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NEXUS BETWEEN INSTITUTIONAL QUALITY, EMPLOYMENT, TRADE OPENNESS & CO2 EMISSIONS: A PANEL ARDL ANALYSIS

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KEYWORDS

Institutional Quality, Employment, Technology & Financial Development

ABSTRACT

This study employs a panel autoregressive distributed lag (ARDL) approach to investigate the relationships between employment, institutional quality, trade openness, and carbon dioxide (CO2) emissions. The analysis focuses on period from 2002 to 2021, encompassing top ten CO2-emitting countries: the United States, China, India, Japan, Russia, Iran, Germany, Saudi Arabia, South Korea, and Indonesia. Study explores how institutional frameworks, in conjunction with economic factors impact environmental outcome. Research emphasizes the potential of strong institutional quality to stimulate the trade, economic growth, and improvements in quality of life. Models developed in study predict an increase in CO2 emissions linked with higher institutional quality, economic development, energy consumption, industrialization, and trade openness. The findings highlight a significant correlation between the variables of institutional quality (IQ), employment (EMP), & trade openness (IMP) and CO2 levels over the long term. By employing a comprehensive panel ARDL approach, this study provides valuable insights into intricate relationships between institutional quality, employment, trade openness, & CO2 emissions.

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INTRODUCTION

The orangery effect that is responsible for rising global temperatures & environmental impairment, is being worsened by human-caused emissions of carbon dioxide. Carbon dioxide output The IR is chimney effect caused by taking in oxygen & giving out carbon dioxide (Jamil & Rasheed, 2023). An insignificant source of global warming rushing carbon emissions rising levels of carbon dioxide emissions are contributing to warming planet (Cooley, Klinsky, Morrow & Satterfield, 2023). Since

"low emissions vehicles" produce less carbon dioxide, acquainted with term may think that gases found in this drain include carbon dioxide & others, like nitrogen. As burning fossil fuels increases atmospheric carbon dioxide, falling energy consumption is preferable than doing nothing. Without warmth of atmosphere, life on Earth would be severely compromised (Li, Li, Sun & Xie, 2022). One of gases that comprise atmosphere surrounding globe as carbon dioxide, CO2. On Earth, carbon dioxide is present in nearly all of environments, and it is vital component in delicate eco-system that be preserved so as to preserve life on our planet (Godin, Liu, Ren & Xu, 2021). Exhaling carbon dioxide into atmosphere is natural process that occurs in living things, including humans, after they have taken in oxygen.

On the other side, in order for plants to develop and create more oxygen for us to breathe, they need sunlight and carbon dioxide in the air. Moreover, the oceans are responsible for taking up a sizeable portion of atmosphere carbon dioxide (Mostafaeipour, Bidokhti, Fakhrzad, Sadegheih & Mehrjerdi, 2022). Carbon dioxide concentrations in Earth's atmosphere have grown gradually for last century. It is now thousands or tens of decades ahead of anything else that has ever happened. Consider the following in light of the possibility that the oceans and vegetation on Earth may soak up surplus carbon dioxide (Godin, Liu, Ren & Xu, 2021). The scientific community has come to the conclusion that an excessive amount of the carbon dioxide and other gases, even if they are present in lower concentrations, function as a barrier to dissipation of heat, which leads to an increase in the average temperature of the entire planet. The phenomenon being discussed is something that is generally referred to as greenhouse effect. This phenomena takes place as result of the direct association that exists between the rise in temperature and the increase in carbon dioxide levels (Zhong, Yang, Ding, Huang, Zhao, Yan & Ye, 2021). Fundamental factor that is responsible for changes in environment is rise in usual global temperature that comes about as direct consequence of rising levels of carbon dioxide in atmosphere.

