

Model Making and Risk Taking

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Overview

- **Quant finance is booming**
- **What do quants actually do ?**
- **Model trading in general**

- **The FX market**
- **Role of quantitative strategy**
- **Main FX models used in practice**
- **What evidence exists that these models work**
- **Current research – flow and minimum spanning trees**

Financial Institutions are hiring more quants

- The number and size of quant groups is increasing
- Why ?
 - Dot-com crash
 - Short memory when it comes to LTCM
 - Marketing / due diligence
 - Success...
- Now dedicated categories in industry surveys

What do quants actually do ?

- **General risk management**
- **Derivatives**
 - Front office pricing
 - Risk management
 - Model validation
 - Structuring
- **Model Trading**
- **Market Strategy**

- **Often a cut between front-line and support**

Model Trading

- **Discretionary trading is no longer dominant**
- **Systematic/Model trading is now very common with risk takers**

- **Who does it ?**
 - Prop desks
 - Asset managers
 - Hedge funds
 - Corporates
 - Reserve managers

Model Styles

- **Arbitrage**
 - especially equities
 - Latency arbitrage e-trading systems (sniping)
- **Technical**
 - Price driven models
 - Pattern recognition of varying complexity
- **Fair value**
- **Macro fundamental**
- **Microstructure models**
- **Credit**

The FX market

- **The FX market is where all buying and selling of world currencies takes place. The product is very simple, but the forces determining prices are highly complex**
- **Market liberalisation (the reduction or elimination of exchange and capital controls) has seen large increases in volume**
- **The market consists of a diffuse world-wide network of bank dealers making markets increasingly via electronic broking systems**

The Market

- **Characteristics**

- 24-hour trading, 5 days a week (about 9pm London Sunday to 10pm London Friday)
- An extremely liquid market
- Highly developed instruments for controlling risk exposure (forwards, options, futures)
- Tight spreads and zero dealing commission

- **How big is it ?**

The Market

- Market Turnover

- Trade volume in the Forex market is around \$1.2 trillion per day. This compares with to the New York Stock Exchange which trades ‘only’ \$25 billion per day

Global foreign exchange market turnover ¹					
Daily averages in April, in billions of US dollars					
	1989	1992	1995	1998 ²	2001
Spot transactions	317	394	494	568	387
Outright forwards	27	58	97	128	131
Foreign exchange swaps	190	324	546	734	656
Estimated gaps in reporting	56	44	53	60	26
Total “traditional” turnover	590	820	1,190	1,490	1,200
<i>Memo: Turnover at April 2001 exchange rates³</i>	570	750	990	1,400	1,200

¹ Adjusted for local and cross-border double-counting. ² Revised since the previous survey. ³ Non-US dollar legs of foreign currency transactions were converted from current US dollar amounts into original currency amounts at average exchange rates for April of each survey year and then reconverted into US dollar amounts at average April 2001 exchange rates.

Table B.1

The Currencies

- **Currency pairs-**
 - **Foreign exchange is always traded as one currency in relation to another**
 - **These are the most traded currency pairs:**

Currency Pair	Symbol	Terminology	Involvement as proportion of total trade
Euro / US Dollar	EUR-USD	“Euro”	30%
US Dollar / Japanese Yen	USD-JPY	“Dollar Yen”	20%
Pound sterling / US Dollar	GBP-USD	“Cable”	11%
Other pairs	-	-	39%

The Places

- Geographical distribution of market turnover

Currency	Share of total trade
United Kingdom	31.1%
United States	15.7%
Japan	9.1%
Singapore	6.2%
Germany	5.4%
Switzerland	4.4%
Hong Kong	4.1%
Other	24.0%

The Players

- **Banks (both as market makers and end users)**
 - Investment banks
 - Commercial banks
- **Hedge funds**
- **Institutions (asset managers, pension funds)**
- **Central Banks (reserve management and own currency intervention)**
- **Corporations (mostly defensive hedging of exposures)**
- **Private investors/speculators/tourists**

Pricing

- **The FX market is the closest real world approximation to the economists' fiction of a 'perfectly competitive' market**
 - Many buyers and sellers
 - no participant can influence the price on a persistent basis
 - perfect information
- **How is the price set?**
 - Dealers give a two way price acting as principal
 - They then manage the risk associated with being given or lifted
 - Flows pass round the market until a new end user is found, at the same or a different price

