

Macroeconomic Policy and Analysis

An Exploration of ‘News-Based’ Surprises on Macroeconomic Variables

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1 Introduction

Macroeconomic news releases are often considered by academic and market participants alike as a harbinger of the general health of the economy, offering insight into unexpected strengths or weaknesses in the trajectory ahead. This report seeks to explore the relationship between macroeconomic releases and responses. The specific focus is on the US release of Non-Farm Payrolls but this narrow focus could be expanded to other indicators such as CPI or PPI. Exchange rates and interest rates both contend fundamental indicators in the macroeconomy and proxy for secondary effects on firms, consumers and central bank economists. Thus they comprise sensible response variables.

The analysis in this report is determinedly US-centric through more designation not choice. China operates within considerable void when it comes to labour market data and significant methodological weaknesses remain in how the labour market is assessed. Such lack of labour market figures leaks into a lack of spare capacity measures which in turn inflicts great uncertainty on the trajectory of economic health. In order to keep some order of focus on the Chinese market, I consider the effect of US macroeconomic news on the Dollar-RMB Exchange Rate. The US is undoubtedly a key market mover of the global economy so the effect of its macroeconomic news releases necessarily have impacts well and beyond its own borders.

In this report I take a slightly different approach to previous assignments. I propose a re-adjusted focus towards not just econometrically identifying the mechanisms by which macroeconomic news signals the health of the economy at large but exactly how recipients of such news match the actual release to previously held beliefs. To comprehensively depict the importance of 'surprise news' I apply Kosegi and Rabin (2006, 2009) theoretical framework of expectations-based reference dependence. From this theoretical framework I estimate a regression equation based on an expectation error term i.e. the deviation of the released data from the expected data as measured by survey responses prior to the release date. This report offers preliminary findings on the importance of surprise NFP news releases as a precursor of macroeconomic response variables but further more rigorous research is required to provide confirmation.

While continued development of this working paper is required, it presents a method of surprise macroeconomic releases on macroeconomic response variables which has not yet been applied to such recent data. As such, this paper to the author's knowledge presents novel findings to the current body of literature.

2 The Macroeconomics of NFP

2.1 *Non-Farm Payroll*

Non-Farm Payrolls (NFP) measures the actual number of paid employees (full and part time) in private and public jobs. The NFP is important because it provides first insight into labour-market conditions and capacity for economic expansion.

2.2 *Summary Mechanisms:*

Loss Functions to Taylor Rules

If more people have jobs, disposable income rises implying consumption expands. More spending is a component of Gross Domestic Product, the broadest measure of economic condition. These labour market figures and subsequent effect on GDP indicate whether the economy is overheating or stalling which in turn determines interest rates. We can simplify this relation to a Taylor Rule where by the central bank aims to minimise a loss function for deviations from target of inflation π^* and of full employment (zero output gap) $Y = \bar{Y}$. In turn via the influence of this Taylor Rule monetary policy setting, changes in interest rates in concomitant with economic health signs will affect the exchange rate both against specific currencies and as measured in an index.

2.2.1 **Loss Function**

Assume central bank minimises absolute deviations from target. Here NFP or labour market capacity can be taken as a proxy for \bar{Y} .

$$L = (\pi - \pi^*)^2 + \lambda(Y - \bar{Y})^2 \tag{1}$$

2.2.2 **Phillips Curve**

Assume a phillps curve relationship between output and inflation where ϵ_t is a cost-push iid shock:

$$\pi_t = \pi_t^e + \theta(Y_t - \bar{Y}) + \epsilon_t \quad (2)$$

2.2.3 Goods Market Equilibrium

Assume a IS curve representing clearing in the goods market. This shows the appropriate interest rate to achieve a certain target of output as proxied by NFP conditional on a iid demand shock η_t .

$$Y_t - \bar{Y} = -\alpha(r_t - \bar{r}) + \eta_t \quad (3)$$

2.2.4 Deriving a Targetting Rule

By solving this subdivided static model through calculus we can optimise central bank outcome conditional on what is in each agents information set.

