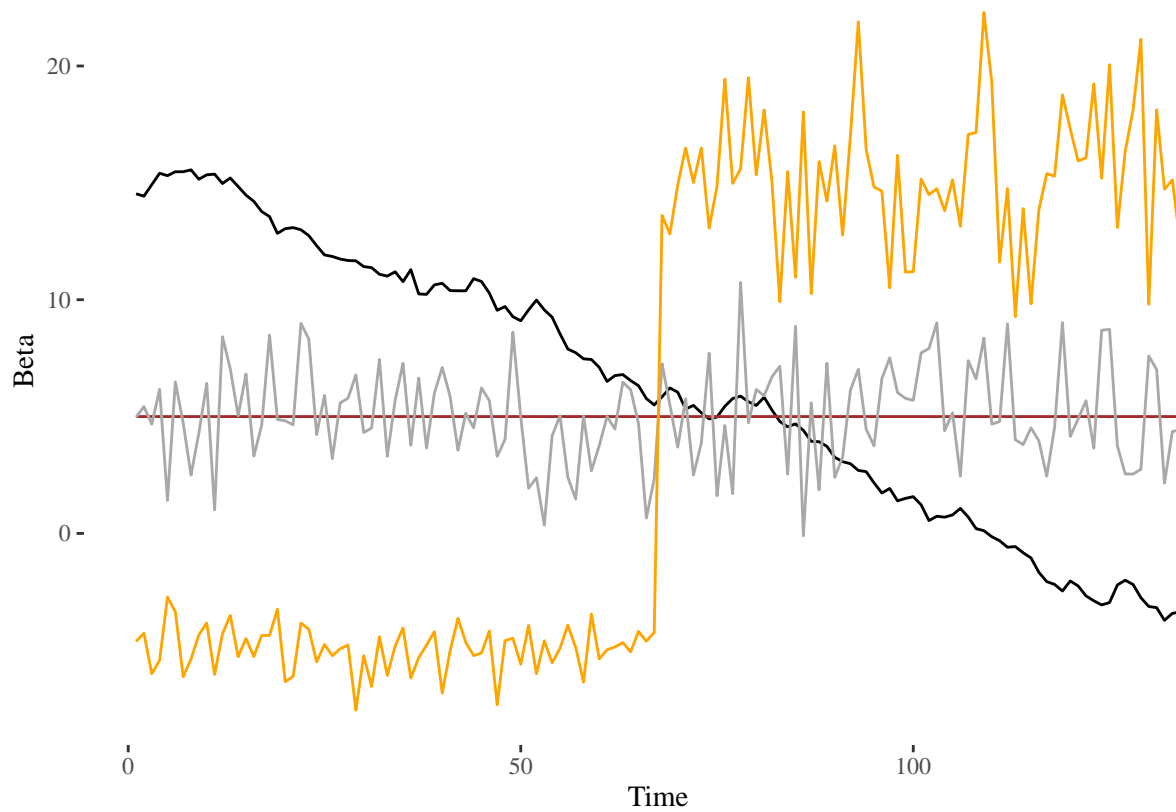
- Assumptions of the test - appropriate in our case???

News.Event	Pair	Time..GMT.	Frequency	M5.Coefficient	std.error	obs	Dates	qLL
UK CPI	GBP/USD	09:30	Monthly	12.6814***	1.7288	135	Oct 2008 to Dec 2019	-12.964***
CA CPI	USD/CAD	13:30	Monthly	-12.896***	2.254	144	Jan 2008 to Dec 2019	-18.387***
CA CRS	USD/CAD	12:30	Monthly	-13.773***	2.112	135	Oct 2008 to Dec 2019	-14.44524***
US CPI	USD/CHF	13:30	Monthly	3.968**	1.207	135	Oct 2008 to Dec 2019	-21.582***
NZ CPI	NZD/USD	21:45	Quarterly	24.109***	2.910	43	Jan 2009 to Oct 2019	-7.267*
AU CPI	AUD/USD	00:30	Quarterly	22.293***	4.145	48	Jan 2008 to Oct 2019	-9.022**
AU RET	AUD/USD	00:30	Monthly	2.893*	1.454*	135	Oct 2008 to Dec 2019	-10.387**

| News.Events	Pair	Time..GMT.	Frequency	M5.Coefficient	std.error	obs	Dates	qLL
US Batch	USD/JPY	13:30	Monthly		NA	135	Oct 2008 to Dec 2019	
1: Average Hourly Earnings Change				10.295***	2.577	NA		
2: US NonFarm Employment Change				17.938***	2.572	NA		
3: Unemployment RateÂ°				1.975	2.579	NA		
Test 1 All News					NA	NA		-28.14001***
Test 2 News 1-2					NA	NA		-24.01494***
Test 3 News 2-3					NA	NA		-20.32601***
Test 4 News 1-3					NA	NA		-7.07818
Test 5 News 2					NA	NA		-17.64316***
CAD Batch	USD/CAD	13:30	Monthly		NA	135	Oct 2008 to Dec 2019	
1: Employment Change				-25.588***	3.940	NA		
2: Unemployment Rate				1.053	3.940	NA		
Test 1 All News					NA	NA		-9.299685
AUD Batch	AUD/USD	00:30	Monthly		NA	135	Oct 2008 to Dec 2019	
1: Employment Change				21.596***	1.842	NA		
2: Unemployment Rate				-11.931***	1.842	NA		
Test 1 All News					NA	NA		-22.91171***
Test 2 News 1					NA	NA		-6.849966
Test 3 News 2					NA	NA		-5.655749