EBS prices

EBS Rates				Properties	Bloomberg		
EUR/USD 1.23 50 1.2325 1.2330 9:29	50 1.2351	51 1.2358 1.2351	1.23 53 1.2358 9:29	USD/JPY 109. 55 109.32 109.33 9:28	56 109.57	57 109.62 109.57	109. 58 109.63 9:28
EUR/JPY 135. 30 134.90 134.90 9:28	32 135.30	33 135.33 135.31	135. 35 135.33 9:28	USD/CHF 1.24 34 1.2428 1.2428 9:28	36 1.2438	38 1.2455 1.2445	1.24 39 1.2458 9:26
EUR/CHF 1.53 59 1.5353 1.5353 9:28	61 1.5361	62 1.5372 1.5362	1.53 64 1.5372 9:27	GBP/USD 1.82 20 1.8206 1.8212 9:13	20 1.8206	27 1.8249 1.8223	1.82 28 1.8251 9:29
EUR/GBP 0.67 750 0.67670 0.67720 9:25	75⁰ 0.67760	79⁵ 0.67765 0.67765	0.67 800 0.67840 9:24	USD/HKD 7.79 92 7.7997	92 7.7997	97 10:35	7.79 98

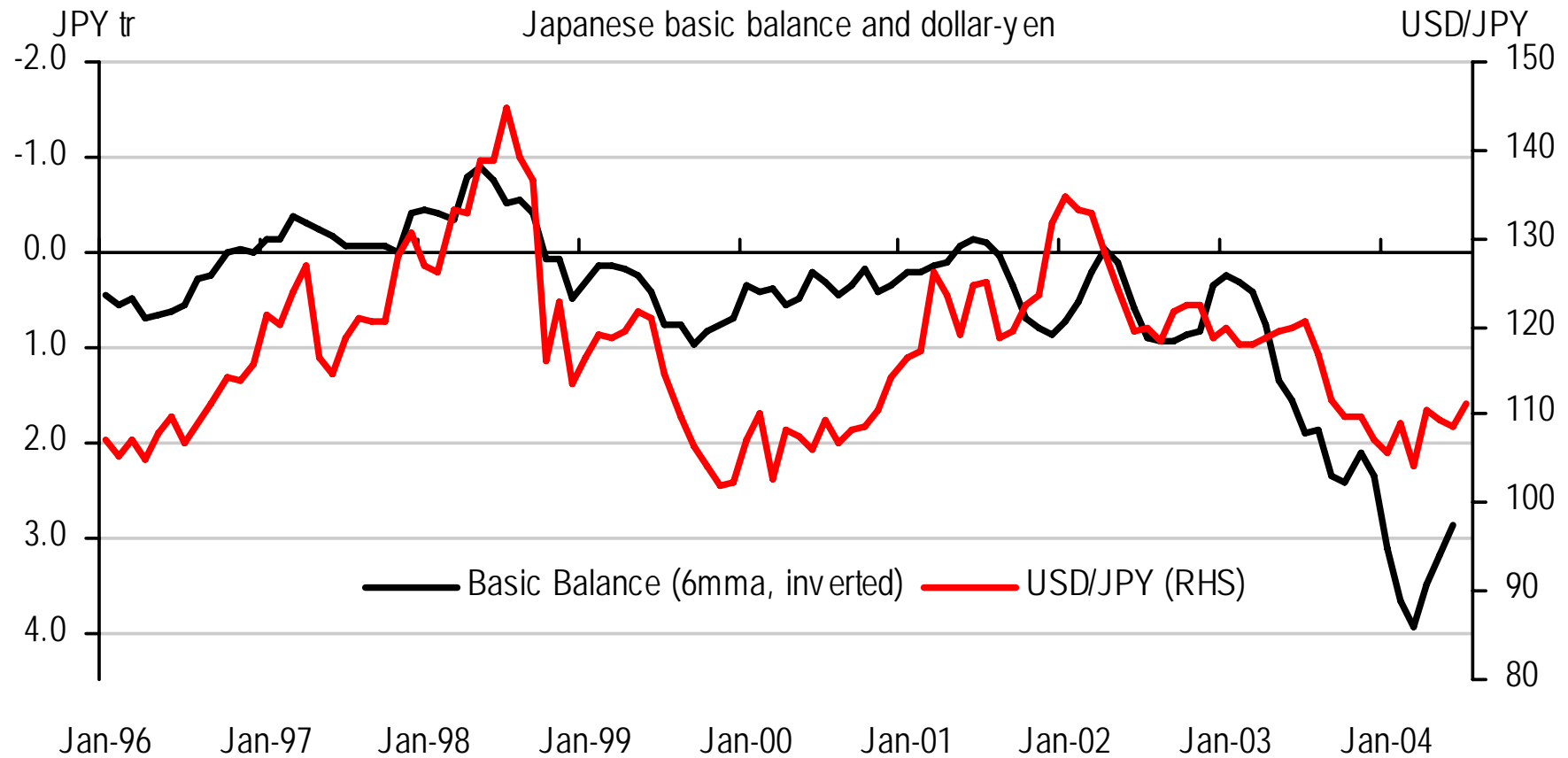
Market share - Euromoney survey

04	03	Bank	Score
1	1	UBS	12.36%
2	3	Deutsche Bank	12.18%
3	2	Citigroup	9.37%
4	4	JPMorgan	5.78%
5	7	HSBC	4.89%
6	5	Goldman Sachs	4.54%
7	9	Barclays Capital	4.08%
8	6	CSFB/Credit Suisse Group	3.79%
9	12	RBS	3.51%
10	11	Merrill Lynch	3.49%
11	10	ABN Amro	3.19%
12	15	Dresdner Kleinwort Wasserstein	2.92%
13	8	Morgan Stanley	2.92%
14	18	Lehman Brothers	2.09%
15	14	Bank of America	2.09%
16	16	State Street Bank & Trust	1.86%
17	17	Royal Bank of Canada	1.49%
18	13	BNP Paribas	1.43%
19	19	SEB	1.22%
20	23	Société Générale	1.16%

What does research/strategy aim to do?

- **Analysis and forecasting of the FX market that adds value for the bank's customers and traders**
- **The basic question is 'what happens next?'**
- **How can we attempt this?**
 - **Fundamental analysis: macroeconomic and policy analysis**
 - **Technical analysis: analysis of price history**
 - **Quantitative analysis: systematic analysis of relevant data sets**

Example: Fundamental analysis



Example: technical analysis



Quantitative strategy – customer side

