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# Exploring the Reverse Relationship between Circular Economy Innovation and Digital Sustainability—The Dual Mediation of Government Incentives

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**Abstract:** The current study aims to examine the reverse association between circular economy innovation (CEI) and digital sustainability (DS), as well as the dual mediation of government incentives (GI) among firms. Data was collected through a structured-questionnaire-based survey among financial institutions (banks, insurance, and financial companies) in Pakistan, Malaysia, and China. The study collected data via structured questionnaires in an online survey and analysed the data using partial least squares structural equation modelling (PLS-SEM), to find results. The results revealed that CEI has a two-way relationship with the DS among firms in the defined context. Furthermore, the results confirmed the dual mediating role of GI between CEI and DS among firms. The outcomes can guide the policy makers to focus on the practices of CEI in the settings of the relevant state support schemes, to enhance the practices of DS among firms in emerging markets. The implications of the study are presented at the end of this study.

**Keywords:** circular economy innovation; digital sustainability; government incentives



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## 1. Introduction

The strategy of the circular economy (CE) has gained wide interest from industries, consultants, business associations, and policy makers around the world [1,2]. It has been widely debated in the relevant literature and in the world economic forums on various platforms, to achieve the long-lasting requirements of societies in the digital era [3]. Due to its wide importance, many companies have started the practices of CEI around the world [4]. In particular, in the views of the UN sustainability agenda, firms are extensively focusing to change their operations from the old business practices to innovative, digital, and CEI systems, to save energy, minimize contamination and depletion of possessions, achieve triple-bottom-line (TPL) efficiencies, and meet the standard of DS [5]. In the race for sustainable development, firms are usually focusing on the practices of DS and circularity to ensure their survival in exaggeratedly competitive environment [6]. Most importantly, due to the pressure of investors, government, and other stakeholders, numerous firms are widely engaged in the practices of sustainability to achieve the long-lasting environmental objectives [7–11].

Concisely, the trend for CEI has attained wide attention among industries to accomplish the sustainable development goals (SDGs) and desired position in the market [12]. It is applied as a new procedure to handle environmental issues, bring perfection and innovation in the production process, wisely use the scarce resources, develop a trend of recycling, and ensure the sustainability of the environment [13]. The application of sustainability measures can improve the production system among industries, ensure clean water, and provide a healthy atmosphere for communities [13,14]. In particular, CEI is suspected to be the prime contributor in achieving the SDGs [15]. As a result, many firms around the world have shown greater interest in adopting the practices of CEI [16], and have upgraded the production system to the advanced level of an ecosystem with the aim of achieving the desired level of performance and implementing the digital ecosystem among industries [16,17].

Moreover, the approach of CEI among industries has adopted the trend of closed-loop practices around the world [18], extending both the biological and technological cycles with the help of digital applications to gain super efficiencies among firms. In this regard, the tendency of rapid digitization such as smart houses, Industry 4.0 (I4.0), big data, cloud computing, etc., have provided the digital toolbox of solutions to advance the systems of industries and government policies to add value to customer services, promote faster economic growth, more efficient usage of resources, and achieve the objectives of DS [11,19–22]. More exactly, DS represents “the organizational activities that seek to advance the sustainable development goals through creative deployment of technologies that create, use, transmit, or source electronic data” [11].

In particular, the integration of CEI with smart technologies can foster the resources efficiency for sustainable production, consumption, and DS [22]. However, there is scarce literature, limited knowledge, and calls for further research to expose the importance of CEI to meet the desired level of DS among firms [22–29]. In addition, it is also rare for people to know, and it has not been attempted so far, how GI facilitates the transition of CEI towards DS among firms [30], especially in the defined context, and in turn, how the application of digital technologies helps in achieving the objectives of CEI and sustainability [11,22,26]. Therefore, we exposed a significant knowledge space in the emerging literature, to examine the reverse association between CEI and DS among firms, along with the dual mediation of GI in the services sector of Pakistan, Malaysia, and China. Hence, this study aims to explore the following shortcomings:

1. Does a reverse relationship exist between CEI and DS among firms in the defined context?
2. Do GI have a dual mediating role between CEI and the DS among firms in the defined context?

Consequently, to find the solutions to the problems, we were required to conduct a study to bridge the gap in the emerging literature. Hence, our study adds to the prior knowledge by examine the two-way relationship between CEI and DS among firms in the defined context, based on the approaches of a resource-based-view theory. It also adds to this by examining the dual mediation of GI between CEI and DS among firms. It is also backed by the evaluation of the correlation of GI with the CEI and DS. The current study also integrated the literature of CEI, DS, and GI, based on the evidence from emerging economies. However, the first part of the paper represents the introduction of the study, followed by theoretical arguments. The next section highlights the methodological procedure and displays the outcomes of the study. In the last section, we included the discussion of references, consequences, and conclusion of the outcomes.

## 2. Theoretical Framework and Construction of Propositions

### 2.1. The Natural-Resource-Based-View Theory

Barney was the first to present the resource-based-view theory in 1991, in the light of environmental challenges among firms, by using the available resources to ensure survival in the target market [31]. The study tried to establish a suitable road map for the existing resources, and to use these resources in the best way for the organization to achieve the

desired level of competition in the target market. The study advised a wise use of the valuable resources (such as physical capital, human capital, organization capital) to meet the required standard of performance. However, it is necessary for every organization to carefully utilize their resources to acquire the viable efficiencies in the target market [32]. The unique and invaluable resources possess the potential to achieve the viable leadership position in the target market and raise a wall of difficulties for competitors. Therefore, by adopting the perspective of resource-based-view theory, we perceived that the practices of CEI and DS can lead firms to achieve TBL efficiencies in the target market.

## 2.2. Relationship between CEI and DS

The strategy of CEI is alleged to be an important act of economic growth, to strengthen the quality of life among societies, drive systematic change, sustain values and the circulation of material, and eliminate waste among societies [33]. Due to these reasons, many practitioners observe CEI as the best model for economic development among societies. In addition, the UN has also recognized it as a significant shift towards a smooth and energetic system to gain competitiveness, sustain technological usage, make efficient responses to global challenges, and achieve the objectives of digital sustainability. Perfection in CEI can lead to obtaining digital competencies and human capital in a much easier and faster way. In particular, the practices of CEI can lead to achieving technological development and digital competencies among firms, to ensure long-lasting business survival and enhance profitability in the modern digital era. The application of CEI can enable industrial settings to design smart manufacturing and services systems to overcome the related pollution and wastage issues in societies [29].

Moreover, the practices of CEI lead to gaining financial and environmental benefits, and play a crucial role in digital transformation [34]. It is considered as an important act for achieving the SDGs and enabling firms to respond to the technological enhancement and DS [35]. Recently, the trend for digital technology has boosted industries and the concept of a digital economy has emerged, reducing the distances among various stakeholders and accelerating towards more powerful innovation. In such a scenario, the culture of CEI is perceived as a primary cause of DS among firms for overcoming the issues of wastage, pollution, and the usage of scarce resources [35]. Likewise, the applications of digital technologies can handle the crucial sustainability challenges and carbon-free practices among firms [11]. Specially, the activities of DS can employ eco-system architectures and ecosystem-level coordination, and enable firms to work competitively to achieve the objectives of sustainable development [11]. However, prior studies paid attention to the practices of CEI and DS in various settings but were less focused on examining the two-way relationship between CEI and DS among firms. Therefore, we can postulate that:

