Impact of natural disasters on agricultural protection: effects for food- and non-food agricultural commodities

Agricultural Economics and Rural Policy group

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Preface

"An investment in knowledge pays the best interest" Benjamin Franklin

After I had finished my master thesis, only a minor thesis was left before graduation. I choose to do a minor thesis instead of an internship for three reasons. Firstly, the most important reason was that I had put a lot of effort in studying literature about both natural disasters and agricultural protection and constructing a database that could be used to show the impact of natural disasters on agricultural protection. I wanted to use this knowledge once more, since it is a 'new' field of research. Secondly, an internship would take 4 months while a minor thesis should be finished in 2 months. This should allowed me to graduate just before or after the 2013 summer. Thirdly, this minor thesis was the perfect opportunity to answer questions that rose during my major thesis presentation. Some questions I should had answered when working on my master thesis, others could be used for a new study. The questions provided me with a good topic for this minor thesis.

Another topic were my English writing skills. In the period that I wrote my master thesis I found out that I will not become the new Shakespeare. It is a pity that I did not had (or took) the time for improving these skills. Thanks to my supervisor, Dr. Ir. Peerlings, this paper has been written in better English than the previous one is. He is a real supervisor: tough when necessary, always honest and respectful. Fortunately he always had time for small talk and discussing my after Wageningen career. I am grateful for his patience and feedback.

The last words are for my parents and my girlfriend Marian. I have been a student for quite some time, but with fulfilling this minor thesis I am now officially a Master of Science. Yeah!

Barry Hoogezand

Abstract

The last decade there has been an increasing attention for the impact of natural disasters. furthermore, since the GATT Uruguay Round there has been growing attention for the effects of agricultural protection. This study combines both elements. Six theories explain why there is agricultural protection: rural bias, vulnerability, development paradox, theory of collective action, shocks and income/price support. This study focuses on the impact of natural disasters on agricultural protection for food and non-food agricultural commodities. Non-food agricultural commodities increase the amount of foreign exchange, which could be used for reconstruction payments. By supporting food agricultural commodities governments could secure food for consumers. Combining the World Bank its Distortions to Agricultural Incentives database with the large scale data on meteorological, hydrological and climatological natural disasters of CRED (Emergency events Database) it is possible to estimate the impact. With a random effects panel data model it is shown that there is no significant difference in the change in agricultural protection after the occurrence of a natural disaster between food and non-food agricultural commodities. Actually no significant effect is found.

Keywords: natural disasters, agricultural incentives, food and non-food agricultural commodities, agricultural support policies.

Table of Content

1. Introducing the research topic

1.1 Background

In the MSc-thesis "the impact of natural disasters on agricultural protection: a panel data analysis" (Hoogezand, 2013) it is shown that there is an increasing level of protection after the occurrence of a natural disaster. During the thesis-presentation some questions were raised. One question was if the increasing level of protection goes for both food (like maize, wheat or rice) and non-food commodities (like tobacco, jute, cotton etc.).

Research on the impact of natural disasters on the economy shows that there is both a direct and indirect impact on the economy. A natural disaster gives a loss of production capacity and especially has for developing countries and small countries a large negative impact. Large developed countries can more easily absorb output shocks from natural disasters (Auffret, 2003; Oh and Reuveny 2010; Noy, 2009). Reasons for agricultural protection are diverse and an overview is provided by Thies and Porche (2007) in their study on agricultural protection: Effective lobby of agricultural producers (theory of collective action), vulnerability of agricultural producers, bias of politicians for rural areas, the effect of exogenous shocks and an incentive for high-income countries to increase the level of protection (development paradox).

The impact of natural disasters on the level of protection for agriculture is already studied, but there has not been a study investigating different impacts for non-food and food agricultural commodities. In studies on agricultural protection there was little attention for the difference between non-food and food agricultural commodities. Although Grilli and Yang (1988) in their paper do investigate the price development between food and non-food agricultural commodities. They show that there are differences in price development and Beleaney and Greenaway (1993) conclude that non-food agricultural commodities have a smaller price effect than food agricultural commodities (Bleaney and Greenaway, 1993).

1.2 Objective and research questions

Governments could change their agricultural support after the occurrence of a natural disaster differently for food and non-food agricultural commodities. The main research question is therefore:

What is the impact of natural disasters on agricultural protection for food and non-food agricultural commodities?

To be able to provide an answer to this broad question it is decomposed into specific research questions.

1. *Why is there agricultural protection for food and non-food agricultural commodities?*
2. *How to measure agricultural protection?*
3. *What is the impact of natural disasters on protection of food and non-food agricultural commodities?*

1.3 Methodology

By combining the University of Louvain's EM-DAT database (OFDA/CRED, 2012) with the World bank's "Distortions to Agricultural Incentives" database (Anderson and Valenzuela, 1955-2007) the effect of natural disasters on agricultural protection can be analysed. The time period covered by this study is 1970-2007 because of the availability of reliable data. This thesis uses the model developed by Hoogezand (2013) to answer the research question about the impact of natural disasters on food and non-food commodities. Research questions 1 and 2 are answered by a literature study. A random effects panel data model will be used to estimate the results. By comparing the effects of a natural disaster on the change in agricultural protection for some selected countries, results can be found. The selected countries represent different stages of development and will be selected based on literature.

1.4 Overview

This study starts in chapter 2 with a theoretical chapter explaining why there are differences in world market prices and domestic prices. This chapter will also give a theoretical explanation why governments could threat non-food and food commodities differently after the occurrence of a natural disaster. A theoretical explanation about the mechanisms behind the Nominal Rate of Assistance is shown in chapter 3. Chapter 4 focuses on the data of both the World Bank as well the EM-DAT database. Chapter 5 discusses the model and its estimation. Chapter 6 presents the results. The final chapter concludes and provides some recommendations.

2. Natural disasters and protection

This chapter provides an overview of existing studies about natural disasters and their impact, distortions in agricultural incentives and why governments impose them, and current research about food and non-food agricultural commodities. Section 2.1 provides an overview of current literature about the impact of natural disasters on an economy. In section 2.2 six reasons why governments impose agricultural protection are given. The last section, 2.3, discusses the literature about differences between food and non-food commodities.

2.1 The impact of natural disasters

Over the last decades there is an increased amount of observed natural disasters, from 30 per year in 1950, to more than 400 in 2000. The amount people affected increased from 25 million to about 300 million in 2000 (Oh and Reuveny, 2010).

A reason for this increased number of observations could be the better collecting and reporting of data, on the other hand global warming could be a reason. The geographical distribution of floods and storms shows that all the major continents are affected, especially the eastern coastal regions of North and South America, Europe and Asia. Drought affects parts of Africa, the Middle East, India and Southeast Asia, and parts of the inner states of North America and Brazil (Strömberg, 2007).

Except for the personal harm that natural disasters cause, they also have a direct and indirect impact on economies.

