NOWHERE TO RUN, NOWHERE TO HIDE: ASSET DIVERSIFICATION IN A FLAT WORLD

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Background and Motivation

- Diversification is and has long been fundamental for risk mitigation
  - **Old Evidence** - Book of Ecclesiastes (935 B.C.): “But divide your investments among many places, for you do not know what risks might lie ahead”; Moral Essays on Proverbs, 1710 by S. Palmer: “Not to venture all your eggs in one basket”.
  - **More Recent Evidence** - Major pension funds, e.g., California Public Employees Retirement System (CalPERS), explicitly claim to diversify investments among stocks, bonds, and real estate to maximize returns at a prudent level of risk; Morningstar Investment Advisory Services advocates diversification to provide exposure across sectors and geographies to reduce portfolio risk

Background and Motivation

- Anecdotal evidence suggests diversification is on the wane
  - **Financial Crises**- Everyone losing due to high correlations among assets
  - **The World is Flat –** Globalisation due to innovations in technology, extensions of global supply chain and increases in global wealth
- Limited Diversification affects investment strategies, fund composition and macroeconomic management
- Little is known about the potential for risk diversification across assets classes internationally and whether it has eroded over time
- Generally linkages or correlations are documented with no explicit modelling of diversification

Related Literature

- Correlations within a single asset class have been examined, sometimes with emphasis on developed versus emerging markets (Bekaert, Hodrick, and Zhang (2009), Bekaert and Harvey (2014), Christofersson, Errunza, Jacobs and Langlois, 2012, Bekaert and Harvey, 2014; Eiling and Gerard, 2014; Conlon, Cotter and Gencay, 2015)
- International evidence on cross-country correlation is mixed: lower for emerging equity markets (Berger, Pukthuanthong and Yang, 2011; and Goetzmann, Li and Rouwenhorst, 2005), but relatively large and rising correlations have been found for tail return dependence (Christofferson, Errunza, Jacobs and Langlois, 2012; and You and Daigler, 2010).
- Lin and Lin (2011) and Liow (2010) assess integration between securitized real estate and equity markets

Integration and Diversification

- We adopt new indexes of diversification potential among real estate, equity and fixed income markets
- Results are for a large spectrum of international markets both individually and in groups
- Diversification index results are within countries, across countries, within asset classes and across asset classes
- Results are presented for
  - Different time based cohorts (e.g., Pre and post 2000s)
  - Different geographical cohorts (e.g., Developing and emerging markets)
  - Diversification indexes and their relation with other Risk measures
  - Robustness of diversification indexes across market cycles, volatility, and credit risk regimes
  - Trends in diversification and association with financial and developmental factors

Preview of Results

- We find a pronounced decline in the diversification indexes within asset classes, across asset classes, within countries and across countries
- Decline in diversification is precipitous in the post-2000 period
- Decline in diversification is strongest for more developed economies
- Diversification results are robust across bull and bear markets and periods of high and low VIX (market volatility) and TED spread (credit risk)
- The generalized downtrend in diversification potential is associated with higher levels of investment risk
- Diversification indexes are related to financial and developmental factors including VIX and the Internet

Our Diversification Indexes

- Our diversification index in % is [100 – Level of Integration].
- If markets are perfectly integrated, diversification index is 0
- Level of Integration is the R-square from fitting a multi-factor model for daily returns data of each asset index within a calendar year
- Factors
  - Based on Principal Components (PCs) for a given year
  - PCs are extrapolated to each following year to obtain the level of integration annually
- Asset indexes include a large number of countries and three assets classes (Equities, 89; Bonds, 25; REITs, 19) annually from 1986 through 2012

The Rationale for the R-Square Measure of Integration

- References:
  - Pukthuanthong, K., and Roll, R., 2009, Global Market Integration: An alternative measure and its application, *Journal of Financial Economics* 94, (November), 214-232.
  - Roll, R. 2013, Volatility, Correlation and Diversification in a Multi-Factor World, *Journal of Portfolio Management* (Winter), 1-8.
- The correlation between two indexes is not a measure of diversification potential when there are two or more factors driving returns in both indexes.
- The reason is that a mimicking portfolio for index B can be constructed from the individual assets in index A. A mimicking portfolio composed solely of index A assets can be constructed to have the same betas on the factors as index B.
- If the mimicking portfolio from A also has zero idiosyncratic risk, it is perfectly correlated with the index B, so the there is no benefit from diversification.
  - The only benefit arises if the mimicking portfolio from A with minimal idiosyncratic risk still has some idiosyncratic risk.

For example: Minimum Variance from combining B with B's Mimicking Portfolio of Assets in A

- Minimum variance portfolio from combining index B with the β_B re-structured portfolio composed of assets in class A.
  - It has a weighting w in index B (and 1-w in the re-structured portfolio A) equal to

$$w = Var(e_{A,t})/[Var(e_{A,t})+Var(e_{B,t})].$$

Where e is the idiosyncratic volatility in the multi-factor model

  - I.e., if the B-mimicking portfolio from the class A assets has no idiosyncratic component, diversifying into B brings absolutely no benefit in terms of risk reduction; w is zero.
    - Assuming, as usual, that the idiosyncratic terms are uncorrelated with the factors and with each other.

Integration Vs. Correlation

- Even if the R-squares are 100% for two indexes on the same factors, the indexes need not be highly correlated.
  - Two indexes can even be negatively correlated and yet there is zero benefit from diversification.
  - Consider the simplest example where ALL asset returns are driven by the simplest multi-factor model, just two factors, f_1 and f_2 affecting every asset, i, with sensitivities, β, and idiosyncratic risk e,

$$R_{i,t} = E_i + \beta_{i,1} f_{1,t} + \beta_{i,2} f_{2,t} + e_{i,t}$$

- Suppose that two asset classes, A and B, have popular broad, well-diversified market indexes; indeed, so well-diversified that both have negligible remaining idiosyncratic volatility; i.e.,

$$R_{A,t} = E_A + \beta_{A,1} f_{1,t} + \beta_{A,2} f_{2,t}$$

$$R_{B,t} = E_B + \beta_{B,1} f_{1,t} + \beta_{B,2} f_{2,t}$$

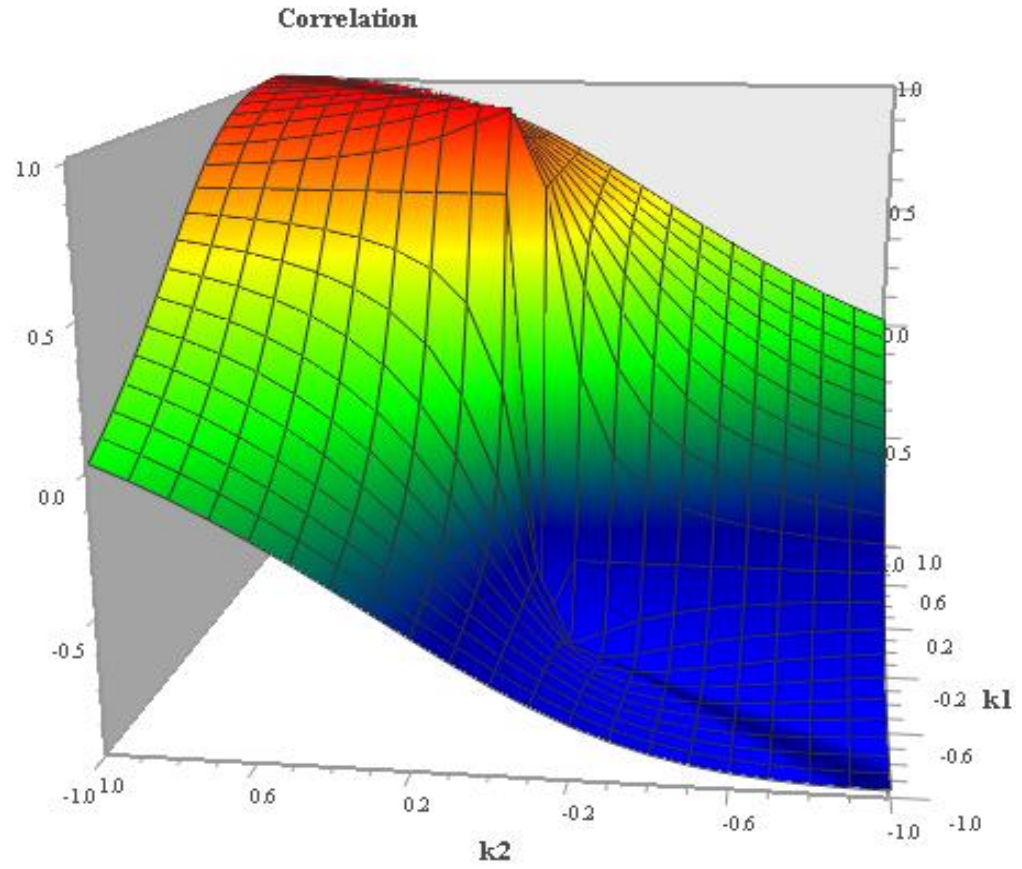
- The correlation between indexes A and B will be perfect if and only if for some $k \neq 0$ both $\beta_{A,1}=k\beta_{B,1}$ and $\beta_{A,2}=k\beta_{B,2}$ (The formal proof relies on the Cauchy inequality)

Integration and Correlation (cont.)

- Suppose factor 1 is related to shocks in real output and factor 2 is related to shocks in expected inflation
- Class A consists of equities and Class B consists of bonds
- A positive shock in factor 1 would increase returns in A but not affect B as much
- Depending on identities of the underlying factors and the respective sensitivities of indexes A and B, their correlation could even be negative even though they are perfectly dependent on the same underlying factors
- Equity Example: Saudi Arabia and Hong Kong

Suppose the two factors have the same volatility and are uncorrelated. Let $\beta_{A,1}=k_1\beta_{B,1}$ and $\beta_{A,2}=k_2\beta_{B,2}$

What's the inter-class correlation for different values of k_1 and k_2?



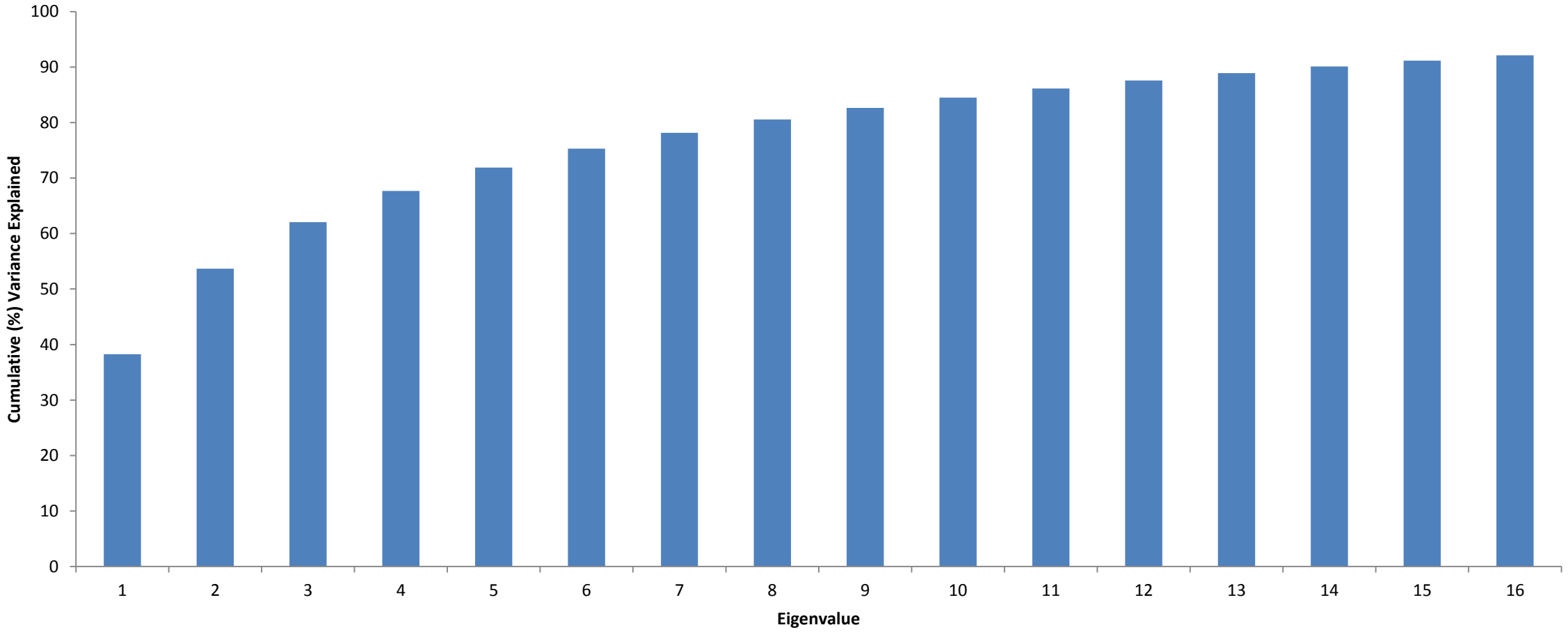
Cohort Members for Asset Classes

Equity	Pre 1974	Australia	Austria	Belgium	Canada	Denmark	France
		Germany	Hong Kong	Ireland	Italy	Japan	Netherlands
		Singapore	South Africa	Switzerland	UK	US	
	1974-1983	Brazil	Malaysia	Norway	South Korea	Spain	Sweden
	1984-1993	Argentina	Bangladesh	Chile	Colombia	Czech Rep.	Ecuador
		Finland	Greece	Hungary	Iceland	India	Israel
		Jordan	Kenya	Luxembourg	Mexico	Morocco	New Zealand
		Pakistan	Panama	Peru	Philippines	Poland	Portugal
		Slovakia	Sri Lanka	Taiwan	Thailand	Turkey	Venezuela
	Post 1993	Bahrain	Botswana	Bulgaria	China	Cote d'Ivoire	Croatia
		Cyprus	Egypt	Estonia	Ghana	Iceland	Indonesia
		Jamaica	Kazakhstan	Kuwait	Latvia	Lebanon	Lithuania
		Macedonia	Malta	Mauritius	Montenegro	Namibia	Nigeria
		Oman	Qatar	Romania	Russia	Saudi Arabia	Serbia
		Slovenia	Trinidad	Tunisia	Ukraine	UAE	Vietnam
		Zambia					
Bonds	Pre 1986	Austria	Belgium	Canada	Denmark	France	Germany
		Ireland	Japan	Netherlands	Sweden	Switzerland	UK
		US					
	1986-1999	Australia	Finland	Italy	New Zealand	Norway	Portugal
		Spain					
	Post 1999	China	Czech Rep.	Mexico	Poland	South Africa	
REITs	Pre 2000	Australia	Belgium	Canada	France	Germany	Netherlands
		South Africa	UK	US			
	Post 2000	Bulgaria	Greece	Hong Kong	Italy	Japan	Malaysia
		Mexico	New Zealand	Singapore	Turkey		

