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Systematic FX trading via micro and macro deep neural networks

Mesirow explains how fusing signals generated from 'micro' and 'macro' deep neural networks (DNNs) can alleviate the effects of high output variance and other issues common with DNNs

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Systematic FX trading via micro and macro deep neural networks

Deep neural networks-based systematic trading algorithms are usually notorious for having high output variance and for being sensitive to the length of the look-back window sizes used in creating their training sets. In this article, we explain how fusing signals generated from 'micro' and 'macro' deep neural network models can alleviate the effects of these issues.

WRITTEN BY MESIROW, VICE PRESIDENT, SENIOR RESEARCH SCIENTIST, MEHRYAR EMAMBAKHSH, PHD

Background

Machine learning algorithms are designed to automatically extract features and patterns hidden within their input data in order to perform decision making with minimal human intervention.

During the last decade, and with the availability of faster computational power and access to huge amounts of data, training deep neural networks (DNNs) has become possible, and their remarkable potential in numerous applications, such as in computer vision, natural language, and signal processing, has

been revealed.

Unlike other types of machine learning algorithms, DNNs do not rely on a separate and manual feature extraction stage. They are capable of learning (spatial or temporal) patterns from the input data, while also being simultaneously optimised for various tasks, such as regression or classification.

Thanks to their non-linearity, DNNs can learn complex patterns and the temporal dependencies between samples can also be modelled via recurrent and/or convolutional architectures.

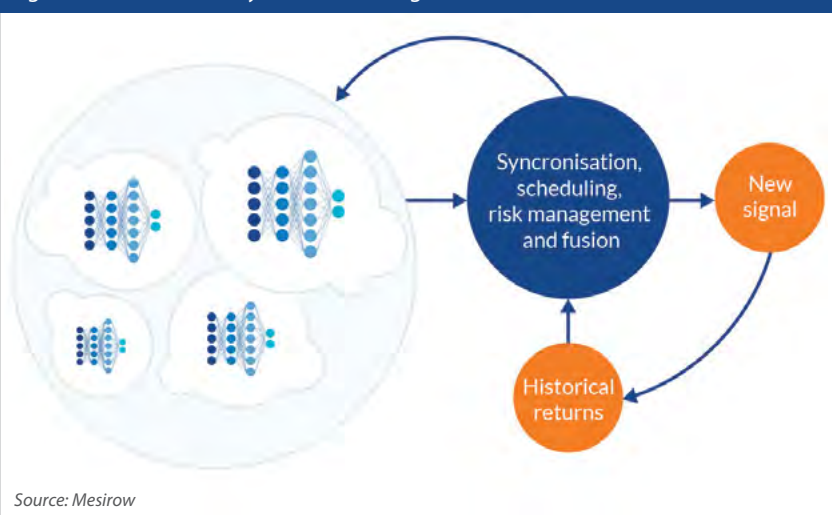
Designing and training DNNs with financial time series data comes with some difficulties, however, and determining the optimal amount of data inputted to train these models can be challenging.

Class over-representation vs. lack of data: Deep neural networks can very easily have thousands of parameters. To optimise over such a high dimensional parameter space, a substantial amount of data is usually required. One way to provide more training data can be to increase the look-back window (LBW) size used to construct the training sets by incorporating more historical data samples.

But more data and more training samples do not necessarily make for better models. Using a large LBW can over-represent classes and cause the models to underfit, to such an extent that the trained DNN fails to model the data accurately.

Therefore, we have a dilemma: too much data can over-represent classes causing our DNN models to underfit, but on the other hand, a lack of data can cause the models to quickly overfit (not be able to generalise unseen data thus creating a high variance in model output and accuracy).

Figure 1: Illustration of systematic trading, via the fusion of micro and macro DNNs



Micro/macro DNN models

Inspired by the bootstrap aggregation (Bagging) methodology, instead of using one DNN model trained over a fixed data range, our solution to the dilemma is to increase the number of DNNs.

Our final prediction signal is calculated from several DNN models, each trained and validated over different ranges: The micro models, capable of learning immediate short-term data trends vs. the macro models, which specialise in recognising more persistent long-term trends from the input financial time series.

The micro models are trained and validated over smaller, but more recent training sets, while the macro models are trained over a much longer period.

Fusing the signals from several micro and macro DNN models reduces the large variance originated from the micro models and raises the lower macro models' accuracy, which can be caused by their high bias level and potential class over-representation. This boosts the overall performance and results in a robust technical strategy.