The indirect damages are the loss of potential production of goods and services, due to the damage to production facilities. These indirect effects, like the loss of (future) harvests as a result of a natural disasters, will occur until the damaged capacity is restored (Auffret, 2003).

Direct impacts depend on the type of disaster. Especially for agriculture, large scale floods, storms, drought, wildfires and extreme temperatures have a direct effect on the level of production. While earthquakes have a smaller impact on agriculture.

The impact of natural disasters is larger for developing countries compared to developed countries (Noy, 2009). Also small countries face a higher effect of natural disasters than larger economies. Due to higher per capita income, better institutions, higher degree of openness to trade and larger government, developed countries prevent that the effect of a disaster is spilling deeper into their economy. Open economies also will experience a smaller negative shock to demand.

2.2 Distortions in agriculture

It is shown that agricultural policies differ across countries: while many countries subsidize their agriculture, many others consistently tax agriculture both directly and indirectly (Dennis and İşcan, 2011). In 2007 the Economist[1] wrote that some countries imposed food-price controls as a reaction to increasing food prices: Argentina, Morocco, Egypt, Mexico and China imposed constraints on domestic prices. Other countries, like India, Vietnam, Serbia and Ukraine had imposed export taxes or limited exports and Argentina and Russia combined both.

Based on an article of Thies and Porche (2007), Hoogezand (2013) gives six reasons why governments are willing to protect agriculture:

[1] http://www.economist.com/node/10250420

1. Theory of collective action

Olson (1965) published in this article his theory that small groups with specific interests can easier organize themselves and are therefore more effective in lobbying and secure governmental support. This theory states that large groups have diffuse interests and are less effective. Small groups such as farmers (Olson uses them in an example) do not have to be a homogeneous group, but have a common interest for more governmental protection, since it increases income. Large groups, such as consumers paying for this protection, have no incentive to organize against this rent-seeking behaviour (Thies and Porche, 2007).

2. Vulnerability

Agricultural producers face an inelastic supply and are therefore vulnerable to market fluctuations. When prices decrease agricultural producers have almost no opportunities to anticipate. Industrial producers in contrary could decrease the level of production when prices fall. Therefore agriculture has an effective lobby by politicians.

3. Rural bias

Politicians have an incentive to support agricultural areas. Rae (1971) calls it "rural bias of electoral institution" indicating that when agricultural protection is established it is difficult to expel it. It is shown that proportional democracies should have larger transfers and redistribution toward farmers if this group represents the majority of the population (Olper and Raimondi, 2009). As Thies and Porche (2007) mention: "Policy change away from agricultural protection should be particularly difficult the greater the number of political actors capable of shaping policy in the legislative or executive process".

4. Shocks

Certain types of shocks could drive changes in producer support by governments (Anderson and Hayami, 1986). Examples are the GATT Uruguay Round, but also entering the European Union. In the latter case the Common Agricultural Policy becomes the standard and it could drive a change in the level of protection. Natural disasters could also be such a shock that drives a change in agricultural protection, since governments could decide to support either consumers or producers.

5. Development Paradox

This paradox, first mentioned by Timmer in his paper of 1991, about the change in level of agricultural protection when a country starts to develop (Timmer, 1991). As soon as a country's economy starts to develop, agricultural policy changes from taxing agriculture to supporting this sector. This paradox suggests that agriculture is taxed and used, to favour the industrial sector. When food costs are kept low urban population could work in the industrial sector for low wages (Thies and Porche, 2007) and agricultural labour sometimes is treated as a surplus labour that can be tapped at will (Dennis and İşcan, 2011). When a country starts to develop, food prices become less elastic due to increasing income of workers in the industrial sector. Farmers therefore demand protection; their income is behind of that of the industrialized sector. A decreasing number of workers in the agricultural sector and more workers in industrialized sectors make that the last group has less incentive to organize against this support (Thies and Porche, 2007).

An example of a highly taxed non-food commodity, fulfilling the development paradox is cotton. It is taxed heavily in developing countries and subsidized heavily in high-income countries (Anderson et al., 2008).

6. Price/income support

Agricultural producers face diverse (random) risks than can threaten their consumption, output and income. Although there are possibilities for farmers to deal with these risks via risk management (diversification, off-farm job) and risk coping (selling assets), both give extra costs. These costs could be interpreted as a kind of insurance premium. One could argue that diversification and off-farm jobs are a kind of 'poor countries measures' with low direct cost for governments.

Governments play an assisting role in risk management. The Common Agricultural Policy (CAP) of the European Union supports farmers by reducing some of the risks by creating price support on some commodities. Market and regulatory barriers are reasons to justify public intervention in the provision of agricultural insurance (Mahul and Stutley, 2010). An example of these market barriers are the high cost for creating an agricultural insurance system. Other problems are informational (adverse selection and moral hazard). One could argue that government interventions in risk management are 'rich countries measures', because there are high costs involved.

By providing risk protection to agricultural producers via subsidies inefficiencies will follow. If farmers are subsidized this gives a welfare loss to society since the costs of risk protection are paid by tax payers. Also moral hazard is a problem regarding government intervention. Governments crowds out private parties and since most subsidies are paid as part of the insurance premium it is in favour of high-risk areas (Skees, 2000).

2.3 Food commodities versus non-food commodities

It is possible to categorise agricultural commodities in different types; this study specifically focuses on the differences between food commodities and non-food agricultural commodities. With a diversification between these commodities it is possible to investigate whether governments react differently after the occurrence of a natural disaster with respect to agricultural commodities used as food (like wheat, rice and potatoes) or non-food, so traded for cash, such as tobacco, cotton and wool. Paarlberg (2000) states that for citizens in poor countries their income and employment depend heavily on world markets for non-food products. These are not only non-food agricultural commodities but also raw materials. Paarlberg also shows that the most important source for food insecurity in developing countries are natural disasters, but also non-accountable political systems and violent internal civil conflicts.

Little is known about economic differences between non-food and food agricultural commodities. Grilli and Yang (1988) investigated the price development between food and non-food agricultural commodities and show that there are differences in price development and Beleaney and Greenaway (1993) conclude, based on Grilli and Yang (1988), that the prices of non-food agricultural commodities are subject to common long-run trends. Non-food commodities have a smaller price-drop since 1980, compared to food commodities. Alderman (2008) shows for non-food agricultural commodities that a price shock has a long lived major impact on the profitability of investments, but has little impact on consumers. The impact gives a rising price for commodities and therefore challenges price stabilization programs. Interesting is that these price peaks give an incorrect price trend and therefore producers have a tendency to over invest.

De Rosa and Govindan (1996) show that overall protection policies result in a bias against agriculture. The effect is a higher protection for manufactured than for non-food agricultural commodities, especially agricultural raw materials. These agricultural raw materials contribute significantly to export revenues, like jute in Bangladesh and cotton in Pakistan. In his study on agricultural incentives, Anderson shows that rice receive almost the highest assistance in both developing and high income countries, while assistance is most negative for tropical cash crops like cotton and tobacco (Anderson and Masters, 2009).