Pre-1986 Assets Used Throughout for Global Factors

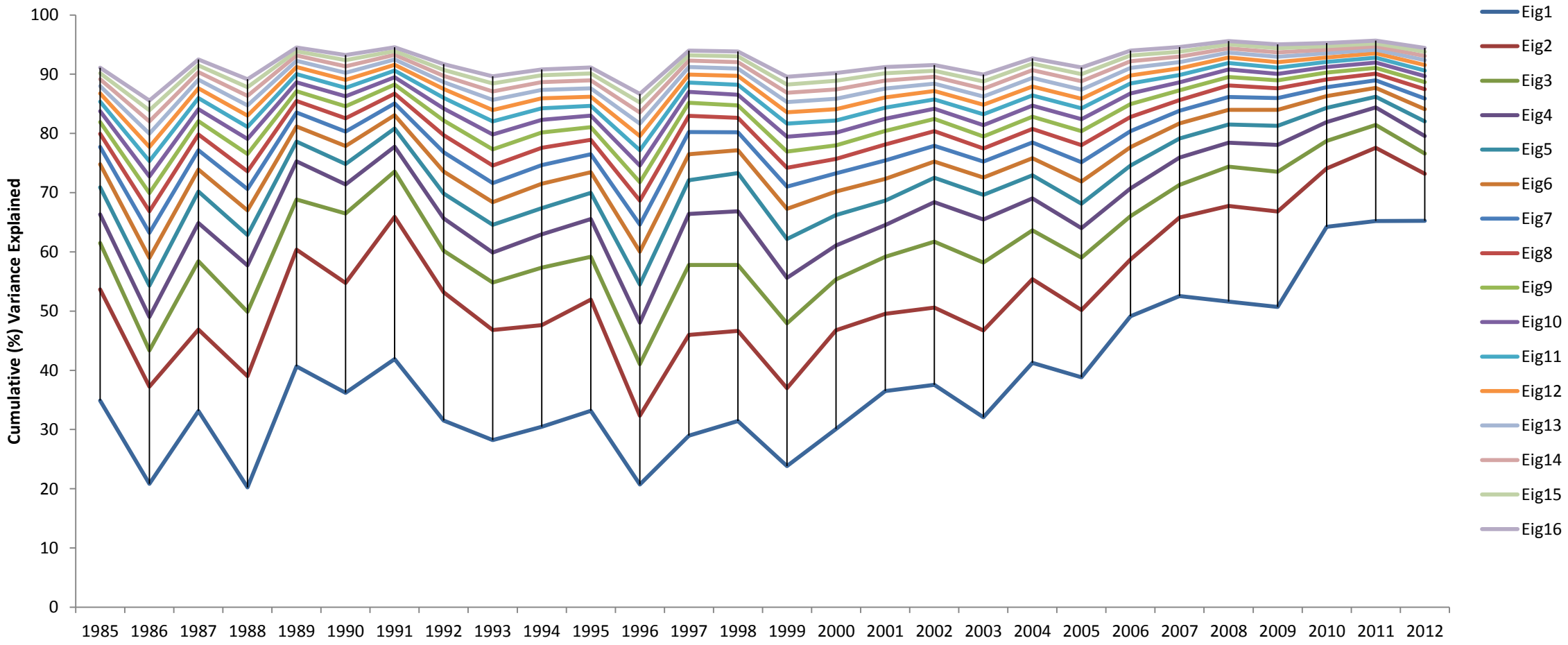
- The pre-1986 markets include Equity: Australia, Austria, Belgium, Canada, Denmark, France, Germany, Hong Kong, Ireland, Italy, Japan, Netherlands, Singapore, South Africa, Switzerland, UK, US, Brazil, Malaysia, Norway, South Korea, Spain, Sweden; Bonds: Austria, Belgium, Canada, Denmark, France, Germany, Ireland, Japan, Netherlands, Sweden, Switzerland, UK, US, and REITs: Australia, Netherlands, UK, and US.
- Because North America is the last region to trade on a given calendar day. If a globally-significant event occurs after the Asian or European markets close but while the North American markets are still open, there could be a co-movement between North America returns and returns in other regions the next day. Including the lagged North American markets yields a 45x45 covariance matrix including lags for 3 asset classes in the US and in Canada.
- To avoid any possible bias in the regression of a pre-1986 country's returns on the global factors associated with that country being heavily weighted in the principal components, a pre-1986 country is excluded from the PC estimation when that country is the dependent variable.

Average Cumulative Percentage of Variance Explained by Sorted Eigenvalues



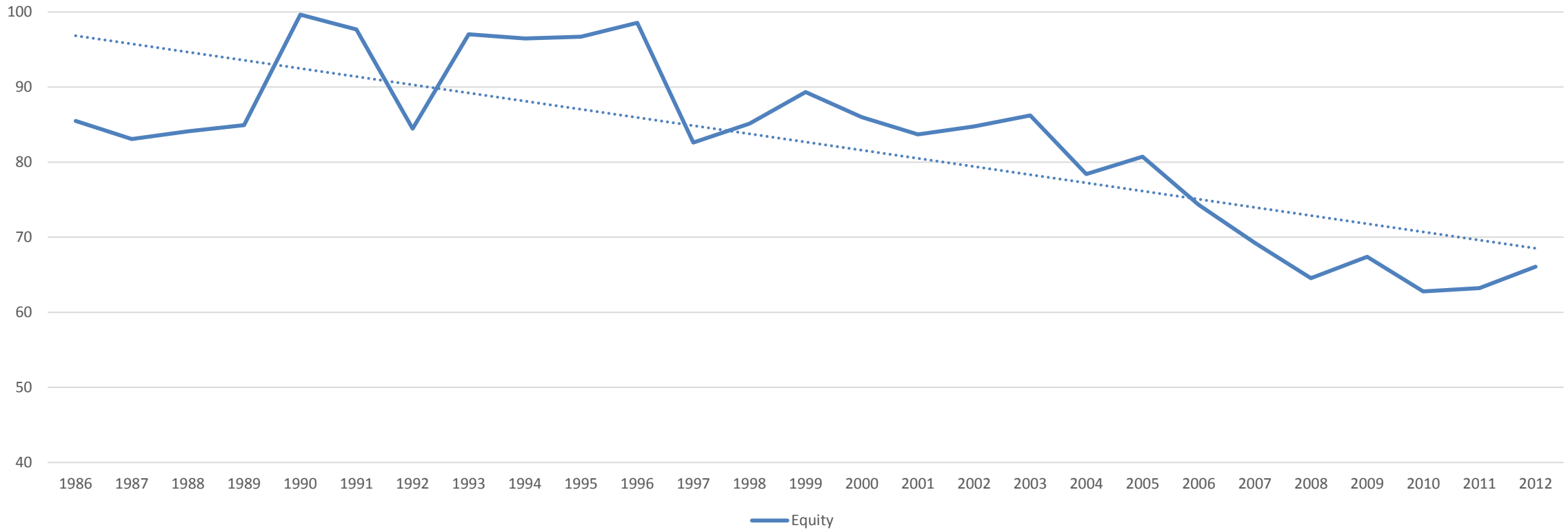
Notes: This figure shows the average cumulative percentage of variance explained by the sorted (low to high) eigenvalues from pre-1986 cohort covariance matrices. These eigenvalues represent averages for the period 1986-2012.

Percentage of Variance Explained over Time by Sorted Eigenvalues



Notes: This figure shows the time series of cumulative percentage of variance explained by the sorted (low to high) eigenvalues from pre-1986 cohort covariance matrices.

Trend in World Equity Diversification Indexes



Notes: This figure shows the average diversification index between 1986 and 2012. There is a time-series plot of the diversification indexes and a fitted linear trend line. The diversification index is 100 minus the average R-square (in percent) from a multi-factor returns model fitted using daily data during every calendar year, 1986-2012. on the dependent variable in each regression is a country-specific return on an asset class and the explanatory variables are global factors.

Time Trends of Diversification Indexes for Equities, Bonds and REITs

Full Sample							
Equity							
World Index	France	Germany	UK	US	Spain	Ireland	Kazakhstan
-1.089	-3.812	-3.236	-3.449	-1.644	-3.228	-2.672	0.941
(-5.892)	(-9.511)	(-8.210)	(-10.029)	(-7.783)	(-8.588)	(-6.806)	(0.300)
Bonds							
World Index	France	Germany	UK	US	Canada	Ireland	China
-0.958	-4.871	-0.566	-0.635	-0.702	-1.484	-1.020	0.008
(-2.623)	(-4.139)	(-1.133)	(-2.143)	(-2.509)	(-6.085)	(-2.899)	(0.205)
REITs							
World Index	France	Germany	UK	US	Canada	Hong Kong	Japan
-1.216	-3.216	-1.024	-2.444	-0.872	-3.178	1.435	0.521
(-5.374)	(-5.334)	(-3.268)	(-6.963)	(-4.843)	(-6.751	(1.257)	(0.686)

Notes: This table shows the coefficient from fitting a linear trend to each market's diversification indexes followed by the associated t-test in parentheses. The first panel is for the full period, followed by pre-2000 in the second panel and post-2000 in the final panel. The diversification index is 100 minus the average R-square (in percent) from a multi-factor returns model fitted using daily data during every calendar year, 1986-2012. on the dependent variable in each regression is a country-specific return on an asset class and the explanatory variables are global factors.

Time Trends of Diversification Indexes for Equities, Bonds and REITs

Pre 2000							
Equity							
World Index	France	Germany	UK	US	Spain	Ireland	Kazakhstan
0.327	-1.086	-0.487	-0.966	-0.750	-0.422	0.369	NA
(0.715)	(-0.962)	(-0.402)	(-0.950)	(-3.344)	(-0.457)	(0.417)	(NA)
Bonds							
World Index	France	Germany	UK	US	Canada	Ireland	China
1.536	2.047	2.434	1.004	0.211	-0.431	1.940	NA
(2.006)	(1.978)	(1.934)	(1.366)	(0.550)	(-2.068)	(2.486)	(NA)
REITs							
World Index	France	Germany	UK	US	Canada	Hong Kong	Japan
0.518	0.868	0.637	0.647	-0.635	-1.147	NA	NA
(1.662)	(1.988)	(1.153)	(1.293)	(-2.384)	(-1.750)	(NA)	(NA)

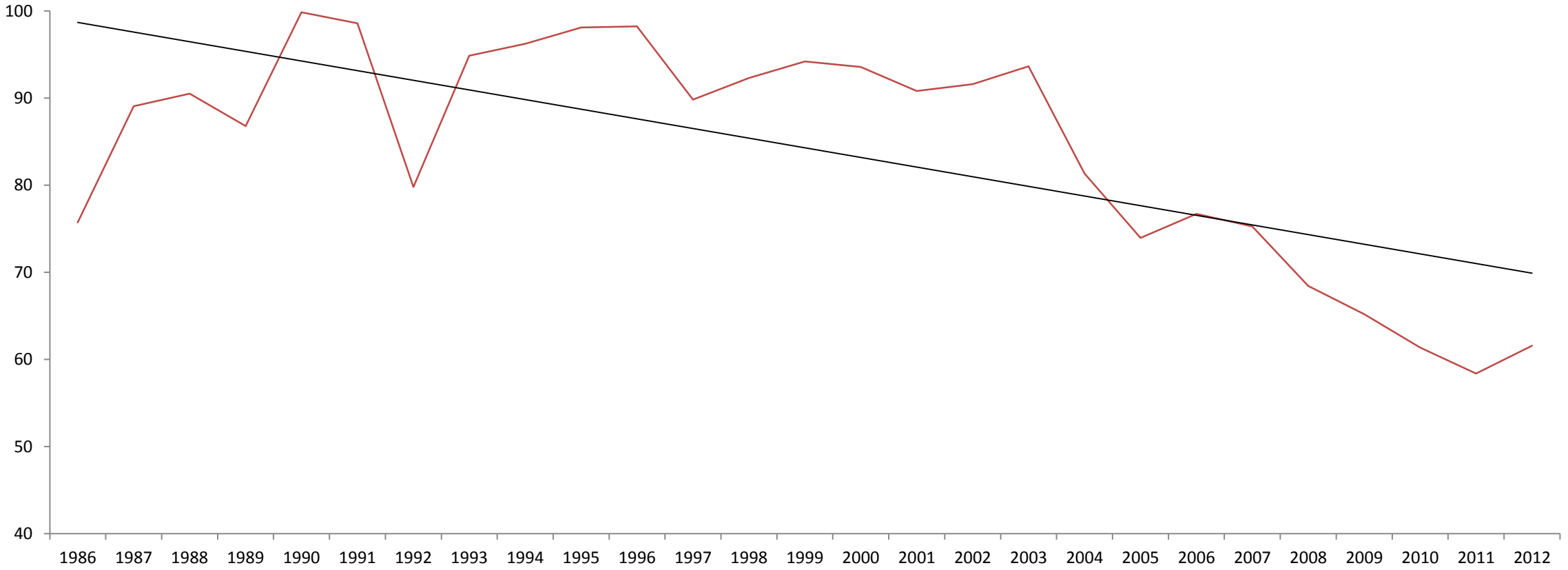
Notes: This table shows the coefficient from fitting a linear trend to each market's diversification indexes followed by the associated t-test in parentheses. The first panel is for the full period, followed by pre-2000 in the second panel and post-2000 in the final panel. The diversification index is 100 minus the average R-square (in percent) from a multi-factor returns model fitted using daily data during every calendar year, 1986-2012. on the dependent variable in each regression is a country-specific return on an asset class and the explanatory variables are global factors.

Time Trends of Diversification Indexes for Equities, Bonds and REITs

Post 2000							
Equity							
World Index	France	Germany	UK	US	Spain	Ireland	Kazakhstan
-2.228	-2.633	-3.955	-3.123	-2.344	-1.999	-4.900	0.941
(-9.009)	(-4.856)	(-9.571)	(-8.331)	(-2.790)	(-3.187)	(-6.609)	(0.300)
Bonds							
World Index	France	Germany	UK	US	Canada	Ireland	China
-3.886	-4.644	-3.885	-2.521	-1.095	-3.804	-3.207	0.008
(-5.858)	(-4.630)	(-4.059)	(-3.834)	(-2.560)	(-5.228)	(-3.280)	(0.205)
REITs							
World Index	France	Germany	UK	US	Canada	Hong Kong	Japan
-3.421	-8.960	-3.489	-5.634	-1.715	-4.566	1.435	0.521
(-9.444)	(-8.998)	(-5.056)	(-13.955)	(-2.444)	(-5.159)	(1.257)	(0.686)

Notes: This table shows the coefficient from fitting a linear trend to each market's diversification indexes followed by the associated t-test in parentheses. The first panel is for the full period, followed by pre-2000 in the second panel and post-2000 in the final panel. The diversification index is 100 minus the average R-square (in percent) from a multi-factor returns model fitted using daily data during every calendar year, 1986-2012. on the dependent variable in each regression is a country-specific return on an asset class and the explanatory variables are global factors.

