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Analyzing the Interactive Effects of Financial Development and Corruption Control on Sustainable Development: A GMM Approach for Asian Middle-Income Countries

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ABSTRACT. This study focuses on analyzing the impact of financial development on sustainable development in middle-income countries in Asia during the period 2002–2021. Furthermore, this study also clarifies the moderating role of corruption control in this impact, which is what differentiates this study from previous studies. Using the Generalized Method of Moments (GMM), the estimation results show that financial development has a positive impact on sustainable development. This study also shows that controlling corruption plays an important role in amplifying the positive impact of financial development on sustainable development. This is a new finding compared to other studies that have looked at this topic. The study results also emphasize that middle-income countries in Asia should build an appropriate financial system to achieve sustainable development goals. They should also do more to fight corruption.

1. INTRODUCTION

Sustainable development is long-term economic, social, and environmental stability [1]. This can only be achieved if countries are aware of the role of financial resources in sustainable development. Reality shows that the goal of sustainable development is not easy, requiring countries to have strong financial resources to meet this process [2]. In particular, capital mobilized from the financial system can significantly contribute to promoting sustainable development [3]. Indeed, financial development can increase the efficiency of mobilizing and using capital in the economy, thereby promoting sustainable development. Financial development not only provides financial resources for the production and business process but also promotes the use of new energy sources, aiming to improve environmental quality. Moreover, financial development is also an important basis for human development [4].

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Therefore, governments in many countries have identified financial development as one of the important policies to promote sustainable development [5]. However, most empirical studies on this issue often stop at examining the impact of financial development on economic growth [6], [7], [8], or the impact of financial development on environmental quality [9], [10], [11], [12], [13], or the impact of financial development on human development [4]. In fact, there are very few studies that consider the impact of financial development on sustainable development, such as studies by Dutta and Saha [14], Zioło et al. [15], and Sakalsiz and Kiliç [16].

On the other hand, corruption control can play an important role in promoting the impact of financial development on sustainable development. Because the level of corruption control can affect profits and risks when investors participate in the financial market [17], it can significantly influence the mobilization of financial resources for sustainable development. Besides, effective corruption control can be a favorable condition to promote the development of the financial sector [18], thereby amplifying the impact of financial development on sustainable development. However, there is still a lack of empirical evidence that sheds light on the role of corruption control in the impact of financial development on sustainable development. This is a big gap that needs to be explored.

To fill the above gap, this study was conducted to analyze the impact of financial development on sustainable development while clarifying the role of corruption control in this impact. The data sample used in this study is 28 middle-income countries in Asia during the period 2002-2021. The author expects that the analytical results of this study will create convincing empirical evidence on the impact of financial development on sustainable development, while affirming the important role of corruption control in this impact, which is something that previous studies have not yet clarified. Furthermore, this study also provides policy implications to promote financial development associated with improving the level of corruption control, aiming at sustainable development in middle-income countries in Asia.

2. LITERATURE REVIEW

In this section, the author focuses on presenting literature related to the impact of financial development on sustainable development. Furthermore, the author also presents an overview of the literature on the role of corruption control in the impact of financial development on sustainable development.

2.1. The impact of financial development on sustainable development

The process towards sustainable development in countries around the globe shows the important role of using capital sources mobilized from the financial system. This role can be explained through a number of theories, such as endogenous growth theory [19] and Keynesian growth theory [20]. In fact, financial development is also considered one of the important

economic drivers in emerging economies [21]. Furthermore, financial development also contributes significantly to reducing greenhouse gas emissions and improving adaptation to climate change [22]. However, to the author's knowledge, there are very few empirical studies examining the impact of financial development on sustainable development. Among them, the study by Dutta and Saha [14] shows that financial development is essential for promoting sustainable development in 143 countries. Indeed, financial development has an important role in promoting investments to improve environmental quality and economic growth, thereby leading to sustainable development. In another study, Zioło et al. [15] prove that financial development is an important driver of sustainable development in particular European Union countries. Recently, Sakalsiz and Kiliç [16] found a negative impact of financial development on sustainable development. Accordingly, financial development can promote investment, but it also leads to an increase in emissions and energy demand, thereby hindering the process of sustainable development.

