



Portfolio Construction in the Presence of Codependence Risk

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Math in Investment Strategies

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A Macro* view at Portfolio Construction: Generalities

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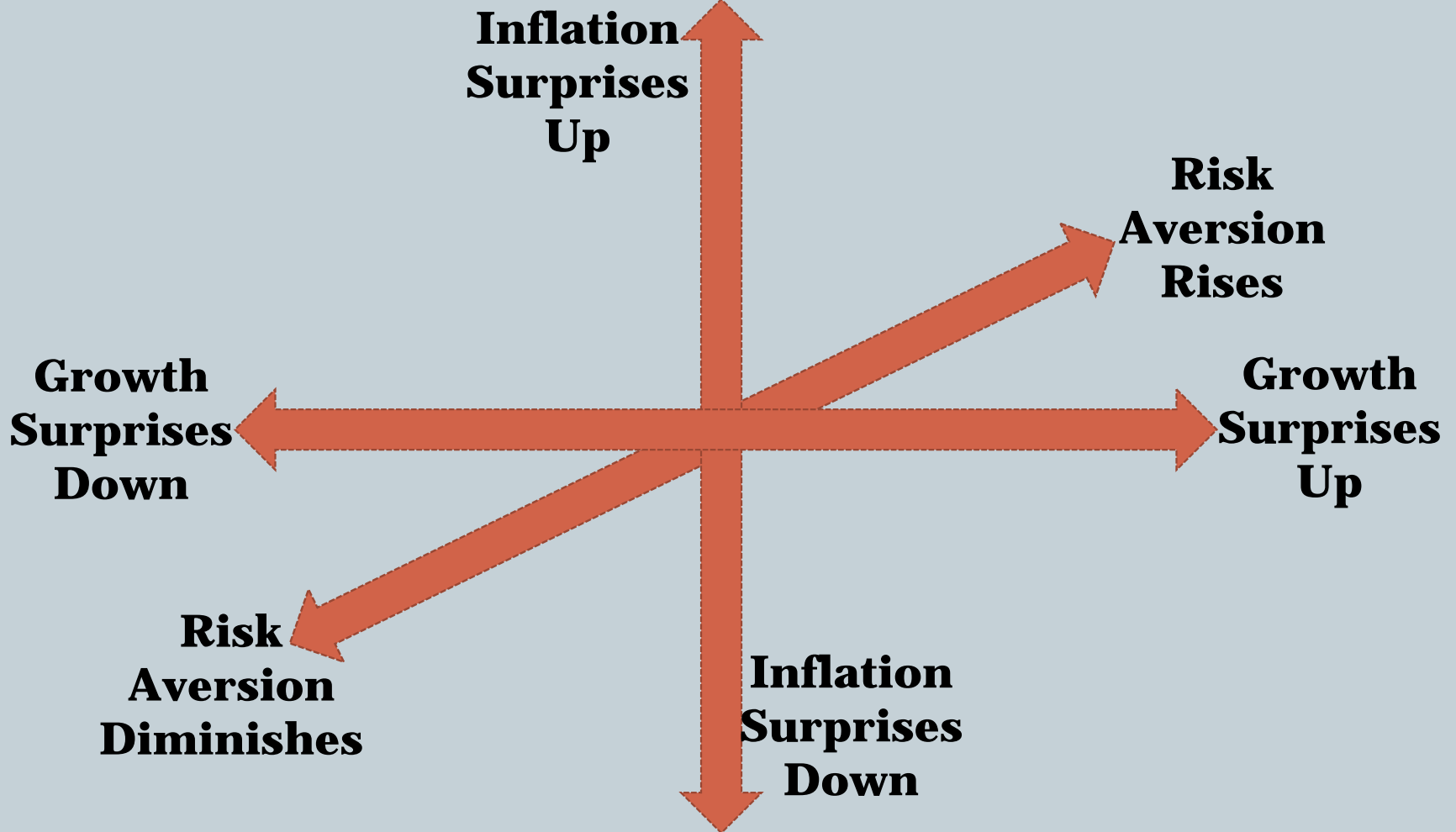
On macroeconomic shifts (or Regimes), asset class returns and dependence risk:

- Variations in expected inflation, expected growth and aggregate risk aversion greatly influence returns of the main asset classes (Money Market securities, Fixed Income securities, Equities and Commodities)
- The dependence between returns of asset classes depends on these variations (see graph next page) from current “regime”
- This dependence risk is hence very important in portfolio management... but it is not that well modeled

