May 16. 2011.

Liberec. Technical University

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Risk Management (statistics behind)

: Basic View to Financial Assets(securities)

: Stock, Bond, Etc.

: Market Risk

: Portfolio.

: Derivatives to reduce risk (particular risk components) with a necessary cost. This is available at cost : not for free.

: VaR (Value at Risk)

“Basic View of Financial Securities”

in my lectures

4^{th}.Floors. Variety of Derivatives.

3^{rd}.Floors : Options (Call, Put)

2nd. Floor : Forwards, Futures, Swaps

1st. Floor : Stock, Bond, Commodity.

Currency Exchange. Loans.

Ground: Economic Activities (Firms,Individuals,Government)

;++

Financing : its Function and Instruments.

Financial Risk

Default Risk (Credit risk):

Market Risk :

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Operational Risk.

Liquidity Risk.

Model Risk.

Systemic Risk.

Others.

Market Risk

Bond Price. (Interest Rates. Credit Rating of Issuer)

Stock Price.

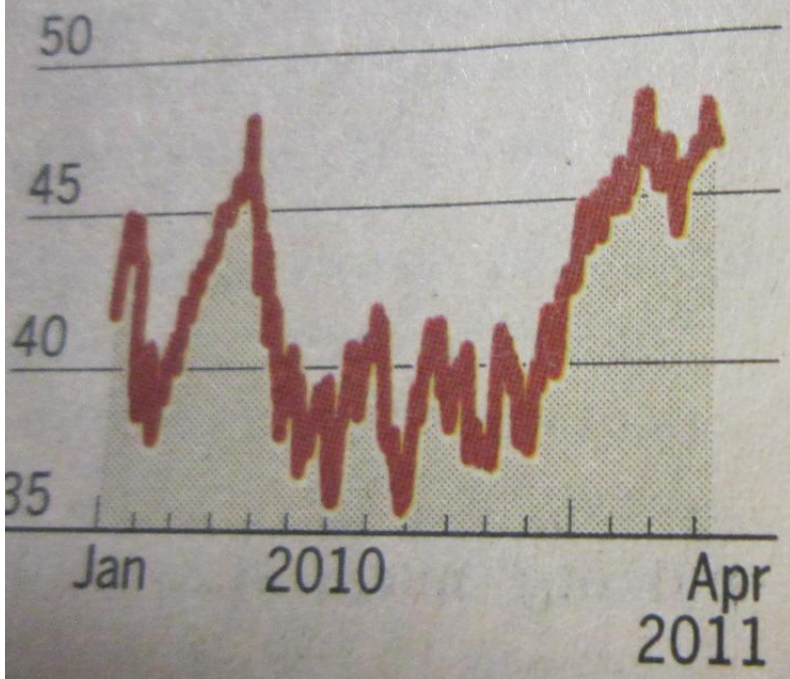
Commodity Price.

Currency Exchange Rates.

The Dow Jones Industrial

JPMorgan Chase

Share price ($)



Source: Thomson Reuters Datastream

Key indicators

Indices	Close	Day's change
S&P 500	1313.68	-0.48
DJ Industrials	12266.04	+2.46
Nasdaq Comp	2754.97	+10.18
Russel 2000	820.59	-1.68
VIX	16.81	-0.2
US 10 yr Treas Bd	3.47	-0.0
US 2 yr Treas Bd	0.73	-0.0

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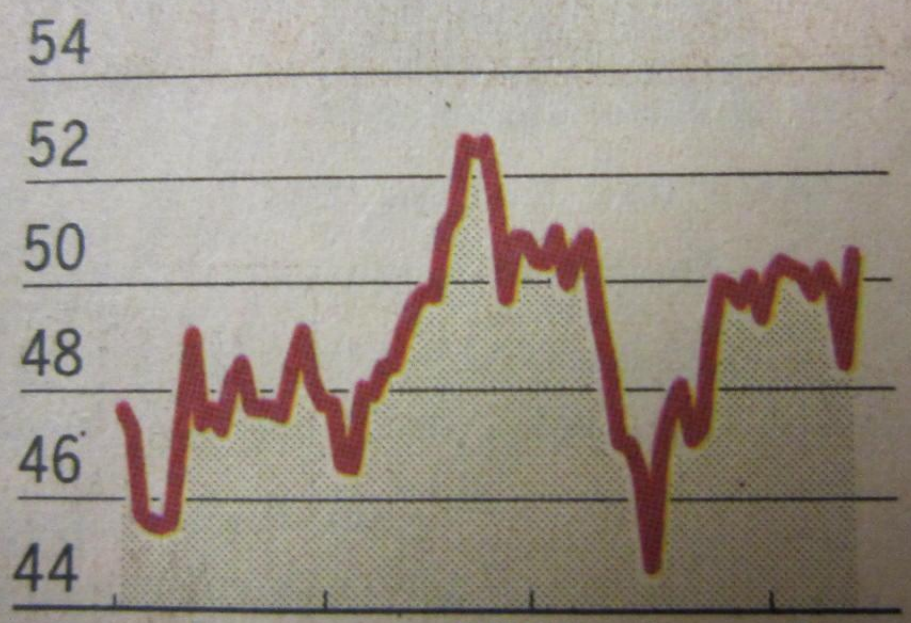
HeidelbergCement

Share price (€)



Source: Thomson Reuters Datastream

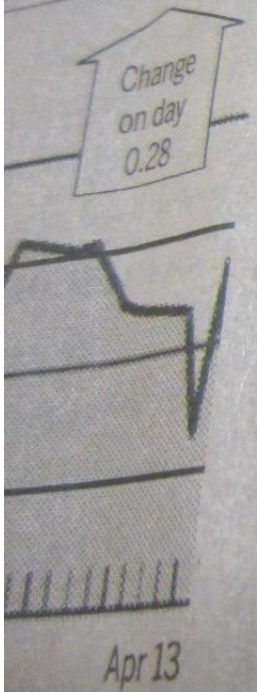
Shares in Al
7.5 per cent t
Ericsson edge
higher to SK
slipped 0.4 pe
Chipmakers r
of their losse
vious session
eon up 0.7 pe
and **STMicro**
per cent high

Carmakers
ered. **Volks**
ence shares
per cent to
Porsche add
to €44.56.

Ups			
Tepco	502	52	+11.56
Toho Zinc	421	21	+5.25
Nippon Soda	346	15	+4.53
Toyobo	122	5	+4.27
Downs			
J.Front Retail	326	-17	-4.96
KansaiEP	1779	-76	-4.10
Isetan Mitukoshi	733	-25	-3.30
Chubu Elec Pwr	1860	-60	-3.13

Based on the constituents of the Nikkei 225 index

DJ Ind	2762.69	2750.93	1321.35
Nasdaq Cmp	1314.03	1312.30	1139.64
S&P 500	1125.62	1135.24	6043.36
FTSE E300	5964.47	6010.44	3129.19
FTSE 100	3091.22	3114.12	4029.34
FTSE All Sh	3998.29	4006.23	7201.12
CAC 40	7135.21	7177.97	845.90
XETRA DAX	835.40	844.59	9655.83
Topix	9516.50	9641.18	24200.3
Nikkei	23981.05	24135.03	6407.4
Hang Seng	6371.06	6364.30	365
SMI	361.56	362.76	
AEX			



Tokyo Elec Power

Share Price

NYSE RISES AND FALL

Issues Traded	Apr 13
Rises	2939
Falls	1296
Unchanged	1514
New Highs	129
New Lows	27

Vol	52 week				Vol		
	High	Low	Yld	P/e	'000s	Stock	Price Chng

Bob Dudley, BP chief executive, has failed to hold the init

Russian roulette

Source: Thomson Reuters Datastream

TNK-BP value

Tot

$49.3

* 50:50 joint ve

MARKETS

Markets update

S&P 500 index

● **US equities**
Financials were in focus as early gains for the sector on the back of robust earnings from JPMorgan faded. Tyco International fell after Schneider Electric said it was 'not currently' in takeover talks with the company

FTSE 100 index

● **UK equities**
Banking stocks powered ahead after JPMorgan of the US unveiled forecast-beating quarterly earnings, while chip designer ARM Holdings was bolstered by upbeat broker comments following a recent bout of weakness

FTSE Eurofirst 300 index

● Eur
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Source: Thomson Reuters Datastream

Spending fears keep equity

GLOBAL OVERVIEW

US retail sales figures disappoint

Oil prices stage sharp rebound

"We believe results at JPM's investment bank bode well for banking and trading results at competing bulge bracket firms," said Frederick Cannon at Keefe, Bruyette and Woods.

