

Commodity derivative markets

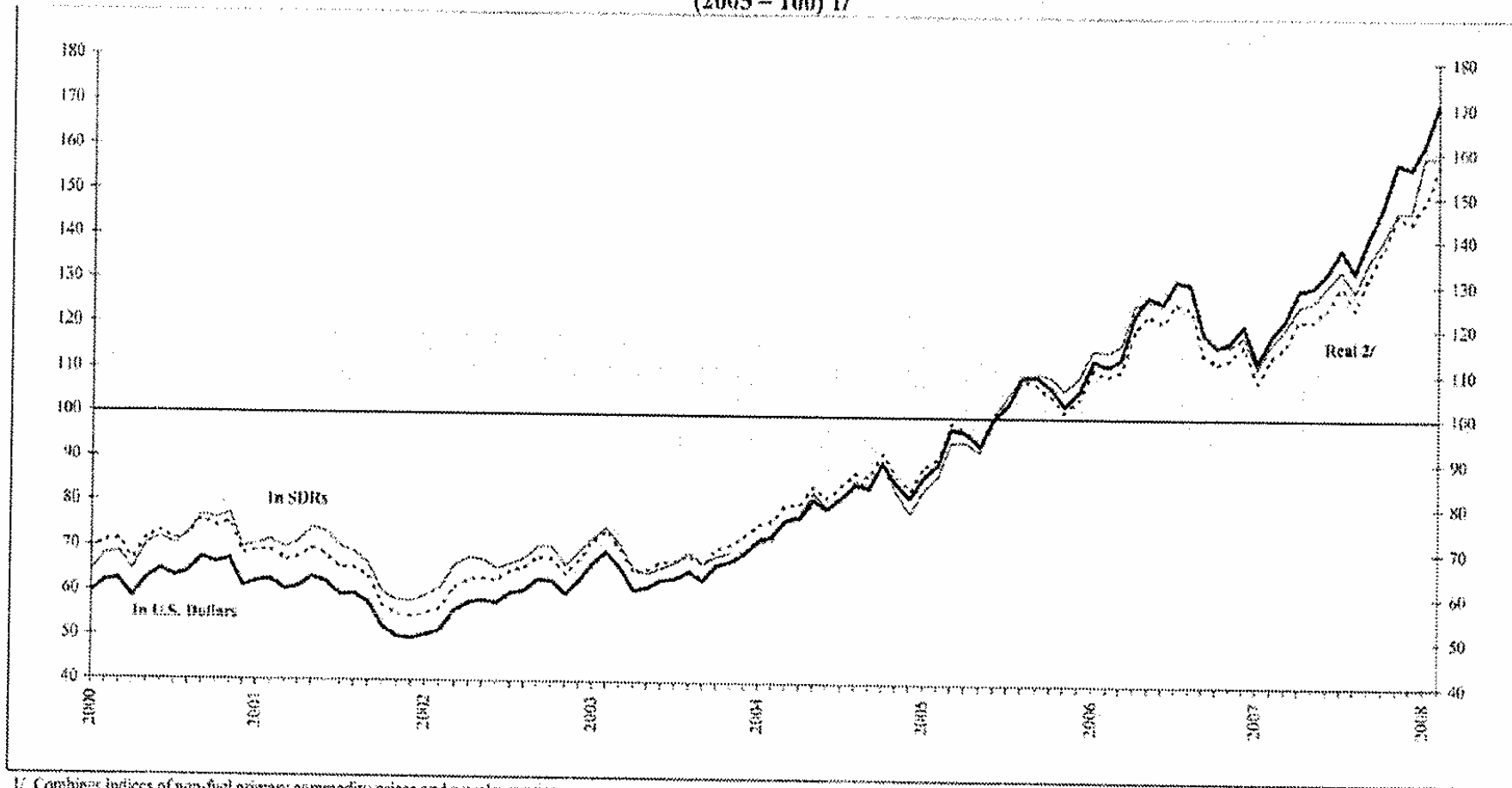
Delphine Lautier

1. Commodity markets today
2. The behavior of commodity prices : main characteristics
3. New trends in research on commodities