* By « Macro » we mean what many refer to as *Financial Macroeconomics*

A Macro view at Portfolio Construction: A Simple Market Regime Framework

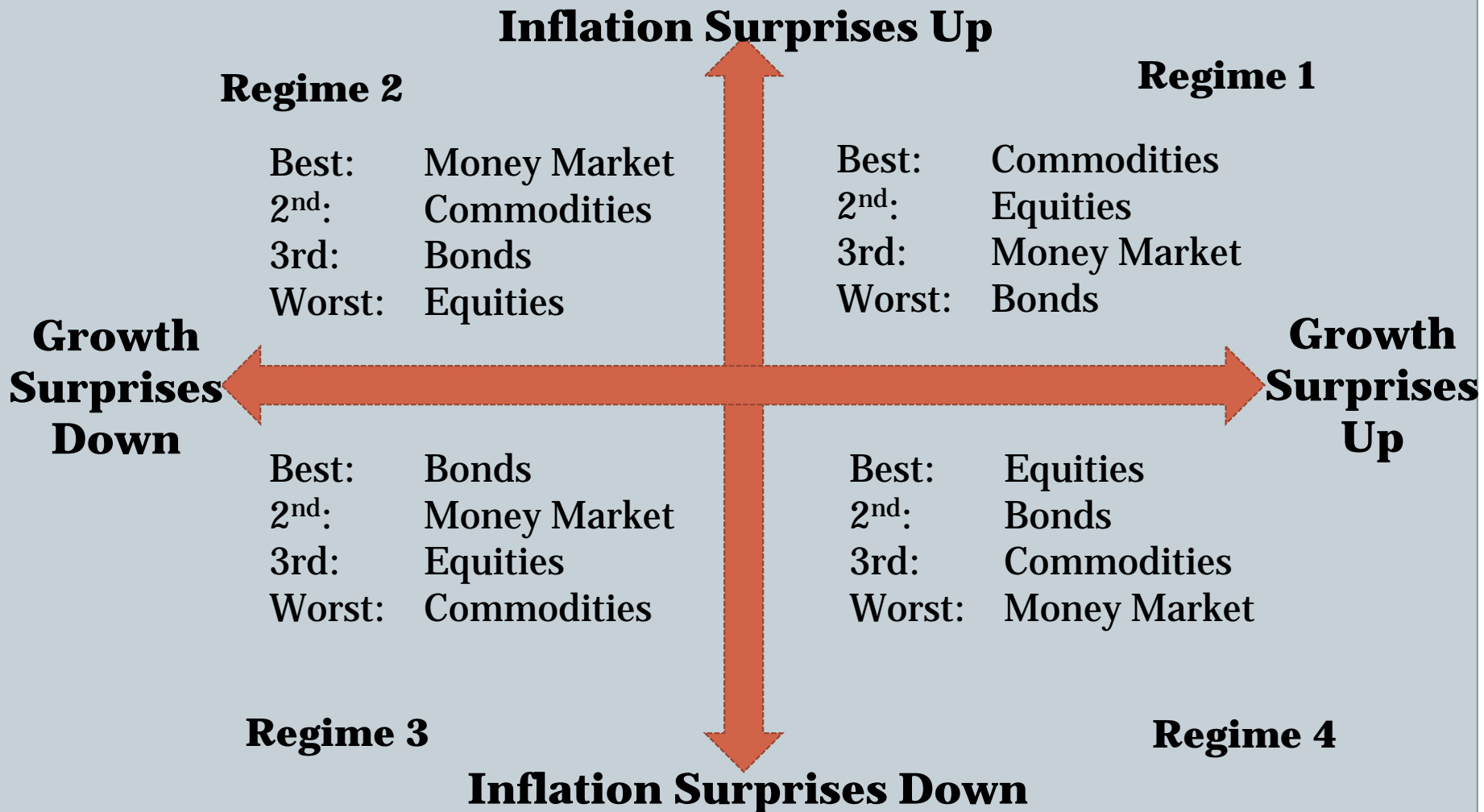
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A Macro view at Portfolio Construction: A Simple Market Regime Framework