Trends in World Diversification Indexes (average of 3 asset classes)



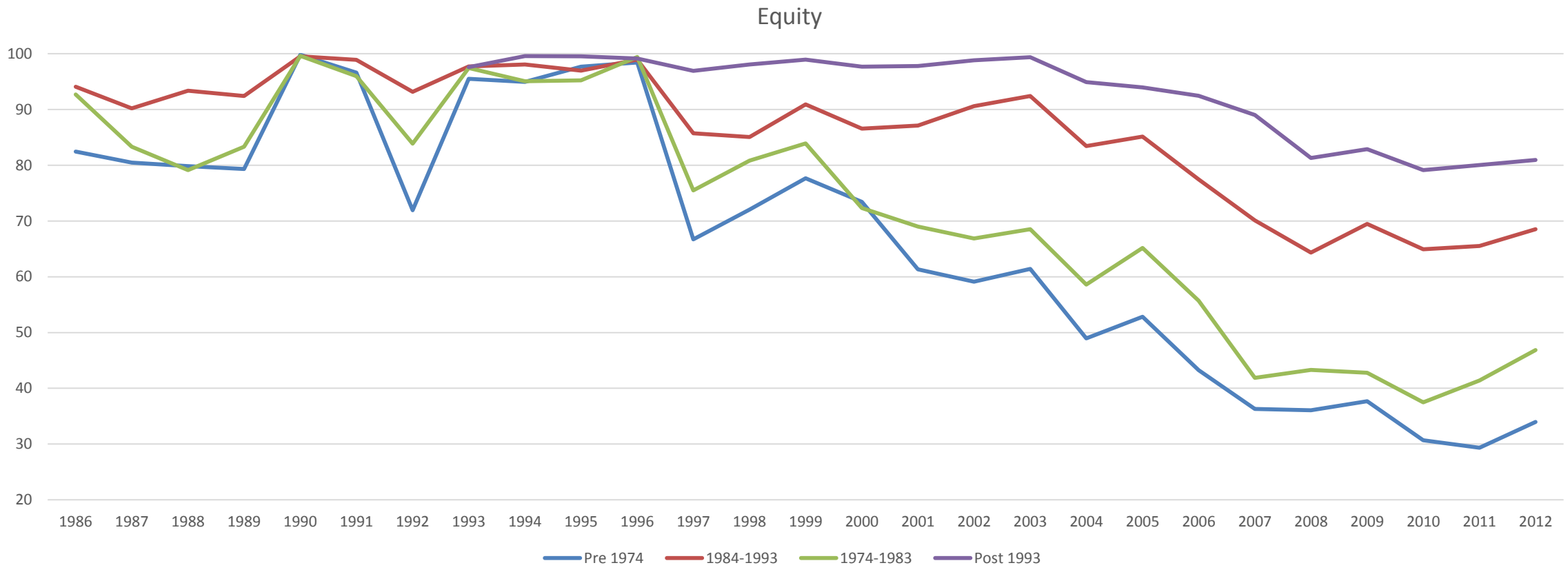
Notes: This figure shows a time series plot of the average diversification index for three asset classes, equities, bonds and REITS along with a fitted linear trend line. The diversification index is 100 minus the average R-square (in percent) from a multi-factor returns model fitted using daily data during every calendar year, 1986-2012. on the dependent variable in each regression is a country-specific return on an asset class and the explanatory variables are global factors.

Time Trends for Diversification Indexes Across Three Asset Classes

Full Sample					
Australia	Belgium	Canada	France	Germany	Italy
-1.858	-2.144	-1.929	-2.371	-1.430	-1.840
(-6.392)	(-5.300)	(-8.240)	(-6.194)	(-4.074)	(-5.125)
Japan	Netherlands	New Zealand	South Africa	UK	US
0.143	-2.125	-2.001	-1.829	-2.176	-0.940
(0.628)	(-5.048)	(-5.654)	(-5.531)	(-7.900)	(-5.991)
Pre 2000					
Australia	Belgium	Canada	France	Germany	Italy
-0.674	1.208	-0.486	0.920	1.261	1.113
(-0.968)	(1.480)	(-1.650)	(1.146)	(1.434)	(1.332)
Japan	Netherlands	New Zealand	South Africa	UK	US
1.226	1.503	-0.320	-0.055	0.228	-0.391
(2.165)	(1.518)	(-0.450)	(-0.087)	(0.353)	(-1.663)
Post 2000					
Australia	Belgium	Canada	France	Germany	Italy
-3.881	-5.458	-4.130	-5.413	-3.776	-4.250
(-5.328)	(-13.906)	(-7.265)	(-31.009)	(-10.473)	(-11.207)
Japan	Netherlands	New Zealand	South Africa	UK	US
0.147	-4.744	-4.574	-4.784	-3.759	-1.718
(0.216)	(-13.820)	(-5.549)	(-6.590)	(-14.203)	(-2.950)

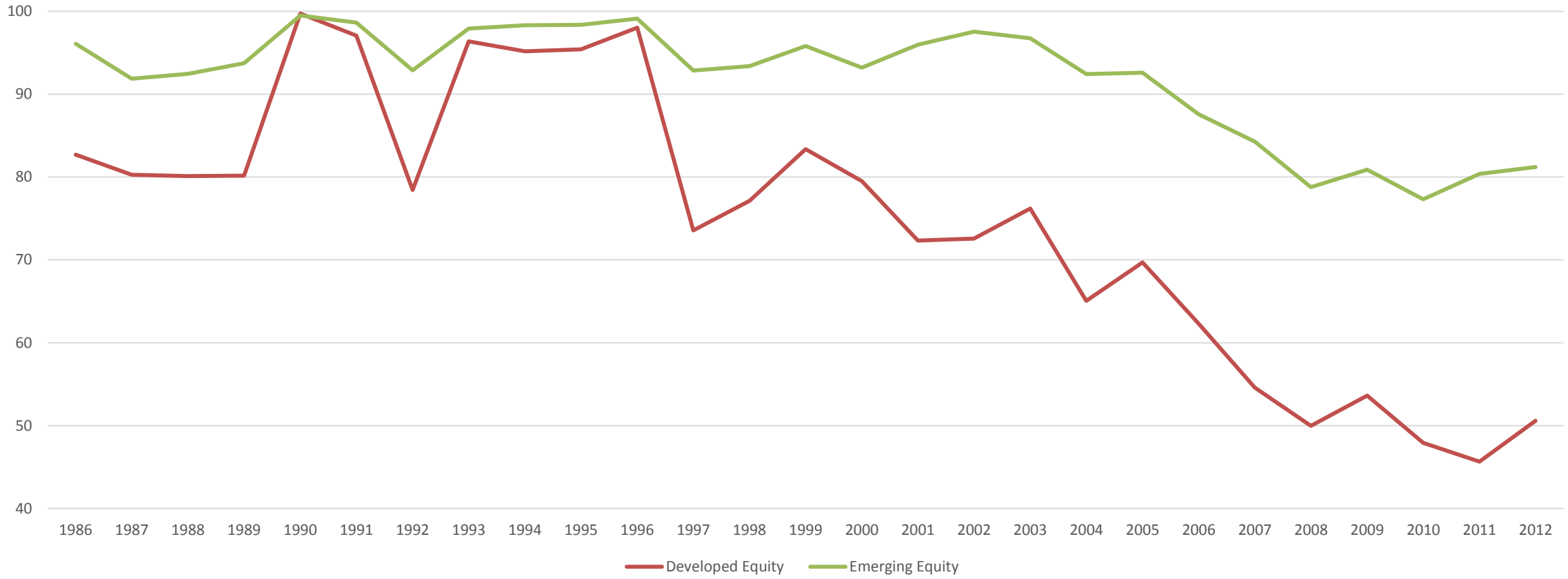
Notes: This table shows the coefficient from fitting a linear trend to the average diversification indexes across asset classes followed by the associated t-test in parentheses. The diversification indexes are created for those countries where the three asset classes, equities, bonds and REITs are available. The indexes represent portfolios containing the three asset classes together.

Trends in World Diversification Indexes by Cohort



Notes: This figure shows the average diversification indexes for equities between 1986 and 2012 broken out by cohort years. The diversification index is 100 minus the average R-square (in percent) from a multi-factor returns model fitted using daily data during every calendar year, 1986-2012. on the dependent variable in each regression is a country-specific return on an asset class and the explanatory variables are global factors.

Trends in World Diversification Indexes for Developed and Emerging Markets



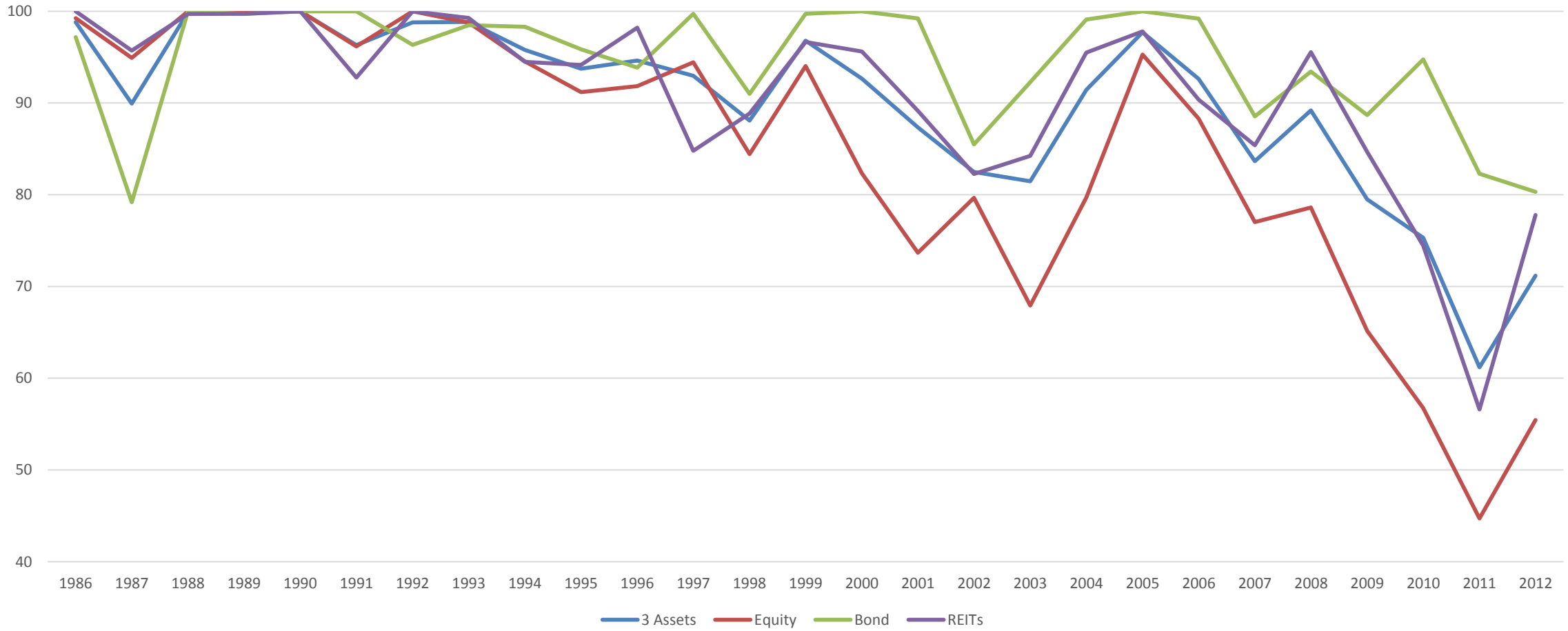
Notes: This figure shows the average diversification indexes equities between 1986 and 2012 broken out for developed and emerging markets. The diversification index is 100 minus the average R-square (in percent) from a multi-factor returns model fitted using daily data during every calendar year, 1986-2012. on the dependent variable in each regression is a country-specific return on an asset class and the explanatory variables are global factors.

Time Trends of Diversification Indexes for Developed and Emerging Markets for Equities, Bonds and REITs

Full Sample					
Equities		Bonds		REITs	
Developed	Emerging	Developed	Emerging	Developed	Emerging
-1.720	-0.629	-0.989	-2.908	-1.357	-1.070
(-7.249)	(-5.332)	(-2.664)	(-3.318)	(-5.539)	(-5.914)
Pre 2000					
Equities		Bonds		REITs	
Developed	Emerging	Developed	Emerging	Developed	Emerging
0.068	0.117	1.536	NA	0.475	0.232
(0.105)	(0.606)	(2.006)	(NA)	(1.461)	(0.565)
Post 2000					
Equities		Bonds		REITs	
Developed	Emerging	Developed	Emerging	Developed	Emerging
-2.849	-1.726	-4.017	-2.908	-3.810	-2.349
(-9.493)	(-6.954)	(-5.926)	(-3.318)	(-9.695)	(-9.400)

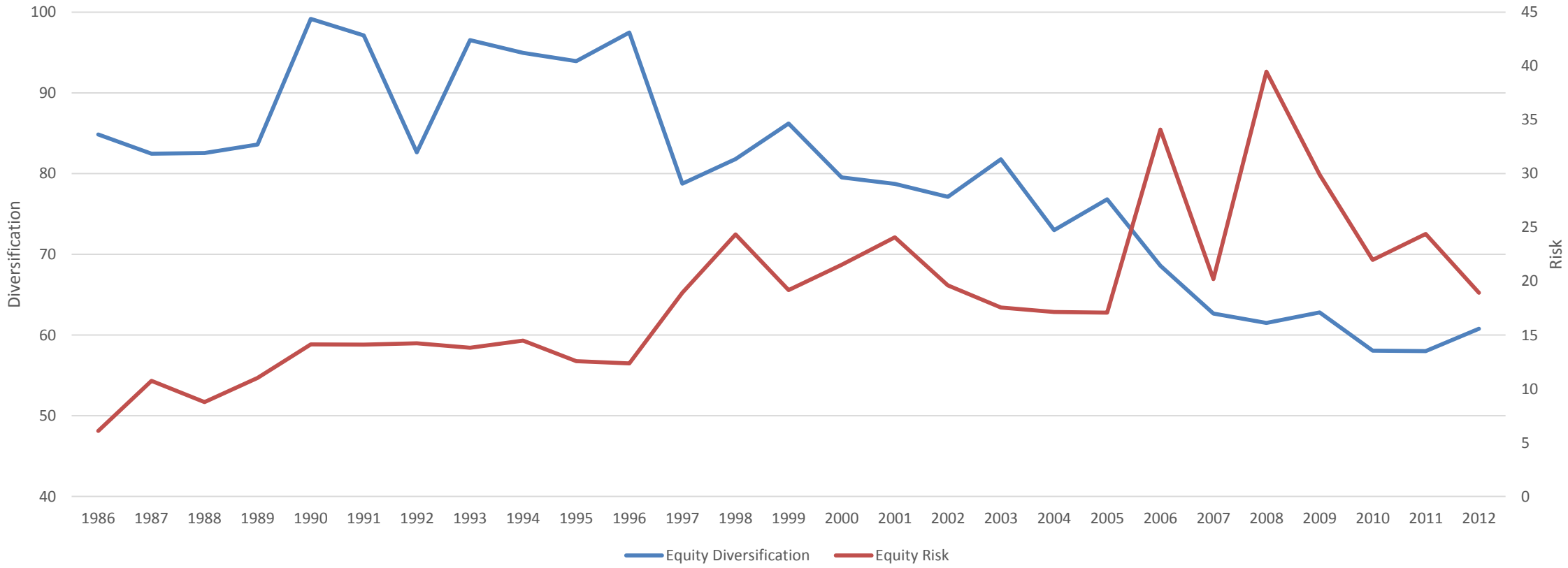
Notes: This table shows the coefficient from fitting a linear trend to the average diversification indexes for developed and emerging markets followed by the associated t-test in parentheses. The first panel is for the full period, followed by pre2000 in the second panel and post2000 in the final panel.

