Introducing NESII – The Nomura Economic Surprise Index for India

- **Our new proprietary indicator, the Nomura Economic Surprise Index for India (NESII), is designed to capture the momentum and direction of data surprises.**

- **Many economic surprise indices exist for big, advanced economies, but few exist in emerging Asia. They are important because markets react to surprises in economic data in relation to expectations, rather than the actual data.**

- **NESII should be considered a tactical tool. It has shown a strong correlation with India's financial markets and can be used to reaffirm nascent price movements. Since the index is mean-reverting, data surprises at extreme levels (either very positive or very negative) can be a useful contrarian tool in picking turning points in India's equity, FX and bond markets.**

- **The most unique feature of NESII is its weekly frequency which makes it a timely measure of market sentiment. The index is available on Bloomberg with the ticker <NGISOINR Index>.**

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See Appendix A-1 for analyst certification, important disclosures and the status of non-US analysts.

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Why a data surprise index for India

Introduction

Data matter, but instead of actual data it is the deviation of that data from consensus expectations, or "data surprises", that matters more to markets. A positive economic data surprise, say on growth, if sustained, drives up markets, as it suggests that economists were too bearish. As economists gradually revise their growth expectations higher, markets rally further. Soon, though, the mental inertia of economists builds up on one side, expectations catch up and actual economic data starts to surprise negatively. Downward revisions begin gradually, causing markets to lose steam and the cycle continues. Hence, the momentum and direction of data surprises is important in gauging how bearish or bullish the market's expectations are on economic fundamentals relative to the actual underlying data.

The objective of a data surprise index is to capture the cycles in data surprises. In this report, we introduce the **N**omura **E**conomic **S**urprise **I**ndex for **I**ndia (NESII) building on the work of Saeed Amen and the Nomura FX Quants team on Growth Surprise Indices for G10 economies (see *Nomura Growth Surprise Indices (GSI) – Creating Nomura's growth surprise indices for G10*, 15 February 2010). NESII is a single numerical index which crystallises the relationship between markets and economic data in India, and tracks the direction and magnitude of economic data surprises.

Advantages of NESII

Surprise indices inherently are mean-reverting because of two fundamental reasons. First, economic data do not move in just one direction, but rather in cycles. Good times do not last forever, but nor do the bad times. Second, research has shown that past outcomes influence the expectations of future outcomes, though with a decaying intensity[1]. A series of small negative/positive data surprises can accumulate over time to have a meaningful impact on expectations and sentiment. But since expectations change only gradually and there is inertia, surprises are mean-reverting.

We highlight three key advantages of NESII:

- **Identifies turning points in market movements.** Since NESII has strong mean-reverting properties, data surprises at extreme levels (either very positive or very negative) can be a useful contrarian tool to identify when the consensus has become too bullish or bearish, and so helps pick turning points in equity, FX and bond markets.

- **Invaluable cross-check.** When NESII starts to mean-revert from extreme levels it sends a strong signal that data surprises will continue in the new direction, and so is an invaluable cross-check for whether or not nascent market rallies or sell-offs will continue.

- **Updated weekly.** NESII is a high-frequency weekly[2] tool, and is readily available for download – Bloomberg ticker < NGISOINR Index>.

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[1] See References for more detail on how past surprises influence future expectations.
[2] We have chosen a weekly index because a limited amount of economic data is released and tracked in India. As a result, on most days when there are no data releases, a daily index would give false signals. For example, if no data is released for several days, then the Z score for those days would be 0 and as a result the index would automatically mean-revert a lot of the time, suggesting that there are no surprises in data.

Constructing NESII

Five steps in creating NESII

Constructing the economic data surprise index was a five-step process: identifying the variables to include, measuring the data surprise, normalising the surprise, weighing and aggregating the data, and smoothing the final index.

Step 1: Identifying the components

Indian economic data are limited. We selected GDP, industrial production, the PMI and wholesale price index (WPI) inflation from a list of variables based on the combination of economic variables[3] that had the highest correlation with movements in the equity, FX and bond markets (see Appendix A: Composition of NESII). WPI inflation (the monthly series) is included in NESII from January 2010 as prior to that it was released on a weekly basis.

Step 2: Defining 'surprise'

We measure the data surprise as the difference between the actual data release and market expectations. For market expectations, we use the median of Bloomberg surveys. In cases where Bloomberg expectations are unavailable, such as for the PMI, we take the 3-month moving average as the market expectation[4].