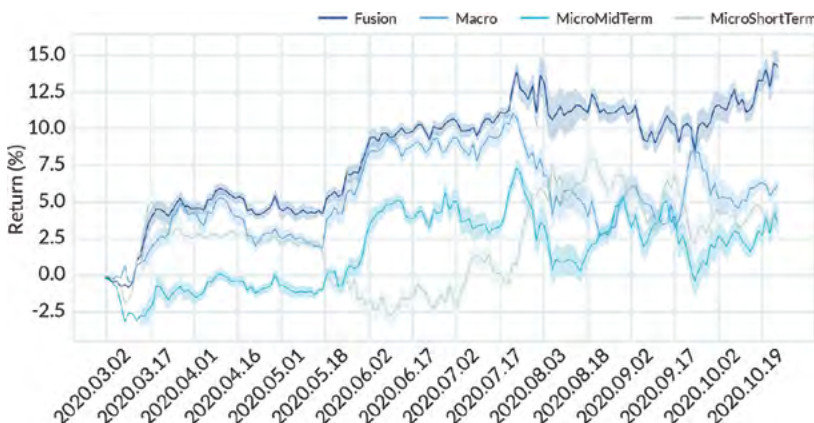
The diagram in Figure 1 illustrates this approach. During the live trading phase, the stream of data is given to several micro and macro DNNs, which independently execute in parallel. The output signals are then fused at the next step to generate the predicted signal.

Setup and performance

Our goal is to predict the next day's price movement for currency pair i , given the spot FX rates of currency i and other 28 currencies, during the previous N days. This process is repeated for all 29 currency pairs.

First, the input data is pre-processed, so that it is stationary and normalised. Then the training and validation samples are labelled. During the training step, in addition

Figure 2: Cumulative returns for Micro, Macro and fusion strategies



Source: Mesirow

Table1: Six-months return and IR for individual micro and macro strategies and their fusion

	MicroMidTerm	MicroShortTerm	Macro	Fusion
IR	0.78	0.38	0.67	1.85
Return (%)	9.14	4.46	7.56	20.37

Source: Mesirow

to finding the optimal weights of the DNN models, separate modules simultaneously optimise the architecture of the DNNs to automatically adjust their hyper-parameters.

Figure 2 shows the cumulative total return and rolling standard deviation in the last 11 business days, over the out-of-sample period of March to end of October 2020. Altogether, three models are used (two micro and one macro), each utilising an input tensor constructed from the FX rates during the previous N days from the 29 currency pairs. The predicted position sizes are then used to calculate the returns. The short and mid-term trend changes in the market are detected by the MicroShortTerm and MicroMidTerm models, respectively, while more persistent long-term patterns are discovered by the macro model. The fusion of these networks generates a robust predictive signal and provides an optimal balance

between bias and variance.

This has increased the 6-months expected total return to 20.37 per cent, while reduced the standard deviation and has resulted in a 6-months information ratio (IR) of 1.85, as detailed in Table 1.

Conclusions

This article briefly summarised the advantages of fusing several DNNs to reduce the lack of data effects vs. class over-representation in order to construct a robust predictive model. As we did not have any specific assumption about the input data, the proposed generic methodology can be applied to any multi-modal financial time series. After 18 months of research and testing, these models were added to Mesirow Currency Management's Alpha Strategies late last year. ■

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INVESTMENT

Right on the money

Currency markets have become more interesting as a result of the pandemic; Lynn Strongin Dodds looks at the opportunities on offer for pension funds and the best strategies to consider

WRITTEN BY LYNN STRONGIN DODDS, A FREELANCE JOURNALIST

The drivers behind currency investing may not have changed, but markets have become more interesting over the past year. The picture is blurring with economies and central banks moving in different directions in terms of monetary and fiscal policy as the pandemic abates. There will be opportunities to be mined but also risks as scenarios can change quickly.

As Schroders multi-asset portfolio manager, Caroline Houdril, points out, the pandemic created an unprecedented macroeconomic landscape for investors to navigate. “We see three opportunity sets in the currencies market created by the Covid crisis – the return of the interest rate differential paradigm, the continued appreciation of commodity prices and the vaccine rollout disparity,” she adds.

Emerging and developed markets

In the developed world, the Bank of Canada set the taper ball rolling in late April, becoming the first major central bank to reduce its pandemic-induced stimulus programmes. There is speculation that the Bank of England could be heading down the tightening path. The central bank’s recent higher growth estimates for the UK economy – 7.25 per cent from a previous forecast of 5 per cent over three years – sent signals that rates could begin to rise in 2022.

Meanwhile, in the US, the Federal Reserve does not yet intend to pullback from its asset purchases but in early May, US Treasury Secretary, Janet Yellen, stated that interest rates may have to rise modestly to prevent the economy from overheating due to higher levels of government spending. Although no timeframe was specified, there are concerns over the impact of the Biden

administration’s roughly \$4 trillion investment package, on top of the \$1.9 trillion it pumped into the economy in March to combat the impact of the pandemic.