Trends in U.S. Diversification Indexes Within and Among Asset classes



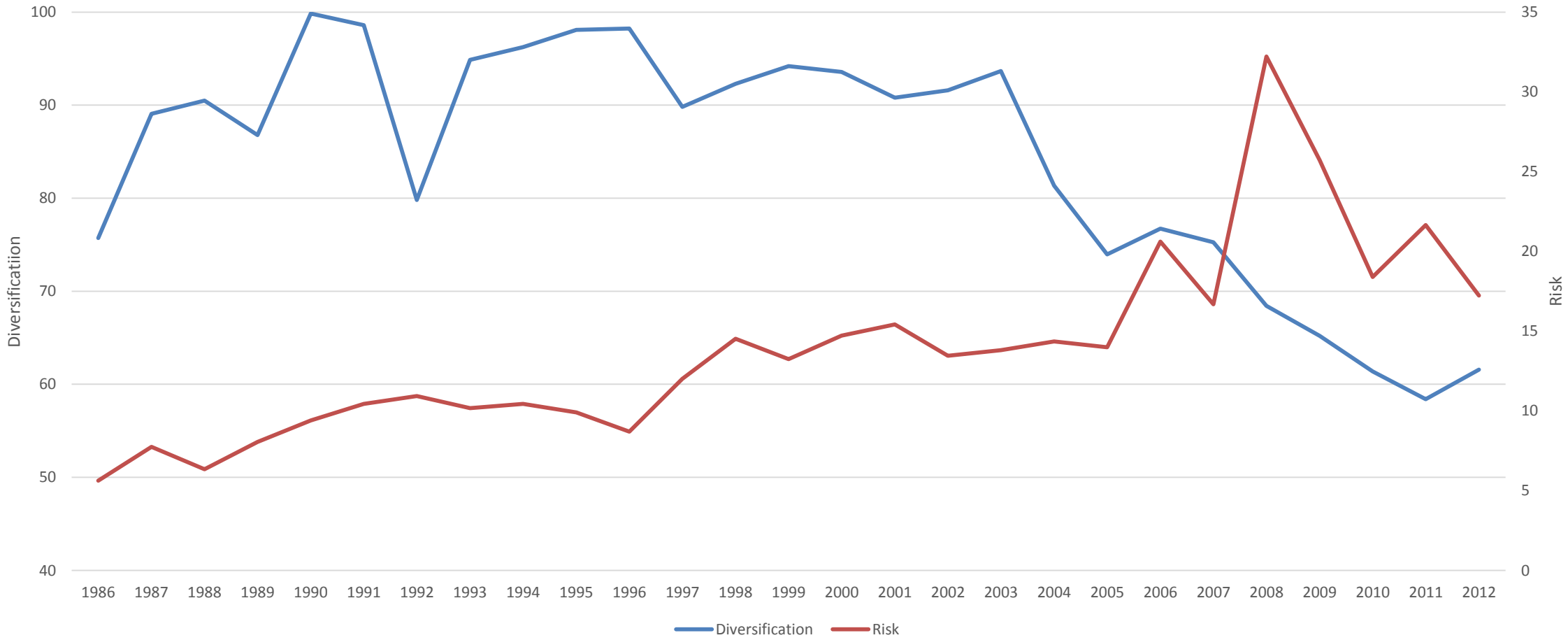
Notes: This figure shows an average of the diversification indexes for the three asset classes, equities, bonds and REITS and for a single country, the US.

Trends in Global Diversification and Risk by Asset Class



Notes: This figure shows the average diversification indexes for each asset class and associated annual standard deviation of returns.

Trends in World Diversification and Risk (average of 3 asset classes)



Notes: This figure shows an average of the diversification indexes and associated risk for the three asset classes, equities, bonds and REITS. There is a time-series plot of the averages of the diversification indexes and risk using the standard deviation of returns.

Variables associated with Diversification Indexes

TED Spread, Percent, Annual, Not Seasonally Adjusted. 1986-2012. From FRED.
VIX, Annual. 1990-2012. From FRED.
SENT, Investor sentiment data, Annual, 1986-2010, From Jeffrey Wurgler.
US MONETARY BASE, US MONETARY BASE CHANGE IN MILLIONS, Annual, 1986-2012, From DataStream.
FEDFUNDS, US FEDERAL FUNDS RATE (MONTHLY AVERAGE), Annual, 1986-2012, From DataStream.
OIL, Crude oil, avg, spot, $/bbl, nominal$, (Crude oil, average spot price of Brent, Dubai and West Texas Intermediate, equally weighed), Annual, 1986-2012, From World Bank WDI.
GLOBAL SUPPLY CHAIN, Global Supply Chain, (Sum of Imports and Exports), Annual, 1986-2012, From World Bank WDI.
INTERNET, Percentage of Individual Using the Internet, Computed as population weighted average of percentage of individuals using the internet by the country, Annual, 1986-2012
GDP PER CAPITA, GDP per capita (constant 2005 US$), GDP per capita is gross domestic product divided by midyear population. Data are in constant 2005 U.S. dollars., Annual, 1986-2012, From World Bank WDI.
AIR TRANSPORT, Air transport, passengers carried, (Air passengers carried include both domestic and international aircraft passengers of air carriers registered in the country), Annual, 1986-2012, From World Bank WDI.
GENDER EQUALITY, Out-of-school children of primary school age, female (number) (Children out of school are the number of primary-school-age children not enrolled in primary or secondary school.), Annual, 1986-2012, From World Bank WDI.
POPULATION, Urban population (% of total) (Urban population refers to people living in urban areas as defined by national statistical offices), Annual, 1986-2012, From World Bank WDI.
1992- ERM crises dummy, 1 for year and 0 for other years
2009-10 - Eurozone bond crises dummy, 1 for years and 0 for other years

Correlations among Variables associated with Diversification Indexes

	TED	VIX	SENT	MBASE	FED	OIL	SUP-CHAIN	NET	GDP	AIR	GEND	POP
TED	1.000											
VIX	0.411	1.000										
SENT	0.098	0.019	1.000									
MBASE	-0.083	0.403	-0.067	1.000								
FED	0.356	-0.269	0.293	-0.704	1.000							
OIL	0.355	0.276	-0.112	0.747	-0.473	1.000						
SUP-CHAIN	0.227	0.287	0.111	0.676	-0.461	0.873	1.000					
NET	0.080	0.363	-0.099	0.899	-0.674	0.916	0.900	1.000				
GDP	0.154	0.333	0.023	0.772	-0.560	0.889	0.981	0.959	1.000			
AIR	0.091	0.323	0.059	0.876	-0.601	0.883	0.941	0.973	0.973	1.000		
GEND	-0.083	-0.291	0.157	-0.809	0.641	-0.914	-0.887	-0.975	-0.945	-0.921	1.000	
POP	0.071	0.354	-0.004	0.849	-0.659	0.866	0.947	0.975	0.985	0.984	-0.940	1.000

Factors related to Diversification Indexes

	Balanced (1996-2010)			Unbalanced (1986-2012)		
	Equity	Bond	REIT	Equity	Bond	REIT
TED	0.079	-17.351	-13.409	-0.398	-11.912	-14.001
	(0.974)	(0.000)***	(0.044)**	(0.854)	(0.000)***	(0.005)***
VIX	-0.340	1.493	0.259	-0.304	1.069	0.407
	(0.003)***	(0.000)***	(0.312)	(0.001)***	(0.000)***	(0.013)**
SENT	1.973	-1.510	3.763	-3.239	-0.172	2.012
	(0.004)***	(0.019)**	(0.007)***	(0.000)***	(0.612)	(0.002)***
FEDFUND	-2.121	3.078	-1.077	-0.161	1.222	-0.013
	(0.000)***	(0.000)***	(0.206)	(0.392)	(0.000)***	(0.973)
INTERNET	-1.662	-0.406	-1.489	-1.602	-0.839	-1.447
	(0.000)***	(0.000)***	(0.001)***	(0.000)***	(0.000)***	(0.000)***
ERM				-9.381	-24.289	-16.614
				(0.000)***	(0.000)***	(0.000)***
Eurozone	2.009	-23.005	-16.774	7.090	-20.175	-10.182
	(0.460)	(0.000)***	(0.002)***	(0.011)**	(0.000)***	(0.041)**
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Nobs	900	300	135	1475	452	230
Adj. R2	0.441	0.614	0.658	0.473	0.620	0.615

The regressions estimate the relation between the diversification indexes, Equity, Bond and REIT, and proxies for macro-financial and developmental factors. The macro-financial factors include TED, VIX, SENT, FEDFUND. Given the high correlation between many developmental factors in table 6, a single variable, INTERNET, is included in the regressions. Results are reported for both balanced panels with timeframe 1996-2010 and unbalanced panels with a timeframe 1986-2012.

Factors related to Diversification Indexes for Developed and Emerging Markets

	Balanced (1996-2010)		Unbalanced (1986-2012)	
	Developed	Emerging	Developed	Emerging
TED	5.925	-7.566	4.669	-7.498
	(0.140)	(0.000)***	(0.172)	(0.000)***
VIX	-0.608	0.011	-0.566	0.069
	(0.001)***	(0.884)	(0.000)***	(0.189)
SENT	2.881	0.785	-4.188	-1.455
	(0.006)***	(0.296)	(0.000)***	(0.017)
FEDFUND	-2.764	-1.281	-0.280	-0.010
	(0.000)***	(0.065)*	(0.209)	(0.970)
INTERNET	-2.317	-0.806	-2.358	-0.671
	(0.000)***	(0.001)**	(0.000)***	(0.000)***
ERM			-13.417	-4.725
			(0.000)***	(0.020)**
Eurozone	9.053	-7.201	16.078	-4.881
	(0.041)**	(0.000)***	(0.000)***	(0.003)***
Country FE	Yes	Yes	Yes	Yes
Nobs	510	390	778	697
Adj. R2	0.551	0.352	0.642	0.328

The regressions estimate the relation between the diversification indexes, Equity, and proxies for macro-financial and developmental factors for developed and emerging markets.

Factors related to Diversification Indexes across time

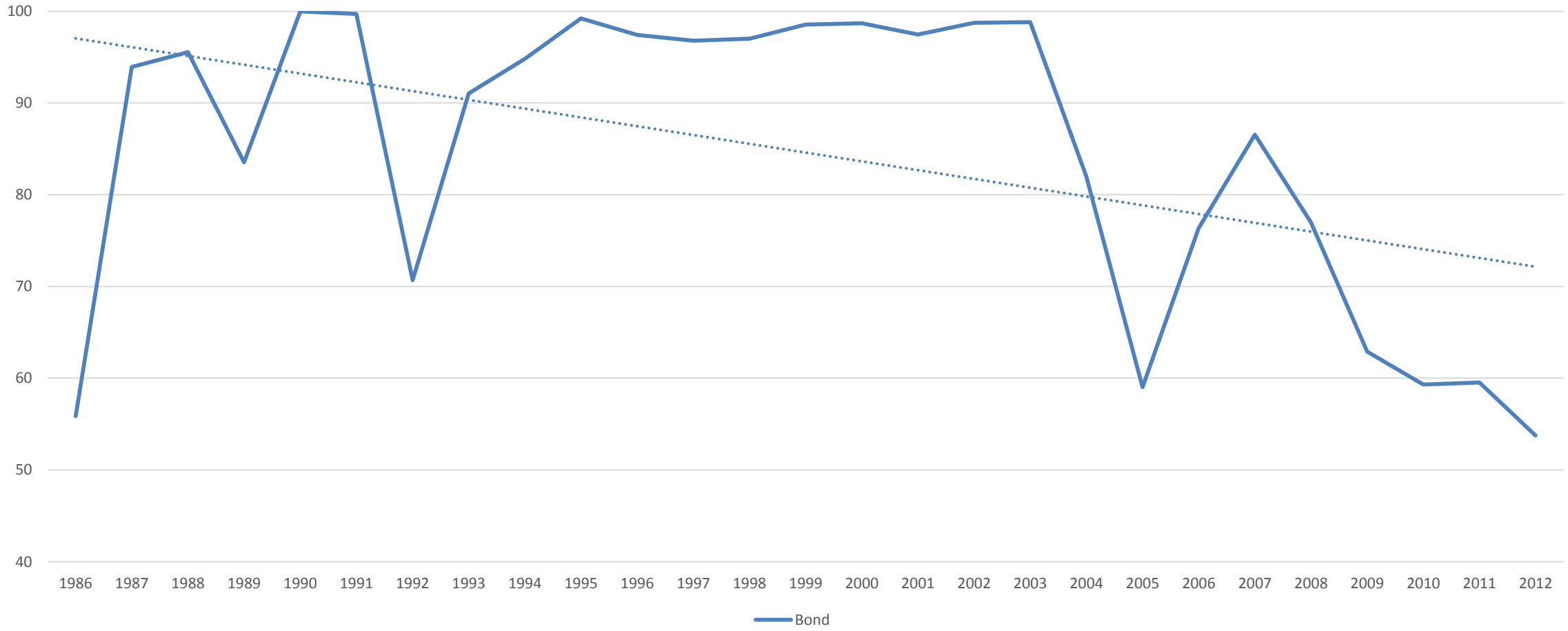
	Balanced (1996-2003)			Unbalanced (1986-1999)		
	Equity	Bond	REIT	Equity	Bond	REIT
TED	16.215	3.279	15.242	-64.475	15.679	-24.581
	(0.001)***	(0.404)	(0.052)*	(0.000)***	(0.032)**	(0.298)
VIX	-1.123	-0.065	-0.749	-0.489	-0.410	-0.359
	(0.000)***	(0.514)	(0.015)**	(0.010)**	(0.003)***	(0.209)
SENT	7.685	0.916	2.870	-13.049	1.867	-6.723
	(0.000)***	(0.664)	(0.488)	(0.000)***	(0.098)*	(0.279)
FEDFUND	-7.720	-0.614	-2.314	5.918	1.384	2.897
	(0.000)***	(0.716)	(0.474)	(0.000)***	(0.001)***	(0.094)*
INTERNET	-2.231	0.144	0.059	3.280	0.159	2.547
	(0.000)***	(0.723)	(0.923)	(0.000)***	(0.640)	(0.201)
ERM				-8.010	-21.855	-10.638
				(0.000)***	(0.000)***	(0.015)**
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Nobs	488	160	72	569	195	81
Adj. R2	0.051	-0.086	-0.060	0.237	0.742	0.172
	Balanced (2004-2010)			Unbalanced (2000-2012)		
	Equity	Bond	REIT	Equity	Bond	REIT
TED	-9.203	84.848	-26.193	10.385	-33.909	14.176
	(0.392)	(0.009)***	(0.349)	(0.001)***	(0.000)***	(0.123)
VIX	0.424	-4.354	1.261	-0.566	2.222	-0.751
	(0.456)	(0.008)***	(0.367)	(0.000)***	(0.000)***	(0.070)*
SENT	-54.450	338.976	-62.818	-6.626	1.997	-6.406
	(0.002)***	(0.000)***	(0.122)	(0.000)***	(0.213)	(0.047)**
FEDFUND	3.552	-23.688	5.329	-0.302	3.658	-1.146
	(0.028)**	(0.000)***	(0.199)	(0.377)	(0.000)***	(0.270)
INTERNET	-2.791	5.495	-3.216	-2.540	0.712	-3.743
	(0.000)***	(0.000)***	(0.006)***	(0.000)***	(0.012)**	(0.000)***
Eurozone	17.925	-56.439	6.279	21.349	-43.621	26.579
	(0.011)**	(0.000)***	(0.705)	(0.000)***	(0.000)***	(0.011)**
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Nobs	553	161	84	906	257	149
Adj. R2	0.31	0.50	0.46	0.40	0.57	0.59

The regressions estimate the relation between the diversification indexes, Equity, Bond and REIT, and proxies for macro-financial and developmental factors for different sub-periods.

