



Macroeconomics and Machine Learning

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Advancing Machine Learning in Finance, Insurance and Economics
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ClientGate

The screenshot displays the ClientGate website interface, which is a financial analytics platform. The main navigation bar includes 'Publications', 'Countries', 'Data & Charts', and a search function. The current view is for Brazil, as indicated by the dropdown menu and the 'Brazil' header.

Risk Metrics for Brazil:

- RISK PREMIUM:** 563bp (basis points). Region: 477bp, World: 449bp.
- ECONOMIC RISK:** 47 (from 0 (lowest) to 100 (highest)). Region: 45, World: 45. Status: Average.
- POLITICAL RISK:** 51 (from 0 (lowest) to 100 (highest)). Region: 50, World: 54. Status: High.
- EARLY WARNING SIGNALS:** Currency. Status: Watch List.

RECENT DATA:

- GDP GROWTH:** 1.1% (Percentage Y/Y). As of 2018. 1.1% in 2017.
- INFLATION RATE:** 4.7% (Percentage Y/Y). As of May 2019. 2.9% in May 2018.
- EXCHANGE RATE:** 3.85 (LC per USD). As of Jul 02, 2019. 3.91 in Jul 2018.
- FOREX RESERVES:** 372bn (USD). As of May 2019. 365bn in May 2018.
- POLICY:** 6.5% (Percentage). As of Jun 2019. 6.5% in Jun 2018.

IN THE NEWS:

- Thousands Of Anti-corruption Protesters Rally In Brazil In Support Of Justice Minister Sergio Moro Wake Of 'car Wash' Probe. Jul 1st, 2019 - SCMP.
- Innovative Time-share Model In São Paulo Allows Apartment To Have Several Owners. Jun 29th, 2019 - Rio Times.

LATEST PUBLICATIONS:

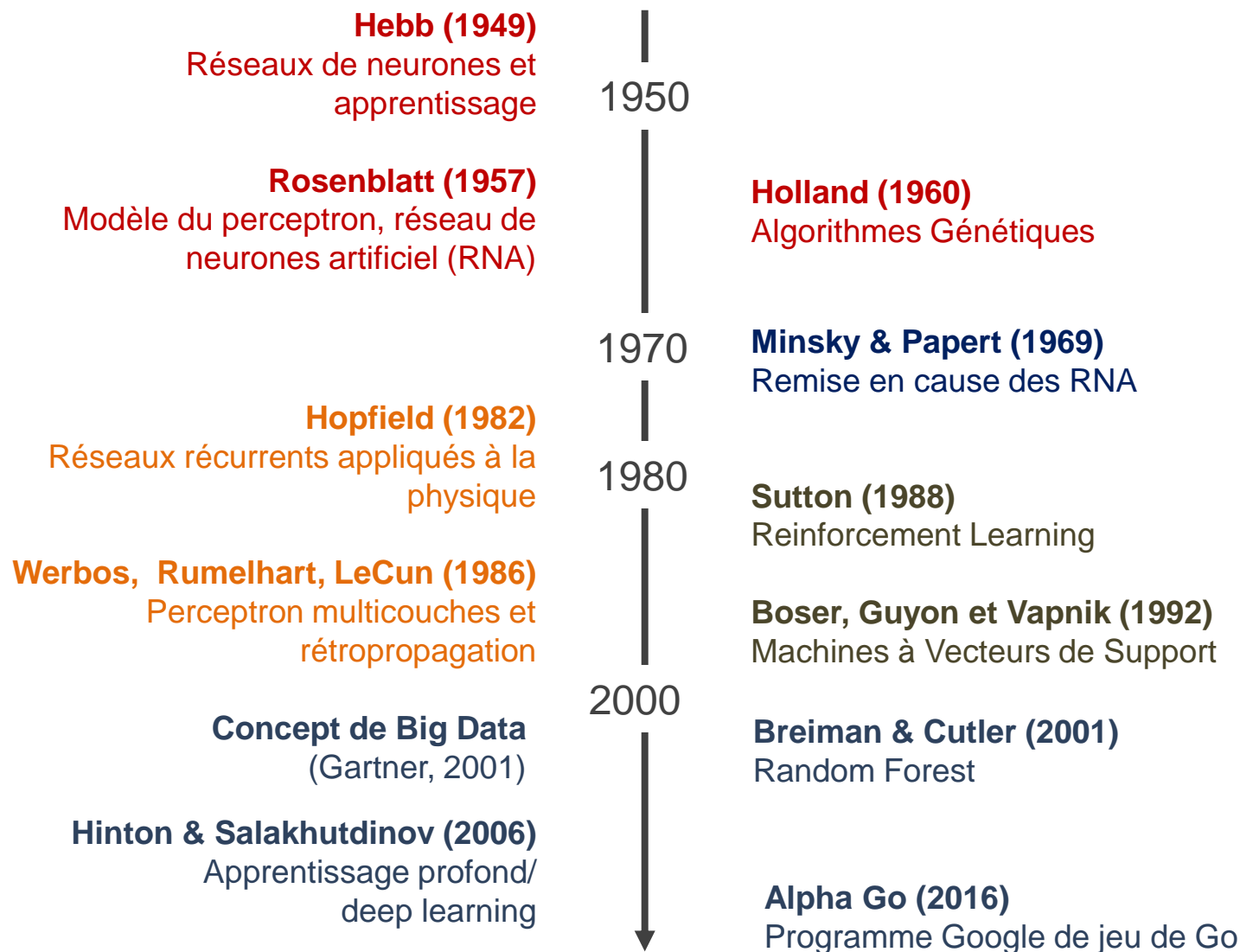
- Turkey: Adjustment Spoiled By Politics Leading To Further Troubles For The Corporate Sector And Currency Risks, Introducing RiskMonitor's Monthly Dashboard & Heatmap, A Visual Check On All Key Changes On Our Quantitative Outputs.** (Monthly Comment) Jun 14th, 2019 | PDF.
- Is The Era Of Independent Central Banks Coming To An End?, Independence: No More Than A Moment In A Sometimes-Multi-Secular History, Somewhat Muddle-Headed Dispute, Ideological Dispute.** (The Banker's Comment) Jun 20th, 2019 | PDF.
- India: PM Modi Relected Amidst Economic Slowdown.** (Flash Comment) Jun 28th, 2019 | PDF.
- Argentina: Economic Pressures On Tight Political Agenda.** (Flash Comment) May 29th, 2019 | PDF.
- Mombasa A High Power Of Attraction For A Small And Almost Peaceful Nation | Haiti: Half Of Hispaniola Suffering | India-Pakistan-Afghanistan: Haunting Borders.** (The Decoder Of Geopolitics) May 16th, 2019 | PDF.

Exchange Rate and Index Charts:

The 'Exchange Rate' bar chart shows the 2% growth of LC per USD against various currencies. The 'Exchange Rate Index' line chart shows the average for 10 emerging markets, weighted by GDP (LC per USD) from Jan 09 to Dec 18.

Country Snapshot: BRAZIL - A Monthly

A brief history of machine learning



Big data and AI

Xeon Phi/Intel
Torch API
MapReduce
Neural Networks
Recursive Partitioning
Theano
MySQL
Deep Learning
AWS
Artificial Intelligence
Big Data
MongoDB
TensorFlow
Machine Learning
R
SVM
Cloud
Python
Smart Data
NoSQL
Hadoop
Cassandra
GPU/NVidia
Random Forest
Spark
Genetic Algorithms
Open Source
Tensor Processing Unit/Google



Economic & Financial Crises

Economic & financial crises since 2017

ACTIVITY

Venezuela (-13.2%),
Congo-Brazzaville (-4.6%),
Kuwait (-2.5%)

China
6% vs 14% in 2007

CURRENCIES

Argentina -20%
Turkey -15%
Brazil -10% Russia -8%
In 2017:
Egypt -44%
Uzbekistan -43%
Congo-Kinshasa -31%

INFLATION

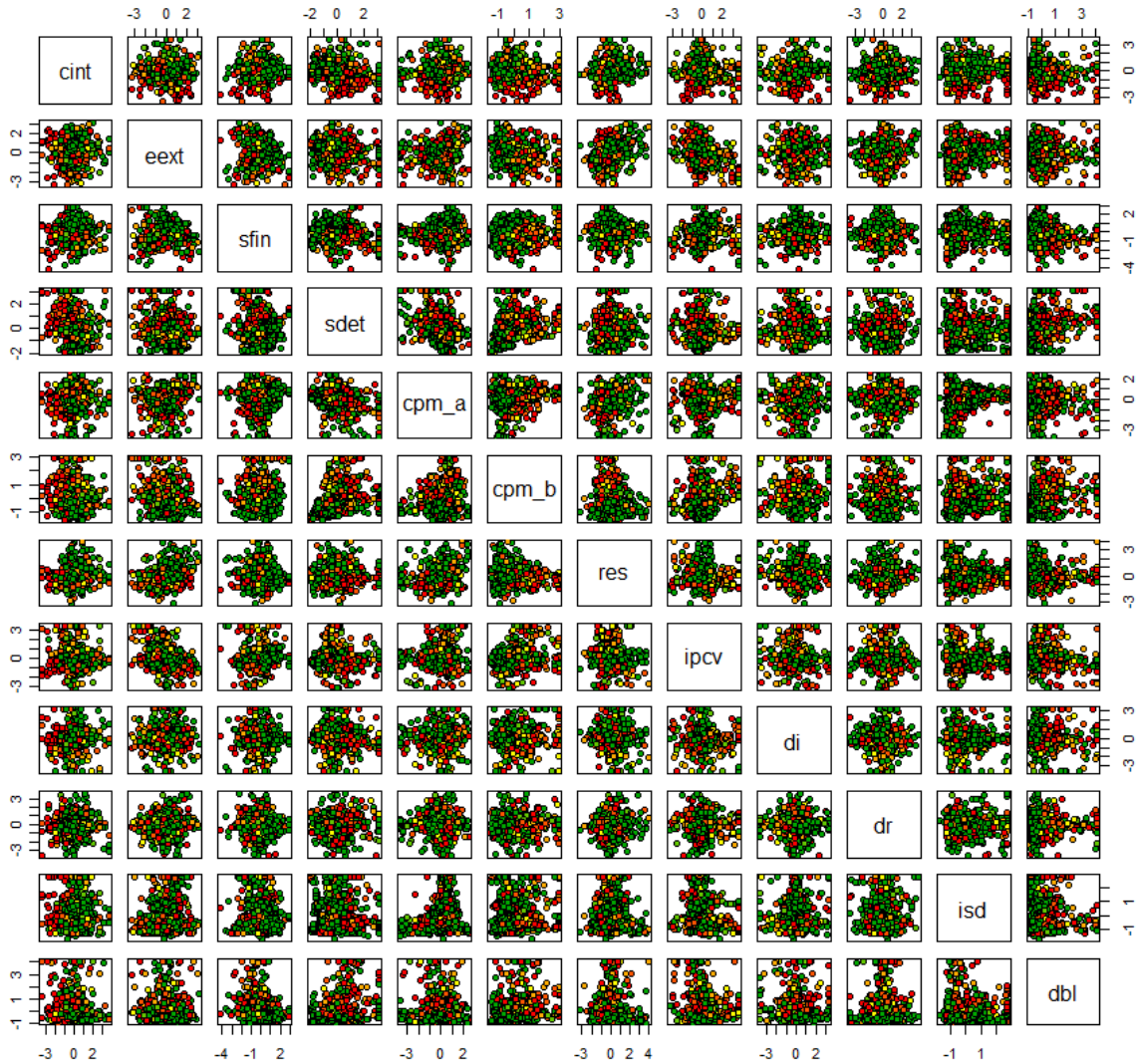
Argentina >30%,
Nigeria 17%, Iran 10%,
Turkey 15%, Ukrain 14%
Congo-Kinshasa 42%
Libya 28%, Egypt 24%
Venezuela >1000%

Forecasting economic and financial crises

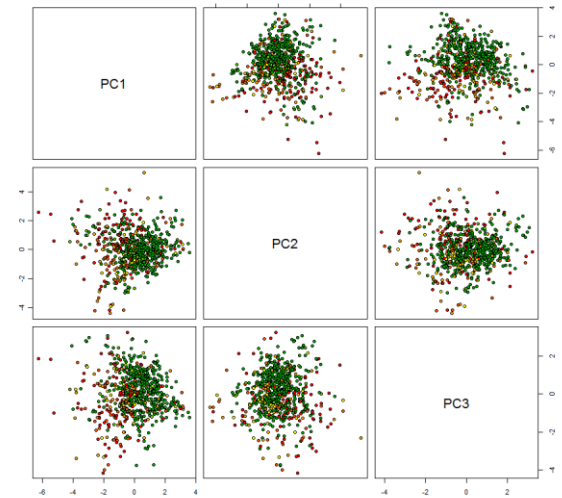
- Krugman (1979), Obstfeld (1994), Cantor and Packer (1996), Eichengreen et al. (1996), Frankel and Rose (1996), Goldstein (1996), Goldstein and Turner (1996), Kaminsky and Reinhart (1999), Komulainen and Lukkarila (2003) , ...
- But forecasting economic and financial crises a few years in advance remains a very difficult exercise, particularly on emerging markets.