1. Commodity markets today

- Huge rise in prices
- Huge rise in transactions volumes

INDICES OF PRIMARY COMMODITY PRICES
(2005 = 100) 1/



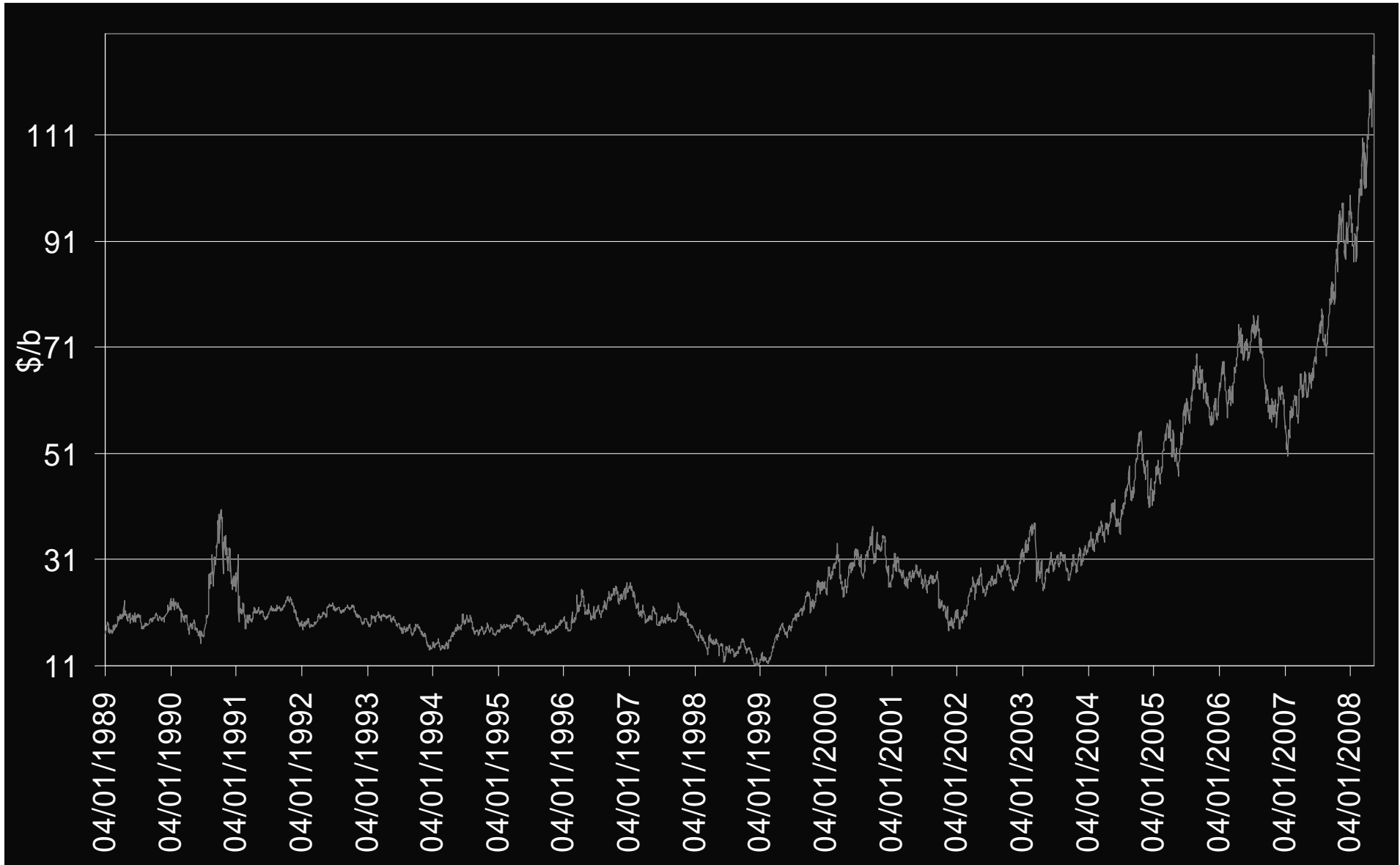
1/ Combined indices of non-fuel primary commodity prices and petroleum prices.

2/ Deflated by US CPI.

