Spring 2020

Culture of countries and country-index crash risk

Jason Petri
jfp21@zips.uakron.edu

Culture of countries and country-index crash risk

Jason Petri

College of Business Administration, The University of Akron, Akron, Ohio 44325

Abstract

This study applies crash risk calculations on country-level indices to identify the relationship between social, political, and economical factors of a large basket of countries and two forms of crash risk. Crash risk indicates levels of risk that are due to market asymmetry. Considering the various makeups of countries and the individualized financial systems that result, this analysis studied the extent that these factors influence the susceptibility of wide changes in the countries respective index. I find that there is no significant relationship between the various measures of societal factors and crash risk. Compared to an economic factor like gross domestic product growth, there appears to be a significant relationship for crash risk.

Keywords: Crash Risk; Culture; Governance

Jason Petri, The University of Akron, Akron, USA, 325 Buchtel Commons, Akron, Ohio 44325, USA.

Email: jfp21@zips.uakron.edu

Introduction

Many previous studies have used measures of crash risk on firm level financial instruments (Huaping, Feifan, 2020; Chen, Stein, 2001). In my attempt to find academic literature, the concept of crash risk has not yet been applied to country-level indices. This study will attempt to discover relationships between two forms of crash risk—negative skewness and down-to-up-volatility—and the aspects of the country's culture, social preferences, and political systems. These relationships, if present, would lead to a better understanding to how crashes may form at a country level.

Empirical methodology

The sample

This study utilizes data provided by MSCI in multiple instances. The data required to calculate country-level crash risk was sourced from the MSCI Developed Markets Indexes database[1]. These indices are developed using the MSCI's Global Investable Market Index (GIMI) methodology. Importantly, these indices are available in the United States Dollar currency. This feature was chosen to consistently remove the effects of regional currency issues in all comparative datasets. This dataset provided data for 73 countries: Argentina, Australia, Austria, Bahrain, Bangladesh, Belgium, Bosnia And Herzegovina, Botswana, Brazil, Bulgaria, Canada, Chile, China, Colombia, Croatia, Czech Republic, Denmark, Egypt, Estonia, Finland, France, Germany, Ghana, Greece, Hong Kong, Hungary, India, Indonesia, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Korea, Kuwait, Lebanon, Lithuania, Malaysia, Mauritius, Mexico, Morocco, Netherlands, New Zealand, Nigeria, Norway, Oman, Pakistan, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russia, Serbia, Singapore, Slovenia, Spain, SRI Lanka, Sweden, Switzerland, Thailand, Tunisia, Turkey, Ukraine, United Arab Emirates, United Kingdom, United States, Vietnam, and Zimbabwe. The data was

[1] See https://www.msci.com/developed-markets

available in daily frequency beginning at the start of year 2000 through the end of 2019. Many countries had all datapoints available throughout this entire timeframe. However, a select group of countries did not have an initial starting date of the beginning of 2000. These countries had various starting dates but remained consistent in reporting once the initial date occurred.

The factors that were utilized to form the independent variables in this study were sourced, in part, from The World Bank data source[2]. In this study, it was necessary to acquire gross domestic product per capita and gross domestic product growth. The gross domestic product figures were stated in constant 2010 United States Dollars. This detail was chosen so values are rooted in a level of value around the midpoint of the timeseries data total range. Gross domestic product growth is represented at an annual frequency as this will align with the frequency of the studied dependent variables for crash risk.

To represent the dimensions of governance across many countries, the Worldwide Governance Indicators were used. This dataset provides six broad dimensions of governance: voice and accountability, political stability and absence of violence/terrorism, government effectiveness, regulatory quality, rule of law, and control of corruption[3]. The data provided is in annual frequency and complete for most countries in the 2000 to 2019 range.

Further independent variables were selected to represent the aspects of society in many different countries. The Hofstede Insights dataset provide six dimensions of national culture. National culture is represented through power distance, individualism versus collectivism, masculinity versus femininity, uncertainty avoidance, long term orientation versus short term normative orientation, and indulgence versus restraint. Power distance (PDI) expresses the [4]degree to which the less powerful

---

[2] See https://data.worldbank.org/

[3] See https://datacatalog.worldbank.org/dataset/worldwide-governance-indicators

[4] See https://hi.hofstede-insights.com/national-culture

members of a society accept and expect that power is distributed unequally. Individualism versus collectivism (IDV) represents a preference to interact with themselves and immediate family whereas more collective societies prefer to interact with wider social groups. Masculinity versus femininity (MAS) represents differing social preferences, like competition versus cooperation. Uncertainty avoidance (UAI) expresses the comfortability of various risk levels and uncertainties. Long term orientation versus short term normative orientation (LTO) expresses the preference to varying time horizons for goals. Indulgence versus restraint (IVR) represents the tendencies for a society to enjoy varying levels of gratification for enjoyment and fun.