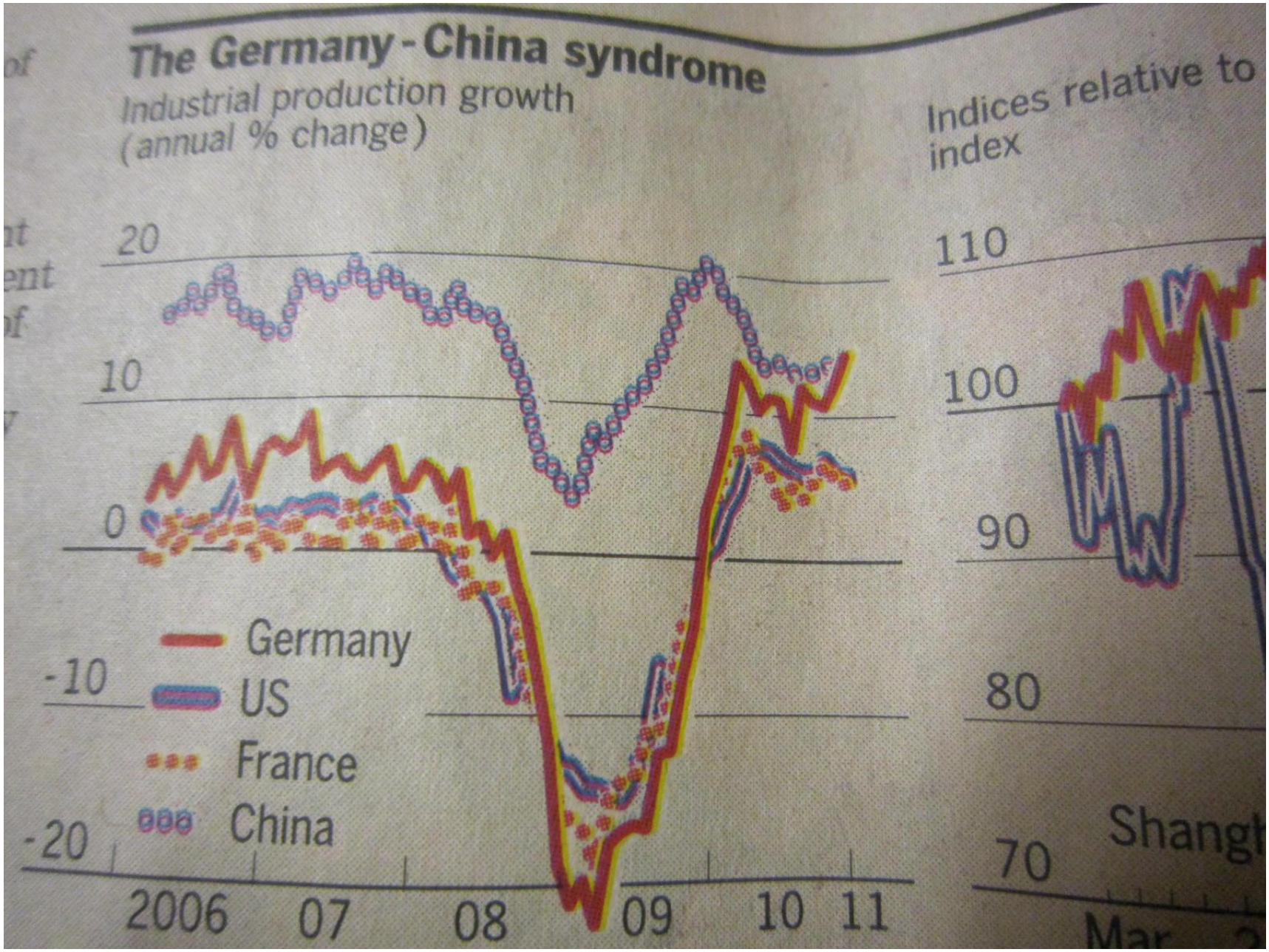
However, Wall Street's early strength quickly evap-

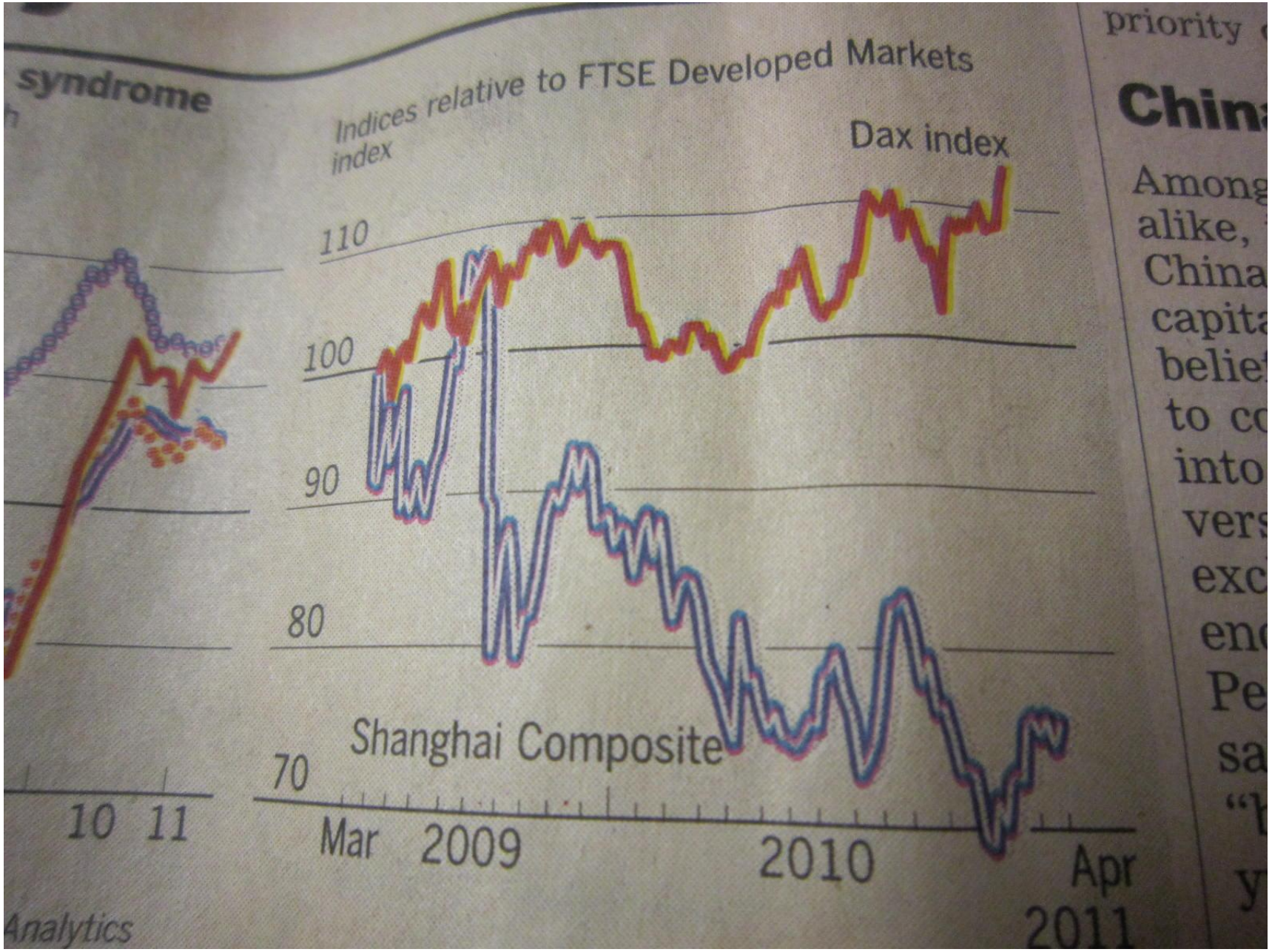
Core sales, which exclude cars, petrol and building materials, also rose a modest 0.4 per cent, but there were upward revisions to the prior two months' core numbers. Analysts said the data reinforced caution about first-quarter US gross domestic product growth, particularly in the light of the narrowing of the trade deficit in February. Paul s Dales at Capital Economics pointed out that the retail sales numbers had not been adjusted for rising prices, and estimated that con-