By contrast, emerging markets (EM) are not faring that well. Rising US government bond yields have put a damper on the EM rebound story in the first quarter and nearly all currencies in this cohort have weakened against the dollar since late February, with a slight recovery at the start of April. The greenback though is 9 per cent stronger against the Brazilian real and 5 per cent higher than the Russian rouble since the start of the year. It has also advanced against the popular Mexican peso and Chinese renminbi.

“There is not a compelling narrative because if you strip out China, growth in emerging markets is only 1.8 per cent,” UBP global head of FX strategy, Peter Kinsella, says. “The FX outlook is more constructive in the G10 currencies. There was a consensus at the beginning of the year that the dollar would weaken, which would have been good for EM but that has not been the case. As a result, it is best for pension funds to focus on idiosyncratic risks and opportunities. For example, we think the Russian rouble has a strong tailwind because of rising oil prices while China’s RMB will also do well.”

Covid-19 impact

The vaccine rollout is also having an impact, although currently it is difficult to predict the exact outcome as countries are going at different paces. UBS head of UK balanced and currency investment solutions, Jonathan Davies, has a base case

with the programme effectively stopping the pandemic and economies eventually normalising.

“At the moment, there are differences with the UK and US ahead, but I see Europe catching up in the second quarter with emerging markets and Japan following later in the year,” he adds. “If the global vaccine programme is not successful in eradicating the pandemic, this may mean more structural changes to the way we live, which will produce winners and losers in certain industries, but I think growth would nevertheless return as I do not think that remaining in a perpetual state of semi-lockdown would be acceptable to the public.”

Mesirow Currency Management chief executive officer, Joseph Hoffman, believes that “if the rollout of Covid vaccines across the globe improves and most countries can achieve herd immunity, this will potentially lead to a weaker dollar because investors will seek riskier assets. However, if the rollout of vaccines continues to struggle... investors may seek safe-haven currencies such as the US dollar, Swiss franc, or Japanese yen”.

Strategies

Against this changing backdrop, it is no surprise that European pension funds are looking to adopt a more hands-on approach. “Although different countries have different issues, we are seeing an increased interest in active management,” Millennium Global head of business development, Charles Goodman, says. “This is partly due to increased macro differentiation and a bigger opportunity set to generate alpha and for dynamic hedging.”

J.P. Morgan Asset Management EMEA head of pension solutions and advisory, Sorca Kelly-Scholte, echoes these sentiments: “People tend to be anchored in what they

were doing before the crisis, but we believe that a dynamic approach to currency hedging has much appeal because it can help pension funds across the board through periods of volatility and potential long-term dollar depreciation.”

The fortunes of the US dollar have become more important to European pension funds as their investments are much more global today, whether it be equities, fixed income, credit or real assets, according to Kelly-Scholte. The currency may still have safe-haven status, but she expects it to depreciate over the next 10-15 years leaving investors at risk if these positions are left unhedged.

Hoffman also notes that due to the persistent low-rate environment in Europe, pension funds are paying about 80 basis points per year to passively hedge portfolio currency risk, a consistent drag on performance. For those that consider currency as an uncompensated risk, he believes a dynamic currency-hedging overlay allows investors to mitigate their FX risk, while enhancing their returns and minimising drawdowns relative to a passive overlay.

“European investors can hedge their currency exposures without incurring the substantial negative carry associated with large interest rate differentials during higher interest rate environments,” he adds. “The same proactive stance is also being applied to generating performance.”

As for currency alpha, Hoffman notes it can be a good investment for European pension funds that are looking for a liquid, alternative source of return due to its low correlation to equities and fixed income. “Portfolios are often constructed using currency forwards that typically do not require full funding like other instruments, such as equities or fixed income, allowing

investors the flexibility to port a currency alpha overlay over other asset class investments as a return enhancer,” he adds.

Some market participants also turn to the classic factor strategies such as carry, value and momentum. As Houdirl puts it, “the well-known interest rate differential dynamic has recently been rewarded in the FX market, i.e. low yielding currencies being penalised to the favour of higher yielding ones. With this factor back in fashion, we are avoiding Japanese yen and the Swiss franc for the time being and preferring currencies with earlier hiking potential like the Canadian dollar and Norwegian krone”.

However, Record Currency Management CIO, Dmitri Tikhonov, notes, “although the carry trade still generates returns, investors should be aware that circumstances can change quickly and abruptly if central banks continue to intervene”.

He points to the value approach as another way of producing returns. There are several ways to construct a portfolio, but he believes one of the most transparent is to benchmark against a well-known indicator such as the purchasing power parity (PPP), which measures prices of a basket of goods in different countries. Exchange rates fluctuate between highs and lows, but over time tend to return to its mean or true value.

Momentum has also proven popular, whereby trend exploits the tendency of currency returns to persist over short-to-medium-term horizons, according to Tikhonov. This means that past returns can somewhat predict the direction of future returns. ■

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