Standard data analysis techniques

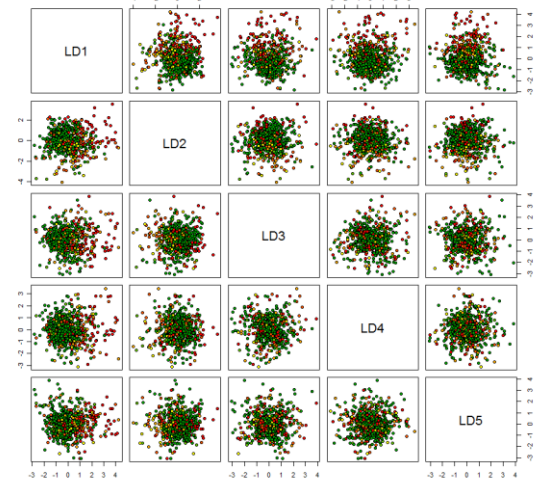
Simple Scat Graphs



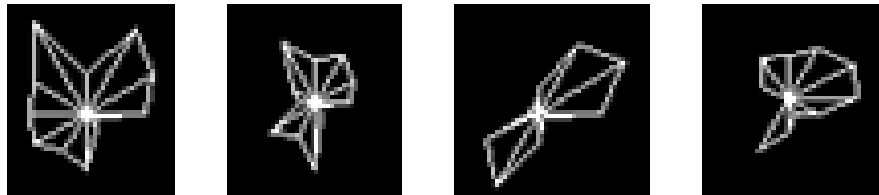
Principal Components Analysis



Linear Discriminant Analysis



Countries, indicators, years... and bufferflies



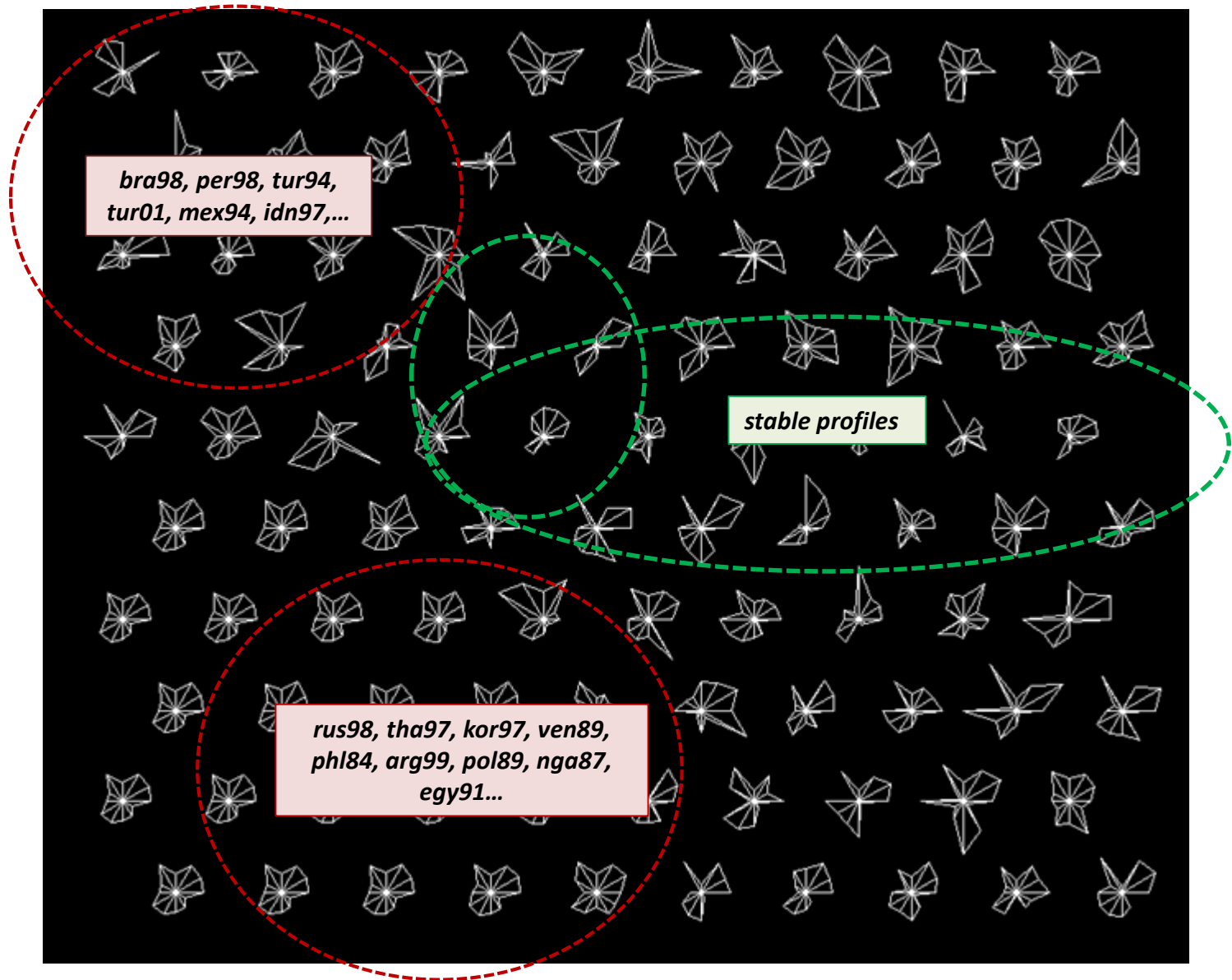
Thousands « butterflies » analysed
on more than 100 countries since the 70s

50 years x 4 quarterly x 100 countries

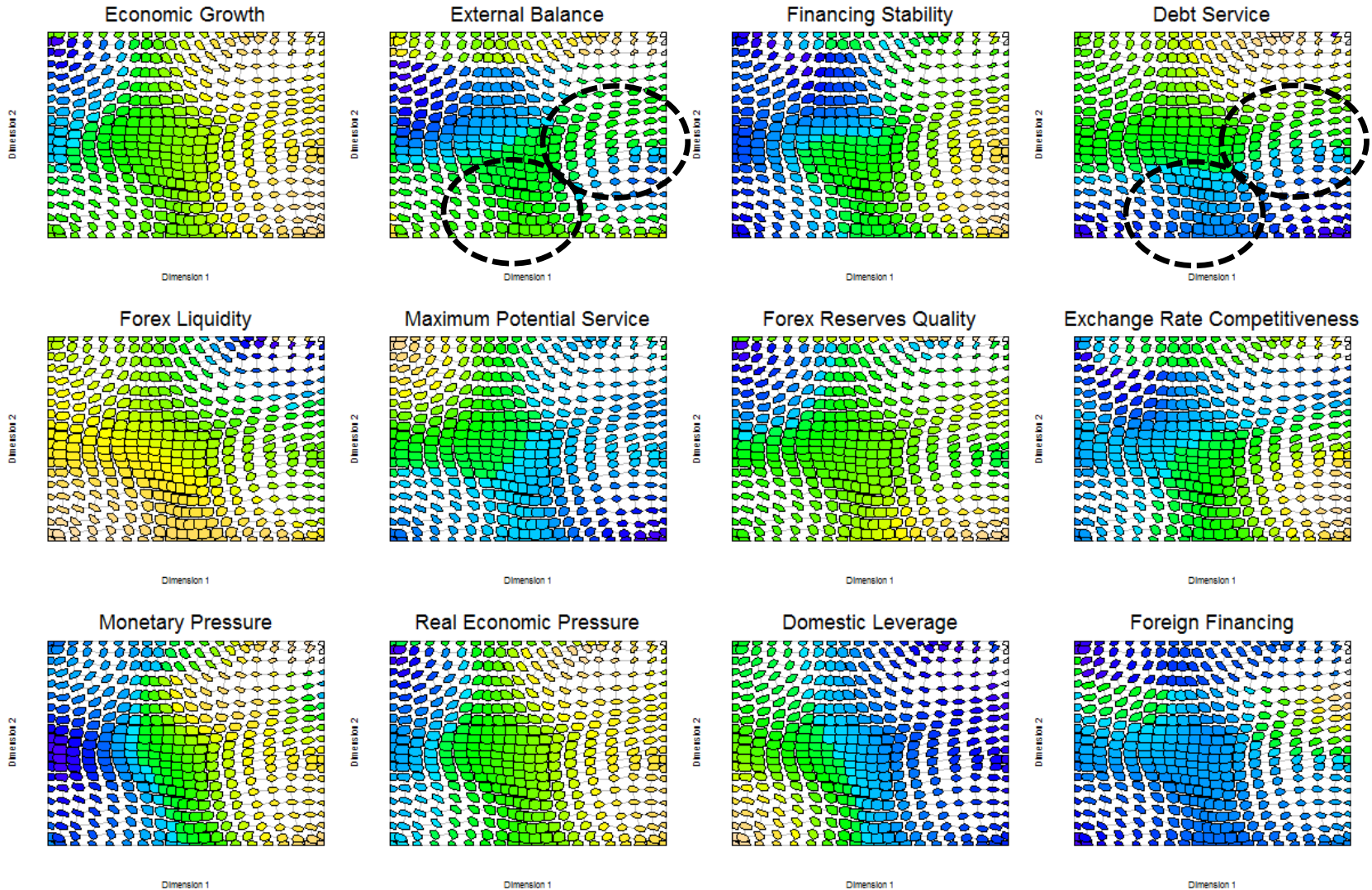
=

20,000 patterns/butterflies to analyse

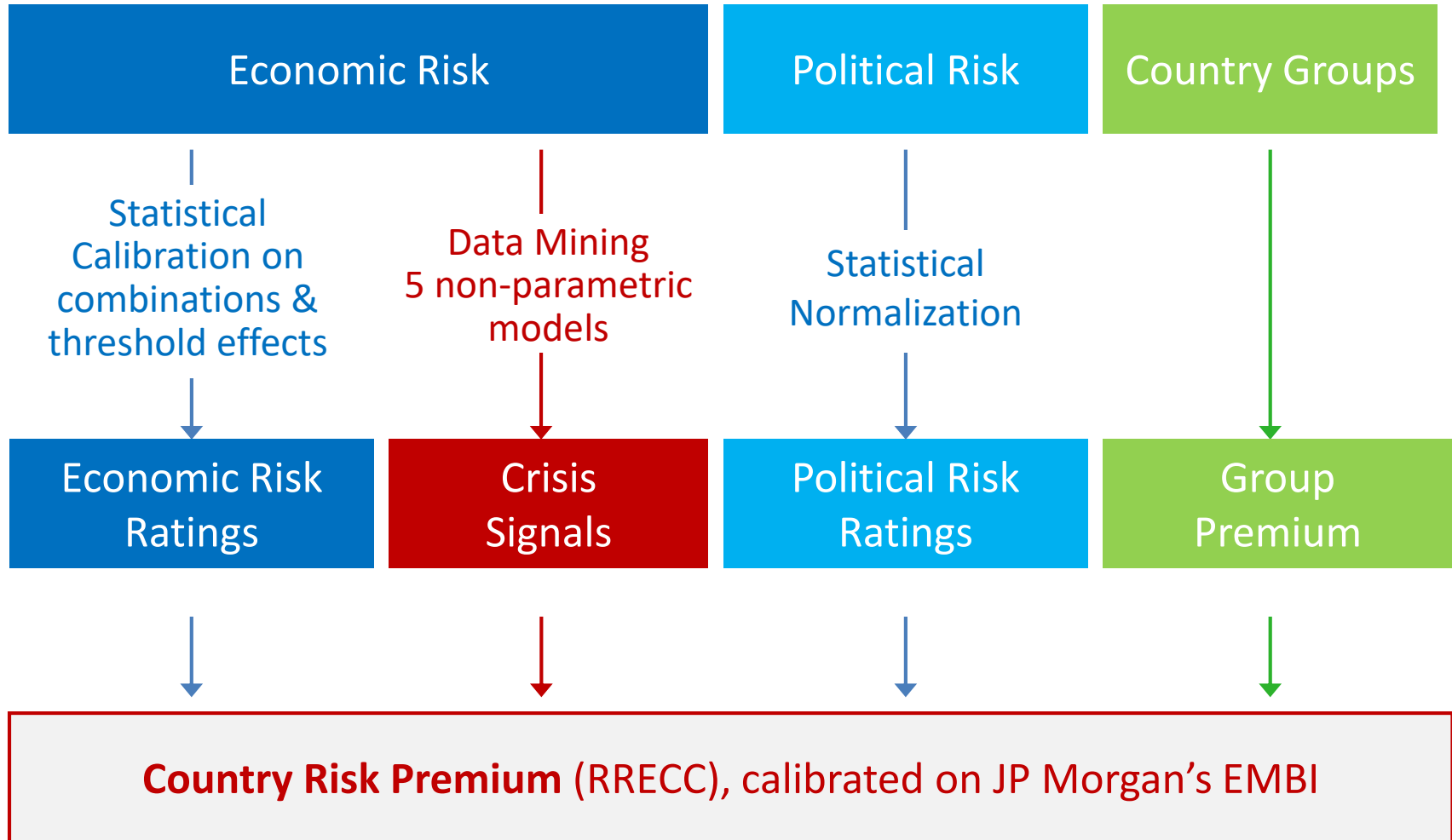
Similarities in macroeconomic patterns and neural networks



Asymetries and non-linearities in factors



RiskMonitor methodology



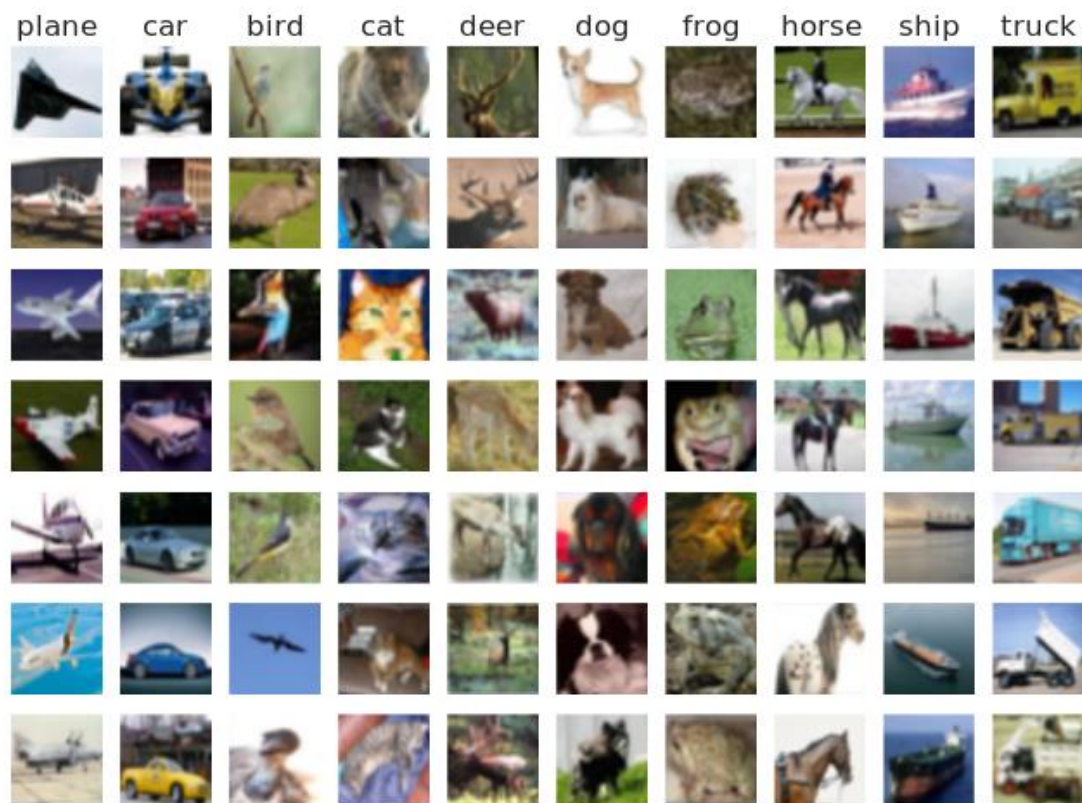
And in finance?

- In the 90s, in finance, most people used neural networks to replace expert systems.
- Kimoto et Yoda (1993), implemented a neural network on the Tokyo Stock Index with... 5 variables!
- Gold and S&P500 (Grudnitski et Obsburn, 1993, Quang Do 1995), and exchange rates (Rawani 1993, Azoff 1994, Avouyi Dovi 1995).
- But today? Advanced econometric models, machine learning, big data, deep learning, text mining,...

