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Stress Testing Correlation Networks

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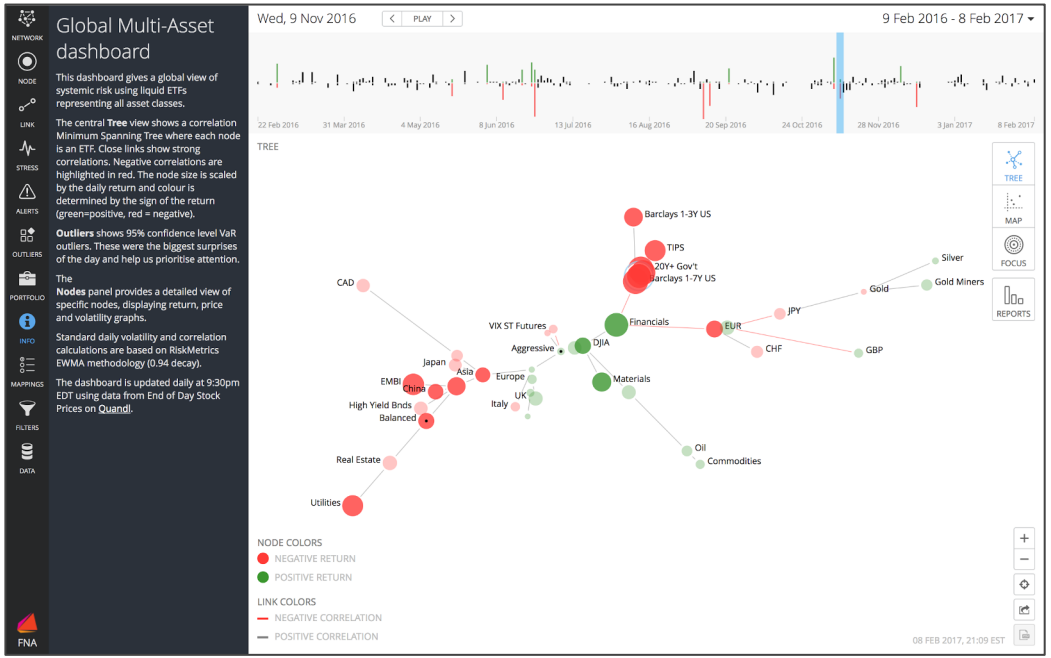
Stress Testing



Challenge

Understand and attribute the impact of changes/shocks in portfolio drivers.

Current Situation

Use existing risk system such as Riskmetrics.

Solution

Augment existing pricing engine with interactive visual interface. Approximate and visualize stress test impact on the fly with returns based stress testing.

Benefits

Ability to see the results from different angles swift stress testing of portfolio returns as a first order approximation of results

Stress Testing Correlation Networks

Visual methods based on networks allow us to:

- understand correlations structures of much larger scale than often done before
- conveniently develop correlation scenarios based on historical structures
- create new correlation structures

-> Correlations become a subjective variable in the stress test

NETWORK
NODE
LINK
STRESS
LIBRARY
ALERTS
OUTLIERS
PORTFOLIO
INFO
MAPPINGS

Global Multi-Asset dashboard

This dashboard gives a global view of systemic risk using liquid ETFs representing all asset classes.

The central **Tree** view shows a correlation Minimum Spanning Tree where each node is an ETF. Close links show strong correlations. Negative correlations are highlighted in red. The node size is scaled by the daily return and colour is determined by the sign of the return (green=positive, red = negative).

Outliers shows 95% confidence level VaR outliers. These were the biggest surprises of the day and help us prioritise attention.

The **Nodes** panel provides a detailed view of specific nodes, displaying return, price and volatility graphs.

Standard daily volatility and correlation calculations are based on RiskMetrics EWMA methodology (0.94 decay).

The dashboard is updated daily at 9:30pm EDT using data from End of Day Stock Prices on Quandl.

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Here we see a correlation map showing the broad global markets. We see different asset classes cluster together, eg oil-energy, precious metals, bonds and equities clustered in the center.

