

A STATISTICAL INVESTIGATION OF VARIABLES ON GOVERNMENT ECONOMIC POLICY CHOICES, BUSINESS ENVIRONMENTS AND PRICES

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ABSTRACT: *Does government economic policy choices have effects on businesses and/or prices? Do they relate in some way? This is the issue the paper seeks to address. We collected data on government economic policy choices, businesses environments and prices from countries in Africa, Asia, America and Europe. The data were subjected to statistical investigation by calculating six correlation coefficients for each continent, ascertaining which variables are correlated, and getting the levels of correlations. The results empirically show that in three continents, government economic policy choices do have effects on the business environment. The continents are Africa (correlation between Govt. Debt to GDP growth and Corruption Index is 0.504488), Asia (0.488973), and America (0.515489). They are all in the same range. The correlation coefficient for Europe is very low (0.016655).*

KEYWORDS: business confidence, corruption index, inflation rate, correlation coefficient, variables

INTRODUCTION

The study investigated business confidence (B.I.) and corruption index (C.I.) as representatives of the business environment of each country; government debt to GDP growth (Db/GDP) represented government economic policy choices; and inflation rate (I.R.) represented the behaviour of prices in each country. According Los and Ocheretin (2019), one of the important indicators that characterize the economy of the country is the business confidence index. It is the basis for tracking the cycles of economic dynamics and analysis of the country's business climate. Another indicator is corruption index which Treisman (2000) defined as the misuse of public office for private gain. Concern about corruption has stimulated the creation of a multiplicity of indicators by a multiplicity of methods by the World Bank, World Economic Forum, Transparency International and commercial rating agencies (Knack, 2007). Inflation rate and government debt to GDP growth are equally important indicators. A paper by Checherita-Westphal et al (2012) found “a non-linear impact of debt on growth with a turning point – beyond which the government debt-to-GDP ratio has a negative impact on long-term growth – at about 90–100% of GDP.” However, they found

out that “the channels through which government debt has a non-linear impact on the economic growth rate are private saving, public investment and total factor productivity.”

METHODOLOGY

In this paper we use the Pearson's correlation coefficient (for samples) to investigate the dependence of pairs of the four indicators giving six pairs. This was done after presenting data collected from four continents in line charts which give initial clear pictures of possible relationships between variables. Pearson's product–moment correlation coefficient ρ is a measure of the linear dependency between two random variables (Ly, 2018).

The Model

The Pearson's Product Moment Correlation Coefficient

Let (X_1, X_2) have a bivariate normal distribution with mean $\vec{\mu} = (\mu_1, \mu_2)'$ and covariance matrix

$$\Sigma = \begin{pmatrix} \sigma_1^2 & \rho\sigma_1\sigma_2 \\ \rho\sigma_1\sigma_2 & \sigma_2^2 \end{pmatrix},$$

where σ_1^2 and σ_2^2 are the population variances of X_1 and X_2 , and where ρ is

$$\rho = \frac{\text{Cov}(X_1, X_2)}{\sigma_1\sigma_2} = \frac{E(X_1X_2) - \mu_1\mu_2}{\sigma_1\sigma_2}.$$

Pearson's correlation coefficient ρ measures the linear association between X_1 and X_2 . In brief, the model is parametrized by the five unknowns $\theta = (\mu_1, \mu_2, \sigma_1, \sigma_2, \rho)$.

Bivariate normal data consisting of n pairs of observations can be sufficiently summarized as $y = (n, \bar{x}_1, \bar{x}_2, s_1, s_2, r)$, where

$$r = \frac{\sum_{j=1}^n (x_{1j} - \bar{x}_1)(x_{2j} - \bar{x}_2)}{ns_1s_2}$$

is the sample correlation coefficient, $\bar{x}_i = \frac{1}{n} \sum_{j=1}^n x_{ij}$ the sample mean, and $s_i^2 = \frac{1}{n} \sum_{j=1}^n (x_{ij} - \bar{x}_i)^2$ the average sums of squares. The bivariate normal model implies that the observations y are functionally related to the parameters by the following likelihood function:

