Risk and Portfolio Management Spring 2010

Exchange Traded Funds:

Gaining Exposure to Sectors

Exchange-traded funds

ETF: Investment vehicles similar to mutual funds but "look like stocks"

        -- traded on an exchange

        -- trading is similar to stocks (long, short, margin)

ETF: can be viewed as a holding company or a fund

        -- started as index trackers

        -- actively managed ETFs since mid 2000's

Arbitrage: authorized participants can **create or redeem** ETFs in
   ``creation units''

        -- creation units: 25K to 100K shares

        -- APs often act as market makers, providing liquidity

History

Milestones:
1993: first US ETF
1998: first European ETFs
2008: first actively managed ETFs

History:
1989: Index Participation Shares, stopped by Chicago Mercantile Exchange
1993: SPY Tracking S&P 500 (a.k.a. Spiders or SPDRS, issuer: State Street)
1996: BGI creates WEBS (World Equity Benchmark Shares), later called I-Shares
1998: Sector SPDRS track 9 sectors of the S&P 500
2008: 680 ETFs in US with 610B in assets, increase of 125B in 12 months
January 2010: US ETF market breaks the 1,000 billion mark in AUM

Global ETF asset growth, as at end August 2009

Assets US$ Bn

ETFs

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Q1-09	Q2-09	Aug-09
ETF Assets Total	$1	$1	$2	$5	$8	$18	$40	$74	$105	$142	$212	$310	$412	$566	$797	$711	$633	$789	$891
ETF Commodity Assets									$0	$0	$0	$0	$1	$3	$6	$10	$13	$16	$18
ETF Fixed Income Assets								$0	$0	$4	$6	$23	$21	$36	$60	$104	$116	$133	$145
ETF Equity Assets	$1	$1	$2	$5	$8	$18	$40	$74	$105	$138	$206	$286	$390	$526	$730	$596	$503	$639	$727
# ETFs	3	3	4	21	21	31	33	92	202	280	282	336	461	714	1172	1592	1634	1707	1,773

Source: ETF Research and Implementation Strategy Team, Barclays Global Investors, Bloomberg

Largest issuers

Top 5 ETF providers around the world ranked by AUM, as at end August 2009

PROVIDER	Aug-09			YTD CHANGE				
	# ETFs	AUM (US$ BN)	% TOTAL	# ETFs	% ETFs	AUM (US$ BN)	% AUM	% MARKET SHARE
iShares	391	$429.32	48.2%	29	8.0%	$100.84	30.7%	2.0%
State Street Global Advisors	104	$139.33	15.6%	6	6.1%	-$6.67	-4.6%	-4.9%
Vanguard	40	$71.71	8.1%	2	5.3%	$26.55	58.8%	1.7%
Lyxor Asset Management	102	$40.78	4.6%	-13	-11.3%	$7.32	21.9%	-0.1%
db x-trackers	110	$31.34	3.5%	12	12.2%	$7.27	30.2%	0.1%

Source: ETF Research and Implementation Strategy Team, Barclays Global Investors, Bloomberg