Australian dollar

Gold price

● **European equities**
Shares in construction and cement groups gained ground amid hopes they would benefit from rebuilding efforts in Japan. Alcatel-Lucent jumped on positive broker comment about the telecoms equipment maker


The Germany - China syndrome
Industrial production growth
(annual % change)
20
10
0
-10
-20
Germany
US
France
China
2006
07
08
09
10
11
Indices relative to
index
110
100
90
80
70


syndrome
Indices relative to FTSE Developed Markets
index
Dax index
110
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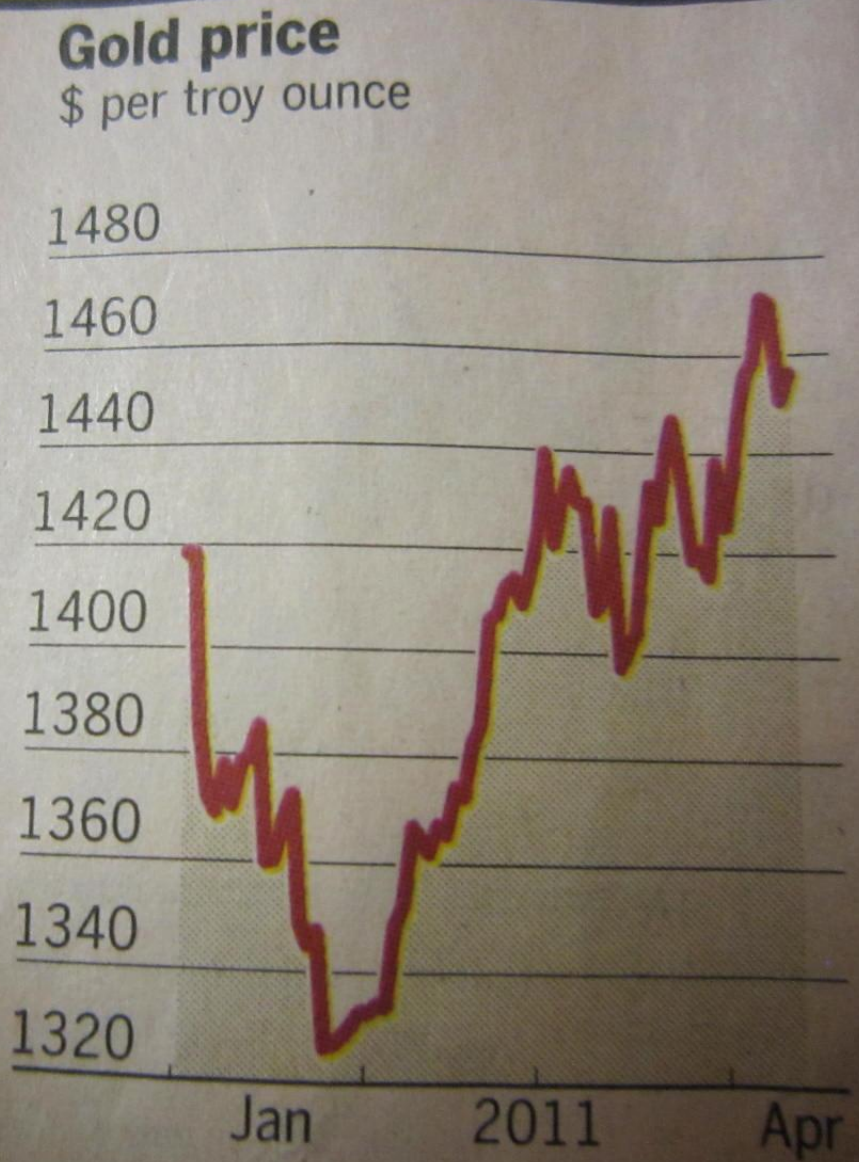

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News Briefing

Silver
Cents per troy ounce

Source: Thomson Reuters Datastream

Silver prices recently rose to a 31-year high, Page 27

Companies

Portfolio

Buy and Hold a single stock.

Buy and Hold several stocks together.

Buy and Hold many stocks together.

What about their risk ? (price fluctuation)

Who buys stocks? Individuals and Institutions.

Value of Portfolio still fluctuates, why?

Stock index (market average).

Index future.

What is a Optimal Portfolio? (Theory behind)

More devices to Hedge the Risk

(development of derivatives)

(Mathematical theory of Pricing behind)

(New field of quantitative engineering)

(Graduates of Engineering schools go to Banks 1990 in Japan)