$$\begin{aligned} f(y|\theta) &= (2\pi\sigma_1\sigma_2\sqrt{1-\rho^2})^{-n} \\ &\times \exp\left(-\frac{n}{2(1-\rho^2)}\left[\frac{(\bar{x}_1-\mu_1)^2}{\sigma_1^2} - 2\rho\frac{(\bar{x}_1-\mu_1)(\bar{x}_2-\mu_2)}{\sigma_1\sigma_2} + \frac{(\bar{x}_2-\mu_2)^2}{\sigma_2^2}\right]\right) \\ &\times \exp\left(-\frac{n}{2(1-\rho^2)}\left[\left(\frac{s_1}{\sigma_1}\right)^2 - 2\rho\left(\frac{rs_1s_2}{\sigma_1\sigma_2}\right) + \left(\frac{s_2}{\sigma_2}\right)^2\right]\right). \end{aligned}$$

For each continent, we have six pairs of X_1 and X_2 .

Data for the Study**Table 1: Business Confidence, Corruption Index, Govt. Debt to GDP growth, Inflation Rate | Africa**

Country	B.C.	As at	C.I.	GD/GDP (As at Dec/20)	I.R.	As at
Angola	-2	Sep/21	27	120	27.66	Jan/22
Cape Verde	0	Dec/21	58	157	6.6	Jan/22
Gambia	35	Mar/21	37	83.1	7.81	Jan/22
Mozambique	85.7	Jun/21	25	122	6.84	Feb/22
Nigeria	- 15.2	Dec/20	25	34.98	15.6	Jan/22
South Africa	43	Dec/21	44	69.9	5.7	Jan/22
Uganda	53.8	Feb/22	27	49.8	3.2	Feb/22

Table 2: Business Confidence, Corruption Index, Govt. Debt to GDP growth, Inflation Rate | Asia

Country	B.C.	As at	C.I.	GD/GDP (As at Dec/20)	I.R.	As at
China	50.2	Feb/22	42	66.8	0.9	Feb/22
Georgia	30.6	Dec/21	56	57.1	13.7	Feb/22
Hong Kong	1	Mar/22	77	38.4	1.2	Jan/22
India	124	Sep/21	40	73.95	6.01	Jan/22
Indonesia	7.1	Dec/21	37	38.5	2.06	Feb/22

Country	B.C.	As at	C.I. (As at Dec/20)	GD/GDP (As at Dec/20)	I.R.	As at
Israel	23.23	Jan/22	60	70.3	3.1	Jan/22
Japan	18	Dec/21	74	266	0.5	Jan/22
Kazakhstan	1	Dec/21	38	23.4	8.5	Feb/22
Malaysia	122	Dec/21	51	60.7	2.3	Jan/22
Maldives	94	Dec/21	43	52.6	0.2	Jan/22
Philippines	39.7	Dec/21	34	53.5	3	Feb/22
Singapore	8	Dec/21	85	131	4	Jan/22
South Korea	91	Feb/22	61	42.6	3.7	Feb/22
Sri Lanka	71	Sep/21	38	101	15.1	Feb/22
Thailand	47.8	Feb/22	36	50.5	5.28	Feb/22

Table 3: Business Confidence, Corruption Index, Govt. Debt to GDP growth, Inflation Rate | America

Country	B.C.	As at	C.I. (As at Dec/20)	GD/GDP (As at Dec/20)	I.R.	As at
Brazil	55.8	Feb/22	38	88.83	10.54	Feb/22
Canada	60.6	Feb/22	77	118	5.1	Jan/22
Chile	51.19	Feb/22	67	33	7.8	Feb/22
Colombia	12.7	Jan/22	39	62.8	8.01	Feb/22
Dominican Rep	55.5	Sep/21	55	69.1	8.7	Jan/22
Ecuador	1532	Jan/22	39	68.9	2.71	Feb/22

Country	B.C.	As at		I.R.	As at
		C.I. (As at Dec/20)	GD/GDP (As at Dec/20)		
Mexico	52.6	Feb/22	31	52.1	7.28 Feb/22
Peru	40.1	Nov/21	38	35.4	6.15 Feb/22
United States	58.6	Feb/22	67	128	7.9 Feb/22

Table 4: Business Confidence, Corruption Index, Govt. Debt to GDP growth, Inflation Rate | Europe

