Stock/Bond Dynamics and the Cross-section of Country Stock Returns

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Cross-section of country stock returns

- With advancements of ETFs, international equity investment based on the macro environment became more popular. Understanding how local/global risk factors influence the stock market performance is important.
- What we know about the cross-country stock market performance:
  - The importance of global factor and the exposure to the factor (e.g., International CAPM; Adler and Dumas 1983)
  - *Dividend yields*, *term premium* (Jensen, Mercer, and Johnson 1986) or *momentum* (Hou, Karolyi, and Kho 2011, Cedenese et al.)
  - Liquidity (e.g., Bekaert, Harvey, and Lundblad 2007, Goyenko and Sarkissian 2014)
- This paper focuses on a new perspective: the hedging aspect of the country stock index and sovereign bond returns

What drives the variation in the stock & bond prices?

- ▷ One important factor that affects both bonds/stocks is uncertainty.
  - Flight-to-quality implies they move in opposite directions.
    $\rightarrow$ Bonds will hedge uncertainty risk of stock holdings.
- ▷ New aspect: stocks are exposed to global risk more than bonds.
  - One could be due to output/dividends being exposed to global risk more than consumption. (Backus-Keho-Kydland 1992) Why?
  - Strong empirical support: stock correlations across different regions much higher than bonds .
- ▷ Consequence: For countries that have dominant local risk, bonds do not hedge stocks' uncertainty risk well.

The SB beta and local uncertainty risk

- When local risk is high, global uncertainty risk is difficult to hedge and the SB beta is positive.

- The SB beta:

$$R_{i,s} = \alpha_i + \beta_i(-\Delta y_{i,t}) + \epsilon_{i,t}$$

  - For domestic investors, bonds do not hedge global uncertainty risk well, weakening the negative SB relationship.
  - For global investors, investments in countries with more local risk require a higher risk premium. Difficult to diversify since uncertainty risk also affects currency values.

Higher local uncertainty risk leads to a relatively positive β_i.

Data

- ▷ Total of 30: 14 in Europe (Austria, Belgium, Finland, France, Germany, Italy, Netherlands, Norway, Russia, Spain, Sweden, Switzerland, Turkey, UK), 9 in Asia (China, India, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, Thailand), 3 in NA (Canada, Mexico, US), 2 in Oceania (Australia and New Zealand), 1 from SA (Brazil) and Africa (South Africa)
- ▷ Stock returns & Bond yields- from Bloomberg
  - Stocks: MSCI Price Index (1990 – 2021)/ Total Return Index (1999 – 2021)
  - Bonds: Ten-year Treasury yields (1990 – 2021)
- ▷ Intraday variance (Oxford-Man), macro variables (Worldbank, OECD, and IMF), and CDS data (intercontinental exchange)

Main result - total returns/daily beta

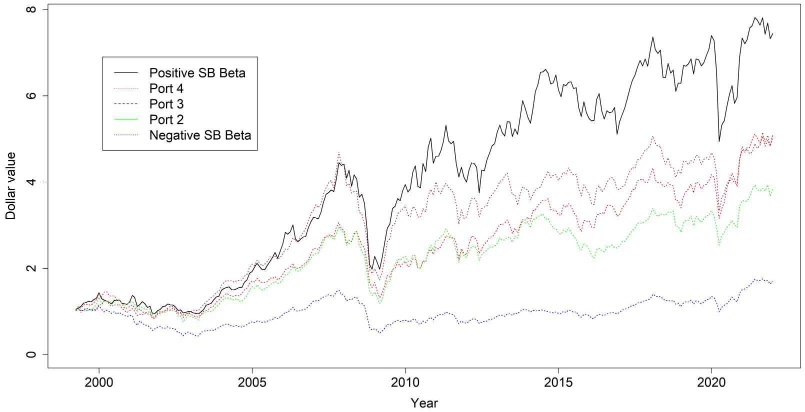
Countries are sorted by their SB beta (estimated using daily data over 180 calendar days), portfolios are formed, and the returns of the following month are evaluated:

	Port 1	Port 2	Port 3	Port 4	Port 5	H–L
Returns	0.46	0.67	0.79	0.87	0.99	0.53**
in USD	(1.24)	(1.93)	(2.28)	(2.54)	(2.56)	(2.46)
ICAPM	−0.12	0.10	0.46	0.63	0.69	0.81***
	(−1.06)	(0.93)	(2.46)	(2.96)	(4.22)	(4.37)
Returns	0.37	0.56	0.81	0.86	1.05	0.68***
in local $	(1.14)	(1.95)	(2.96)	(3.14)	(3.47)	(3.24)
Currency	0.07	0.09	−0.05	−0.02	−0.12	−0.19*
returns	(0.51)	(0.66)	(−0.35)	(−0.14)	(−1.03)	(−1.72)
SB Beta	−14.50	−8.14	−3.96	0.68	6.06	20.56

Units: in monthly returns (%)
The results are robust when betas are estimated using weekly, monthly returns.