Because of the actions of humans, the concentration of atmospheric carbon dioxide in environment has more than likely increased by a factor of two over the past few centuries and the impact of the technological advancements. However, human existence has become distracted owing to changes in the environment as a result of technological advancements in this century, which brought about positive thinking and attitudes (Khan, Khan & Muhammad, 2021). If GDP growth and energy usage have a negative association, economic expansion encourages latter's use, resulting in lower carbon emissions. Their interdependence can effectively demonstrate the correlation between variables X and Y. The interaction coefficient indicates that financial development serves a twofold purpose in enhancing energy efficiency and mitigating greenhouse gas emissions. This correlation is evidenced by reality that these objectives are interrelated. Aside the positive correlation between heightened economic activity and greenhouse gas emissions (Qayyum, Ali, Nizamani, Li, Yu & Jahanger, 2021). Based on research about carbon emissions accounting, it has been determined that international commerce is accountable for the approximately 20 to 30 percent of overall dioxide of carbon (CO2) emissions. The aforementioned emissions constitute majority of emissions that are contributing to phenomenon of global warming.

According to most recent estimates, roughly 8 billion tonne of atmospheric carbon dioxide (CO2) were released into the atmosphere in 2015 due to manufacturing and distribution of traded goods

and services. This number represents around 25 percent of world's total CO2 emissions (Kirikkaleli & Adebayo, 2021). An idea of institutional quality has recently garnered increased attention from economists, scientists, and policymakers in the context of environmental policy. In point of fact, the government possesses capacity to influence the state of environment in both a direct and indirect fashion. The rule of law is essential element in government that has gained widespread support in recent decades. It is hallmark of competent and well-functioning constitutional structure since it guarantees that laws are managed reliably and fairly throughout the country (Godil, Sharif, Agha & Jermsittiparsert, 2021). On top of this, possessing an effective rule of law helps lessen influence that market failure has on society. This is because a higher standard of law contributes to a calmer society. If government agencies are doing their tasks properly and fairly, they may increase amount of fruitful cooperation between market players. That job is referred to " job." As consequence of this, application of law has evolved as vital element in method of managing problems that are linked with environmental issues.

Thus, enact procedures for reducing greenhouse gases (CO2), an effect must be established, and companies would have minimal problems complying with such limits if they were adopted. This is because managing CO2 requires a decisive rule of law (Ahmad, Ahmed, Majeed & Huang, 2021). The purpose of this study is to gain understanding of the empirical relationship that exists between the various dimensions that make up moderation role that institutional quality plays. Employment, technological advancement, increased financial growth, and more commercial openness are the variables that are contributing to environment. The significance of each component of environment has been established, which helps to strengthen connections between many structures. Thus, this relationship contributes academically and offers new perspectives on how to comprehend this issue. An excellent example of novelty is the production of something that is unique in comparison to what already exists, or the execution of an improved idea, resulting in the birth of a new or new idea. Numerous studies have been conducted to analyze the Institutional integrity and climate in both the developed countries and developing countries. In this connection, these countries have been examined from a variety of the perspectives. My research is the first of its kind since I focused on the nations responsible for the greatest amount of carbon dioxide emissions to examine the connections between the various factors.

LITERATURE REVIEW

This study aims to examine the impact of ICT, energy consumption, industrialization, and financial development on carbon dioxide pollution in a cross-section of 12 Asian countries. The present study uses long-term data spanning two decades, from 1994 to 2013. Data on Internet use, carbon dioxide emissions, power consumption, GDP, and economic growth were examined using a panel unit root test that accounted for cross-sectional dependence. Stationarity in the initial difference was found for all of aforementioned factors (Zahoor et al., 2022). The cointegration test indicates a consistent relationship among ICT, energy, GDP, and CO2 emissions over time. Increasing energy use and GDP have a positive correlation with carbon dioxide emissions, thereby contributing to the rate of their increase. Due to its large impact on emissions, promoting ICT is being considered as a major method for lowering countries' carbon dioxide output in a number of contexts. In this linking, energy consumption, GDP, and monetary growth are all indicators of economic progress, all of which rise in

tandem with the carbon dioxide emissions. The use of ICT is associated with higher rates of energy consumption, GDP growth, and greenhouse gas emissions. Energy usage and gross domestic product have a marginal relationship.