Optimal monetary policy is consistent with the following targetting rule:

$$Y_t - \bar{Y} = -\frac{\theta}{\lambda}(\pi_t - \pi^*) \quad (4)$$

If a positive supply shock e.g. lots of new jobs created increases π then a lower Y is required next period to bring inflation back to target.

2.2.5 Deriving a Taylor Rule

Now we can explicitly define how a Central Banker actually responds to news about output i.e. how the NFP influences their beliefs of $Y - \bar{Y}$ and how they set interest rates to reduce overheating in the economy. This type of rule is termed an **Optimal Monetary Policy Reaction Function** or a Taylor Rule:

$$r_t = \bar{r} + \frac{1}{\alpha} \frac{\theta}{\lambda + \theta^2} \epsilon_t + \frac{1}{\alpha} \eta_t \quad (5)$$

The pass-through of NFP data and the output gap of the economy depends on parameters concerning the inflation aversion of the central bank (λ), supply side structure of the economy given by slope of the phillips curve (θ) and interest sensitivity of aggregate demand given by slope of the IS curve (α).

3 Behavioural Theory

3.1 Reference Dependent Utility

Kahneman and Tversky (1979) were the first to realise economic agents feel losses and gains in terms not in absolute terms but in relative comparative means. Such a framework of measuring utility is termed 'Reference Dependent Preferences'. Kozegi and Rabin (2006) built on these ideas but proposed an alternative process of reference point formation. They propose the 'environmental endogeneity principle' by which an agents' expectation operator of utility determines how subsequent losses and gains are felt. In laying down such a process they developed more fully specified utility models which both endogenise and fully define how and why a context influences behaviour.

Under these tenants, we can depict gain-loss utility as a additively separable function $\mu()$ which is piecewise and dependant on the strength of gain-loss utility (η) and the degree of loss aversion (λ). We assume total utility $u(c|r)$ depends on both tangible consumption utility c and reference based utility r derived from realisation or disappointment of expectations

Third generation reference dependence models (Kozegi and Rabin 2009) further tease out the key determinant of 'surprise-based' utility in what is terms 'news utility'. The authors rightly state the psychology of disappointment and elation is not just about contemporaneous consumption relative to expectations but about the comparison of new beliefs with the old.

Thus, in this most developed framework, behaviours are determined by a comparison of not just outcomes to beliefs, but new beliefs to old beliefs. This proposition requires the introduction of new parameter $\gamma_{t,\tau}$ which represents the degree to which you care about "prospective gain-loss utility' compared to contemporaneous utility'.

3.2 Applying Reference Dependence to NFP Data

Suppose on day t a NFP forecast is made and on day τ news is released about the macroeconomic indicator. We can compare 4 situations of realised (r) to actual (a) and calculate how these relative realisations affect utility. Suppose that you believe with $p = 1/2$ that the release on day τ will be 10,000 new jobs and $1/2$ that it will be 15,000.

Suppose that on day f you gain insight from a market rumour which induces beliefs $q > 1/2$ that the release will be 15,000 and with probability $1 - q < 1/2$ it will be 10,000. Assume additionally with probability 0.5 the rumour will be 10,000 with probability q and 15,000 with probability $1 - q$. Assume between t and τ you learn of no new rumours. Assume you receive truthful news of the real NFP new job count on day τ . Suppose for simplicity you bet £1000 on correct guess of NFP release such that your wealth is added to by the $1/1000$ value of the NFP release. This is a theoretical proxy for how NFP data affects macroeconomic variables like interest rates and exchange rates which in turn affects firms' revenues and costs.

