Hurricanes, economic growth and transmission channels
Empirical evidence for countries on differing levels of development

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ABSTRACT

While the short-term growth consequences of natural disasters are comparatively well studied, little is known about the long-run perspective. Based on truly exogenous storm indicators, derived from a meteorological database, we show that the growth effects of tropical storms go well beyond the short-term perspective. A disaggregated analysis reveals that the reaction of economic growth to the occurrence of hurricanes depends strongly on the level of development of the afflicted countries with developing countries being most negatively affected. We also consider through which channels tropical storms affect long-run growth and find the investment share as well as fertility to react systematically to tropical storms.

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1. Introduction

Although natural disasters have always affected life on planet earth, only recently economists have started analyzing the effects of natural disasters on economic development. This rising interest in the growth effects of natural disasters was triggered by the expectation that the ongoing process of global warming increases the frequency or at least the severity of certain types of natural hazards and extreme weather events. Under a warming climate, extreme temperatures and precipitation events are expected to occur more often (Banholzer, Kossin, & Donner, 2014). The same holds true for the length, frequency and/or intensity of heat waves (IPCC, 2013). For other natural hazards such as tropical storms the picture is yet less clear (see e.g. Callaghan & Power, 2010; Grinsted, Moore, & Jevrejeva, 2012; Thomas, 2014; Wang & Lee, 2008), as tropical storms become natural disasters typically only when making landfall and global warming tends to affect tropical cyclone tracks (Murakami & Wang, 2010).

Most of the existing literature on the growth effects of natural disasters is concerned with the short-term growth impact of natural disasters (see, e.g., Felbermayr & Gröschl, 2014; Noy, 2009; Raddatz, 2007). In their comprehensive analysis of the short-term effects of different sorts of natural disasters Felbermayr and Gröschl (2014) conclude that the effect of natural disasters on short-term economic growth is "naturally negative". Much less attention has been devoted to the question whether natural disasters have medium- and long-term growth effects. The likely reason for the strong focus on short-term growth effects is that according to standard neoclassical growth theory a natural disaster has no effect on long-run per-capita GDP. Interpreting a disaster as a shock on a country's capital stock (or population), this shock leads to a negative (positive) effect on per-capita income in the short-run. Whenever an economy's capital stock is damaged or parts of the working population die this leads almost immediately to a drop in output, a finding which has been documented in many case studies of the short-term growth effects of natural disasters. As an example, Hurricane Matthew had disastrous effects when hitting Haiti in early October 2016. Matthew came with a death toll of more than 500 in Haiti, and also led to a destruction of some 210,000 houses, a loss of crop of up to 80%, a blowdown of thousands of large coconut, breadfruit and plantain trees and drowns of livestock in the affected area (Stewart, 2017). Even if firms' capital stocks remain unaffected and disasters demand no death toll,

damages in the public infrastructure might cause a drop in output in the short term. Throughout Hurricane Matthew not only streets and bridges were destroyed or severely damaged, but also power and phone lines, leaving parts of the country at least temporarily without electric power and communication (Stewart, 2017). However, according to neoclassical growth theory, these effects are unlikely to persist for long periods of time as a consequence of a temporarily rising per-capita savings rate which will drive the capital stock to its initial per-capita level, leaving the economy without a long-term growth effect (see also Rossi, Wright, Wright, & Weber-Burdin, 1983). Especially when the disaster-affected countries are supported by international aid or when a large share of the occurring damages are insured, a recovery might be reached quite soon. In fact the studies by von Peter, von Dahlen, and Saxena (2012) and Breckner, Englmaier, Stowasser, and Sunde (2016) indicate that the short-term growth consequences of disasters tend to be smaller whenever the insurance coverage is higher, as it is typically the case in highly developed countries.