Crash risk measures

This study uses two measures of firm-specific crash risk that was supported in Chen et al. (2001) but with an adaptation to be used at a country level. The works cited that support firm-specific crash risk use weekly price returns. In this study, provided by the MSCI Developed Market Indexes, weekly returns are estimated as the residuals from the market model. In the market mode, the market proxy used was the MSCI World Gross Index USD. This represents the returns of the aggregate of all countries. Using the following index market model estimate for weekly returns, the returns attributed to the aggregate are removed (Hutton, Marcus, and Tehranian, 2009):

$$r_{i,t} = \alpha_i + \beta_{1,i} r_{m,t-2} + \beta_{2,i} r_{m,t-1} + \beta_{3,i} r_{m,t} + \beta_{4,i} r_{m,t+1} + \beta_{5,i} r_{m,t+2} + \epsilon_{i,t}$$

where $r_{i,t}$ is the return on country index *i* in week *t*, and $r_{m,t}$ is the return on the MSCI World Gross Index USD in week *t*. We include the lead and lag terms of the global index to allow for non-synchronous trading (Dimson, 1979). The country-specific weekly returns are denoted as $W_{i,t}$ equating to the natural log of one plus the residual from the market model for country *i* in week t.

$$W_{i,t} = \ln(1 + \epsilon_{i,t})$$

Crash risk was calculated in two forms in this study: negative skewness (NCSKEW) and down-to-up volatility (DUVOL). Negative skewness is calculated by negating the raised number of weeks *n* minus 1 in year *t* to the 3/2 power, multiplying by the number of weeks *n* in year *t*, and the sum of the cubed weekly returns in year *t* then dividing by the number of weeks *n* in year *t* minus 1 multiplied by the number of weeks *n* in year *t* minus 2 multiplied by the sum of the squared weekly returns in year *t* to the 3/2 power. The equation is as follows:

$$NCSKEW_{i,t} = -\frac{n(n-1)^{\frac{3}{2}}(\sum W_{i,t}^3)}{(n-1)(n-2)(\sum W_{i,t}^2)^{\frac{3}{2}}}$$

A higher value of negative skewness represents a more negatively skewed return distribution and higher crash risk.

To calculate the other form of crash risk studied in this paper, down-to-up-volatility, we separate all weekly returns $W_{i,t}$ in the calendar year *t* that are negative from those returns that are positive. These returns are sorted into their respective groups as either down weeks or up weeks. Down-to-up-volatility is calculated as the log of the number of up weeks n_u in year *t* minus 1 multiplied by the sum of the squared weekly returns of down weeks all divided the product of the number of down weeks n_d minus 1 and the sum of the squared weekly returns of all up weeks. The equation is as follows:

$$DUVOL_{i,t} = \log\left(\left[(n_u - 1)\sum_{Down} W_{i,t}^2\right] \Big/ \left[(n_d - 1)\sum_{Up} W_{i,t}^2\right]\right)$$

A higher value of down-to-up-volatility represents a higher crash risk.

Hypotheses

This study explores the relationships between crash risk and cultural factors at the country level. Several hypotheses are explored.

H1: Positive gross domestic product growth has a negative relationship on crash risk

H2: Gross domestic product per capita has a negative relationship on crash risk

H3: Higher standards of regulatory quality, voice and accountability, more stable political systems and the absence of terrorism, effective government, influential rules of law, and controls of corruption have a negative relationship on crash risk

H4: Less individualized countries that exhibit feminine characteristics among citizens have a negative relationship on crash risk

H5: Countries that express more uncertainty avoidance and have a longer orientation to decisions have a negative relationship with crash risk

H6: Countries that are more indulgent will have a positive relationship with crash risk

Empirical models

Exploring Hypothesis 1

The study explores the relationship between the gross domestic product growth year over year and the crash risk for a country. The increase in annual gross domestic product should influence crash risk in a negative direction. Studies highlight that relationships between financial markets and the economic growth of a country exist (Banerjee, Ahmed, Hossain, 2017). The following regression model will be used to explore this relationship:

$$CrashRisk_t = \beta_0 + \beta_1(GDPGrowth_t) + \epsilon_t$$

where $CrashRisk_t$ is either the negative skewness or down-to-up-volatility measure in year *t* for a given country and $GDPGrowth_t$ is the annual growth rate in year *t* for a given country.

