

ERSA Research Brief

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Climate, Technological Change and Economic Growth

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1. Introduction

A change in the global climate has been seen by many as a key threat to long-run economic growth. Many potential channels of transmission have been identified both theoretically and empirically, and a negative growth effect from climate change is not a conclusive one. Following the oil price shocks in the 1970s, the world entertained such fears with regards to the world exhausting its supply of energy resources. However, technological innovation has almost removed the fear of energy exhaustions. The interesting question that this paper asks is whether technological change will make nonsense of the fear that climate change will halt worldwide economic growth and hamper poverty reduction efforts in the developing world. Since countries and regions differ in terms of their ability to develop and adopt new technology, the impact of climate change on economic growth will differ across the regions of the world. Even in the world of equal access to existing technology, differences in factor endowments will imply differences in the impact of climate change across regions, unless technological change is neutral (benefits all factors of production equally) and the share of the climate sensitive sector in aggregate output is equal across regions of the world. None of these conditions is likely to hold in practice. The obvious implication is that climate change will affect world income distribution by hurting some countries more than others. There are two possible adaptation responses.

- Developing and applying climate resistance technologies to mitigate the negative effects (both direct and indirect) of climate change;
- Developing and applying technologies that reduce the dependence of the economy on climate sensitive sectors.

Fortunately, these two responses are complementary. However, these require that both the rate and the direction of technological change are endogenous.

2. Key Results and Implications

The main conclusion of the paper is that there is a tendency for technological change to be biased towards the inputs employed in the dominant sector (in terms of employment of labour) of the economy. In an economy in which the climate sector employs a larger share of the labour force, technological change will be biased towards the sector and thus raises the relative marginal

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product of the inputs employed in the climate sector, if the inputs are sufficiently substitutable. On the other hand, if the climate sector is the least employer of labour in the economy, then innovators will direct their efforts towards the development of technology that complements the factors employed in the non-climate sensitive sector. If the elasticity of substitution between the factors employed in the two sectors is sufficiently large, this development implies bias in technology in favour of the factors employed in the non-climate sensitive sector. In the case where the inputs are complementary, *non-climate sensitive sector* complementary technology is bias towards the inputs in the *climate sensitive sector* in the sense that non-climate sensitive sector complementary technology raises the relative marginal productivity of the factors employed in the climate sensitive sector, and hence the rewards to these factors.

The implication of this finding is that growth can be sustained in a world with changing climate when the degree of substitution between the production factors is sufficiently strong. In an economy with large climate sector, the development of climate sensitive sector complementary technology will more than offset the decline in productivity of the factors employed by the sector and thus offset any adverse growth effect from climate change. On the other hand, if the climate sector is the least employer of labour, then technology will tend to be bias towards the non-climate sensitive sector, thereby raising the productivity of the inputs in that sector. The increase in the productivity in the dominant sector will more than offset any productivity declines emanating from changing climate.

3. Concluding thoughts

The conclusions from this paper imply that it is not the dominance of the climate sector *per se* that makes climate change potentially bad for growth. Rather, it is the ability of an economy to innovate at the world technology frontier, and the extent of complementarity and substitutability between the two sectors. An advanced economy capable of undertaking frontier innovations will have its rate of economic growth and development least affected by climate change, even if the climate sector is sufficiently large. On the contrary, a poor country with a large climate sector may have its rate of growth affected significantly by climate change due to its inability to undertake frontier innovations. A poor country would suffer more from climate because of the climate sensitive sector use of inferior technology, the main reason why a developed economy would escape the vagaries of the weather due to avoidance of sectors that depend excessively on the climate. More so less developed countries would have less incentive to innovate owing to the costs associated with frontier innovations. Inevitably, this magnifies the opportunity cost of bootstrapping out of poverty and entrench the tendency to feed off the climate sensitive sector with ramifications for further deterioration and reduced growth. Further, information bottlenecks, insecure tenure rights and lack of inputs may set an upper bound on the ability to migrate out of the climate sensitive sector. The whole process is thus self-enforcing, with less development feeding into high dependence on climate sensitive sectors which in turns results in reduced abilities to undertake frontier innovations to curtail the effects of deteriorating climate. A clear policy option to stave off dependence on the climate sector should include, among others institutional support for developing countries, and reform of land tenure systems and information and credit constraints which militate against the development of frontier technologies in developing countries.