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The Misery Index, Corruption and Income Inequality in Latin American Countries: A Panel Cointegration and Causality Analysis

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Abstract

The globalization process has led to considerable increases in the flow of goods, services and financial assets, and thus global production and wealth have risen substantially during the past 40 years. However, discussion has now centered around the rising income inequality and poverty in some parts of the world. In this regard, the Latin American region is one of the leading regions in terms of income inequality. This study investigates the interaction among misery index, corruption and income inequality in Latin American countries during the 2002-2014 period, employing the Westerlund and Edgerton (2007) LM bootstrap cointegration test and the Kónya (2006) bootstrap panel Granger causality test. The findings reveal that increases in both the misery index and corruption played a part in the increases in income inequality. Furthermore, the results of the causality test reveal unidirectional causality from the misery index to income inequality and bidirectional causality between corruption and income inequality.

Keywords: income inequality; misery index; corruption; Latin American countries.

JEL classification: C23; D30; D73; E24; E31; O54.

1. INTRODUCTION

Since the 1980s, many countries have experienced considerable growth rates concurrent with the globalization process. However, no significant improvements have been made in both inequality and poverty at either the inter-country or intra-country level. Global inequality has ranged from 0.55 to 0.70 as of 2010 depending on the measure: gross and/or net Gini coefficient (after tax and transfers from social insurance programs) (Dabla-Norris *et al.*, 2015). Meanwhile, intra-country income inequality follows a similar trend. Consequently, inter-country and intra-country inequality has been at the top of national and international policy-makers' agendas in recent years. Therefore, researchers have been

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motivated to reveal the factors behind income inequality. We focus on the interaction among the misery index of inflation and unemployment, corruption, and income inequality in the Latin American region, which has remained the most unequal area in the world despite experiencing decreases in its Gini coefficient (Tsounta and Osueke, 2014).

Inflation affects all the sources of income including both labor and capital income and transfers heterogeneously, and thus has the potential to change the income distribution through various channels (Monnin, 2014). The major interaction channels between inflation and income inequality are as follows (Li and Zou, 2002): First, inflation may cause wages to fall behind prices and in turn result in an income transfer from wage earners to profits. Secondly, inflation decreases the real value of the outstanding debts and leads to an income transfer from creditors to debtors unless the interest rates are fully adjusted to the changes in the inflation rate. Finally, inflation can influence income inequality through economic growth. Therefore, the net impact of inflation on the income inequality depends on the impact of inflation on various sources of income. Another macroeconomic variable, unemployment, also has the potential to affect income inequality by causing revenue loss, changing the share of factor revenues and increasing poverty. Unemployment may also affect income inequality through inflation (Björklund, 1991). In addition, corruption can influence income inequality through diverse channels such as decreasing the economic growth, unfair tax systems, inefficient use of public funding, the conscious misuse of public social expenditures, poor institutional and legal structure, and educational inequality (Gupta *et al.*, 1998).

This paper investigates the interaction among the misery index, corruption and income inequality in Latin American countries during the 2002-2014 period, employing the Westerlund and Edgerton (2007) LM bootstrap cointegration test and the Kónya (2006) bootstrap panel Granger causality test. Our study is one of the early studies researching the impact of the misery index, consisting of inflation and unemployment on income inequality. A second generation econometric test is also used in the empirical analysis. The paper therefore contributes to the current empirical literature on these issues. The literature itself is reviewed in the Section 2. The dataset and the econometric methodology of the study are then explained in Section 3. Section 4 presents the empirical analysis and the major findings, and the study is concluded in Section 5.

2. LITERATURE REVIEW

There have been extensive studies on the inflation-inequality nexus and unemployment-inequality nexus, but a limited number of studies have investigated the interaction between the misery index, consisting of both inflation and unemployment, and income inequality. The papers examining the interaction between the inflation-inequality nexus have reached mixed findings, while most of the studies have revealed a positive relationship between unemployment and income inequality or a negative relationship between employment and income inequality (e.g., see Apergis *et al.*, 2010; Bulir, 2001; Ferreira de Mendonça and Martins Esteves, 2014; Monnin, 2014; Rice and Lozada, 1983; Thalassinos *et al.*, 2012).