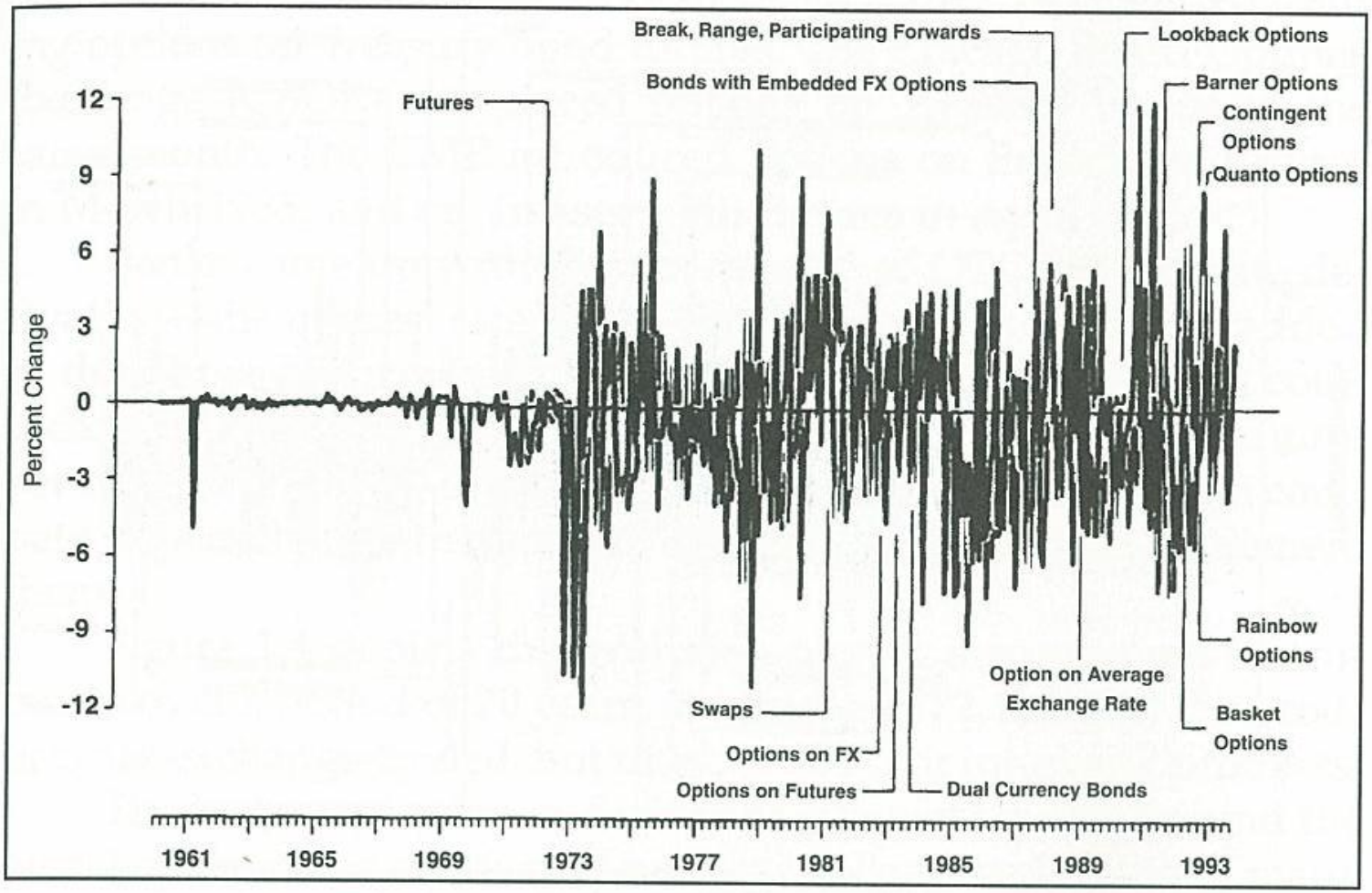
Interest rates derivatives.

Currency derivatives.

Others.

FIGURE 1.2

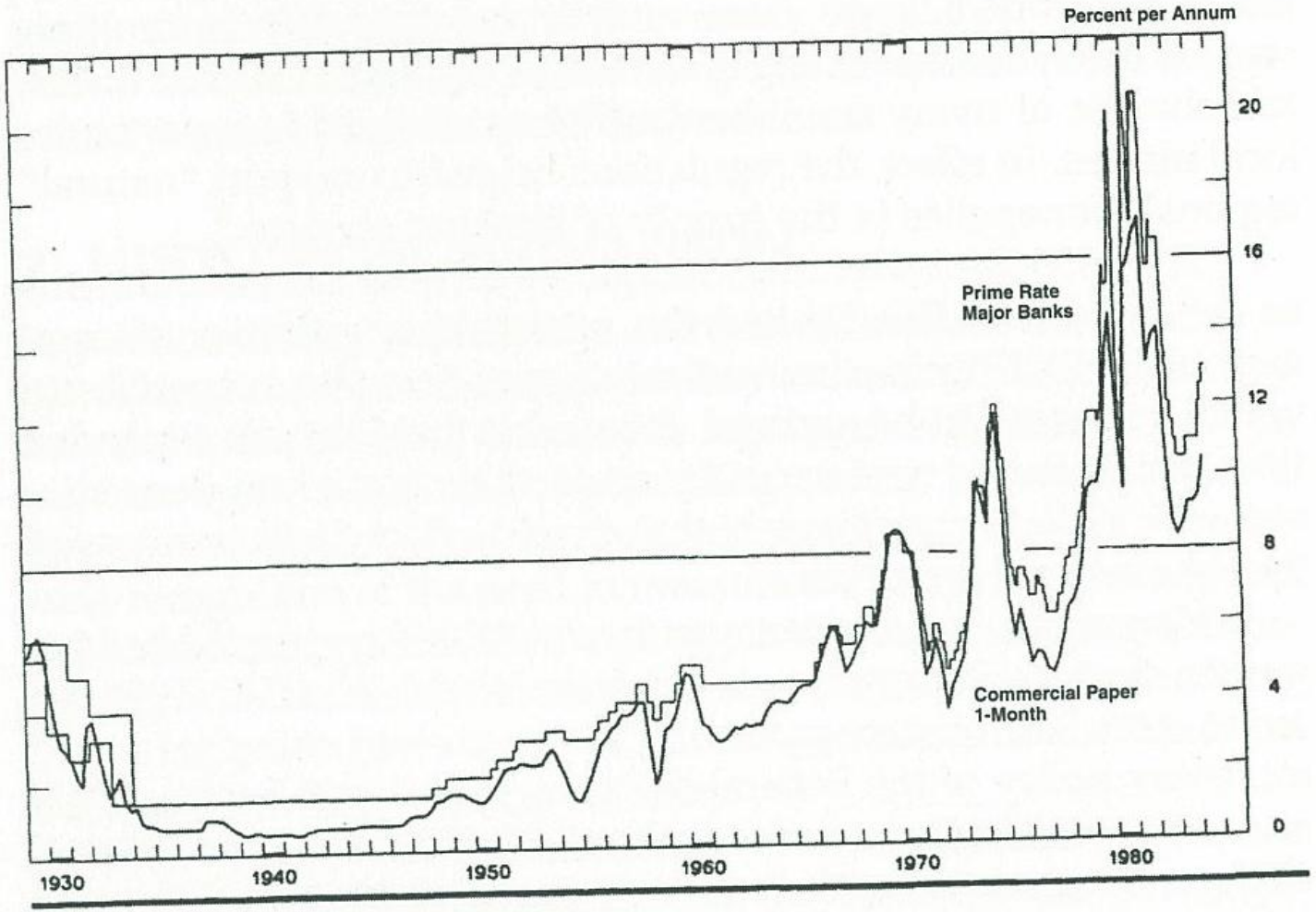
Month-End German Deutsche Mark/U.S. Dollar Exchange Rates



Source: Smithson et al. (1995)