Exploring Hypothesis 2

The study explores the relationship between gross domestic product per capita and the crash risk for a country. Given a wealthier country on a per capita basis, the lower the crash risk should be experienced. The following regression model will be used to explore this relationship:

$$CrashRisk_t = \beta_0 + \beta_1(GDPPerCapita_t) + \epsilon_t$$

where $CrashRisk_t$ is either the negative skewness or down-to-up-volatility measure in year *t* for a given country and $GDPPerCapita_t$ is the annual growth rate in year *t* for a given country.

Exploring Hypothesis 3

The study explores the relationship between standards of regulatory quality, voice and accountability, political systems and the absence of terrorism, government effectiveness, rules of law, and controls of corruption and the measures of crash risk. A country that exhibits a more regulative society, more emphasis on voice and accountability, less terrorism and a structured political system, effective government, standardized and actionable rules of law, and structures in society where corruption is controlled should exhibit lower crash risk. The following regression model will be used to explore this relationship:

$$CrashRisk_t = \beta_0 + \beta_1(COC_t) + \beta_2(GE_t) + \beta_3(PS_t) + \beta_4(RQ_t) + \beta_5(ROL_t) + \beta_6(VA_t) + \epsilon_t$$

where $CrashRisk_t$ is either the negative skewness or down-to-up-volatility measure in year *t* for a given country, COC_t is the control of corruption, GE_t is the government effectiveness measure, PS_t is the political stability and absence of violence measure, RQ_t is the regulatory quality measure, ROL_t is the rule of law measure, and VA_t is the voice and accountability measure.

Exploring Hypothesis 4

The study explores the relationship between individualism and the influence of crash risk for a country. A country where there are fewer individualized social dynamics should result in a lower crash risk value. The following regression model will be used to explore this relationship:

$$CrashRisk_t = \beta_0 + \beta_1(IDV_t) + \epsilon_t$$

where $CrashRisk_t$ is either the negative skewness or down-to-up-volatility measure in year *t* for a given country, IDV_t is the measure of individualism in year *t* for a given country.

Exploring Hypothesis 5

The study explores the relationship between countries that have a tendency to avoid uncertainty and show a tendency to oversee decisions with a longer time horizon have a negative correlation to crash risk. Other works have shown that psychological factors can have influence on the stock market (Huaping, Feifan, 2020). The following regression model will be used to explore this relationship:

$$CrashRisk_t = \beta_0 + \beta_1(UAI_t) + \beta_2(LTO_t) + \epsilon_t$$

where $CrashRisk_t$ is either the negative skewness or down-to-up-volatility measure in year *t* for a given country, UAI_t is the representation of uncertainty avoidance for a given country, and LTO_t is the representation of a country's tendency to plan further out when making decisions.

Exploring Hypothesis 6

The study explores the relationship between the country's tendency to express more indulgence for pleasures and the country's crash risk. Given a country that is pursues indulgence, the higher the expected crash risk. The following regression model will be used to explore this relationship:

$$CrashRisk_t = \beta_0 + \beta_1(IVR_t) + \epsilon_t$$

where $CrashRisk_t$ is either the negative skewness or down-to-up-volatility measure in year *t* for a given country and IVR_t is the measure for a country to pursue restraint or indulgence year *t* for a given country.

Empirical results

Hypothesis 1: The effects of gross domestic product growth and crash risk

The hypothesis was analyzed at the aggregate level of every country's crash risk and gross domestic product growth for years available in the period 2000 to 2018. The table below shows the sample of data distributed over the time period. Year 2019 was excluded due to the annual gross domestic product data not available from the source. The table also shows the number of observations in each year, the weight that the observations of each year have over the entire period, and average annual values for GDPGrowth, DUVOL, and NCSKEW.