Step 3: Normalising the surprise

We normalise different data surprises before aggregating them by calculating their standard scores[5] to adjust for different scale, unit of measurement and the magnitude of surprise. This is because changes in inflation are measured in percentage points while those in PMI are measured in index levels. We also assign a sign to the standard score of each variable based on how the market perceives the surprise. For example, a lower than expected inflation reading is taken positively, while a lower than expected GDP reading is negative for the economy.

Step 4: Weighing and aggregating the index

We aggregate the different standard scores into one numerical value for the period, calling it an aggregate Z-score. We assign equal weights to all the variables to calculate the aggregate Z-score for two reasons: 1) the market attaches a different level of importance to different data points, and hence fitting the data for one market would weaken the relationship with other markets; and 2) it keeps the index free of historical biases as the degree of importance that investors attach to different data tends to vary over time, while the importance may also vary depending on the stage of the business cycle[6].

Step 5: Smoothing the index

We calculate a 3-month exponential moving average of the weekly aggregate Z-scores to get the final NESII level for the week. This is done to incorporate the influence of past data surprises on the market's reaction.

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[3] Since the markets are also gradually tracking the new CPI inflation measure, we will review the composition of NESII in future once we have sufficient history for the new CPI series.
[4] This is a reasonable assumption as the markets react to divergence from near-term trend.
[5] A standard score indicates the number of standard deviations a data point is above or below the mean.
[6] For example during a downturn growth data is more important than inflation data and vice versa. While one can statistically estimate the relative importance of the data based on past data, over-fitting may result in biases based on the stage of the business cycle during the historical data.

Interpreting NESII movements over time

Figure 1 plots NESII since 2004. The construction of NESII is such that a reading below zero indicates that economic data are surprising negatively, while a reading above zero suggests data are surprising positively. We also look at the 3-month (13-week) moving average to gauge a slightly longer-term trend of data surprises in the market.

Fig. 1: Reading NESII
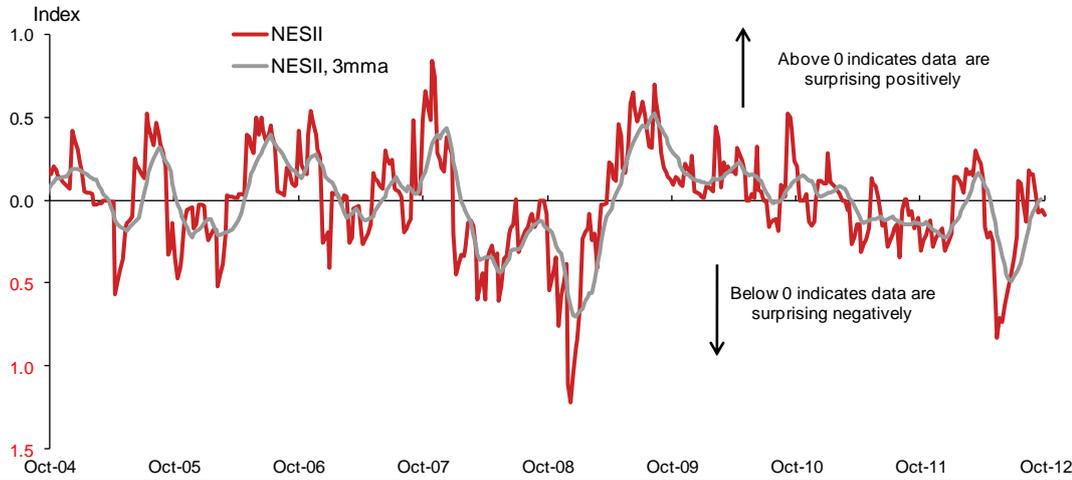
Source: Nomura Global Economics

The mean-reverting property of NESII has been a useful contrarian tool. Long before the global financial crisis in September 2008, NESII started turning lower (from November 2007) as data surprised below expectations due to the ongoing synchronized global economic slowdown – a good real-time indicator of the ongoing slump in India's GDP growth (Figure 2). It went deeper into negative territory in 2008, but hit a trough in December 2008, suggesting that economic data, while weak, were in line with downbeat consensus expectations. NESII turned positive in April 2009, as data started to surprise positively – a period that also marked the business cycle trough for India. More recently, after a string of negative surprises in 2H 2011, NESII began to turn from an extreme negative level in July 2012, suggesting that consensus was becoming too bearish on India.[7]