Grilli and Yang (1988) in their database classify cotton, hides, jute, rubber and tobacco as non-food agricultural commodities. From the distortion to agricultural incentives database (Anderson and Valenzuela, 1955-2007), we can add: pyrethrum, sisal and wool to these non-food agricultural commodities.

3. The Nominal Rate of Assistance

Since this study relies on the Nominal Rate of Assistance (NRA) to measure agricultural protection, this chapter will go into deep about this World Bank measure. In section 3.1 different measurements for agricultural distortion are explained and why the Nominal Rate of Assistance is used. Section 3.2 explains how the NRA measures border support, while section 3.3 focuses on how the NRA measures domestic support. The trading costs are explained in section 3.4. Section 3.5 explains the pro and cons of the NRA measure.

3.1 How to measure distortions

When studying the impact of natural disasters on agricultural protection, a tool for measuring this protection is necessary. In the literature on agricultural protection, two different measures are used: the Producers Surplus Estimate (PSE) and the Nominal Rate of Assistance (NRA).

Anderson and Masters (2009) state that "a market policy distortion is, by definition, imposed by a government to create a gap between the marginal social return to a seller and the marginal social cost to a buyer in a transaction". In words of the OECD, it takes into account all policies which raise prices received by domestic producers. The definition of the Nominal Rate of Assistance is "the percentage difference between the unit gross returns to producers [...] and world prices" (Cahill and Legg, 1990).

Both measures (PSE and NRA), show the difference between domestic prices for commodities and what it would be under free trade. The reason for applying the NRA in this research is the larger amount of countries in the dataset, distributed over all continents for which the NRA is available. The NRA has proven its usefulness in various studies like Dennis and Işcan (2011), Lloyd et al. (2010), Olper and Raimondi (2009), Olper et al. (2009) and Olper and Swinnen (2009).

The NRA measures the difference between a price for a certain commodity in a certain country and what this price would be under free trade. If the NRA is equal to zero, it indicates that there is free trade and the world market price equals the domestic price. When there is a difference, it could be either positive or negative. When negative it indicates that there is a taxation of agriculture, when positive there is support for agricultural producers.

Government intervention could be at the border or within a country; both are taken into account within the NRA. Therefore the NRA exists of both the Nominal Rate of Assistance *border support* and the Nominal Rate of Assistance *domestic support* (Anderson, 2009):

$$NRA_{it} = NRA_{BS} + NRA_{DS} \qquad (3.1)$$

Where the Nominal Rate of Assistance for a certain commodity in country *i* in a certain year *t* exists of both border support NRA_{BS} and domestic support NRA_{DS} in the same year for that commodity.

The *Consumer Tax Equivalent* (CTE) is equal to the Nominal Rate of Assistance for border support. An advantage of this Consumer Tax Equivalent measure is that it shows the agricultural distortion of a certain commodity paid or received by the final consumer. It is explained in section 3.3.

Anderson and Masters (2009) show some effects of government intervention in agriculture. One of the developments that change the difference between world market prices and domestic prices is the effect of agricultural protection on world market prices and exchange rates. If a country is a large producer of a certain product, world market prices could be disturbed when a government intervenes in this market. Another consequence of the effect of government intervention could be the impact on

the exchange rate, the price of traded goods compared to non-traded goods. These effects could have an impact on the price wedge between world market prices and domestic prices as explained further in this section.

It is also possible that other elements despite government intervention determine a price wedge. For example trade and processing costs. To overcome these elements, the value chain activities have to be recognized. The value chain activities increase the farmgate price plus domestic trading cost, and therefore, have to be filtered out for a good comparison with undistorted world market prices and to measure the effect of government intervention on prices (Anderson and Masters, 2009).

The following section will explain how the NRA takes above elements into account. First the Nominal Rate of Assistance *border support* is discussed and then the Nominal Rate of Assistance *domestic support* is explained.

3.2 Nominal Rate of Assistance border support

A government has different methods to intervene at its border. Most common are an import subsidy or tax, or export subsidy or tax and non-tariff measures (e.g. rules of origin, technical restrictions). In equation (3.2) it is shown how the NRA *borders support* is constructed (Anderson, 2009):

$$NRA_{BS} = \frac{E*P(1+t_m)-E*P}{E*P} = t_m \qquad (3.2)$$

Where *(E)* is the nominal exchange rate, *(P)* is the dollar-denominated world price of the commodity (Bates and Block, 2009) and t_m the difference, so the government distortion. In case of an import tax t_m will become negative. An option for governments is to intervene via export subsidies or an export tax (t_m) is the negative and positive respectively.

If any of the taxes or subsidies are specific instead of ad valorem (for example subsidy per kilogram instead of as percentage), these subsidies are calculated as ad valorem equivalents. In case of a production tax (a tax for domestic producers) the t_m is negative. In words of Anderson (2009) the NRA_{BS} is "the unit value of production at the distorted price, less its value at the undistorted free-market price expressed as a fraction of the undistorted price". In absence of any externalities (e.g. exchange rate distortions and domestic trading cost) a country could maximize domestic welfare by allowing both the domestic price of the farm product and the consumer price of the farm product to be equal to *(E*P)* (Anderson and Masters, 2009).

There could be three reasons for a difference between the domestic and world market prices. Government intervention, exchange rate effects and market integration. All are explained below, whereby market integration is explained when the *domestic support* measure is discussed.

1. Government intervention

In general the government has four possible methods for border interventions: import subsidy, import tax, export subsidy and export tax. The most common trade distortion is an ad valorem tax on competing imports, called a tariff (Anderson, 2009). Reasons for government intervention in agriculture are diverse as explained in chapter 2. By applying trade distortions in favour of domestic producers (export subsidy, import tariff) foreign products become more expensive. If the tariff is high enough, no foreign products will flow-in the country and domestic supply and demand will determine the domestic price. Domestic producers receive a higher price than under free trade.

If governments impose a border intervention that will increase domestic supply (export tax, import subsidy) it will decrease domestic prices. This is in favour of domestic consumers. Due to government intervention no supply will flow-out a country and domestic prices will fall below world market level. Consumers have to pay less for their agricultural products and domestic producers face lower prices than it would be under free trade.

Natural disaster

Above interventions could be implemented after the occurrence of a natural disaster. Governments could choose to either support producers or consumers.

2. (Real) exchange rates

Despite government interventions there is also the exchange rate effect on the difference between domestic and the world market price of the identical product in the international market. This real exchange rate creates a gap between "the price received by all exporters and the price paid by all importers for foreign currency, thereby changing both the exchange rate received by exporters and the exchange rate paid by importers relative to the equilibrium rate *E*, that would prevail without this distortion in the domestic market for foreign currency" (Anderson, 2009). Exporters face an official low rate. This official low exchange rate can be treated like a tax on exports. This (implicit) tax reduces the level of exports.