Mon, 26 Sep 2016 PLAY 27 Sep 2015 - 26 Sep 2016

8 Oct 2015 16 Nov 2015 21 Dec 2015 27 Jan 2016 2 Mar 2016 6 Apr 2016 10 May 2016 14 Jun 2016 19 Jul 2016 22 Aug 2016 26 Sep 2016

TREE

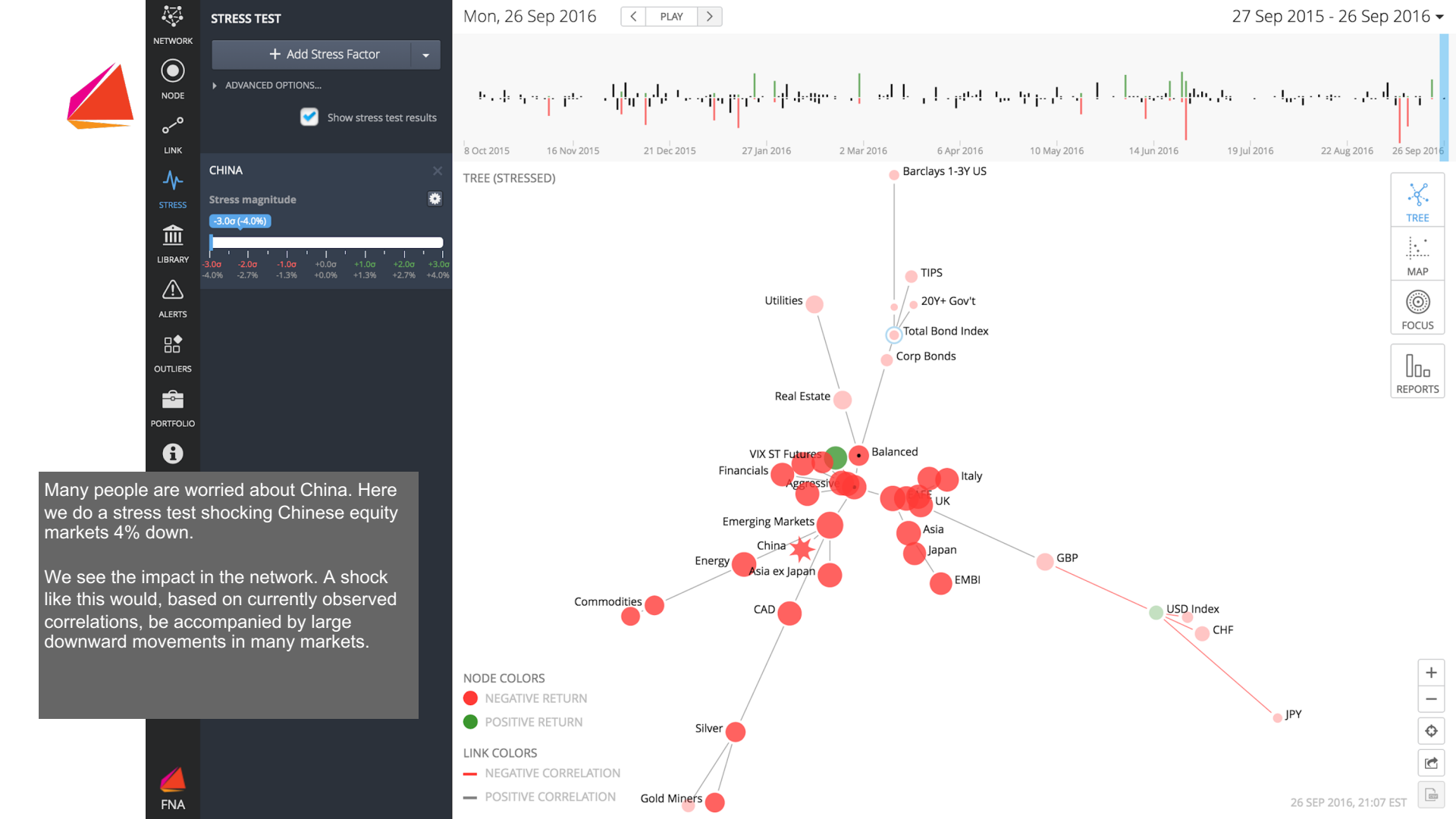
TREE MAP FOCUS REPORTS

Barclays 1-3Y US
TIPS
Utilities
Barclays 1-7Y US
Total Bond Index
Corp Bonds
Real Estate
VIX ST Futures
Balanced
Financials
Germany
Aggressive
EAFE
France
Emerging Markets
Asia
China
Japan
Energy
GBP
Asia ex Japan
EMBI
Oil
CAD
EUR
CHF
JPY
Silver
Gold Miners

NODE COLORS
NEGATIVE RETURN
POSITIVE RETURN

LINK COLORS
NEGATIVE CORRELATION
POSITIVE CORRELATION

26 SEP 2016, 21:07 EST



Many people are worried about China. Here we do a stress test shocking Chinese equity markets 4% down.