Quantitative finance & Hedge Funds

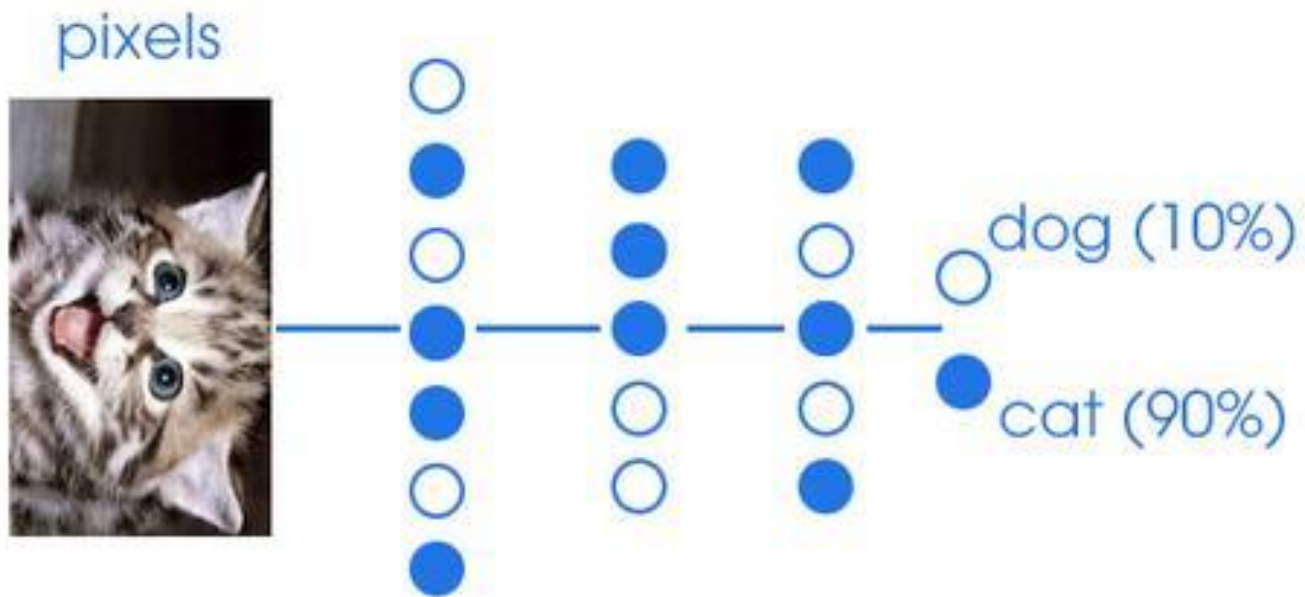
	AUM in 2017 (USD bn)	Quantitative
Bridgewater Associates	122.2	(Non)
AQR Capital Management	69.6	Oui
JPMorgan AM	45.0	(Oui)
Renaissance Technologies	42.0	Oui
Two Sigma	38.9	Oui
De Shaw & Co	34.7	Oui
Man Group	33.9	Oui
Millennium Management	33.9	Oui
Och-Ziff Capital Management	33.5	(Oui)
Winton Group	32.0	(Oui)

Computer Vision



Source: dominodatalab

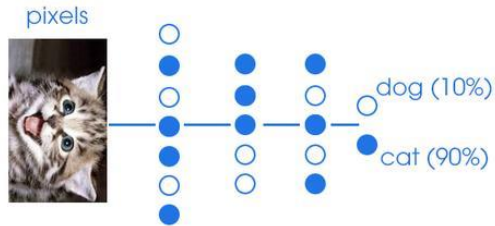
Standard Neural Networks



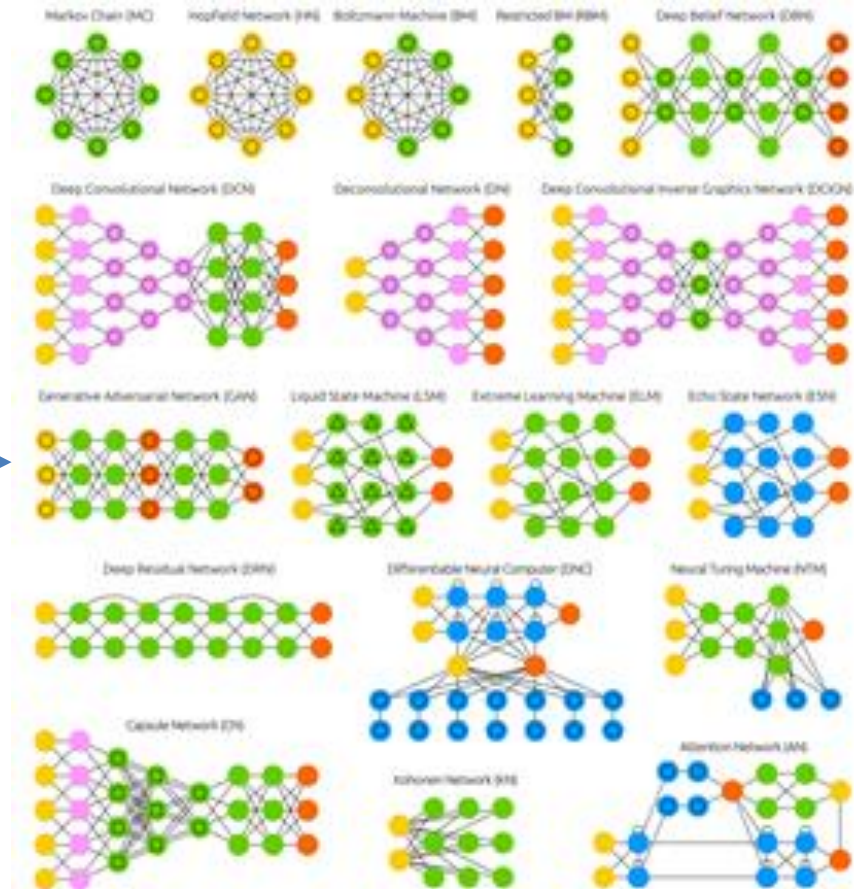
... but sometimes more difficult than cats & dogs!



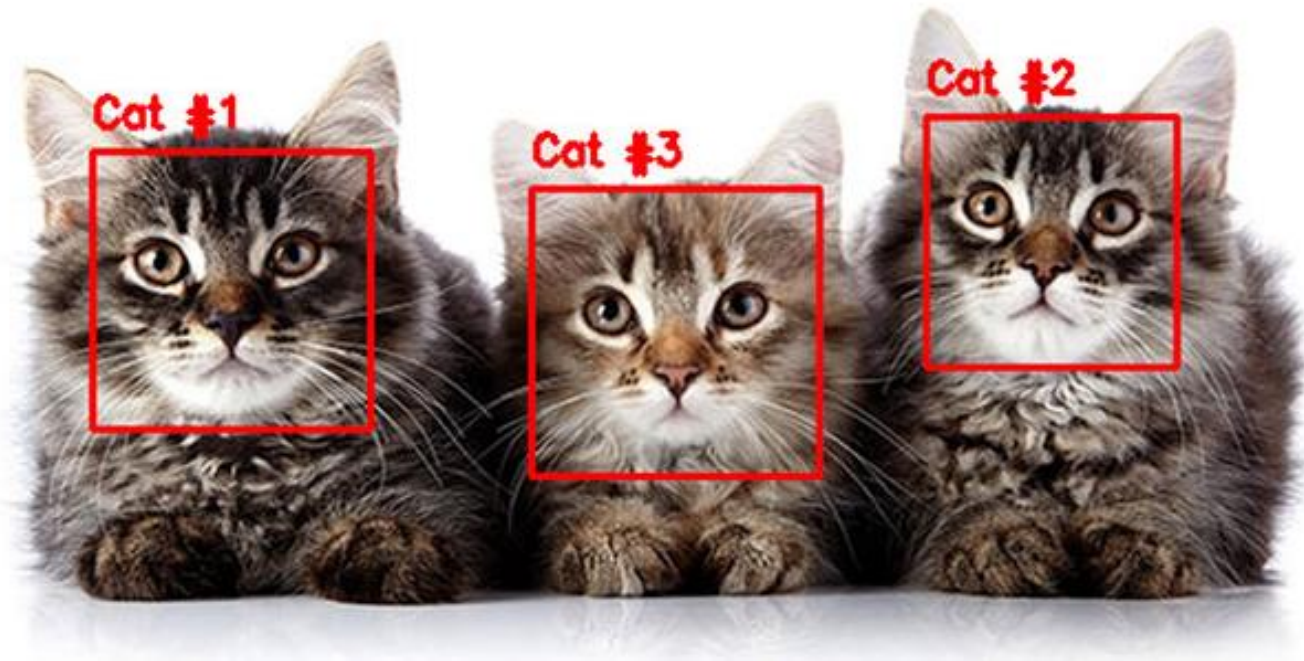
From perceptrons to deep learning



Le Neural Network Zoo du Asimov Institute



The revolution of the cat!



A speculative bubble on financial markets?

Shiller PE Index

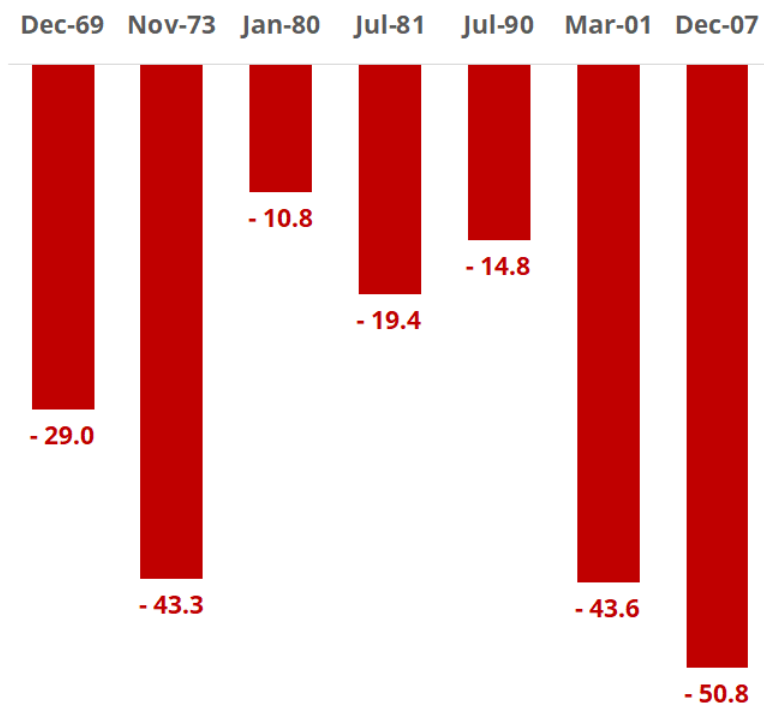
Nov. 2019



Source: Shiller

SP500 changes during US recessions

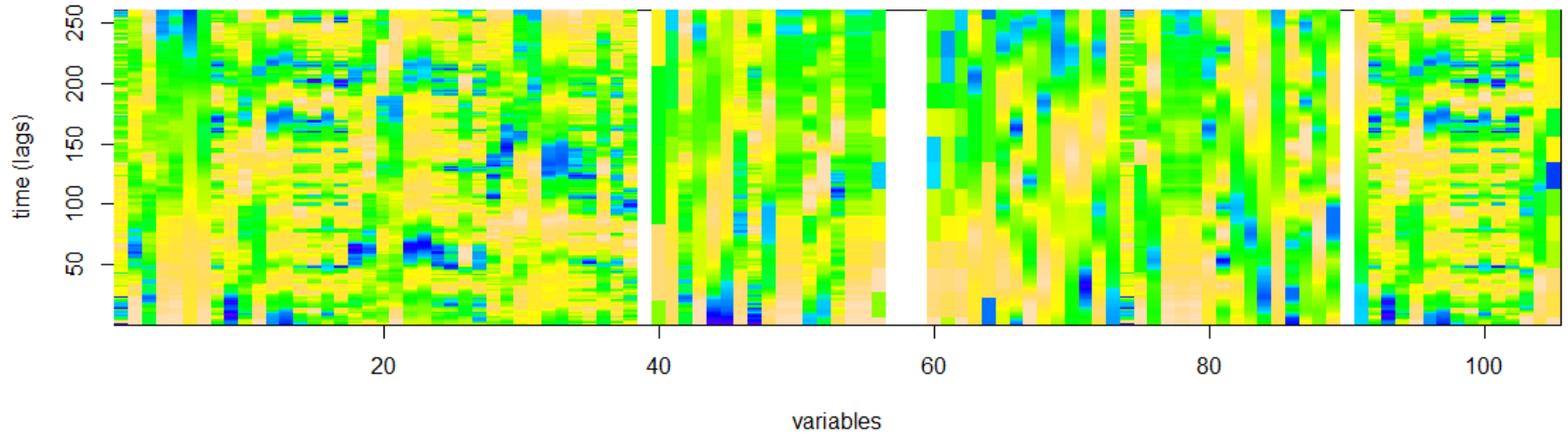
Size of S&P500 changes during US recessions (%)