Results

Time-series of SB beta-sorted equity portfolios in USD



Is sovereign default risk in bond yields priced? *Unlikely...*

- Sovereign bond yields moves when credit spread varies.
- If default risk is priced in the stock market, an shocks to CDS spread and stock returns should be negatively related. $\rightarrow$ Ceteris paribus, a positive SB relationship is expected.
- Consider a decomposition of first-difference in bond yields:

$$R^i_{S,t+1} = a^i + b^i(-\Delta y^i_{t+1} + \Delta CDS^i_{t+1}) + c^i(-\Delta CDS^i_{t+1}) + \epsilon^i_{t+1}$$

Portfolios formed after sorting by risk-free yield beta

	Port 1	Port 2	Port 3	Port 4	Port 5	H –L
Returns in USD	0.33 (0.89)	0.70 (1.97)	0.31 (0.86)	0.46 (1.22)	0.79 (2.08)	0.47** (2.34)

Portfolios formed after sorting by CDS beta

	Port 1	Port 2	Port 3	Port 4	Port 5	H –L
Returns in USD	0.66 (1.57)	0.56 (1.25)	0.46 (1.25)	0.59 (1.31)	0.41 (1.02)	−0.25 (−1.45)

Cross-sectional regressions

Country-specific characteristic or time-varying risk premium?

	$\hat{\beta}^i_{d,t}$	$\bar{\hat{\beta}}^i_d$	GDP/cap	Total GDP	$\frac{\text{\% Export}}{\text{GDP}}$	GDP growth	Inf. (π)	Ave-R^2
Model 1	0.037***							0.073
	(3.14)							
Model 2	0.050***	−0.019						0.140
	(3.31)	(−1.06)						
Model 3	0.030***		−0.003	55.127	0.000	8.256	−0.041	0.348
	(2.68)		(−0.45)	(0.73)	(1.27)	(1.02)	(−0.84)	

Common return predictors

	$\hat{\beta}^i_{d,t}$	Div. yield	Term spread	Momentum	Ave-R^2
Model 4	0.025**	0.344			0.116
	(2.34)	(0.05)			
Model 5	0.026**		0.004		0.141
	(2.45)		(0.11)		
Model 6	0.023**			0.591	0.172
	(2.49)			(1.06)	
Model 7	0.027**	−3.249	0.044	0.406	0.278
	(2.44)	(−0.46)	(0.56)	(0.68)	

Cross-sectional regressions - Other controls

Nominal-real covariance (*à* la Campbell, Pflueger, Viceira 2020)

	$\hat{\beta}^i_{d,t}$	π	ΔGDP	$\Delta GDP \times \pi$	Δc	$\Delta c \times \pi$	$\rho_{\pi,\mathrm{GDP}}$	$\rho_{\pi,\Delta c}$	R^2
Model 8	0.021∗∗	0.018	6.838	−1.814					0.266
	(2.02)	(0.16)	(1.32)	(−1.02)					
Model 9	0.023∗∗	−0.023	2.524				−0.290∗		0.312
	(2.13)	(−0.34)	(0.84)				(−1.92)		
Model 10	0.034∗∗∗	−0.033			−1.821	−0.121			0.332
	(2.69)	(−0.71)			(−0.32)	(−0.89)			
Model 11	0.032∗∗∗	−0.017			1.005			1.005	0.304
	(2.64)	(−0.37)			(0.59)			(0.59)	

Exposure to global illiquidity (Bakaert, Harvey, Lundblad 2007)/Treasury illiquidity (Goyenko, Sarkissian 2014)

	$\hat{\beta}^i_{d,t}$	Treas. Illiq.	Amihud	Zero ret.	Zero volume	R^2
Model 12	0.018∗∗	0.000				0.131
	(2.01)	(−0.62)				
Model 13	0.016∗		30.112			0.131
	(1.82)		(0.70)			
Model 14	0.021∗∗			0.031		0.127
	(2.43)			(0.62)		
Model 15	0.015∗				0.030	0.123
	(1.65)				(0.65)	

Are stocks correlated more across regions than bonds?