Meanwhile, most empirical studies often only consider the impact of financial development on aspects of sustainable development, which are green growth, economic growth, environmental quality, or social development. Indeed, Ahmed et al. [5] found an important role of financial development in green growth in countries in the South Asian region. In another study, Ngo et al. [23] have proven that financial development has a positive impact on green growth in a data sample of 36 countries around the world. As for the impact of financial development on economic growth, this impact is clearly demonstrated through more effective capital allocation [24], [25], [26], [27], [28] and promotion of investment [6]. However, financial resources that are not used effectively can hinder economic growth [29]. Additionally, financial development can reduce environmental quality through increased energy consumption, leading to increased carbon emissions [12], [30], [31], [32]. Accordingly, financial development can promote overinvestment, increasing industrial zones and thereby destroying the green economy [33]. However, financial development that helps investors use eco-friendly technologies can lower energy use and carbon emissions, which improves the environment. From a social development perspective, Awdeh et al. [4] found that financial development had a positive impact on human development in 185 countries.

In general, the impact of financial development on sustainable development is a topic that has been found in several empirical studies, but there are still many conflicting views, and certain gaps exist. In particular, there are very few empirical studies that consider sustainable development through comprehensive indicators in economic, social, and environmental aspects.

2.2. The role of corruption control in the impact of financial development on sustainable development

Corruption can be understood as the abuse of public power for private gain [34]. Institutional theory has suggested the moderating role of corruption control in the impact of financial development on sustainable development. Accordingly, well-controlled corruption can provide a stable investment environment and promote fair production and business activities [8]. Controlling corruption is also a motivation for individuals and companies to participate in the process of capital accumulation, increasing the efficiency of the financial sector, and promoting production and business activities, which are foundational for sustainable development. Empirically, controlling corruption can promote sustainable development through stimulating economic growth [35], [36], improving environmental quality [37], [38], especially human development [39]. However, there is a lack of empirical studies examining sustainable development through composite indicators, creating a significant research gap.

Besides, several empirical studies have attempted to examine the role of corruption control on the impact of financial development on sustainable development. Some empirical studies suggest that increased corruption can indirectly impact sustainable development. This impact is clearly shown through reduced income and reduced efficiency in using financial resources [38]. With a more specific opinion, Mauro [17] believes that corruption can affect profits and risks when investors participate in the financial market, thereby significantly affecting the mobilization of financial resources for sustainable development. Indeed, increased corruption can cause investors to face many risks [40], especially increasing the costs and decreasing the efficiency of their investments [41]. Therefore, improved levels of corruption control will support the financial sector in providing capital to the economy. This is the driving force to amplify the positive impact of financial development on sustainable development. This process focuses on promoting sustainable development in aspects such as economic growth [8], [42], environmental quality [32], and human development [39].

3. DATA AND METHODOLOGY

3.1. Estimation method

Existing literature shows that sustainable development can be significantly affected by financial development, corruption control, and especially the interaction between these two factors. Therefore, the author proposes a research model as follows:

$$LnSDI_{it} = \alpha_2 + \beta_{21} FD_{it} + \beta_{22} CC_{it} + \beta_{23} FD_{it} \times CC_{it} + \delta_2 X_{it} + \varepsilon_{it}$$

LnSDI refers to sustainable development, which is measured using the logarithm of the Sustainable Development Index, as noted by Zioło et al. [15] and Sakalsiz and Kiliç [16]; this information is provided by the Sustainable Development Solutions Network (SDSN). FD is the financial development index [15], [16]; this data is published by the International Monetary Fund (IMF). CC is corruption control [37], [41]; this data is published in the World Governance Index

(WGI). FD×CC is the interaction variable between financial development (FD) and corruption control (CC); this variable is built based on the ideas of Tamazian and Rao [32], Kutan et al. [42], Cooray and Schneider [18], and Fengju and Wubishet [8]. The control variables (X) include foreign direct investment (FDI) and population growth (POP). The author determined these control variables based on the ideas of Tamazian and Rao [32] and Wen et al. [13].