$r \rightarrow a$	Forecast Day t	Release Day τ
good \rightarrow good	$+(q - \frac{1}{2})\gamma\eta x$	$m(w + 15) + (1 - q)\eta x$
good \rightarrow bad	$+(q - \frac{1}{2})\gamma\eta x$	$m(w + 10) - q\lambda\eta x$
bad \rightarrow bad	$-(q - \frac{1}{2})\gamma\lambda\eta x$	$m(w + 10) - (1 - q)\lambda\eta x$
bad \rightarrow good	$-(q - \frac{1}{2})\gamma\lambda\eta x$	$m(w + 15) + q\eta x$
average utility	$-\frac{1}{2}(q - \frac{1}{2})\gamma(\lambda - 1)\eta x$	$m(w + 12.5) - q(1 - q)(\lambda - 1)\eta x$

Table 1: News-Based Utility

As we can see from this tabulated comparison of utility realisations the comparative new versus old belief of macroeconomic news has important influence on behaviour. In light of this theoretical exposition, I will conduct my analysis in light of surprise news - the difference between forecast NFP and actual NFP.

4 Data

All rates and actual NFP release data was obtained from the Federal Reserve of St. Louis (FRED). The expectations of NFP was compiled both from FRED and the Bureau of Labour Statistics reports.

4.1 Calculations

Using the data obtained from the above sources, I calculated an error in NFP or **surprise component of NFP release** by subtracting the forecast from the realised. Daily data was obtained for the market rates and a spread between day-before-release

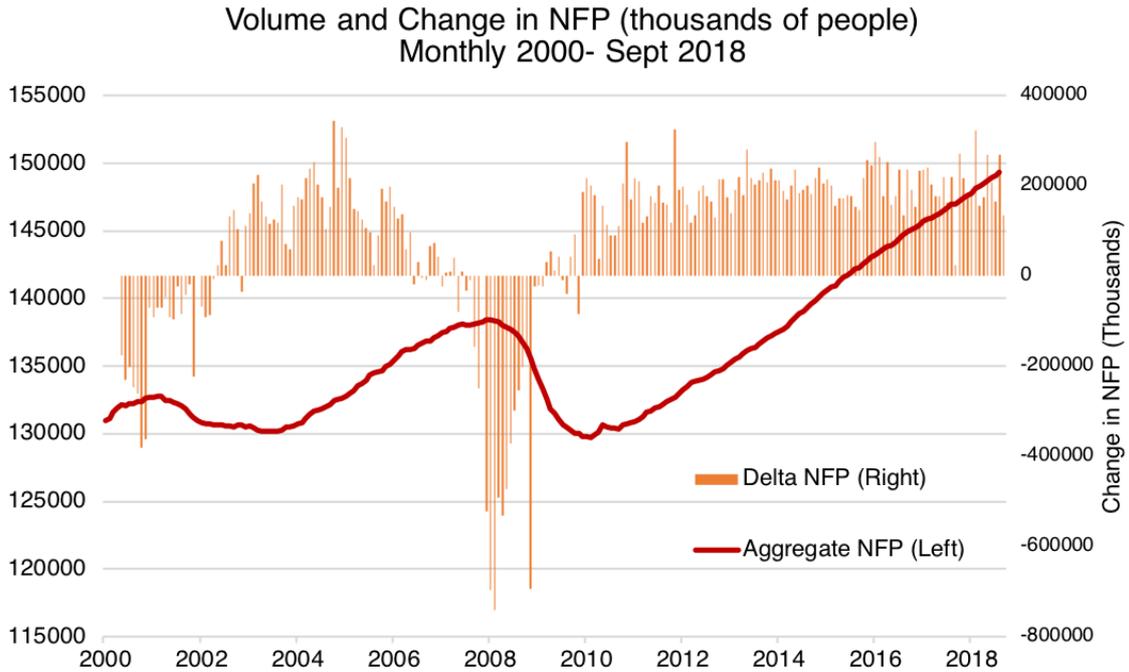


Figure 1: Swings in NFP Attributable to Economic Cycle and Recessionary Periods (see 2008-2009)
Source: FRED

market close and day-of-release market close was calculated. These variables are termed ΔER and ΔIR .