- **Quantitative analysis is being by banks used to create a competitive advantage**
- **FX Flow**
 - Analysis of proprietary FX transactional data
 - Development of a trading model
- **Economic surprise**
 - Measurement of the ‘news’ component of macro economic announcements
 - Identification of market moving data releases
- **Currency trees**
 - Mapping the complex relationships between currency markets
 - Identification of changes

FX model trading

- **Significant variation in the degree of complexity**
- **Macro models**
- **Purchasing power parity (PPP) models**
- **Trend following models**
- **Mean reversion models**
- **Carry models**
- **Microstructure models**
- **Other**

FX model trading

- **Macro models**
- **Econometric models based on macro data inputs**
 - inflation data (CPI , GDP deflator, average earnings, producer prices)
 - activity data (GDP, consumer confidence , PMI, industrial prod)
 - trade data (current account)
 - portfolio flows (capital account)
- **Involve mathematical fitting of complex functional forms**
- **Long term as data is typically monthly or quarterly**

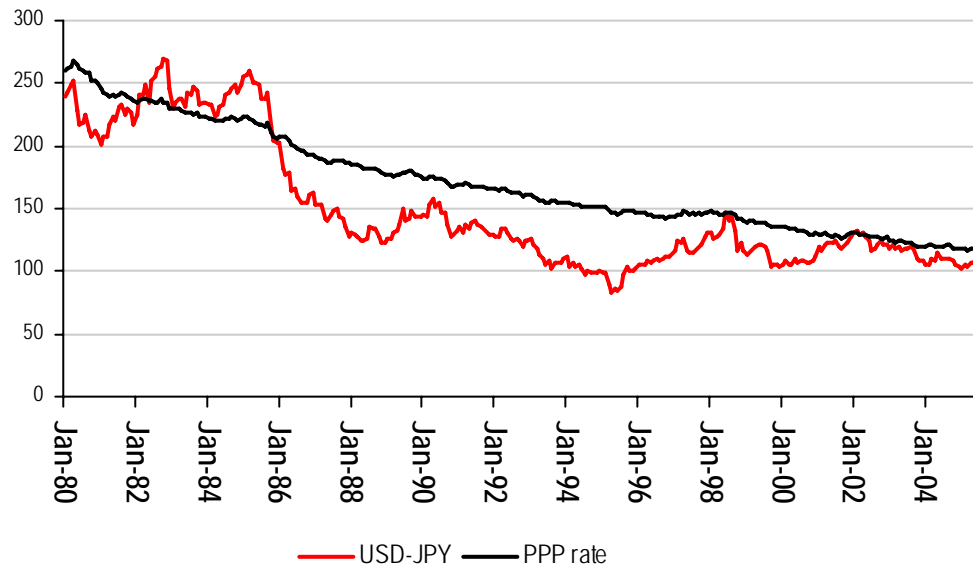
FX model trading

- **PPP models**
- **Similar to true macro models in that there is an economic rationale**
- **Compares the price of a basket of goods in two countries and deduces the appropriate FX rate**
- **Currencies are judged to be over/under valued relative to current spot**
- **Can traded using back-tested rules of thumb**
- **Formal statistical co-integration techniques sometimes applied**

FX model trading

- PPP models

USDJPY and PPP rate



FX model trading

- Trend models
- Based on anecdotal evidence that markets trend
- No real theoretical rationale
- Probably the most common style of currency model

- What exactly is a trend though...