Country	B.C.	As at	As at		I.R.	As at
			C.I. (As at Dec/20)	GD/GDP (As at Dec/20)		
Albania	-1.5	Mar/21	36	77.9	3.9	Feb/22
Austria	13.2	Feb/22	76	83.9	5.9	Feb/22
Belgium	2.3	Feb/22	76	114	8.04	Feb/22
Bulgaria	20.3	Feb/22	44	22.7*	9.1	Jan/22
Croatia	5.9	Feb/22	47	88.7	5.7	Jan/22
Cyprus	109	Feb/22	57	118	6.6	Feb/22
Czech Republic	101	Feb/22	54	38.1	11.1	Feb/22
Denmark	-2	Feb/22	88	42.2	4.8	Feb/22
Estonia	103	Feb/22	75	18.2	12	Feb/22
Finland	23.5	Feb/22	85	69.2	4.4	Jan/22
France	112	Feb/22	69	116	3.6	Feb/22
Germany	98.9	Feb/22	80	69.8	5.1	Feb/22
Hungary	5.3	Feb/22	44	80.4	8.3	Feb/22

Country	B.C.	As at	C.I. (As at Dec/20)	GD/GDP (As at Dec/20)	I.R.	As at
Ireland	17	Sep/21	72	59.5	5.6	Feb/22
Italy	113	Feb/22	53	156	5.7	Feb/22
Latvia	-1.6	Jan/22	57	43.5	8.7	Feb/22
Lithuania	3.1	Feb/22	60	47.3	14.2	Feb/22
Luxembourg	115	Feb/22	80	24.9	6.6	Feb/22
Macedonia	26.5	Jan/22	35	51.2	7.6	Feb/22
Malta	116	Feb/22	53	54.3	4.1	Jan/22
Netherlands	8.5	Feb/22	82	54.5	6.2	Feb/22
Norway	8.6	Dec/21	84	46	3.7	Feb/22
Poland	-10.7	Feb/22	56	57.5	9.2	Jan/22
Portugal	2.5	Feb/22	61	134	4.2	Feb/22
Romania	-1	Feb/22	44	47.3	8.35	Jan/22
Russia	2.3	Feb/22	30	17.8	9.17	Feb/22
Slovakia	-8	Feb/22	49	60.6	8.4	Jan/22
Slovenia	10	Feb/22	60	80.8	6.9	Feb/22
Spain	10.4	Feb/22	62	119	7.6	Feb/22
Sweden	115	Feb/22	85	39.9	3.7	Jan/22
Switzerland	105	Feb/22	85	42.9	2.2	Feb/22
Turkey	110	Feb/22	40	39.5	54.44	Feb/22
Ukraine	112	Dec/21	33	60.8	10.7	Feb/22

Country	B.C.	As at	C.I. (As at Dec/20)	GD/GDP (As at Dec/20)	I.R.	As at
United Kingdom	-9	Mar/22	77	94.9	5.5	Jan/22

Source: www.tradingeconomics.com

These data are assumed to be normally distributed.

The model we use for the study is the use of line charts in combination with correlation coefficients for samples, r , for pairs of (X_1, X_2) 's, where