For the estimation method, the author uses estimation methods on panel data, including pooled regression model (Pooled OLS), fixed effects model (FEM), and random effects model (REM). These are basic estimation methods on panel data. These estimation methods are only really suitable when the model does not violate the regression hypotheses; that is, it is not defective. This estimation method has numerous advantages in overcoming model defects, especially controlling possible endogeneity in the model [43].

3.2. Data

The data sample used in this study includes 28 middle-income countries in Asia during the period 2002–2021. In which, sustainable development index data is published by the SDSN. Financial development index data published by the IMF. Corruption control data is published by the World Bank's Worldwide Governance Indicator (WGI). Data for control variables in the model are published in the World Development Indicator (WDI).

4. EMPIRICAL RESULTS

The descriptive statistical results of the data sample are presented in Table 1 below:

Table 1. Results describe data

Variable	Mean	Std. Dev.	Min	Max
LnSDI	4.15	0.09	3.90	4.32
FD	0.28	0.16	0.05	0.74
CC	-0.64	0.58	-1.67	1.62
FDI	4.68	6.11	-37.17	55.07
POP	1.33	1.22	-2.88	11.79

Table 1 shows that LnSDI has a mean value of 4.15 (equivalent to 63.70); the lowest value is 3.90 (equivalent to 49.60), belonging to Nepal in 2002; the highest value is 4.32 (equivalent to 75.06), belonging to Georgia in 2021. The mean value of financial development (FD) is 0.28; the smallest value (0.05) belongs to Tajikistan in 2005, and the largest value (0.74) belongs to Thailand in 2020. For corruption control, the mean value is -0.64; the lowest value (-1.67) belongs to Myanmar in 2010, and the highest value (1.62) belongs to Bhutan in 2020.

Table 2. Correlation matrix

Variable	LnSDI	FD	CC	FD×CC	FDI	POP
LnSDI	1.00					
FD	0.26	1.00				
CC	0.32	0.42	1.00			
FD×CC	0.16	-0.07	0.73	1.00		
FDI	0.14	-0.13	-0.10	0.02	1.00	
POP	-0.14	0.01	-0.02	0.07	0.06	1.00

The results of the correlation analysis in Table 2 show that sustainable development (LnSDI) is positively correlated with financial development (FD), corruption control (CC), and the interaction variable FD×CC. For the control variables, sustainable development (LnSDI) is positively correlated with foreign direct investment (FDI) but negatively correlated with population growth (POP).

Table 3. Results on the model estimation by the basic estimators

LnSDI	Pooled OLS	FEM	REM
FD	0.0797*** (0.01)	0.3923*** (0.00)	0.3349*** (0.00)
CC	0.0505*** (0.000)	0.0805*** (0.00)	0.0772*** (0.00)
FD×CC	-0.0393 (0.41)	-0.1549*** (0.00)	-0.1482*** (0.00)
FDI	0.0029*** (0.00)	-0.0001 (0.68)	-0.0001 (0.84)
POP	-0.0104*** (0.00)	-0.0028 (0.16)	-0.0030 (0.13)
_cons	4.1554*** (0.00)	4.0764*** (0.00)	4.0911*** (0.00)
R^2	17.62%	30.13%	30.09%
Significance level	23.70*** (0.00)	45.46*** (0.00)	203.91*** (0.00)
F test	61.74*** (0.00)		
Hausman test	23.96*** (0.00)		
Note: ***significant at 1%.			

Table 3 presents the model estimation results using basic methods suitable for panel data, namely Pooled OLS, FEM, and REM. Accordingly, the F and Hausman tests indicate that the FEM estimation results are more appropriate than other basic estimation methods. Therefore, the author uses the results of FEM estimation to test the regression hypotheses in the next step.