These countries should prioritize the development of renewable energy sources as a substitute for their reliance on non-renewable fossil fuels. ICT poses no environmental threat, and incorporating a carbon dioxide emissions reduction strategy into ICT policy is viable (Saud, Chen & Haseeb, 2020). Consumption is the primary source of CO2 emissions over the long run. Researchers have found a causal association, which is the mutual, between energy use and carbon dioxide emissions in various countries. As an investigation into the Granger causation relationship between energy use and CO2 emissions in Australia's context, the present study has policy implications (Jun, Mahmood & Zakaria, 2020). These countries can reduce their energy use to reduce pollution levels without suffering economic consequences (Tachie, Xingle, Dauda, Mensah, Appiah & Adjei, 2020). Thus, the employment-to-population proportion measures a country's labor force. Individuals who were engaged in the production or provision of products or services for financial gain at any point during the reference period are considered to be employed. The employment rate is a measure of economic growth (Uzar & Eyuboglu, 2019). In this regard, the results indicate a causal relationship between carbon dioxide emissions and employment in the short term and the direct relationship between energy availability and jobs.

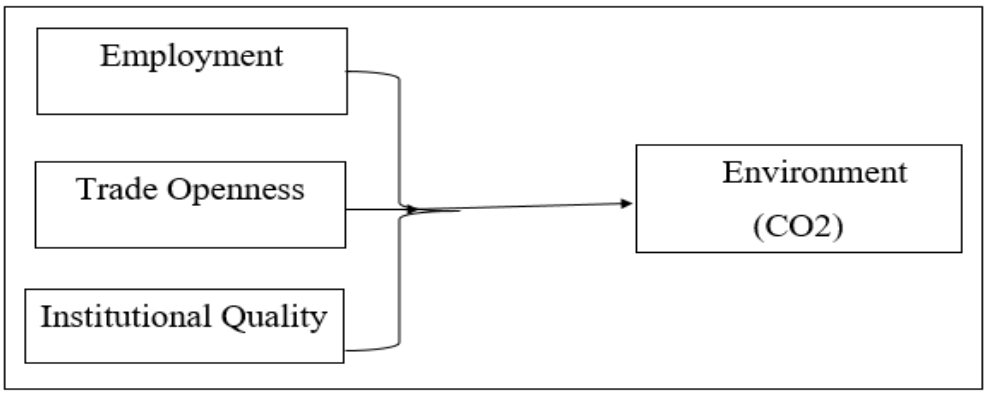
According to the results, engagement and readily available energy appear connected. Some data suggest a link between access to electricity and economic growth and job creation (Le & Ozturk, 2020). According to study's findings, the expected coefficients of ECT in the equations for carbon dioxide emissions, GDP, and employment are significant from a statistical point of view (Abbasi & Adedoyin, 2021). A notable rise in RES utilization can positively impact GDP and employment growth, while simultaneously reducing the CO2 emissions. Fossil fuel usage does not contribute to energy access or employment, and also leads to the increased carbon dioxide emissions. Southeast European countries have untapped potential for renewable energy production. The suboptimal energy efficiency of the system could be a contributing factor to these outcomes (Dong et al., 2018). The subsequent rationales are as follows: This study examines the economic benefits and costs of the tourism industry, including its environmental impact, spillover effects on other sectors, and negative externalities. The study reveals high CO2 emissions in Mediterranean countries, highlighting the need for policymakers to implement measures to reduce emissions and ensure sustainable tourism development (Shahbaz et al., 2021).

CO2 emissions are affected by several factors, including market liberalization, the use of energy from renewable sources, and economic development. Economic growth has been the main driver of carbon dioxide (CO2) releases for the very long time (Dauda et al., 2021). Increased trade freedom between countries can lead to the exploitation of their comparative advantages, resulting in a rise in their GDP. The environmental impact of a path can be either positive or negative, depending on its route (Mutascu, 2018). Trade can attract companies to countries where their knowledge can lead to cleaner production and a cleaner environment (Dauda et al., 2021). Greater scale effect relative to technique/composition effect is expected to result in adverse environmental consequences of

trade liberalization. Trade liberalization can have unforeseen impacts on pollution levels (Mutascu, 2018). Macro-economic indicators exhibit a sudden and drastic shift from upward trend to negative trend, whereas the opposite is not observed. As wealth increases, there is a corresponding increase in energy consumption and pollution due to the expansion of trade. The ratchet effect may impede the reduction of energy consumption over decreased commerce. This offers evidence of their contented and robust partnership.