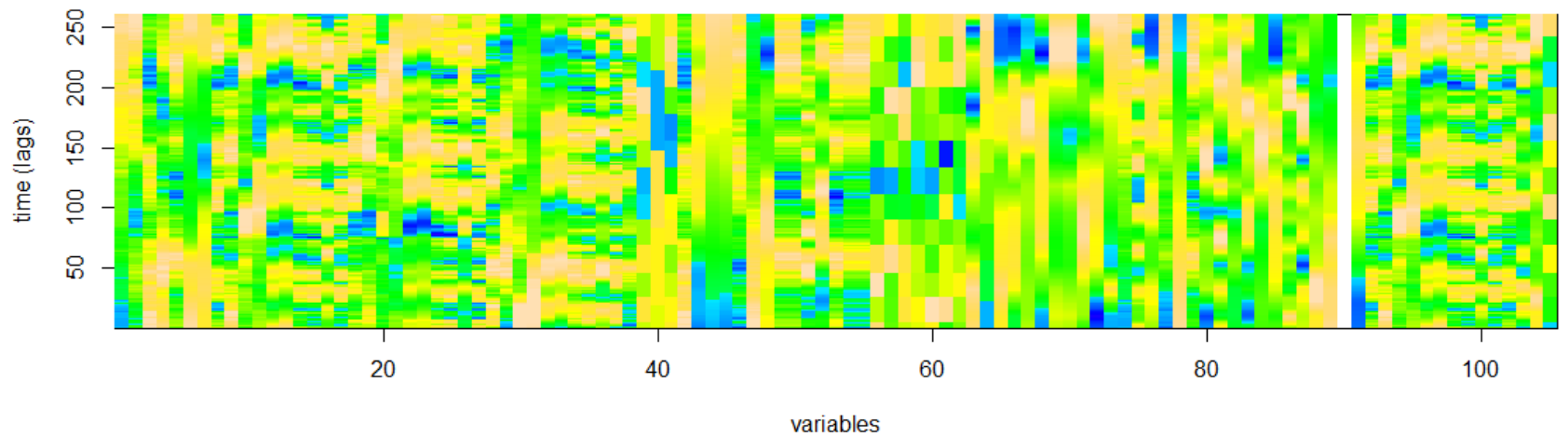
Source: TAC ECONOMICS, Datastream

« Patterns » du QMA et convolution

USA: 1995

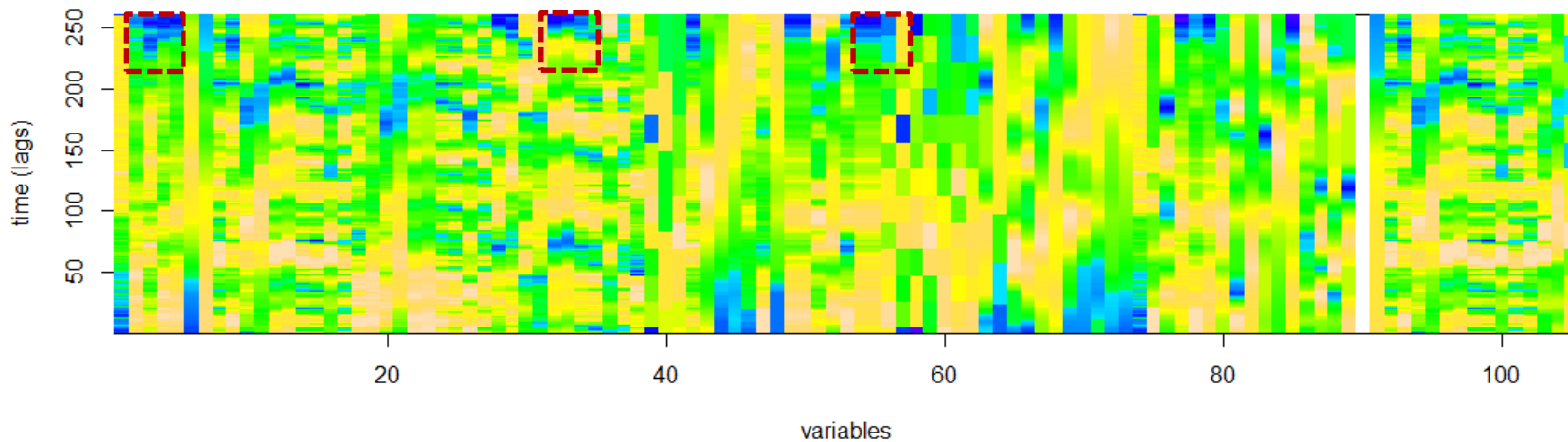


USA: 2005

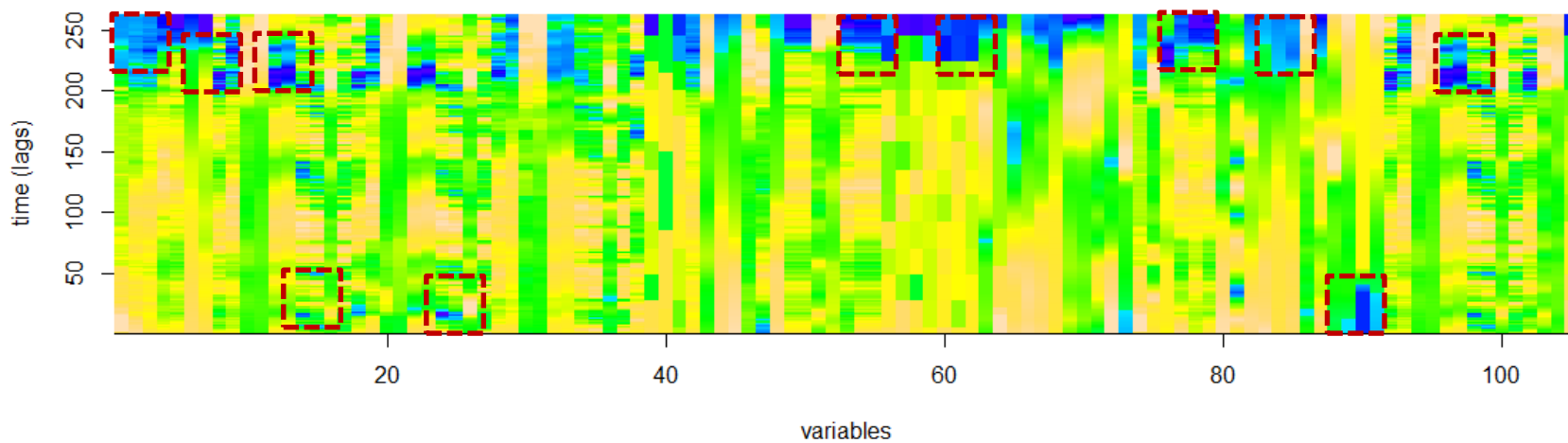


« Patterns » du QMA et convolution

USA: 2000



USA: 2008



The never-ending cycle

QMA summary of Fair Values

Summary of Market Fair Values

	Market Level (Jan. 03)	Fair Value November 19	Gap to Fair Value	Expected short-term direction	Change over one month
Equity Indices					
S&P 500	3 235	2 849	386	Decrease	Increase
CAC 40	6 044	5 344	700	Decrease	Increase
DAX 30	13 219	12 103	1116	Decrease	Stable
FTSE 100	7 622	7 268	354	Decrease	Increase
Nikkei 225	23 657	21 578	2079	Decrease	Increase
10-Year Government Benchmarks					
US Treasury 10 Year Yield	1.79%	2.62%	-83 bp	Increase	Stable
French OAT 10 Year Yield	0.02%	0.69%	-67 bp	Increase	Increase
German Bund 10 Year Yield	-0.28%	-0.29%	+1 bp	Stable	Increase
UK Gilt 10 Year Yield	0.74%	2.50%	-176 bp	Increase	Stable
Japan JGB 10 Year Yield	-0.02%	-0.01%	-1 bp	Stable	Increase
Corporate Spreads					
Euro 5-7 Year A	36 bp	47 bp	-11 bp	Increase	Decrease
US 5-Year A	104 bp	104 bp	0 bp	Stable	Decrease

Source: TAC ECONOMICS

The never-ending cycle

QMA summary of early warning signals

Summary of Early Warning Signals

	Market Level (Jan. 03)	01.2020	02.2020	03.2020	3-month outlook	04.2020	05.2020	06.2020	6-month outlook
Equity Indices									
S&P 500	3 235	[Strong improvement]			↗	[Strong improvement]			↗
CAC 40	6 044	[Strong deterioration]	[Strong improvement]			↗	[Strong improvement]		
DAX 30	13 219	[Strong deterioration]	[Strong deterioration]	[Strong improvement]		↗	[Strong improvement]		
FTSE 100	7 622	[Double signal]			↗	[Strong improvement]			↗
Nikkei 225	23 657	[Strong deterioration]	[Strong improvement]			↗	[Double signal]		
10-Year Government Bond Rates									
US Treasury 10 Year Yield	1.79%	[Strong deterioration]			↗	[Strong deterioration]			↘
French OAT 10 Year Yield	0.02%	[Strong deterioration]			↗	[Strong deterioration]			↗
German Bund 10 Year Yield	-0.28%	[Strong deterioration]	[Strong improvement]			↘	[Strong deterioration]		
UK Gilt 10 Year Yield	0.74%	[Strong deterioration]	[Strong improvement]			↗	[Double signal]	[Double signal]	-
Japan JGB 10 Year Yield	-0.02%	[Strong deterioration]	[Double signal]	[Strong deterioration]		↗	[Double signal]	[Strong deterioration]	↗
Corporate Spreads									
Euro 5-7 Year A	36 bp	[Double signal]			↗	[Double signal]			↘
US 5-Year A	104 bp	[Strong deterioration]			-	[Strong deterioration]	[Strong improvement]	[Strong deterioration]	-

Source: TAC ECONOMICS

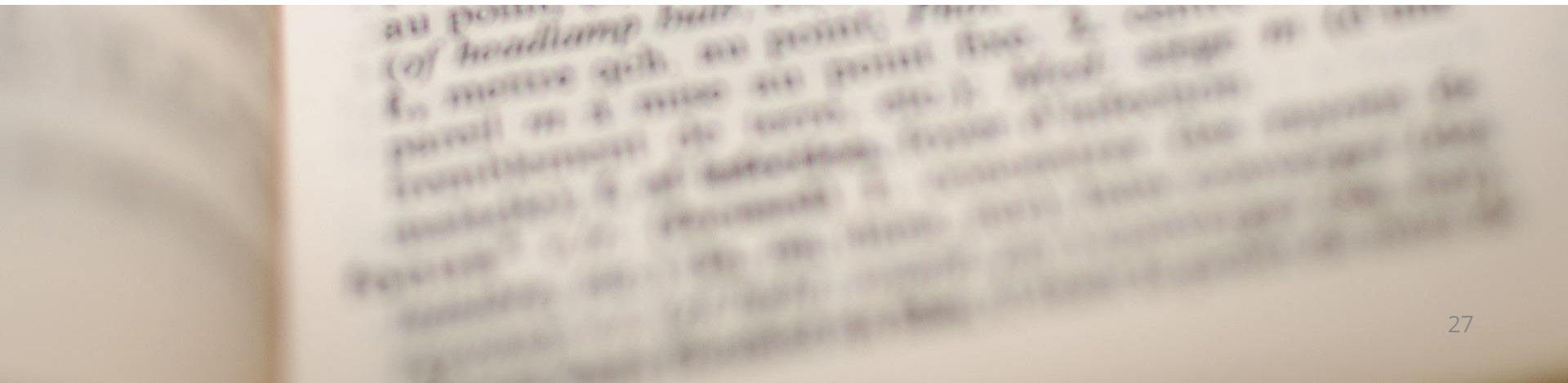
Legend:

Strong improvement	Strong deterioration	Double signal	No sudden change
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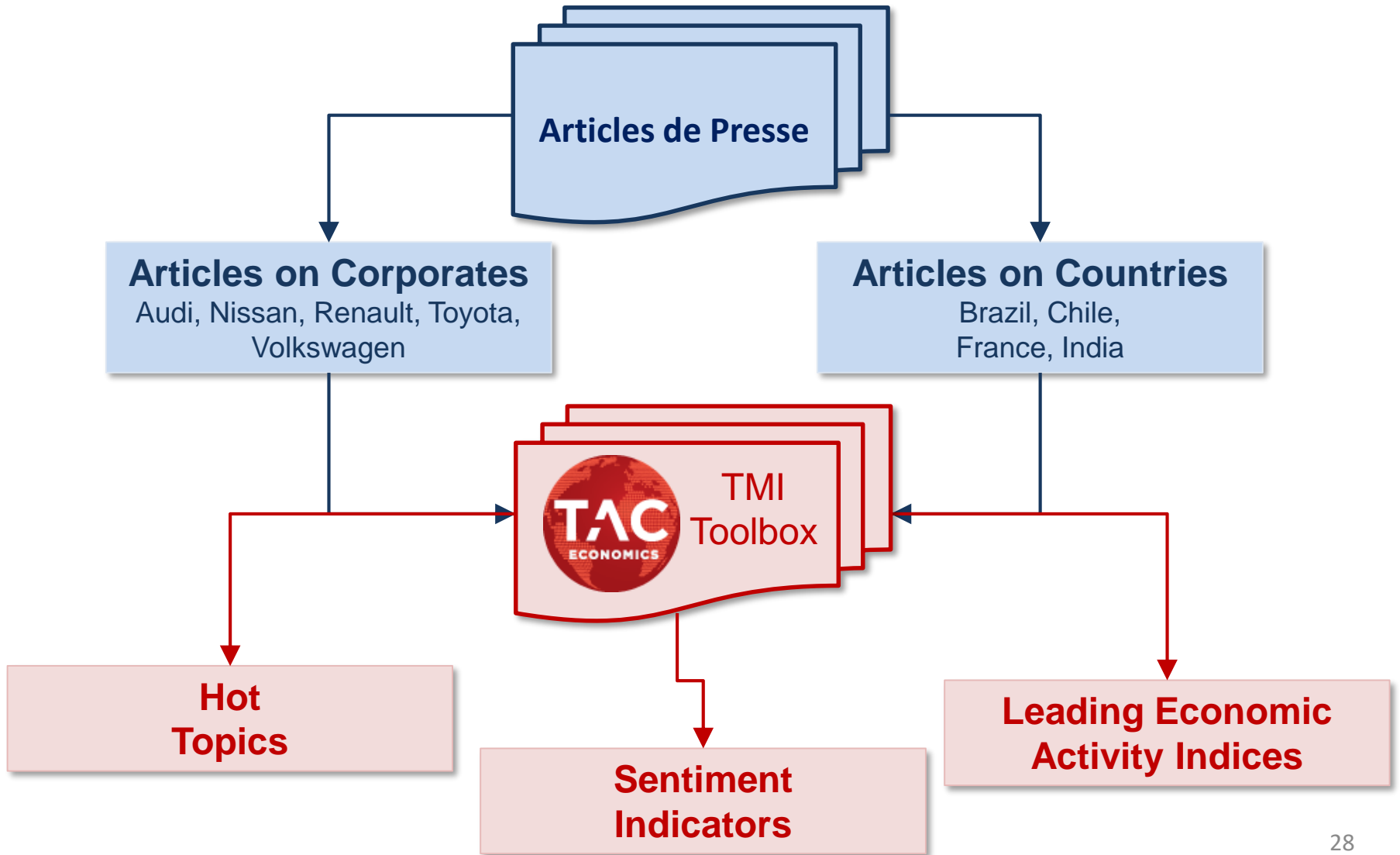
↘ ↗ Medium term outlook compared to the current market level / - indicates neutral outlook