5-Mar-08

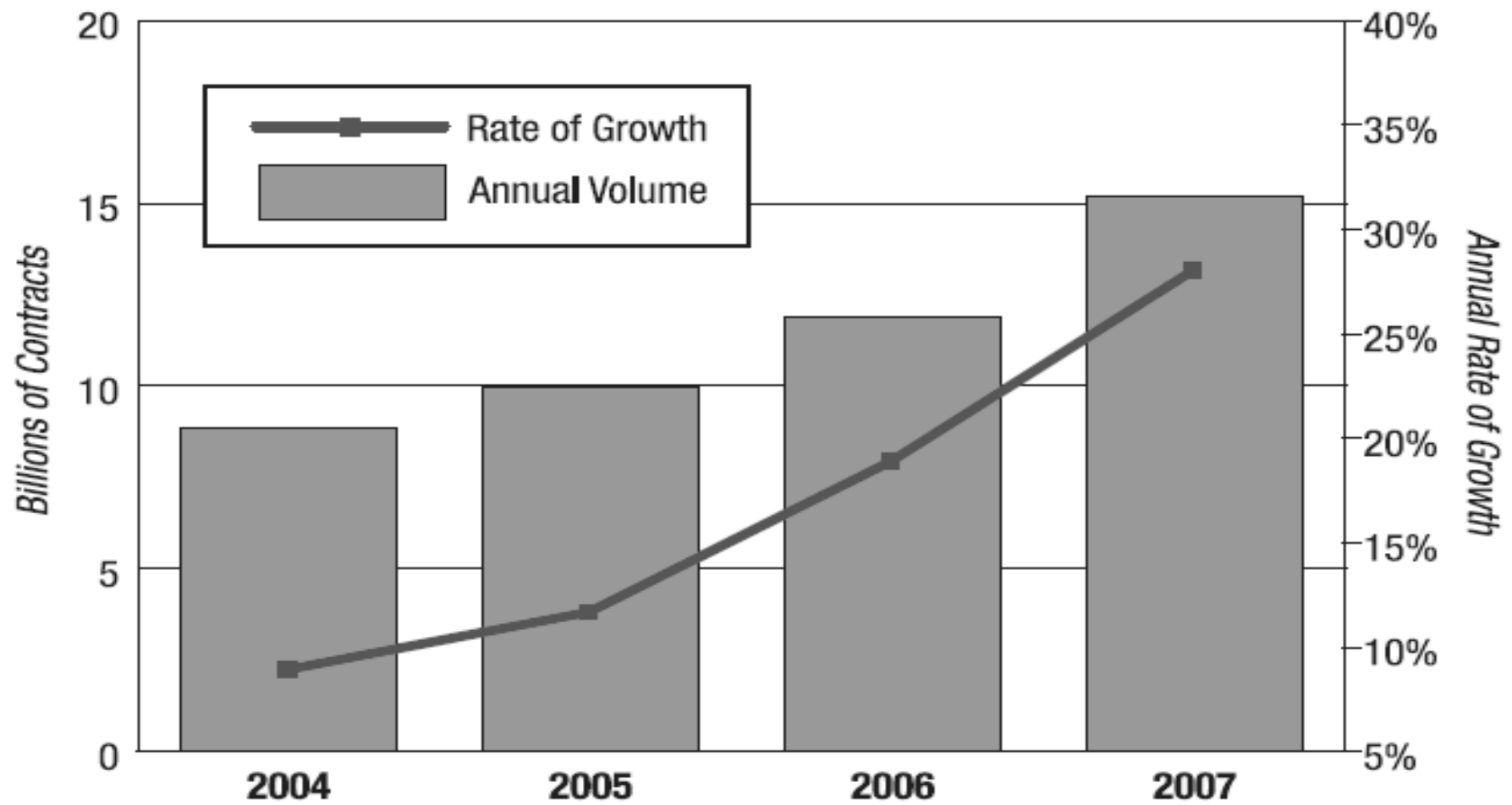
Source: IMF

Light Sweet Crude Oil, Nymex



Shooting Upward

Growth in Global Futures and Options Trading Over the Last Four Years



Source : FIA

Growth rate of transaction volume on exchanges, by category, 2006-2007

- Individual equity 42.25%
- Foreign currency 39.43%
- **Agriculture 32.02%**
- **Industrial metals 29.72%**
- **Energy 28.61%**
- Interest rates 17.14%

- For oil, the volume of exchange traded derivatives is around 15 times larger than the volume of production
- For gold, copper and aluminum, it is around 40 times larger

Source : B. de Combret

The most important commodity markets today

Ranked by number of contracts traded :

- Crude oil, Natural gas, petroleum products
- Soy Meal, Soybean & Corn
- Aluminium, Gold, Copper

Top 20 Energy Futures and Options Worldwide

Ranked by Number of Contracts Traded and/or cleared in 2007

> 232,000,000

Rank	Contract	2007	2006	% Change
1	Light Sweet Crude Oil Futures, Nymex	121,525,967	71,053,203	71.04%
2	Brent Crude Oil Futures, ICE Futures Europe	59,728,941	44,345,927	34.69%
3	WTI Crude Oil Futures, ICE Futures Europe	51,388,362	28,672,639	79.22%
4	European Style Natural Gas Options, Nymex Clearport *	29,921,068	19,515,968	53.32%
5	Natural Gas Futures, Nymex	29,786,318	23,029,988	29.34%
6	Light Sweet Crude Oil Options on Futures, Nymex	28,398,793	21,016,562	35.13%
7	Gas Oil Futures, ICE Futures Europe	24,509,884	18,289,877	34.01%
8	NY Harbor RBOB Gasoline Futures, Nymex	19,791,439	3,883,261	409.66%
9	No. 2 Heating Oil Futures, Nymex	18,078,976	13,990,589	29.22%
10	Henry Hub Swap Futures, Nymex Clearport *	16,207,044	24,157,726	-32.91%
11	Crude Oil Futures, MCX	13,938,813	4,466,538	212.07%
12	Fuel Oil Futures, SHFE	12,005,094	12,734,045	-5.72%
13	Henry Hub Penultimate Swap Futures, Nymex Clearport *	10,117,889	7,973,290	26.90%
14	Gasoline Futures, Tocom	7,529,706	12,932,848	-41.78%
15	miNY Crude Oil Futures, Nymex	5,185,214	9,323,467	-44.39%
16	Natural Gas Options on Futures, Nymex	5,051,879	9,581,663	-47.28%
17	Gasoline Futures, C-Com	3,635,329	4,953,168	-26.61%
18	Kerosene Futures, C-Com	2,685,345	4,027,192	-33.32%
19	Kerosene Futures, Tocom	2,350,819	4,492,904	-47.68%
20	European Style Crude Oil Options, Nymex Clearport *	1,879,999	379,250	395.71%

* Traded primarily off-exchange.