Stock correlations across continents

	Asia	Africa	Europe	Lat Am	Aus & NZ	US & Can
Asia	0.493	0.450	0.437	0.485	0.385	0.457
Europe	0.437	0.521	0.627	0.538	0.428	0.608
Lat Am	0.485	0.590	0.538	0.623	0.414	0.630
Aus & NZ	0.385	0.428	0.428	0.414	0.463	0.461
US & Can	0.457	0.576	0.608	0.630	0.461	0.747

Bond correlations across continents

	Asia	Africa	Europe	Lat Am	Aus & NZ	US & Can
Asia	0.127	0.121	0.139	0.117	0.186	0.179
Europe	0.139	0.127	0.482	0.138	0.360	0.469
Lat Am	0.117	0.248	0.138	0.336	0.086	0.119
Aus & NZ	0.186	0.143	0.360	0.086	0.625	0.492
US & Can	0.179	0.102	0.469	0.119	0.492	0.752

	Same Continent	Different Continent	Paired t-test
S/B Difference	0.292	0.126	−0.151
T-statistics	(11.54)	(1.93)	(−2.12)
P-value	0.000	0.063	0.051

Country-level analysis: "Stock minus bond correlations"

	Region				Region		
	Different	Same	S-D		Diff Continent	Same	S-D
Australia	0.263	-0.161	-0.424	Mexico	0.417	0.287	-0.130
Austria	0.218	-0.025	-0.244	Netherlands	0.223	0.065	-0.158
Belgium	0.220	0.043	-0.177	Norway	0.230	0.118	-0.112
Brazil	0.363	0.287	-0.076	NZ	0.077	-0.161	-0.238
Canada	0.284	-0.004	-0.288	Philippines	0.364	0.391	0.027
China	0.413	0.474	0.061	Russia	0.360	0.459	0.099
Finland	0.155	-0.071	-0.225	Singapore	0.201	0.367	0.166
France	0.271	0.091	-0.180	S. Africa	0.365	.	.
Germany	0.247	0.096	-0.151	Spain	0.331	0.243	-0.088
India	0.345	0.389	0.044	Sweden	0.277	0.134	-0.143
Indonesia	0.318	0.410	0.092	Switzerland	0.226	0.163	-0.063
Italy	0.332	0.262	-0.070	Thailand	0.223	0.282	0.058
Japan	0.292	0.341	0.049	Turkey	0.254	0.290	0.036
Korea	0.297	0.346	0.050	UK	0.290	0.157	-0.133
Malaysia	0.200	0.293	0.094	USA	0.265	-0.004	-0.270
				Mean	0.277	0.192	-0.083
				T-stat	(22.07)	(5.71)	(-3.10)

Hedging global uncertainty risk using bonds

- Stocks are heavily exposed to global (uncertainty risk)
- Bonds better hedge global uncertainty risk when SB beta/correlation is negative?
- Need an estimate of local global uncertainty. A stochastic volatility (SV) model on global returns:

$$R^*_{m,t} = \beta^*_0 + \exp(h^*_t/2)\epsilon^*_t$$
$$h^*_{t+1} = \mu^*_h + \varphi^*_h(h^*_t - \mu^*_h) + \sigma^*_h\eta^*_t,$$

Hedging global variance risk using bonds

$$\Delta y^i_{t+1} = \alpha_0 + \alpha_1 \Delta \exp(h^*_{t+1}/2) + \alpha_2 \Delta \exp(h^*_{t+1}/2) \times \text{SB Beta}^i_t + \alpha_3 \text{SB Beta}^i_t + e^i_{t+1}$$

	Quarterly changes in yields			
$\Delta \exp(h^*_t/2)$	3.253	3.258	2.556	2.540
	(1.06)	(1.09)	(1.03)	(0.81)
$\Delta \exp(h^*_t/2) \times$ SB Beta	0.506	0.512		
	(4.75)	(5.11)		
SB Beta	0.004	0.006		
	(2.85)	(3.21)		
$\Delta \exp(h^*_t/2) \times$ SB Cor			26.770	26.910
			(7.27)	(7.55)
SB Cor			0.104	0.134
			(2.57)	(1.70)
Country Fixed Effect	N	Y	N	Y
R^2	0.017	0.029	0.026	0.036
Number of Obs.	3,131	3,131	3,131	3,131