We see the impact in the network. A shock like this would, based on currently observed correlations, be accompanied by large downward movements in many markets.

NETWORK
NODE
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NETWORK
24 Jun 2016

Scale 587.37
Number of Nodes 41

Auto scale

+ Add Charts

SYSTEMATIC RISK

0.67

CONCENTRATION RISK

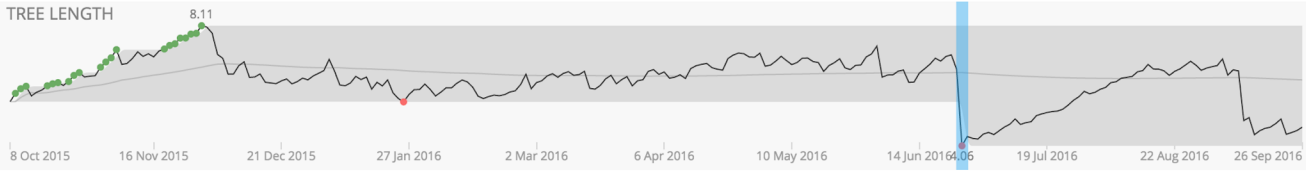
0.13

TREE LENGTH

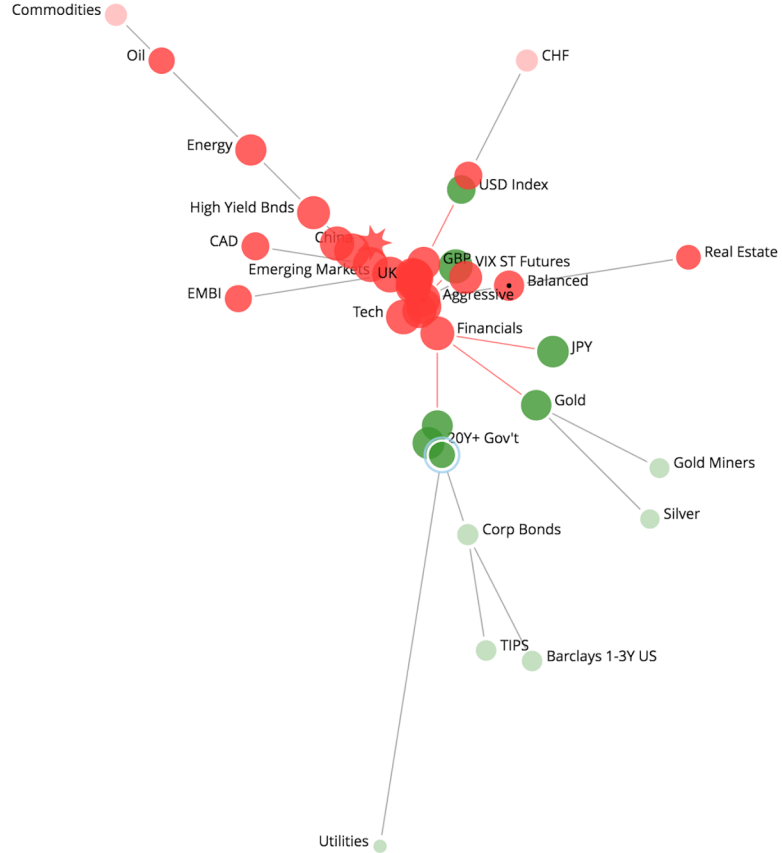
4.06

The impact would have been worse during the time period of strongest correlations, the August sell-off

Fri, 24 Jun 2016 PLAY 27 Sep 2015 - 26 Sep 2016



TREE (STRESSED)