$$r = \frac{\sum_{j=1}^n (x_{1j} - \bar{x}_1)(x_{2j} - \bar{x}_2)}{n s_1 s_2}$$

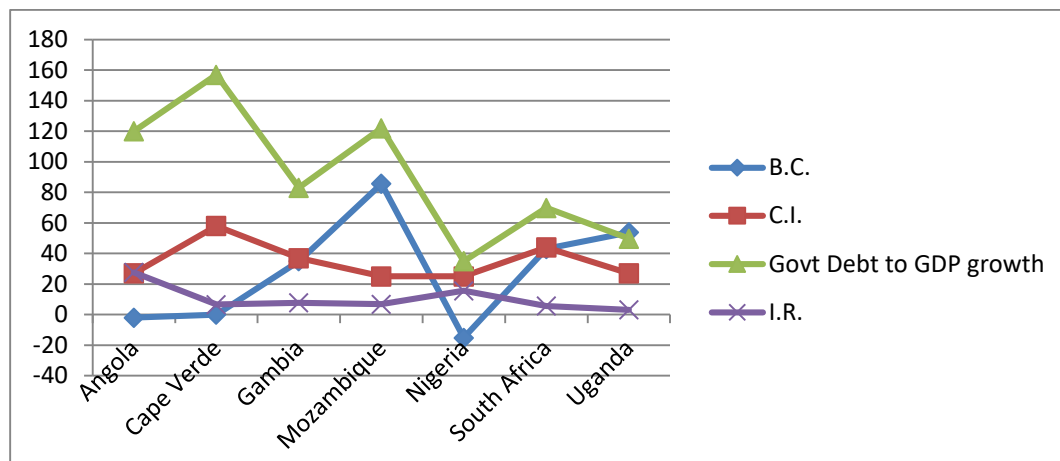
Model Implementation

The 6 (X_1, X_2) pairs are: (B.C., C.I.), (B.C., Db/GDP), (B.C., I.R.), (C.I., Db/GDP), (C.I., I.R.), (Db/GDP, I.R.), for each continent.

Table 5: Four variables values for Africa

	B.C.	C.I.	Govt Debt to GDP growth	I.R.
Angola	-2	27	120	27.66
Cape Verde	0	58	157	6.6
Gambia	35	37	83.1	7.81
Mozambique	85.7	25	122	6.84
Nigeria	-15	25	34.98	15.6
South Africa	43	44	69.9	5.7
Uganda	53.8	27	49.8	3.2

Chart 1: Four variables chart for Africa



This chart shows a possible relationship between government debt to GDP growth and corruption index (C.I.).

Correlation coefficients can be high or low (magnitude), and positive or negative (direction) and $-1 \leq r \leq +1$. -1 and $+1$ indicate perfect negative and perfect positive correlation coefficients. The values of r lower than ± 0.40 are said to be low, between 0.40 and 0.60 are moderate, and above 0.60 are high (Obilor & Amadi, 2018).

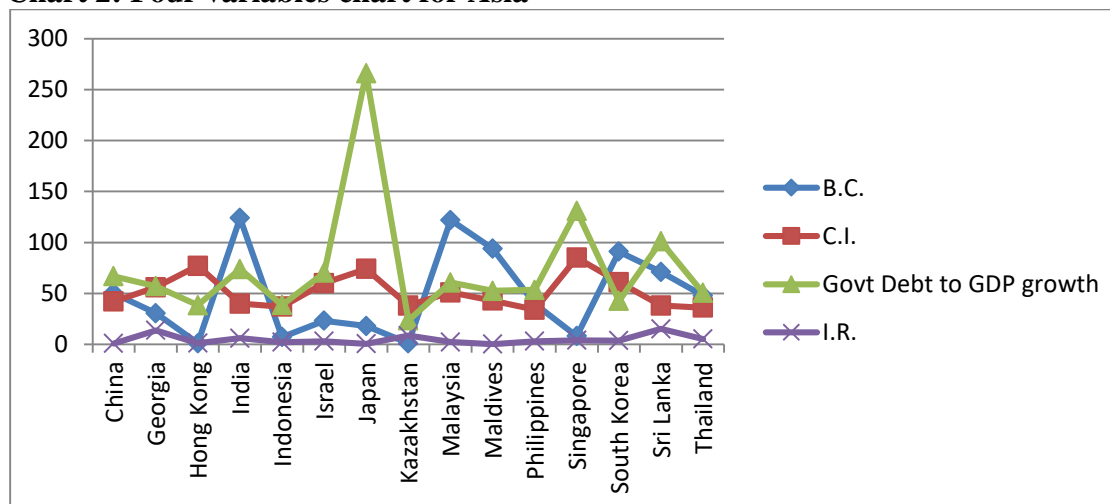
Table 6: Computations of the Pearson's correlation coefficient, r , between variables: Africa

Variables	r Value for Variables	Nature of r
B.C. and C.I.	-0.22309	Negative Low
B.C. and Govt. Debt to GDP	0.005921	Positive Extreme Low
B.C. and I.R.	-0.60698	Negative High
C.I. and Govt. Debt to GDP	0.504488	Positive Moderate
C.I. and I.R.	-0.36287	Negative Low
Govt. Debt to GDP and I.R.	0.118513	Positive Low