SB relationship and the amount of local uncertainty risk

1) SV estimate of country-specific returns:

$$R^i_{m,t} = \beta^i_0 + \beta^i_m R^*_{m,t} + \beta^i_q \Delta q^i_t + \exp(h^i_t/2)\epsilon^i_t$$
$$h^i_{t+1} = \mu^i_h + \varphi^i_h(h^i_t - \mu^i_h) + \sigma^i_h \eta^i_t,$$

Note: From Ito's lemma, vol of the variance = variance ($\exp(h^i_t)$).

2) Use intraday data to find the forecast error of 5-day RV:

$$RV^i_{t+1,t+5} = b_0 + b_1 RV^i_{t-5,t} + b_2 RV_{t-22,t} + e^i_{t+1,t+5}$$

Estimate the standard deviation of the residual ($SD(\omega^i_t)$) in the regression:

$$\hat{e}^i_t = c_0 + c_1 \sum_{j \in \text{countries}} \hat{e}^j_t + \omega^i_t,$$

$\rightarrow$ Expect the SB beta to me more positive when volatility of variance of the country-specific component is higher!

Size of Uncertainty risk estimated from stock returns

	Dep . Variable: $\hat{\beta}^i$			
$\exp(h_t^i)$	12.450	88.925		
	(3.21)	(2.24)		
$\exp(h_t^*)$	-65.370	-16.884		
	(-0.61)	(-2.26)		
Idiosyncratic vol. of RV			51.537	34.413
			(4.27)	(3.01)
Volatility of RV			-33.543	-20.957
			(-3.10)	(-2.05)
FE Country	N	Y	N	Y
FE Time	Y	Y	Y	Y
R^2	0.302	0.532	0.242	0.525
# of Obs.	2,824	2,824	1,568	1,568

→ These results so far suggest that when there is more local uncertainty risk, both the SB beta and the SB correlations will be more positive.

SB Correlation and Stock or Bond Variance

Controlling for stock return volatility, bond yield volatility should measure the amount of local uncertainty.

$$\text{Dep}_{i,t} = \underbrace{b}_{>0}\sigma_t(\Delta y^i) + \underbrace{c}_{<0}\sigma_t(R_s^i) + \text{FE}_{i,t} + e_{i,t}$$

	$\hat{\beta}^i$			$\hat{\rho}^i$		
SD(Δy^i)	14.952	4.953	4.224	0.494	0.204	0.154
	(4.10)	(3.10)	(2.80)	(3.86)	(2.35)	(2.41)
SD(R_m^i)	−0.777	−1.345	−0.976	0.023	−0.018	0.010
	(−2.37)	(−5.98)	(−3.11)	(3.69)	(−2.98)	(1.97)
FE Country	N	Y	Y	N	Y	Y
FE Time	Y	N	Y	Y	N	Y
R^2	0.206	0.382	0.382	0.255	0.274	0.468
# of Obs.	8,130	8,130	8,130	8,130	8,130	8,130

Does country-specific volatility of variance predict returns?

Result of the cross-sectional regression:

	Dep. var.: Leading month returns			
	Model 1	Model 2	Model 3	Model 4
Country-specific VOV	0.052**	0.047**		
	(2.22)	(2.04)		
Local RV			0.003	0.002
			(1.27)	(1.13)
ICAPM Beta	−0.006		−0.006	
	(−1.50)		(−1.34)	

Consumption dynamics

Epstein-Zin (1991) preference for country i and world $(^*)$:

$$m_{t+1}^{i/*} = \theta \log \beta - \frac{\theta}{\psi} \Delta c_{t+1}^{i/*} + (\theta - 1) R_{TW,t+1}^{i/*},$$

Country i:

$$\begin{aligned}
\Delta c_{t+1}^{i} &= \mu + x_t^* + x_t^i + \sqrt{v_t^i}\epsilon_{c,t+1}^i + \sqrt{v_t^*}\epsilon_{c,t+1}^* \\
x_{t+1}^i &= \xi_l x_t^i + \lambda_x \varphi_x \sqrt{v_t^i}\epsilon_{x,t+1}^i \\
v_{t+1}^i &= v_{l0} + v_{l1} v_t^i + \sigma_l \sqrt{v_t^i}\epsilon_{v,t+1}^i \\
\pi_{t+1}^i &= p_0 + p_1 \pi_t^i + \sigma_{pl} \sqrt{v_t^i}\epsilon_{\pi,t+1}^i + \sigma_{pg} \sqrt{v_t^*}\epsilon_{\pi,t+1}^*,
\end{aligned} \tag{1}$$