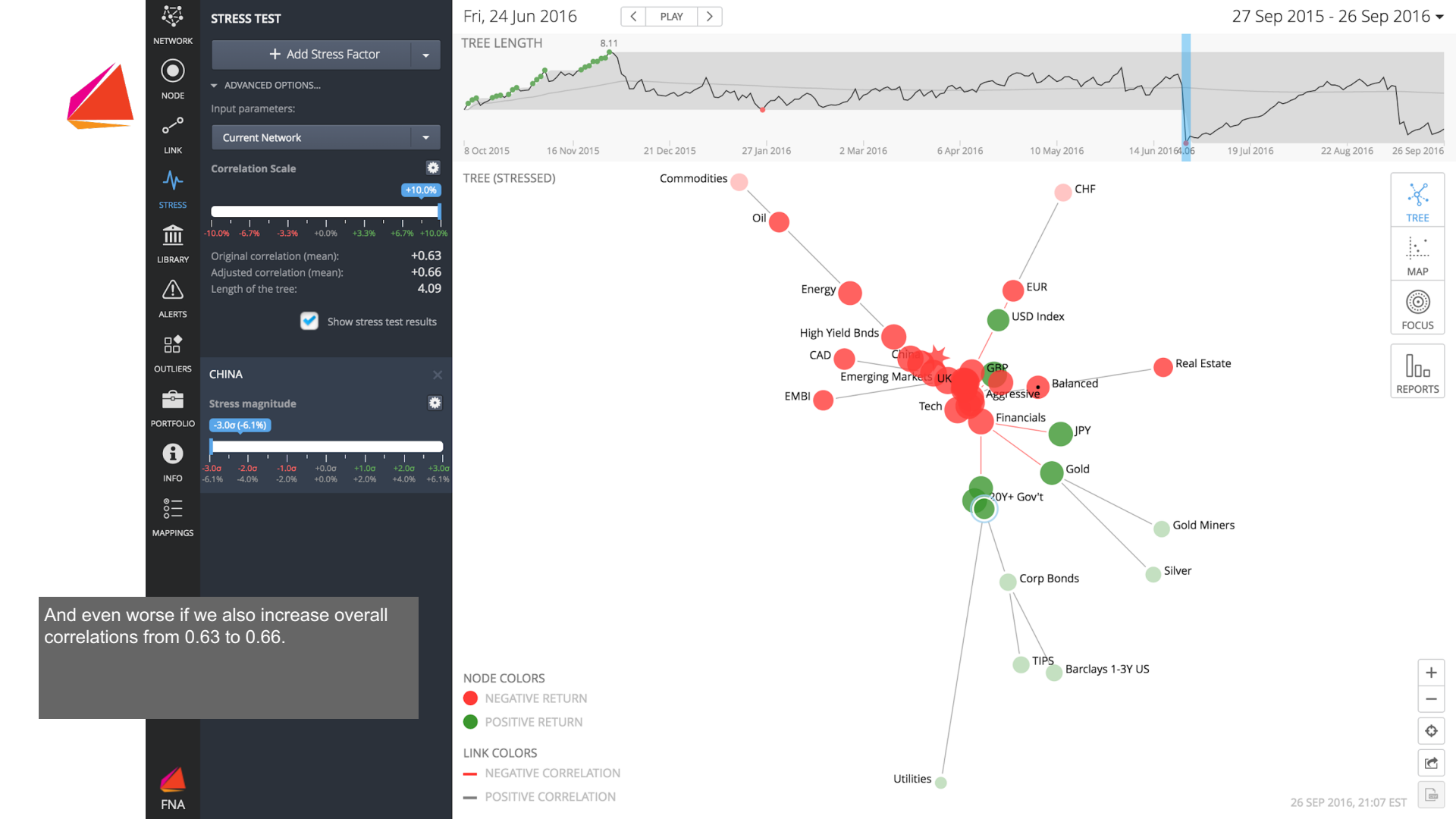


TREE
MAP
FOCUS
REPORTS