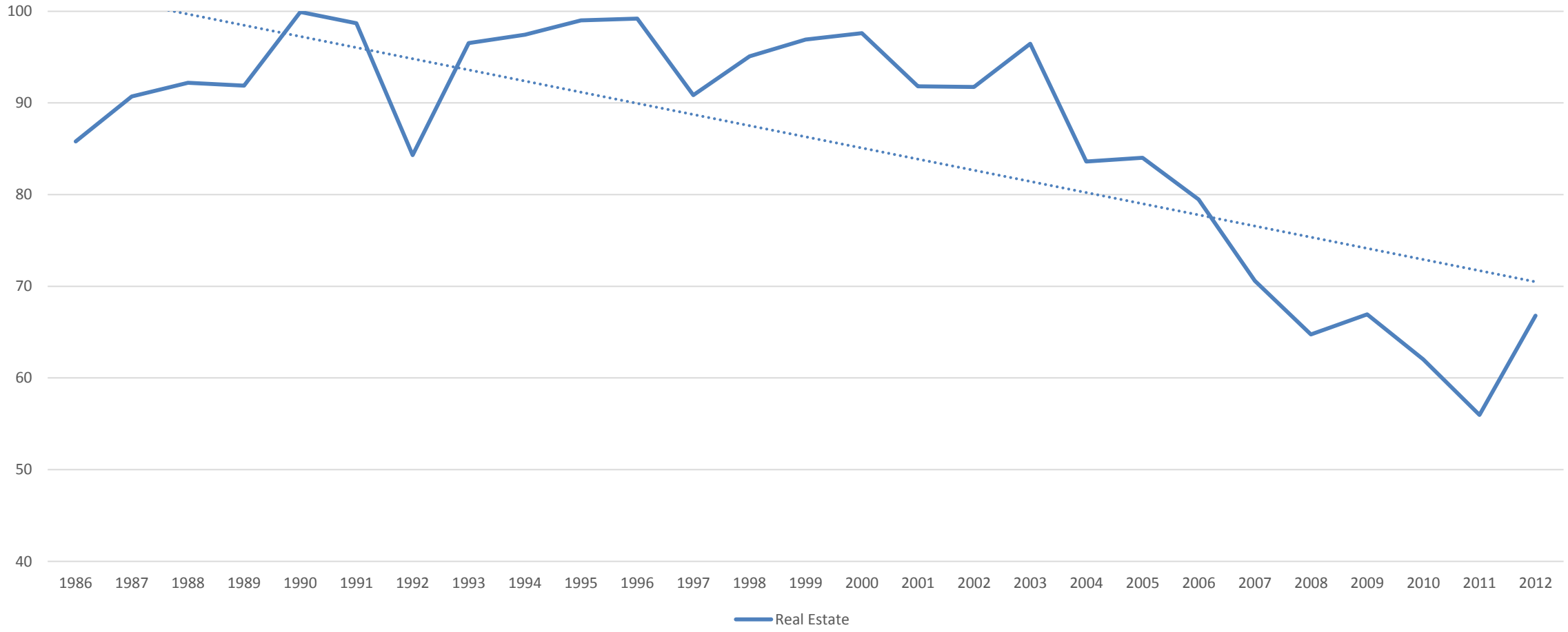
Summary of Findings

- We find a pronounced decline in our diversification indexes within asset classes, across asset classes, within countries and across countries
- Decline in diversification is precipitous in the post-2000 period
- Decline in diversification is strongest for more developed economies
- Diversification results robust across bull and bear markets and periods of high and low VIX (market volatility) and TED spread (credit risk)
- The generalized downtrend in diversification potential is associated with higher levels of investment risk
- Diversification indexes related to financial and developmental factors including VIX and Internet

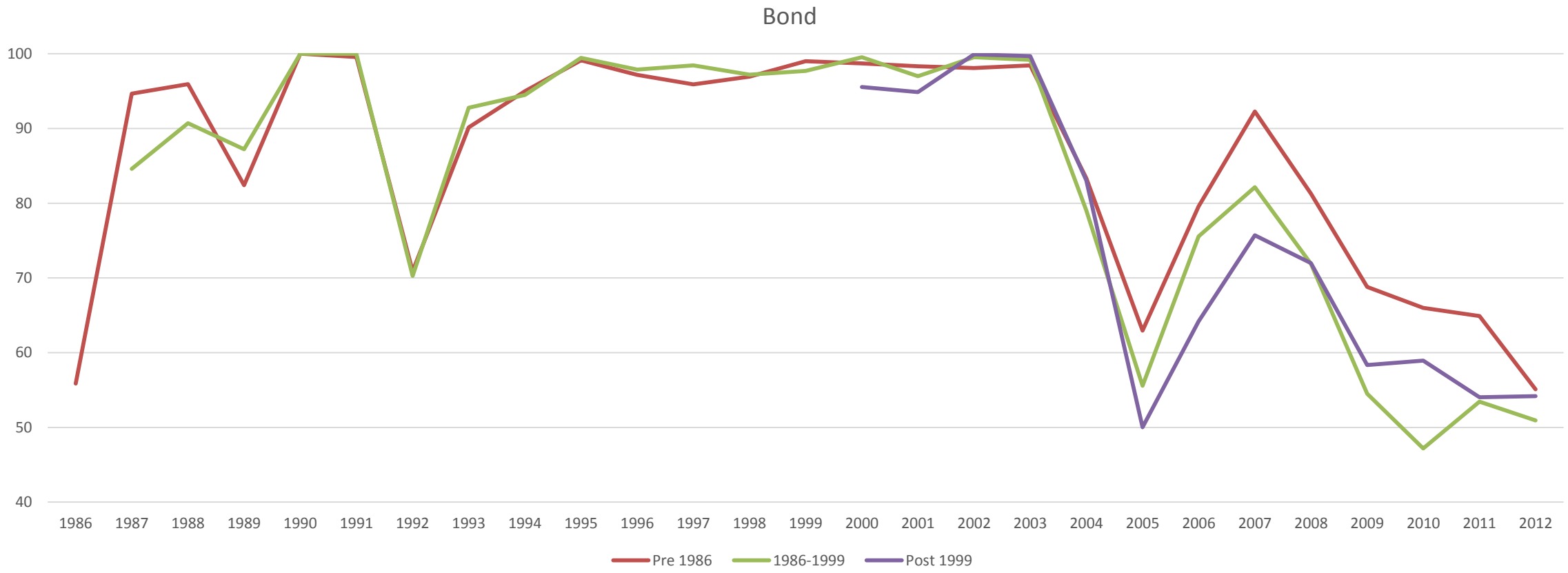
Trend in World Bond Diversification Indexes



Trends in World Real Estate Diversification Indexes

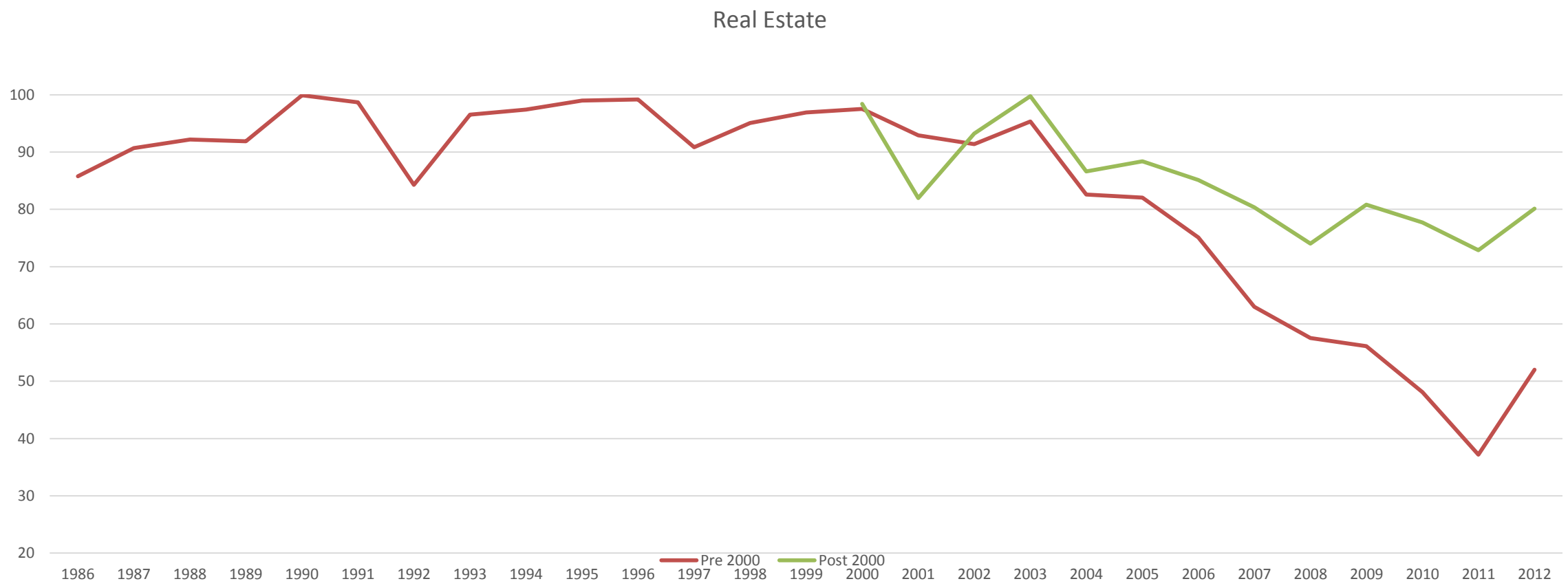


Trends in World Diversification Indexes by Cohort



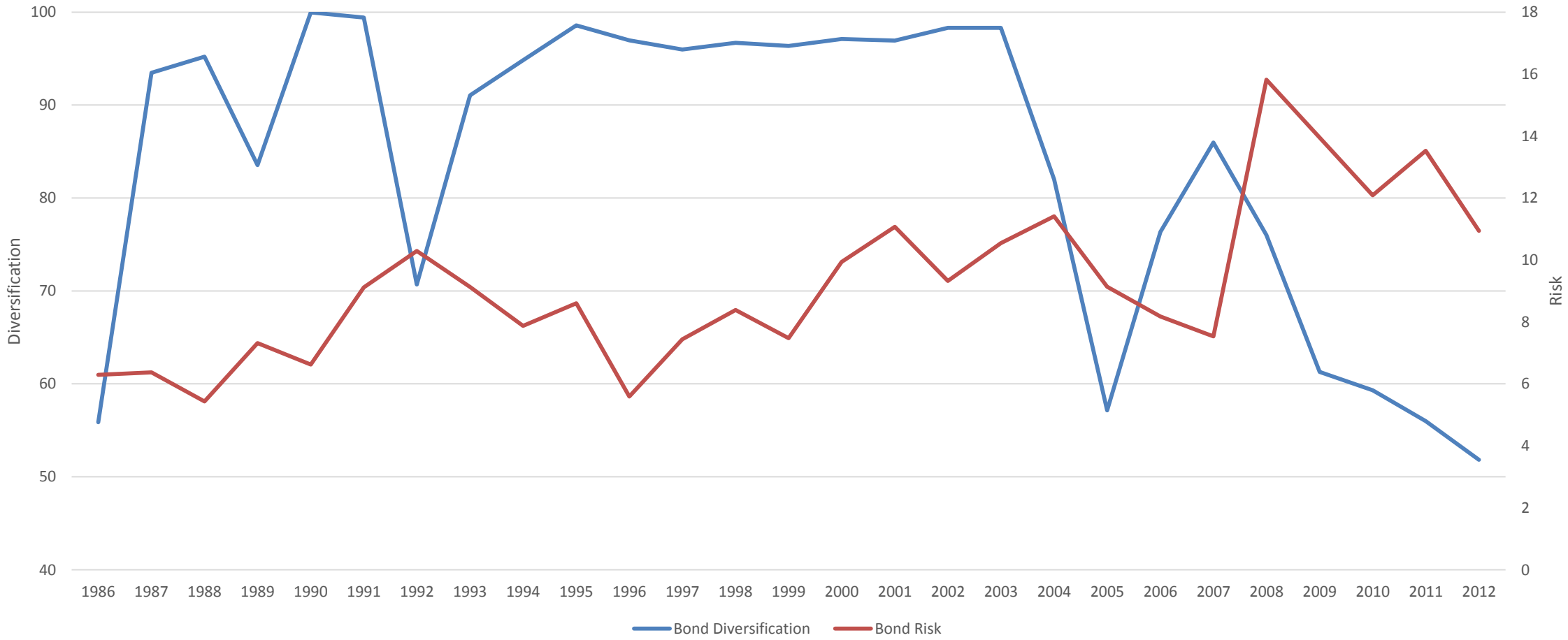
Notes: This figure shows the average diversification indexes for each asset class between 1986 and 2012 broken out by cohort years. The diversification index is 100 minus the average R-square (in percent) from a multi-factor returns model fitted using daily data during every calendar year, 1986-2012. on the dependent variable in each regression is a country-specific return on an asset class and the explanatory variables are global factors.