**H1.** *There is a two-way association between CEI and DS among firms.*

## 2.3. Relationship between CEI and GI

CEI is the higher-level rethink of the production system and engineering process, ensuring the achievement of SDGs [36], and is the “transition from linear economic models based on take, make, use and waste towards circular models that minimize, recover, recycle, and reuse materials, water, and energy” to meet the fast-changing requirements of societies. However, the shifting procedure involves some necessary measures and requires some essential supplies to complete a more perfect and environmentally friendly business model. CEI is the prime strategy for reducing the adverse effects on the environment, and leads to meeting the desired level of economics growth in an aggressive business landscape. In such a scenario, the incentive plans play a key role among firms to gain motivation for transition, eco-innovation, CEI, and business-model innovation (BMI), to meet the TBL efficiencies and DS. In particular, the transition process towards CEI requires financial and non-financial resources to facilitate the journey of CEI among firms [37]. Specifically, the financial incentives are perceived as the key indicators to implement the innovation process among firms and enhance consumer attention. Incentives boost capabilities among firms

for adopting sustainability measures to create values for communities and start valuable business practices [37]. Mainly, the activities of CEI inspire the investors toward firms and display useful outcomes for the owners [37]. Hence, we can set out this proposition:

**H2.** *There is a positive correlation between CEI and GI among firms.*

#### 2.4. Relationship between GI and DS

The government support in term of financial and non-financial incentives is perceived as highly important for economic growth and firms' profitability. GI are vital to achieve corporate social responsibility, create change in the business paradigm, improve performance, minimize the R&D expenditures, and create values for the societies in the modern digital landscape. Due to these reasons, many countries have launched incentive schemes to support firms in qualification, internationalization and innovation, and achieve the objectives of the SDGs [38]. In addition, the incentives system can enable firms to improve their competitive advantage, enhance sustainable growth and extend their capabilities [39–41]. In particular, the GI system can play a better role in obtaining TBL efficiencies among firms [42], driving the firms towards sustainability measures [42,43].

In particular, in emerging economies, the GI schemes, especially financial incentives, can play an important role in promoting the practices of sustainability among firms [41,44], as through sufficient financing, firms can easily adopt the practices of sustainability and fulfil the corporate social responsibilities in an efficient way [45]. Likewise, the state-based technical and policies support can help in a significant way to achieve the objectives of the SDGs among firms [40,46]. However, prior studies paid attention to the TBL aspects of sustainability but were less focused on evaluating the relationship of government financial and non-financial incentives with the DS among firms. Therefore, we can hypothesis in this study that:

**H3.** *There is a positive correlation between GI and the DS among firms.*

#### 2.5. Relationship between CEI, GI and DS

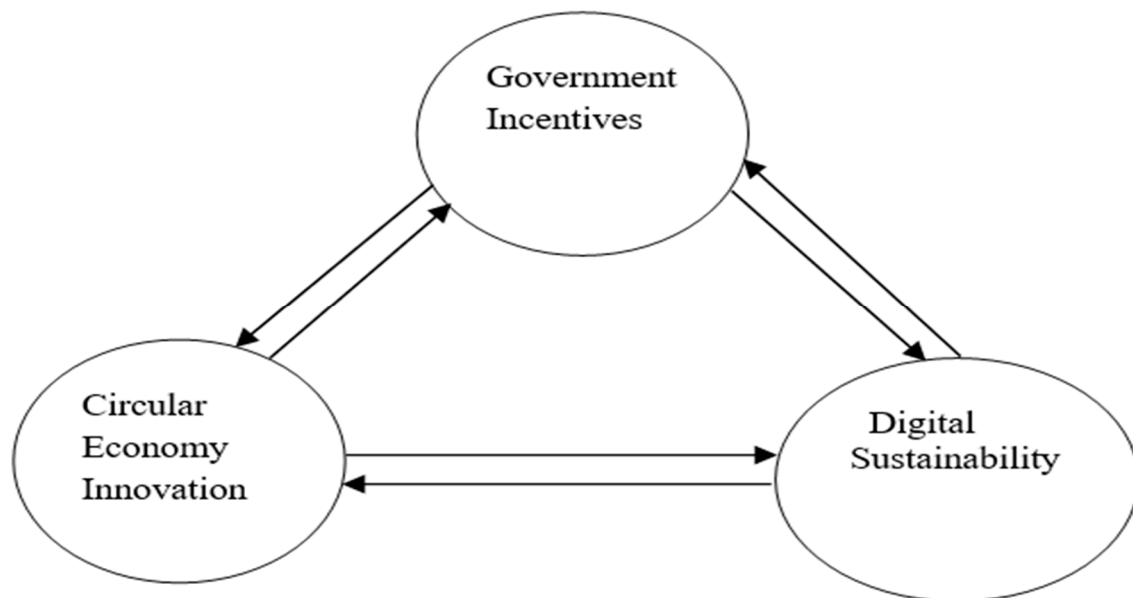
From the point of views of UN sustainability measures, firms have initiated the TBL approaches and DS programs to enhance their survival in a competitive environment. Many countries around the world have established numerous schemes to facilitate the transition of a traditional organizational setup to more advanced and sustainable measures. In particular the financial schemes have facilitated firms among developing countries, due to their scarce resources and limited budget, as the lack of guidance and financial resources can divert their focus from the sustainability measures towards unwanted practices. In such a scenario, GI can significantly contribute to the TBL efficiencies among firms [47]. Broadly, the members of UE have started the initiatives of sustainability in the context of TBL and are focusing on converting the old business practices to new, sustainable, and CEI practices [48,49]. However, due to the issues in an atmosphere of environmental deprivation and the pressure, many firms have revised their management practices and pattern of business activities, and launched the initiatives of CEI and DS to increase the chances of SDG achievement [11].

Generally, the GI facilitates the launching of the sustainability measures among firms and supporting the transition process towards CEI and DS practices. In particular, the government subsidies can help in regulating the environmental issues, encourage eco-innovation, green programs, CEI, DS, and achieve the TBL efficiencies among firms [50–52]. Due to its importance, the members of EU have launched the initiatives of CE to ensure the efficiencies of TBL and DS among firms. The practices of CE are especially perceived as the key initiatives for achieving the SDGs among firms [49]. For this purpose, the GI can widely contribute to gaining TBL efficiencies, SDGs, CEI, DS, and changing the old production system to advanced and sustainable business activities [53]. Overall, the environment-based policies can widely contribute to the CEI and BMI to gain SDGs among firms [54,55]. Hence,

the GI are helpful in controlling the environmental degradation, transition process, CEI, and DS, for successfully achieving the SDGs among firms [56]. Thus, we can propose that

**H4.** *GI have a dual mediation between CEI and DS among firms.*

After the discussion of the relevant literature and the key theoretical considerations, the current study has drawn the following conceptual framework, based on CEI, DS, and GI, as presented in (Figure 1).



**Figure 1.** Conceptual Framework.

### 3. Methodology

#### 3.1. Procedure of Sampling and Data Collection

This research has followed the procedure of an online survey, using a questionnaire-based approach to collect data from the CEO, senior managers, and operation managers among financial institutions (banks, insurance, and financial companies) in Pakistan, Malaysia, and China. The data was collected to evaluate the dual association between CEI, DS, and GI in the financial sectors. We applied the procedure of G-Power to draw up the sample size of the study, which is widely preferable in PLS-SEM [57]. The outcome has displayed that 119 is the lowest number of datasets necessary to prove association among constructs. To maintain the authenticity of sample size, 306 questionnaires were distributed in each unit, using a random-sampling technique. Meanwhile, only 204 questionnaires were found to be accurate for the analysis in all cases. It was also made clear to the participants that the information was collected for the research survey only.

#### 3.2. Instruments

We adopted and adapted the scale of the current study from the previous literature, as displayed in (Table 1). The scale includes the demographic factors and other required information about the constructs to present the true image of the study and increase the readability. A well-structured instrument was executed, as usually the firms do not maintain the records of CEI, DS, and GI in a systematic way. The items were closed-ended, but an option was provided to select the perfect choice as per their opinions. The range of the scale was from strongly disagree to strongly agree, using the criteria of a five-point Likert scale. A team of professional researchers assessed the perfection of the scale, and approved its authenticity. However, we eliminated some items as per their advice, due to weakness. After that, the scale was verified using a pilot study.