FX model trading

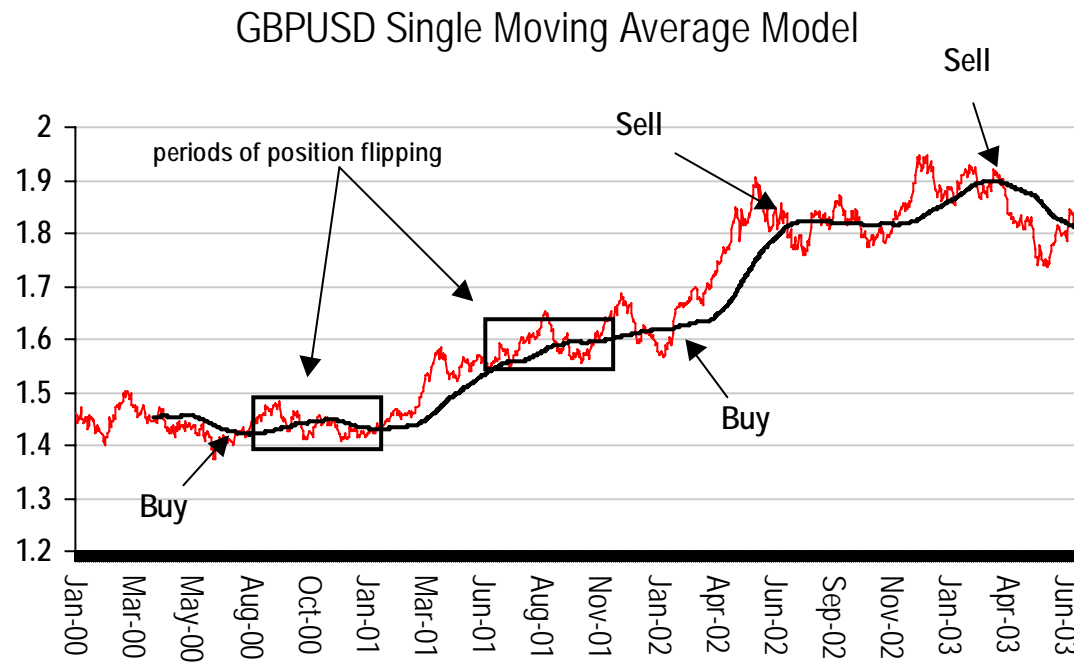
- **Trends are different things to different people**
 - progressively higher highs and lower lows ?
 - trends of hours or years?
- **Mathematical definitions of trend can be tested statistically**
 - positive auto-correlation
 - geometric Brownian motion with drift
- **Statistical results are generally not significant (Durbin-Watson Dickey-Fuller variations etc)**

FX model trading

- In practice most trend models simply founded on backtesting
- Usually involve one or more moving averages
- Model variations very highly correlated
- Single moving average crossover models as good as any
- More advanced (data mined?) models have a **switch**

- Long term Sharpe ratio about 0.5

FX model trading



- Typical approach to trend models - really quite simple
- Complex variations not much better

FX model trading

- **Mean reversion models**
- **Opposite to trend following models**
- **“Sell the highs and buy the lows”**
- **Work during periods of “range trading” in markets**

- **Less common and usually more actively traded than trend models**
- **Usually dependent on a switch**

FX model trading

- Carry models
- Theoretical rationale in the forward rate bias (lots of academic work)
- If the best estimator of future price is current spot rather than the forward rate then one should be able to “earn the carry”
- Strategies involve buying a basket of high yielding ccys and selling a basket of low yielding ccys
- ‘Risk switch’ now quite usual
- Characterised by steady returns followed by big drawdowns

FX model trading

- **Microstructure models**
- **Rationale in recent advances in market microstructure theory**
- **Usually based on customer flow data analysed by banks and custodians**
- **Flow from certain types of participant has a leading impact on the market**
- **Typically un-correlated with other models**