World:

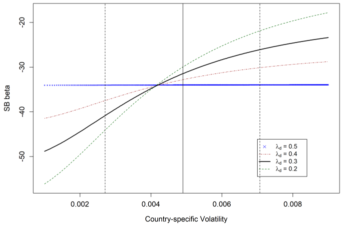
$$\begin{aligned}
\Delta c_{t+1}^{*} &= \mu + x_t^* + \sqrt{v_t^*}\epsilon_{c,t+1}^* \\
x_{t+1}^* &= \xi_g x_t^* + \sqrt{1-\lambda_x}\varphi_x \sqrt{v_t^*}\epsilon_{x,t+1}^* \\
v_{t+1}^* &= v_{g0} + v_{g1} v_t^* + \sigma_g \sqrt{v_t^*}\epsilon_{v,t+1}^*, \\
\pi_{t+1}^* &= p_0 + p_1 \pi_t^* + \sigma_{pg} \sqrt{v_t^*}\epsilon_{\pi,t+1}^*
\end{aligned} \tag{2}$$

Dividend dynamics

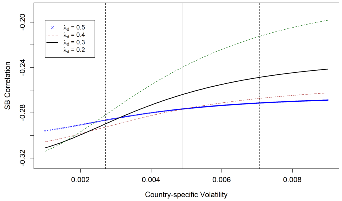
$$\Delta d^i_{t+1} = \mu_d + \phi\lambda_d(x^i_t + \varphi_d\sqrt{v^i_t}\epsilon^i_{d,t+1}) + \phi(1-\lambda_d)(x^*_t + \varphi_d\sqrt{v^*_t}\epsilon^*_{d,t+1}),$$

- Key assumption: $\lambda_d < 0.5$
- Preference: $\gamma = 15$, ψ=2, β=0.9985
- Consumption: μ=0.0015, $\xi_g = \xi_l$=0.979, λ_x=0.25, φ_x 0.044
- Variance: v_{g1}=0.912, $\sqrt{\bar{v}_t{}^*} = 0.0036$, v_{l1}=0.972, $\sqrt{\bar{v}_t{}^i}$=0.0049
- Dividends: μ_d=0.0025, ϕ=5.0, λ_d=0.3, φ_d=4.0, $\sigma_g = 1.94 \times 10^{-4}$, $\sigma_l = 5.10 \times 10^{-4}$
- Correlations: ρ_{cv} = -0.30, ρ_{cd} = 0.45, ρ_{xv}=-0.45, $\rho_{cx} = 0$, $\rho_{nr} = 0$

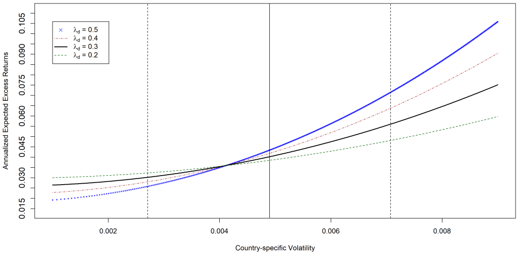
Model Implications: SB Beta/Correlations



(a) Nominal 10Y SB beta

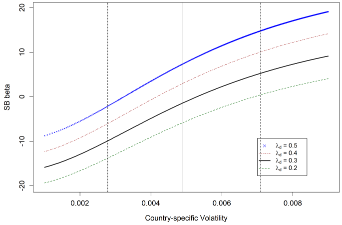


(b) Nominal 10Y SB correlation

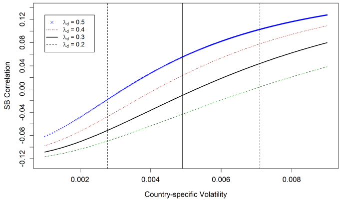


(c) Expected excess stock returns

Model Implications: SB Correlation



(a) Nominal 10Y SB beta



(b) Nominal 10Y SB correlation

$$\rho_{cx} = \text{-}0.4,\ \rho_{nr} = \text{-}0.3$$

Conclusion

- ▷ Countries with a positive relationship between returns on stocks and bonds have higher future stock returns.
- ▷ Stock and bond returns are relatively positively related if
  - there is more uncertainty shock within the country or region.
  - sovereign bond yield is volatile.
- ▷ Evidence of local risk priced in the international equity market