For example, Rice and Lozada (1983) examined the impact of unemployment and inflation on income inequality in the US during the 1968–1976 period and revealed that unemployment had a positive impact on income inequality, whereas inflation had a negative impact. However, Cardoso *et al.* (1995) researched the impact of inflation and unemployment

on income inequality in the six largest metropolitan regions of Brazil during the 1980s, employing a regression analysis, and found that both inflation and unemployment were significant determinants of income inequality. Bulir (2001) also analyzed the interaction between inflation and income inequality in 80 countries, employing panel regression, and found a nonlinear relationship between inflation and income inequality. Inflation caused relatively more improvements in income inequality during the transition from hyperinflation to low inflation levels, but the gains from price stability were relatively less at low inflation rates. In addition, Bulir (2001) found that employment had a negative impact on income inequality. Li and Zou (2002) also employed panel regression to research the impact of inflation on income inequality in 46 countries during the 1950-1992 period, and concluded that inflation increased the income inequality. Apergis *et al.* (2010) researched the impact of corruption and a series of variables including unemployment on the income inequality of 50 US states and established that unemployment had a positive impact on income inequality.

Yue (2011) examined the long term relationship between inflation, economic growth and income inequality in Korea during the 1980-2002 period with an error-correction model but found no significant cointegrating relationship between inflation and income inequality. Dobson and Ramlogan-Dobson (2010) reached the same finding for the sample of Latin American countries. Meanwhile, Thalassinos *et al.* (2012) researched the interaction between inflation and income inequality in 13 European countries during the 2000-2009 period, employing panel regression, and found that inflation had a positive impact on income inequality, while employment also had a positive impact. In another study, Monnin (2014) investigated the relationship between inflation and income inequality in 10 OECD countries during the 1971-2010 period, revealing a U- shaped relationship; that is to say, a negative relationship between inflation and income inequality, whereby increases in inflation decrease income inequality until 13% of inflation, at which point there is a positive relationship between the two variables. Monnin (2014)also revealed a positive relationship between unemployment and income inequality for the same sample. Finally Sadeghi *et al.* (2014) employed a smooth transition autoregressive model to research the interaction between the misery index and income inequality in Iran during the 1972-2011 period and revealed that the misery index had a strong positive impact on income inequality.

The literature on the relationship between corruption and income inequality is richer relative to the literature on the interaction between the misery index and income inequality. Most of the studies have discovered that increases in corruption raised income equality (e.g. see Apergis *et al.*, 2010; Dincer and Gunalp, 2008; Ferreira de Mendonça and Martins Esteves, 2014; Gupta *et al.*, 1998; Huang, 2013; Li *et al.*, 2000; Mehrara *et al.*, 2011; Ullah and Ahmad, 2007). Meanwhile, relatively few studies have found that decreases in the corruption increased income inequality (e.g., see Dobson and Ramlogan-Dobson, 2010; Mehrara *et al.*, 2011; Rodriguez Andres and Ramlogan-Dobson, 2008; Wong, 2017).

In one of the latter studies, Gupta *et al.* (1998) examined the impact of corruption proxied by different indicators on the income inequality in a group of countries with different growth rates during the 1980-1997 period, revealing that corruption affected income inequality positively. In contrast, Li *et al.* (2000) investigated the impact of corruption on income inequality in 47 countries during the period 1982–1994, employing panel regression, and revealed that the impact of corruption on income inequality followed an inverted U. Meanwhile, Gyimah-Brempong (2002) employed a dynamic panel estimator to research the impact of corruption on the economic growth and income inequality of 21

African countries during the 1993–1999 period and revealed a positive relationship between corruption and income inequality.