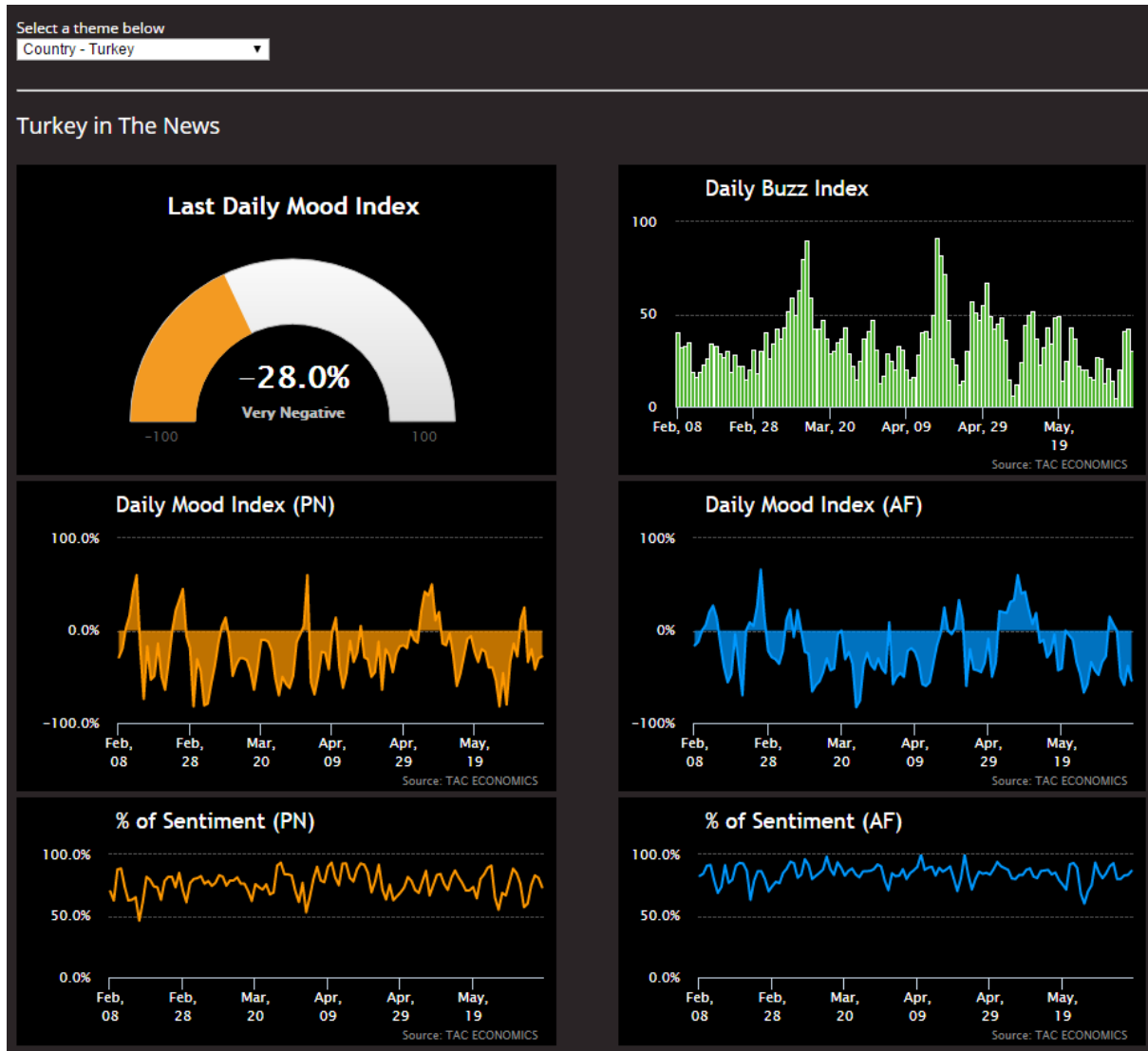
News, International Press & Text Mining



Objectives

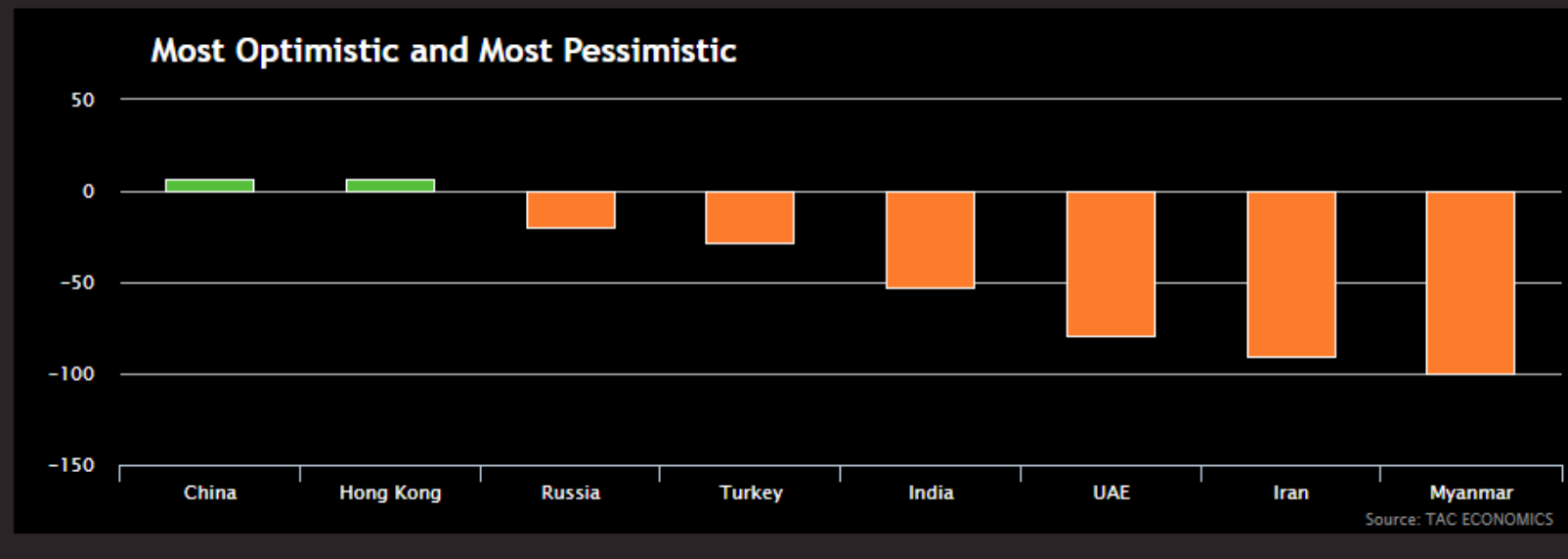


Sentiment analysis world news

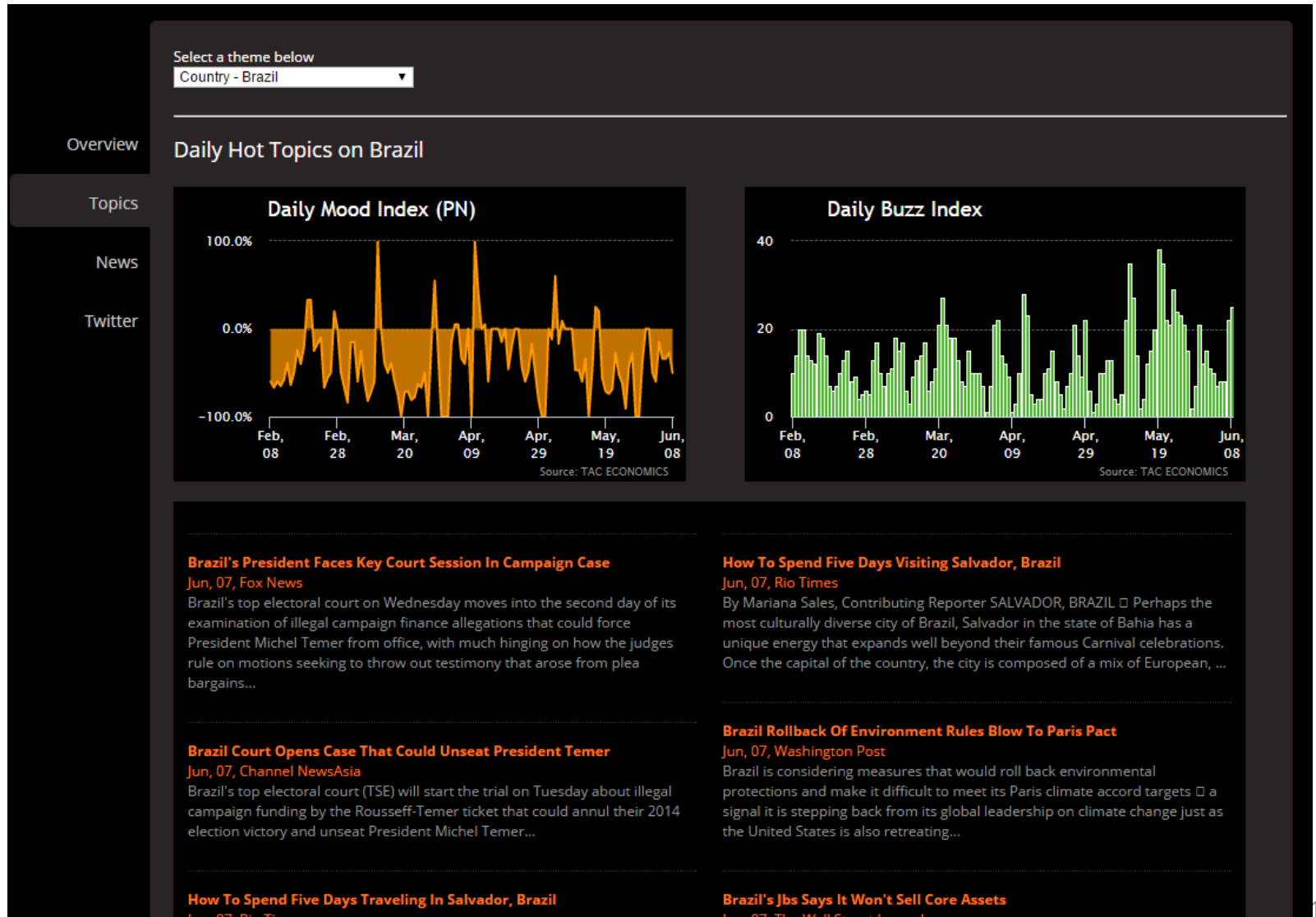


TAC Mood Index by Country

The Mood Index by country on June 08, 2017

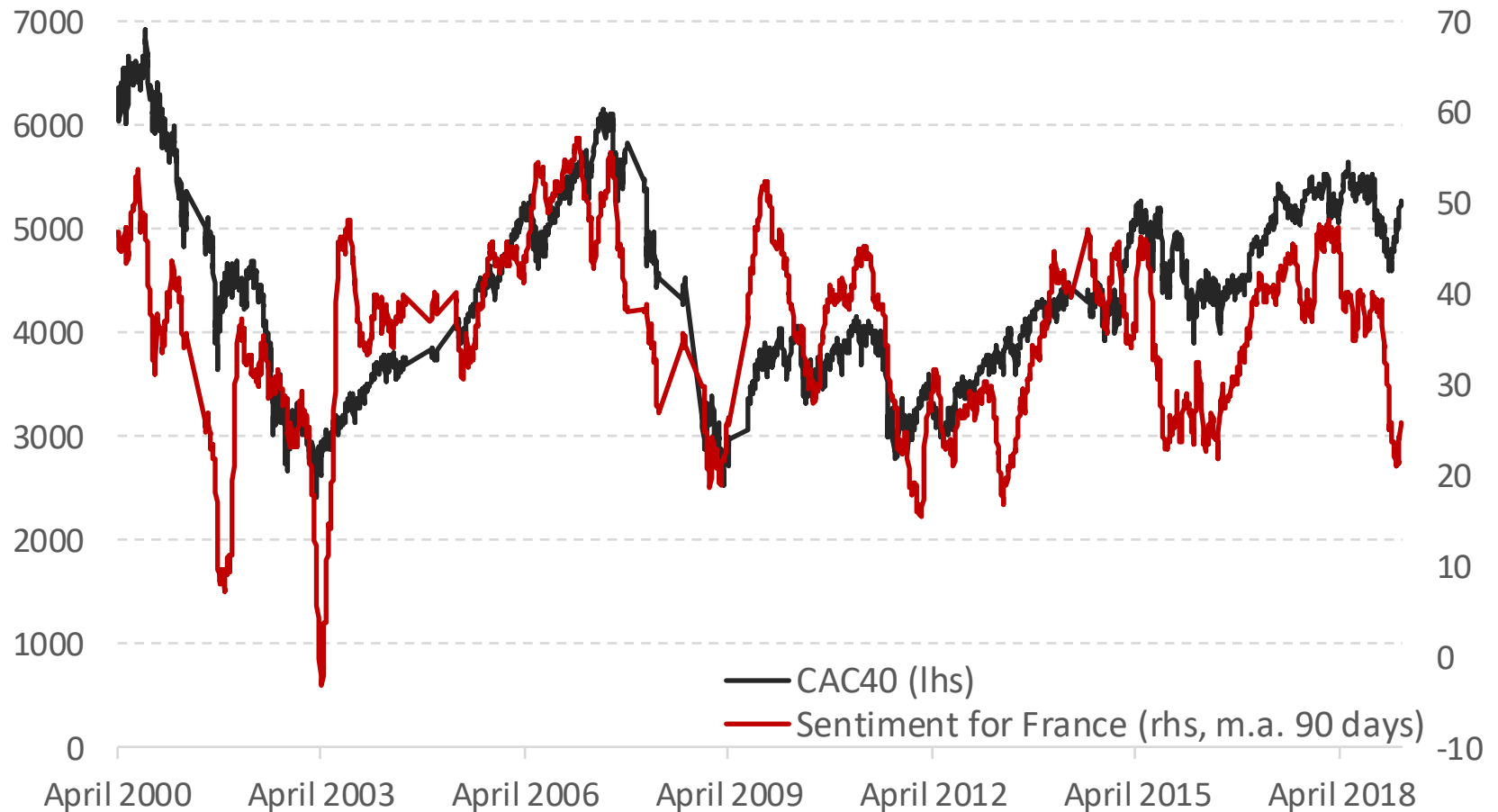


Hot Topics of the Day



Sentiment Indicators and Financial Markets

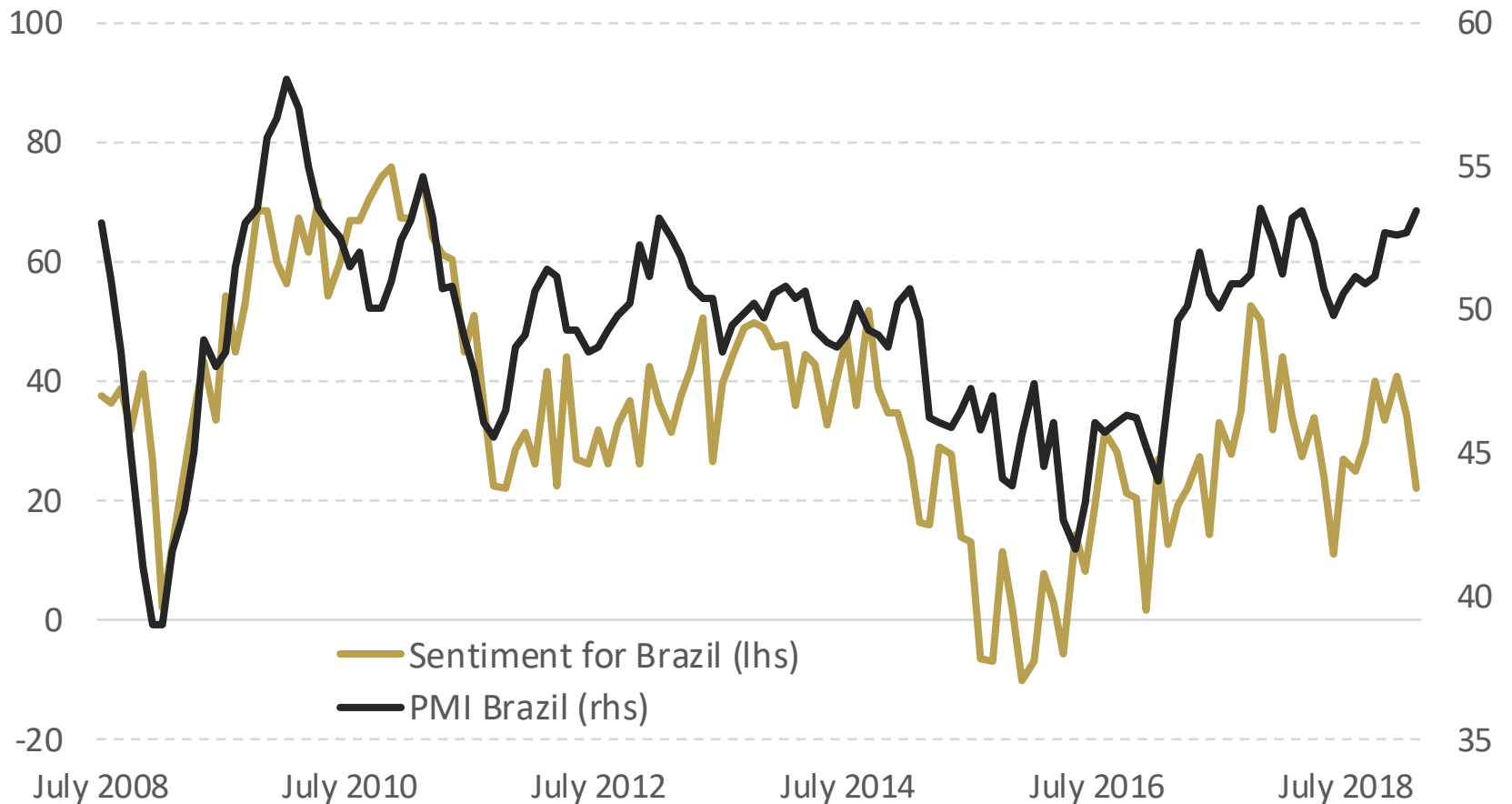
Sentiment for France vs CAC40



Source: TAC ECONOMICS

Sentiment Indicators and PMI

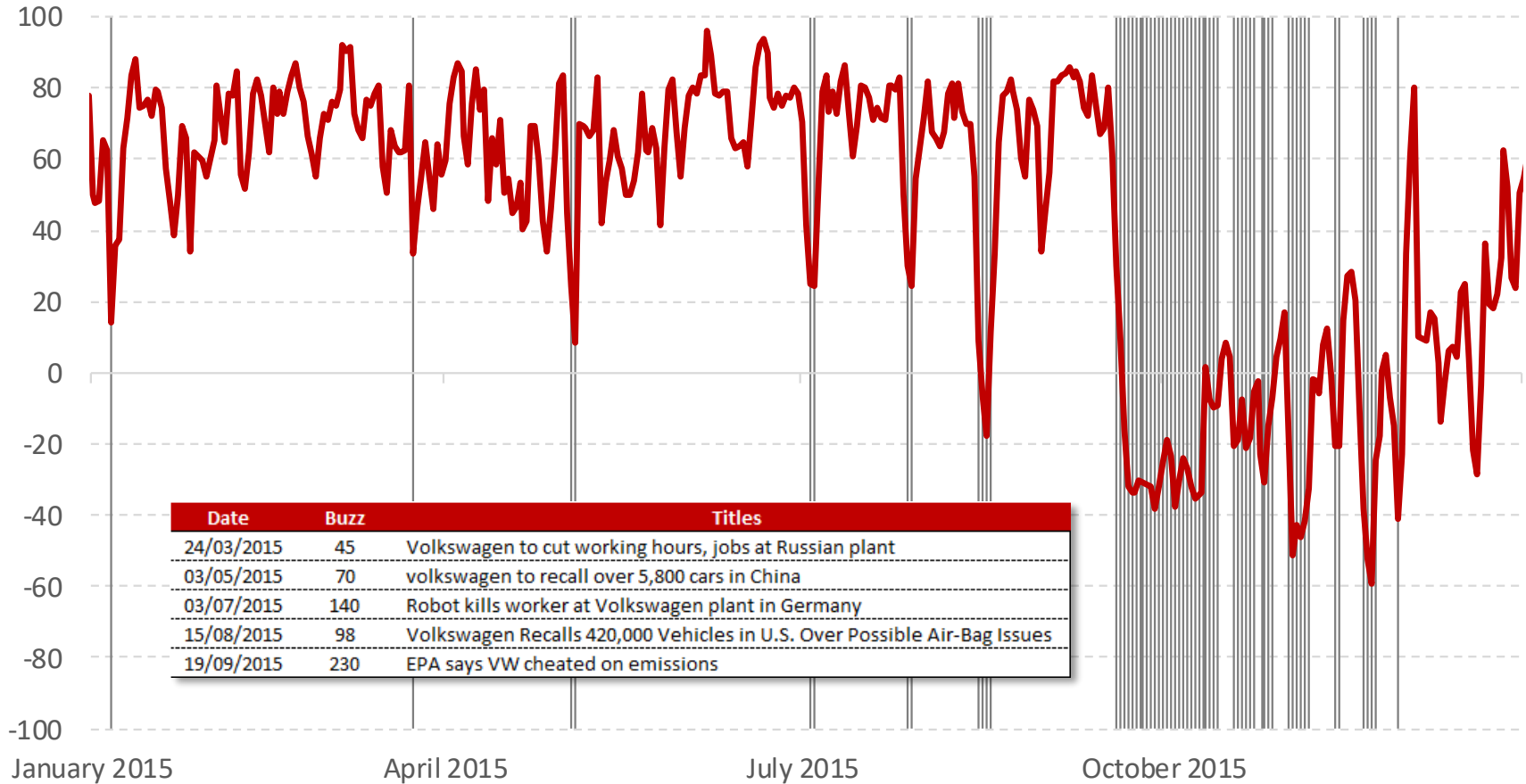
Sentiment for Brazil vs PMI



Source: TAC ECONOMICS

Reputational Risk: Volkswagen & the Diesel Gate

Volkswagen



Source: TAC ECONOMICS

Signaux QMA de novembre 2019



	Market Level (Nov. 04)	11.2019	12.2019	01.2020	3-month outlook
Equity Indices					
S&P 500	3 067	[Grey]			-
CAC 40	5 762	[Teal]			↗
DAX 30	12 961	[Grey]			↗
FTSE 100	7 302	[Red]		[Grey]	↘
Nikkei 225	22 851	[Red]	[Grey]	[Teal]	↗

Legend:
Strong improvement
Strong deterioration
Double signal
No sudden change

↘ ↗ Medium term outlook compared to the current market level / - indicates neutral outlook