Source : FIA

Top 20 Agricultural Futures and Options Worldwide

Ranked by Number of Contracts Traded in 2007

Rank	Contract	2007	2006	% Change
1	Soy Meal Futures, DCE	64,719,466	31,549,669	105.14%
2	Corn Futures, DCE	59,436,742	67,645,036	-12.13%
3	Corn Futures, CME	54,520,152	47,239,893	15.41%
4	No. 1 Soybean Futures, DCE	47,432,721	8,897,061	433.13%
5	White Sugar Futures, ZCE	45,468,481	29,342,066	54.96%
6	Rubber Futures, SHFE	42,191,727	26,047,061	61.98%
7	Strong Gluten Wheat Futures, ZCE	38,982,788	14,676,238	165.62%
8	Soybean Futures, CME	31,726,316	22,647,784	40.09%
9	Sugar #11 Futures, ICE Futures U.S.	21,263,799	15,100,721	40.81%
10	Wheat Futures, CME	19,582,706	16,224,871	20.70%
11	Corn Futures, CME	14,691,277	11,317,388	29.81%
12	Soy Oil Futures, DCE	13,283,866	10,333,006	28.56%
13	Soybean Oil Futures, CME	13,170,914	9,488,524	38.81%
14	Non-GMO Soybean Futures, TGE	12,280,932	9,885,557	24.23%
15	Soybean Meal Futures, CME	12,213,315	9,350,043	30.62%
16	Live Cattle Futures, CME	8,587,973	8,209,698	4.61%
17	Soybean Options on Futures, CME	8,215,582	6,042,797	35.96%
18	Pepper Futures, NCDEX	7,488,534	4,535,589	65.11%
19	Lean Hog Futures, CME	7,264,832	6,481,001	12.09%
20	Rubber Futures, Tocom	7,062,252	9,661,388	-26.90%

Source : FIA

Top 20 Metals Futures and Options Worldwide

Ranked by Number of Contracts Traded in 2007

Rank	Contract	2007	2006	% Change
1	High Grade Primary Aluminum Futures, LME	40,229,693	36,418,131	10.47%
2	Gold Futures, Nymex	25,060,440	15,917,584	57.44%
3	Copper Futures, LME	21,420,450	18,864,246	13.55%
4	Gold Futures, Tocom	18,203,194	22,228,198	-18.11%
5	Copper Futures, SHFE	16,328,011	5,393,419	202.74%
6	Copper Futures, MCX	15,375,506	5,293,964	190.43%
7	Special High Grade Zinc Futures, LME	12,556,285	11,706,008	7.26%
8	Zinc Futures, SHFE	10,215,449	*	
9	Silver Futures, MCX	9,183,273	9,498,544	-3.32%
10	Platinum Futures, Tocom	9,169,890	11,018,069	-16.77%
11	100 oz. Gold Futures, CME	7,898,027	8,452,484	-6.56%
12	Gold Futures, MCX	7,604,891	9,957,351	-23.63%
13	Silver Futures, Nymex	6,817,137	5,433,063	25.48%
14	Silver M Futures, MCX	6,258,376	2,982,222	109.86%
15	Aluminum Futures, SHFE	4,823,552	13,931,476	-65.38%
16	Standard Lead Futures, LME	4,697,862	4,568,140	2.84%
17	Primary Nickel Futures, LME	3,792,788	4,177,557	-9.21%
18	Copper Futures, Nymex	3,753,168	3,281,312	14.38%
19	Gold Options on Futures, Nymex	3,554,858	3,708,573	-4.14%
20	Zinc Futures, MCX	3,551,909	562,647	531.29%