ETFs by Asset Class

Global ETF assets by type of exposure, ranked by AUM, as at end August 2009

Region of Exposure	Aug-09				YTD Change				
	# ETFs	Total Listings	AUM (US$ BN)	% TOTAL	# ETFs	Total Listings	AUM Change	% AUM	% TOTAL
Equity	1,439	2,558	$726.90	81.6%	95	306	$130.00	21.8%	-2.3%
North America - Equity	474	650	$378.11	42.5%	2	24	$35.31	10.3%	-5.8%
Emerging Markets - Equity	259	522	$122.76	13.8%	29	77	$51.84	73.1%	3.8%
Europe - Equity	400	841	$98.88	11.1%	50	147	$23.28	30.8%	0.5%
Asia Pacific - Equity	144	234	$61.58	6.9%	9	23	$9.36	17.9%	-0.4%
Global - Equity	100	243	$15.45	1.7%	3	30	$4.55	41.7%	0.2%
Global (ex-US) - Equity	62	68	$50.13	5.6%	2	5	$5.65	12.7%	-0.6%
Fixed Income	232	417	$144.90	16.3%	71	124	$41.14	39.6%	1.7%
Fixed Income - All (ex-Cash)	215	384	$135.98	15.3%	67	116	$44.56	48.8%	2.4%
Fixed Income - Cash (Money Market)	17	33	$8.93	1.0%	4	8	-$3.42	-27.7%	-0.7%
Commodities	58	118	$17.72	2.0%	10	40	$8.15	85.2%	0.6%
Mixed (Equity & Fixed Income)	28	28	$0.43	0.0%	2	2	$0.15	53.2%	0.0%
Currency	14	14	$0.52	0.1%	1	1	$0.13	34.5%	0.0%
Alternative	2	2	$0.05	0.0%	2	2	$0.05	100.0%	0.0%
Total	1,773	3,137	$890.52	100.0%	181	475	$179.62	25.3%	

Source: ETF Research and Implementation Strategy Team, Barclays Global Investors, Bloomberg

Main advantages of ETFs

Investors

-- Diversification at an affordable price

-- Low expense ratios

-- Behave like index mutual funds but are more flexible

-- Limit orders, short-selling, options

-- Lower fees

-- Tax efficiency: lower turnover than MFs (no need to sell assets each time
   someone sells, less capital gains)

-- No ``load'' (Entrance fees, or exit fees, like many mutual funds)

Professionals

-- Used for trading & hedging by pros (HF managers, traders)

-- Gain exposure to a sector or country easily

-- Proxies for market factors for explaining stock returns

20 most active US ETFs (as of Feb 2009)

TICKER	DESCRIPTION	AUM	AVG VOL (3m)	EX RATIO (bps)
SPY	0.1 SP500	93B	366M	8
EFA	MSCI Intl Eq	31B	36M	34
GLD	Gold 0.1 oz	21B	13M	NA
EEM	MSCI Emerging Mkts.	19B	100M	72
IVV	SP 500 I-Share	15B	7M	9
QQQQ	Nasdaq 100 Index 1/10	12B	150M	20
IWM	Russel 2000	10B	77M	20
IWF	Russel 1000 Growth	10B	8M	20
AGG	Bond ETF	9.5B	0.7 M	20
IWD	Russel 1000 Value	9.2B	7M	20
VTI	Vanguard MSCI 1300	9.2B	11M	71
DIA	Dow 30	8.9B	32M	14
TIP	Inflation-prot bonds	8.6B	0.7M	20
XLF	Financial SPDR	7.7B	200M	23
SHY	1-3 yr Treasurys	7.7B	1.3M	15
LQD	IG Corporates	6.9B	1.4M	15
MDY	Mid-Cap SPDR	6.8B	10M	25
FXI	China Xinghua 25	5.9B	43M	74
IWB	Russel 1000	5.7B	9M	15
EWJ	Japan	5.6B	32M	52

Sector ETFs

TICKER	DESCRIPTION	AUM ($B) *	VOL ($M)
XLF	Financial SPDR	7.7	177
XLE	Energy SPDR	4.4	40
OIH	Oil Services HLDR	5	11
XLK	Tech SPDR	1.8	8
IGE	Natural Resources	1.2	0.8
PHO	Water Resources	1.3	0.5
XLP	Consumer Staples	2.23	6.7
XLV	Health Care	2.06	6
XLU	Utilities	1.9	8
MOO	Agribusiness	0.6	0.5
GDX	Gold Miners	2.7	7.5
PPH	Pharmaceuticals	1.5	0.6
PBW	Clean Energy	0.6	0.8
IYR	Real Estate	1.66	37
BBH	Biotech HOLDRS	1.38	0.1
XLI	Industrials	1.1	12.1
SMH	Semiconductors	0.75	12
IYE	Energy Ishare	0.6	1.5
IBB	Biotechnology	na	0.9
IYW	Technology	0.6	0.3
XME	Metals & Mining	0.2	1.8
RTH	Retail	0.35	5
RKH	Regional Banks	0.3	2.5
IYT	Transportation	0.37	0.8
XLY	Consumer Discretionary	0.6	7