**Table 1.** Instruments of the Study.

Variables		Items	Authors
Circular Economy Innovation		8	Rodríguez-Espíndola et al. (2022), Rehman et al. (2022) [58,59]
Digital Sustainability		16	Kallinikos (2013), Seele (2016), Bradley (2007), Stuermer et al. (2017), George (2020), Wut et al. (2021) [11,60–64]
Government Incentives	Financial Incentives	6	Anwar et al. (2020) [42]
	Non-Financial Incentives	6	Anwar et al. (2020) [42]

### 3.3. Technique

We examined the collected data with the help of PLS-SEM to confirm the hypothesis. Usually, PLS-SEM is preferable for evaluating all steps in a systematic procedure, displaying results in one tick, and is highly recommended in projection surveys [65–67]. Due to these reasons, we decided to apply the technique of PLS-SEM to ensure the validation of the results in the proposed conceptual model.

## 4. Results

This study examined the data with the support of PLS-SEM to present a true image of the results. Usually, the procedure of PLS-SEM includes the assessment of measurement and structural models, to authenticate the theoretical framework and confirm the proposed hypothesis [68,69]. In the assessment of the measurement model, we focused on the factors loadings, composite reliability, and average variance extracted (AVE), to examine the convergent validity. As per the authentication procedure, the values of the factor loading should be 0.7 or superior, for composite reliability 0.7 or superior, and for AVE, 0.5 or superior, to confirm the accuracy of model (see Table 2). However, we observed that all the values are greater than the recommended values, and ensure the accuracy of model (Appendix A).

In addition, we executed the procedure of Fornell and Larcker [70] to judge the perfection in discriminant validity. However, the results (Table 3) display the fact that all the diagonal items are greater in the relevant rows and columns. Further, we authenticated the results of discriminant validity with the support of HTMT, as shown in (Table 3). Moreover, we applied the technique of variance inflation factor (VIF) to manage the issues of multicollinearity.

In the next stage of PLS-SEM, to evaluate the structural model, the step of bootstrapping was operated to confirm the hypothesis. The outcomes clarified the fact that CEI has a two-way relationship with the DS among firms in the defined context (Table 4). In addition, the findings revealed that the GI have a positive correlation with the DS and CEI among firms. Furthermore, the outcomes exposed the fact that the scores of the Q-squares are greater than zero, so we can conclude that the predictive relevance occurs in the current study (Table 5). The results of the R-square show considerable variance in the relevant constructs in the respective models (Table 5). The results show that DS created greater variance in the GI as compared to CEI. Moreover, the results clarified the fact that GI have a two-way mediation between CEI and the DS among firms in the defined context (Table 6). Interestingly, it was observed that the CEI imposed stronger effects on the DS among firms in Pakistan, as compared to other reverse effects. However, the outcomes revealed that the DS pose wider consequences for the CEI, as compared to the reverse effects in Malaysia and China. The results also shown a good model fit in both cases (Table 7). Moreover, the SRMR, d\_ULS, d\_G, chi-Square, and NFI of the saturated model and estimated model are compared in (Figures 2–4), for better clarification.

**Table 2.** Factor Loading, Composite Reliability, and AVE.

Construct	Items	Pakistan						Malaysia						China					
		FA.L	CO.R	AVE	FA.L	CO.R	AVE	FA.L	CO.R	AVE	FA.L	CO.R	AVE	FA.L	CO.R	AVE	FA.L	CO.R	AVE
		Model-A			Model-B			Model-A			Model-B			Model-A			Model-B		
Circular Economy Innovation	CEI-1	0.708			0.795			0.875			0.875			0.796			0.798		
	CEI-2	0.761			0.721			0.706			0.707			0.836			0.836		
	CEI-3	0.689			0.756			0.716			0.716			0.838			0.838		
	CEI-4	0.791	0.918	0.586	0.696	0.922	0.598	0.699	0.927	0.615	0.699	0.927	0.615	0.727	0.937	0.651	0.725	0.937	0.651
	CEI-5	0.888			0.78			0.876			0.875			0.737			0.737		
	CEI-6	0.78			0.884			0.758			0.758			0.814			0.815		
	CEI-7	0.746			0.789			0.875			0.875			0.846			0.845		
	CEI-8	0.744			0.753			0.742			0.741			0.848			0.849		
Government Incentives	GI-1	0.807			0.807			0.543			0.543			0.543			0.543		
	GI-2	0.774			0.776			0.712			0.712			0.699			0.699		
	GI-3	0.853			0.853			0.696			0.696			0.655			0.655		
	GI-4	0.803	0.959	0.597	0.802	0.957	0.586	0.813	0.889	0.538	0.813	0.889	0.538	0.700	0.85	0.548	0.700	0.850	0.548
	GI-5	0.829			0.827			0.835			0.836			0.677			0.677		
	GI-6	0.835			0.835			0.745			0.745			0.714			0.714		
	GI-7	0.789			0.789			0.751			0.751			0.683			0.684		
Digital Sustainability	DS-1	0.781			0.696			0.705			0.705			0.875			0.875		
	DS-2	0.751			0.784			0.835			0.835			0.773			0.773		
	DS-3	0.786			0.700			0.671			0.671			0.710			0.710		
	DS-4	0.899			0.775			0.714			0.714			0.802			0.802		
	DS-5	0.737			0.888			0.690			0.690			0.699			0.699		
	DS-6	0.790			0.723			0.734			0.734			0.728			0.728		
	DS-7	0.803			0.760			0.766			0.766			0.671			0.671		
	DS-8	0.826	0.932	0.661	0.713	0.932	0.661	0.861	0.955	0.571	0.862	0.955	0.571	0.748	0.958	0.592	0.748	0.958	0.591
	DS-9	0.697			0.749			0.703			0.703			0.781			0.781		
	DS-10	0.772			0.611			0.754			0.754			0.725			0.725		
	DS-11	0.885			0.763			0.781			0.781			0.886			0.886		
	DS-12	0.718			0.786			0.873			0.873			0.778			0.779		
	DS-13	0.794			0.906			0.714			0.714			0.793			0.793		
	DS-14	0.707			0.743			0.767			0.767			0.833			0.833		
	DS-15	0.743			0.794			0.845			0.845			0.692			0.692		
	DS-16	0.624			0.811			0.620			0.620			0.774			0.774		

**Table 3.** Results of the Discriminant Validity and HTMT.

Discriminant Validity				HTMT			
Pakistan							
Model-I							
	CEI	DS	GI		CEI	DS	GI
CEI	0.765			CEI			
DS	0.535	0.772		DS	0.513		
GI	0.435	0.453	0.813	GI	0.423	0.411	
Model-II							
	CEI	DG	GI		CEI	DS	GI
CEI	0.773			CEI			
DG	0.518	0.766		DS	0.505		
GI	0.434	0.446	0.813	GI	0.401	0.406	
Malaysia							
Model-I							
	CEI	DS	GI		CEI	DS	GI
CEI	0.843			CEI			
DS	0.562	0.832		DS	0.511		
GI	0.462	0.461	0.927	GI	0.467	0.339	
Model-II							
	CEI	DS	GI		CEI	DS	GI
CEI	0.842			CEI			
DS	0.563	0.831		DS	0.541		
GI	0.461	0.462	0.926	GI	0.367	0.339	
China							
Model-I							
	CEI	DS	GI		CEI	DS	GI
CEI	0.873			CEI			
DS	0.553	0.837		DS	0.462		
GI	0.482	0.572	0.921	GI	0.340	0.441	
Model-II							
	CEI	DS	GI		CEI	DS	GI
CEI	0.872			CEI			
DS	0.551	0.834		DS	0.462		
GI	0.482	0.571	0.920	GI	0.454	0.441	

Nevertheless, based on outcomes, it can be said that CEI has a greater role in enhancing the practices of DS among firms in Pakistan, as they may widely focus on the activities of CEI to offer superior benefits to their customers. It is also possible that the firms in Pakistan are widely focused on producing the corporate documents, images, videos, and web pages, etc., in digital forms, and actively keeping them updated for their stakeholders. It can also be said that the necessary technology is available to firms in Pakistan to develop, store, and share the digital contents. It can be said that the Pakistani firms ensure the maintenance of content-development technologies and financial resources to achieve the objectives of DS. It is also possible that the digital contents are rich in the descriptive information and highly understandable for users. It is possible that the Pakistani firms arrange workshops and training programs to keep their staff members engaged with the digital content, to promote the activities of DS practices.