Reasons for a change in real exchange rates could depend on macroeconomic effects. Increasing rates could be due to the inflow of foreign currency as a result of foreign aid and a commodity boom. This exchange rate appreciation lowers the incentive to produce the same level of importables compared to exportables. However, it does not provide a change in the prices of exportables compared to importables.

The effect of government that borrow more from abroad for increasing domestic spending (in general) does have an effect on the real exchange rate, but this effect is not taken into account in the NRA.

Natural disaster

Little research has been done to the impact of natural disasters on monetary and exchange rate policies. Even issues as, the inflationary impact, exchange rates, and aid surge in a disaster aftermath have not been examined (Cavallo and Noy, 2009).

3. Market integration

For some products transport costs are so high that these products are therefore not traded internationally. In that case domestic prices fluctuate over time within the band created by the cost, insurance and freight (CIF) import price and the 'free on board' (FOB) export price (Anderson, 2009). In discussing the Nominal Rate of Assistance *Domestic Support* it is shown how to take these non-traded commodities into account.

3.3 Nominal Rate of Assistance Domestic support

Despite border interventions, governments could support agriculture also on a domestic level. Examples are taxes or subsidies on local level, imposed by local and provincial governments.

For products that are not traded internationally, another measure has to be applied. If a product has no world market it is not possible to measure the difference between the world market prices and domestic prices. Since these support or tax measures are an agricultural distortion they should be measured and taken into account. Both a tax and subsidy do have an impact on domestic prices, faced by both producers and consumers. The extent of the impact of these distortions depends on the price elasticities of domestic demand and supply of the commodity. For example a production tax for a

certain good has the following effect (S_f<0) on the NRA when the tax on consumption is zero (Anderson, 2009):

$$NRA_{DS} = \frac{S_f}{1+\frac{\epsilon}{\eta}} \quad (3.3)$$

Where η is the (absolute value of the) price elasticity of demand and ϵ price elasticity of supply. If calculated as Consumer Tax Equivalent (CTE), this production tax is paid by consumers giving (Anderson, 2009):

$$CTE = \frac{-S_f}{1+\frac{\eta'}{\epsilon}} \quad (3.4)$$

So in the case of the CTE the production tax is equal to the negative of the farmer its subsidy (in this example a production tax with S_f<0), divided by the ratio of the price elasticity of demand and supply.

Other factors can determine domestic distortions to agricultural incentives as well. These non-governmental influences should be filtered out of the NRA measure. One example is a difference in quality of products produced domestically and traded on the world market. To prevent that the NRA measures this difference and treat it as a government intervention, prices should be deflated or inflated by the level of quality the imported good is perceived by domestic consumers (q_m or q_x) (Anderson and Masters, 2009).

Another aspect wherefore the NRA has to be corrected, is the impact of trading cost as explanation for the difference between domestic and world market prices. This non-governmental reason should not be measured in the NRA.

3.4 Trading cost

An example of trading cost is the cost for transporting goods from rural areas to a harbour. By measuring these domestic transportation cost (T_f) the NRA can be corrected for these cost. T_f is the domestic transport cost as fraction of the price received by farmers. International trading cost do not have an impact with respect to the distortion measure, when using FOB (Free On Board, for exportables) and CIF (Cost Insurance and Freight, for importables) as international price. These costs are relevant if there is no trade (e.g. due to high trade tax on commodities) or if the border prices are unrepresentative (e.g. due to low volumes). To prevent the NRA measuring the international trading cost as governmental distortion, it is corrected by T_m (for import) or T_x (for export). Both measure the proportion by which the domestic price of the import- or export-competing product is above what it would be at the country's border.

To filter-out the non-governmental effects in the NRA measure, the previous mentioned measures have to be summed up by the farmgate price (Anderson, 2009).

$$E * P = \frac{P_f(1+T_f)(1+m_p)(1-q_m)}{1+T_m} \quad (3.5)$$

Where *(E)* is the domestic currency price of foreign exchange, *(P)* is the foreign currency price of the identical product in the international market and it is equal to the farmgate price (P_f) where the previous mentioned non-governmental trade distortions are summed up as fraction, T_f is the domestic transport cost, m_p the fraction of the price for processor-wholesaler costs and q_m the fraction by which the quality of the good is comparable with the goods traded at the world market. All domestic goods are compared with $1 + T_m$, where T_m is the proportion by which the domestic price of the

import-competing product is raised above what it would otherwise be at the country's border (Anderson, 2009).

For exportables the farmgate price has to be corrected for domestic influences and quality differences with the world market (Anderson, 2009):

$$E * P = \frac{P_f(1+T_f)(1+m_p)(1+T_x)}{1-q_x} \quad (3.6)$$

Again (P_f) is the farmgate prices, where the internal trading cost are added T_f and the fraction of the cost for processor-wholesalers and the cost for export (the Free On Board cost). This is compared with the quality difference q_x.

3.5 Discussion

As mentioned, the NRA has proven its usefulness in various studies, still there is some debate about what this measure covers. An example is the subsidy for farm inputs, such as for energy, pesticides and credit. These subsidies are not included in the NRA as shown by Cahill and Legg (1990). Another debate is about the NRA measure in Europe. Since 1992, the total support (including direct payments) and the market price support (specific for individual commodities) began to diverge. From the year 2004, almost 50 billion euro support was provided via income payments. These payments benefit agriculture and keep resources in the agricultural sector; these resources would otherwise probably leave the sector. These decoupled measures and payments are only taken into account in the non-product-specific part of the NRA (Anderson, 2009). So, the NRA for an individual commodity does not cover these decoupled payments and is therefore for individual (groups) commodities biased (Dennis and İşcan, 2011).

The Nominal Rate of Assistance compares the domestic price with what it would be at an undistorted world market. To measure this undistorted world market price is difficult. This is especially true for highly distorted markets like for rice, sugar and dairy,. Another caveat is that although Anderson (2008) corrects for quality differences these are difficult to determine in practice.

4. Methodology

To examine the relation between natural disasters and the level of protection for food and non-food agricultural commodities, a database is created. Information about natural disasters is gathered in the EM-DAT dataset (OFDA/CRED, 2012). The data about the level of protection is taken from the 'Distortions to Agricultural Incentives dataset', managed by the World Bank (Anderson and Valenzuela, 1955-2007).

First it is important to set the time period. While the EM-DAT database covers the time period 1900-2011, the World Bank dataset contains data from mid 1950s until 2007. Since the 1970s, the observed natural disasters increased rapidly over time (see chapter 2). Therefore, 1970 is selected as the starting year of this study and since the used agricultural distortions database contains only data until 2007, this is the upper bound and this makes the time-interval for this study 1970-2007.