Fig. 2: NESII and Indian GDP growth
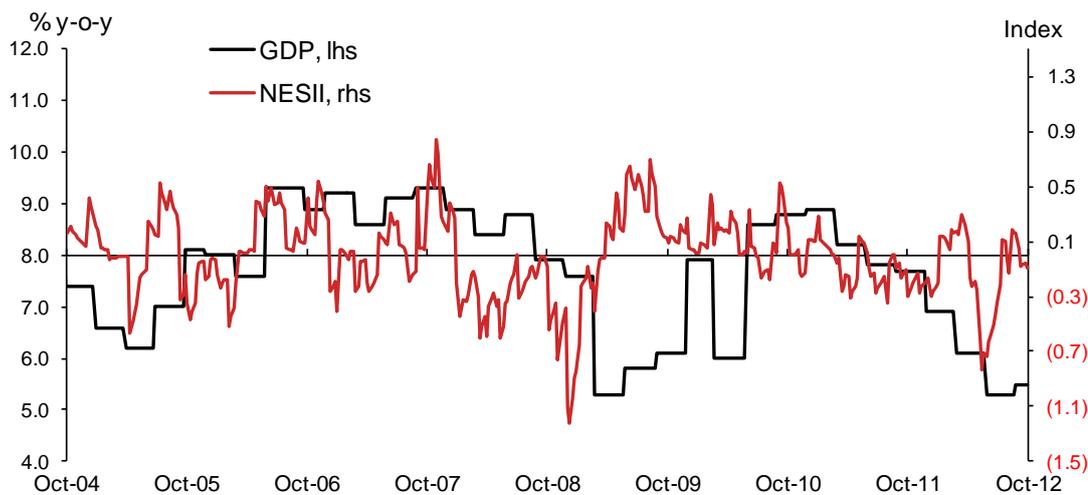
Note: The GDP growth rate shown here is the actual data released.

Source: Bloomberg and Nomura Global Economics

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[7] Interestingly, the cycles in NESII also indicate the changing economic conditions. From 2004 to 2007, when the economy was going through a boom, NESII moved in regular cycles indicating stable economic conditions but nonetheless capturing the cyclical nature of economic data surprises. Since August 2009, though, NESII has moved in irregular, volatile cycles, but the long-term direction has been downward, reflecting the unstable, volatile and overall worsening economic imbalances in India.

NESII as a tactical tool

NESII has a high contemporaneous correlation with market prices, but its main advantage is that it exhibits mean-reversion. We statistically tested the mean reversion (see Appendix B: Mean reversion test) and the results confirm that NESII mean-reverts around 0, in line with our ex-ante expectations. This essentially means that when it is at extremes and begins to revert, as it did recently in July, it sends a strong signal that data surprises will continue in the new direction, and so is an invaluable cross-check on whether or not nascent market rallies or sell-offs will continue. Moreover, since NESII is a weekly index it gives a timely indication of upcoming surprises.

We find that rising NESII values (positive data surprises) correspond with periods of rising equity markets, INR appreciation and higher bond yields. The 3-month moving average (3mma) of NESII has a strong correlation with the 3mma of market movements: 0.67 with equity markets, -0.61 with USD/INR (higher NESII = INR appreciation) and 0.41 with bond yields (Figure 3). We further test its usefulness by calculating its success ratio – defined as the percentage of times NESII has correctly mapped the sign (above/below 0) of the specific market movement in a given sample space (Figure 4). NESII's success ratio is 72% for the equity market, 66% for the currency market and 57% for the bond market.

Fig. 3: Correlation of NESII with India's asset markets
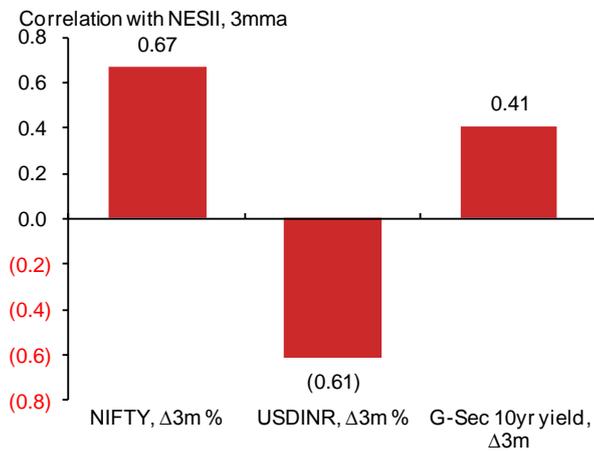
Source: Bloomberg and Nomura Global Economics.