FX model trading

- Other models include
- Directional models based on risk reversal data
- Directional models base on IMM positions data
- Complex algorithms based on price (genetic algorithms, neural networks etc)
- Volatility models (directional , curve trades etc)

Do these models really work

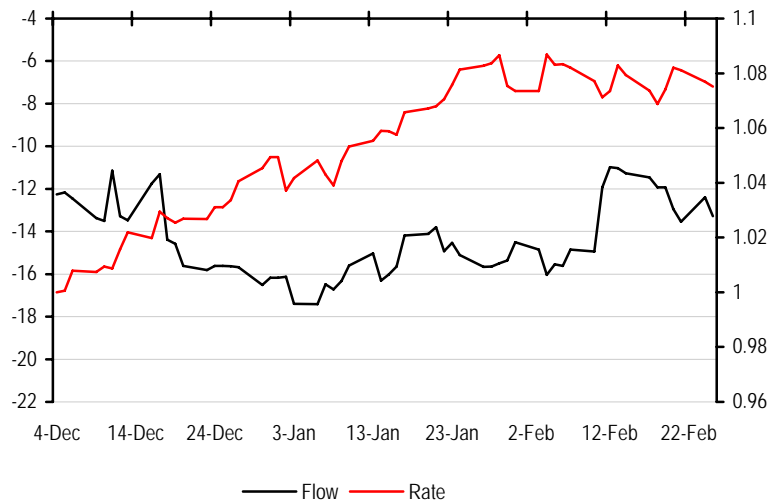
- Evidence that currency alpha is achievable
 - some academic work (forward rate bias)
 - anecdotal evidence of successful overlay managers and hedge funds
- Survey results – Sharpe ratio ~ 0.5

	1 Year	3 Years	5 Years	7 Years
Annualised Mean Return	0.93	1.13	0.54	1.29

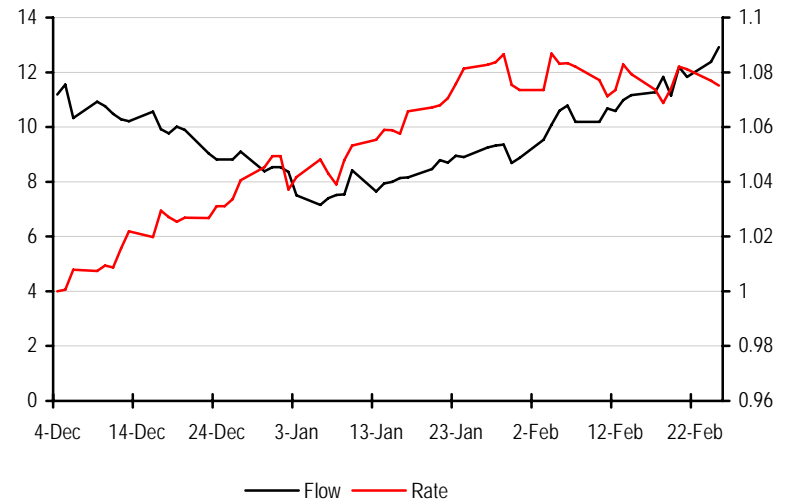
- Russell/Mellon survey. The survey considered 18 active currency managers over 7 years up to June 2003
- Otherwise it is very hard to tell – limited reporting/survival bias