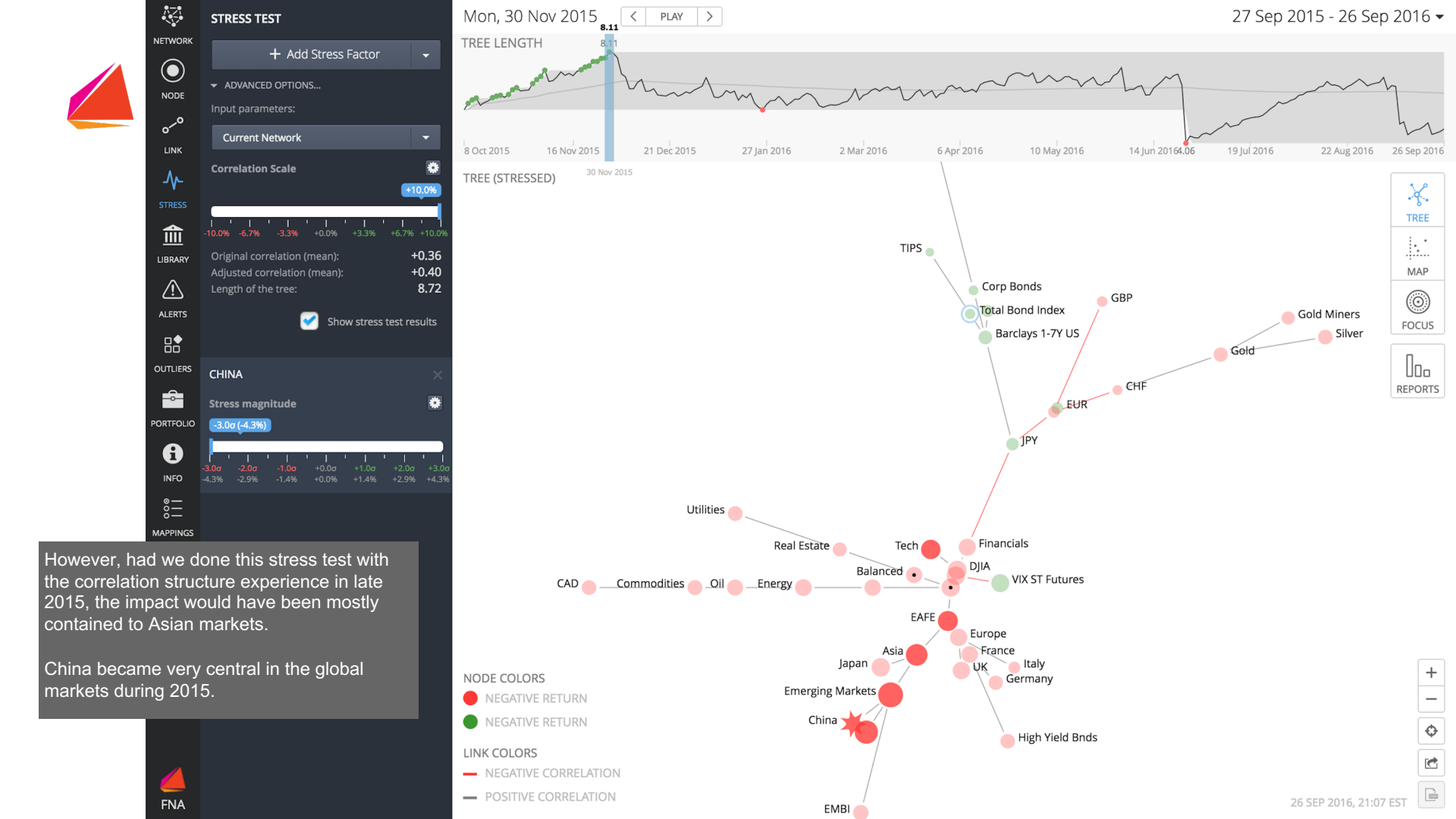
NODE COLORS
NEGATIVE RETURN
POSITIVE RETURN