For $(X1, X2) = (C.I., Db/GDP)$, $r = 0.504488$ (positive moderate) in Africa

Table 7: Four variables values

	B.C.	C.I.	Govt Debt to GDP growth	I.R.
China	50.2	42	66.8	0.9
Georgia	30.6	56	57.1	13.7
Hong Kong	1	77	38.4	1.2
India	124	40	73.95	6.01
Indonesia	7.1	37	38.5	2.06
Israel	23.2	60	70.3	3.1
Japan	18	74	266	0.5
Kazakhstan	1	38	23.4	8.5
Malaysia	122	51	60.7	2.3
Maldives	94	43	52.6	0.2
Philippines	39.7	34	53.5	3
Singapore	8	85	131	4
South Korea	91	61	42.6	3.7
Sri Lanka	71	38	101	15.1
Thailand	47.8	36	50.5	5.28

Chart 2: Four variables chart for Asia

This chart shows a possible relationship between government debt to GDP growth and corruption index (C.I.).

Table 8: Computations of the Pearson's correlation coefficient, r, between variables: Asia

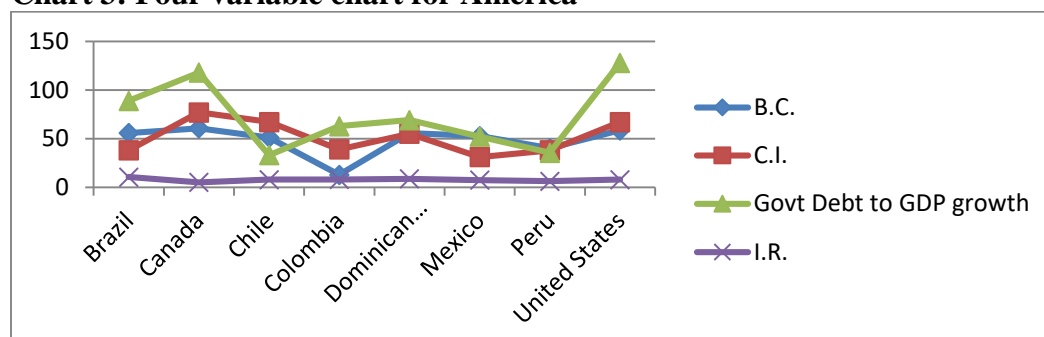
Variables	r Value for Variables	Nature of r
B.C. and C.I.	-0.33818	Negative Low
B.C. and Govt. Debt to GDP	-0.13371	Negative Low
B.C. and I.R.	0.01781	Negative Very Low
C.I. and Govt. Debt to GDP	0.488973	Positive Moderate
C.I. and I.R.	-0.24714	Negative Low
Govt. Debt to GDP and I.R.	-0.12662	Negative Low

For $(X1, X2) = (C.I., Db/GDP)$, $r = 0.488973$ (positive moderate) in Asia

Table 9: Four variables for America

	B.C.	C.I.	Govt Debt to GDP growth	I.R.
Brazil	55.8	38	88.83	10.54
Canada	60.6	77	118	5.1
Chile	51.2	67	33	7.8
Colombia	12.7	39	62.8	8.01
Dominican Rep	55.5	55	69.1	8.7
Mexico	52.6	31	52.1	7.28
Peru	40.1	38	35.4	6.15
United States	58.6	67	128	7.9

Chart 3: Four variable chart for America



The chart shows a possible relationship between government debt to GDP growth and corruption index (C.I.); between business confidence (B.C.) and government debt to GDP growth; between business confidence (B.C.) and corruption index (C.I.).