Hypothesis 1

Year	Frequency	Percent	GDPGrowth	DUVOL	NCSKEW
2000	43	4.09	5.05	-0.05	-0.12
2001	43	4.09	2.16	0.17	0.90
2002	43	4.09	3.04	0.05	0.10
2003	43	4.09	3.28	0.01	-0.06
2004	43	4.09	4.99	-0.03	-0.18
2005	44	4.19	4.32	-0.01	-0.09
2006	49	4.66	5.70	-0.08	-0.36
2007	49	4.66	5.36	0.01	-0.03
2008	49	4.66	2.81	0.09	0.32
2009	58	5.52	-0.82	-0.05	-0.12
2010	58	5.52	4.26	-0.02	0.02
2011	59	5.61	3.27	0.06	0.24
2012	60	5.71	2.32	-0.01	-0.02
2013	61	5.8	2.63	0.10	0.41
2014	61	5.8	2.91	0.08	0.43
2015	72	6.85	2.92	-0.03	-0.02
2016	72	6.85	2.76	-0.01	0.13
2017	72	6.85	3.30	-0.06	-0.20
2018	72	6.85	3.23	0.00	0.08
Total	**1051**	**99.98**	**3.34**	**0.01**	**0.08**

The following table shows the results form the regression model stated in the hypothesis. The table includes the coefficient and p values for the model when DUVOL or NCSKEW were used as the target value. For each respective target used in the model, the R^2 and number of observations are listed.

Hypothesis 1

	Crash Risk Measure			
	DUVOL		**NCSKEW**	
Model	**Coef**	**p value**	**Coef**	**p value**
Const	0.023	0.021	0.144	0.000
GDPGrowth	-0.004	0.069	-0.021	0.011
R^2	*0.003*		*0.006*	
n	*1051*		*1051*	

The table above indicates significance for both coefficients at a 95% confidence level, the constant and the independent variable GDPGrowth, in the NCSKEW model. In the DUVOL model, the results for the dependent variable, GDPGrowth, did not result in significance at the 95% confidence level. The constant parameter does indicate significance at the 95% confidence level. In conclusion, GDPGrowth has a significant relationship with the NCSKEW measure of crash risk at the 95% confidence level. The independent variable GDPGrowth does not have a significant relationship with the DUVOL measure of crash risk at the 95% confidence level.

Hypothesis 2: The effects of gross domestic product per capita and crash risk

The hypothesis was analyzed at the aggregate level of every country's crash risk and gross domestic product per capita for years available in the period 2000 to 2018. The table below shows the sample of data distributed over the time period. Year 2019 was excluded due to the annual gross domestic product data not available from the source. The table also shows the number of observations in each year, the weight that the observations of each year have over the entire period, and average annual values for GDPPerCapita, DUVOL, and NCSKEW.

Hypothesis 2

Year	Frequency	Percent	GDPPerCapita	DUVOL	NCSKEW
2000	43	4.09	25130.36	-0.05	-0.12
2001	43	4.09	25416.26	0.17	0.90
2002	43	4.09	25758.67	0.05	0.10
2003	43	4.09	26118.04	0.01	-0.06
2004	43	4.09	26957.71	-0.03	-0.18
2005	44	4.19	27082.41	-0.01	-0.09
2006	49	4.66	29328.25	-0.08	-0.36
2007	49	4.66	29955.52	0.01	-0.03
2008	49	4.66	29796.15	0.09	0.32
2009	58	5.52	25352.93	-0.05	-0.12
2010	58	5.52	25845.74	-0.02	0.02
2011	59	5.61	25929.99	0.06	0.24
2012	60	5.71	25717.62	-0.01	-0.02
2013	61	5.8	25494.34	0.10	0.41
2014	61	5.8	25831.00	0.08	0.43
2015	72	6.85	23336.38	-0.03	-0.02
2016	72	6.85	23641.17	-0.01	0.13
2017	72	6.85	24089.43	-0.06	-0.20
2018	72	6.85	24526.79	0.00	0.08
Total	**1051**	**99.98**	**26068.88**	**0.01**	**0.08**

The following table shows the results from the regression model stated in the hypothesis. The table includes the coefficient and p values for the model when DUVOL or NCSKEW were used as the target value. For each respective target used in the model, the R^2 and number of observations are listed.

Hypothesis 2

	Crash Risk Measure			
	DUVOL		**NCSKEW**	
Model	**Coef**	**p value**	**Coef**	**p value**
const	-0.004	0.748	0.035	0.102
GDPPerCapita	0.000	0.106	0.000	0.237
R^2	*0.002*		*0.001*	
n	*1051*		*1051*	

The table above indicates insignificance for both coefficients at a 95% confidence level, the constant and the independent variable GDPPerCapita, in the NCSKEW model and the DUVOL model. In conclusion, GDPPerCapita does not have a significant relationship with either forms of crash risk at the 95% confidence level.