In another study, Dincer and Gunalp (2008) employed panel regression to analyze the impact of corruption on the income inequality and poverty of all 50 US states during the 1981-1997 period and found that corruption raised income inequality. However, Rodriguez Andres and Ramlogan-Dobson (2008) researched the impact of corruption on the income inequality of Latin American countries during the 1981-2000 period, employing panel regression, and reached contrary results; in other words, decreases in corruption increased income inequality. Meanwhile, Dobson and Ramlogan-Dobson (2010) utilized panel regression to research the corruption–inequality nexus in 19 Latin American countries during the period 1984–2003 and revealed that corruption had a negative impact on income inequality, in other words decreases in the corruption raised income inequality. They asserted that this finding may result from a relatively higher shadow economy. Dobson and Ramlogan-Dobson (2012) also reached the same finding for Latin American countries but found that increases in corruption raised the income inequality for the whole panel. Mehrara *et al.* (2011) researched the impact of corruption on income inequality in 11 OPEC countries and 31 OECD countries, employing a dynamic panel estimator, and found that corruption had a positive impact on the income inequality in OECD countries but no significant impact in OPEC countries, possibly due to oil revenues.

Meanwhile, Huang (2013) analyzed the causal interaction between income inequality and corruption in 10 Asian countries during the 1995-2010 period by employing a bootstrap panel Granger causality test. The results revealed unidirectional causality from corruption to income inequality in China and Philippines and unidirectional causality from income inequality to corruption in Indonesia, Japan, Korea, and Thailand. In contrast, Ferreira de Mendonça and Martins Esteves (2014) researched determinants on income inequality in 27 Brazilian regions during the period 1999-2008, employing dynamic panel regression, and revealed that declines in unemployment and corruption decreased income inequality. Finally, Wong (2017) researched the impact of corruption on the income inequality of 34 countries in Asian and Latin America over the period 1996-2009 and found that corruption had no direct impact on income inequality.

3. DATA AND ECONOMETRIC METHODOLOGY

We researched the interaction among the misery index consisting of inflation and unemployment, corruption and income inequality in selected Latin American countries during the 2002-2014 period, employing the Westerlund and Edgerton (2007) LM bootstrap cointegration test and the bootstrap panel Granger causality test of Kónya (2006).

3.1 Data

In the paper, the Gini coefficient was used as a dependent variable to represent income inequality. We used the misery index, also called the economic discomfort index, which was defined as the sum of the inflation rate and the unemployment rate by Okun (1970). Meanwhile, corruption was represented by the control of corruption (COC) index of the World Bank (2018b) and the value of the index varies from -2.5 to +2.5, whereby increases in the index represent less corruption. The description of the variables is given in Table no. 1.

Table no. 1 – Data description

Variables	Description	Data Source
GINI	GINI index	World Bank (2018a)
MIS	Misery index (sum of inflation (end of period consumer prices index) and unemployment rate (% of total labor force))	IMF (2017)
COC	Control of corruption	World Bank (2018b)

We benefited from the Stata 14.0, E-views 10.0, and Gauss 11.0 programs for the econometric application. The descriptive statistics and correlation matrix is displayed in Table no. 2. The correlation matrix indicated a weak positive correlation between the Gini coefficient and the misery index and a relatively stronger negative correlation between the Gini coefficient and COC.

Table no. 2 – Data summary and correlation matrix

Variable	Obs	Mean	Std. Dev.	Min	Max
GINI	143	50.4935	4.593197	41.32	60.16
MIS	143	13.65945	6.570253	5.181	63.403
COC	143	-0.2888459	0.6278931	-1.444359	1.358376
	GINI	MIS	COC		
GINI	1.0000				
MIS	0.0300	1.0000			
COC	-0.4068	0.2254	1.0000		

3.2 Econometric Methodology

In the econometric application, first we conducted tests of cross-sectional dependency and homogeneity for the determination of the further tests employed in the paper. We then employed the panel unit root test of Pesaran (2007), the Westerlund and Edgerton (2007) LM bootstrap panel cointegration test, and the Kónya (2006) bootstrap panel Granger causality test, considering the results of the cross-sectional dependency and homogeneity tests.

The Westerlund and Edgerton (2007) LM bootstrap panel cointegration test considers the cross-sectional dependency between the series and yields effective results for small sample sizes, and it also allows for autocorrelation and heteroscedasticity in the cointegrating equation. However, the Kónya (2006) bootstrap panel Granger causality test takes note of both cross-sectional dependency and heterogeneity. The test relies on a Seemingly Unrelated Regressions (SUR) estimation which yields more efficient results in the case of cross-sectional dependency between the series. The causality direction is investigated by Wald tests with bootstrap critical values. Furthermore, the test does not dictate any pretests (Kónya, 2006).