*Feb 2009

Country ETFs

TICKER	DESCRIPTION	AUM ($B)	VOL ($M)
EWZ	MSCI Brazil	3.5	20
EWJ	MSCI Japan	5.6	32
FXI	Xinghua 25	5.94	43
EWT	Taiwan	1.3	12
EWY	Korea	1.26	3.8
EWC	Canada	1	1.8
EWH	Hong Kong	1.1	5
EWS	Singapore	0.7	3
RSX	Russia	0.4	1.3
EWA	Australia	0.5	2.9
EWW	Mexico	0.5	3.2

ETFs as Risk-Factors?

$$I_1, I_2, \ldots I_n \qquad \text{reference ETFs}$$

$$\frac{\Delta S}{S} = \sum_{k=1}^{n} \beta_{sk} \frac{\Delta I_k}{I_k} + \varepsilon_s$$

-- Unlike eigenvectors, ETFs can have strong correlations

-- Use sparse regression techniques to map stock to ETFs

-- Use stock's sector to match stock to ETF

-- In case of several ETFs per sector, use liquidity, highest R-squared

PCA Eigenportfolios as Risk Factors

$$\frac{\Delta S}{S} = \sum_{j=1}^{m} \beta_{sj} F_j + \varepsilon_s$$

$$F_j = \text{return of eigenportfolio} \ \# \ j$$

$$F_j = \sum_{i=1}^{N} \left(\frac{V_i^{(j)}}{\sigma_i} \right) R_i = \sum_{i=1}^{N} w_i^{(j)} R_i$$

-- Factors arise directly from data analysis
-- Uncorrelated factors

-- Identification problem
-- Noise

Identifying PCA Factors with ETFs by regression

$$F_j = \sum_{k=1}^{m} \beta_{jk} \frac{\Delta I_k}{I_k} + \varepsilon_j$$

Multiple regression: solve $\quad \min_{\alpha,\beta} \sum_{t=1}^{T} \left(F_{jt} - \alpha - \sum_{k=1}^{n} \beta_{jk} \frac{\Delta I_{kt}}{I_{kt}} \right)^2$

Sparse regression: Matching Pursuit algorithm

R-squared statistic $\qquad R^2 = 1 - \frac{Var(\varepsilon)}{Var(F)}$ $\qquad$ Good fit=high R-squared

Matching Pursuit Algorithm

$X_{1t}, ..., X_{nt}$ explanatory variables $E(X_i) = 0, E(X_i^2) = 1$

Y_t dependent variable (target) $E(Y) = 0, E(Y^2) = 1$

$$j(1) = \arg\max_j \langle Y, X_j \rangle = \arg\max_j \frac{1}{T} \sum_{t=1}^{T} Y_t X_{jt}$$

Find largest inner product
Subtract projection

$$\varepsilon^{(1)} = Y - \langle Y, X_{j(1)} \rangle X_{j(1)}$$

....

$$j(n) = \arg\max_j \langle \varepsilon^{(n-1)}, X_j \rangle, \quad \gamma_n = \langle \varepsilon^{(n-1)}, X_{j(n)} \rangle$$

Iterate, replacing *Y* by
residuals

$$\varepsilon^{(n)} = \varepsilon^{(n-1)} - \langle \varepsilon^{(n-1)}, X_{j(n)} \rangle X_{j(n)} = \varepsilon^{(n-1)} - \gamma_n X_{j(n)}$$

if $\langle (\varepsilon^{(n)} - \varepsilon^{(n-1)})^2 \rangle \leq v$ stop

Stop when gain is negligible

....