Hypothesis 3: The effects of country governance and crash risk

The hypothesis was analyzed at the aggregate level of every country's crash risk and indices for country governance for years available in the period 2000 to 2019. These indices include measures for corruption, government effectiveness, political stability, regulatory quality, rule of law, and voice and accountability. The table below shows the sample of data distributed over the time period. The table also shows the number of observations in each year, the weight that the observations of each year have over the entire period, and average annual values for COC, GE, PS, RQ, ROL, VA, DUVOL, and NCSKEW.

Hypothesis 3

Year	Frequency	Percent	COC	GE	PS	RQ	ROL	VA	DUVOL	NCSKEW
2000	42	3.81	0.98	1.03	0.47	0.98	0.90	0.73	-0.05	-0.14
2001	42	3.81	0.98	1.03	0.47	0.98	0.90	0.73	0.17	0.91
2002	42	3.81	0.96	1.06	0.51	0.96	0.93	0.73	0.05	0.12
2003	42	3.81	1.00	1.08	0.26	0.99	0.94	0.75	0.00	-0.08
2004	42	3.81	0.95	1.06	0.20	0.96	0.91	0.82	-0.02	-0.16
2005	43	3.9	0.90	0.99	0.28	0.92	0.88	0.75	0.00	-0.08
2006	48	4.35	0.88	0.95	0.30	0.90	0.84	0.47	-0.07	-0.34
2007	48	4.35	0.87	0.97	0.27	0.92	0.85	0.47	0.01	-0.02
2008	48	4.35	0.86	0.95	0.25	0.93	0.86	0.47	0.09	0.32
2009	57	5.17	0.64	0.77	0.14	0.78	0.67	0.37	-0.05	-0.13
2010	57	5.17	0.63	0.78	0.15	0.77	0.68	0.37	-0.02	0.02
2011	58	5.26	0.61	0.76	0.15	0.76	0.65	0.38	0.05	0.21
2012	59	5.35	0.60	0.74	0.13	0.73	0.63	0.40	-0.01	-0.01
2013	60	5.44	0.58	0.74	0.12	0.72	0.62	0.37	0.10	0.42
2014	60	5.44	0.55	0.76	0.15	0.72	0.68	0.35	0.07	0.42
2015	71	6.44	0.45	0.66	0.09	0.64	0.56	0.35	-0.03	-0.02
2016	71	6.44	0.47	0.64	0.08	0.64	0.56	0.34	-0.01	0.06
2017	71	6.44	0.43	0.63	0.11	0.64	0.55	0.33	-0.06	-0.19
2018	71	6.44	0.44	0.62	0.12	0.64	0.55	0.34	0.00	0.08
2019	71	6.44	0.44	0.62	0.12	0.64	0.55	0.34	0.04	0.23
Total	**1103**	**100.03**	**0.71**	**0.84**	**0.22**	**0.81**	**0.74**	**0.49**	**0.01**	**0.08**

The following table shows the results from the regression model stated in the hypothesis. The table includes the coefficient and p values for the model when DUVOL or NCSKEW were used as the target value. For each respective target used in the model, the R^2 and number of observations are listed.

Hypothesis 3

	Crash Risk Measure			
	DUVOL		NCSKEW	
Model	**Coef**	**p value**	**Coef**	**p value**
const	0.009	0.526	0.084	0.102
COC	0.026	0.371	0.055	0.102
GE	0.037	0.255	0.081	0.615
PS	-0.003	0.792	0.002	0.517
RQ	-0.037	0.183	-0.121	0.963
ROL	-0.043	0.241	-0.075	0.259
VA	0.033	0.008	0.092	0.053
R^2	0.010		0.005	
n	*1103*		*1103*	

The table above indicates mostly insignificance across either model for all independent variables used. The only parameter that shows significance at the 95% confidence level is VA—voice and accountability when the DUVOL target variable was assigned. In the NCSKEW model, this same variable was insignificant at the 95% confidence level.

Hypothesis 4: The effects of country's individualism and crash risk

The hypothesis was analyzed at the aggregate level of every country's crash risk and an index for individualistic tendencies for years available in the period 2000 to 2019. In other studies, there are significant linkages to cultural distances between countries and financial market trading (Lucey, Zhang, 2010). The table below shows the sample of data distributed over the time period. The table also shows the number of observations in each year, the weight that the observations of each year have over the entire period, and average annual values for IDV, DUVOL, and NCSKEW.