Trends in World REIT Diversification Indexes by Cohort



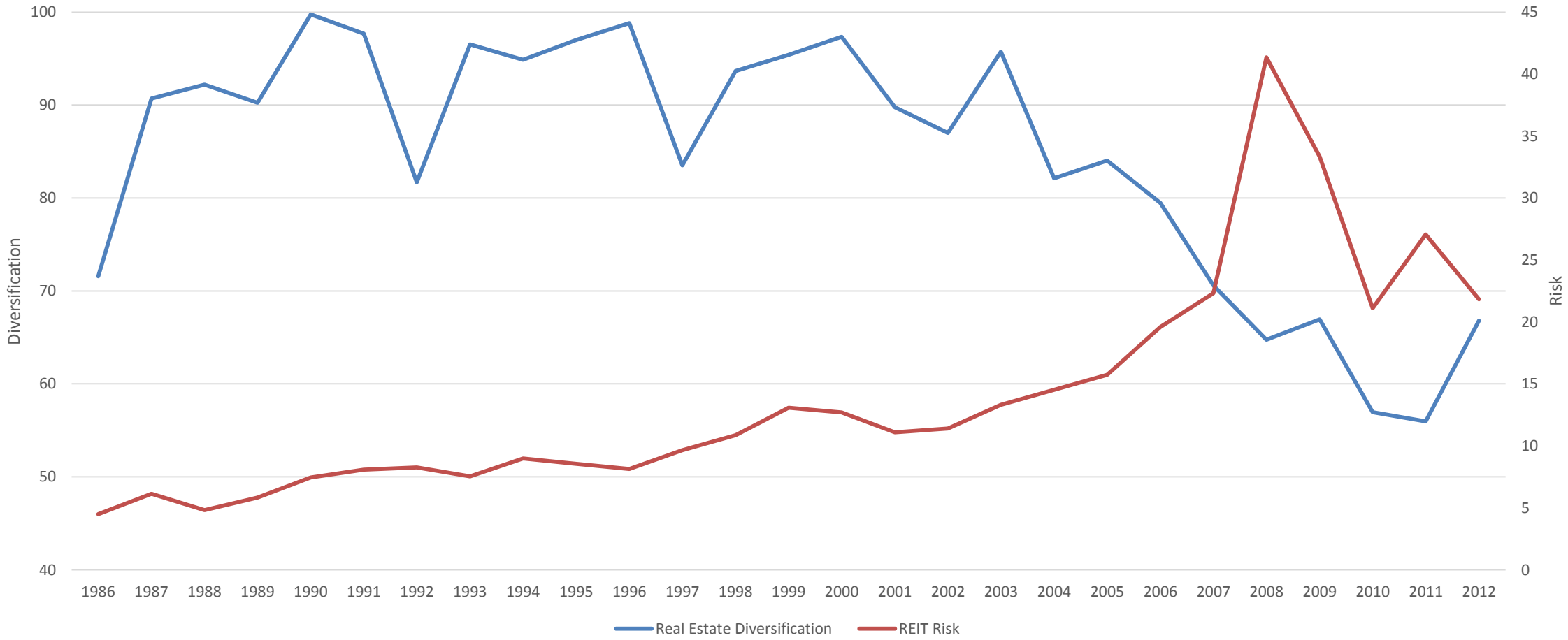
Notes: This figure shows the average diversification indexes for each asset class between 1986 and 2012 broken out by cohort years. The diversification index is 100 minus the average R-square (in percent) from a multi-factor returns model fitted using daily data during every calendar year, 1986-2012. on the dependent variable in each regression is a country-specific return on an asset class and the explanatory variables are global factors.

Trends in Bond Global Diversification and Risk by Asset Class



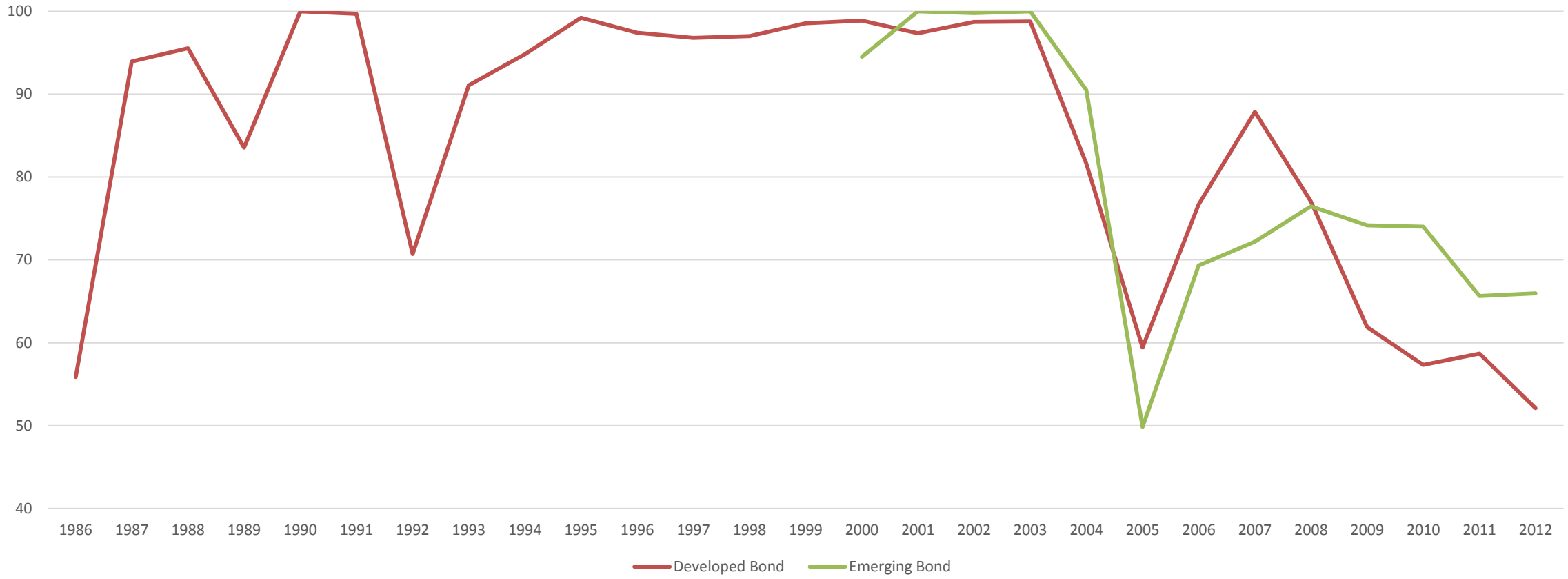
Notes: This figure shows the average diversification indexes for each asset class and associated annual standard deviation of returns.

Trends in REIT Global Diversification and Risk by Asset Class



Notes: This figure shows the average diversification indexes for each asset class and associated annual standard deviation of returns.

Trends in Bond World Diversification Indexes for Developed and Emerging Markets

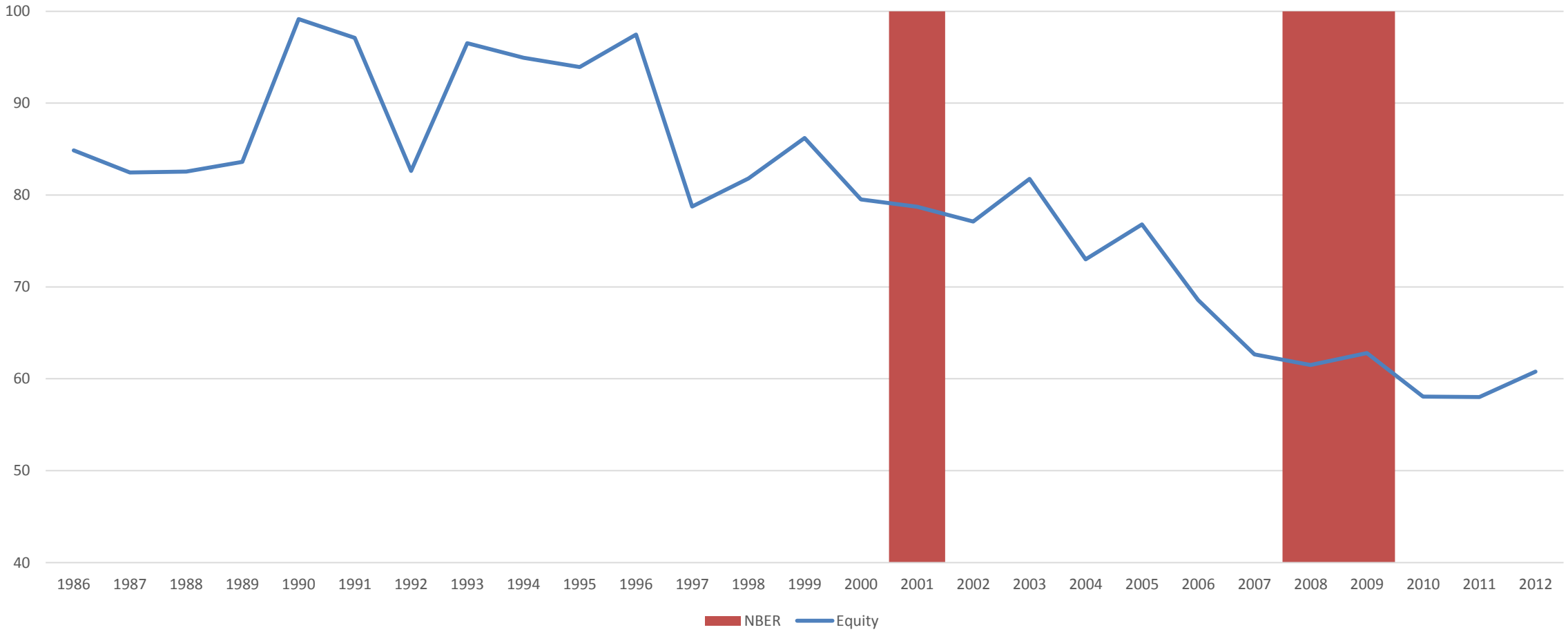


Notes: This figure shows the average diversification indexes for each asset class between 1986 and 2012 broken out for developed and emerging markets. The diversification index is 100 minus the average R-square (in percent) from a multi-factor returns model fitted using daily data during every calendar year, 1986-2012. on the dependent variable in each regression is a country-specific return on an asset class and the explanatory variables are global factors.

Trends in REIT World Diversification Indexes for Developed and Emerging Markets

Notes: This figure shows the average diversification indexes for each asset class between 1986 and 2012 broken out for developed and emerging markets. The diversification index is 100 minus the average R-square (in percent) from a multi-factor returns model fitted using daily data during every calendar year, 1986-2012. on the dependent variable in each regression is a country-specific return on an asset class and the explanatory variables are global factors.

Trend in Equity World Diversification Indexes and Recessions

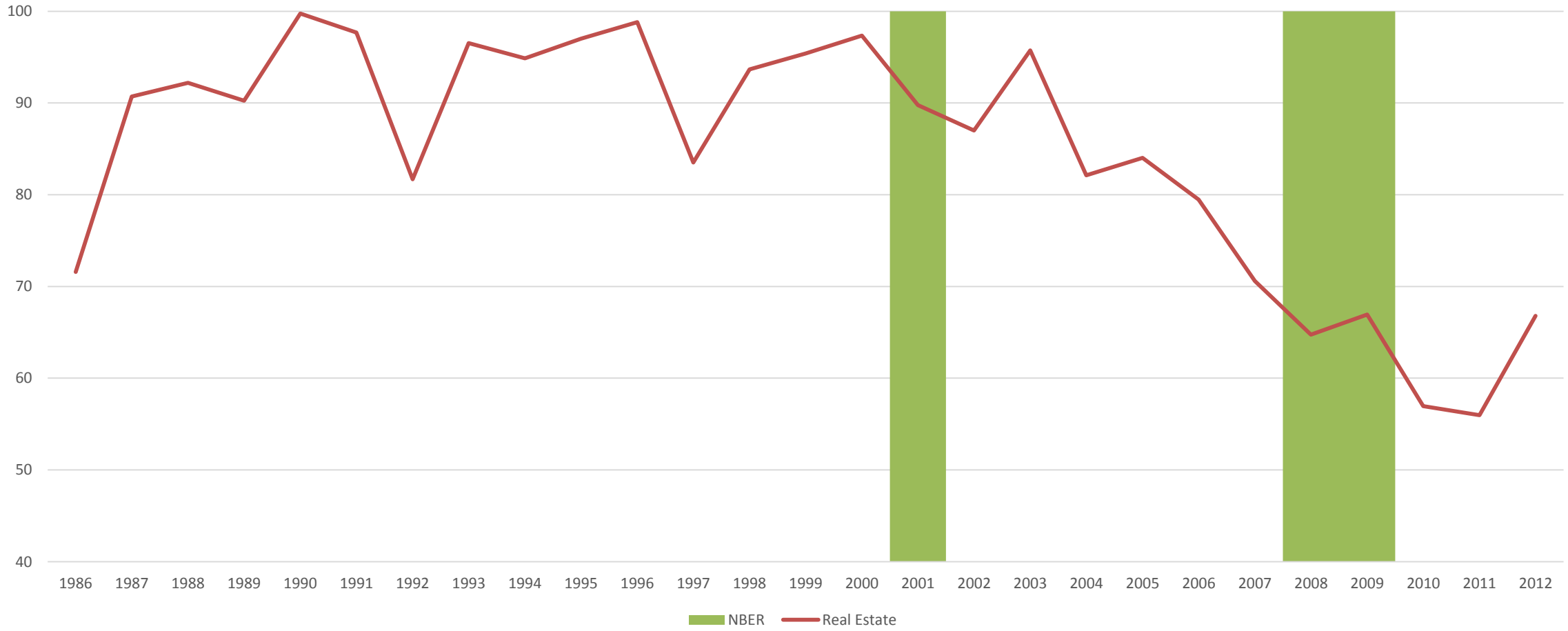


Notes: This figure shows the average diversification indexes for each asset class and NBER recessions between 1986 and 2012.