5 Descriptive Statistics

5.1 Historical Overview of NFP:

Figure 1 plots both the volume of NFP data and also the change from the prior month. Arguably the change in NFP number is much more informative. It measures the number of jobs created or lost in the U.S. economy over the prior month so gives a better indication of an imminent uptick or downswing relative to last month's vitals.

Key Historical Highlight: The close relationship between economic health and NFP release can be discerned by the clear boom-bust cycle displayed with especially significant downswing in NFP occurring during the 2008-2009 recession and in the aftermath the dot-com recession.

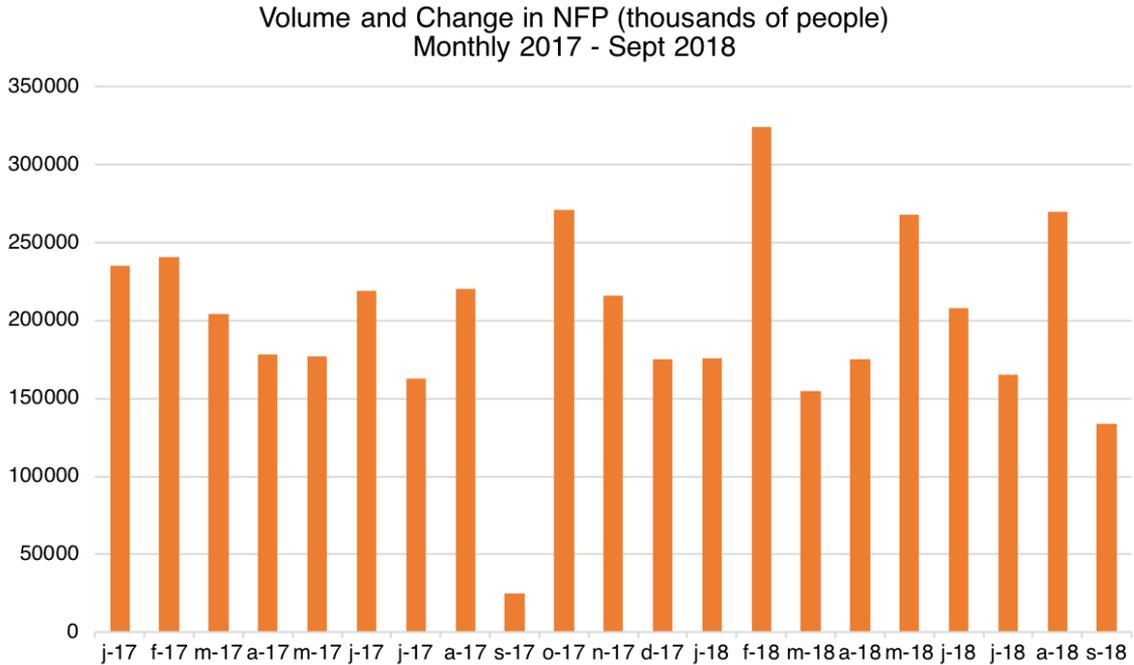


Figure 2: Recent collapse in NFP
Source: FRED

5.2 Recent Changes to NFP:

Figure 2 plots a narrower time period.

Key Recent Comment: One key comment to note is the lower than expected job creation in the past month (September 2018). The most convincing market commentary attributes this shortfall to Hurricane Florence in mid-September representing a negative drag on NFP.