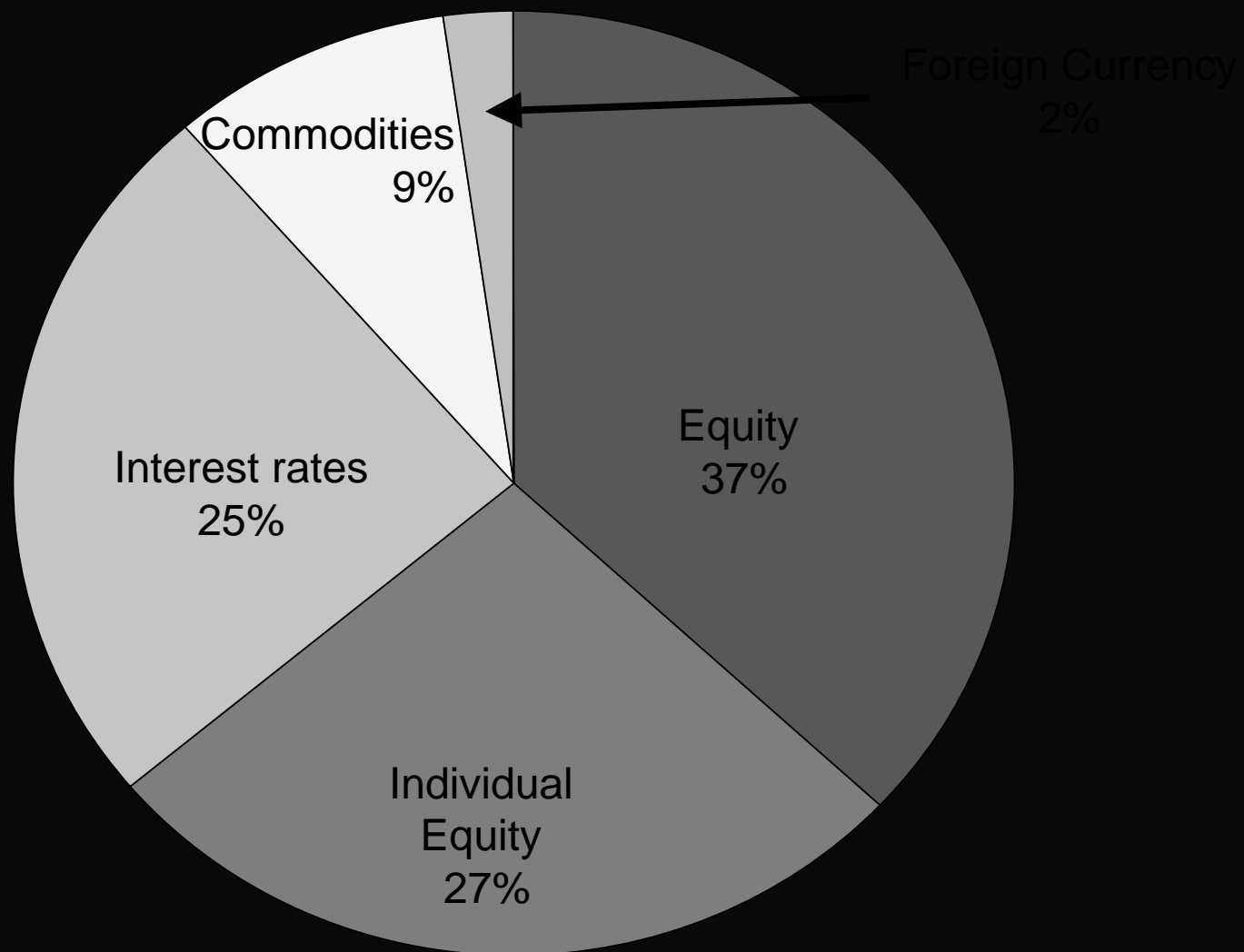
* Not listed for trading in 2006.

Source : FIA

The relative importance of commodity markets

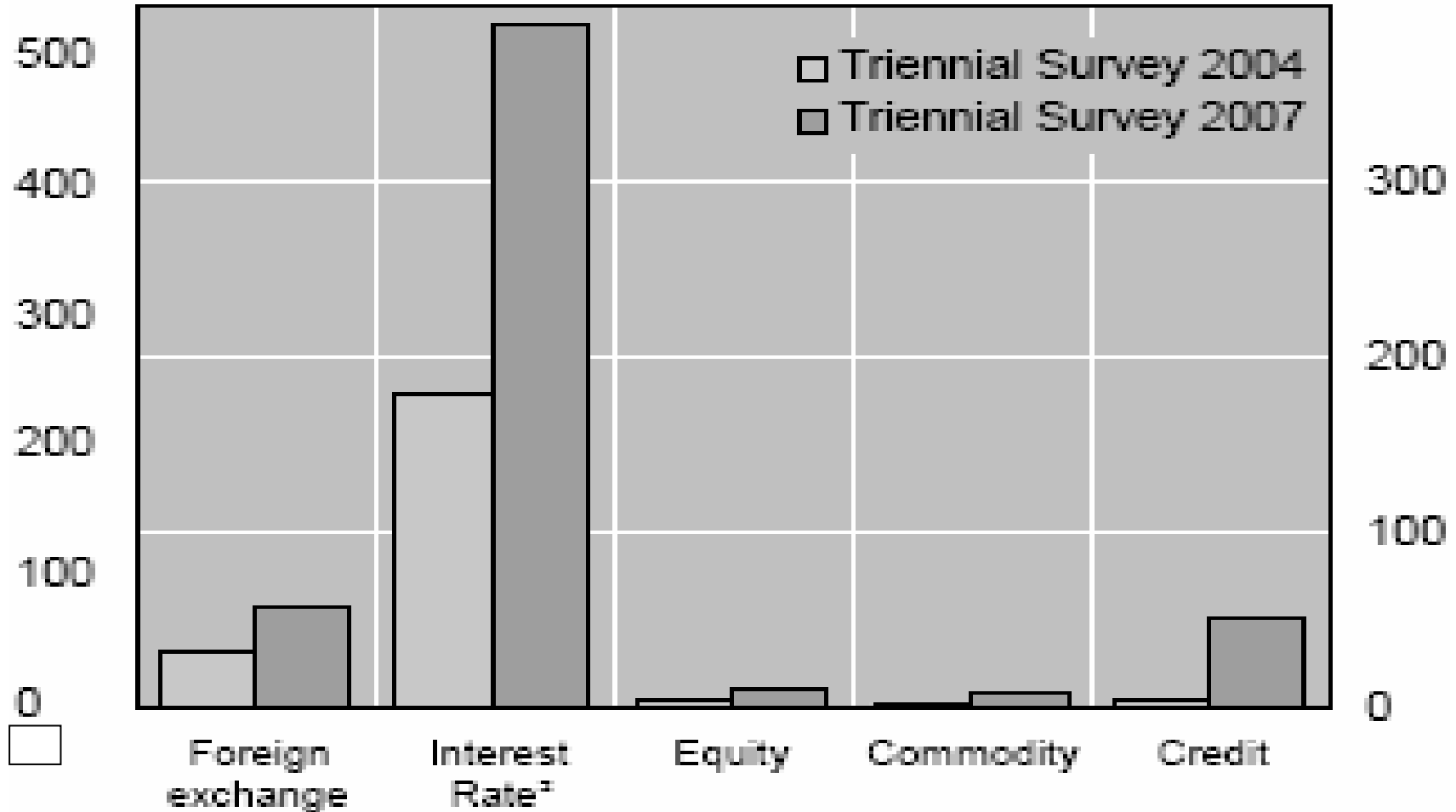
- Exchange traded contracts
- OTC markets