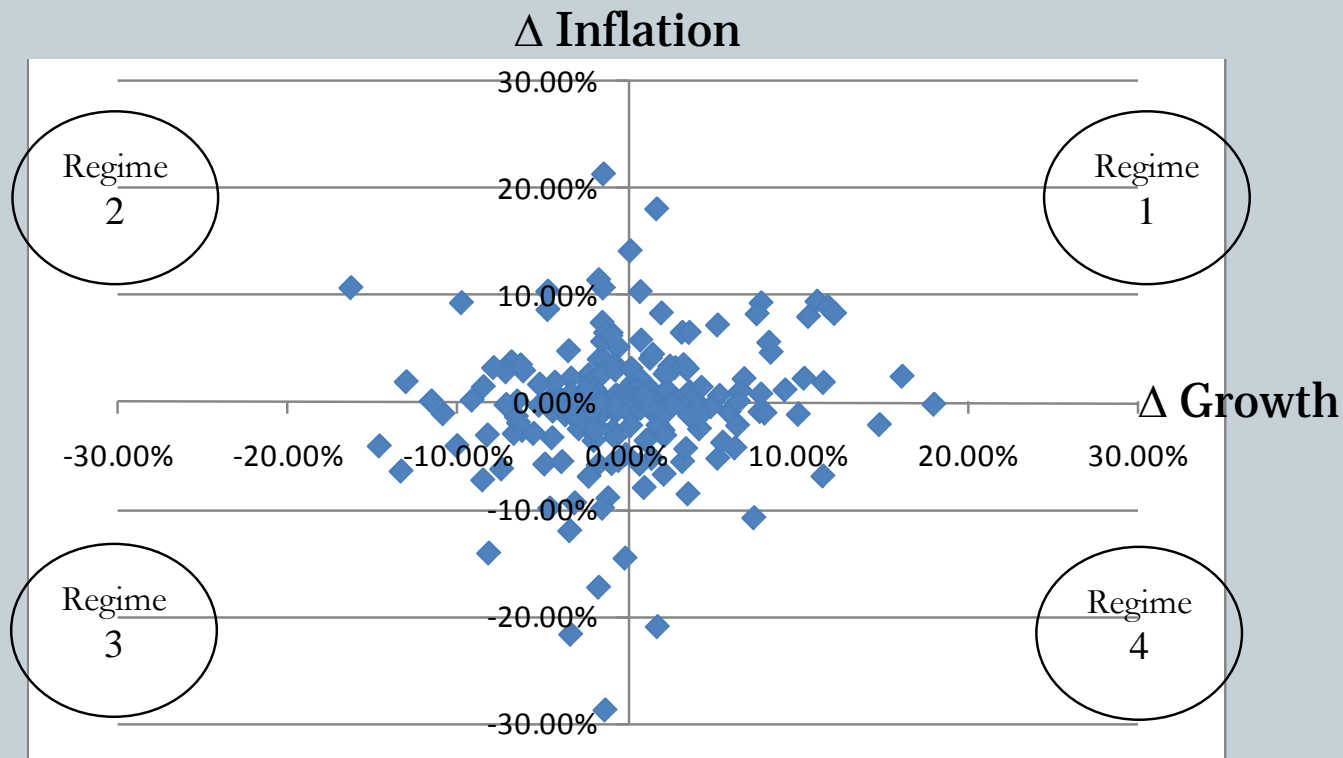
*“Equities for recoveries,
Bonds for crises”*

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A Macro view at Portfolio Construction: Observed Annual Variations of Observed Real Growth and Inflation

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* From 1792 to 2010 (source: www.measuringworth.com/datasets).

Regime (d Gwth & d Infl) Frequency

26.56%	24.22%	28.91%	20.31%
1	2	3	4

A Macro view at Portfolio Construction: We are not alone...!

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The screenshot shows a Coursera video player interface. The video is titled "The link between equity markets and the growth-inflation mix - Part 2". The slide displayed in the video shows a 2x2 matrix with the following quadrants: "Perfection" (top-left), "Warming" (top-right), "Cooling" (bottom-left), and "Too Hot" (bottom-right). The vertical axis is labeled "Strong GDP growth" at the top and "Low GDP growth" at the bottom. The horizontal axis is labeled "Low inflation" on the left and "High inflation" on the right. A fifth category, "Too cold", is indicated at the bottom-left corner of the matrix.