$$\beta_j = \sum_{j(m)=j} \gamma_m, \qquad Y = \sum_{j=1}^{n} \beta_j X_j + \varepsilon$$
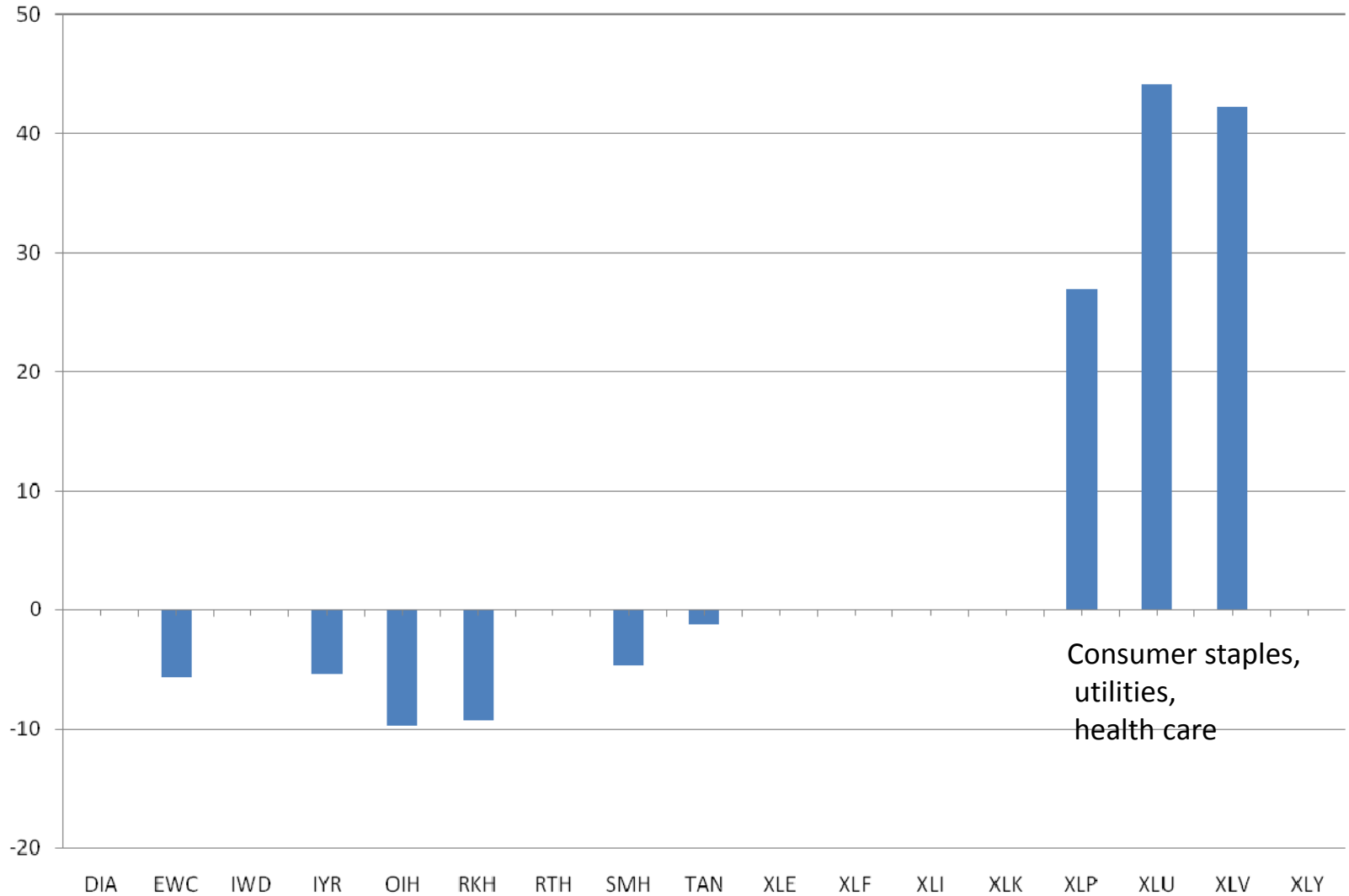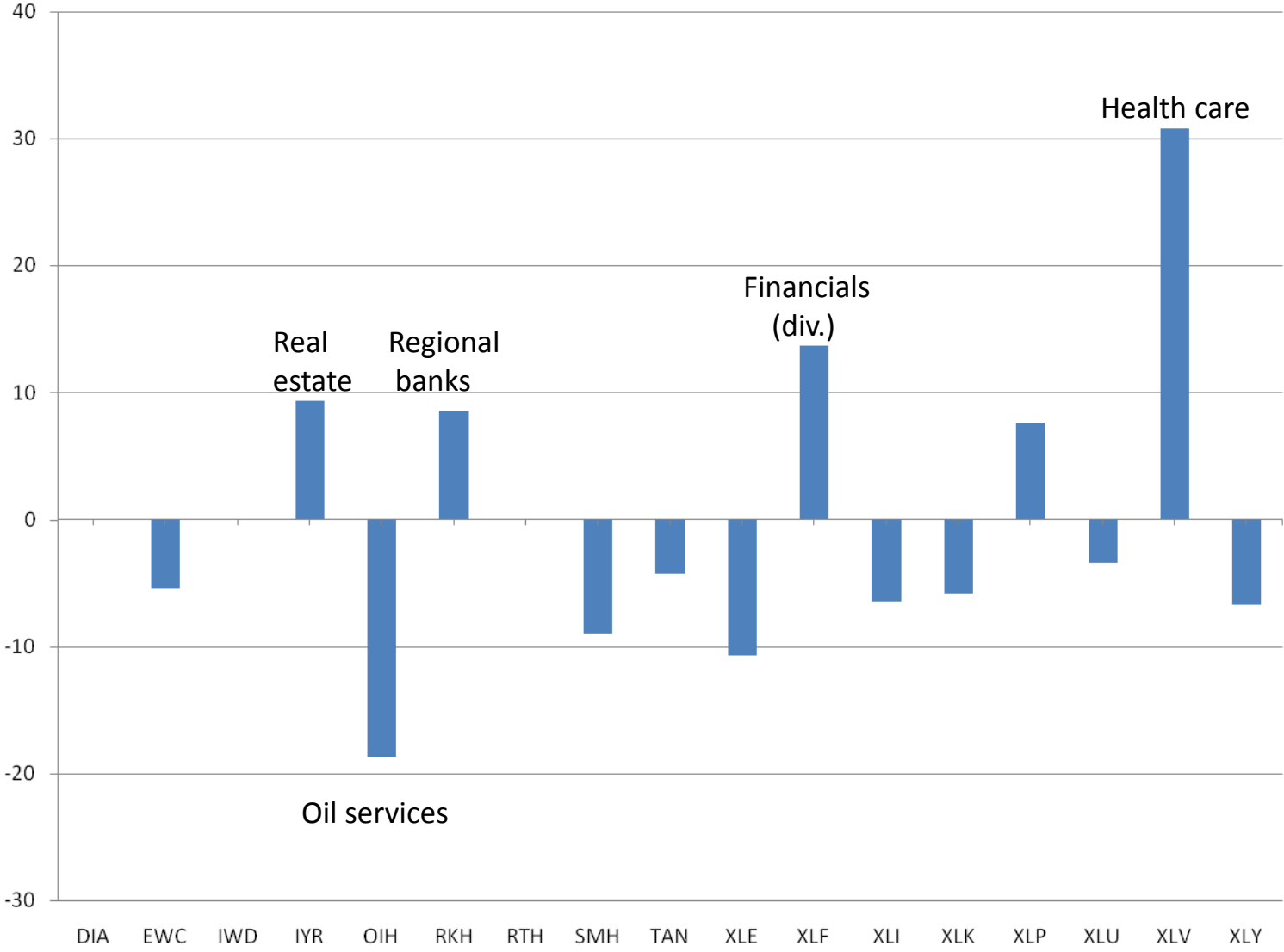
Factor #1 versus SPY daily returns