Exchange traded contracts



Positions in OTC derivative markets

Notional Amounts by risk category



Source : BIS, November 2007

Unit : USD billion

2. The characteristics of commodity prices

- Importance of quality differentials
 - A lot of cross hedging in commodity markets
 - Derivative products (swaps) on price differentials
- Seasonality in the prices and basis

$$\text{Basis} : F(t,T) - S(t)$$

where:

- $F(t,T)$ is the futures prices at t for delivery at T
- $S(t)$ is the spot price

Seasonality is important for agricultural products (supply side) and for energy (demand side).

Seasonality of the basis of petroleum products:

During the winter, fuel oil inventory are rare and the basis is negative; during the summer, stocks are abundant and the basis is positive.

Commodity prices' volatility

- High level of prices' volatility

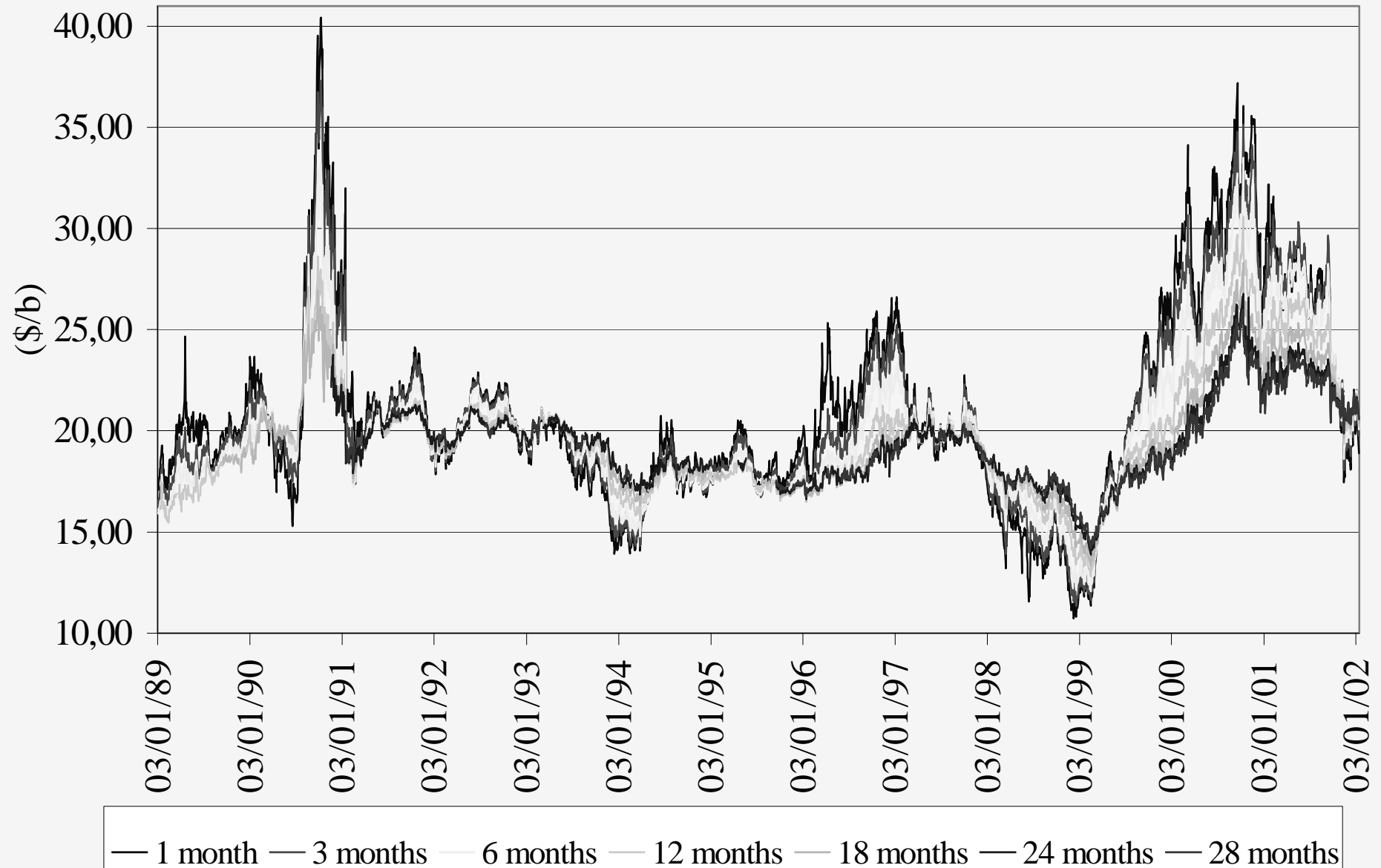
Market	Annualized Volatility		Annualized Volatility (bp)	
	2006	2007	2006	2007
Interest Rates (Money Market)				
Eurodollar	10.3%	17.1%	54.5	80.2
Euribor	10.7%	9.5%	35.8	41.5
Euroyen	56.6%	26.2%	28.8	21.8
Interest Rates (Government Bonds)				
10-year Treasury Note	3.8%	5.2%		
Bund	3.8%	4.1%		
JGB	3.6%	3.4%		
Equity				
S&P 500	9.7%	15.9%		
Euro Stoxx 50	14.4%	15.5%		
Topix	18.9%	20.6%		
Foreign currencies				
British pound	7.6%	6.9%		
Euro	7.2%	6.1%		
Japanese yen	8.0%	9.3%		
Commodities				
Crude oil	26.4%	29.7%		
Natural gas	62.2%	47.2%		
Wheat	29.5%	33.7%		
Corn	28.3%	32.3%		
Copper	38.5%	32.9%		
Aluminum	32.2%	22.1%		