4. EMPIRICAL ANALYSIS

4.1 Cross-sectional dependency and homogeneity tests

We tested the cross-sectional dependency between the variables with the CD_{LM1} test of Breusch and Pagan (1980) and $LM_{adj.}$ test of Pesaran *et al.* (2008), because the time

dimension of the dataset (T=13) was found to be higher than the cross-sectional dimension of the dataset (N=11). The results are presented in Table no. 3. The null hypothesis (that there is cross-sectional independency) was rejected in light of the results, and we concluded that there was cross-sectional dependency between the series. The homogeneity of the slope coefficients of the cross-sections was then examined using the delta and adjusted delta tests of Pesaran and Yamagata (2008); the results are displayed in Table no. 3. The null hypothesis (slope coefficients are homogeneous) were rejected as a result of the findings and the slope coefficients among the cross-sections were found to be heterogeneous.

Table no. 3 – Results of cross-sectional dependency and homogeneity tests

Cross-sectional dependency tests				
Variables	**CD_{LM1} test statistic**	**CD_{LM1} P value**	**LM_{adj} test statistic**	**LM_{adj} P value**
GINI	7.553	0.017	23.903	0.002
MIS	6.022	0.001	16.451	0.028
COC	11.372	0.002	19.667	0.000
Homogeneity tests				
Test	Test statistic		P value	
Delta tilde	32.894		0.000	
Adjusted delta tilde	22.861		0.003	

4.2 Panel unit root tests

The stationarity of the variables was assessed by a cross-sectional augmented IPS (CIPS) unit root test, a simple average of the individual cross-sectionally augmented Dickey-Fuller (CADF) tests of Pesaran (2007) which takes note of cross-sectional dependency. The results are displayed in Table no. 4. They indicate that all the variables were not stationary at the level but became stationary after first-differencing.

Table no. 4 – Results of Cips panel unit root test

	Level		**First Difference**	
Variables	**Constant**	**Constant + Trend**	**Constant**	**Constant + Trend**
GINI	-1.006	-1.274	-6.823*	-8.421*
MIS	-1.153	-1.099	-8.033*	-9.554*
COC	-0.972	-0.831	-9.423*	-9.736*

*Note: * significant at 1% level*

4.3 Westerlund and Edgerton (2007) LM bootstrap cointegration test

The cointegrating relationship among the misery index, corruption and income inequality was analyzed with the LM bootstrap cointegration test of Westerlund and Edgerton (2007). The results are displayed in Table no. 5. Furthermore, critical values were provided with 10.000 simulations, and lag and lead values were taken as 1. Table no. 5 indicates that the null hypothesis (there is a cointegrating relationship between the variables) should be accepted. We therefore concluded that there was a long run relationship between the misery index, corruption, and income inequality.

Table no. 5 – Results of Westerlund and Edgerton (2007) LM bootstrap cointegration test

LM_N^+	Constant			Constant and Trend		
	Test statistic	Asymptotic p-value	Bootstrap p-value	Test statistic	Asymptotic p-value	Bootstrap p-value
	0.642	0.138	0.386	6.425	0.003	0.459

The cointegrating coefficients were estimated by FMOLS, considering only heterogeneity, and DSUR, considering both heterogeneity and cross-sectional dependency after the determination of the cointegrating relationship between the variables. The results are displayed in Table no. 6. The results of DSUR revealed that a 1 unit increase in the COC (a 1 unit decrease in corruption) variable caused a 19% of decrease in the GINI (income inequality) variable, while the estimations by FMOLS showed that a 1 unit increase in the COC variable led to a 17% decrease in the GINI variable. Meanwhile, the estimations by DSUR revealed that a 1 unit increase in the MIS (misery index) variable caused a 28% of decrease in the GINI (income inequality) variable, while the estimations by FMOLS showed that a 1 unit increase in the MIS variable led to a 25% decrease in the GINI variable. Consequently, the misery index had a relatively greater impact on the GINI coefficient when compared with the COC variable.