Table 4. Results on hypothesis testing

Test	Result
Modified Wald test	4,971.92*** (0.00)
Wooldridge test	124.92*** (0.00)
Test of endogeneity	40.75*** (0.00)
Mean VIF	2.34
Note: ***significant at 1%.	

Table 4 shows that the mean VIF is relatively low, meaning the multicollinearity phenomenon in the model is considered not serious. However, this research model has heteroscedasticity, autocorrelation, and endogeneity. To solve these problems, the author estimated the research model using the GMM method; the results are presented in Table 5.

Table 5. Estimation results using the GMM

LnSDI		Coef.	P>|z|
FD		0.1399***	0.00
CC		-0.0130	0.67
FD×CC		0.2446**	0.04
FDI		0.0104***	0.00
POP		-0.0499***	0.00
_cons		4.2051***	0.00
Number of instruments		13	
Number of groups		28	
Significance level		186.82*** (0.00)	
Arellano-Bond test	AR (1)	-2.73*** (0.01)	
	AR (2)	-0.18 (0.86)	
Sargan test		11.20 (0.13)	
Note: **significant at 5%, ***significant at 1%.			

The estimated results using the GMM method are statistically significant, with all tests consistent (Table 5). Accordingly, the estimation results show that financial development (FD) has a positive impact on sustainable development (LnSDI). Thus, financial development is an important motivation to promote sustainable development in middle-income countries in Asia. This impact is evident through providing financial resources to stimulate economic growth [14], [21], improve environmental quality [14], [22], and promote social development [4].

Regarding corruption control, this study has found a positive impact of corruption control (CC) on sustainable development (LnSDI). Accordingly, corruption control contributes to improving the investment environment and promoting production and business activities [8], thereby promoting sustainable development. In particular, this study also found a positive impact of the interaction variable FD×CC on sustainable development (LnSDI). Thus, controlling corruption can amplify the impact of financial development on sustainable development, a new finding compared to previous studies. This conclusion is appropriate because controlling corruption can indirectly impact sustainable development by improving the efficiency of using financial resources [38], reducing risks in the investment process [40], and improving investment efficiency [41]. It can be seen that controlling corruption not only has a direct impact on sustainable development but can also indirectly impact sustainable development through promoting the efficiency of financial development.

For the control variables, sustainable development (LnSDI) is positively affected by foreign direct investment (FDI) but negatively affected by population growth (POP). This result is consistent with previous comments by Tamazian and Rao [32] and Wen et al. [13]. Thus, foreign direct investment is the foundation for sustainable development. However, high population growth in middle-income countries can burden them, hindering sustainable development.

5. CONCLUSION

The goal of this study is to analyze the impact of financial development on sustainable development in middle-income countries in Asia and consider the role of corruption control in this impact. This is also an interesting point of this study compared to previous studies. With that goal, the author uses the GMM method to estimate the research model. The estimated results show that financial development is an important driving force to promote sustainable development in these countries. In particular, this impact is significantly amplified when the level of corruption control is improved, which is a new finding of this study compared to previous studies. Additionally, the estimated results indicate that foreign direct investment positively impacts sustainable development, while population growth negatively impacts it.

The results of this study provide a dependable foundation for middle-income countries in Asia to identify appropriate policies that will promote financial development and enhance the

effectiveness of corruption control, with the ultimate goal of promoting sustainable development. Specifically, middle-income countries in Asia should promote the comprehensive development of the financial system, focusing on increasing capital sources for highly efficient and environmentally friendly projects. Besides, these countries should make more efforts to improve institutional quality and strengthen measures to prevent corruption. In addition, middle-income countries in Asia should pay more attention to improving their ability to attract foreign direct investment and control excessive population growth, especially paying more attention to developing high-quality human resources. These are important foundations for these countries to aim for sustainable development goals.

Although the research goal has been achieved, this research still has certain limitations. For example, due to limited access to data, the author has not analyzed separately for each country, especially not clarifying the differences in research results between countries or different regions. Future studies could overcome these limitations to generate interesting empirical evidence.

Conflicts of Interest: The author declares that there are no conflicts of interest regarding the publication of this paper.

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