Source : FIA

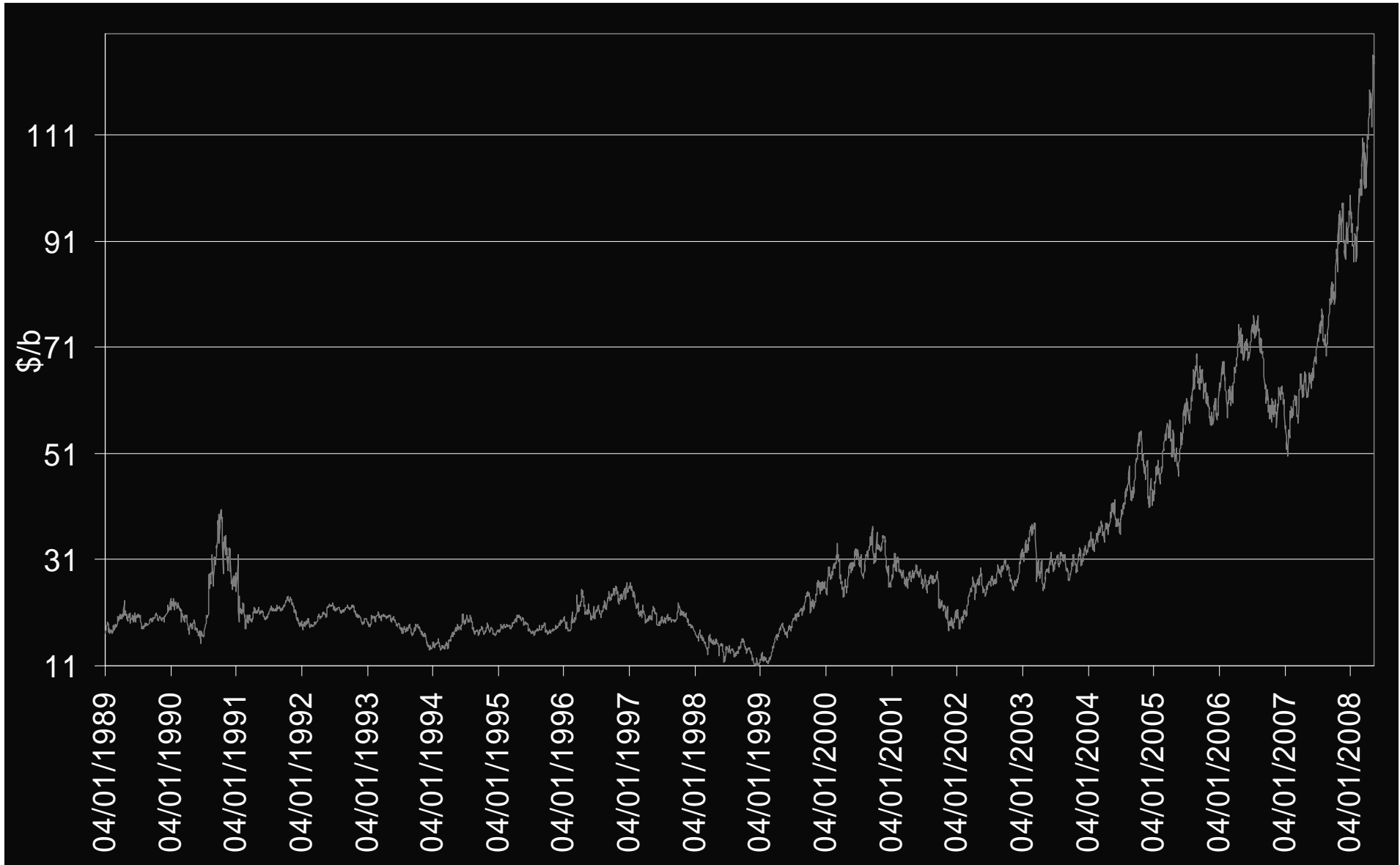
Commodity prices' volatility

- High level of prices' volatility
- Volatility rises when commodity prices rise
- Mean reverting behavior
 - for storable commodities
 - still relevant ?