Based on the results, it can be said that the firms in Pakistan obtain sufficient funds for sustainability practices from the funding agencies, and other financial subsidies are available to them. It can be said that the firms can access interest-free or low-level-interest loans and other facilities, to implement the strategies of DS. It is also possible that the government supports the development of science parks, SDGs incubators, and computerized labs in rural areas to promote the trend for digital sustainability among firms. It can also be said that the government departments provide special assistance to initiate the practices of



DS among firms in Pakistan. Furthermore, it can be said that the Pakistani government encourages firms to implement the practices of digital sustainability to fulfil the corporate social responsibilities among communities. However, the results have clarified the fact that the practices of DS play a greater role in improving the initiatives of CEI among firms in Malaysia and China. It is possible that the firms in Malaysia and China have widely adopted the practices of DS to improve the TBL efficiencies.

**Table 4.** Results of Direct Affects (Confirmation of Hypothesis).

Country	Hypothesis	Relationship	Estimate	SM	SD	T-Value	Decision	F-Square	VIF
Pakistan	H1	CEI → DS	0.418	0.423	0.053	7.841	Supported	0.216	1.233
		CEI ← DS	0.405	0.407	0.055	7.418		0.193	1.248
	H2	CEI → GI	0.435	0.439	0.049	8.885	Supported	0.233	1.000
		CEI ← GI	0.254	0.254	0.06	4.257		0.076	1.043
	H3	GI → DS	0.271	0.269	0.057	4.793	Supported	0.091	1.233
		GI ← DS	0.446	0.445	0.049	9.14		0.248	1.248
Malaysia	H1	CEI → DS	0.406	0.405	0.049	8.271	Supported	0.231	1.360
		CEI ← DS	0.463	0.462	0.05	9.219		0.231	1.548
	H2	CEI → GI	0.514	0.520	0.044	11.73	Supported	0.360	1.003
		CEI ← GI	0.239	0.242	0.056	4.274		0.548	1.548
	H3	GI → DS	0.386	0.389	0.050	7.749	Supported	0.209	1.360
		GI ← DS	0.595	0.601	0.035	17.166		0.548	1.021
China	H1	CEI → DS	0.460	0.458	0.046	10.076	Supported	0.327	1.282
		CEI ← DS	0.535	0.534	0.05	10.67		0.327	1.491
	H2	CEI → GI	0.469	0.476	0.048	9.827	Supported	0.282	1.000
		CEI ← GI	0.161	0.165	0.058	2.761		0.03	1.491
	H3	GI → DS	0.358	0.362	0.045	7.911	Supported	0.198	1.282
		GI ← DS	0.574	0.58	0.035	16.494		0.491	1.000

**Table 5.** R-Square and Q-Square.

Model-I			Model-II		
Variable	R-Square	Q-Square	Variable	R-Square	Q-Square
<b>Pakistan</b>					
Digital Sustainability	0.346	0.195	Circular Economy Innovation	0.319	0.186
Government Incentives	0.189	0.121	Government Incentives	0.199	0.127
<b>Malaysia</b>					
Digital Sustainability	0.475	0.162	Circular Economy Innovation	0.403	0.132
Government Incentives	0.265	0.139	Government Incentives	0.354	0.193
<b>China</b>					
Digital Sustainability	0.494	0.173	Circular Economy Innovation	0.412	0.167
Government Incentives	0.220	0.812	Government Incentives	0.329	0.561

**Table 6.** Results of Indirect Affects (Confirmation of Hypothesis).

Country	Hypothesis	Relationship	Estimate	SM	SD	T-Value	CILL	CIUL	Decision
Pakistan	H4	CEI → GI → DS	0.118	0.118	0.028	4.182	0.068	0.171	Supported
		CEI ← GI ← DS	0.113	0.113	0.031	3.679	0.061	0.165	
Malaysia	H4	CEI → GI → DS	0.199	0.202	0.03	6.723	0.14	0.254	Supported
		CEI ← GI ← DS	0.142	0.146	0.035	4.017	0.066	0.210	
China	H4	CEI → GI → DS	0.168	0.172	0.026	6.391	0.118	0.218	Supported
		CEI ← GI ← DS	0.092	0.096	0.035	2.635	0.023	0.159	

**Table 7.** Comparison of Model Fit.

Model-I			Model-II		
Saturated Model		Estimated Model	Saturated Model		Estimated Model
Pakistan					
SRMR	0.058	0.058	SRMR	0.055	0.055
d_ULS	1.68	1.68	d_ULS	1.486	1.486
d_G	0.841	0.841	d_G	0.562	0.562
Chi-Square	1274.349	1274.349	Chi-Square	918.948	918.948
NFI	0.822	0.822	NFI	0.864	0.864
Malaysia					
SRMR	0.068	0.068	SRMR	0.068	0.068
d_ULS	2.311	2.311	d_ULS	2.311	2.311
d_G	1.578	1.578	d_G	1.579	1.579
Chi-square	2112.33	2112.33	Chi-square	2112.505	2112.505
NFI	0.72	0.72	NFI	0.72	0.72
China					
SRMR	0.075	0.075	SRMR	0.075	0.075
d_ULS	2.757	2.757	d_ULS	2.757	2.757
d_G	1.959	1.959	d_G	1.958	1.958
Chi-square	2634.627	2634.627	Chi-square	2634.729	2634.729
NFI	0.673	0.673	NFI	0.673	0.673

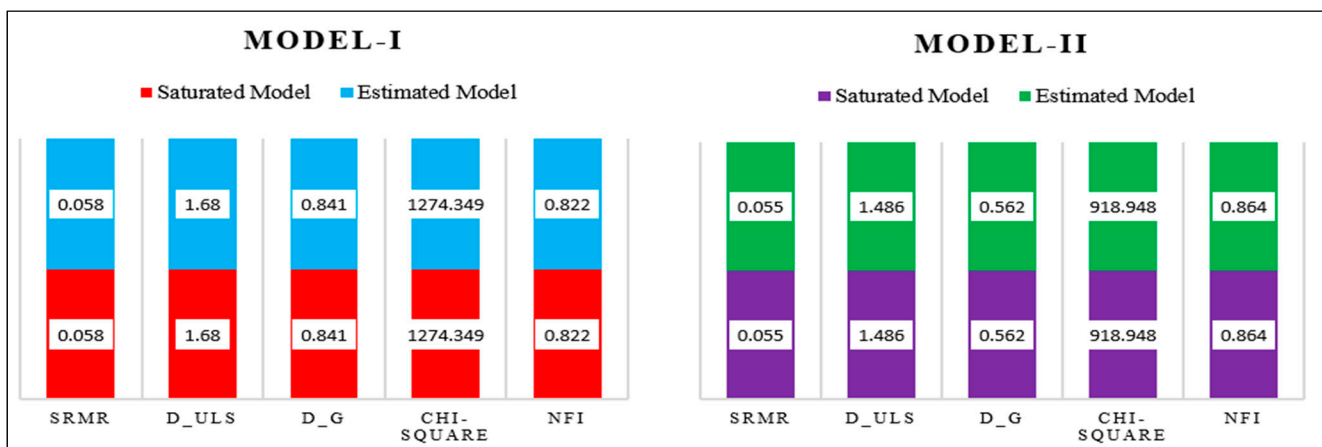


Figure 2. Comparison of Model Fit in Pakistan.