4.1 Data natural disasters

The data from the natural disasters comes from the EM-DAT database. This EMergency events DATabase is founded by the Centre for Research on the Epidemiology of Disasters (CRED) research institute, part of the University of Louvain. This database contains a collection of 18.000 observations for 226 countries. The first observations are for 1900 and the database is updated on daily basis (OFDA/CRED, 2012). This database distinguishes between two main types of disasters: Natural and Technological types of disasters. Technical disasters are for example chemical spills and airline crashes. Within the natural disasters there are more subsections like geophysical disasters, hydro-meteorological and climatological disasters.

This study focuses on the impact of large scale natural disasters on agricultural protection; therefore technological disasters are not included in this study. Within the group of natural disasters, only hydro-meteorological and climatological disasters are included. It is less likely that geophysical shocks have a direct impact on agriculture. Therefore a change of the level of agricultural protection directly related to the occurrence of a geophysical natural disaster is less likely. Sivakumar (2005) excludes geophysical disasters in his study on the impact of natural disasters on agriculture, since agriculture depends highly on weather, climate and water availability. Noy and Cavallo (2009) show that hydro-meteorological disasters have the largest number of people affected and killed.

The types of disasters that are included are now: *droughts, extreme temperature events, floods, insect infestations, wildfires* and *windstorms.*

For a disaster to be included in the EM-DAT database, the impact of the disasters has to fulfil at least one of these criteria:

1. 10 or more people are reported killed or missing and assumed dead.
2. 100 or more people are reported affected.
3. The regime asked for external help or,
4. The regime declared a state of emergency.

To select disasters that drive a policy change, since it has to influence the level of agricultural protection, large scale natural disasters are selected. These types of disasters affect a large amount of people and/or have a large impact on the agricultural sector. If a natural disaster affects lots of people governments could decide to change the agricultural protection such that domestic consumers pay lower prices for agricultural food commodities. This change in protection could affect agricultural

producers since prices will decrease and farmers face decreasing revenues for their products. This is typically for agricultural food commodities, where the governments have to decide whether to support producers or consumers.

To select these large scale natural disasters, the classification of Munich Re (2006) can be used. This classification is also used by Gassebner et al. (2010) and Felbermayr and Gröschl (2011). To be classified as *large scale disaster*, the disaster included in the database should meet one of the following criteria (Munich Re, 2006):

1. Number of killed is no fewer than 1000
2. Number of injured is no fewer than 1000
3. Number of affected is no fewer than 100.000 or,
4. Amount of damages is no less than $ 1 billion.

The dollar values are based on the year 2000.

4.2 Constructing count variable

In his 2009 study, Noy presumes that the impact of a specific natural disaster on the economy depends on the magnitude of the disaster relative to the size of the economy. For this study the size of the economy is not relevant since only large scale natural disasters are included. The reasons for agricultural protection show that small interest groups could have a large influence on governmental policy. A disaster with an impact on rural areas could lead to a policy change, even if it has a relatively small impact compared to total GDP or population. The disaster count variable for country *i* at year *t* (modified from (Noy, 2009) and (Noy and Vu, 2010)) is given by 4.1:

$$D_{it} = \sum\left(\frac{(12-m_t)}{12}\right) + \sum\left(\frac{m_{t-1}}{12}\right) \qquad (4.1)$$

Where m_t is the month in country *i* at year *t* in which the disaster occurs, the m_{t-1} is the spill over effect of a natural disaster in the previous year.

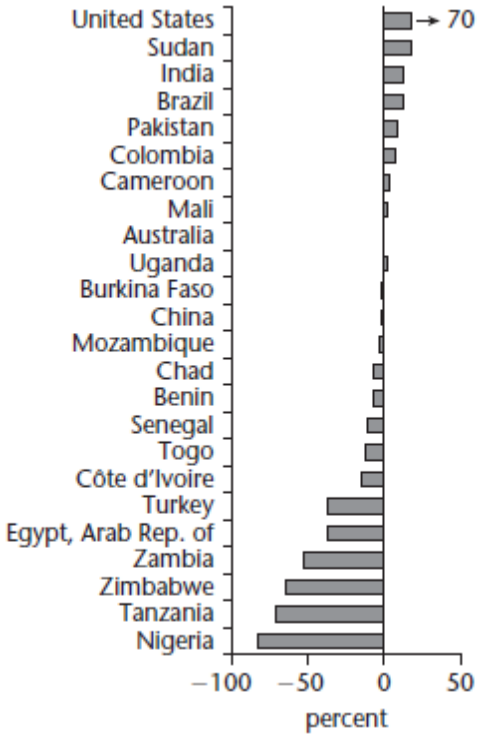
4.3 Constructing the database

The World Bank dataset for Distortions to Agricultural Incentives has observations for 74 countries (See appendix A). The included food items in this research are *Cotton, Tobacco, Rice, and Wheat*. In chapter 2 it is shown that cotton and tobacco face the highest taxation and rice is one of the most supported agricultural commodities. Wheat is produced on almost all continents.

Cotton

As Anderson (2009) shows, cotton is the non-food agricultural commodity with the highest level of protection in high-income countries, but the lowest Nominal Rate of Assistance in developing countries as shown in figure 4.1. The observations of cotton in this database are: Australia, Benin, Brazil, Burkina Faso, Cameroon, Chad, China, Colombia, Cote d'Ivore, Egypt, India, Mali, Mozambique, Nigeria, Pakistan, Senegal, Sudan, Tanzania, Togo, Turkey, Uganda, United States of America, Zambia and Zimbabwe.

Figure 4.1 NRA for cotton by country 2000-2004 (Anderson, 2009)