Fig. 4: Success ratio

Asset class	Success Ratio
	%
Equity	72
Currency	66
Bonds	57

Source: Nomura Global Economics.

We believe the contemporaneous and steady relationship between market movements juxtaposed with NESII's mean-reverting property make it a handy tool to gauge the direction of markets, especially when it is at extremes, and/or as an input in rule-based trading strategies.

We see NESII as an invaluable tactical tool to gauge market expectations vis-a-vis actual economic data. Below we look at NESII's relation with each financial market.

India's equity market and NESII

In line with our ex-ante expectations, equity market movements show a strong positive correlation with NESII (Figure 5). Positive economic data surprises force markets to adjust their underlying economic assumptions higher, resulting in a market rally. NESII signalled both the market slump in September 2008 and the upturn in Q1 2009.

Fig. 5: NESII and India's equity market
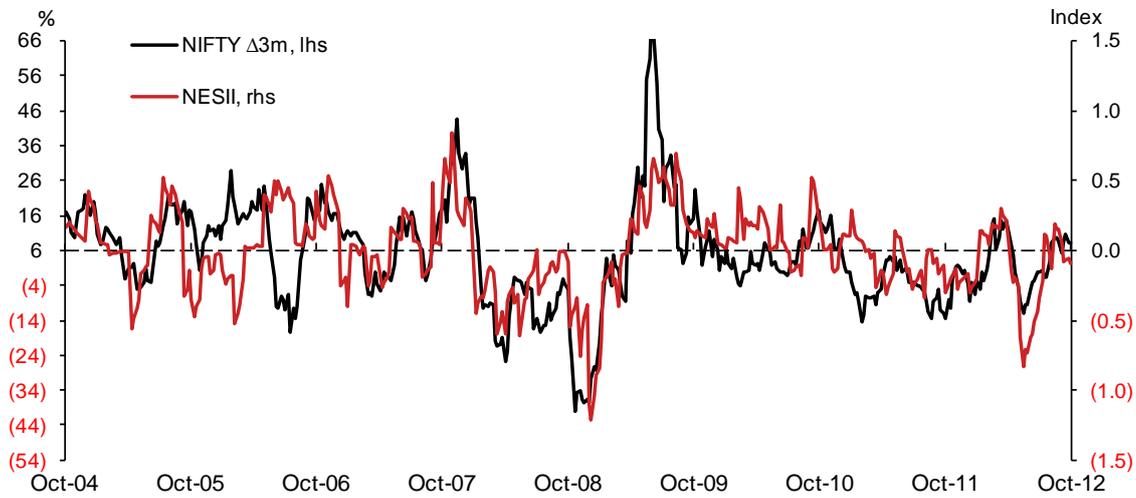
Source: CEIC and Nomura Global Economics

India's foreign exchange market and NESII

FX market movements are negatively correlated with NESII (Figure 6). Worsening economic fundamentals such as weak growth or higher inflation (or a falling NESII value) lead to INR depreciation. Sharp drops in NESII in Q4 2008 and Q2 2012 were accompanied by around 15% depreciation in INR (against USD). More recently, the improving value of NESII has been accompanied by INR appreciation.

Fig. 6: NESII and India's foreign exchange market
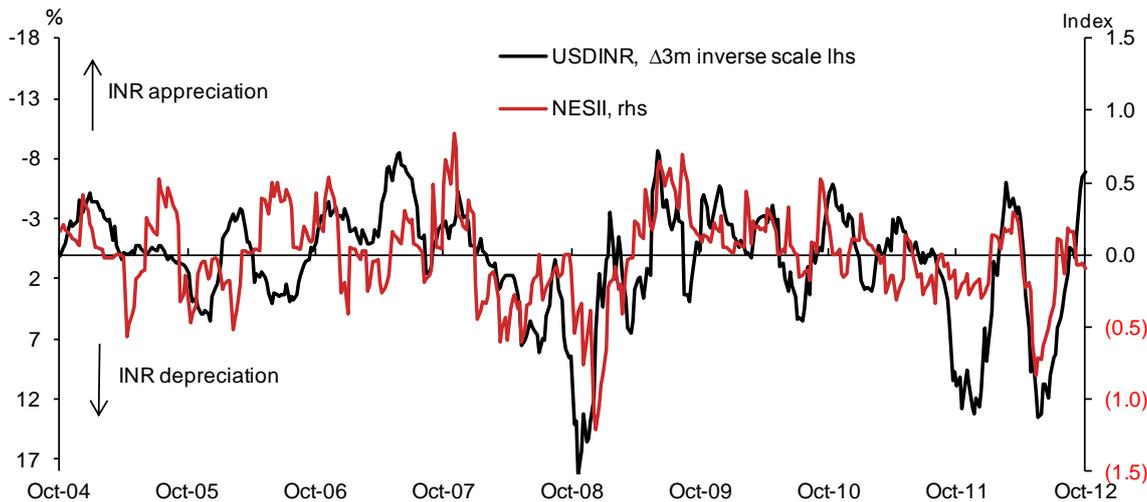
Source: CEIC and Nomura Global Economics