5   Parameter Path Estimations
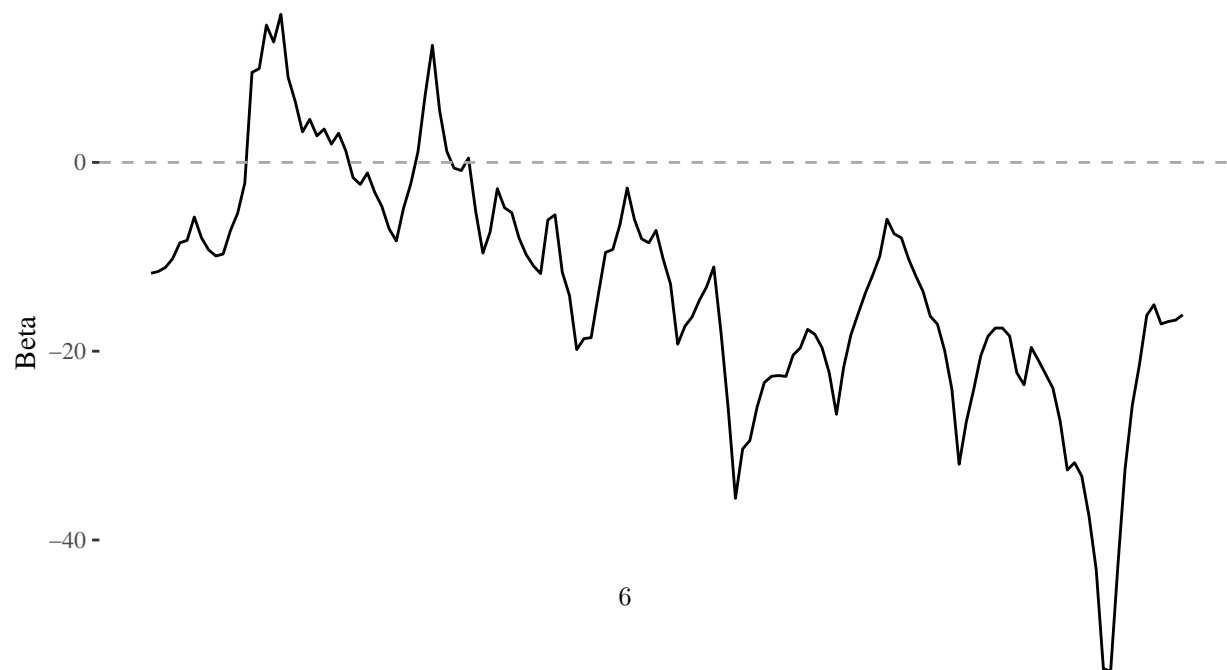
6   Conclusion

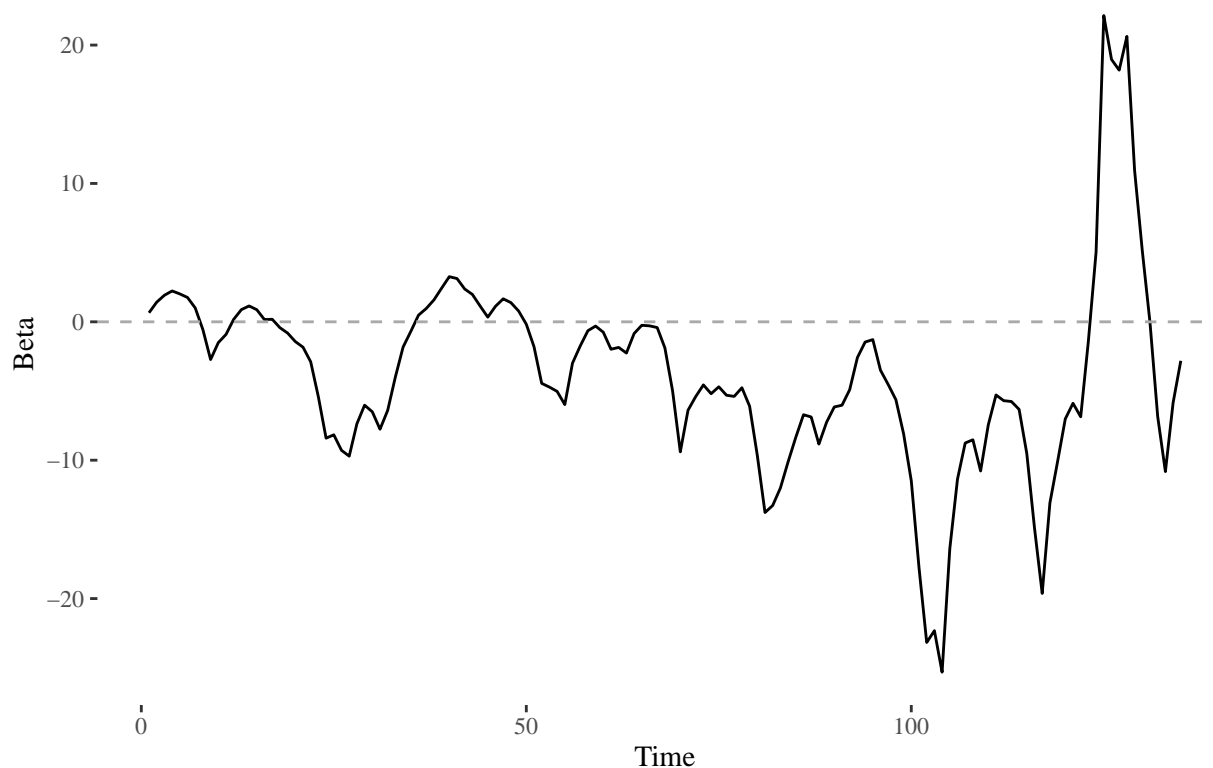# 7   Appendix

7.1   Parameter Paths