Hypothesis 4

Year	Frequency	Percent	IDV	DUVOL	NCSKEW
2000	40	4.4	51.70	-0.06	-0.13
2001	40	4.4	51.70	0.18	0.96
2002	40	4.4	51.70	0.05	0.09
2003	40	4.4	51.70	0.00	-0.08
2004	40	4.4	51.70	-0.02	-0.14
2005	40	4.4	51.70	0.02	0.01
2006	41	4.51	51.05	-0.04	-0.17
2007	41	4.51	51.05	0.05	0.13
2008	41	4.51	51.05	0.08	0.28
2009	46	5.06	48.54	-0.04	-0.14
2010	46	5.06	48.54	0.03	0.12
2011	47	5.17	48.15	0.06	0.18
2012	48	5.28	48.10	-0.01	-0.02
2013	49	5.39	48.06	0.11	0.44
2014	49	5.39	48.06	0.05	0.34
2015	52	5.72	47.58	-0.04	-0.12
2016	52	5.72	47.58	-0.02	0.09
2017	52	5.72	47.58	-0.03	-0.08
2018	52	5.72	47.58	0.03	0.22
2019	53	5.83	46.94	0.08	0.35
Total	**909**	**99.99**	**49.50**	**0.02**	**0.12**

The following table shows the results from the regression model stated in the hypothesis. The table includes the coefficient and p values for the model when DUVOL or NCSKEW were used as the target value. For each respective target used in the model, the R^2 and number of observations are listed.

Hypothesis 4

	Crash Risk Measure			
	DUVOL		NCSKEW	
Model	Coef	p value	Coef	p value
const	-0.003	0.882	0.041	0.507
IDV	0.001	0.078	0.002	0.171
R^2	0.003		0.002	
n	*909*		*909*	

The table above indicates insignificance across either model for all independent variables used at a 95% confidence level. In conclusion, the individualism of a country has no significant relationship with crash risk.

Hypothesis 5: The effects of a country's uncertainty avoidance, planning horizon, and crash risk

The hypothesis was analyzed at the aggregate level of every country's crash risk, uncertainty avoidance, and long-term orientation index for years available in the period 2000 to 2019. The table below shows the sample of data distributed over the time period. The table also shows the number of observations in each year, the weight that the observations of each year have over the entire period, and average annual values for UAI, LTO, DUVOL, and NCSKEW.

Hypothesis 5

Year	Frequency	Percent	UAI	LTO	DUVOL	NCSKEW
2000	33	4.88	59.03	42.70	-0.07	-0.20
2001	33	4.88	59.03	42.70	0.19	1.08
2002	33	4.88	59.03	42.70	0.04	0.06
2003	33	4.88	59.03	42.70	0.03	0.03
2004	33	4.88	59.03	42.70	-0.03	-0.19
2005	33	4.88	59.03	42.70	0.02	0.01
2006	33	4.88	59.03	42.70	-0.06	-0.21
2007	33	4.88	59.03	42.70	0.06	0.17
2008	33	4.88	59.03	42.70	0.10	0.35
2009	34	5.03	58.18	43.79	-0.04	-0.12
2010	34	5.03	58.18	43.79	0.04	0.19
2011	34	5.03	58.18	43.79	0.06	0.22
2012	34	5.03	58.18	43.79	-0.03	-0.10
2013	34	5.03	58.18	43.79	0.13	0.54
2014	34	5.03	58.18	43.79	0.07	0.41
2015	35	5.18	58.23	43.69	-0.04	-0.16
2016	35	5.18	58.23	43.69	-0.02	0.06
2017	35	5.18	58.23	43.69	-0.02	-0.11
2018	35	5.18	58.23	43.69	0.04	0.23
2019	35	5.18	58.23	43.69	0.09	0.37
Total	**676**	**100**	**58.57**	**43.27**	**0.03**	**0.13**

The following table shows the results from the regression model stated in the hypothesis. The table includes the coefficient and p values for the model when DUVOL or NCSKEW were used as the target value. For each respective target used in the model, the R^2 and number of observations are listed.

Hypothesis 5

	Crash Risk Measure			
	DUVOL		**NCSKEW**	
Model	**Coef**	**p value**	**Coef**	**p value**
Const	0.016	0.606	0.087	0.453
UAI	0.000	0.826	0.001	0.457
LTO	0.000	0.647	0.000	0.794
R^2	*0*		*0.001*	
n	*676*		*676*	

The table above indicates insignificance across either model for all independent variables used at a 95% confidence level. In conclusion, the tendency to avoid uncertainty and long-term orientation of a country has no significant relationship with crash risk.