FIGURE 1.1

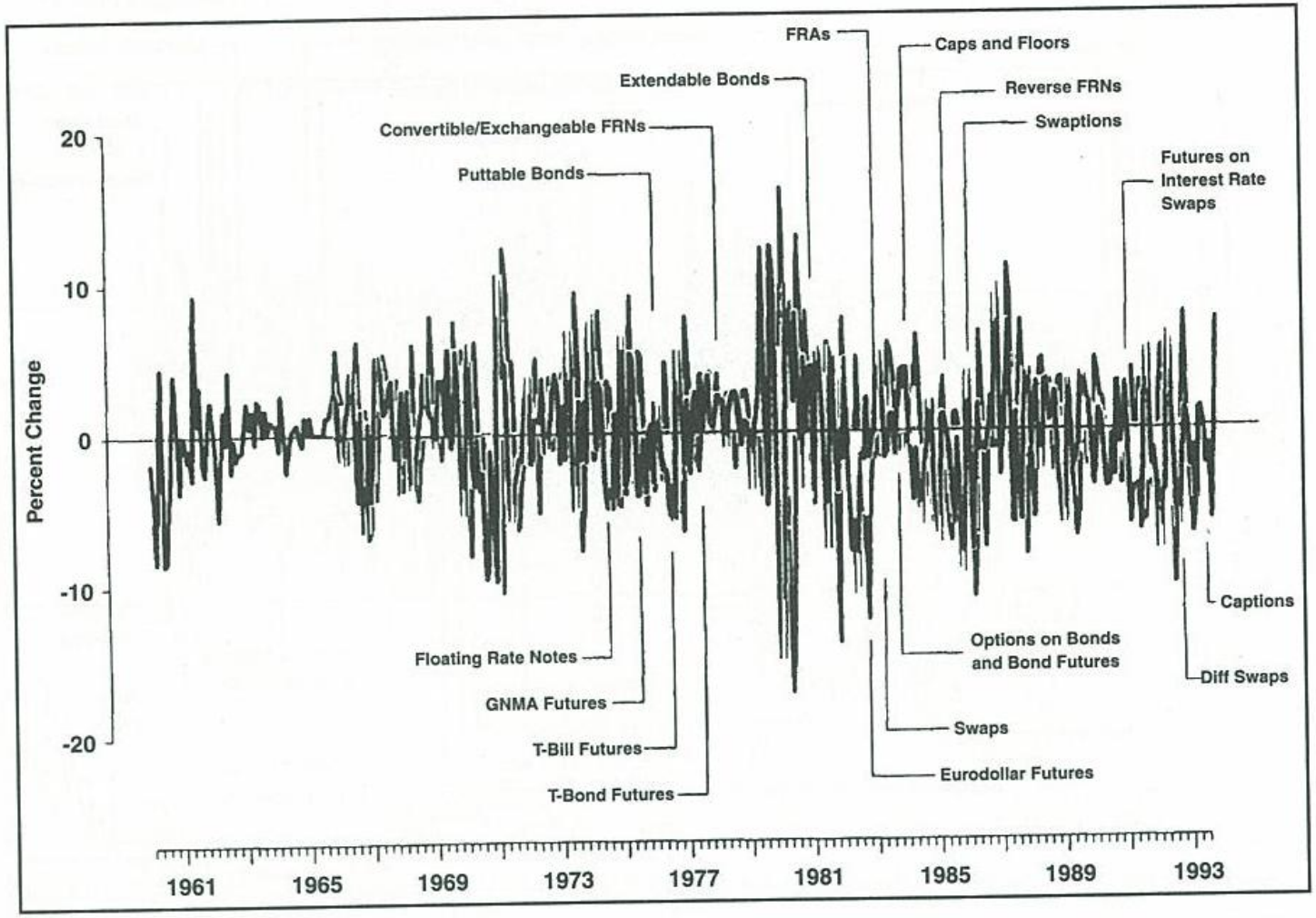
Short-Term Interest Rates, Business Borrowing Prime Rate (Effective Date of Change), Commercial Paper (Quarterly Averages)



Source: Board of Governors of the Federal Reserve System

FIGURE 1.3

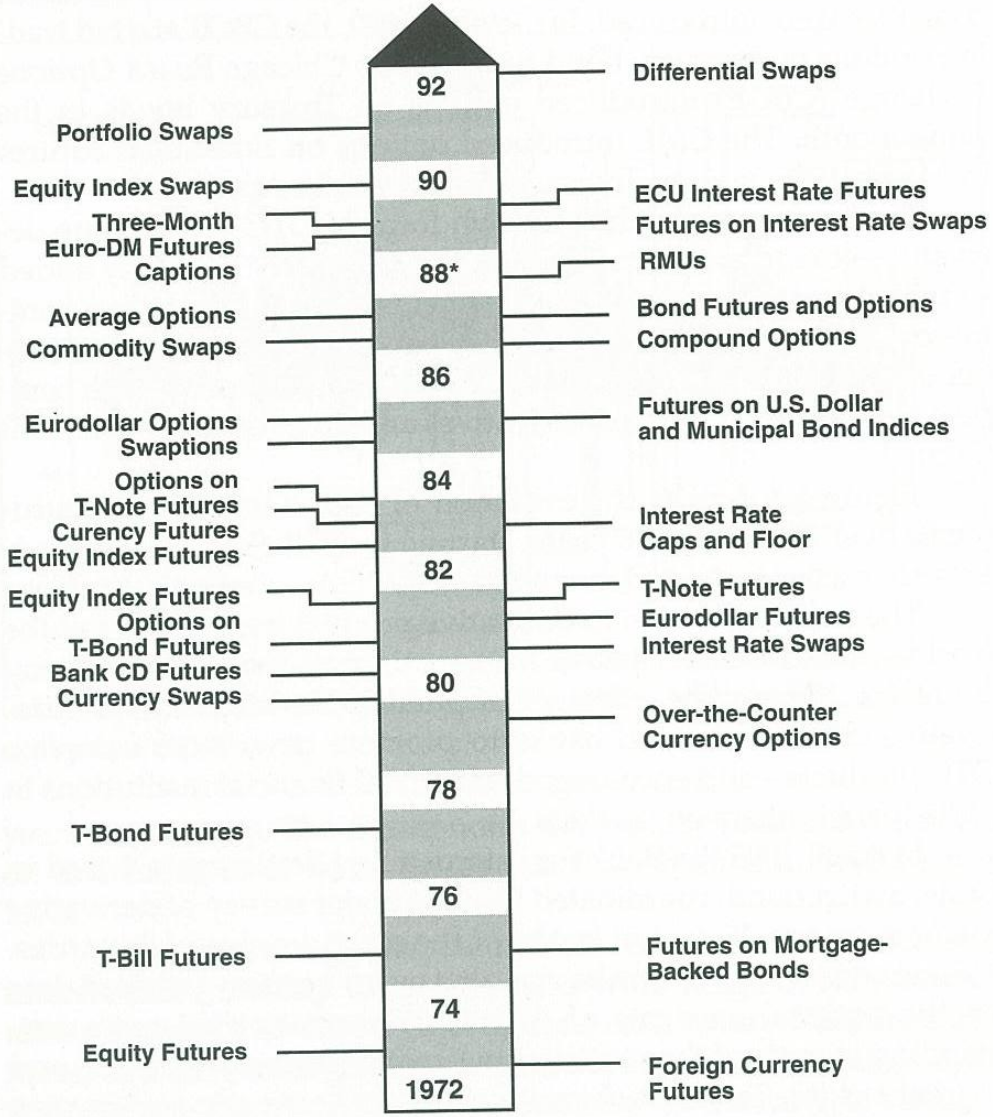
Percentage Change in Yields on Five-Year U.S. Treasury Bonds