However, the view that natural disasters leave long-term growth unaffected might be wrong. Many natural disasters occur quite often in certain regions. As an example, the Philippines are often victims of 20 or more hurricanes annually. As mentioned earlier, within the ongoing process of global warming the frequency and/or severity of certain types of natural hazards and extreme weather events will likely further increase. Repeatedly occurring disasters might prevent that countries reach their long-term equilibrium. Moreover, post-disaster aid flows are typically comparatively small in comparison to suffered damages and GDP so that the expectation that post disaster aid might speed up the recovery process significantly might be overly optimistic (Becerra, Cavallo, & Noy, 2014). In general, the implicit assumption of neoclassical growth theory that key macroeconomic factors such as saving and investment behavior, human capital formation or population growth remain unaffected by disasters is also quite unlikely to hold in reality (see e.g. Berlemann, Steinhardt, & Tutt, 2015 or Berlemann & Wenzel, 2016). Individuals which smooth their consumption over their (expected) lifetime might decrease their savings in consequence of increased life risk. On the other hand, individual saving might also increase as a consequence of precautionary saving whenever disasters make capital losses more likely (Roson, Calzadilla, & Pauli, 2005). An increase in perceived or objective disaster risk might also have a negative effect on fertility as raising a family in a more risky environment is less attractive. However, especially in poor countries where children serve as an insurance against old-age poverty increased disaster risk might induce an increase in fertility (Boldrin, De Nardi, & Jones, 2005). Post-disaster government fiscal activity might also affect long-run growth, depending on which concrete measures are taken.

Only recently, empirical research on the long-run growth effects of natural disasters intensified. However, as Noy and DuPont (2016) argue, the existing empirical evidence is yet inconclusive. In their literature review, Cavallo and Noy (2011) come to the conclusion "A further significant lacuna in the current state of our knowledge is the absence of any agreement regarding the long-run effects of these disasters". One might suspect that three reasons are responsible for the relatively mixed picture. First, it seems to be questionable to treat all (climatic) disasters as homogenous, as one might easily imagine different disasters to affect economic development differently. Second and even more problematic, inappropriate measurement of natural disaster severity might have contributed to the yet ambiguous results (see also Cavallo & Noy, 2011). The vast majority of existing studies relies on data from the EM-DAT database.[1] As Strobl (2012) argues, the EM-DAT data was collected

from various different sources and thus is likely contaminated with measurement error since the reporting sources differ in their motives, methodologies and quality of reporting disaster damages. Moreover, using the EM-DAT disasters intensity indicators likely leads to an endogeneity problem in growth regressions as (i) the monetized damage of a disaster and (ii) insurance coverage and thus the probability of inclusion into the database depend on per capita GDP, the dependent variable in growth regressions (Felbermayr & Gröschl, 2014). Third, the typically employed approach to study the effect of natural disasters in Barro-type regressions is likely inadequate. When adding a disaster variable to a set of likely determinants of economic growth in a growth regression, the estimation approach likely suffers from multicollinearity as the long-term effect of natural disasters on economic growth must be transmitted through at least one channel (this problem is also known as "overcontrolling problem", see Dell, Jones, & Olken, 2014). Fourth, the effects of natural disasters on long-term growth might depend on the level of development of a country, as highly developed countries can protect themselves much better against the consequences of natural disasters than less developed countries (Skidmore & Toya, 2007).

In this paper we contribute to the literature by studying the short-, medium- and long-run growth effects of one disaster type, tropical storms, systematically within a unified panel estimation approach. Instead of using EM-DAT data we rely on truly exogenous meteorological storm data to construct appropriate hurricane indicators. Moreover, we avoid the mentioned overcontrolling problem by using a two-way fixed effects estimation approach without possibly multicollinear control variables. Our analysis shows that tropical storms in fact affect economic growth negatively both in the short- and the long-run in the full country sample. However, the aggregate analysis masks that the growth effects factually depend on the level of development of the afflicted countries. While there are – if at all – slightly positive long-run growth effects in the group of high income countries, the effects are negative in the groups of the middle and especially in low income countries. In order to understand the mechanics behind these effects we also study the relevance of three of the earlier mentioned channels through which tropical storms might affect growth figures (saving/investment, fertility and fiscal activity). We find that especially the saving/investment channel drives the strongly negative growth effects in countries on low levels of development.

The remainder of the paper is organized as follows. In the second Section, we review the literature on growth effects of tropical storms. Section three outlines the estimation approach and presents and describes the employed data. Section four delivers and discusses the estimation results for growth effects of hurricanes in the full country sample. In Section five we study long-run growth effects in countries on differing levels of development. Section six deals with an empirical analysis of possible transmission channels through which tropical storms affect economic growth. The final section summarizes and draws some conclusions.

2. Related literature

In the following we summarize briefly the most closely related literature. We start out with the literature studying potential growth effects of tropical storms. We then turn to a discussion of a number of transmission channels though which natural disasters in general might affect long-term growth and the relatively small existing empirical literature on this issue.

2.1. Growth effects of hurricanes

The number of papers which has investigated the growth effects of natural disasters is relatively small. Only a few papers have yet

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[1] For more information on the EM-DAT database see: http://www.emdat.be/.