Trend in Bond World Diversification Indexes and Recessions

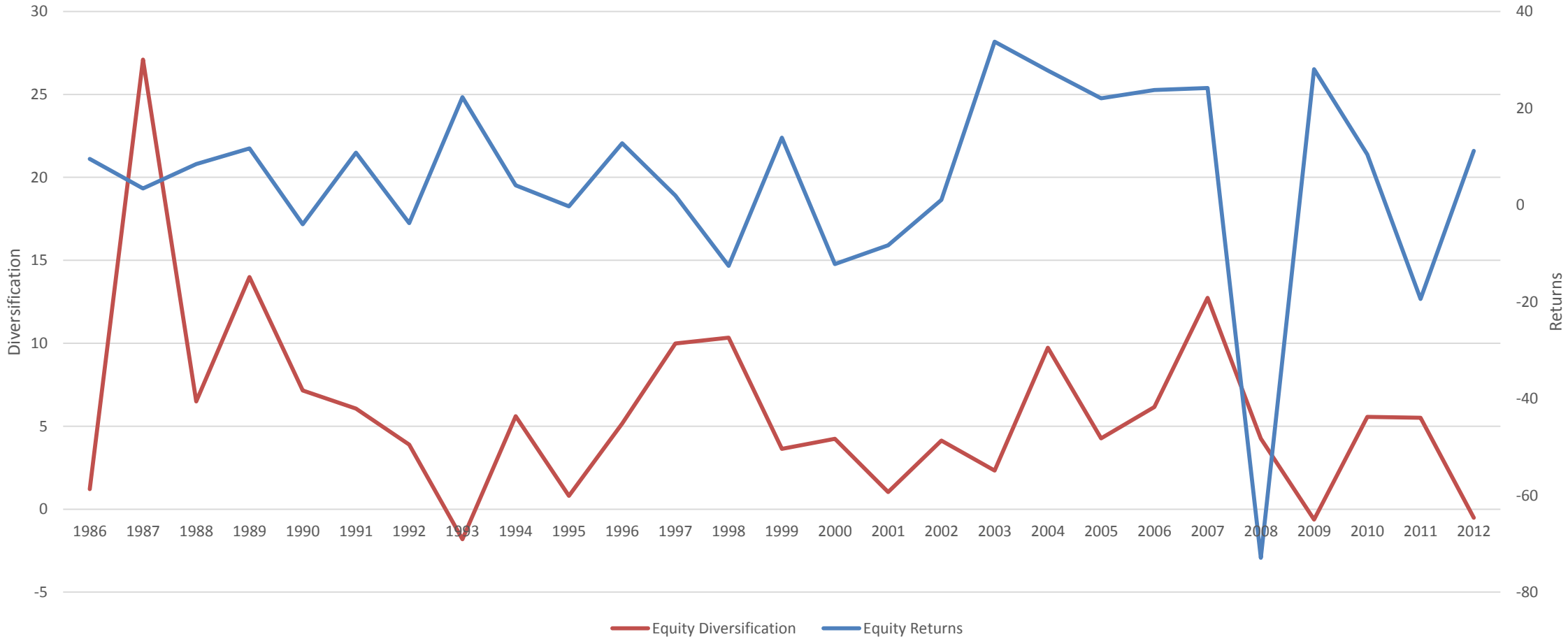
Notes: This figure shows the average diversification indexes for each asset class and NBER recessions between 1986 and 2012.

Trend in REIT World Diversification Indexes and Recessions



Notes: This figure shows the average diversification indexes for each asset class and NBER recessions between 1986 and 2012.

Difference in Diversification Indexes for Bear and Bull Equity Returns

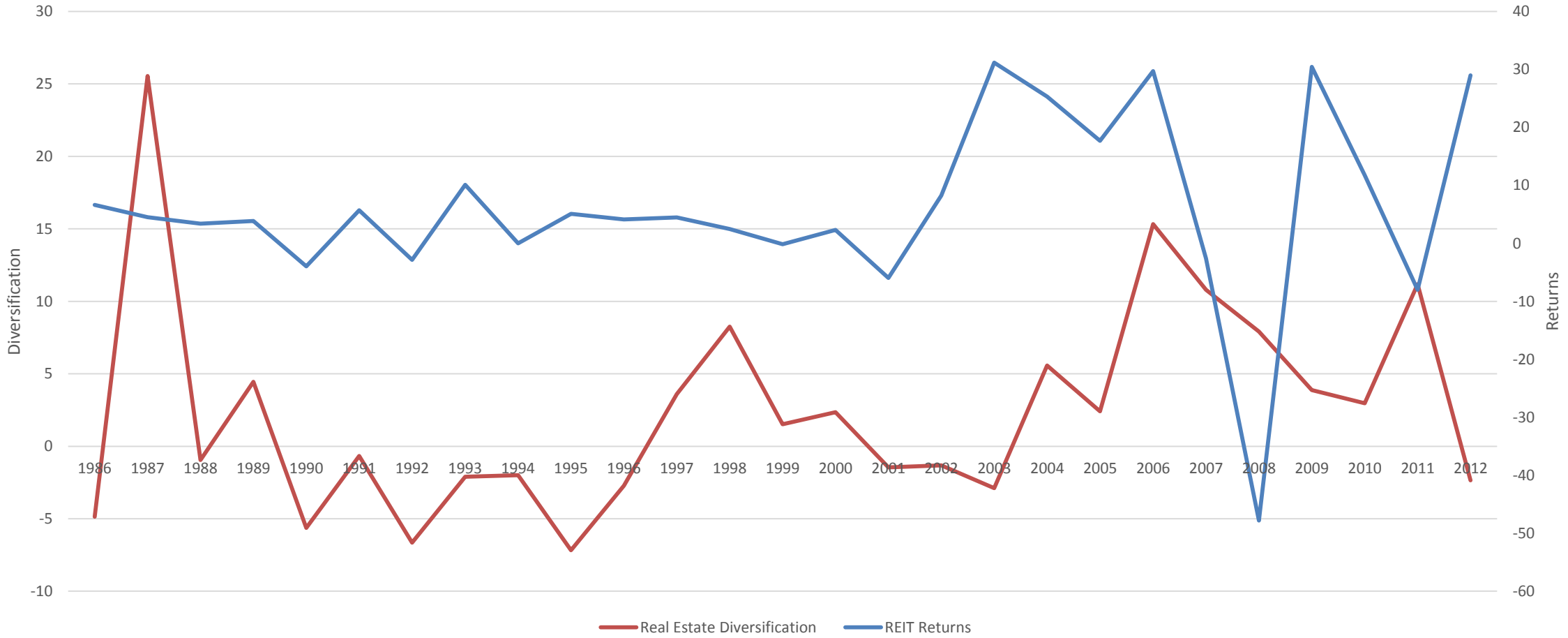


Notes: This figure uses the average diversification indexes for each asset class between 1986 and 2012. In panel A there are the average returns and the difference in diversification between bear and bull returns using values above (bull) and below (bear) the median return.

Difference in Diversification Indexes for Bear and Bull Bond Returns

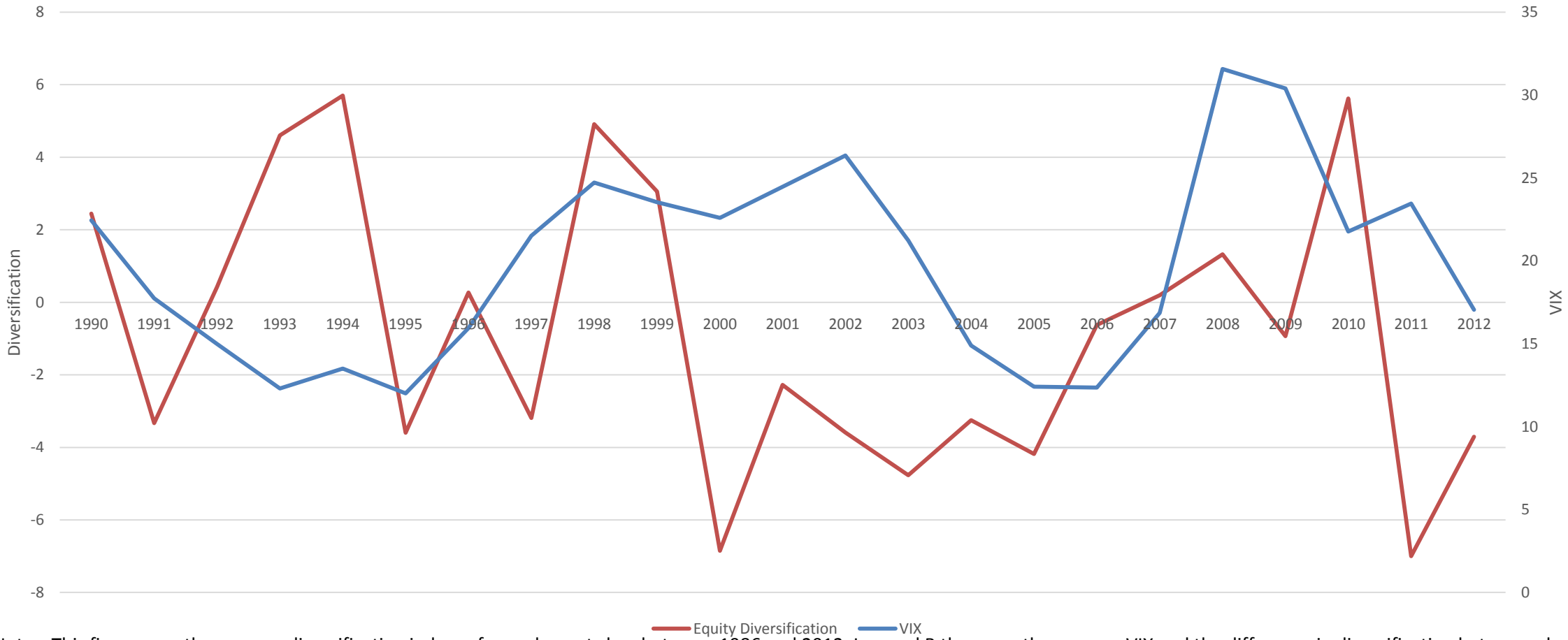
Notes: This figure uses the average diversification indexes for each asset class between 1986 and 2012. In panel A there are the average returns and the difference in diversification between bear and bull returns using values above (bull) and below (bear) the median return.

Difference in Diversification Indexes for Bear and Bull REIT Returns



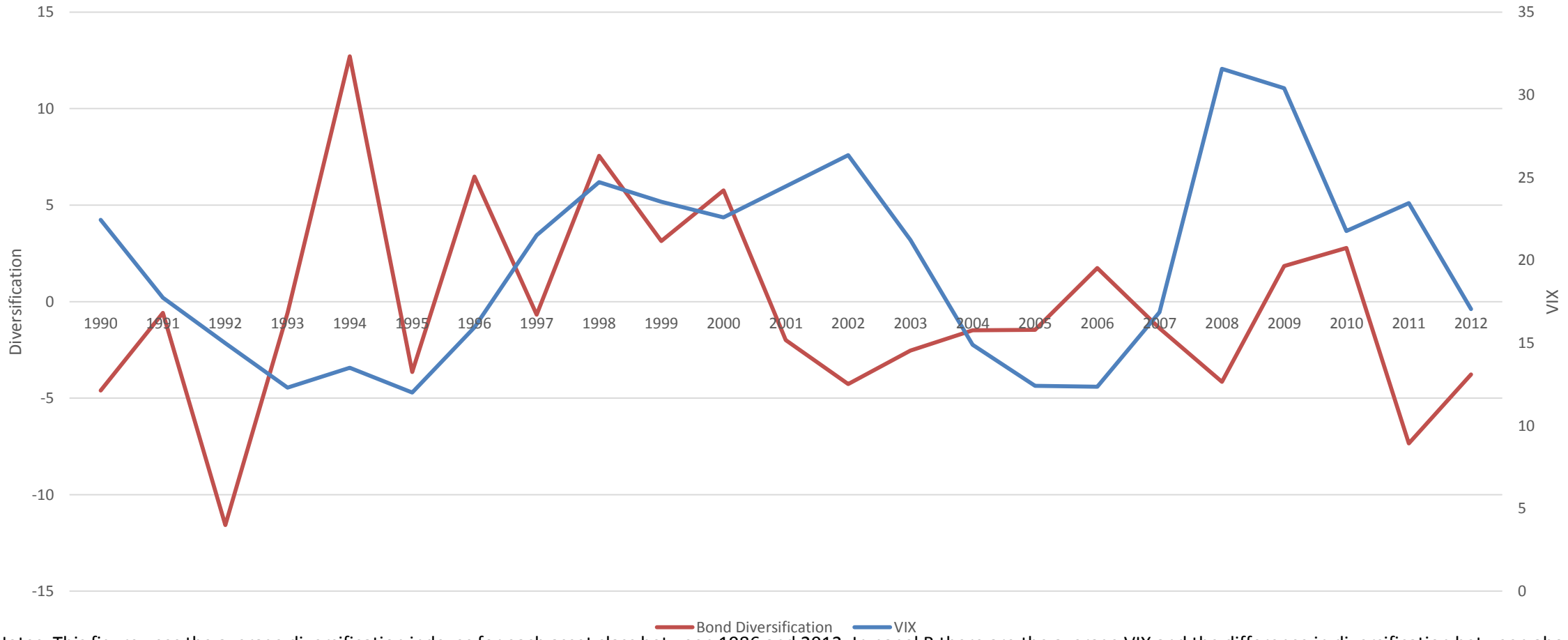
Notes: This figure uses the average diversification indexes for each asset class between 1986 and 2012. In panel A there are the average returns and the difference in diversification between bear and bull returns using values above (bull) and below (bear) the median return.

Difference in Equity Diversification Indexes for High and Low VIX



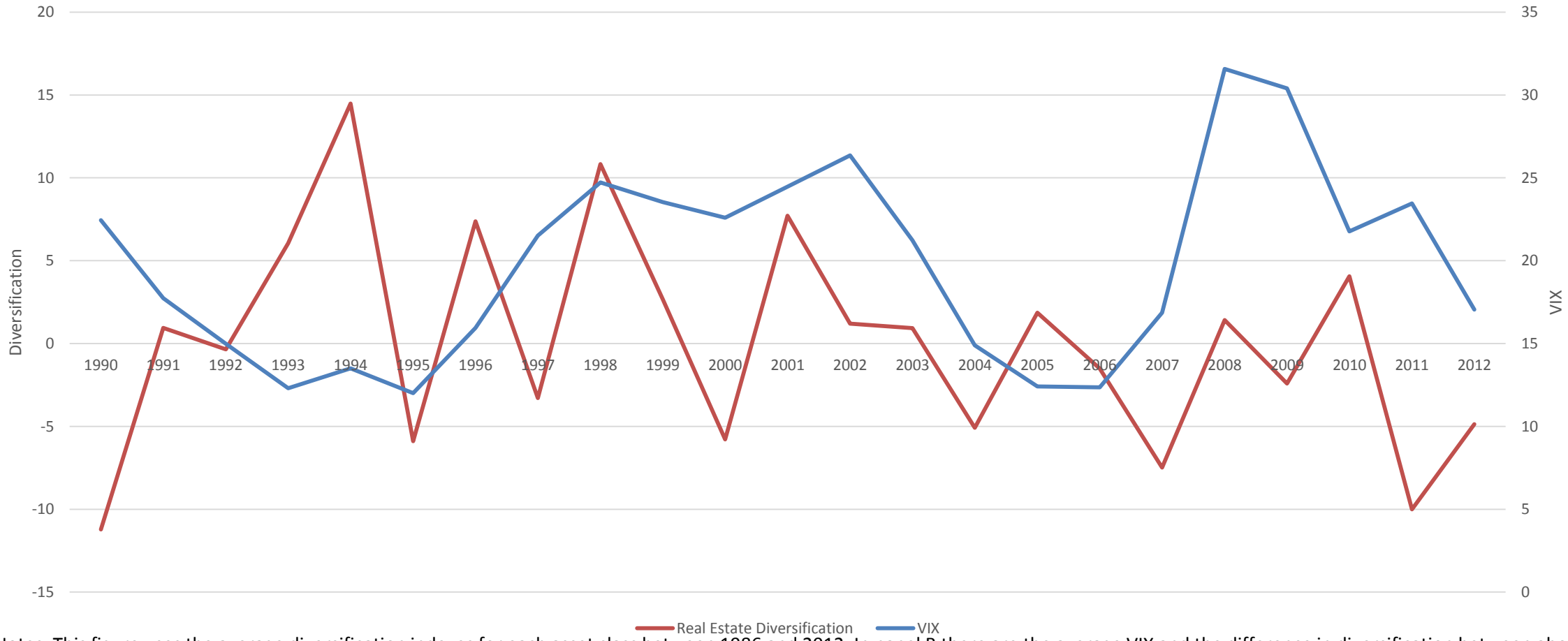
Notes: This figure uses the average diversification indexes for each asset class between 1986 and 2012. In panel B there are the average VIX and the difference in diversification between above (high VIX) and below (low VIX) the median VIX values.