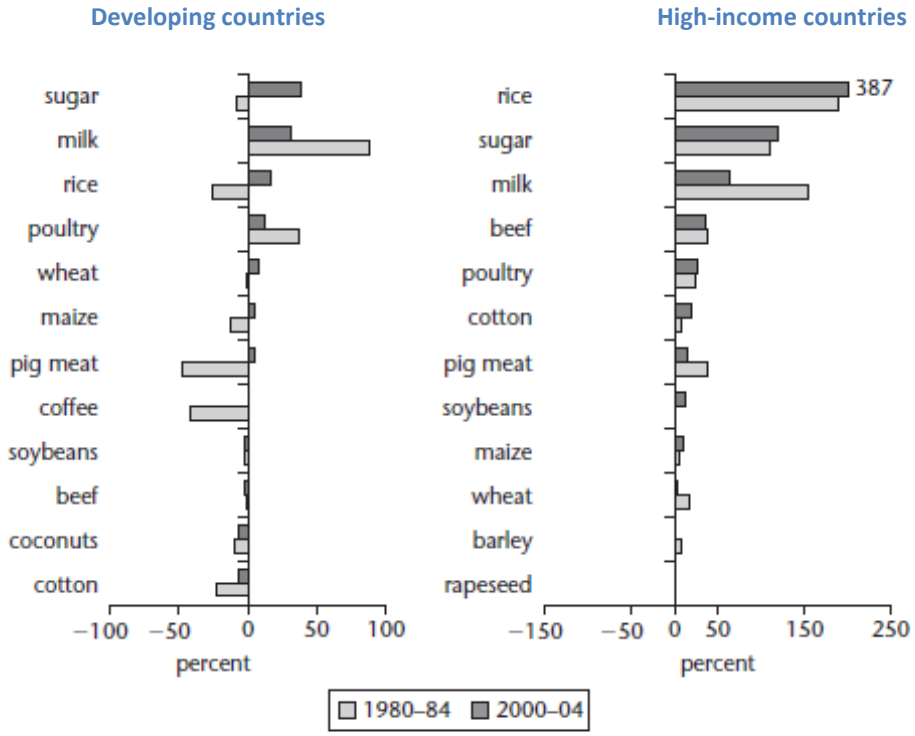
Tobacco

In the database the following countries have observations for tobacco: Australia, Benin, Brazil, Burkina Faso, Cameroon, Chad, China, Colombia, Cote d'Ivore, Egypt, India, Mali, Mozambique, Nigeria, Pakistan, Senegal, Sudan, Tanzania, Togo, Turkey, Uganda, United States of America, Zambia and Zimbabwe. These can be either producing or importing countries. The weighted average of the NRA in Mozambique, Tanzania, Zambia and Zimbabwe is -60%. This number indicates that in these countries governments tax tobacco producing farmers.

Rice

Figure 4.2 shows that in developing countries rice producers were in the period 1980-1984 taxed by the government. In the following decades, the rice producers have received protection, where in high-Income countries the average level of protection increased as well. Overall it is shown that rice is one of the most supported commodities in both high-Income countries and developing countries. There are quite a lot of countries with observations for rice both producing and importing: Australia, Bangladesh, Brazil, Bulgaria, China, Colombia, Cote d'Ivore, Dominican Republic, Ecuador, Egypt, France, Ghana, Hungary, India, Indonesia, Italy, Japan, Korea, Madagascar, Malaysia, Mexico, Mozambique, Nicaragua, Nigeria, Pakistan, Philippines, Portugal, Romania, Senegal, Spain, Sri Lanka, Tanzania, Thailand, Turkey, Uganda, United States of America, Vietnam, and Zambia.

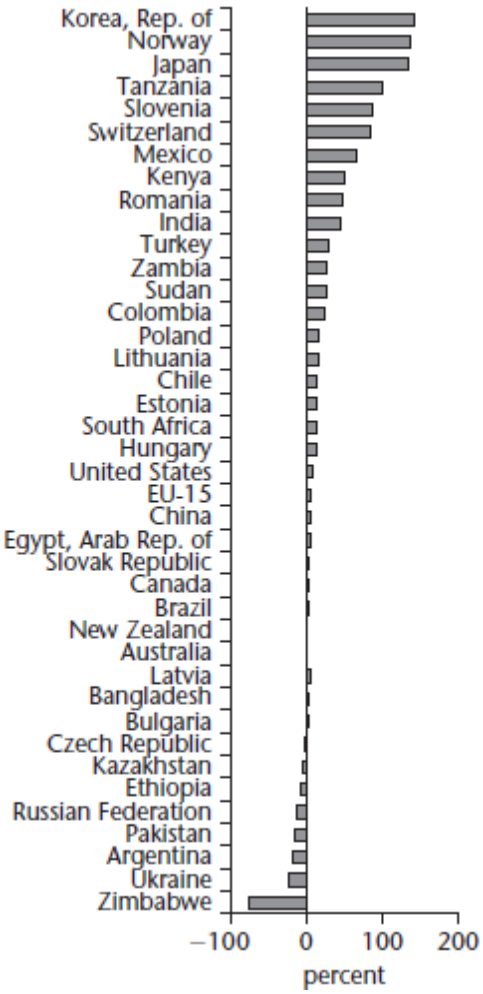
Figure 4.2 NRAs, for developing and high-income countries, 1980-1984 and 2000-2004 Anderson (2009)



Wheat

In figure 4.2 it is shown that wheat is one of the least supported commodities in high-income countries. For several countries the NRA for wheat is given in figure 4.3. It shows that especially South Korea has high levels of support for wheat producers, while Zimbabwe taxes its domestic wheat producers. The average level of NRA for wheat in the EU-15 is close to zero. Countries that have observations for wheat in the database are: Argentina, Australia, Austria, Bangladesh, Brazil, Bulgaria, Canada, Chile, China, Czech Republic, Denmark, Egypt, Estonia, Ethiopia, Finland, France, Germany, Hungary, India, Ireland, Italy, Japan, Kazakhstan, Kenya, Korea, Latvia, Lithuania, Mexico, Netherlands, New Zealand, Norway, Pakistan, Poland, Portugal, Romania, South-Africa, Russia, Slovakia, Slovenia, Spain, Sudan, Sweden, Switzerland, Tanzania, Turkey, United Kingdom, Ukraine, United States of America, Zambia and Zimbabwe.

Figure 4.3 NRA for wheat by country 2000-2004 Anderson (2009)



4.4 Building the model

To study the impact of natural disasters on protection for agricultural food and non-food commodities, panel data analysis is used. In the analysis two dimensions are used namely time (years) and countries. The analysis is applied for each commodity separately. The dataset is balanced which means that all countries remain in the dataset every year, a total of 3537 observations.

To investigate the change in policy, absolute NRA_{it} (country *i* at year *t)* values are not sufficient. To find the change in policy, one has to compare the year before the disaster and the year after the disaster ($NRA_{it} - NRA_{it-1}$) as done by Albala-Bertrand (1993). This gives:

$$\Delta NRA_{it} = \frac{NRA_{it} - NRA_{it-1}}{NRA_{it-1}} \qquad (4.2)$$

The characteristics of the ΔNRA_{it} show that it is not normally distributed with very large outliers. Further research shows that 9.9% of the observations in the database are severe outliers.