$y = 0.9856x + 0.0223$
$R^2 = 0.9716$
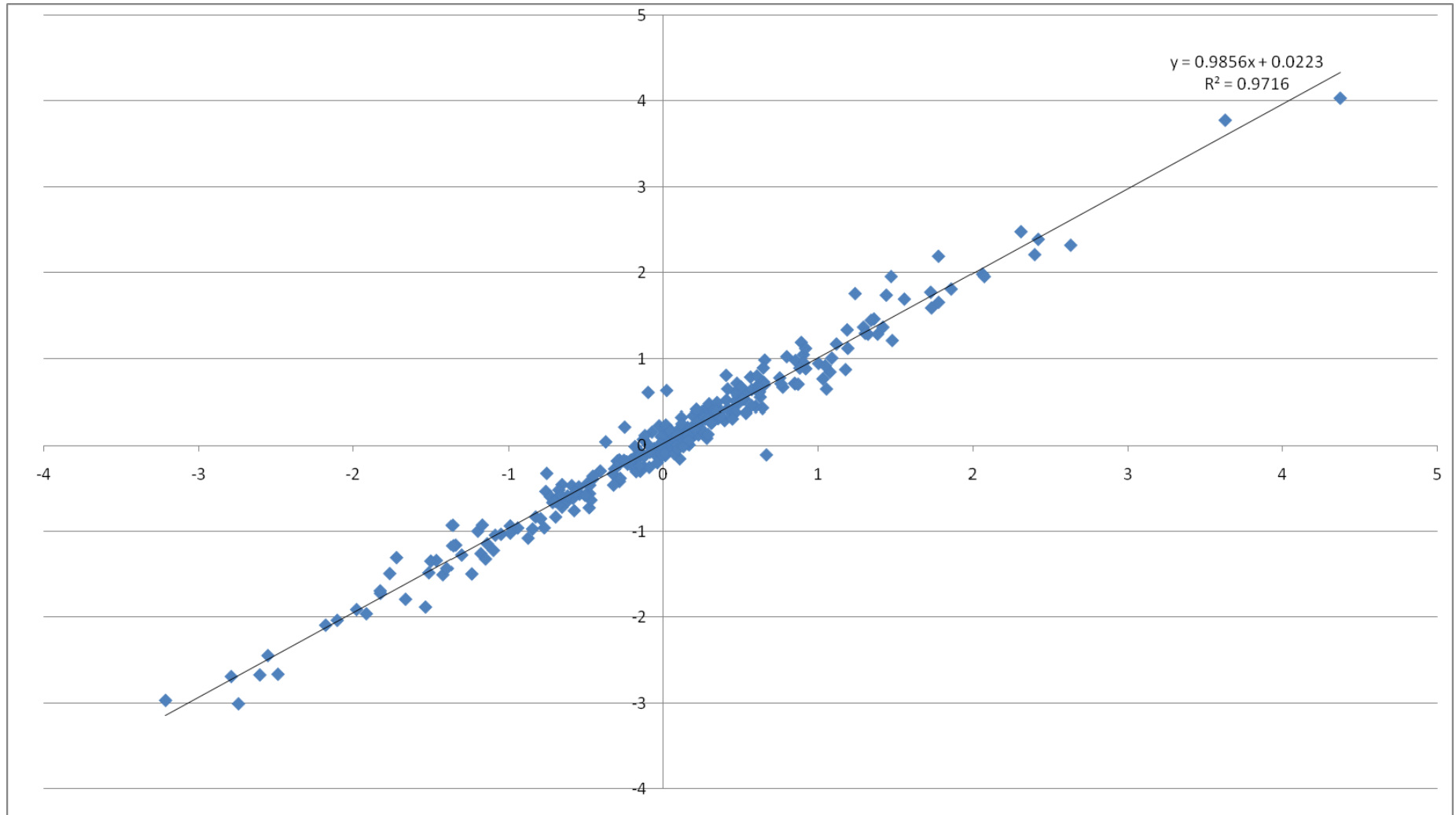
Factor # 1 returns : MP regression on ETFs
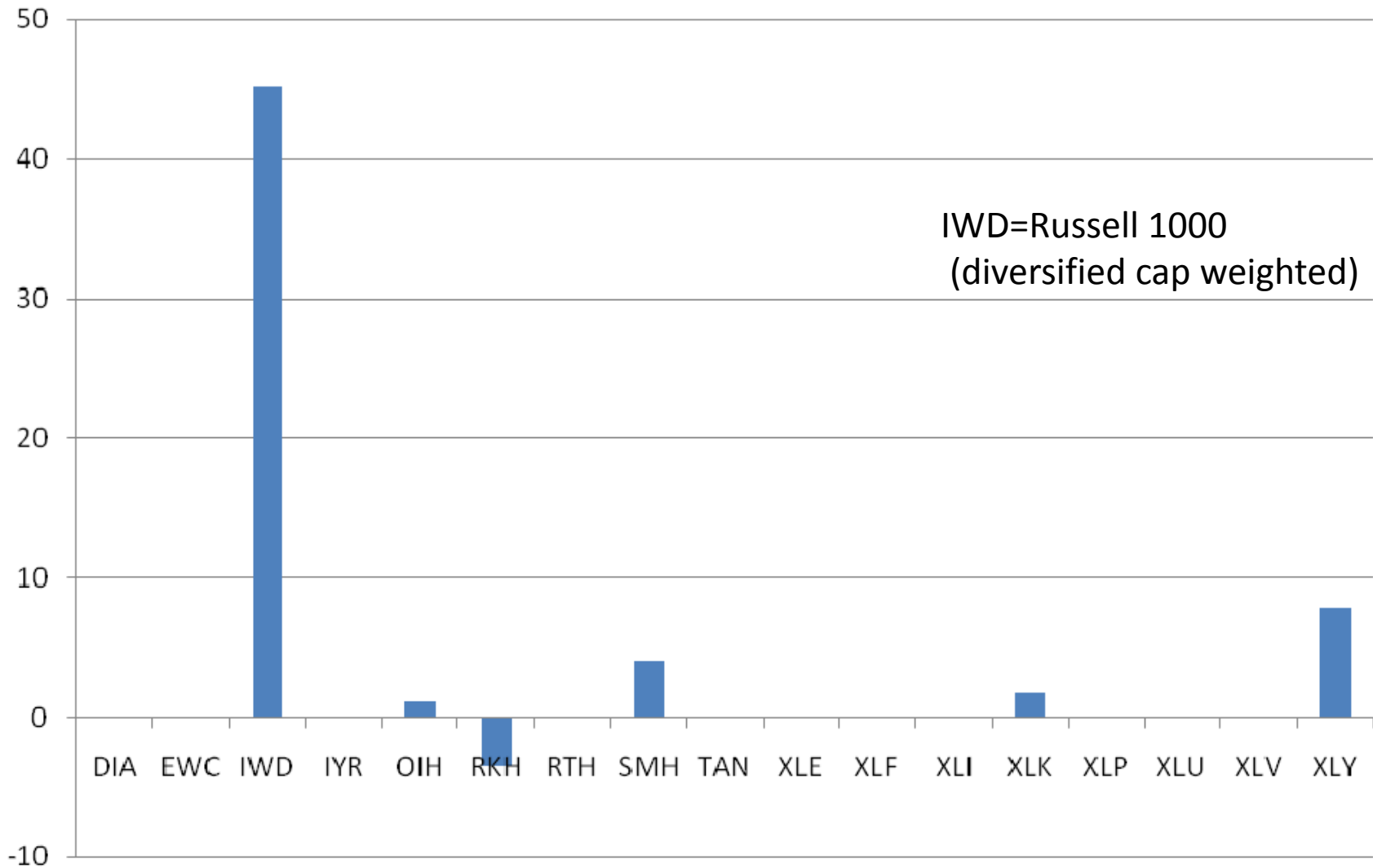
Factor # 2 returns : MP regression on ETFs

Consumer staples,
utilities,
health care

Factor # 3 returns : MP regression on ETFs

Factor # 4 returns : MP regression on ETFs