Table no. 6 – Estimation of cointegrating coefficients

Dependent variable: GINI		MIS	COC
Method	DSUR	0.287**	-0.194**
	FMOLS	0.259*	-0.173**

*Note: *, ** indicates that it is significant at 1% and 5% respectively*

The impact of misery index consisting of inflation and unemployment on income inequality theoretically can be changed depending on the individual effects of inflation and unemployment, but is probably expected to raise the unemployment. The relevant empirical literature also verifies this expectation. On the one hand, most of the empirical studies have revealed that the unemployment raised the unemployment (e.g., see Apergis *et al.*, 2010; Bulir, 2001; Ferreira de Mendonça and Martins Esteves, 2014; Monnin, 2014; Rice and Lozada, 1983; Thalassinos *et al.*, 2012). On the other side, the existing literature on the nexus between inflation and income inequality has stayed inconclusive. However, our findings were found to be consistent with Li and Zou (2002), Thalassinos *et al.* (2012), and Sieron (2017). Furthermore, Bulir (2001) and Monnin (2014) revealed that impact of inflation on income inequality varied depending on the inflation level.

The corruption can raise the income inequality by considering the suggestions of Gupta *et al.* (1998) and the large part of existing empirical literature verified the theoretical considerations (e.g. see Apergis *et al.*, 2010; Dwiputri *et al.*, 2018; Ferreira de Mendonça and Martins Esteves, 2014; Huang, 2013; Mehrara *et al.*, 2011). However, Rodriguez Andres and Ramlogan-Dobson (2008), Dobson and Ramlogan-Dobson (2010) and Dobson and Ramlogan-Dobson (2012) reached the opposite findings for Latin American countries and they evaluated that this finding may result from a relatively higher shadow economy, but de Ferreira de Mendonça and Martins Esteves (2014) revealed that improvements in the corruption decreased the income inequality in 27 Brazilian regions. Our findings was consistent with de Ferreira de Mendonça and Martins Esteves (2014) and the general trend in the empirical literature. The

differences in the findings may be the result of the different study periods, because Latin American countries have experienced significant growth rates, FDI inflows and tax revenues, and made considerable educational investments. These improvements have the potential to change the interaction between corruption and income inequality.

4.4 Kónya (2006) bootstrap panel Granger causality test

The causal interaction among the misery index, corruption, and income inequality was examined by the bootstrap panel Granger causality test of Kónya (2006), considering both heterogeneity and cross-sectional dependency, and the results are displayed in Tables no. 7 and no. 8. First, we investigated the causal relationship between misery (MIS) and income inequality (GINI) and revealed a unilateral causality from the misery index to income inequality proxied by the Gini coefficient, as reported in Table no. 7. Therefore, the misery index consisting of inflation and unemployment was found to be a significant factor in explaining income inequality.

Table no. 7 – Results of bootstrap panel granger causality test for GINI and MIS

Countries	H_0: GINI does not cause MIS				H_0: MIS does not cause GINI			
	Wald stat.	Bootstrap Critical Values			Wald stat.	Bootstrap Critical Values		
		1%	5%	10%		1 %	5%	10%
Argentina	3.725	35.890	24.543	6.554	19.89**	28.07	18.04	14.57
Bolivia	2.853	32.871	16.453	8.770	23.04**	35.13	20.73	8.03
Brazil	1.662	34.780	22.831	7.688	45.22**	49.78	18.61	8.30
Costa Rica	0.973	49.323	13.870	8.890	38.49**	60.67	16.01	9.47
Ecuador	3.634	34.213	18.653	8.678	39.38***	33.47	45.11	13.88
El Salvador	2.648	46.871	35.809	12.554	41.93**	48.12	21.07	11.43
Honduras	3.997	48.341	36.980	12.541	29.55***	28.90	17.60	23.32
Panama	5.116	46.551	22.091	8.455	33.05**	61.96	18.47	12.43
Paraguay	2.372	42.809	17.980	11.893	46.98***	42.17	19.39	18.89
Peru	1.775	46.431	15.980	12.890	41.23***	29.74	19.63	11.10
Uruguay	0.873	39.07	22.09	11.892	40.66***	36.91	16.28	12.53

*Note: *, **, *** indicate rejection of the null hypothesis at 1%, 5% and 10% significance levels respectively.*

The causal relationship between corruption (COC) and income inequality (GINI) was then analyzed, and the results elicited a bilateral causality between corruption and income inequality. There was therefore a mutual interaction between corruption and income inequality.