Difference in Bond Diversification Indexes for High and Low VIX



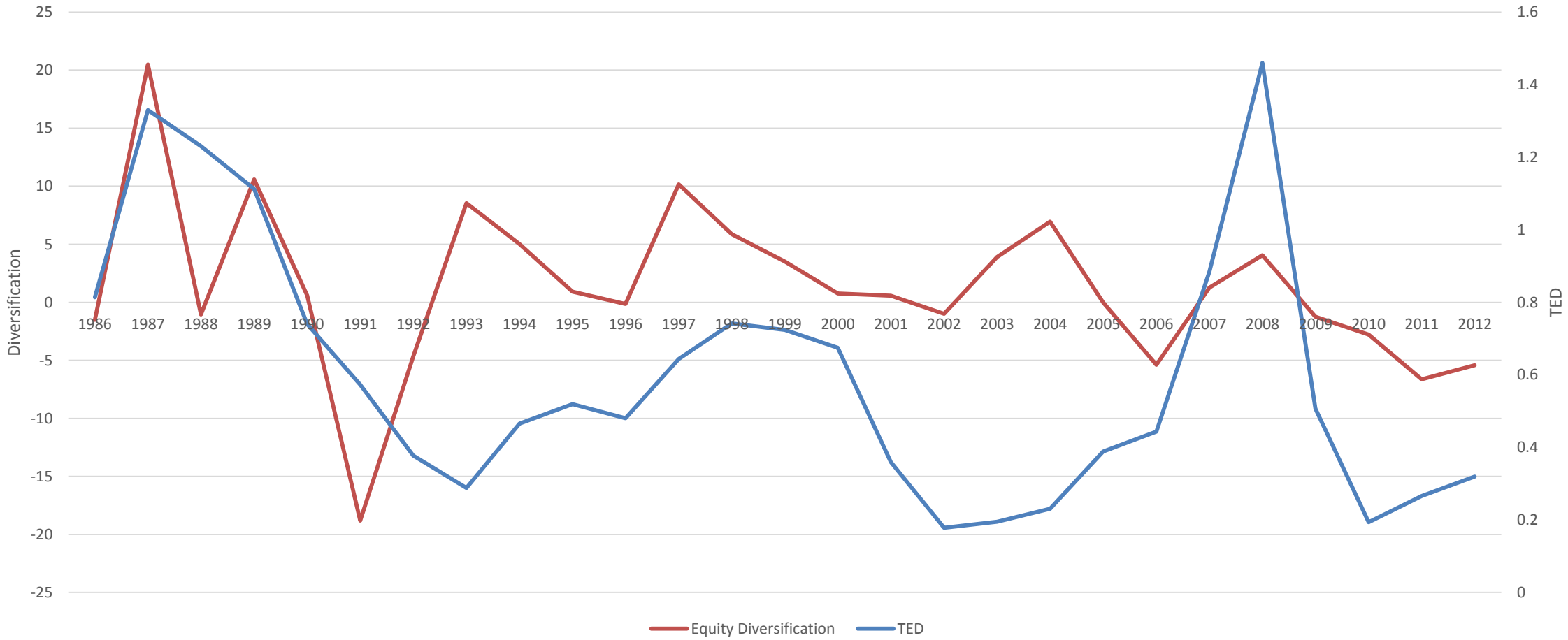
Notes: This figure uses the average diversification indexes for each asset class between 1986 and 2012. In panel B there are the average VIX and the difference in diversification between above (high VIX) and below (low VIX) the median VIX values.

Difference in REIT Diversification Indexes for High and Low VIX



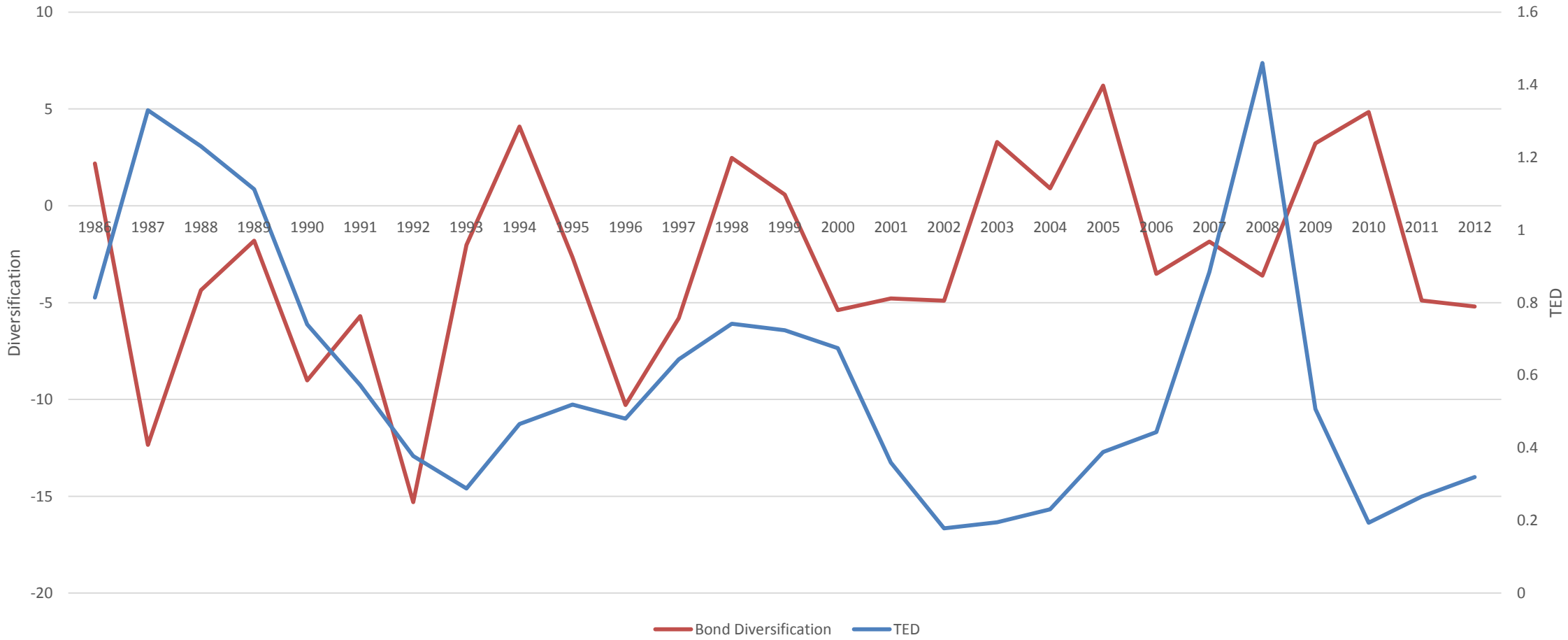
Notes: This figure uses the average diversification indexes for each asset class between 1986 and 2012. In panel B there are the average VIX and the difference in diversification between above (high VIX) and below (low VIX) the median VIX values.

Difference in Equity Diversification Indexes for High and Low TED



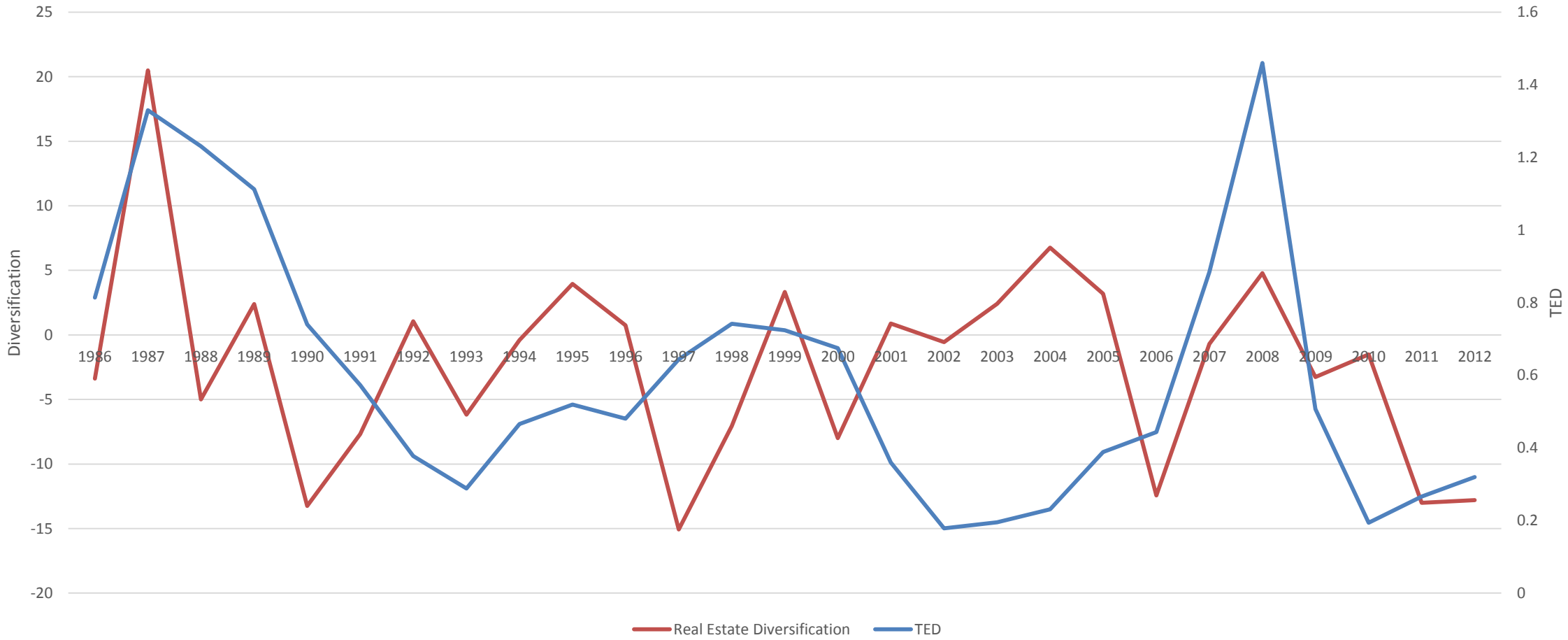
Notes: This figure uses the average diversification indexes for each asset class between 1986 and 2012. In panel C there are the average TED spreads and the difference in diversification between above (high TED) and below (low TED) the median TED values.

Difference in Bond Diversification Indexes for High and Low TED



Notes: This figure uses the average diversification indexes for each asset class between 1986 and 2012. In panel C there are the average TED spreads and the difference in diversification between above (high TED) and below (low TED) the median TED values.

Difference in REIT Diversification Indexes for High and Low TED



Notes: This figure uses the average diversification indexes for each asset class between 1986 and 2012. In panel C there are the average TED spreads and the difference in diversification between above (high TED) and below (low TED) the median TED values.

Correlations of World Diversification Indexes

Correlations between World Diversification Indexes for Raw Returns

Full Period

Contemporaneous

	Equity	Bond	REITs
Equity	1.000		
Bond	0.664	1.000	
REITs	0.884	0.837	1.000

Lead Equity

	Equity	Bond	REITs
Equity	1.000		
Bond	0.707	1.000	
REITs	0.786	0.836	1.000

Lead Bonds

	Equity	Bond	REITs
Equity	1.000		
Bond	0.531	1.000	
REITs	0.922	0.601	1.000

Lead REITs

	Equity	Bond	REITs
Equity	1.000		
Bond	0.739	1.000	
REITs	0.725	0.742	1.000

Pre2000

Contemporaneous

	Equity	Bond	REITs
Equity	1.000		
Bond	0.363	1.000	
REITs	0.656	0.874	1.000

Lead Equity

	Equity	Bond	REITs
Equity	1.000		
Bond	-0.103	1.000	
REITs	-0.229	0.711	1.000

Lead Bonds

	Equity	Bond	REITs
Equity	1.000		
Bond	-0.081	1.000	
REITs	0.683	-0.069	1.000

Lead REITs

	Equity	Bond	REITs
Equity	1.000		
Bond	0.332	1.000	
REITs	0.137	-0.036	1.000

Post2000

Contemporaneous

	Equity	Bond	REITs
Equity	1.000		
Bond	0.729	1.000	
REITs	0.977	0.774	1.000

Lead Equity

	Equity	Bond	REITs
Equity	1.000		
Bond	0.770	1.000	
REITs	0.885	0.738	1.000

Lead Bonds

	Equity	Bond	REITs
Equity	1.000		
Bond	0.771	1.000	
REITs	0.979	0.734	1.000

Lead REITs

	Equity	Bond	REITs
Equity	1.000		
Bond	0.692	1.000	
REITs	0.844	0.813	1.000

This table shows the contemporaneous, lead and lag correlation coefficients between the average diversification indexes. Correlation coefficients are reported for the full period, a pre2000 period and a post2000 period.

Correlations of Diversification Indexes

Panel A: Correlations between Diversification Indexes for Bear and Bull Returns (Bear minus Bull Returns) and Average Returns			
	Equity	Bond	REITs
Full Period	-0.024	0.080	-0.051
Pre 2000	-0.271	-0.024	0.168
Post 2000	0.111	0.186	-0.236
Panel B: Correlations between Diversification Indexes for high and low TED (High TED minus Low TED) and Mean TED			
	Equity	Bond	REITs
Full Period	0.386	-0.221	0.288
Pre 2000	0.400	-0.050	0.386
Post 2000	0.299	-0.240	0.186
Panel C: Correlations between Diversification Indexes for high and low VIX (High VIX minus Low VIX) and Mean VIX			
	Equity	Bond	REITs
Full Period	-0.022	-0.054	-0.051
Pre 2000	0.127	0.120	-0.146
Post 2000	0.130	-0.127	0.205

Notes: This table shows the correlation coefficients between the diversification indexes for bear and bull returns (bear minus bull returns) and average returns (panel A), correlations between diversification indexes for high and low TED (high TED minus low TED) and mean TED (panel B), and correlations between diversification indexes for high and low VIX (high VIX minus low VIX) and mean VIX (panel C).

Differences in World Diversification Indexes

	Equity	Bonds	REITs
Bear minus Bull Returns	5.868 (5.290)	-1.454 (-1.137)	2.408 (1.711)
High minus Low VIX	-0.815 (-1.017)	-0.351 (-0.321)	0.070 (0.052)
High minus Low Ted	1.280 (0.937)	-2.800 (-2.748)	-2.234 (-1.501)

Notes: The table shows the mean difference between diversifications indexes stratified by bear minus bull returns, high minus low VIX and high minus low TED spreads. These are followed in parentheses by t-statistics of testing whether the differences are significantly different from zero.