LINK COLORS
NEGATIVE CORRELATION
POSITIVE CORRELATION

26 SEP 2016, 21:07 EST

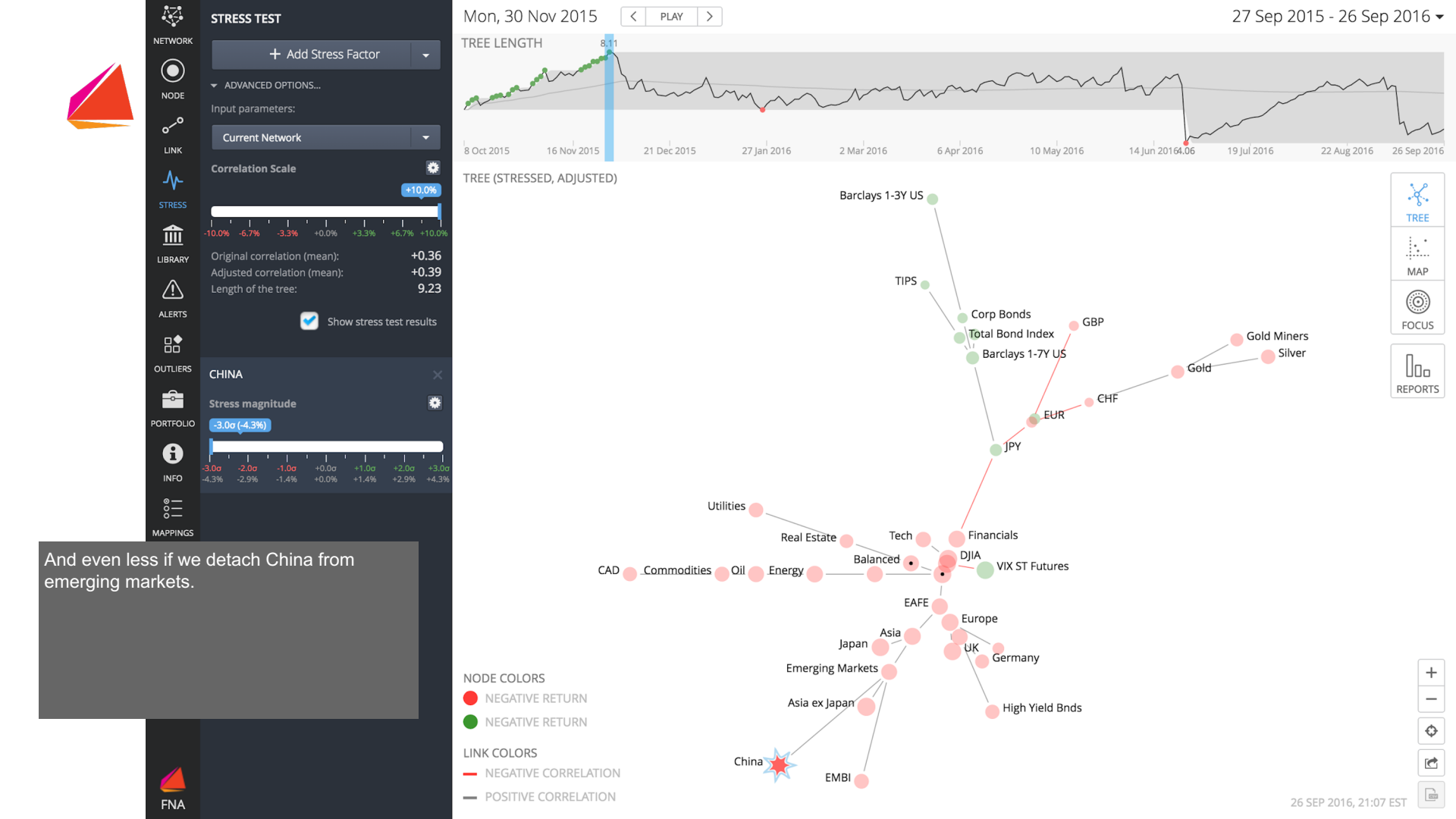


And even worse if we also increase overall correlations from 0.63 to 0.66.



However, had we done this stress test with the correlation structure experience in late 2015, the impact would have been mostly contained to Asian markets.

China became very central in the global markets during 2015.



And even less if we detach China from emerging markets.

Questions & Exercises

1. What is the story with the EU Debt Crisis Dashboard?

2. Design a stress test for Brexit

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Correlation Networks - Scripting Example

Correlations - Create Network

```
# Import price data
table.import.quandl {
    -table prices.csv
    -codelist codes.csv
    -start_date 2017-01-01
    -authtoken ZpDe8gKuTzofqPtWVynD
}

system.reset_db

# build network
network.build.correlation {
   -table prices.csv
   -returns_method log
   -window 100
}
```

Correlations - Filter links

```
# count number of links and drop networks with no links
network.stats.size
network.drop -filter size==0

# calculate distance measure for links
arc.property.set {
     -property distance
     -value 1-abs(pearson_correlation)
     -type Numeric
}

# identify minimum spanning tree and drop links not in it
arc.cluster.spanning_tree -arc_weight distance -type min
arc.drop -filter spanning_tree==false
```

Correlations - Create Dashboard

```
# calculate network layout
vertex.layout.radial_tree -arc_length distance

# save series on file
series.save -file corr

# create dashboard
dashboard.new
dashboard.view.network -x x -y y
dashboard.mappings.vertex.label -text label
dashboard.mappings.arc -arrow :0
dashboard.save -file corr -series corr
```

Dashboards

FNA Dashboard - User Guide
Guide for reading FNA Dashboards

FNA Correlations - Analyst Guide
Step-by-step guide for creating required data for Cross-Asset Dashboard

FNA Dashboard - Analyst Guide
Step-by-step guide for creating Cross-Asset Dashboard

Scripts (need to be run in order):
1. xasset_data
2. xasset_series
3. xasset_dashboard

Files (need to be uploaded on account):
Quandl prices: xasset_prices.csv
Data transformation: xasset_transformations.csv
Portfolios: xasset_portfolio1.csv, xasset_portfolio2.csv
Info panel: xasset_info.txt
Node labels: xasset_labels.csv

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