Table no. 8 – Results of bootstrap panel granger causality test for GINI and COC

Countries	H_0: GINI does not cause COC				H_0: COC does not cause GINI			
	Wald stat.	Bootstrap critical values			Wald stat.	Bootstrap critical values		
		1%	5%	10%		1 %	5%	10%
Argentina	34.89**	37.601	17.65	8.018	45.78***	26.447	14.363	9.513
Bolivia	22.78**	46.005	15.24	8.593	42.49***	32.643	18.517	12.521
Brazil	15.07*	42.094	23.80	7.725	38.02***	28.943	15.092	10.551
Costa Rica	39.54**	44.001	21.00	8.990	29.56***	25.469	12.563	8.826
Ecuador	29.51**	33.677	15.77	9.187	33.67***	29.367	14.415	10.266

Countries	H_0: GINI does not cause COC				H_0: COC does not cause GINI			
	Wald stat.	Bootstrap critical values			Wald stat.	Bootstrap critical values		
		1%	5%	10%		1 %	5%	10%
El Salvador	39.02***	38.284	17.65	11.34	42.11**	25.148	12.627	9.585
Honduras	41.67**	33.433	15.24	7.93	36.82***	25.153	11.725	7.862
Panama	42.38***	49.358	11.80	9.22	45.08**	26.047	15.944	9.376
Paraguay	19.89**	48.649	11.00	8.44	33.26***	22.819	12.567	8.545
Peru	38.66**	48.671	15.77	7.05	31.03**	26.598	12.718	7.875
Uruguay	28.14**	37.396	19.65	10.33	29.64**	26.222	15.659	9.772

*Note: *, **, *** indicate rejection of the null hypothesis at 1%, 5% and 10% significance levels respectively.*

5. CONCLUSION

A large number of countries have experienced considerable expansions in their national economies as of the 1980s, yet inter-country and intra-country inequality have remained at high levels. Only Latin America and Sub-Sahara Africa have seen decreases in income inequality in recent years, although these regions are still the most unequal regions in the world (Tsounta and Osueke, 2014). This study investigated the role of the misery index and corruption in the high level of income inequality in Latin American countries during the 2002-2014 period, employing the Westerlund and Edgerton (2007) LM bootstrap cointegration test and the Kónya (2006) bootstrap panel Granger causality test. The results suggest that increases in both the misery index and corruption played a part in increases in income inequality. Furthermore, the results of the causality test revealed unidirectional causality from the misery index to income inequality and bidirectional causality between corruption and income inequality.

Our findings regarding the misery-inequality nexus are consistent with the general trend in the empirical literature. The misery index, consisting of inflation and unemployment, has a significant impact on inequality over the short and long run. However, the findings regarding the corruption-inequality nexus contradict the findings of Rodriguez Andres and Ramlogan-Dobson (2008), and Dobson and Ramlogan-Dobson (2010). This may be the result of the period in which the studies were conducted, because Latin American countries have experienced significant growth rates, FDI inflows and tax revenues, and made considerable educational investments. These improvements have the potential to change the interaction between corruption and income inequality. Finally, the bidirectional causality between corruption and inequality has verified that corruption and inequality feed each other, because in a country with relatively higher income inequality, the rich people employ their economic resources to maintain their existing position and increase their interests, whereas the poor lack many basic rights.

The theoretical considerations and empirical findings reveal that price stability, unemployment and corruption are important instruments to decrease the income inequality. In this context, economic policies to provide the price stability and create the employment also will make a significant contribution to decrease the income inequality. Furthermore, efficient institutional structures and incentives can prevent the emergence of corruption. Besides credible deterrence based on accountability and enforcement mechanisms can significantly decrease the individuals to take corruptive actions (World Bank, 2019). Therefore, efficiently functioning of institutions and incentive structure and establishing an effective deterrence system will decrease the corruption and in turn income inequality.

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