The positive correlation between reduced trade openness and reduced CO2 emissions is evident during corresponding years (Rahman et al., 2020). The study's objective was to evaluate Tunisia's economic progress in relation to trade openness, emission of greenhouse gases, and economic growth from 1961 to 2005. ICT poses no environmental threat, and incorporating a carbon dioxide emissions reduction strategy into ICT policy is feasible (Saud et al., 2020). The employment rate is a measure of economic growth (Uzar & Eyuboglu, 2019). According to study's findings, expected coefficients of the ECT in the equations for carbon dioxide emissions, GDP, and employment are significant from a statistical point of the view (Abbasi & Adedoyin, 2021). The suboptimal energy efficiency of the system could be a contributing factor to these outcomes (Dong et al., 2018). The period covered by the study was from 1961 to 2005. According to findings from recent research, participation in trade has a positive impact, both in the immediate future and in the long term, on levels of carbon dioxide emissions. In spite of this, it will, in the long run, negatively impact the amount of CO2 emitted (Lv & Xu, 2019). The correlation between economic expansion and CO2 emissions was found as a U. On the other hand, the quality of institutions and the amount of FDI, or foreign direct investment, CO2 emissions.

Figure 1 Conceptual Framework



RESEARCH METHODOLOGY

The research uses data taken from World Development Index (WDI) on an annual basis, beginning in 2002 and continuing through 2020, in order to make the findings easier to understand. We visited eleven completely different nations during our trip. Members include the Communist Party of China, the United States, India, the Russian Federation, Japan, Iran, the Republic of Korea, Saudi Arabia, and Indonesia. The World Development Indicator (WDI) was utilized as a data source for this particular investigation. We used the Augmented Dickey-Fuller test, often known as ADF, to

carry out a unit root analysis so that we could determine degree to which the variables exhibited stationarity. The Wald test is used to determine whether or not variables in a model exhibit long-run cointegration, & ARDL is applied in order to carry out long-run parameter estimation analysis. Both of these tests are applied in conjunction with one another. Current model was conceived with the intention of carrying out an in-depth investigation into a deconstructed study of atmospheric quantities of carbon dioxide.

RESULTS AND DISCUSSION

Table 1 Descriptive Analysis

	Mean	Maximum	Minimum	SD	Skewness	Kurtosis
CO2	8.885	19.598	0.897	4.767	0.026	2.343
IMP	5.360	35.465	-32.467	11.416	-0.552	4.362
EMP	8.176	79.829	57.511	5.606	0.060	2.097
IQ	1.100	3.063	-3.371	1.938	0.241	1.564

Earlier, examples for years 2004-2021 were provided to illustrate the factors covered. According to the preceding table, the mean value of CO2 is 7.667, which is much higher than the values of the other indicators. Means for IMP, EMP, and IQ are 8.775, 2.350, and 2.300, respectively. In addition, 12,416, 4,616 and 1.928 are corresponding standard deviation numbers. All of these metrics showed that major predictors add substantially to atmospheric CO2 concentrations. To provide a complete picture of phenomena, the table should also include its extremes in terms of maximum, minimum, skew, and kurtosis.

Table 2 Unit Root

	Individual Intercept				None			
Variable	LLC Test	IPS Test	ADF-Fisher C-Square	PP-Fisher C-Square	LLC Test	ADF-Fisher C-Square	PP-Fisher C-Square	Results
CO2	-2.313 0.010	0.604 0.727	19.716 0.476	28.048 0.108	0.210 0.583	22.322 0.323	37.269 0.011	I (1)
EMP	0.413 0.660	1.320 0.907	14.745 0.791	12.130 0.912	-1.676 0.047	35.361 0.018	34.356 0.024	I (1)
IMP	-2.633 0.004	-4.300 0.000	57.964 0.000	79.093 0.000	0.199 0.579	65.065 0.000	91.285 0.000	I (0)
IQ	-0.690	0.157	22.185	26.256	-1.500	35.997	33.001	I (1)
	0.245	0.562	0.331	0.158	0.067	0.015	0.034	

Table 2a Unit Root

	Intercept and Trend				None			
Variable	LLC Test	IPS Test	ADF-Fisher C-Square	PP-Fisher C-Square	LLC Test	ADF-Fisher C-Square	PP-Fisher C-Square	Results
CO2	-0.191 0.424	1.608 0.946	11.999 0.916	11.501 0.932	0.210 0.583	22.322 0.323	37.269 0.011	I (1)
EMP	1.716 0.957	1.977 0.976	8.471 0.988	16.613 0.678	-1.676 0.047	35.361 0.018	34.356 0.024	I (1)
IMP	-6.194 0.000	-5.999 0.000	70.710 0.000	116.147 0.000	0.199 0.579	65.065 0.000	91.285 0.000	I (0)