Main result - price returns/daily beta

Countries are sorted by their SB beta, portfolios are formed, and the returns of the next month are evaluated:

	Port 1	Port 2	Port 3	Port 4	Port 5	H–L
Returns	0.18	0.63	0.64	0.85	0.86	0.68***
in USD	(0.59)	(2.26)	(2.27)	(2.91)	(2.45)	(2.86)
ICAPM	−0.40	0.15	0.18	0.43	0.46	0.86***
	(−3.55)	(1.56)	(1.44)	(3.13)	(2.80)	(4.62)
Returns	0.12	0.53	0.63	0.82	0.92	0.81***
in local $	(0.44)	(2.25)	(2.70)	(3.39)	(3.05)	(3.56)
Currency	0.05	0.08	−0.02	0.01	−0.11	−0.16
returns	(0.42)	(0.80)	(−0.16)	(0.07)	(−0.94)	(−1.27)

Main Result - Alternative Specifications

A. Weekly Estimation

	Total returns						Price returns					
	Port 1	Port 2	Port 3	Port 4	Port 5	H–L	Port 1	Port 2	Port 3	Port 4	Port 5	H–L
Returns	0.28	0.32	0.53	0.52	0.93	0.65***	0.02	0.23	0.50	0.67	0.66	0.66**
in USD	(0.74)	(0.86)	(1.45)	(1.38)	(2.27)	(2.73)	(0.05)	(0.77)	(1.71)	(2.08)	(1.76)	(2.57)
ICAPM	−0.18	0.10	0.32	0.30	0.92	1.11***	−0.35	−0.02	0.22	0.28	0.44	0.81***
	(−1.77)	(0.60)	(2.47)	(2.03)	(4.32)	(5.16)	(−2.45)	(−0.15)	(1.60)	(1.60)	(2.01)	(3.83)
Returns	0.22	0.26	0.35	0.62	1.05	0.83***	0.00	0.25	0.49	0.67	0.81	−0.81***
in local $	(0.68)	(0.85)	(2.11)	(2.06)	(3.14)	(3.60)	(0.01)	(1.05)	(2.04)	(2.51)	(2.45)	(3.40)
Currency	0.06	0.06	−0.07	−0.09	−0.11	−0.17	0.01	−0.03	0.02	0.00	−0.14	−0.15
returns	(0.40)	(0.41)	(−0.47)	(−0.68)	(−0.97)	(−1.59)	(0.09)	(−0.24)	(0.16)	(0.01)	(−1.06)	(−1.09)

B. Monthly Estimation

	Total returns						Price returns					
	Port 1	Port 2	Port 3	Port 4	Port 5	H–L	Port 1	Port 2	Port 3	Port 4	Port 5	H–L
Returns	0.15	0.26	0.32	0.72	0.71	0.57**	0.55	0.52	0.46	0.87	0.96	0.42**
in USD	(0.47)	(0.87)	(1.13)	(2.27)	(1.95)	(2.34)	(1.72)	(1.81)	(1.57)	(2.67)	(2.68)	(2.06)
ICAPM	−0.18	−0.01	−0.07	0.42	0.46	0.66***	−0.11	0.08	0.28	0.41	0.85	0.96***
	(−1.17)	(−0.11)	(−0.43)	(2.80)	(2.31)	(3.27)	(−0.85)	(0.71)	(2.07)	(2.79)	(4.64)	(4.77)
Returns	0.13	0.30	0.31	0.71	0.80	0.68***	0.60	0.44	0.57	0.88	1.07	0.50***
in local $	(0.44)	(1.26)	(1.27)	(2.79)	(2.61)	(3.04)	(2.28)	(1.82)	(2.31)	(3.39)	(3.61)	(2.72)
Currency	0.02	−0.05	0.01	0.01	−0.09	−0.10	−0.05	0.07	−0.10	−0.01	−0.11	−0.07
returns	(0.20)	(−0.40)	(0.10)	(0.05)	(−0.80)	(−0.90)	(−0.40)	(0.69)	(−0.85)	(−0.07)	(−0.93)	(−0.64)

Go Back