India's bond market and NESII

The relation between NESII and the bond market, while positive, is not as strong as that for the equity or FX markets. This is because yields are determined not just by the economic data, but also by central bank bias, the stage of the business cycle and open market operations. For instance, periods of rising growth and inflation lead to a positive correlation between NESII and bond yields as higher growth raises expectations of higher interest rates. However, in periods of falling growth but rising inflation, the correlation depends on whether the central bank is biased towards growth or inflation. When the central bank is biased towards controlling inflation, bond

markets react to inflation, leading to a negative correlation with NESII[8], as was the case in 2011 (Figure 7).

Fig. 7: NESII and India's bond market
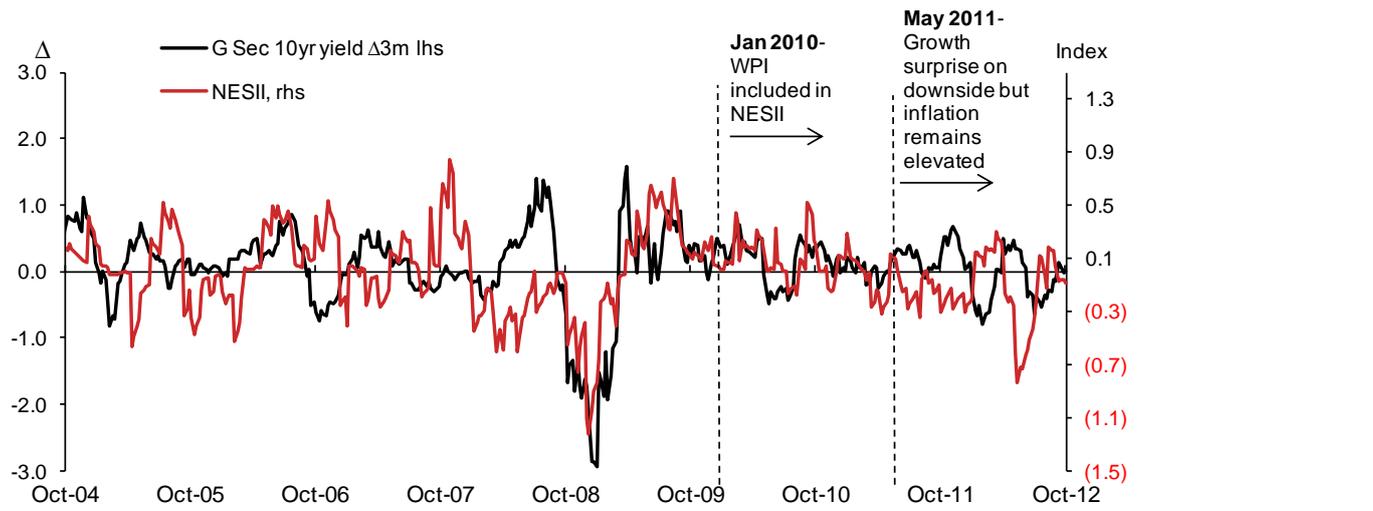
Source: Bloomberg, CEIC and Nomura Global Economics

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[8] Surprises in inflation have a negative sign in NESII.

Conclusion

Through Nomura's Economic Surprise Index for India (NESII), we have tried to statistically represent in a single numerical index the two key features of the relationship between economic data and markets. First, markets react to the deviation of data from expectations rather than the actual data; and second, that markets have a memory of past surprises. NESII includes growth and inflation data, which are most relevant to markets. NESII is released on a weekly basis, making it a timely indicator of economic data surprises.

