CHAPTER V
CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This study examines the impact of public debt on renewable energy development and investigates how financial institutions and markets moderate this association. The study utilized two-stage mechanism for dividing the renewable energy development in terms of the renewable energy investment (REI) as the input side and renewable energy generation (REG) as the output side. The application of spatial econometrics to empirically test the direct and indirect effects of this association. In accordance with that, this study draws the following conclusions.

First, the direct effect indicates that public debt affects renewable energy in a nonlinear way across its stages of development. At the investment stage, public debt shows an inverted U-shaped relationship with REI. It implies that moderate levels of debt stimulate REI, but excessive debt levels hinder REI. This is because rising fiscal risks and higher costs of borrowing would discourage investment in the subsequent phase. In contrast, at the generation stage, public debt has a U-shaped relationship with REG, reflecting delayed benefits of debt-financed renewable infrastructure. At lower debt levels, public borrowing tends to reduce renewable energy generation during the early transition phase. However, once public debt exceeds its optimal threshold, renewable energy generation increases as previously debt-financed infrastructure becomes operational and starts to produce energy output.

Second, the indirect (spatial) effects reveal that public debt generates a negative spillover effect on renewable energy generation across LMICs. High public debt in one country can reduce REG in neighboring countries through regional crowding-out effects, tighter liquidity, and higher risk perceptions. While GDP per capita supports REG domestically, its spillover effect is negative. Financial institutions show negative direct and spillover effects, whereas financial markets exert positive effects both domestically and regionally. Population growth negatively affects REG at the domestic level.

Third, the moderating effects indicate that financial sector development, including financial institutions (FI) and financial markets (FM), strengthens the nonlinear impact of public debt across different stages of renewable energy development. Financial institutions act mainly as a domestic stabilizer, by strengthening the ability of public debt to support renewable energy investment and generation within countries, but with limited regional transmission. In contrast, financial markets play a stronger role both domestically and regionally by amplifying the nonlinear effect of public debt on renewable energy generation through financial integration, green financial instruments, and positive spillover effects across countries.

Overall, public debt can support renewable energy development in LMICs, but its effectiveness depends on debt levels, the stage of renewable energy development, and the strength of the financial system. Sound debt management, stronger financial institutions, and deeper regional financial market integration are essential to ensure that public debt contributes effectively to the clean energy transition.

5.2 Recommendations

5.2.1 Recommendation for Policymakers

The research findings provided certain recommendations for policy making. Policymakers in low- and middle-income countries should try to keep public debt below damaging levels. It should be long-term and contribute to the Sustainable Development Goals. Debt in excessive levels can have negative spillovers. Fiscal governance should also allow for regional fiscal coordination in transparent debt reporting, risk assessment and financing. The aforementioned measures will ensure that public debt does not have unintended impacts in the area and it also supports the development of renewable energy in the country.

Strong financial institutions are needed to ensure effective resource allocation, improved credit intermediation, and better access to long-term green finance. Policymakers ought to strengthen such institutions, which act as a domestic stabilizer. Thus, improving the ability of public debt in renewable energy

development. At the same time, more extensive and better-integrated financial markets are required to decrease capital costs, prioritize sustainable investment, allow the easy issuance of green bonds, and promote cross-border co-financing impacts that produce beneficial spillovers across the region.

A higher GDP per capita means a better economy which helps in the betterment of renewable energy. Policymakers do need to make sure that the growth of the economy is aligns with the clean energy objective. They must also reduce the dependency on fossil fuels, improve the energy efficiency standard, and align the renewable energy target regionally. In addition, the harmful impact of rising population growth warrant implementation of effective demand-side management, enhancement of energy efficiency and large-scale promotion of decentralized renewable technologies so that any further pressure from growing population does not result in growing fossil use. In conclusion, customized measures that reconcile the management of sustainable debt, the strengthening of the financial sector, and green economic growth will better support a successful and inclusive transition to renewable energies in low-and middle-income countries.

5.2.2 Recommendation for Researchers

There are many limitations in this study which may help future research. Initially, the analysis uses renewable energy investment and generation data, which do not fully reflect actual renewable energy use. Future research can involve datasets on renewable energy consumption for a more complete evaluation of energy-transition results. Another suggestion for future research is the comparison by economic linkages, trade flow and financial integration of alternative spatial weight matrices that better reflect the real interrelationships among the countries. Finally, given that this research makes use of a static SDM framework, future research should try to use dynamic spatial panel models, which are better suited to capture adjustment processes, persistence effects and long-run spillover dynamics.