5.3 Market Rates

Figure 3 plots the 3month Tbill secondary market yield and Figure 4 the dollar-RMB exchange rate over the period from the beginning of 2010 to October 2018. As aforementioned the secondary market 3-month Tbill gives a reliable estimate of US short-term interest rates. This rate is also particularly important given literature deeming the relevance of yield curve inversion in predicting recessionary periods (Estrella and Mishkin 1996). A dollar exchange rate index would more comprehensively assess the effect of macroeconomic news on the general US position in the forex environment but to keep a China focus this paper investigates the China-US exchange rate. It is important to interpret this series with caution - while the state may now not directly engage with currency manipulation, the rate at which the RMB appre-

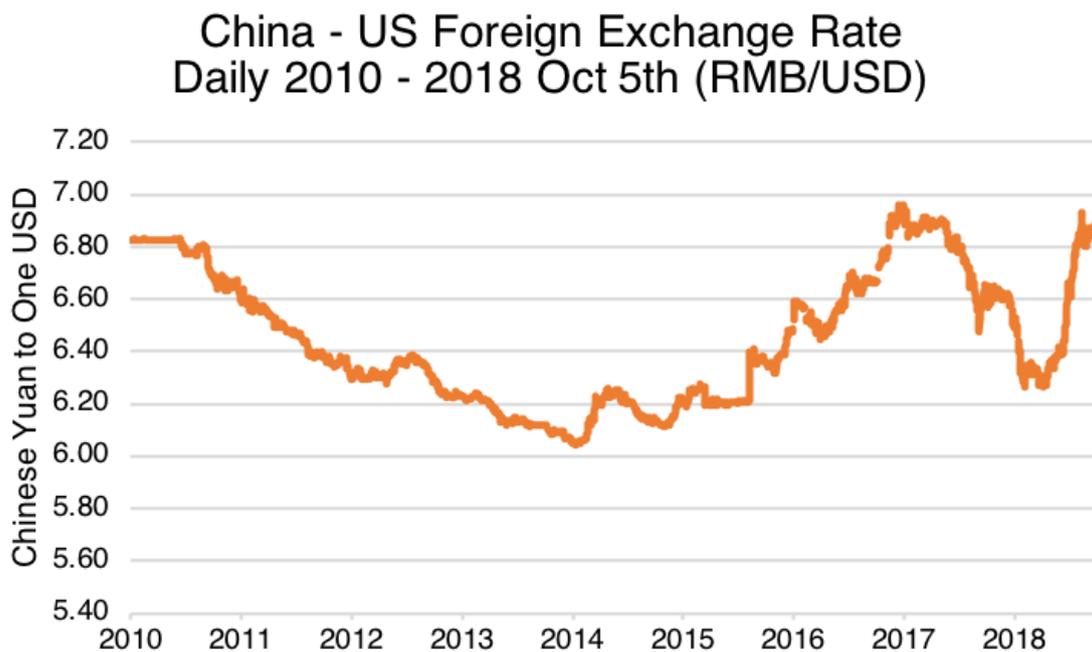


Figure 3: Recent Volatility in US-China Exchange Rate
Source: FRED

ciates is still not under complete freedom. A visualisation of each series offers useful priori information but we must impose an econometric framework to rigorously test news surprises.

5.4 *Actual, Forecast and Errors*

Figure 5 plots the times series of forecast NFP release expectations, actual realised figures and the error between these two measures (all measured in thousands of people). Interestingly, the actual release is much more volatile than the forecast and this volatility is rarely priced into the expectations.

Figure 6 gives an a-priori but not informative view of the effect of surprise NFP releases i.e. the error on each release between forecast and realised on inter-day exchange rate and interest rate volatility.