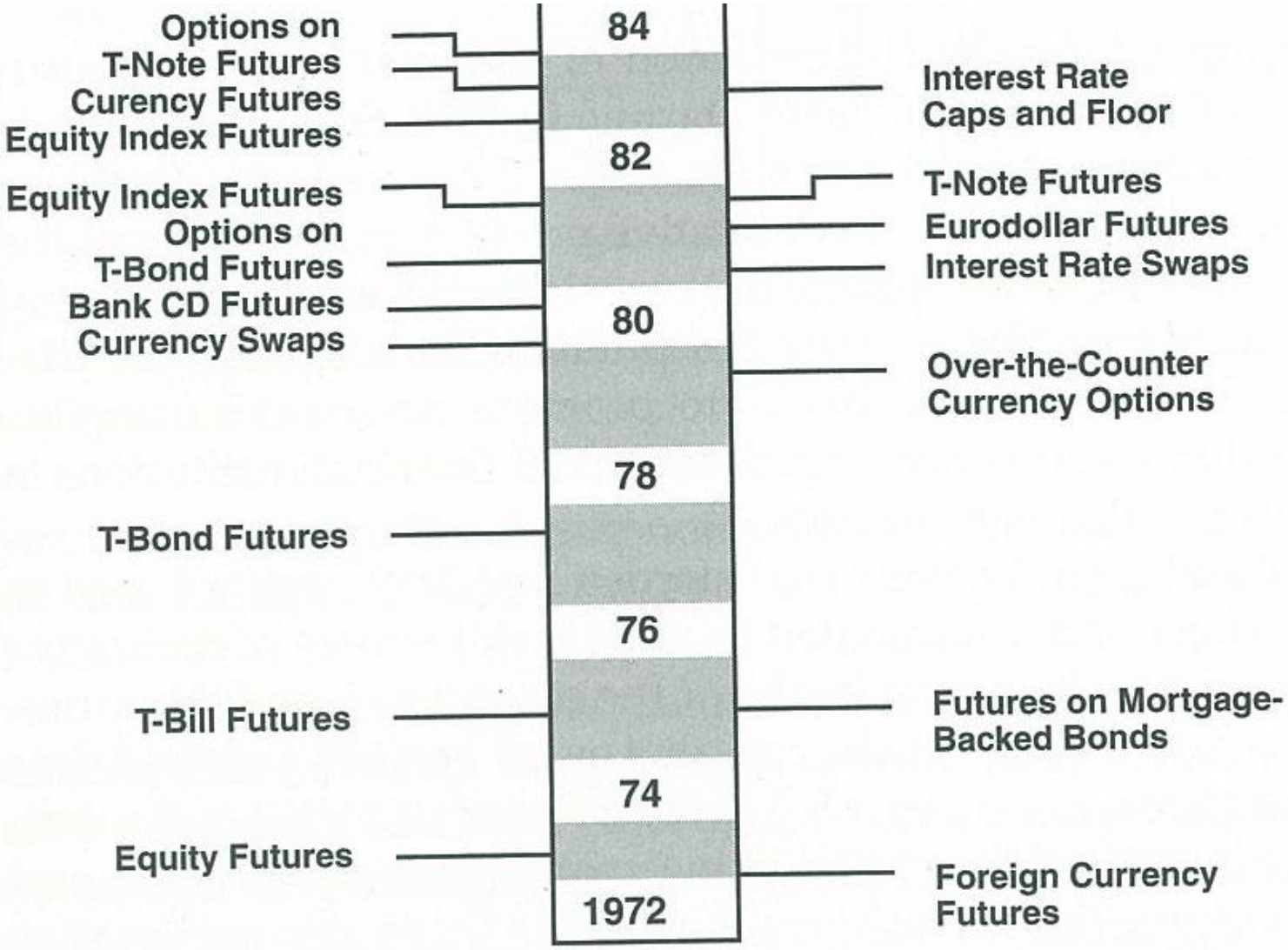
Source: Smithson et al. (1995)

FIGURE 1.4

The Evolution of Risk Management Products



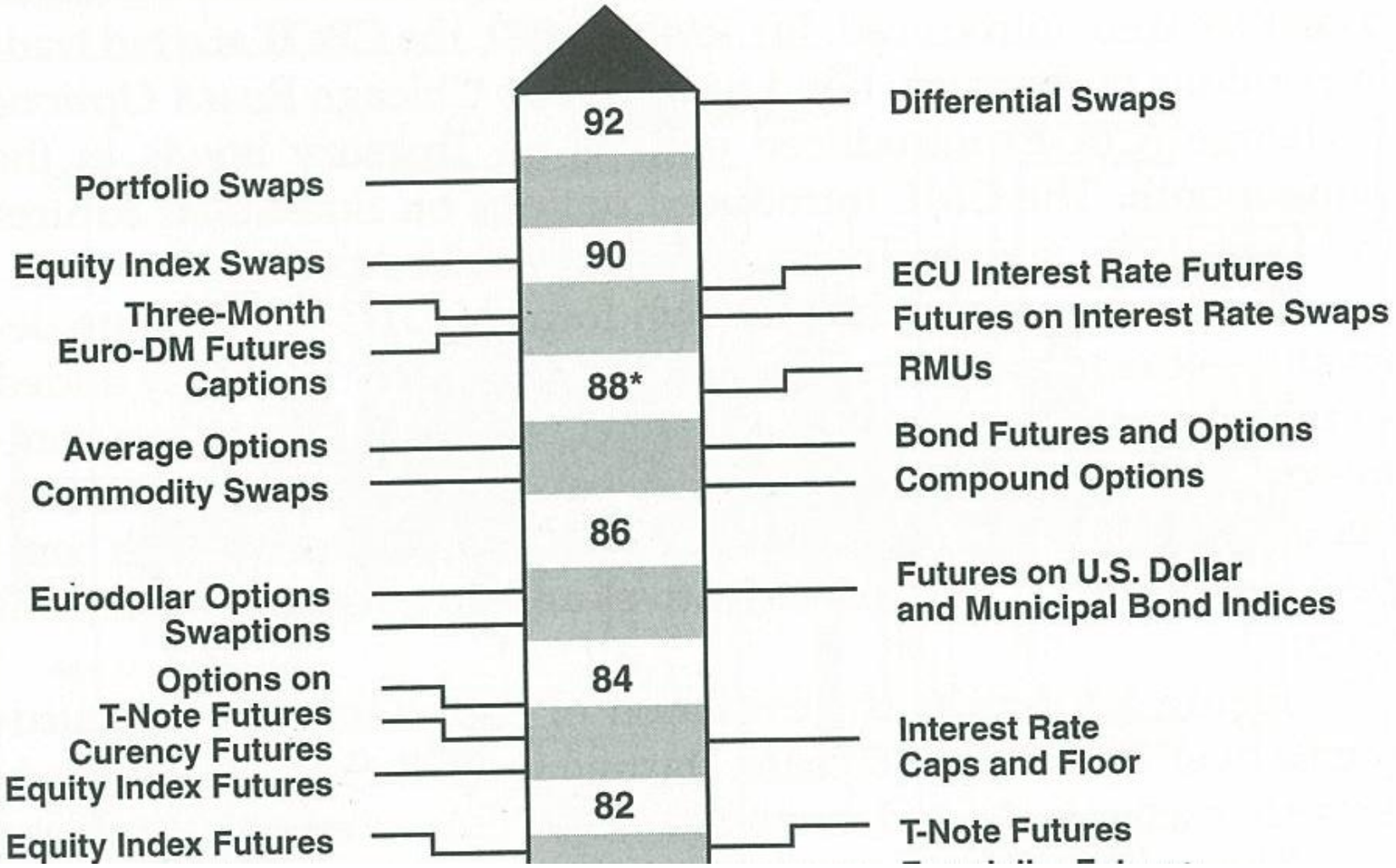
Source: The Economist, April 10, 1993



Source: The Economist, April 10, 1993

FIGURE 1.4

The Evolution of Risk Management Products



Needs for Risk Management

New kinds of Securities/Derivatives

: large volume and not a simple price behavior

: need systematic measurement?