The main advantage of NESII is its positive contemporaneous correlation with movements in financial markets. Statistical tests show that NESII exhibits mean reversion and in the past has shown a good relationship with India's equity, FX and government bond market prices and across different economic cycles, suggesting that it captures the fundamental relationship between markets and economic data. It is a handy tool to identify turning points in markets and as an input in rule-based trading strategies, particularly when it is at extreme levels.

We recommend NESII for market watchers to gauge the current dynamics of the relationship between economic data and specific asset classes in India. Historical data for NESII is available from January 2004 onwards.

NESII will be updated at market close of the last working day of the week, and is available on Bloomberg with the ticker <NGISOINR Index>

Appendices

Appendix A: Composition of NESII

To see both the short- and long-term relationship between NESII and the equity (NIFTY), FX (INR/USD) and bond (10yr G Sec yield) markets, we calculate the correlations between 1) NESII and market movements (% Δ in 3-month in the case of equity and FX markets and Δ3-month in the case of the bond market) in the three asset classes; and 2) the 3-month-moving-average (3mma) of NESII and the 3mma of market moves in the three asset classes.

We include industrial production (IP), WPI inflation and real GDP in our base composition as economists actively forecast these variables, suggesting that they are closely tracked by the markets. Further, we include the PMI since it is the only high-frequency leading indicator followed in India. We calculate the correlation of market movements with a combination of other economic data as well, such as car sales, exports and CPI inflation. Correlations show that IP, PMI, WPI and GDP make the best combination of economic data to best track market movements.

Fig. 8: Correlations between NESII levels and asset markets

Basket	NIFTY, Δ3m %	USDINR, Δ3m %	G-Sec 10yr yield, Δ3m
Base (IP, PMI, WPI, GDP)	**0.56**	**(0.44)**	**0.30**
Base + Car Sales	0.50	(0.43)	0.31
Base + CPI IW	**0.50**	**(0.47)**	**0.26**
Base + Exports	0.30	(0.38)	0.30
Base + Car Sales +CPI-IW	0.46	(0.47)	0.27

Source: Nomura Global Economics

Fig. 9: Correlations between the NESII 3-month moving average and asset markets

Basket	NIFTY, Δ3m %	USDINR, Δ3m %	G-Sec 10yr yield, Δ3m
Base (IP, PMI, WPI, GDP)	**0.67**	**(0.61)**	**0.41**
Base + Car Sales	0.61	(0.59)	0.44
Base + CPI IW	**0.61**	**(0.64)**	**0.38**
Base + Exports	0.33	(0.54)	0.42
Base + Car Sales + CPI-IW	0.57	(0.64)	0.40

Source: Nomura Global Economics

Appendix B: Mean-reversion test

We use the following equation to test for mean reversion:

$$\Delta NESII_t = \eta(Mean - NESII_{t-1}) + u_t \qquad (1)$$

Equation (1) is a simplified arithmetic version of the Ornstein-Uhlenback process (see References), which says that if a series is mean-reverting then the next value should depend on the deviation of the previous value from the mean.

Rearranging,

$$NESII_t = \eta * Mean + (1 - \eta) * NESII_{t-1} + u_t \qquad (2)$$

NESII in an ideal case should have a mean of 0 in which we cannot use the above equation. So, we re-level the NESII by adding 100 to be able to test the above equation. Now the re-levelled NESII (RL-NESII) should mean-revert around 100. The results (Figure 10) support our hypothesis that RL-NESII is mean-reverting at around 100, hence the original NESII mean-reverts at around 0.

Fig. 10: Result of mean-reversion test

Equation: RL-NESII$_t$=Mean*η+(1-η)*RL-NESII$_{t-1}$				
	Coefficient	Std. Error	t-Statistic	Prob.
Mean	**100.03**	**0.04**	**2223.01**	**0.00**
η	**0.16**	**0.02**	**6.62**	**0.00**
R-squared	0.73	Mean dependent var		100.02
Adjusted R-squared	0.73	S.D. dependent var		0.29
S.E. of regression	0.15	Akaike info criterion		-0.91
Sum squared resid	10.72	Schwarz criterion		-0.89
Log likelihood	211.86	Hannan-Quinn criter.		-0.91
Durbin-Watson stat	1.99			

Source: Nomura Global Economics

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