Hypothesis 6: The effects of a country's desire for indulgence and crash risk

The hypothesis was analyzed at the aggregate level of every country's crash risk and desire for indulgence for years available in the period 2000 to 2019. The table below shows the sample of data distributed over the time period. The table also shows the number of observations in each year, the weight that the observations of each year have over the entire period, and average annual values for IVR, DUVOL, and NCSKEW.

Hypothesis 6

Year	Frequency	Percent	IVR	DUVOL	NCSKEW
2000	41	4.36	47.90	-0.05	-0.12
2001	41	4.36	47.90	0.19	1.00
2002	41	4.36	47.90	0.05	0.09
2003	41	4.36	47.90	0.02	-0.03
2004	41	4.36	47.90	-0.03	-0.19
2005	41	4.36	47.90	0.02	-0.02
2006	41	4.36	47.90	-0.05	-0.24
2007	41	4.36	47.90	0.05	0.10
2008	41	4.36	47.90	0.08	0.26
2009	47	4.99	46.81	-0.03	-0.09
2010	47	4.99	46.81	0.02	0.13
2011	48	5.1	47.85	0.07	0.21
2012	49	5.21	48.14	-0.02	-0.09
2013	50	5.31	47.68	0.09	0.40
2014	50	5.31	47.68	0.07	0.39
2015	56	5.95	45.54	-0.05	-0.08
2016	56	5.95	45.54	0.00	0.14
2017	56	5.95	45.54	-0.05	-0.23
2018	56	5.95	45.54	0.02	0.18
2019	57	6.06	45.40	0.05	0.28
Total	**941**	**100.01**	**47.18**	**0.02**	**0.10**

The following table shows the results from the regression model stated in the hypothesis. The table includes the coefficient and p values for the model when DUVOL or NCSKEW were used as the target value. For each respective target used in the model, the R^2 and number of observations are listed.

Hypothesis 6

	Crash Risk Measure			
	DUVOL		**NCSKEW**	
Model	**Coef**	**p value**	**Coef**	**p value**
const	0.021	0.231	0.095	0.153
IVR	0.000	0.953	0.000	0.876
R^2	*0*		*0*	
n	*941*		*941*	

The table above indicates insignificance across either model for all independent variables used at a 95% confidence level. In conclusion, the tendency to desire more indulgent forms of satisfaction of a country has no significant relationship with crash risk.

Variable Definition

Measures of Country Governance

COC is the measure of corruption

GE is the measure of government effectiveness

PS is the measure of political stability

RQ is the measure of regulatory quality

ROL is the measure of rule of law

VA is the measure of voice and accountability

Measures of Country Culture

PDI expresses the power distance measure. The degree to which the less powerful members of a society accept and expect that power is distributed unequally

IDV is the measure of individualism versus collectivism. This represents a preference to interact with themselves and immediate family whereas more collective societies prefer to interact in wider groups

MAS is the measure of masculinity versus femininity. This represents differing social preferences, like competition versus cooperation

UAI is the measure of uncertainty avoidance. This measure expresses the comfortability of various risk levels and uncertainties

LTO is the measure for long term orientation versus short term normative orientation. This expresses the preference to varying time horizons for goals

IVR is the measure for indulgence versus restraint. This represents the tendencies for a society to enjoy varying levels of gratification for enjoyment and fun

Measures of Crash Risk

NCSKEW is the variable that stands for negative skewness

DUVOL is the variable that stands for down-to-up-volatility

References

Banerjee, P. K., Ahmed, M. N., & Hossain, M. M. (2017). Bank, Stock Market and Economic Growth: Bangladesh Perspective. *Journal of Developing Areas*, *51*(2), 17–29.

Chen, J., Hong, H., Stein, J.C., 2001. Forecasting crashes: trading volume, past returns, and conditional skewness in stock prices. Journal of Financial Economics 61(3), 345-381.

Dimson, E., 1979. Risk measurement when shares are subject to infrequent trading. Journal of Financial Economics 7(2), 197–226.

Huaping Zhang, & Feifan Li. (2020). Influence of Limited Attention and Over-Optimism of Investors on Stock Price Crash Risk. *Revista Argentina de Clínica Psicológica*, *29*(2), 96–105.

Hutton, A.P., Marcus, A.J., Tehranian, H., 2009. Opaque financial reports, R2 , and crash risk. Journal of Financial Economics 94(1), 67-86.

Lucey BM, Zhang Q. Does cultural distance matter in international stock market comovement? Evidence from emerging economies around the world. *Emerging Markets Review*. 2010;11(1):62-78. doi:10.1016/j.ememar.2009.11.003.