Current research - flow analysis

Global Real Money EUR/USD Flow

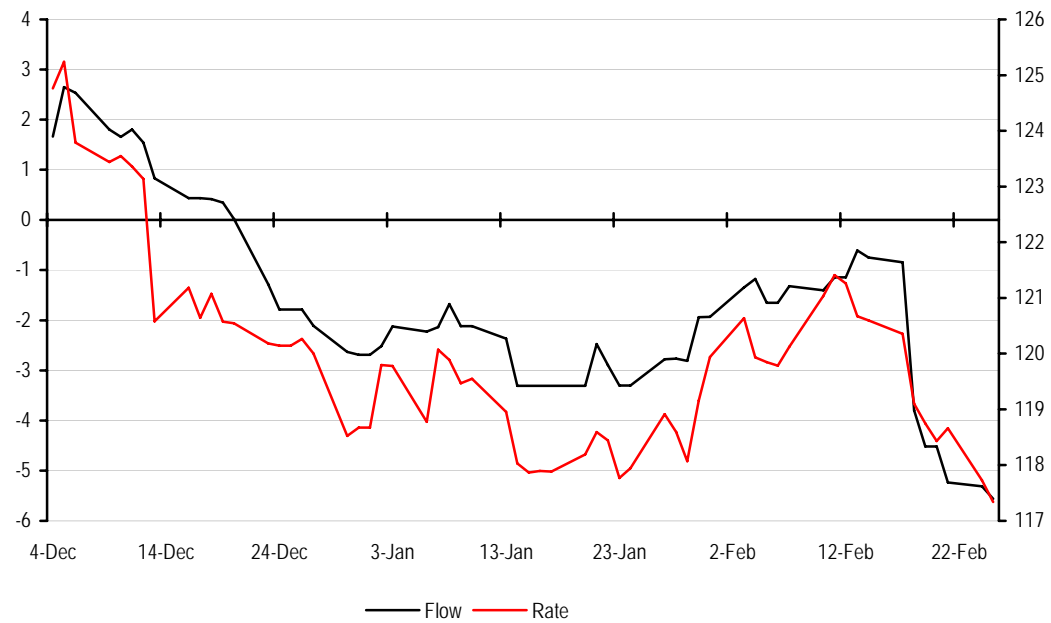


European Corporate EUR/USD Flow



Which flow to watch - Dynamic Flow

USD/JPY Dynamic flow

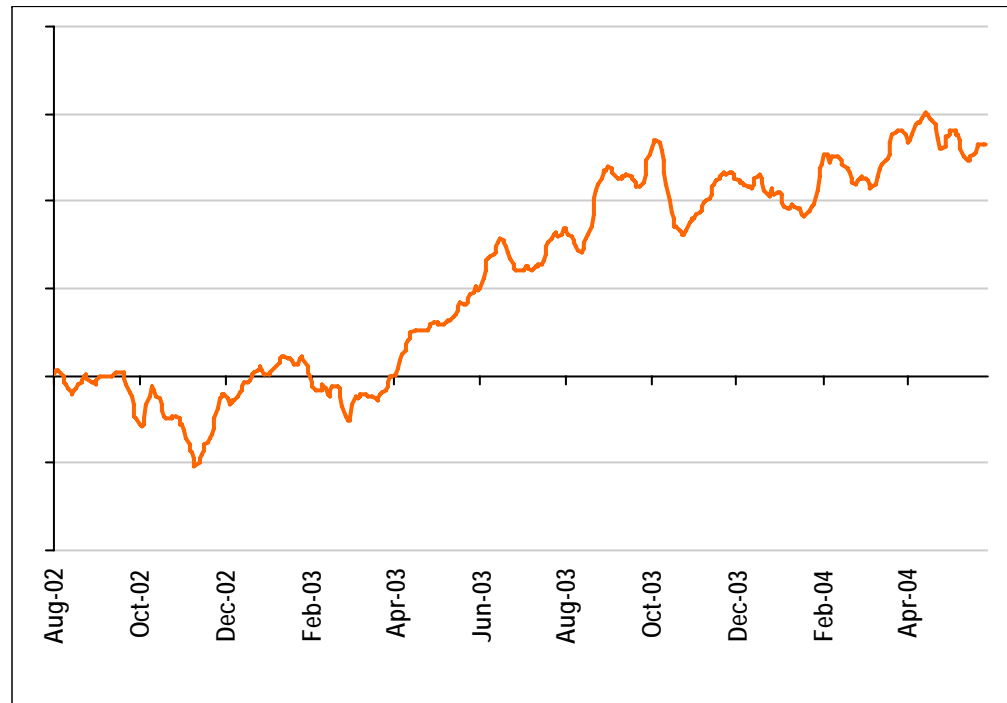


Time structure is evident

- **Dynamic flow related to price moves**
- **Looks like 5/10 days is characteristic of the time structure**
- **Future price moves are relate to recent flow - (ARMA, lag regression)**
- **Also looking at machine learning**

- **It needs a lot of infrastructure**

Does actually work ?

