



Water security, risk and economic growth: lessons from a dynamical systems model

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Investments in the physical infrastructure, human capital, and institutions needed for water resources management have been a noteworthy feature in the development of most civilisations. These investments affect the economy in two distinct ways: (i) by improving the factor productivity of water in multiple sectors of the economy, especially those that are water intensive such as agriculture and energy; and (ii) by reducing the acute and chronic harmful effects of water-related hazards like floods, droughts, and water-related diseases. The need for capital investment to mitigate these risks in order to promote economic growth is widely acknowledged, but prior work to conceptualise the relationship between water-related risks and economic growth has focused on the productive and harmful roles of water in the economy independently. Here the two influences are combined using a simple, dynamical model of water-related investment, risk, and growth at the national level. The model suggests the existence of a context-specific threshold above which growth proceeds along an 'S'-curve. In many cases there is a requirement for initial investment in water-related assets to enable growth. Below the threshold it is possible for a poverty trap to arise. The presence and location of the poverty trap is context-specific and depends on the relative exposure of productive water-related assets to risk, compared with risks faced by assets in the wider economy. Exogenous changes in the level of water-related risk (through, for example, climate and land cover change) can potentially push an economy away from a growth path towards a poverty trap. These results illustrate the value of accounting for environmental risk in models of economic growth and may offer guidance in the design of robust policies for investment in water-related productive assets to manage risk, particularly in the face of global and regional environmental change.