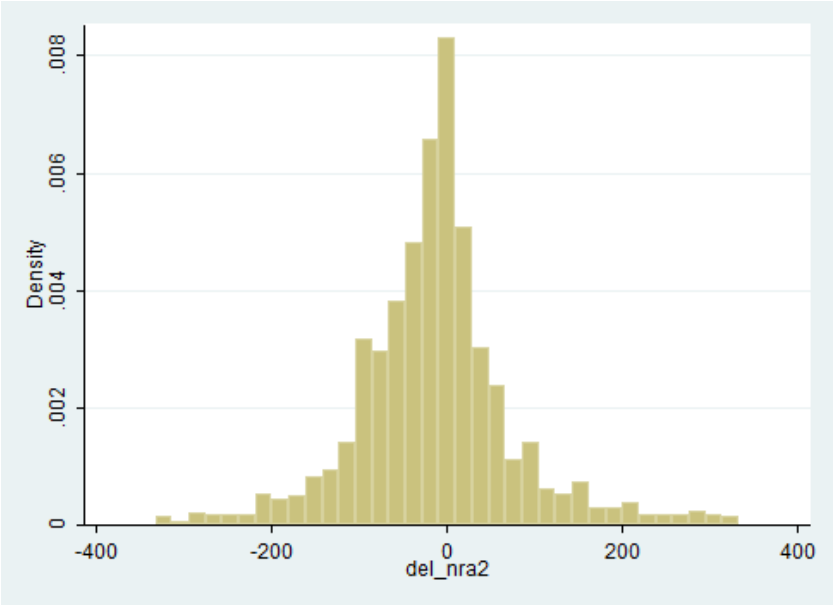
These outliers could lead to estimation bias, which occurs when the model overestimates due to some outliers ($\Delta NRA_{Zimbabwe\ 2006}$ for wheat with a value of 2.24+08). To prevent an estimation bias, the ΔNRA_{it} has to be corrected for outliers. Observations smaller than -336.4 and larger than 334.1 are considered to be outliers. The ΔNRA_{it} is therefore modified accordingly, and $\Delta NRA2_{it}$ is created.

The lower and upper bound above which outliers are erased are therefore -334 and 334, so the new $\Delta NRA2_{it}$ becomes:

$$\Delta NRA2_{it} = -334 < \Delta NRA_{it} < 334 \qquad (4.3)$$

As shown in figure 4.4, the standard deviation of the $\Delta NRA2_{it}$ has improved and it shows that there are almost no severe outliers anymore. Although at a loss of 365 observations (now 3172), the standard deviation has become better interpretable and the ΔNRA_{it} is corrected for the estimation bias.

Figure 4.4 Histogram of $\Delta NRA2_{it}$



4.5 The model

To give a general conclusion about the impact of natural disasters on the agricultural protection for food and non-food agricultural commodities a count variable has to be constructed. Equation 4.1 can be rewritten as done in 4.4, where (all_{count}) is equal to D_{it}.

$$all_{count,t} = flood_{cv,t} + wildf_{cv,t} + drough_{cv,t} + storm_{cv,t} + extr.temperature_{cv,t} \qquad (4.4)$$

The all_{count} count variable counts the disasters that occurred in a certain year in a specific country. These disasters are: *flood, wildfires, droughts, storms* and *extreme temperatures.* As explained in section 4.1 only specific hydro-meteorological and climatological events with an expected direct impact on agriculture are selected.

Since only one type of commodity is tested, a panel data model can be used to investigate the impact of natural disasters on agricultural protection for food and non-food agricultural commodities. A Hausman test is a suitable technique to test whether the model should be estimated with a fixed or random effects model (Verbeek, 2008). The null hypothesis is that the suitable model is a random effects, fixed effects is the alternative. The test compares the estimates from the fixed and random effects model

It is shown that the H0 hypothesis is accepted and the differences in coefficients are not systematic. The Hausman test shows for each commodity the presence of random effects. Therefore the panel data model is estimated with the random effects model. Random effects model assumes that the variation across variables is random and uncorrelated with the independent variable. The model estimated is:

$$\Delta NRA2_{it} = \alpha + \beta NRA_{it-1} + \gamma D_{it} + \theta X_{it-1} + \varepsilon_{it} \quad (4.5)$$

With $\varepsilon_{it} = c_i + \mu_{it}$, so the error term consists of a country specific component c_i (that does not vary over time) and a remainder component that is assumed to be uncorrelated over time μ_{it}. All correlation of the error terms over time is attributed to the individual effects c_i (Verbeek, 2008). The $\Delta NRA2_{it}$ is the growth of the Nominal Rate of Assistance corrected for outliers, NRA_{it-1} the lagged Nominal Rate of Assistance to control for before-disaster levels of support. D_{it} a disaster count variable for country *i* at year *t* as shown in equation 4.1 and X_{it-1} are control variables to control for other effects that could have an impact on the change in level of agricultural protection as explained below.

4.6 Control Variables

For each control variable the lagged variable is used to mitigate possible endogeneity and simultaneous effects. For some variables the natural logarithm is used.

Lagged Government expenditure: a larger government could have the means and incentive to respond after a disaster. Although a government might be less efficient in handling disaster response initiatives than private actors (Skidmore and Toya, 2002).

Lagged Rural population: as shown in section 2.2, governments have an incentive to support agriculture. It is expected that in countries with a large rural population agricultural protection will not decrease after the occurrence of a natural disaster (Hee Park and Jensen, 2007).

Lagged logarithm of Openness of trade: an open country has possibilities to import risk reducing technology. Thereby, increasing openness results in higher rates of exports and increased growth (Edwards, 1993). If the income of exports is not equally distributed among the population, it is possible that rural areas do not profit as much as other regions of a country. The theory of rural bias, theory of collective action or development paradox could be reasons for governments to increase their agricultural support when openness of trade increases (Hoogezand, 2013).

Lagged logarithm of Population: a larger population could drive a government for a more active role with respect to food security related issues. In section 2.2 the impact of population on agricultural protection is explained (Felbermayr and Gröschl, 2011).

Lagged Polity: a variable from the Polity IV index (Marshall and Jaggers, 2010). This database measures the level of democracy in a country. To overcome estimation bias, the Polity Index is corrected for outliers via $-10 < polity < 10$. Olper et al. (2009) have shown that there is a significant positive effect of a democratic transition on agricultural protection. Increasing levels of democracy will give increasing rates of protection. It is shown that autocratic countries tend to tax more and spend less for general public goods than democratic countries, because more resources are used for private interest in autocratic countries. The theories of collective action and rural bias give theoretical explanations for this effect. So, there is a positive correlation between the level of democracy and the level of agricultural protection (Olper et al., 2009).

Lagged logarithm of Agricultural Value Added (as percentage of GDP): it shows the level of comparative advantage. A large share of agriculture value added in GDP, shows the comparative advantage among industrialized countries. This measure also captures how short-run factors (like natural disasters) affect the level of production (Hee Park and Jensen, 2007). When agriculture becomes less important in a country its GDP, then the lobby can become more effective, as explained in section 2.2. It is expected to be negatively correlated with the NRA. (Hee Park and Jensen, 2007)

Lagged WTO agreement: for the years after the start of the negotiations of the GATT Uruguay Round a declining level of agricultural protection is expected, since this was an important issue at the bargaining table (Thies and Porche, 2007).

Lagged EU membership: countries entering the European Union have to adopt the Common Agricultural Policy (CAP). So entering the EU could therefore drive a change in the domestic NRA (Thies and Porche, 2007).