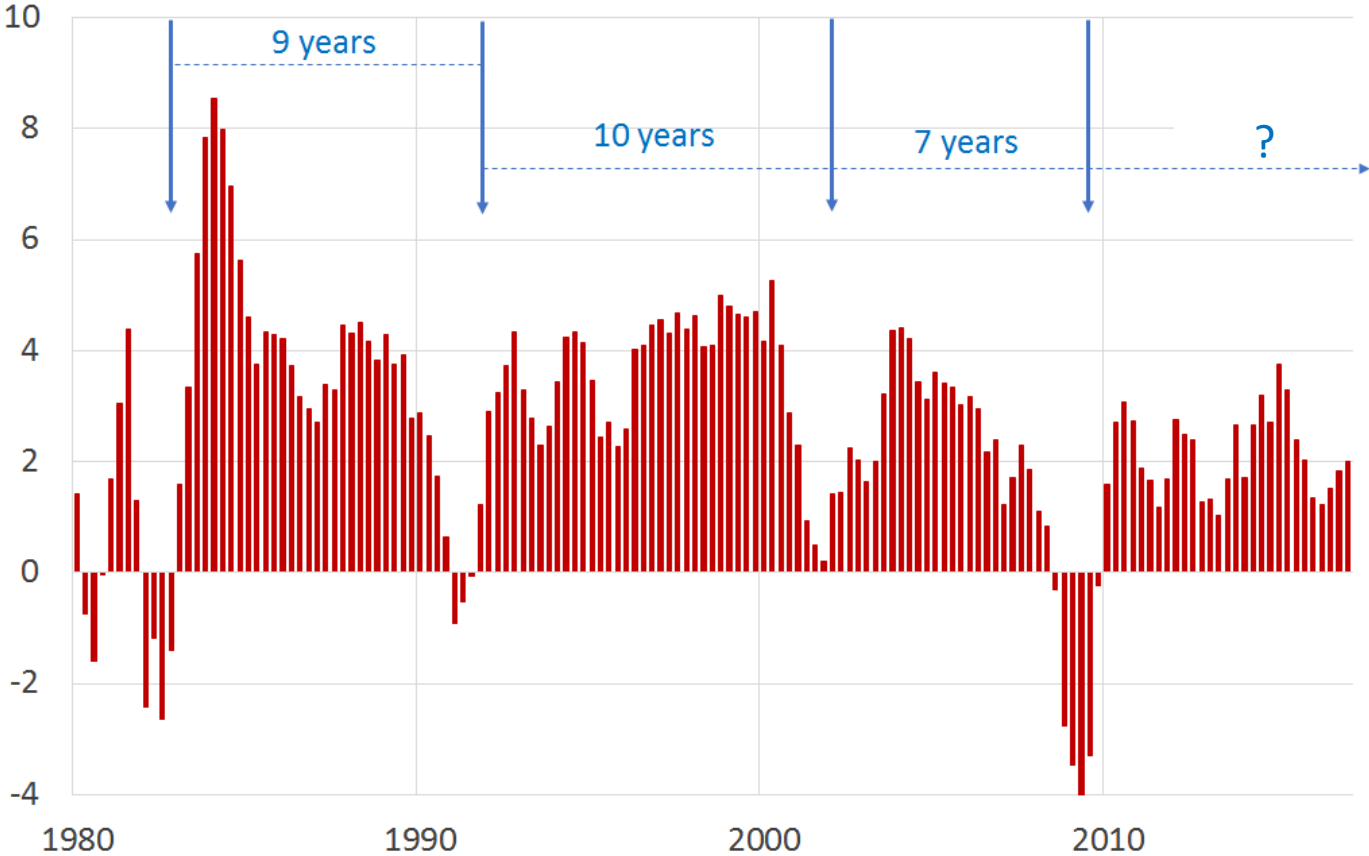


**Timing et ampleur
du retournement du cycle US**



US Business Cycle

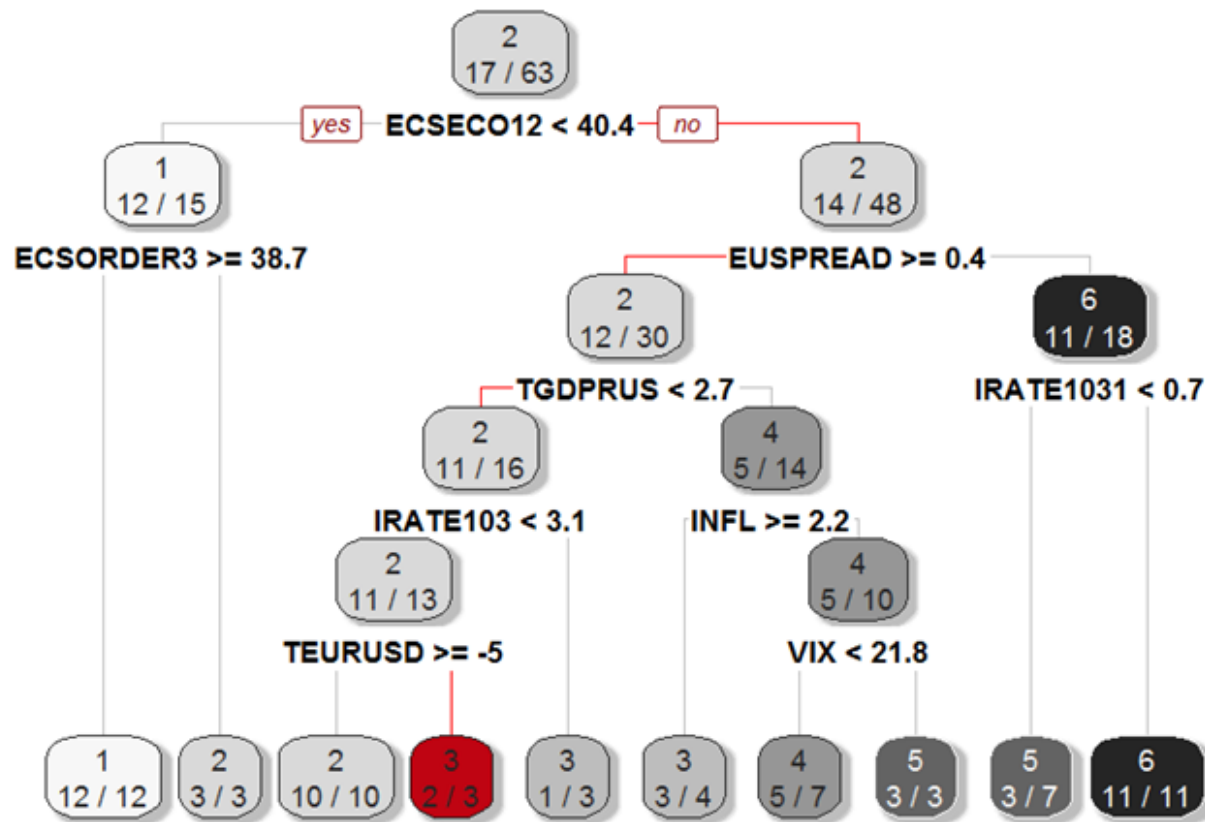
US GDP growth
Y/Y, in %



Source: Datastream, TAC ECONOMICS

CART Applied to Real GDP Growth Forecast

EU GDP growth - Model 2 quarters: 84.1 %

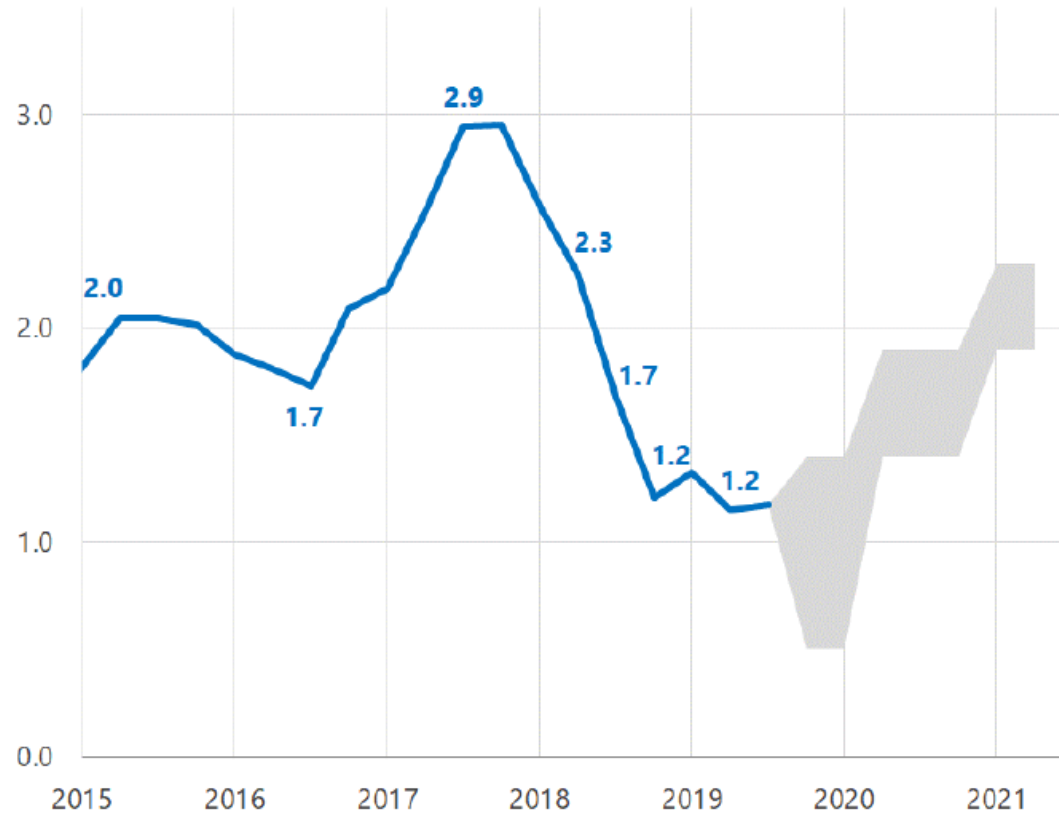


2020/21 scenario: modest cyclical slowdown and recovery

Eurozone: outputs from the quants – Machine Learning Models

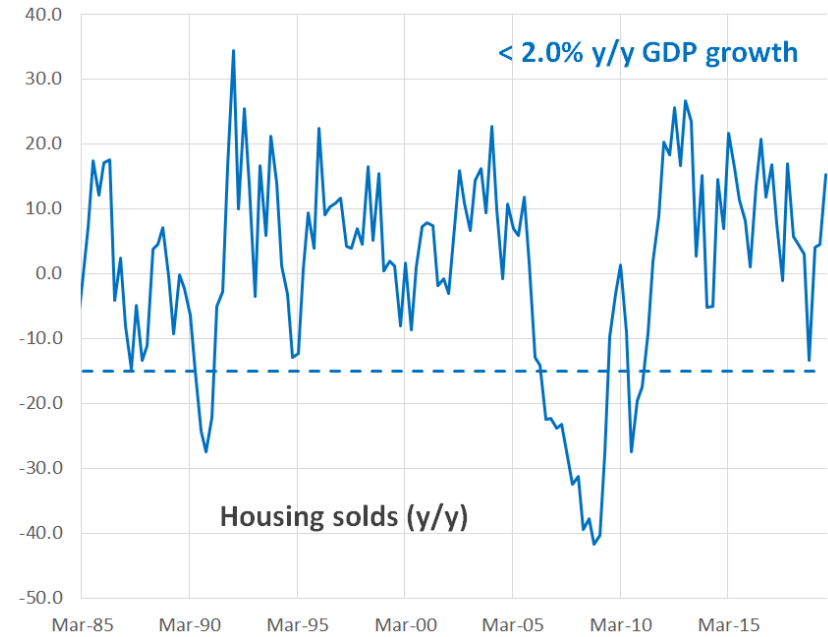
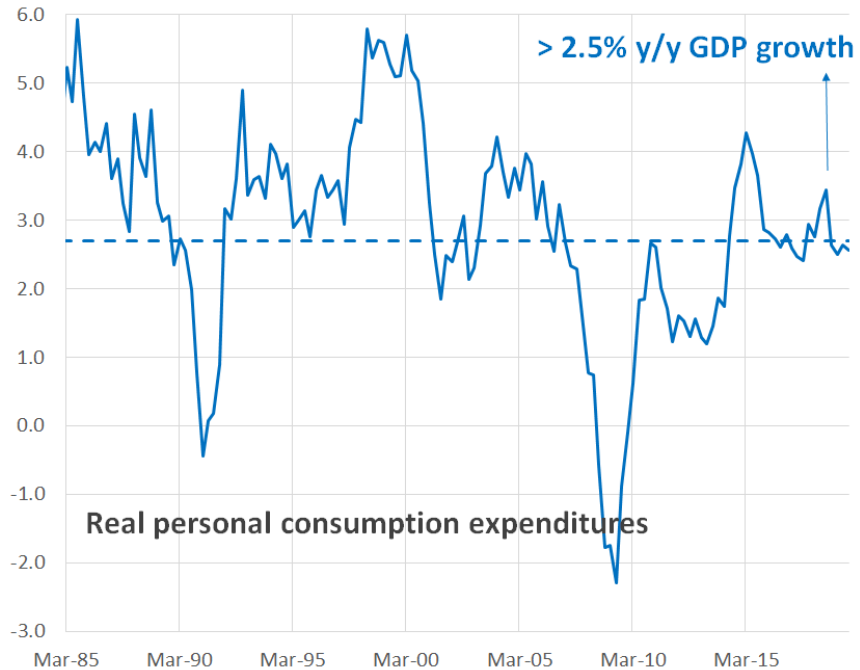
EUZ GDP growth projections

Y/Y growth in %



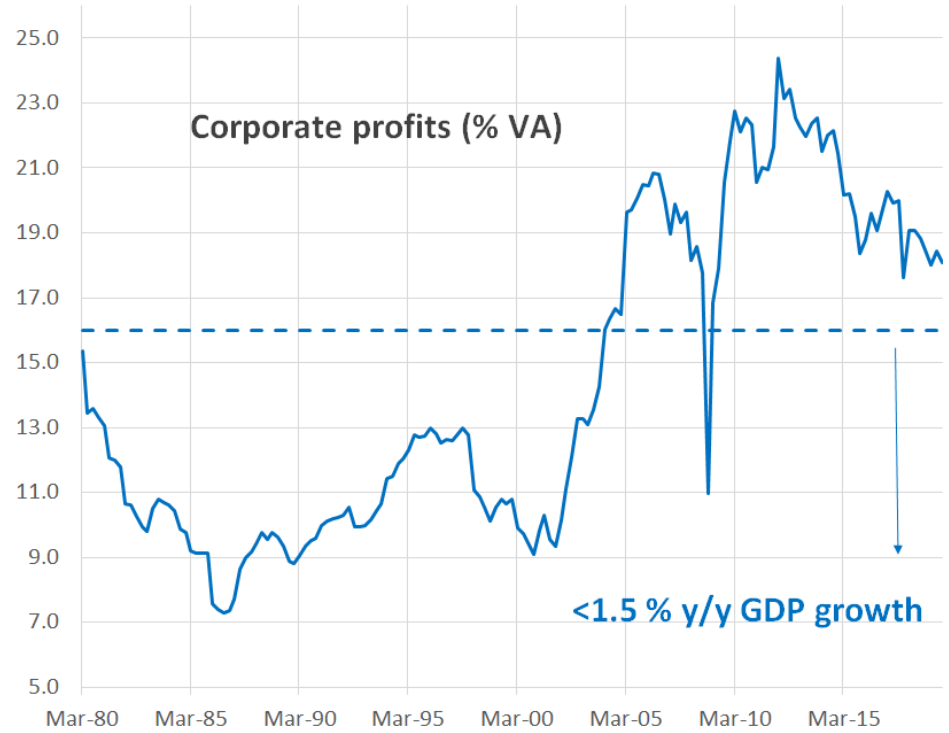
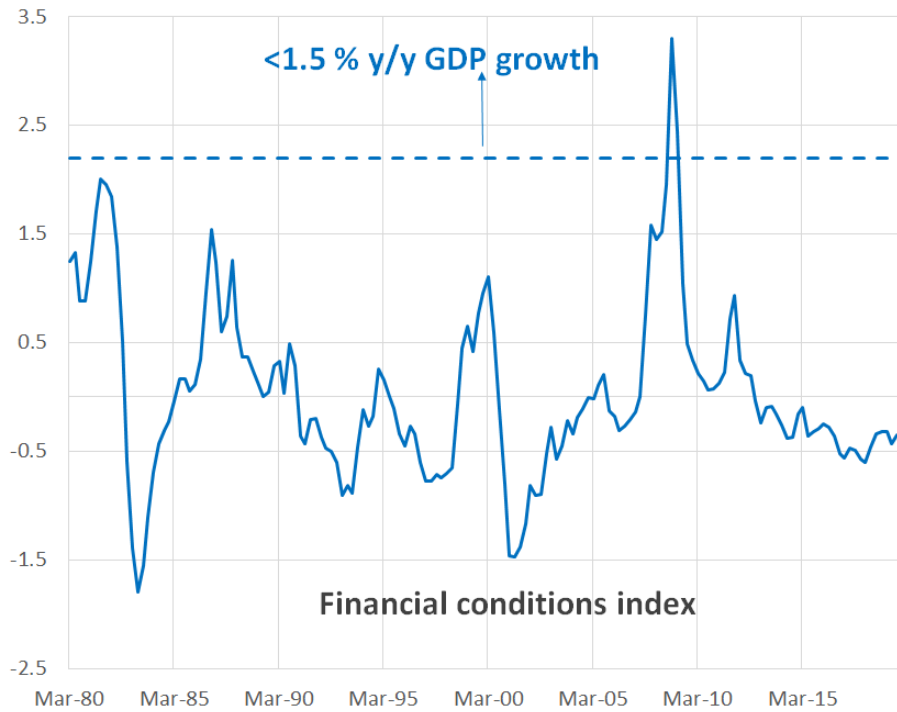
2020/21 scenario: modest cyclical slowdown and recovery

US: outputs from the quants - Machine Learning Models



2020/21 scenario: modest cyclical slowdown and recovery

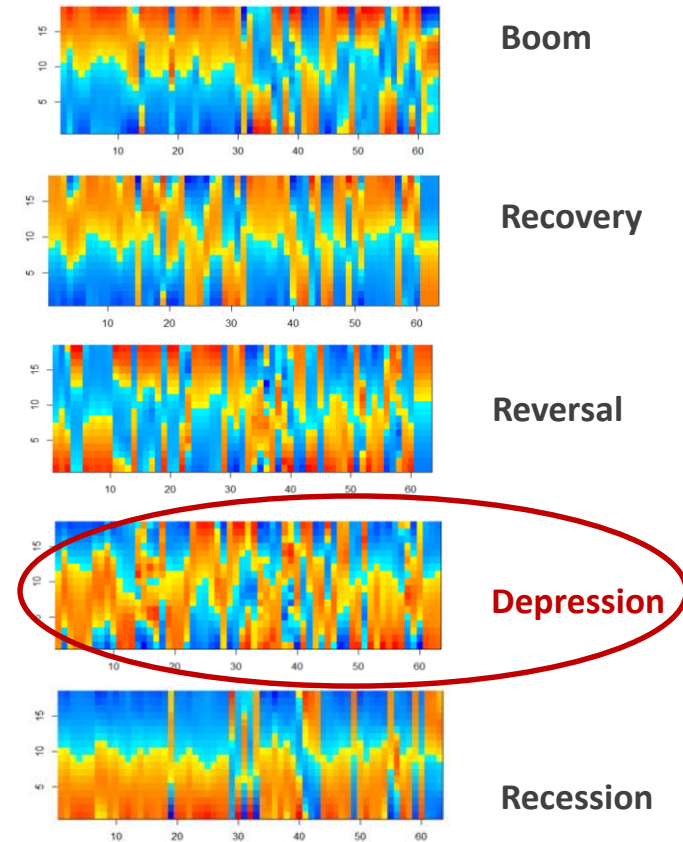
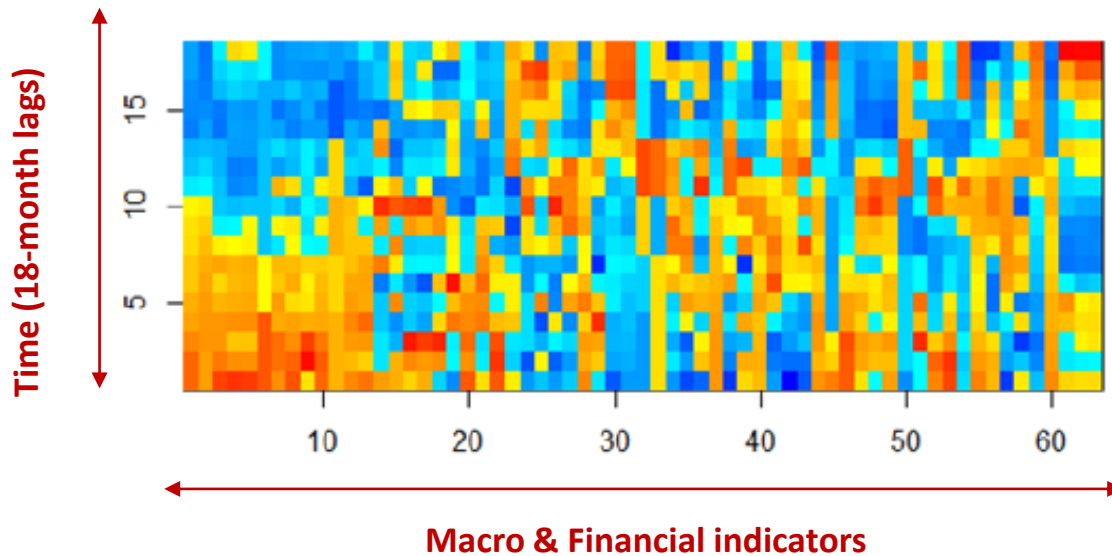
US: outputs from the quants - Machine Learning Models



