



# Natural disasters and agricultural protection: A panel data analysis

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## ABSTRACT

We explore the impact of natural disasters on the degree of agricultural protection using data from 76 countries thereby covering more than 70 of the most traded agricultural commodities. Theoretically, the direction of this effect is not a priori directly clear as it balances the trade-off between protecting the economic interests of the domestic agricultural sector on the one hand and ensuring food availability for the society at large on the other. Our most important findings suggest that natural disasters generally raise agricultural trade controls to favor domestic farmers. These barriers are mainly provided by limiting imports in the aftermath of a natural event. However, the protection pattern differs among countries. To be more specific, floods and storms increase agricultural protection in high-income countries, while trade barriers in many LDCs are reduced during periods of extreme drought in an attempt to diminish food scarcity. Finally, it turns out that a large part of the change in agricultural protection caused by a natural disaster is explained by a number of commodity specific particularities (i.e., food vs. cash crops).

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## 1. Introduction

One of the main threats to sustainable economic development the next decade is the re-occurrence of natural disasters. It is widely documented in the previous literature that these events hamper in particular productivity growth in the agricultural sector as the production in this sector depends to a large extent on the climatic and biophysical conditions present (i.e., [Benson & Clay E., 2003](#); [Fomby, Ikeda, & Loayza, 2011](#); [Loayza, Olaberria, Rigolini, & Christiaensen, 2012](#)). The main impact of natural disasters on agriculture arises from the physical damage caused to crops and livestock production leading to harvest failures and reduced revenues from animal husbandry (see also [Loayza et al., 2012](#); [Lobell, Schlenker, & Costa-Roberts, 2011](#); [Raddatz, 2009](#); [Sivakumar, Motha, & Das, 2005](#); [Haile, 2005](#); [Mohan, 2016](#); [Mohan & Strobl, 2017](#); [Rosenzweig, Iglesias, Yang, Epstein, & Chivian, 2001](#); [Spencer & Polachek, 2015](#); [Strobl, 2011](#); [Blanc & Strobl, 2016](#)). However, the complete impact may go beyond the direct production loss. The indirect impact is typically related to the destruction of farm infrastructure (i.e., storage buildings, irrigation systems, installations, machinery and equipment) or environmental degradation ([Charveriat, 2000](#); [De Haen & Hemrich, 2007](#)). Consequently, the impact of disasters might

therefore not be limited to only one growing season, but may eventually trigger local food shortages in the years following a disaster.

These adverse impacts have in particular important implications for developing countries where agriculture traditionally accounts for more than a quarter of GDP and total employment, compared to less than 5 percent in most industrialized countries ([World Bank, 2015](#)). Besides, the agricultural sector in these countries is regarded as not very competitive since it is dominated by high-risk and low-return smallholder farming systems ([De Haen & Hemrich, 2007](#); [Devereux, 2001](#)). All the more, it is these particular countries that are the most exposed to natural disasters. According to figures reported by EM-DAT, about fifty percent of the least developed nations face a high risk of natural disasters ([EM-DAT, 2015](#); [Klomp, 2016](#)).

The political responses to a number of recent major natural disasters have brought agricultural assistance back into the spotlight (i.e., [Chang & Zilberman, 2013](#); [Garrett, Marsh, & Marshall, 2006](#)). To manage the economic impact of natural disasters on the agricultural sector, governments may use the three trade instruments that are at their disposal: import tariffs, quotas that restrict import quantities and, production (coupled and decoupled) or export subsidies.<sup>1</sup> However, whether, and if so in which direction, the

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<sup>1</sup> A noteworthy feature of the WTO is that government financial support by providing agricultural disaster relief is permitted under WTO legislation when the farmers' losses exceed 30 percent of average gross income or production in the past three years.

agricultural trade policy changes after a natural disaster is contested since it depends on the trade-off between ensuring food security for the society at large on the one hand and stabilizing economic profits of domestic farmers on the other (Reilly, Hohmann, & Kane, 1994). To be more specific, when in the aftermath of a disaster, the government places more weight on achieving the former objective than on the latter, then it will reduce export subsidies or abolish import tariffs and quotas. This view is supported by the empirical evidence of Bastos, Straume, and Urrego (2013) who find that rainfall shortages generally lead to lower applied tariffs on agricultural imports. In contrast, when governments choose to support the farmers at the expense of other taxpayers to ensure the future existence of a viable domestic agricultural sector, then it will increase import tariffs to protect the agricultural sector from cheap imports and non-competitive importing practices, stimulate domestic production or even provide direct income support. For instance, in 2012 the US Senate passed a new Farm Bill that contained important program updates on disaster relief for areas hardest hit by extreme weather events. This bill addressed additional assistance to cover up for the production capacity losses as well as direct income losses caused by natural catastrophes.