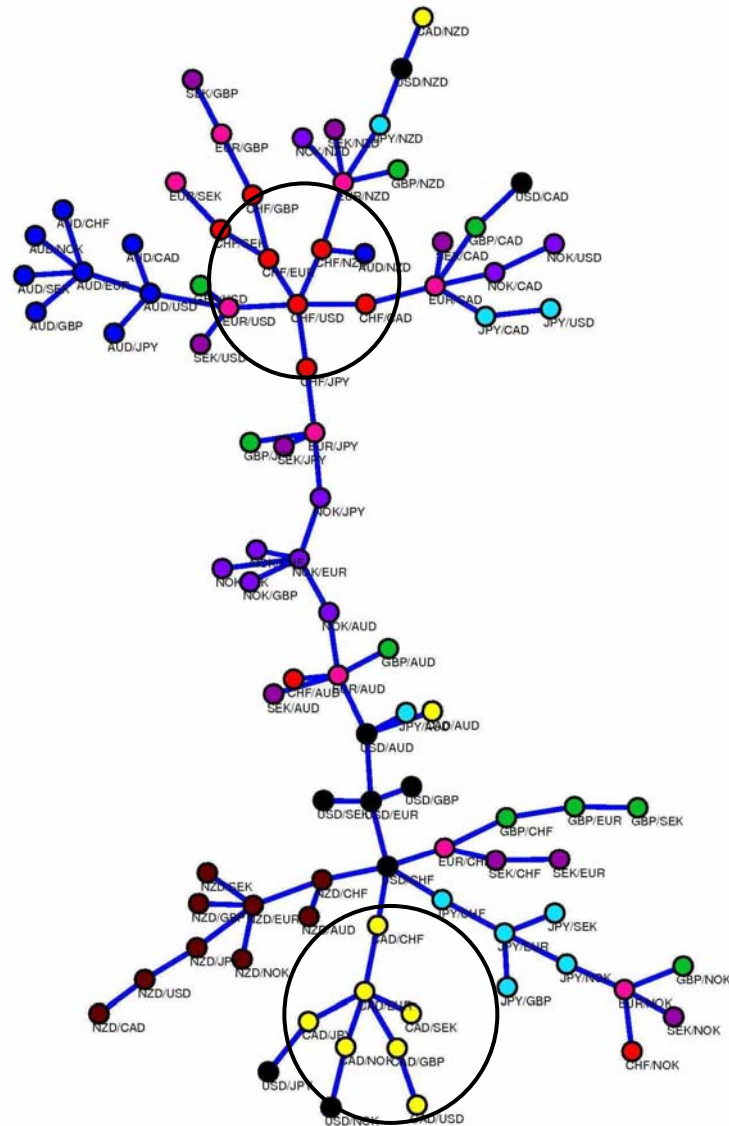


- **Seems to ! - but needs a lot of infrastructure**

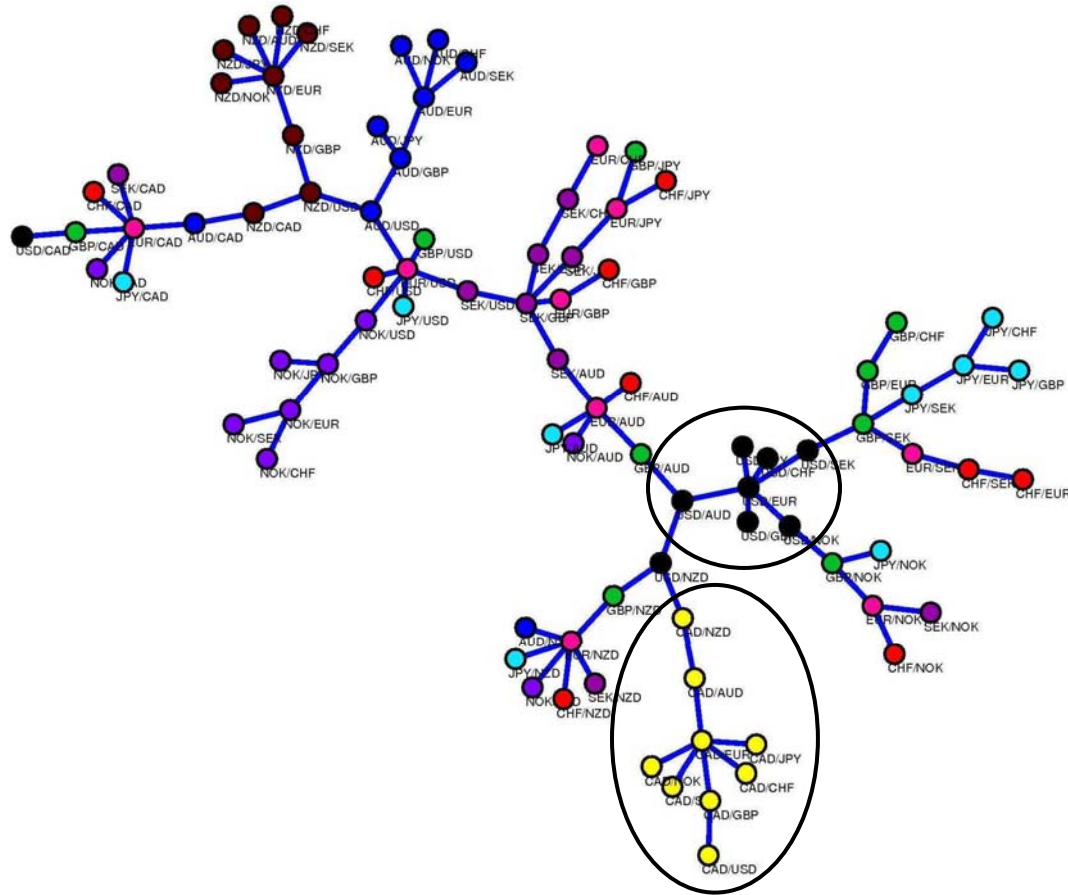
Cross currency correlations

- Initial work done in equities
- The correlation structures of the FX market can be mapped using a correlation filtering procedure
- We use the technique of minimum spanning trees (MST) to extract the key relationships across all the major currency markets
- Signals can be generated which show when a particular currency is “in play” and adapted for model trading

Currency tree - June 2004



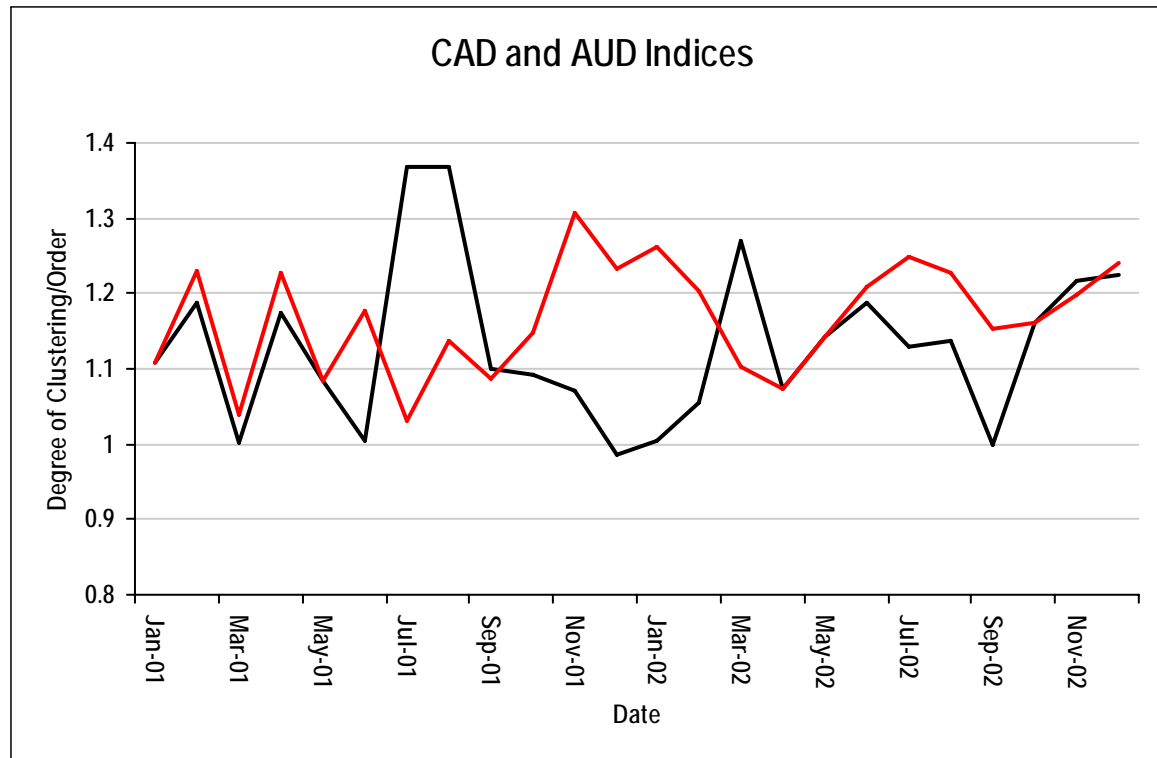
Currency tree - 1 month later



Clustering indices

- The important thing is how clustered each base currency is
- The more clustered the base, the more “in play” it is
- It is then possible to identify when a particular currency is starting to move in an ordered way even if moves are small
- The tree can be represented as a set of indices currency by currency

Currencies moving in and out of play



And finally

- **Quantitative analysis is being used by banks to differentiate themselves in a fiercely competitive market**
- **Quants are heavily involved in derivatives and increasingly involved model trading and strategy**
- **FX is amenable to model trading since it is a simple, highly active market with plenty of data**
- **Requires a mix of quant skills, market knowledge and significant technology to make it work**
- **Big demand for new ideas**