The close-up shows the slide titled "Where do you want to go?". It features a compass rose diagram with four quadrants: "Overheating" (top-right), "High Inflation" (right), "Stagflation" (bottom-right), and "Low GDP Growth" (bottom). The vertical axis is labeled "Strong GDP Growth" at the top and "Low GDP Growth" at the bottom. The horizontal axis is labeled "Low Inflation" on the left and "High Inflation" on the right. A red arrow points from the center towards the "Overheating" quadrant. A small compass icon is shown on the left side of the slide.

See: [The-link-between-equity-markets-and-the-growth-inflation-mix-part-2](#)

A Representation of Codependence risk: Equity Outperformance vs. Bonds

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Equities for recoveries, bonds for slowdowns

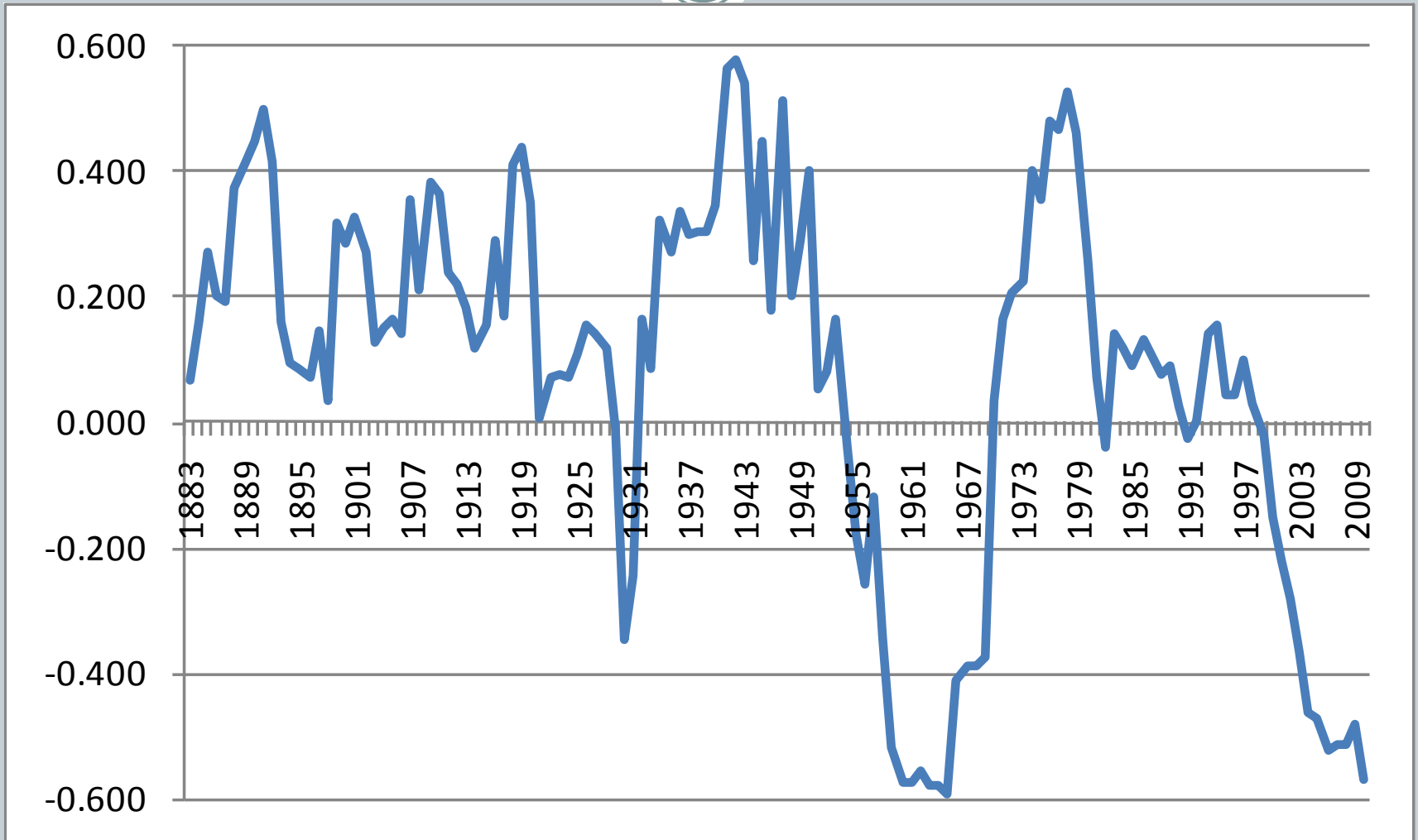


10:52 / 13:05

See: [The-link-between-equity-markets-and-the-growth-inflation-mix-part-1](#)