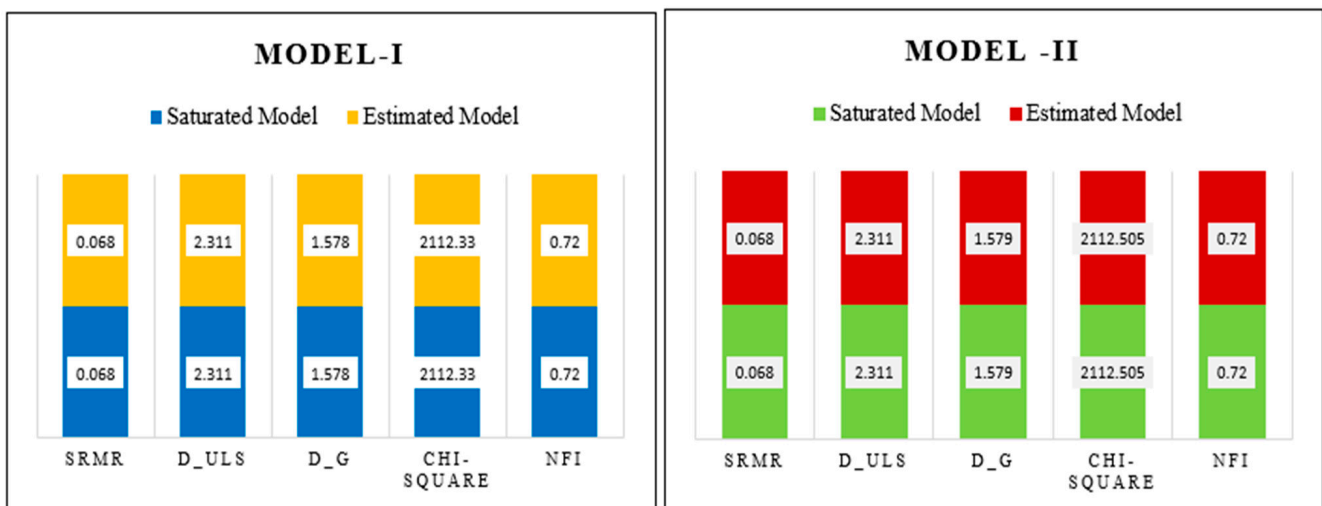


Figure 3. Comparison of Model Fit in Malaysia.

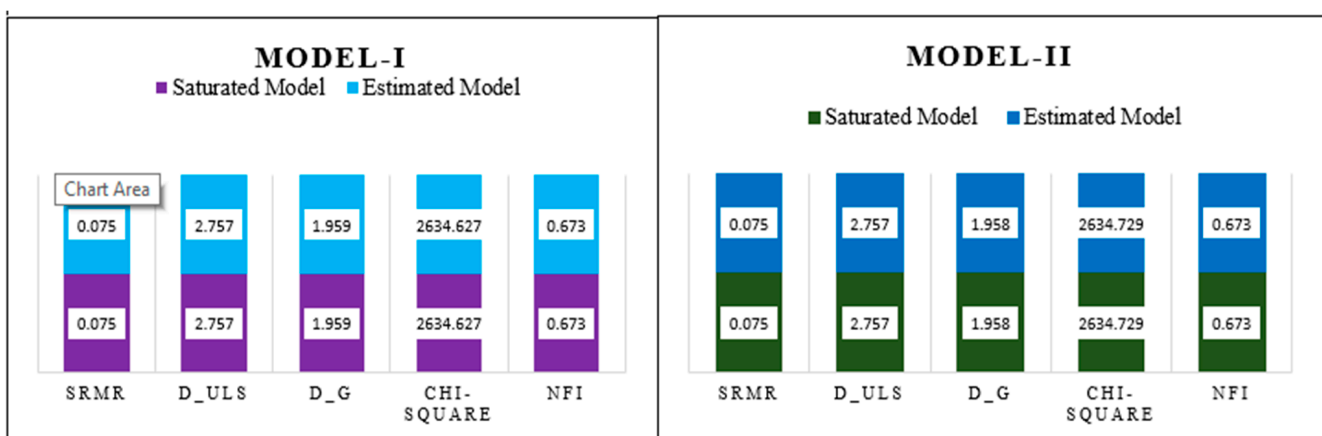


Figure 4. Comparison of Model Fit in China.

## 5. Discussion

The current study intends to evaluate the reverse relationship between CEI with the DS among firms, along with the dual mediation of GI. The outcomes clarified the fact that the CEI has two-way positive, significant relationship with the DS among firms. In addition, GI has positive correlation with the DS and CEI among firms. The results

have also shown that GI behaved as a dual mediator between CEI and DS among firms. Consequently, the strategies of CEI in relation to GI have the advantage of fostering the practices of DS among firms. In the same way, the practices of DS in the context of GI have the advantage of implementing the practices of CEI among firms. The application of CEI has the advantage of initiating more sustainable activities in the context of DS, which can lead to bringing perfection to the business activities and improving the services system among communities. Specifically, the initiatives of CEI transform the firms from a conventional means of business practices to a more advanced digital system, which can lead to more environmentally friendly business activities.

The managerial impetus was the evaluation of the reverse relationship between CEI, DS, and GI and the confirmation of the hypothesis. However, the findings of the current study are parallel to the study [53], which examined the nexus between green innovation, SDGs, and GI. It also parallels the outcomes of a study [71] that evaluated the connections between SDGs, financial performance, and green innovation. It is also analogous with the prior studies [72,73], in the context of sustainability drivers for firms. The study also in line with a previous study [74] in the context of green initiatives, sustainable development, and resource-based-view theory. However, the outcomes of the present study are unique, compared to previous findings, due to the exploration of the reverse relationship between CEI, DS, and GI among firms in the emerging market. The outcomes are also distinctive due to the dual mediation of GI. The results are also exceptional when compared to parallel studies, due to the comparison of a two-way relationship between CEI and DS among firms.

### *5.1. Implications of the Study*

#### *5.1.1. Practical Implications*

The outcomes of the present study imply that firms can concentrate on the practices of CEI, DS, and the combination of the defined factors could be a wise plan to attain digital efficiencies among firms. In the same way, the activities of DS relating to GI have the advantage of implementing the practices of CEI and sustainability among firms. The tactics of CEI and the focusing on the government incentives to achieve the degree of digitization can improve the firm's interest in launching more sustainable business activities for greater market shares. The initiatives of CEI can enhance the competencies among workers and motivate them towards higher performance. The strategies of CEI with the support of GI among firms can lead towards an innovative and sustainable production system that can result in the achievement of a higher degree of competition. The higher degree of competition can develop self-confidence among employees and take firms toward a leadership position in the target market. Due to the position in the market, communities perceive the firm as a prime and reliable brand in society, which ultimately leads to an increase in the market shares. The leadership position can help to increase profitability and build innovation capabilities among employees. The competitive strategies of CEI can help in building trust among communities and enhance the degree of digital efficiencies among firms. The stakeholders' trust can enable the firms to establish a lead over new companies, enhance loyalty in innovation, and result in superior business performance and sustainable-development practices.