WTI : Futures prices, 1989-2002



Light Sweet Crude Oil, Nymex



Movements of price curves

- Commodity futures contracts' maturity :
 - Up to 7 years for crude oil
 - Up to 3-4 years for agricultural products and metals
- Samuelson effect
 - Decreasing pattern of volatilities along the prices curve
 - Propagation of shocks. It depends on:
 - the stocks' level (the effect sometimes disappears when stocks are abundant)
 - production, transportation and storage costs

Movements of prices curves

- Principal component analysis
- Three kind of movements :
 - parallel shift in the curve (level factor)
 - relative shift of the curve (steepness factor)
 - curvature factor (only for long-term contracts)

3. New trends in research on commodities

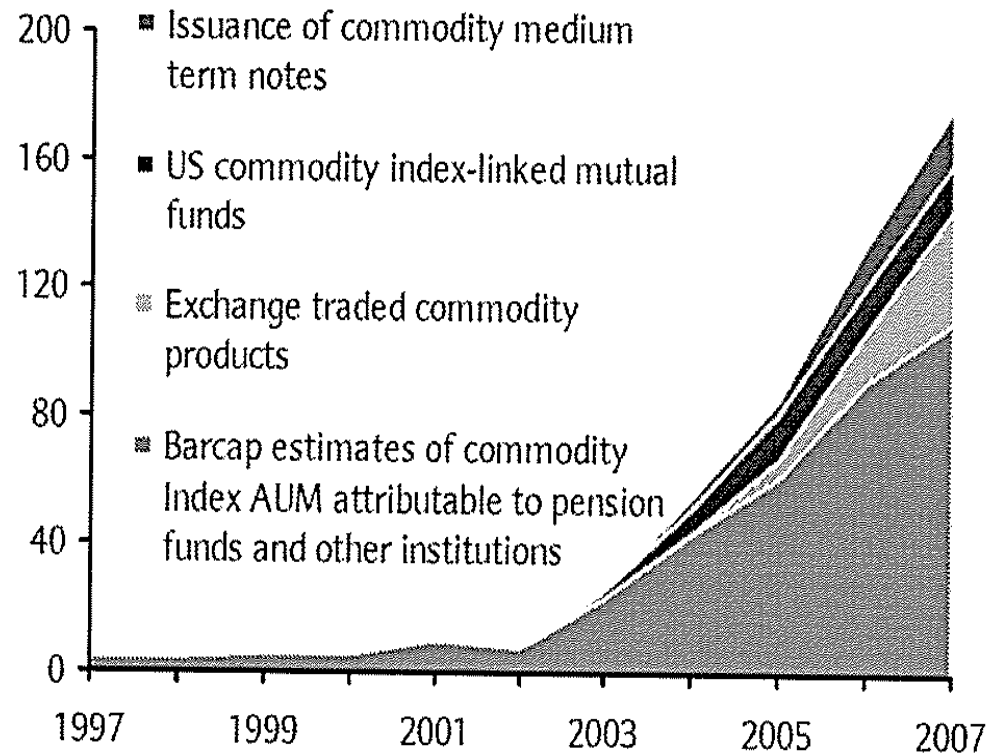
- **Subjects inspired by other financial markets**
 - Market efficiency (technical analysis)
 - IFRS (International Financial Reporting Standards) :
 - Valuation of inventories
 - Valuation of mineral reserves
 - Hedging versus speculation (cross hedging)

- **Subjects that are more specific to commodities:**
 - Real options
 - Mineral reserves
 - Extensively used in the petroleum industry:
auctions on undeveloped fields
 - Market integration and price convergence
 - In the energy field
 - Between energy and agricultural products
 - The influence of speculation on prices
 - CFTC data
 - Commodity as a new class of assets

Commodity as a new class of asset

- Development of commodity indexes / futures on c.i.
 - CRB (Commodity Research Bureau)
 - S&P GSCI : (S& P Goldman Sachs Commodity Index)
 - S&P GSCI Excess Return Index
- Commodity are used for diversification purposes
 - Massive investments in commodities because of their counter-cyclic nature

Commodity investments assets under managements (billion \$)



Source: Barclays

- Most active players:
 - Commodity Trading Advisors
 - Hedge funds
 - Pension funds
 - Insurance companies
- Invest in commodity indexes (S&P GSCI)
- Intend to invest more in the future
Barclays Capital Survey (2007) :
 - Two years ago, 15% of institutional investors intended to invest more than 10% of their portfolios in commodities
 - Today, they are 50%