A Representation of Codependence risk: Equity-Bond Return Correlation (12Y Rolling Window)

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A Macro view at Portfolio Construction: Bond-Equity Return Correlation (12Y rolling window)

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Regime (d Growth & d Inflation)			
1	2	3	4
Observed frequency of same sign variations			
55.88%	35.48%	45.95%	65.38%
Observed frequency of inverse sign variations			
44.12%	64.52%	54.05%	34.62%

A Macro view at Portfolio Construction: Main Challenges

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Codependence Risk is significant. Here are the challenges to properly integrate it in Portfolio Construction models:

- Changes in expected inflation and expected growth are difficult to measure, especially over short periods (hence the need of “nowcasting”)
- Aggregate Risk Aversion is an even bigger problem: it is not well defined (hence more difficult to measure as well).
- When one builds a portfolio, she/he must forecast returns, volatility and codependence. The existing literature on the latter is not developed well enough for practical applications

Modeling Codependence Risk: Objectives

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- Build correlation models and forecasting techniques that incorporate macroeconomic explanatory variables like inflation, growth, market volatility and measures of aggregate risk aversion, in the context of a stock-bond portfolio construction
- Go beyond correlations by looking at dependence models (e.g. copulas), which provide a more general measure of codependence of asset returns
- Try to apply the findings to the case of a simple Equity-Bond Global Macro hedge fund strategy
- Document the “value added” by the proposed codependence forecasting model

Modeling Codependence Risk: Variables and Data

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Observable data and frequency:

- Government Bond Futures (continuous contracts ; daily)
- Equity Index Futures (continuous contracts ; daily)
- Recorded inflation rate (monthly)
- Recorded growth rate (monthly)
- Risk aversion (daily for market proxies)

There have been attempts to estimate inflation in real time.

See MIT's Billion Prices Project:
<http://bpp.mit.edu/>

Example: the CNN Fear-and-Greed Index:
<http://money.cnn.com/data/fear-and-greed/>

Modeling Codependence Risk: Variables and Data

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Non-observable data:

- Daily changes in growth expectations
- Daily changes in inflation expectations

The Philadelphia FED's (quarterly) survey of professional forecasters can be a good proxy:

<https://www.philadelphiafed.org/research-and-data/real-time-center/survey-of-professional-forecasters/>

Appendix:

What is a Global Macro Investment Strategy (GMIS)?

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- Invests in all main asset classes
- If restrained to « Long Only », such strategies are often referred to « Tactical Asset Allocation ». Global Macro Hedge Funds go « Long » or « Short »
- Decisions to go Long or Short may be Discretionary (based on the Portfolio Manager's « documented intuition ») or Systematic (based on mathematical models – no human input except for the design of the strategy)
- Most of the time uses Futures contracts to maintain a high level of liquidity

Appendix:

Example of a Systematic GMIS portfolio

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Bond Futures	Exposure (%)	Commodity Futures	Exposure (%)	FX and Equity Futures	Exposure (%)
US 2YR Note Futures	-2.50%	Crude Oil Futures	-0.40%	USD/CAD Futures	0.44%
AU 3YR Bond Futures	4.69%	Gas Futures	-0.66%	USD/GBP Futures	-1.03%
US 10YR Note Futures	4.86%	Heating Futures	0.67%	USD/JPY Futures	-0.33%
CAN 10YR Bond Futures	7.52%	Gold Futures	0.00%	USD/AUD Futures	0.83%
Euro Bund Futures	23.32%	Silver Futures	0.00%	USD/EUR Futures	-1.62%
JPY 10YR Bond Futures	24.35%	Soybean Futures	0.91%	USD/MXN Futures	-2.50%
AU 10YR Bond Futures	6.35%	Wheat Futures	-0.07%	USD/CHF Futures	0.00%
German Schatz	-5.05%	Copper Futures	0.00%	MSCI Emerging Futures	-14.36%
English Gilts	4.99%	Brent Futures	-0.82%	S&P 500 Futures	21.59%
		Corn Futures	-0.84%	Euro Stoxx 50 Futures	0.84%
		Sugar Futures	-0.11%	FTSE 100 Futures	-2.75%
				Nikkei Futures	9.87%
				Russells Futures	-0.63%

Some references

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