Additionally, the current report adds to the previous works by comparing the role of CEI and GI in acquiring improvement in the digital efficiencies among firms in emerging markets, especially in Pakistan, Malaysia, and China. Consequently, practitioners can adopt more perfect and sustainable business practices to achieve a higher degree of competition and their long-term objectives. The outcomes can also guide policy makers to build a sustainable eco-system as per the UN sustainability agenda, to provide better services among societies. The programs of CEI connected to GI can help policy makers to approve more reliable business strategies that can ensure market attraction and improve their digital efficiencies. In addition, the study observed that the firms extensively concentrate on the CEI to implement the practices of SDGs. Hence, policy makers should divert their

consideration to the strategies of CEI to improve the digital efficiencies in the views of TBL as well as SDGs as per the UN sustainability agenda across the world.

### 5.1.2. Theoretical Implications

The current research integrated the contents of CEI, GI, and DS centred on the outcomes from Pakistan, Malaysia, and China, and accepted the planned investigation model. This study adds to the prior literature by evaluating the reverse relationship between CEI and DS among firms, established on the resource-based-view theory. It also contributes to research by examining the mediation of GI between both CEI and DS among firms. The outcomes of the study have supported the natural resource-based-view theory by confirming the proposed theoretical framework with the support of collected data. The authentication of the model also guides the practitioners to adopt the strategies of CEI, DS, and GI and the integration of these factors can enhance digital efficiencies among firms. The outcome of the study also adds to the natural resource-based-view theory in the context of internal efficiencies and the market obligations related to GI obtaining SDGs among societies.

## 6. Conclusions and Future Directions

The under-investigation study attempts to evaluate the reverse association between CEI and the DS, along with the dual mediation of GI. The outcomes have been encouraged by the support of a pragmatic proof that the initiatives of CEI in the relations of GI show a greater responsibility in reaching digital efficiencies among firms. The outcomes also add to the prior literature by confirming the proposed hypothesis. Ultimately, the findings also add significant information to the relevant literature, and guide the policy makers to adopt more interesting strategies for DS. They will also direct the experts to outline more sustainable schemes to accomplish the SDGs among communities. However, while looking at the results, practitioners should understand the boundaries of the data and plan their policies accordingly. The study is also based only on the resource-based-view theory, and the addition of the stakeholder and contingency theories can bring a different shape to the results. However, to improve understanding of the relevant literature and bring efficiencies to business practices, the future study can examine the mediating role of energy policies, personality traits, BMI, and the application of contingency theories. Furthermore, this study was limited to Pakistan, China, and Malaysia only, while conducting a study in the European context could provide a different picture of the results.

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## Appendix A

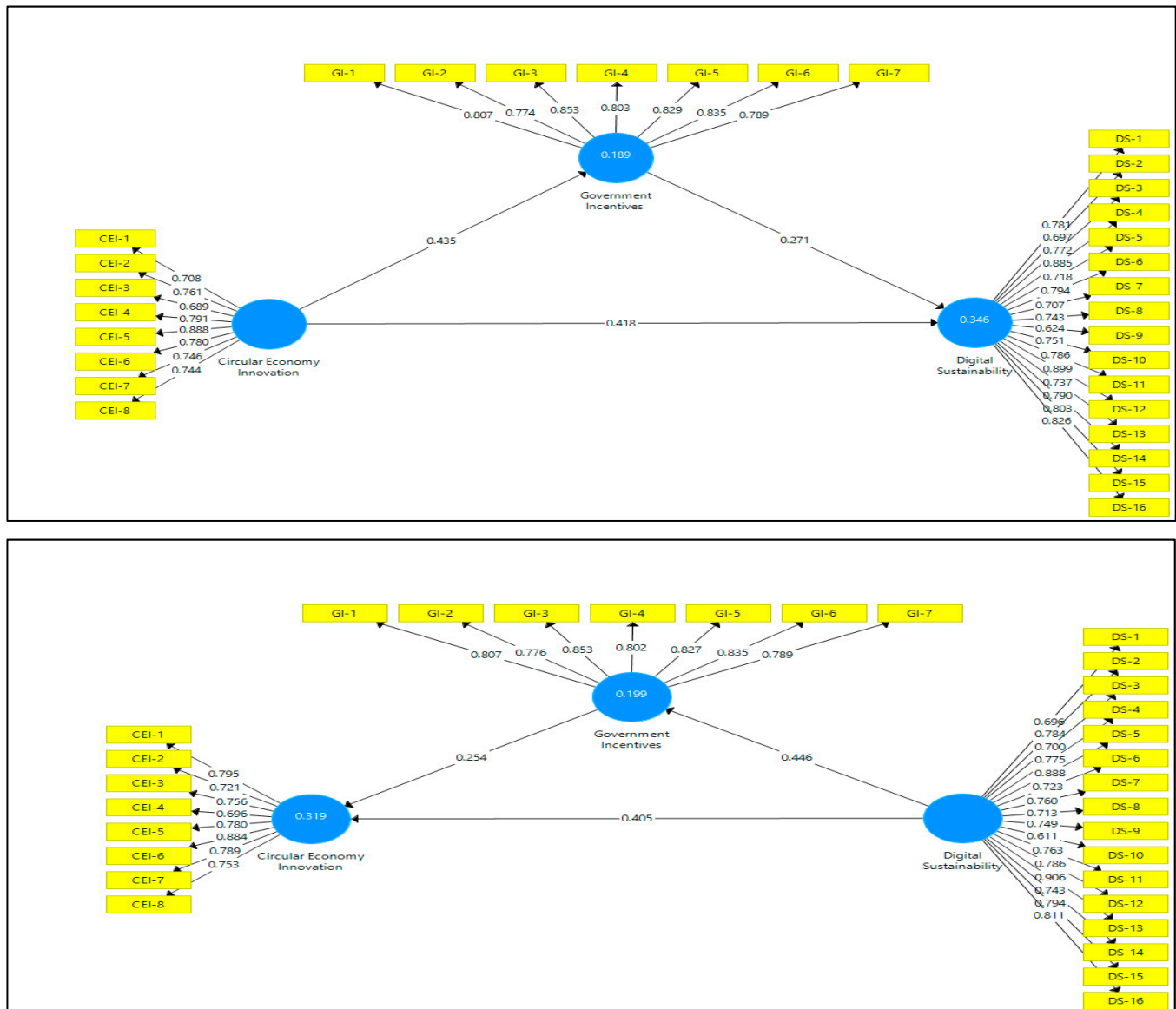


Figure A1. Pakistan-Based Measurement Model.