Canadian Core Retail Sales
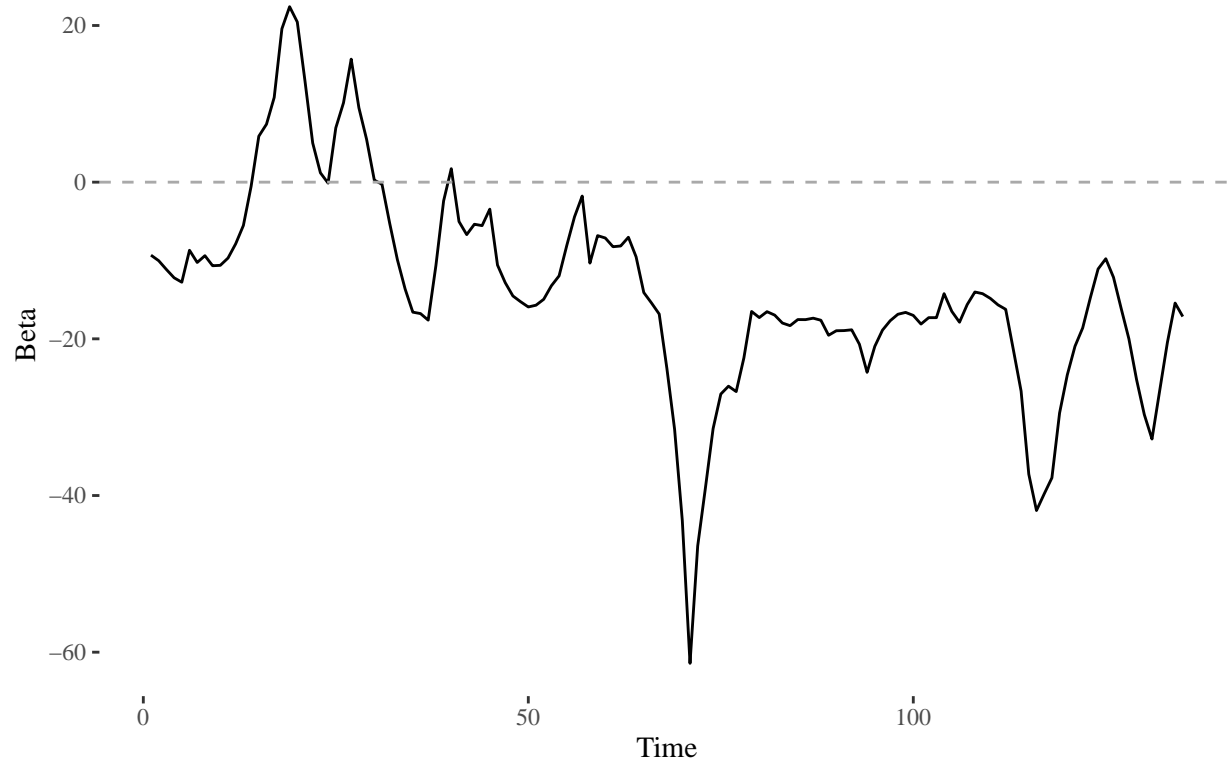
Canadian Consumer Price Index

Australian Retail Sales

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