: Regulation side and Banks

1988. Basel committee and BIS. And Regulators.

Since 1988--- development of statistical analysis/system

Measure the Market Risk
(statistical methodology)

Today's price is known, but what about tomorrow's.

Change of the Market Price of Portfolio.

Daily change. 10 days change.

Uncertainty. Stochastics (randomness?).

Technical matter

Rate of change = change/(today' price)

How do we measure this ? Statistical methodology comes in.

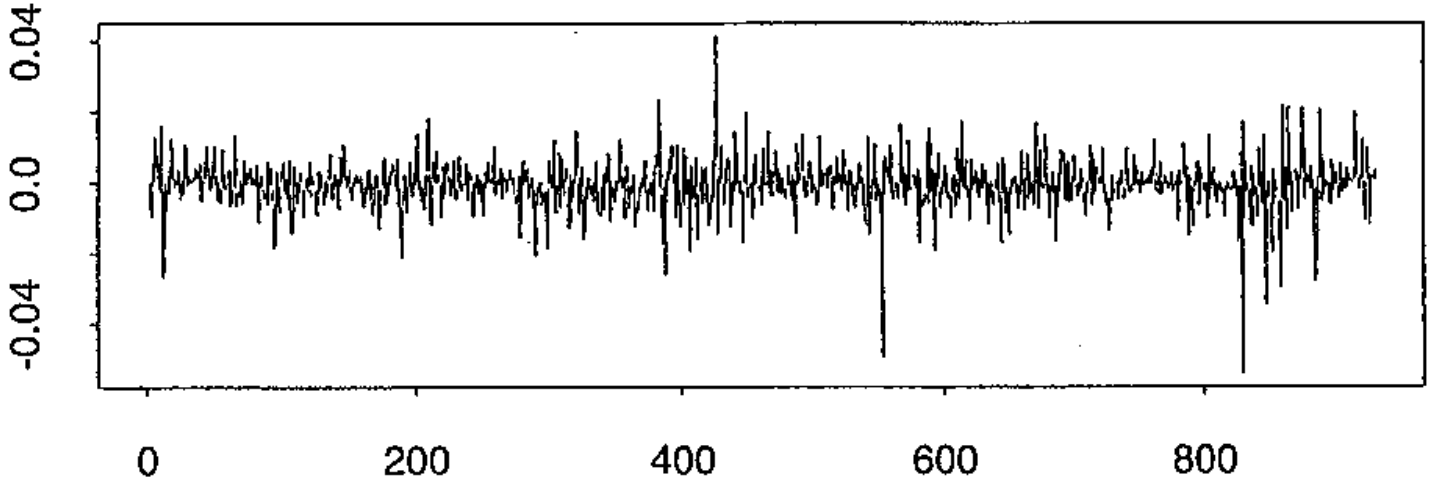


Figure 1. YEN/USD daily data: time series plot of log-ratios.

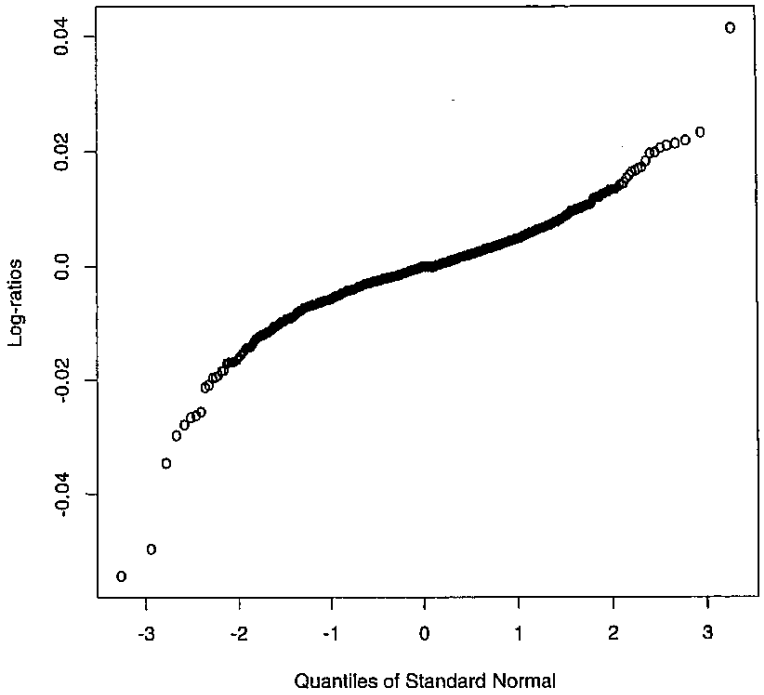


Figure 2. YEN/USD daily data: normal probability plot of log-ratios.

2. The I.I.D. Normal Model

Let $S_{i,t}; i = 1, \ldots, n$ be the values of n assets in portfolio at time t. For each factor asset, the rate of return $X_{i,t} = (S_{i,t+1} - S_{i,t})/S_{i,t}$ is the building block of the estimation as follows. The rate of return is approximately the log-ratio $Y_{i,t} = \log S_{i,t+1} - \log S_{i,t}$. Given the investment ratios $a_i; i = 1, \ldots, n$ with $\sum_{i=1}^{n} a_i = 1$, the rate of return of the portfolio is written as $X_t = \sum_{i=1}^{n} a_i X_{i,t}$ and

$$V_{t+1} - V_t = V_t X_t = V_t \sum_{i=1}^{n} a_i X_{i,t} .$$

The starting point is then making a graph of the past returns as in Figure 1 where the log-ratios of YEN/USD daily data are plotted against time. Once we assume that daily returns are independent and identically distributed (i.i.d.), the normal probability plot such as Figure 2 is useful to identify the shape of the probability distribution.

Under the i.i.d. normal assumption, $X_{i,t}, X_{i,t-1}, \ldots$ are assumed to be i.i.d. normal random variables for each i. The mean $\mu_i = E(X_{i,t})$ and the covariance $\sigma_{ij} = \mathrm{Cov}(X_{i,t}, X_{j,t})$ are therefore time-independent. Then,

$$V_{t+1} - V_t = V_t \sum_{i=1}^{n} a_i X_{i,t} \sim N(V_t \mu_p, (V_t \sigma_p)^2), \tag{1}$$

where $\mu_p = \sum_{i=1}^{n} a_i \mu_i$ and $\sigma_p^2 = \sum_i \sum_j a_i a_j \sigma_{ij}$. Given the value of V_t, the increment is also a normal random variable. The $\alpha\%$ point of the portfolio increment is easily computed as $V_t(\mu_p - z_\alpha \sigma_p)$ using the $\alpha\%$ quantile z_α of the standard normal distribution.

Given a sample $X_{i,t-1}, \ldots, X_{i,t-T}$ over T time periods, the usual estimates of the mean vector $\boldsymbol{\mu} = (\mu_1, \ldots, \mu_n)^\top$ and the variance-covariance matrix $\Sigma = [\sigma_{ij}]$ are the sample mean $\hat{\boldsymbol{\mu}}$ and the sample variance-covariance matrix $\hat{\Sigma}$; i.e.,

$$\hat{\mu}_i = \frac{1}{T} \sum_{s=1}^{T} X_{i,t-s}, \quad \hat{\sigma}_{ij} = \frac{1}{T} \sum_{s=1}^{T} (X_{i,t-s} - \hat{\mu}_i)(X_{j,t-s} - \hat{\mu}_j).$$

Once we have these estimates, the VaR of a portfolio with arbitrary value of investment ratios can be economically estimated from the Equation (1).