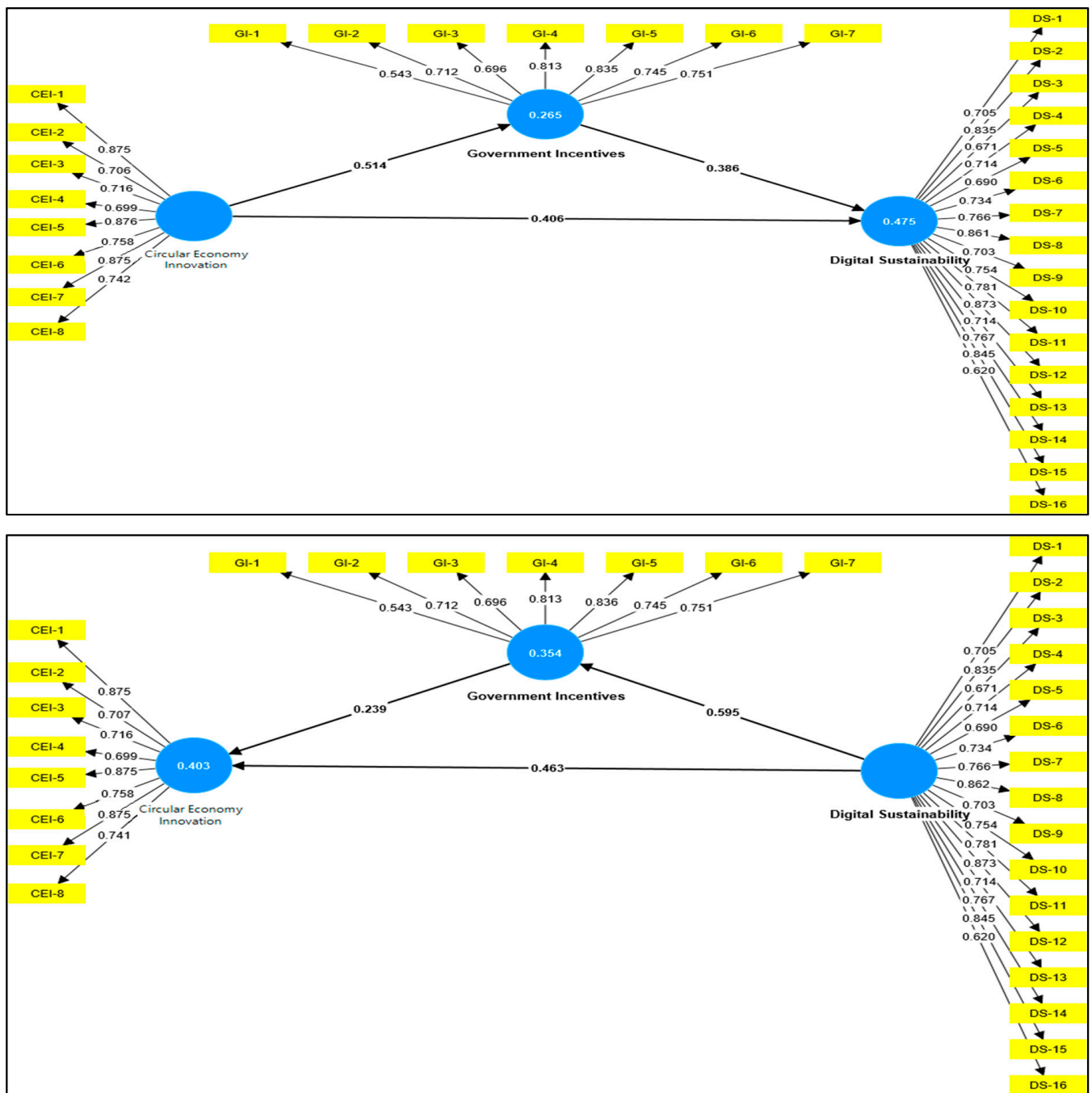


Figure A2. Malaysia-Based Measurement Model.



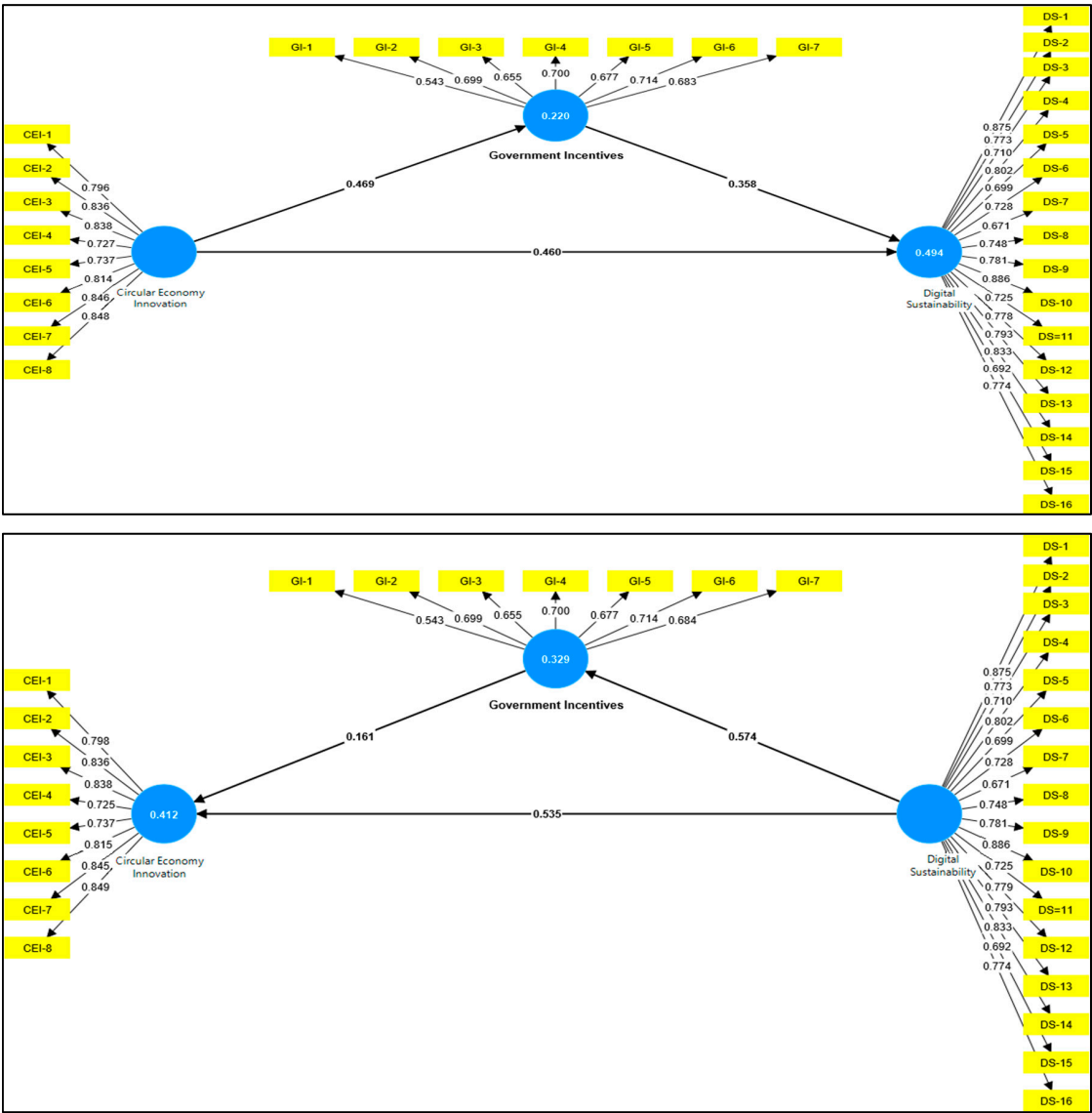


Figure A3. China-Based Measurement Model.

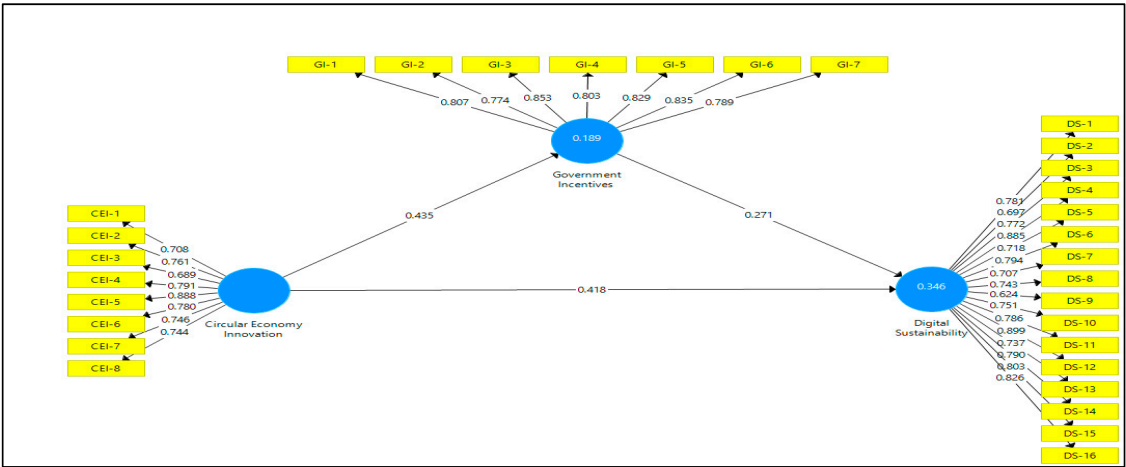


Figure A4. Cont.