Table 10: Computations of the Pearson's correlation coefficient, r , between variables: America

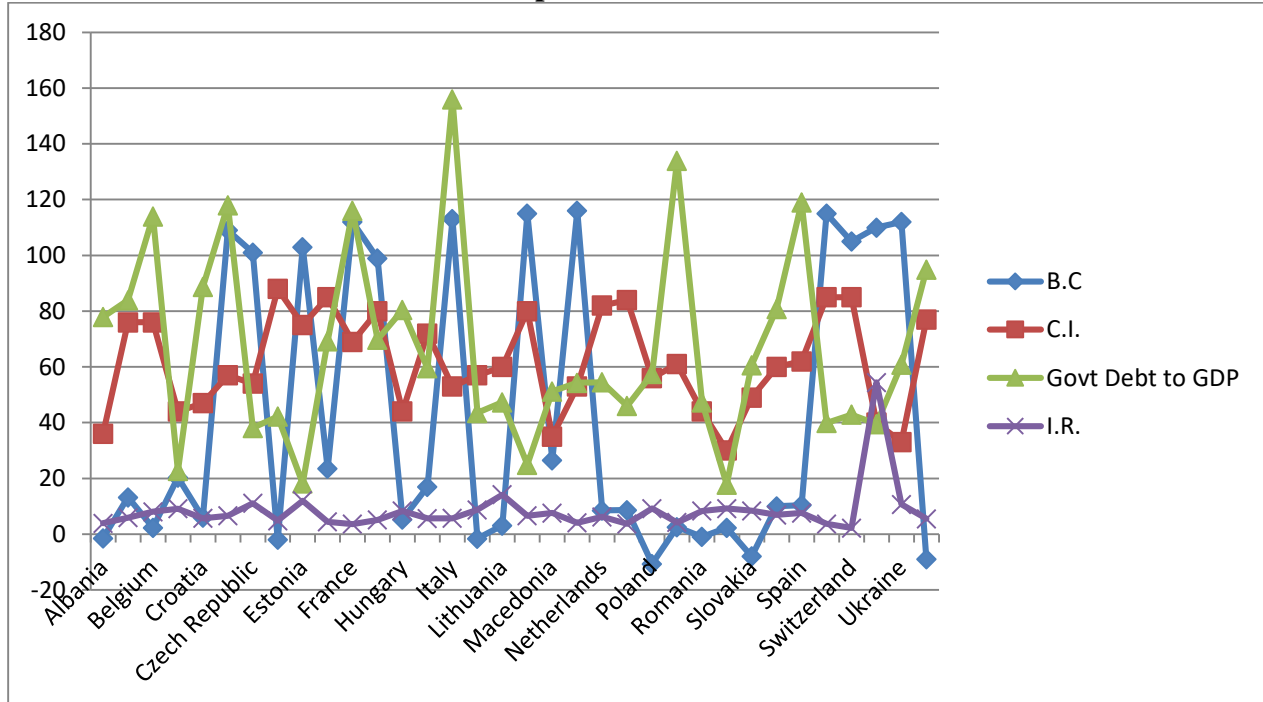
Variables	r Value for Variables	Nature of r
B.C. and C.I.	0.479481	Positive Moderate
B.C. and Govt. Debt to GDP	0.428345	Positive Moderate
B.C. and I.R.	-0.007	Negative Extreme Low
C.I. and Govt. Debt to GDP	0.515489	Positive Moderate
C.I. and I.R.	-0.36026	Negative Low
Govt. Debt to GDP and I.R.	-0.01232	Negative Extreme Low

For $(X_1, X_2) = (C.I., Db/GDP)$, $r = 0.515489$ (Positive moderate) in America.
 Additionally, for $(X_1, X_2) = (B.C., C.I.)$, $r = 0.479481$ (Positive moderate)
 and for $(X_1, X_2) = (B.C., Db/GDP)$, $r = 0.428345$ (Positive moderate)