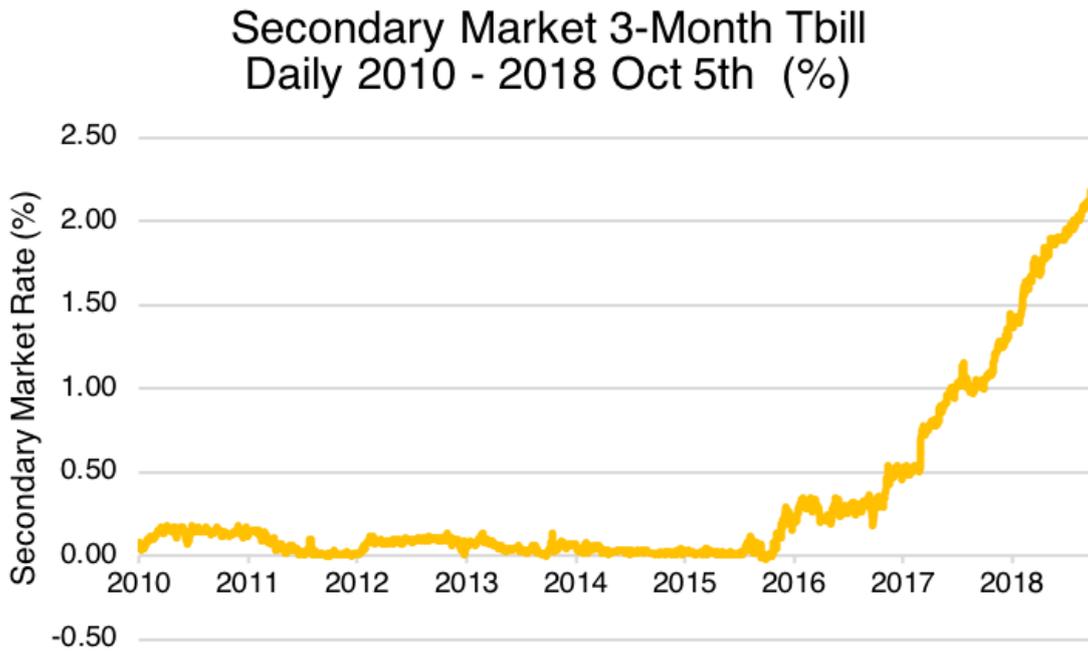


Figure 4: US 3-month short term rate trending upwards
Source: FRED

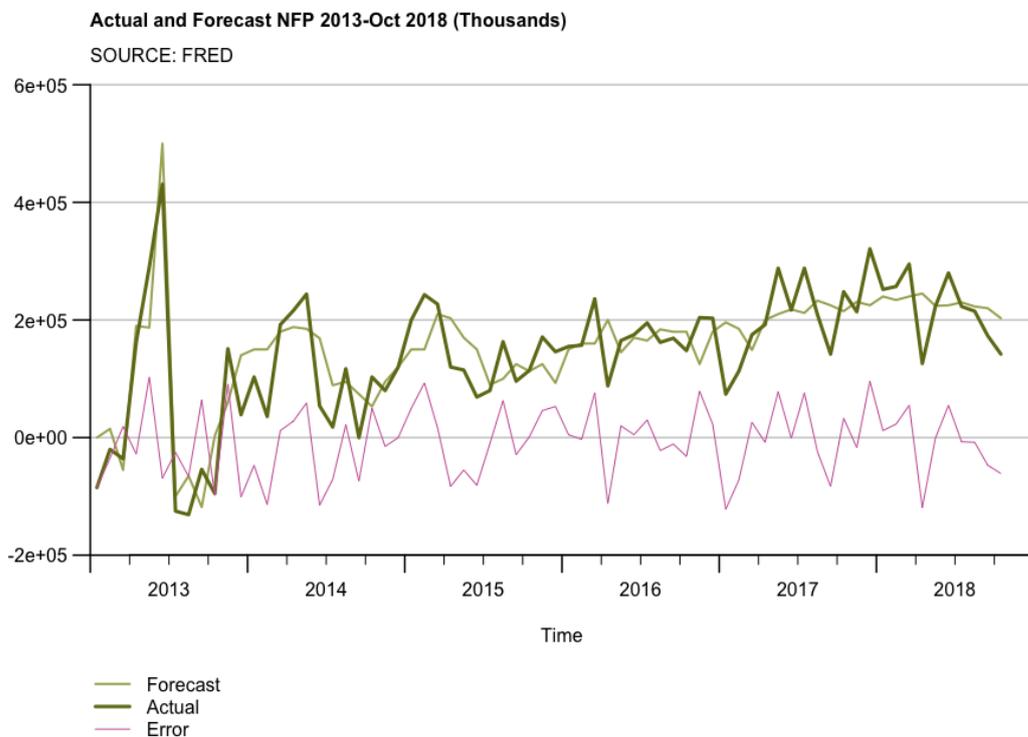


Figure 5: The Surprise Component of NFP Release

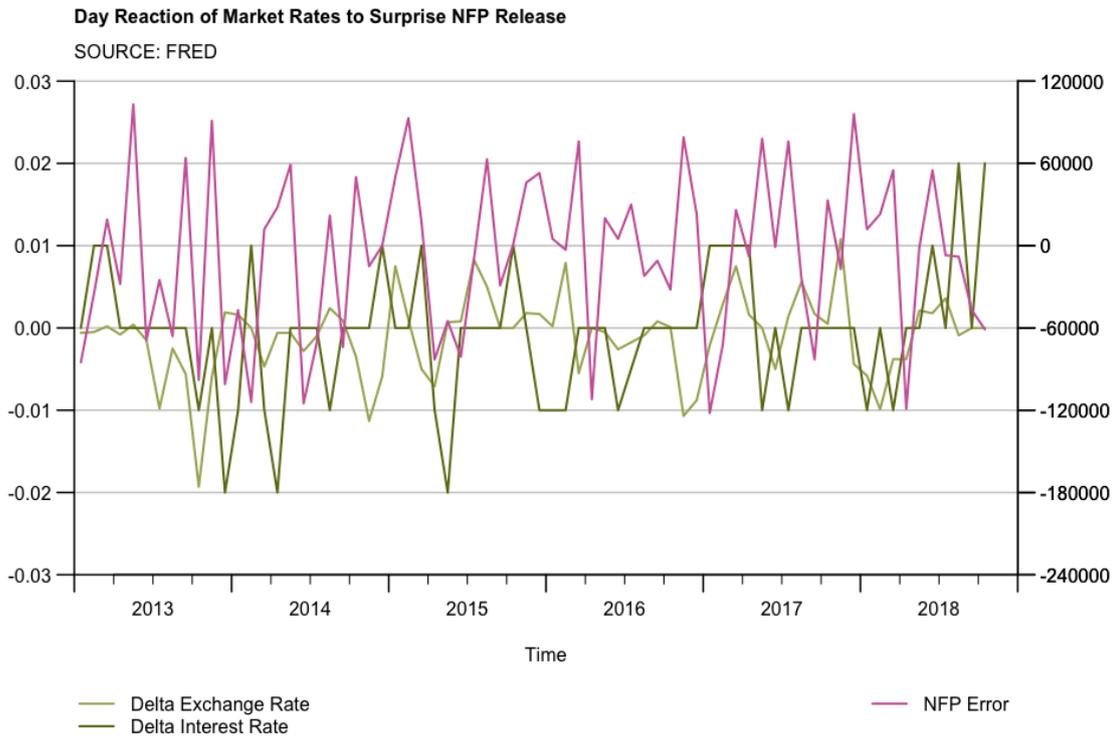


Figure 6: One Day Prior Market Reaction to Surprise News

5.5 Correlation Analysis

Figure 7 plots the baseline correlation between the NFP error components with ΔER and ΔIR . The pearson's correlation coefficient is 0.67 for exchange rate and 0.73 for market interest rate. A regression analysis can help us discern correlation from causation.