IQ	1.094	-0.737	26.783	38.200	-1.500	35.997	33.001	I (1)
	0.863	0.231	0.142	0.008	0.067	0.015	0.034	

Table 3 Correlation Matrix

Variables	CO2	IMP	EMP	IQ
CO2	1.000			
IMP	0.084	1.000		
EMP	0.292	0.125	1.000	
IQ	0.471	0.061	0.244	1.000

The correlation matrix presents the relationships between the variables of interest: CO2 emissions (CO2), trade openness (IMP), employment (EMP), and institutional quality (IQ). The diagonal line represents the correlation of each variable with itself, which is always equal to 1. Looking at the off-diagonal elements, we observe that the correlation coefficient between CO2 emissions and trade openness is 0.074, indicating the weak and positive correlation. Similarly, the correlation coefficient between CO2 emissions and employment is 0.282, suggesting a moderate positive correlation. The strongest correlation is observed between the CO2 emissions and institutional quality, with the coefficient of 0.471, indicating moderate positive relationship. In this regard, these findings suggest that institutional quality may have relatively stronger influence upon CO2 emissions compared to trade openness and employment.

Panel Autoregressive Distributed Lag Models, Interval & Absolute Precision

Table 5 below displays the results of a Panel the ARDL method model analysis. Trade transparency, quality of institutions, jobs, and environmental (CO2) aspects were modeled to examine their short- and long-term interrelationships. Study looked at data from 2004 over 2021. Trade openness (IMP), occupation (EMP), quality of institutions (IQ) all have long-term effect on environmental pollution (CO2), as measured by their respective coefficients. Panel ARDL method was used to discover this linking. Rise of single unit in EMP, IMP, IQ increases 0.0277, 0.1435, respectively 1.2128 metric tons of CO2 released into atmosphere.

Table 4 Short-Term and Long-Term Panel ARDL Estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
	Long Run Equation			
IMP	0.027692	0.012740	2.173564	0.0315
EMP	0.143517	0.055453	2.588069	0.0107
IQ	-1.212813	0.300459	4.036536	0.0001
	Short Run Equation			
ECT	-0.104699	0.046913	-2.231760	0.0273
D (CO2 (-1))	0.102181	0.108238	0.944038	0.3468
d(IMP)	0.128737	0.003017	2.895993	0.0044
d(EMP)	0.156852	0.031155	0.219948	0.8262
d(IQ)	-0.296920	0.132699	-2.237544	0.0269
C	0.084001	0.253679	0.331130	0.7411

Granger Causality Analysis

Table 5 summarizes the findings from paired Granger causality analyses for IMP, CO2, EMP, and IQ using just one lags and a sample period covering 2002-2021. It is feasible to evaluate the results side by side. The assumption of no the Granger causal relationship between the two variables is the basis for each test. Thus, the F-statistic and accompanying p-value are presented after each test. Assuming no Granger causality among IMP constitutes the null hypothesis of the first test. After running the numbers, we got an F-statistic of 1.67540 and a p-value of 0.4562. We cannot reject the null hypothesis that IMP Granger's causation does hold for CO2 because the p-value is more significant than 0.05.

Table 5 Granger Causality Test

Null Hypothesis:	OBS	F-Statistic	PROB.
IMP does not Granger Cause CO2	190	1.46790	0.2272
CO2 does not Granger Cause IMP		1.60603	0.2066
EMP does not Granger Cause CO2	190	1.37702	0.2421
CO2 does not Granger Cause EMP		1.05680	0.3053
IQ does not Granger Cause CO2	190	8.53192	0.0039
CO2 does not Granger Cause IQ		2.22332	0.1376