Surprisingly, the empirical evidence on the consequences of natural disasters on agricultural support is quite limited and inconclusive. Compared to the earlier literature, the contribution of our study is twofold. First, we focus on a wide set of protection measures. Existing studies are primarily concerned with the impact of extreme weather events on the applied tariff rate (i.e., Bastos et al., 2013). However, support to domestic farmers can also be provided by production subsidies or even direct income support. Secondly, we concentrate on different kinds of natural disasters that affect agricultural productivity – floods, droughts and storms. Beforehand there is no reason to assume that the different natural disasters would influence the agricultural sector to the same extent or even in the same direction. Droughts, for example, exhaust the availability of water as an input to agriculture, while storms are a large threat to the physical capital used in the production.

For this purpose, we use a dynamic panel model including data from 76 countries thereby covering more than 70 of the most internationally traded agricultural commodities. Our data on agricultural protection in a particular country-year is based on the information reported by the “*Estimates of Distortions to Agricultural Incentives*” dataset of the World Bank. The so-called nominal rate of assistance measures the percentage by which government policies have raised (lowered) gross returns to farmers above (below) what they would be without the government’s intervention. In addition, several exogenous measures on the frequency of natural disasters are created based on the information provided mainly by the “Geological and Meteorological Events Database” collected by CESifo and the “Global Active Archive of Large Flood Events” database provided by the Dartmouth Flood Observatory. Our most important empirical findings suggest that natural disasters raise agricultural trade controls. These barriers are mainly provided by limiting imports in the aftermath. However, the protection pattern differs among countries. To be more specific, it turns out that most extreme weather events increase agricultural protection in rich countries, while extreme droughts often reduce trade barriers in poor countries in an attempt to reduce food scarcity.

The remainder of the paper is structured as follows. Section 2 provides our theoretical foundation underlying our hypotheses and discusses in more detail how our contribution is related to previous studies on support to the agricultural sector. Section 3 describes the data and methodology used. Section 4 reports our results for the influence of natural disasters on support to the agricultural sector, while the final section offers the conclusions.

## 2. Theoretical foundation

A natural disaster increases the marginal cost of domestic agricultural producers, thus generating a shortfall in agricultural output that foreign producers have an incentive to meet. Consequently, this adverse supply shock affects the domestic profits, the consumer surplus and the revenue accruing from the trade policies in place (Bastos et al., 2013). The negative impact of natural disasters on the agricultural production supports the idea to help the domestic agricultural sector using government policy. Already in non-disaster periods, many countries provide support to their agricultural sector through a complex array of policy measures. Different rationales for such pervasive state interventions are proposed in the literature such as stabilizing farmers’ income, ensuring food security and protecting rural smallholders from non-competitive marketing practices (i.e., Dehn, 2000; Timmer, Falcon, & Pearson, 1983). In the aftermath of a natural disaster, some of these objectives may work contradictory. For instance, an increase in the tariff rate raises profits of domestic farmers, but reduces the food availability within a country due to fewer imports<sup>2</sup>. Alternatively, when the government attempts to increase food availability for the entire population and at the same time would like to support the domestic agricultural sector, it may increase the subsidy per unit produced. However, this strategy will worsen the fiscal balance as tariff revenues fall and subsidy expenses go up. Since many countries, especially developing countries, already suffer from a large public debt, this policy is not sustainable in the long run for these countries. In Table 1 we summarize the impact of a trade policy change after a natural disaster on the three main objectives that the government tries to maximize: profit of domestic farmers, food availability and the fiscal balance. The scenarios outlined in the table illustrate that it is theoretically not directly clear whether, and if so, in which direction, natural disasters should affect agricultural protection. The optimal response of the policy maker on setting the tariff rate and subsidy per unit produced in the aftermath of a natural disaster depends on the weights given to the specific objectives. One can therefore argue that the question of whether natural disasters affect trade policies is ultimately an empirical one.

Nevertheless, the existing literature mentions various reasons why the degree of agricultural protection should be changed in favour of the domestic agricultural sector in the period following a natural disaster. The first argument on which we build is related to the comparative advantage of the agricultural sector. The traditional trade theory, starting already with Ricardo in the nineteenth century, argues that when a country has a comparative advantage in agriculture it should specialize itself in this sector and there is no need for government assistance or involvement as there are gains from trade (Swinnen, 2010a). However, following this strategy, it leaves countries that do not have a comparative advantage in food production to rely heavily on imports, which make them rather vulnerable to adverse global food supply or terms of trade shocks (Streeten, 1993). To ensure a minimum degree of food self-sufficiency, governments may want to protect a small or non-competitive agricultural sector from import competing competition and support domestic food production to nurture its own industry (Stiglitz & Greenwald, 2006).

Conversely, one can also argue that when a country specializes itself in agriculture and a large share of GDP is contributed by the this particular sector through exports or domestic consumption, an adverse production shock such as a natural catastrophe may disrupt the national economy disproportionately leading to widespread unemployment and high inflation rates. For instance, Benson and Clay (2003) report that a fifty percent fall in

<sup>2</sup> In this study we assume that agricultural demand is inelastic.

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