Statistical Models

for daily change (rates of change)

Normal distribution ?

Non-Normal ?

Fat tails and Stochastic Volatilities

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Database. Statistical Analysis.

Communication Network. Computing.

Statistical analysis +Computing + mathematics + economics + database management

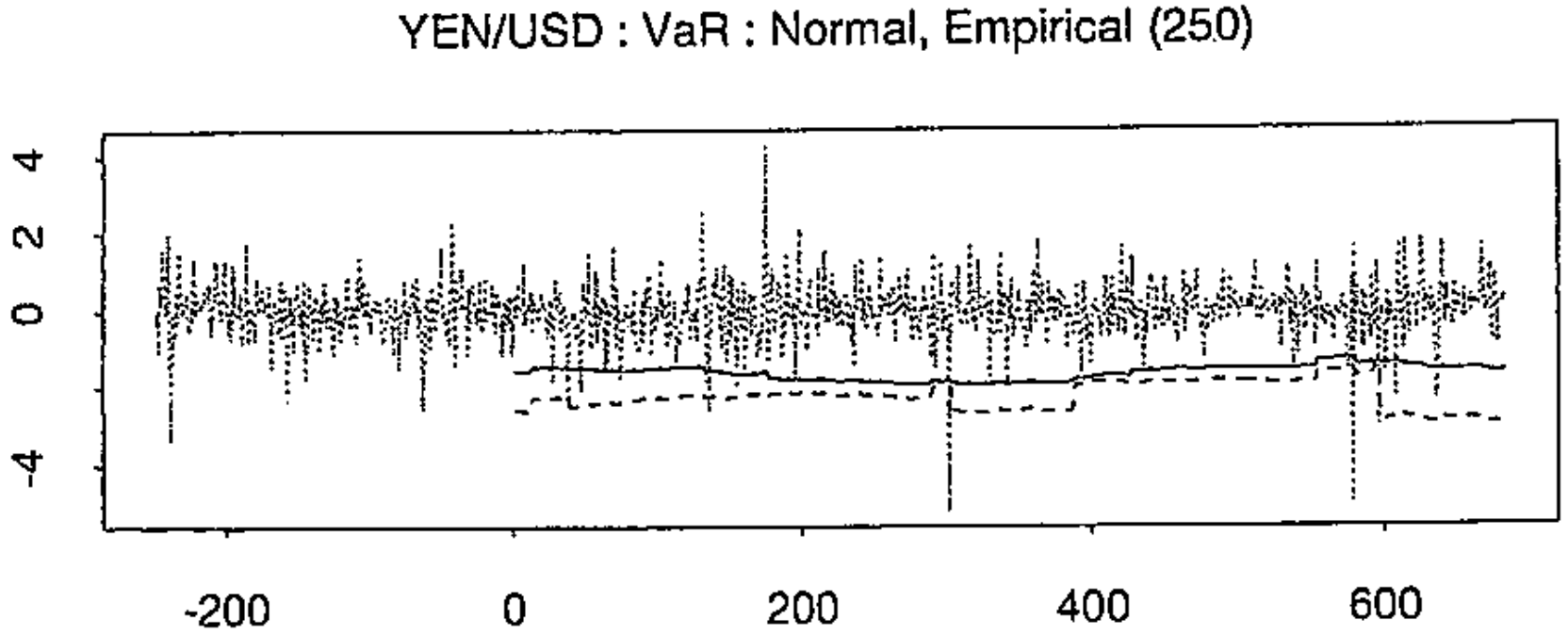

Figure 4. YEN/USD daily data: 1% VaR estimates by i.i.d. normal model (solid line) and empirical CDF model (broken line) along with log-ratios.

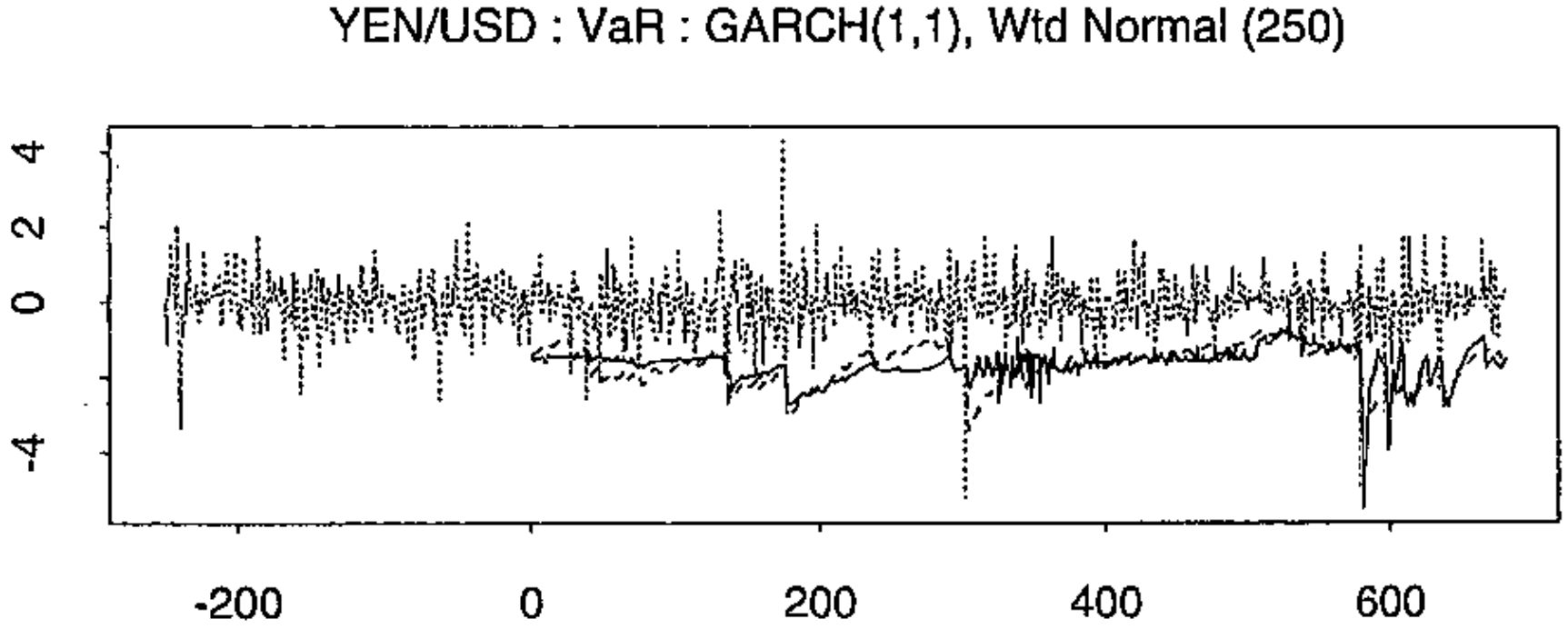

Figure 9. YEN/USD daily data: 1% VaR estimates by GARCH(1,1) model (solid line) and weighted normal model (broken line) along with log-ratios.

Figure 9 draws an example of the VaR estimates by univariate GARCH(1,1) model. The VaR estimates move rather radically as if they copied the rates of return themselves. We may ask whether the move is too sharp from a practitioner's point of view.

2008/2009 Financial Crisis and VaR

Did VaR work well during the crisis period?

: Need to see

the statistical property of the price movements and

assumptions the methodology is based on.

Thank you.

Tomorrow 17: University Life in Japan.

Wed. 18 th. : Financial Markets.

Th. 19th. : Rating of Firms.