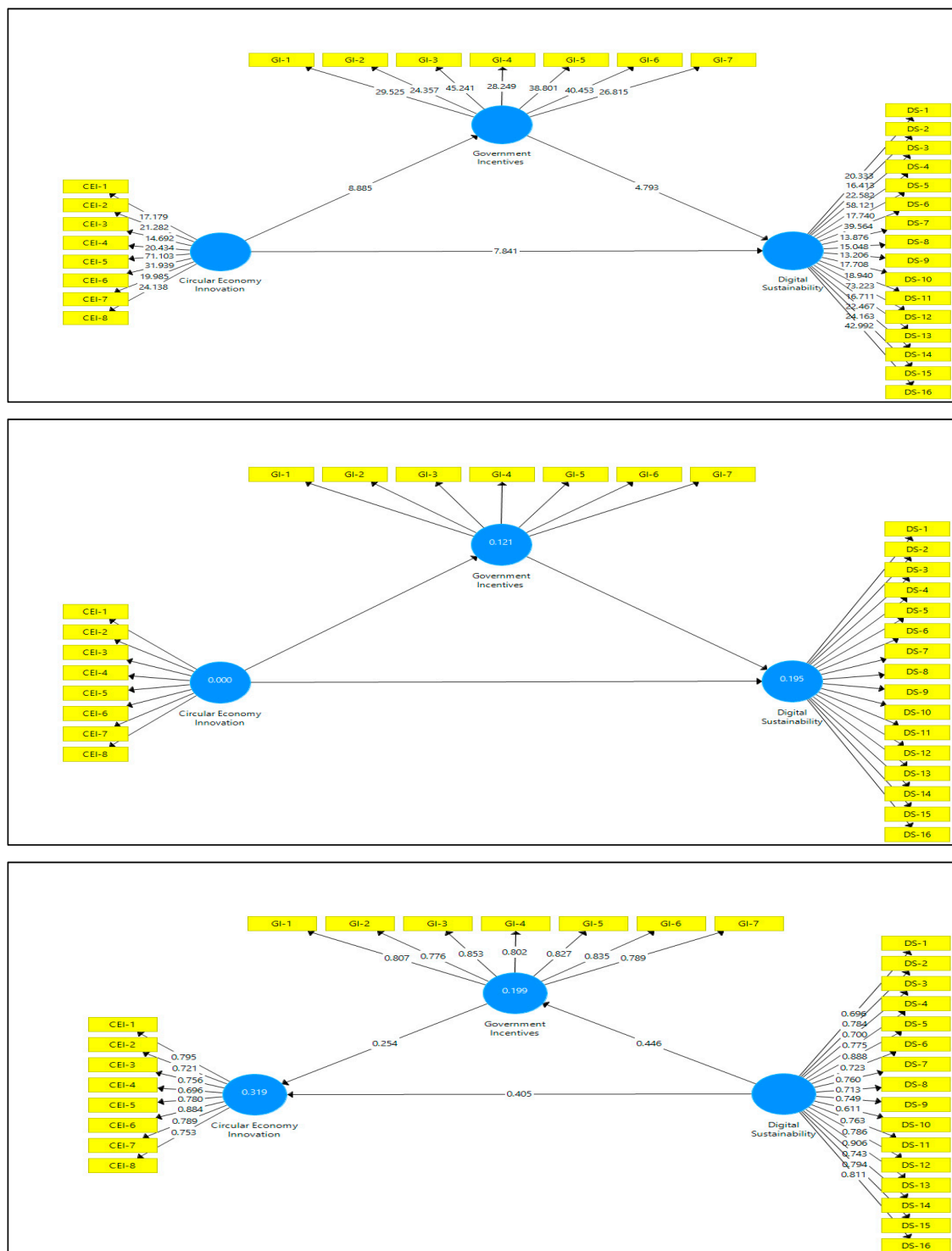


Figure A4. Cont.

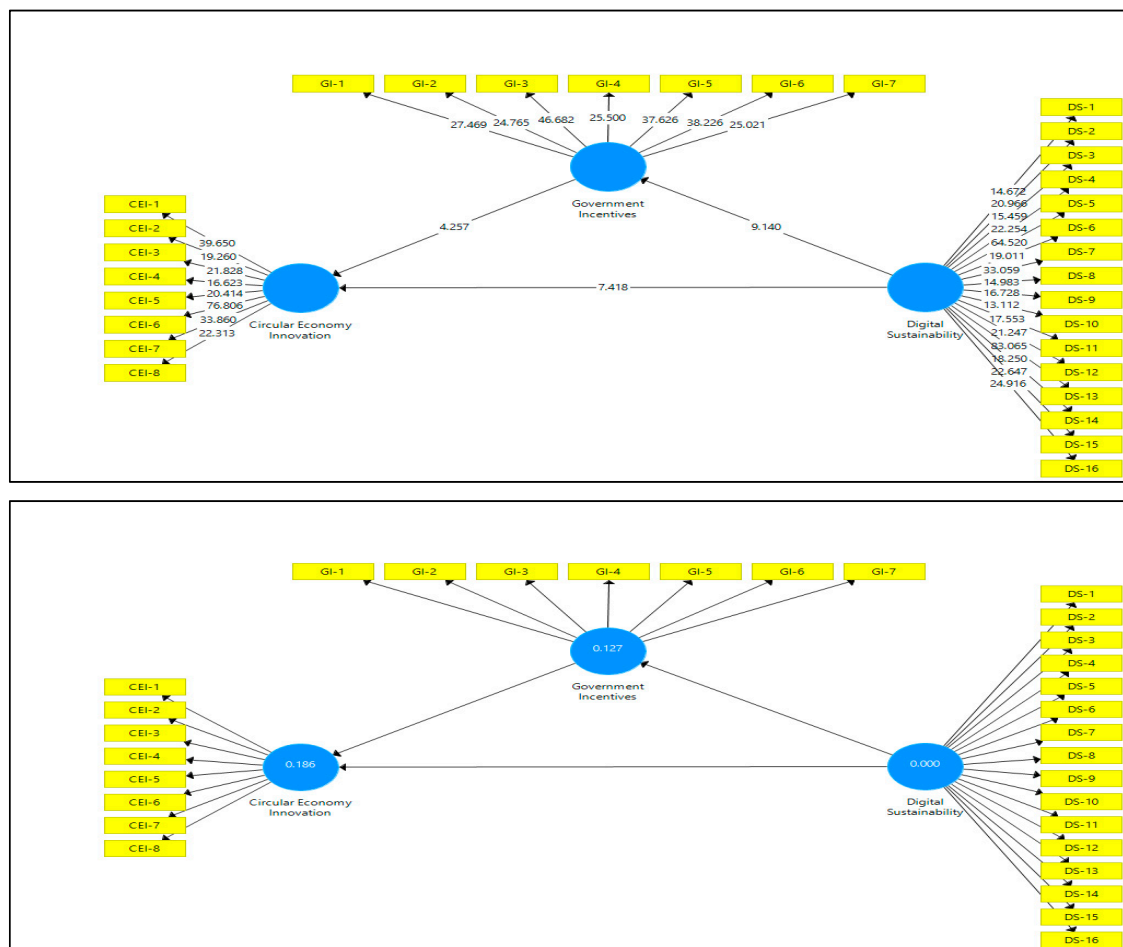


Figure A4. Pakistan-based models.

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