Relevant Code Used

Script for index model regression

```python
def index_model_regression(data, benchmark, country):
    daily_returns = pd.DataFrame(data, columns=[country, benchmark]).pct_change()
    first_row = daily_returns[country].first_valid_index()
    last_row = daily_returns[country].last_valid_index()
    mrm2 = daily_returns[benchmark][first_row: last_row - 4].tolist()
    mrm1 = daily_returns[benchmark][first_row + 1: last_row - 3].tolist()
    mr = daily_returns[benchmark][first_row + 2: last_row - 2].tolist()
    mrp1 = daily_returns[benchmark][first_row + 3: last_row - 1].tolist()
    mrp2 = daily_returns[benchmark][first_row + 4: last_row].tolist()
    cr = daily_returns[country][first_row + 2: last_row - 2].tolist()

    regression_data = pd.DataFrame({'MRM2': mrm2, 'MRM1': mrm1, 'MR': mr, 'MRP1': mrp1, 'MRP2': mrp2, 'CR': cr})

    fitted_regression = ols("CR ~ MRM2 + MRM1 + MR + MRP1 + MRP2", regression_data).fit()

    epsilon = pd.DataFrame({country: fitted_regression.resid}).set_index(data["Date"][first_row + 2: last_row - 2])
    epsilon = epsilon.apply(lambda e: np.log(1 + e))

    return epsilon
```

Script for crash risk

```python
def negative_skewness(residuals):
    monthly_residual_squared = []
    monthly_residual_cubed = []
    negative_skewness_dataframe = pd.DataFrame()
    previous_month = residuals.iloc[0].name.split("/")[0]

    for index, row in residuals.iterrows():
        current_month = index.split("/")[0]

        if current_month != previous_month or index == residuals.iloc[-1].name:
            sum_cubed = sum(monthly_residual_cubed)
            sum_squared = sum(monthly_residual_squared)
            num_elements = len(monthly_residual_squared)
            ncskew_numerator = -((num_elements * (num_elements - 1) ** (3 / 2)) * sum_cubed)
            ncskew_denominator = (num_elements - 1) * (num_elements - 2) * (sum_squared) ** (3 / 2)
            ncskew = ncskew_numerator / ncskew_denominator

            if previous_month == str(12):
                ncskew.name = f'{previous_month}/1/{(int(index.split("/")[2]) - 1)}'
            else:
                ncskew.name = f'{previous_month}/1/{(int(index.split("/")[2]))}'

            negative_skewness_dataframe = negative_skewness_dataframe.append(ncskew)

            monthly_residual_squared = []
            monthly_residual_cubed = []

            monthly_residual_squared.append(row ** 2)
            monthly_residual_cubed.append(row ** 3)

        else:
            monthly_residual_squared.append(row ** 2)
            monthly_residual_cubed.append(row ** 3)

        previous_month = current_month


    return negative_skewness_dataframe
```

```python
def down_up_volatility(residuals):
    monthly_residual_squared_down = []
    monthly_residual_squared_up = []
    duvol_dataframe = pd.DataFrame()
    previous_month = residuals.iloc[0].name.split("/")[0]

    for index, row in residuals.iterrows():
        current_month = index.split("/")[0]

        if current_month != previous_month or index == residuals.iloc[-1].name:
            sum_squared_down = sum(monthly_residual_squared_down)
            sum_squared_up = sum(monthly_residual_squared_up)
            num_elements_down = len(monthly_residual_squared_down)
            num_elements_up = len(monthly_residual_squared_up)

            duvol_numerator = (num_elements_up - 1) * sum_squared_down
            duvol_denominator = (num_elements_down - 1) * sum_squared_up
            duvol = np.log10(duvol_numerator / duvol_denominator)
            if previous_month == str(12):
                duvol.name = f'{previous_month}/1/{(int(index.split("/")[2]) - 1)}'
            else:
                duvol.name = f'{previous_month}/1/{index.split("/")[2]}'
            duvol_dataframe = duvol_dataframe.append(duvol)

            monthly_residual_squared_down = []
            monthly_residual_squared_up = []

            if row.values[0] < 0:
                monthly_residual_squared_down.append(row ** 2)
            else:
                monthly_residual_squared_up.append(row ** 2)

        else:
            if row.values[0] < 0:
                monthly_residual_squared_down.append(row ** 2)
            else:
                monthly_residual_squared_up.append(row ** 2)

        previous_month = current_month

    return duvol_dataframe
```