2020/21 scenario: modest cyclical slowdown and recovery

US: outputs from the quants - Heatmaps

USA Cyclical situation over the past 18 months (November19)

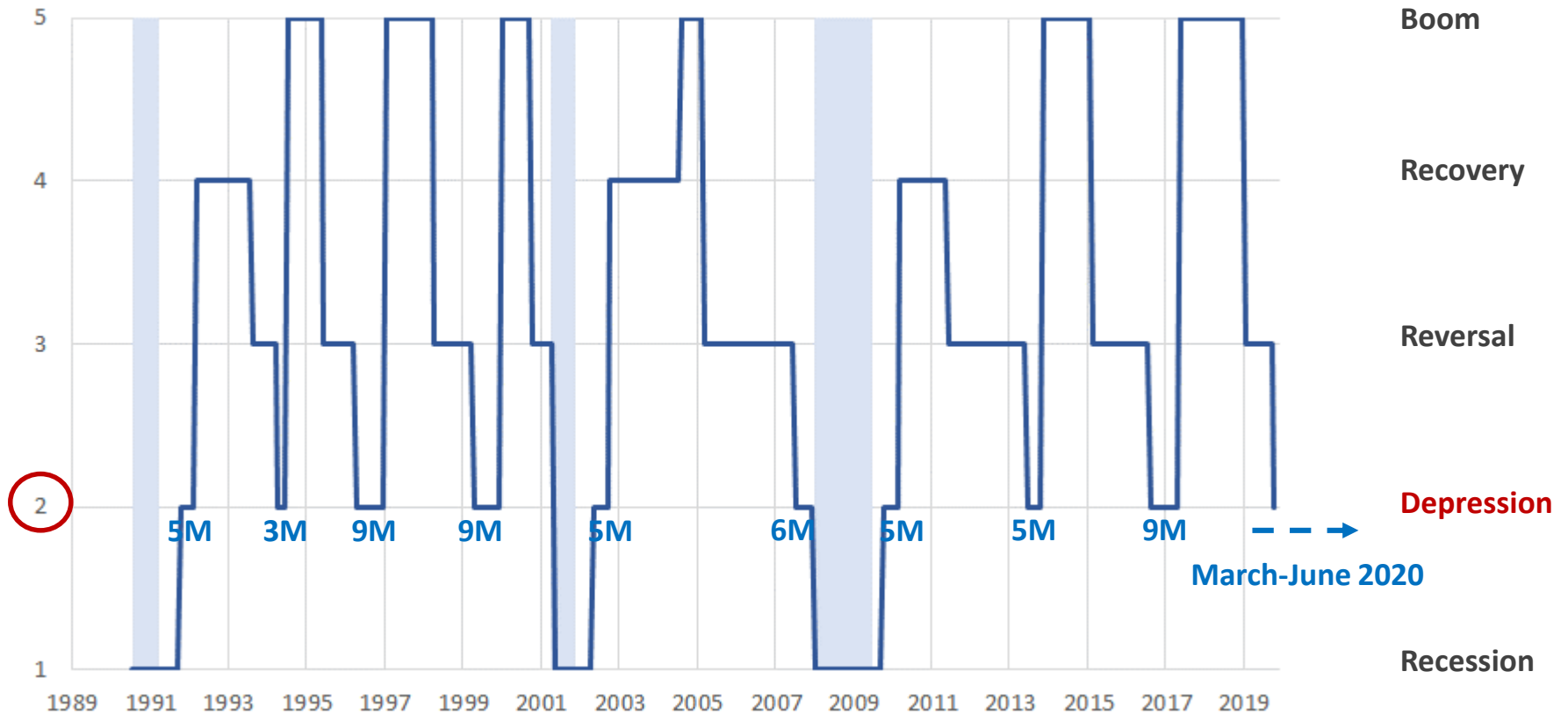


Macro & Financial indicators

- Leading indicators
- Manufacturing sector (production, survey, capacity)
- Household situation (income, confidence, consumption, labor market)
- Housing market (permits, price)
- Prices
- Financial market (rates, stocks, financial conditions, exchange rate)

2020/21 scenario: modest cyclical slowdown and recovery

US: outputs from the quants - Heatmaps



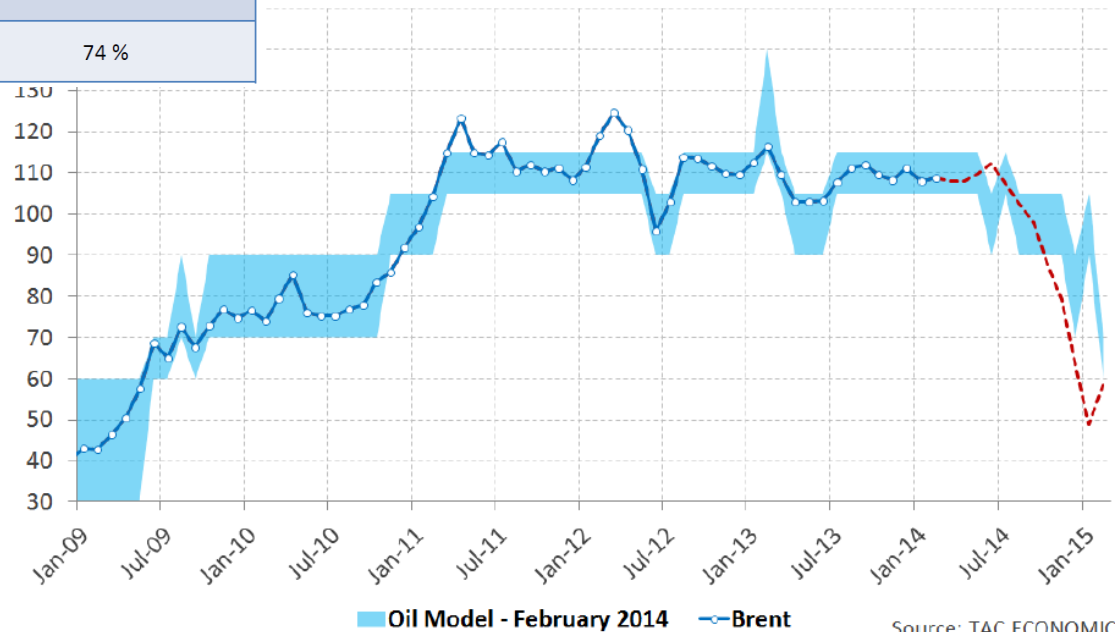


Conclusion

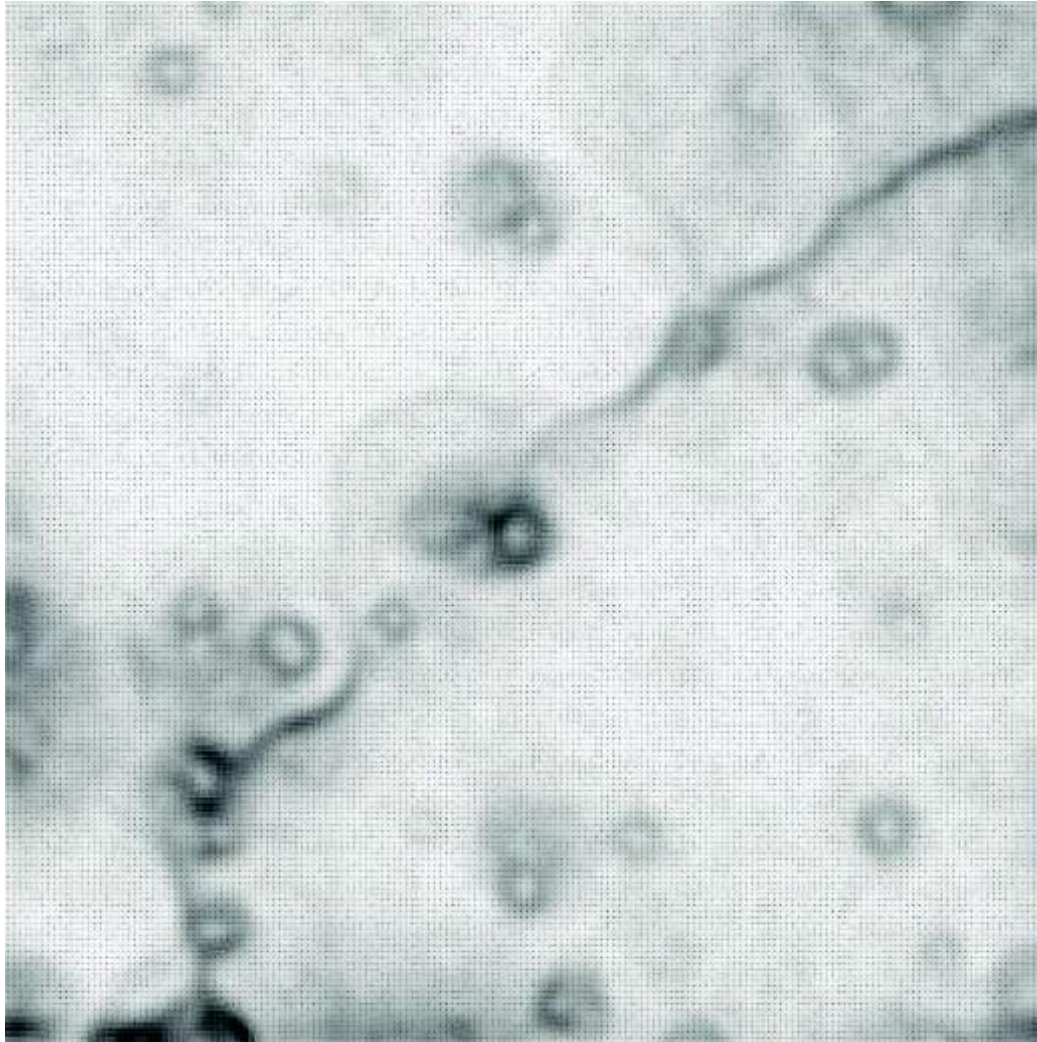
Machine Learning on Oil Price Forecasts

	Average accuracy (training dataset)	Average accuracy (testing, dataset 1)
Naive Bayes	96 %	88 %
Tree Bagging	99.9 %	90 %
Gradient Boosted Machine	100 %	90 %
Supervised SOM	86 %	75 %
Neural Network multilayer perceptron	82 %	74 %
Random Forest	100 %	90 %
Support Vector Machine	96 %	88 %
k-nearest neighbors	84 %	74 %

TAC Brent short-term Projections (\$/bl)

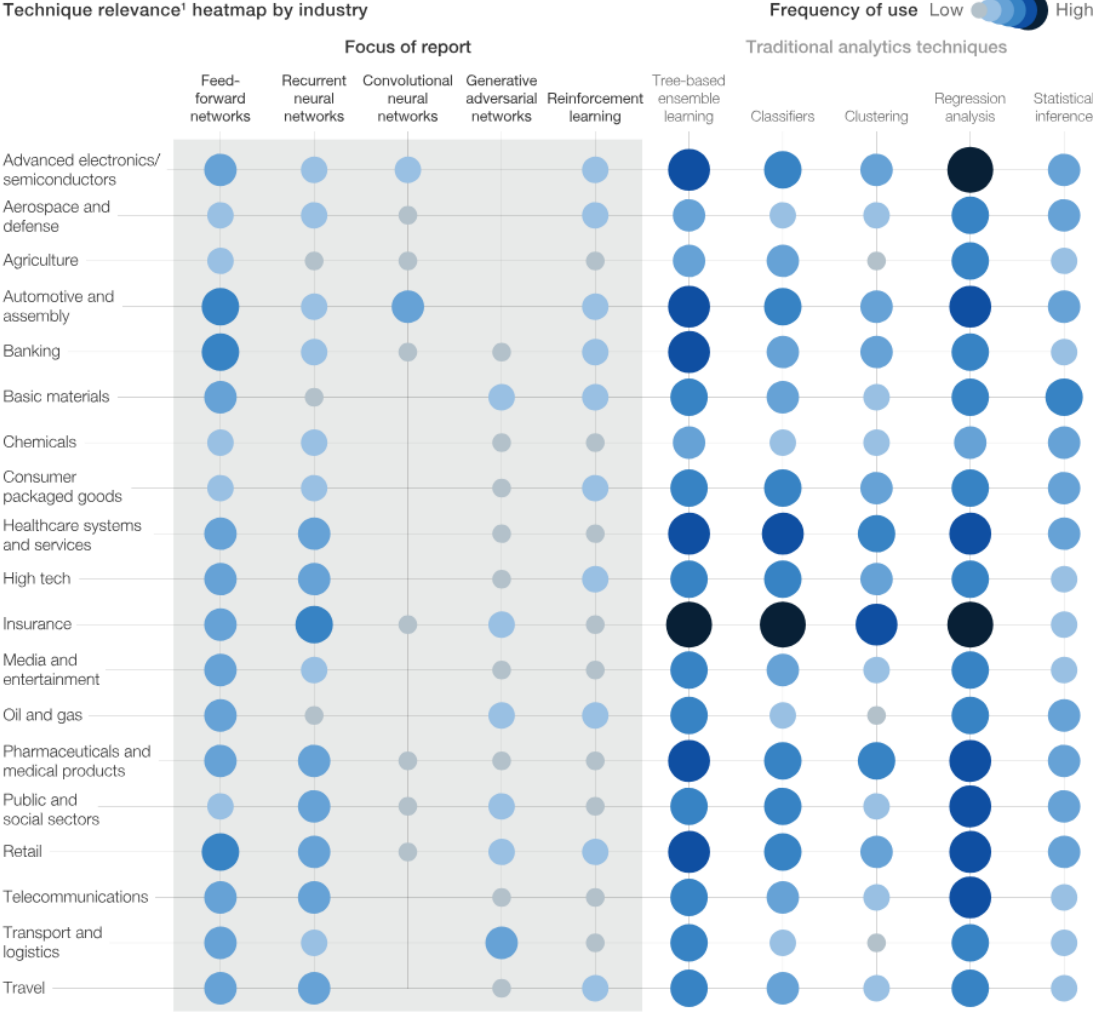


A typology of French SMEs



IA and sectors of economic activity

Technique relevance¹ heatmap by industry



¹Relevance refers to frequency of use in our use case library, with the most frequently found cases marked as high relevance and the least frequently found as low relevance. Absence of circles indicates no or statistically insignificant number of use cases.
 Note: List of techniques is not exhaustive.

Conclusion

- More data, better models, more computing power,....macroeconomic and financial analysis will necessarily be impacted.
- But deep learning is not a crystal ball !
- A be aware of self fulfilling prophecies: if we all use similar models with the same data. We might share the same forecasts... and we might then increase the systemic risk.
- If systems continue to be automated, the next step will be the automatization of AI and machine learning process. The job of « data scientist » is also at risk, and will be automated (AutoML).

Thank you for your attention

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