In second scenario, we test the null hypothesis that CO2 emissions are not related to the degree to which markets are open to participation (IMP). In end, the F-statistic was 1.24253 and the p-value was 0.2176. Still, because p-value is higher than 0.05, it is not possible to reject the null hypothesis. Therefore, the Granger causality test does not support hypothesis that a connection exists between CO2 emissions and IMP. Third hypothesis test assumes no Granger causation between employment (EMP) and CO2 emissions (the null hypothesis). A p-value of 0.3421 and F-statistic of 1.38834 were calculated from data. We cannot reject null hypothesis that there is no Granger causation between employment (EMP) and CO2 emissions since p-value is greater than 0.05. The fourth hypothesis is tested on premise that a Granger causal relationship does not exist between institutional quality (IQ) and CO2 emissions, which is null hypothesis. A p-value of 0.0049 and an F-statistic of 8.54192 were calculated from the data.

The p-value for the Granger causality of CO2 emissions due to institutional quality (IQ) is less than 0.05, hence this is a significant prediction. Therefore, we cannot accept the alternative hypothesis. Assuming there is no relationship between CO2 emissions and institutional quality (IQ) is the null hypothesis for the sixth test. The F-statistic calculated by the team was 2.24532, and the p-value was 0.1376. It would be impractical to reject the null hypothesis with a p-value greater than 0.05. As a result, we can't say that CO2 emissions Granger have a major impact on IQ in the short or long term. However, it must be emphasized that there is not enough proof to believe this phenomenon through various outcomes of the study based upon the results over statistical procedures. There is no Granger causal link between the trade openness (IMP), employment (EMP), and CO2 emissions, as shown by the paired Granger causation tests. However, in this linking, there is data to support the claim that higher levels of the institutional quality (IQ) Granger are associated with more carbon dioxide emissions.

DISCUSSION

The results indicated that Long-run solutions coefficients and statistical significance, while short-run equations exhibit lagging CO2 & variable-independent changes. Information criteria assess model fit and used Panel ARDL analyzes from 2001 to 2021. We can evaluate how institutional quality, job opportunities, and the trade openness affect CO2 emissions. Our findings are presented below. The 'pollution haven' theory is given more support in the region as the result of the positive correlation between CO2 emissions and employment and trade openness with external sources. In addition, the panel threshold approach is utilized in order to assign Institutional Quality, which, once achieved, results in a reduction in the CO2 emissions (Ibrahim & Law, 2016). Every single one of these predictions is having an effect, not only on CO2 but also on the phenomenon. In this regard, the discovery also indicates that the forecasters are accurately predicting the level of emission, which indicates that the environment is suffering adverse consequences as a result of these sources (Godil et al., 2020).

The empirical relationship between institutional quality and CO2 has been extensively studied across various geographical regions, with a majority of the studies utilizing a substantial number of participants and multiple dimensions. Notably, the findings consistently highlight the significant role of institutional quality in relation to the CO2, with statistical increases observed in conjunction with other variables. Hence, the presence of the correlation serves as an indication of a connection (Obobisa et al., 2022). For nations with inadequate institutional frameworks to effectively attain the ecological advantages of commerce, a transformational process will be necessary. In the context of reducing the pollution levels, the efficacy of the nations with robust institutional frameworks is comparatively more significant than that of trade. The presence of a robust institutional framework has the potential to enhance trade, foster economic growth, and improve the overall quality of life (Godil et al., 2020).

CONCLUSION

According to the findings of this research, the employment rate and the degree to which businesses are willing to engage in trade are both at the point of first difference. On the other hand, the quality of other institutions was comparable, which suggests that data was collected from various sources. The regressors in the equation over the long term indicate that the amount of CO2 has shifted as a consequence of changes in all of remaining variables, notably IMP, IQ, EMP. After determining an adequate amount of cointegration in models at hand, the next step is to estimate the long-term or short-term ARDL variables for models. Fact that lagged Error Correction Term E (uit) coefficients of the model are negative and highly significant is evidence that the relationship between features is particularly reliable throughout a lengthy period. According to the findings of the ARDL panel, the quality of the institutions has a significant influence on carbon dioxide emissions, both over long run and in short run. While all other elements remain the same, a decline in CO2 emissions can be observed when level of Institutional Quality is increased. Degree to which markets for employment and trade are open has a considerable impact on concentration of CO2 in the atmosphere. When it comes to formulating policies intended to protect environment, findings are of a larger significance to decision-makers.

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