Table 11: Four variable values for Europe

	B.C.	C.I.	Govt Debt to GDP growth	I.R.
Albania	-1.5	36	77.9	3.9
Austria	13.2	76	83.9	5.9
Belgium	2.3	76	114	8.04
Bulgaria	20.3	44	22.7	9.1
Croatia	5.9	47	88.7	5.7
Cyprus	109	57	118	6.6
Czech Republic	101	54	38.1	11.1
Denmark	-2	88	42.2	4.8
Estonia	103	75	18.2	12
Finland	23.5	85	69.2	4.4
France	112	69	116	3.6
Germany	98.9	80	69.8	5.1
Hungary	5.3	44	80.4	8.3
Ireland	17	72	59.5	5.6
Italy	113	53	156	5.7
Latvia	-1.6	57	43.5	8.7
Lithuania	3.1	60	47.3	14.2
Luxembourg	115	80	24.9	6.6
Macedonia	26.5	35	51.2	7.6
Malta	116	53	54.3	4.1
Netherlands	8.5	82	54.5	6.2
Norway	8.6	84	46	3.7
Poland	-10.7	56	57.5	9.2
Portugal	2.5	61	134	4.2
Romania	-1	44	47.3	8.35
Russia	2.3	30	17.8	9.17
Slovakia	-8	49	60.6	8.4
Slovenia	10	60	80.8	6.9
Spain	10.4	62	119	7.6
Sweden	115	85	39.9	3.7
Switzerland	105	85	42.9	2.2
Turkey	110	40	39.5	54.44
Ukraine	112	33	60.8	10.7
United Kingdom	-9	77	94.9	5.5

Chart 3: Four variables chart for Europe



The chart indicates no possible relationship between any of the variables.

Table 12: Computations of the Pearson's correlation coefficient, r, between variables: Europe

Variables	r Value for	Nature of r
B.C. and C.I.	0.092206	Positive Extreme Low
B.C. and Govt. Debt to GDP	-0.04239	Negative Extreme Low
B.C. and I.R.	0.183139	Positive Low
C.I. and Govt. Debt to GDP	0.016655	Positive Extreme Low
C.I. and I.R.	-0.33612	Negative Low
Govt. Debt to GDP and I.R.	-0.23135	Negative Low

For $(X_1, X_2) = (C.I., Db/GDP)$, $r = 0.016655$ (positive extreme low) in Europe

RESULT AND DISCUSSION

In Africa, it is only the correlation coefficient between government debt to GDP growth and corruption index $\{(X_1, X_2) = (C.I., Db/GDP)\}$ that is **positively moderate** at 0.504488. That of business confidence and inflation rate $\{(X_1, X_2) = (B.C., I.R.)\}$ is negatively high. There is no significant correlation between the other four pairs. In Asia, it is only the correlation coefficient

between government debt to GDP growth and corruption index $\{(X1, X2) = (C.I., Db/GDP)\}$ that is **positively moderate** at 0.488973. All others are low. In America, the correlation coefficients of business confidence and corruption index $\{(X1, X2) = (B.C., C.I)\}$, business confidence and government debt to GDP $\{(X1, X2) = (B.C., Db/GDP)\}$, corruption index and government debt to GDP growth $\{(X1, X2) = (C.I., Db/GDP)\}$ are all **positively moderate**, with that of government debt to GDP and corruption index being the highest at 0.515489, while all other three are low. In Europe, all six correlation coefficients are low at 0.092206, -0.1239, 0.183139, 0.016655, -0.33612, and -0.23135.

CONCLUSION

In Africa, government economic policy choices have effects on the business environment. Also, the business environment has negative effects on prices. In Asia also, government economic policy choices have effects on the business environment. In America, government economic policy choices have effects on the business environment, but the business environment has low negative effects on prices. In Europe, the business environment, government economic policy choices, and prices are not correlated.

References

- Los, V., & Ocheretin, D. (2019). Construction of business confidence index based on a system of economic indicators. In *SHS Web of Conferences* (Vol. 65, p. 06003). EDP Sciences.
- Treisman, D. (2000). The causes of corruption: a cross-national study. *Journal of public economics*, 76(3), 399-457.
- Knack, S. (2007). Measuring corruption: A critique of indicators in Eastern Europe and Central Asia. *Journal of Public Policy*, 27(3), 255-291.
- Checherita-Westphal, C., & Rother, P. (2012). The impact of high government debt on economic growth and its channels: An empirical investigation for the euro area. *European economic review*, 56(7), 1392-1405.
- Ly, A., Marsman, M., & Wagenmakers, E. J. (2018). Analytic posteriors for Pearson's correlation coefficient. *Statistica Neerlandica*, 72(1), 4-13.
- Obilor, E. I., & Amadi, E. C. (2018). Test for significance of Pearson's correlation coefficient. *International Journal of Innovative Mathematics, Statistics & Energy Policies*, 6(1), 11-23.