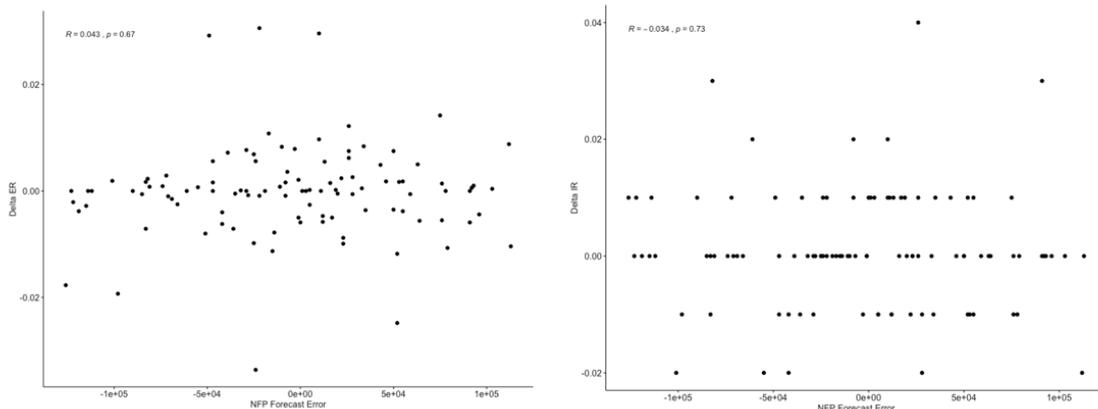


Figure 7: Correlation between NFP Surprise Error and Market Rates

6 Econometric Framework

I estimate the following model for various response variables e.g. exchange rate and interest rate and various economics series (NFP, CPI, PPI etc). To investigate the effect of news we can estimate the simple regression:

$$\Delta s_t = \alpha_0 + \sum_{i=j}^n a_i(x_{it} - x_{it}^e) \quad (6)$$

Where x_i^e is the expectation error of each economic series at time t . Δs_t is defined as the difference in market rate at market close on the day preceding and following the release day. Equation (x) can estimated across any number from $j = 1$ to n news variables. For my investigation, I will only investigate the effect of NFP so $j = 1, n = 1$ but the fit of this regression model could be improved by adding more indicators.

7 Econometric Results

A simple regression demonstrates surprise in NFP release has a significant effect in inducing a day-to-day exchange rate effect but has no effect on interest rate. This implies perhaps the market does not expect the central bank to react so sensitively to unexpected deviations in Y as proxied by NFP.

While such a regression framework would be useful in extracting the quantitative effect of surprise labour news on macroeconomic response variables, this level of basic specification must be interpreted with caution and in some ways, the correlation coefficient is a more suitable metric than an overly simplified regression. With more time, I believe this specification could be greatly expanded to find interesting and novel findings.

DepVar	ExplanVar	P-Value
Delta ER	NFP_Error	0.087*
Delta IR	NFP_Error	0.318

Table 2: Test of significance of NFP Error

* = 0.1, ** = 0.05, ***=0.01

8 Conclusion

To conclude, this report has presented the short-run effect of macroeconomic labour release data on macroeconomic response variables namely market interest rates and exchange rates. The key to understanding the transmission mechanism of macroeconomic news releases to the economy at large is in understanding the dual mechanism at work. Labour figures are an inherent measure of spare capacity and general health of the economy. However, perhaps more important is the release of NFP in meeting, exceeding or disappointing expectations of the future economic trajectory.

In this light I find Kozegi and Rabin (2006,2009) behavioural approach of news-based reference-dependent utility a suitably applicable theoretical framework. When we frame the NFP as a surprise or as an expectation error, it is these unanticipated changes which becomes highly significant coefficients in the determination of rate changes. Further research would do well to investigate both the gradual 'pricing-in' of sequential perception changes into market rates and in also specifying a more comprehensive regression design to mitigate the impact of confounding variables or spurious correlation.

While continued development of this working paper is required, it presents a method of surprise macroeconomic releases on macroeconomic response variables which has not yet been applied to such recent data. As such, this paper to the author's knowledge presents novel findings to the current body of literature.

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