Lagged Inflation: the percentage GDP deflator, is corrected for outliers via: $\left(\frac{infl\_gdp}{1+infl\_gdp}\right)$, it is used as a measure of inflation. Inflation has a direct effect on agricultural producers since it reduces real producer prices and the value of their savings. Governments could therefore have an incentive to increase agricultural protection when inflation increases (Dennis and İşcan, 2011)

Lagged logarithm of GDP per capita: As Dennis and Işcan (2011) and Raddatz (2009) show, this control variable can be used to control for the development paradox, explained in section 2.2. A positive relationship is expected, so when GDP per capita increases, the NRA will increase as well.

5. Empirical results

Based on the steps taken in the previous chapters, the impact of natural disasters on agricultural protection for food agricultural commodities and non-food agricultural commodities is shown. For each individual type of disaster the results are provided.

For each commodity only countries with a NRA observation in the dataset are included because the impact of a natural disaster on the change in NRA is studied. Both the overall count variable (see 4.4) and the selected individual natural disasters are tested for their impact.

Results Cotton

The estimated impact of natural disasters on agricultural protection for the non-food commodity cotton is shown in table 5.1.

Table 5.1 Estimation results for Cotton

Variables	All count cv	Drought cv	Flood cv	Wildfire cv	Extr. Temp cv	Storm cv
Lagged NRA,t	-32.16**	-32.41**	-31.79**	-32.79**	-32.45**	-31.99**
	(14.77)	(14.73)	(14.72)	(14.78)	(14.68)	(14.76)
All count variable,t	0.427					
	(3.947)					
Drought cv,t		6.720				
		(13.34)				
Flood cv,t			-3.851			
			(7.881)			
Wildfire cv,t				28.70		
				(54.54)		
Extreme temp cv,t					60.41*	
					(36.23)	
Storm cv,t						-0.193
						(7.125)
Lagged Gov. Expenditures	0.935	0.952	0.914	0.975	0.964	0.927
	(1.006)	(1.005)	(1.004)	(1.008)	(1.002)	(1.005)
Lagged Rural population	0.0748	0.0704	0.0931	0.0331	-0.0270	0.0910
	(0.561)	(0.551)	(0.550)	(0.559)	(0.553)	(0.569)
Lagged Log Openness	-0.495	-0.527	1.385	-0.142	-0.655	-0.0912
	(11.54)	(11.13)	(11.54)	(11.10)	(11.08)	(11.35)
Lagged Log Population	-5.636	-5.714	-3.811	-5.231	-5.701	-5.259
	(4.723)	(3.764)	(4.799)	(3.684)	(3.680)	(4.244)
Lagged Polity	1.654**	1.695**	1.643**	1.655**	1.554*	1.645**
	(0.827)	(0.830)	(0.824)	(0.824)	(0.824)	(0.828)
Lagged Log Agri value added	-10.43	-10.25	-10.47	-8.950	-7.957	-10.77
	(12.36)	(12.18)	(12.15)	(12.58)	(12.23)	(12.59)
Lagged GATT Uruguay Round	-19.81**	-20.23**	-19.72**	-20.12**	-20.07**	-19.73**
	(9.419)	(9.444)	(9.396)	(9.422)	(9.377)	(9.408)
Lagged EU membership	0	0	0	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)
Lagged Inflation	-2.510	-2.388	-2.532	-2.517	-2.431	-2.500
	(5.507)	(5.511)	(5.506)	(5.506)	(5.494)	(5.512)
Lagged Log GDP per capita	2.894	2.977	2.610	2.580	1.855	2.942
	(9.590)	(9.586)	(9.606)	(9.606)	(9.586)	(9.625)
Constant	85.14	85.08	49.73	76.58	91.13	77.36
	(157.1)	(145.7)	(156.7)	(145.2)	(145.0)	(152.7)
Observations	595	595	595	595	595	595
Standard errors in parentheses						
*** p<0.01, ** p<0.05, * p<0.1						

Results for each disaster individually show a significant positive result for the impact of extreme temperatures on the changing growth of agricultural protection for cotton. The following control variables have a significant impact on the change of the Nominal Rate of Assistance:

Lagged NRA: The lagged Nominal Rate of Assistance has a significant negative result on the growth of the NRA in year *t.* This shows that there is a decreasing level protection over time. When in the previous year the NRA was 1 percentage-point higher, in year *t* the level of protection decreases with almost 32 percentage points. Although figure 4.2 shows that the average level of NRA in high-income countries in 2000-2004 is higher than in 1980-1984, it is shown that overall there is a decreasing level of protection with respect to cotton. An explanation could be that under pressure of WTO agreements the level of protection decreases.

Lagged Polity: Lagged Polity shows a positive significant result, indicating that when a country becomes more democratic there is growing assistance for cotton producers. The hypothesis of Olper et al. (2009) is correct for this study. When countries increase their level of democracy with 1 percentage point, their level of protection will increase with almost 1.6 percentage point. This can be explained by the theory of collective action and the rural bias (section 2.2).

Lagged GATT Uruguay Round: During the GATT Uruguay Round negotiations agricultural protection was on the bargaining table. Thies and Porche (2007) show that most governments decreased their level of protection after the WTO agreement. This is confirmed by the results found, there is a significant negative effect. For the years after the WTO negotiations, the change of the NRA decreases with almost 20 percentage points.

Extreme temperatures count variable: The results show that after the occurrence of large scale extreme temperatures, governments increase their support for cotton producers with 60 percentage-point. Further research should be conducted to explain this significant effect of extreme temperatures on increasing agricultural support for cotton producers.

Results Rice

The estimated impact of both the overall count variable as in (4.4) and the selected individual natural disasters for the agricultural food commodity rice is shown in table 5.2.

Table 5.2 Estimation results for rice

VARIABLES	all_dum2	drough_dum	flood_dum	wildf_dum	temp_dum	storm_dum
Lagged NRA	-1.646	-1.733	-1.345	-0.740	-1.277	-1.663
	(3.397)	(3.364)	(3.365)	(3.393)	(3.386)	(3.360)
All count variable,t	-0.969					
	(2.975)					
Drought cv,t		-9.427				
		(12.16)				
Flood cv,t			1.736			
			(5.722)			
Wildfire cv,t				44.45		
				(36.38)		
Extreme temp cv,t					9.648	
					(28.48)	
Storm cv,t						-2.909
						(4.493)
Lagged Gov. Expenditures	0.434	0.481	0.424	0.469	0.404	0.430
	(0.826)	(0.828)	(0.825)	(0.825)	(0.827)	(0.825)
Lagged Rural population	0.146	0.143	0.117	0.0937	0.127	0.140
	(0.324)	(0.321)	(0.325)	(0.323)	(0.322)	(0.321)
Lagged Log Openness	7.526	7.202	7.062	7.533	7.353	7.809
	(7.258)	(7.208)	(7.238)	(7.208)	(7.216)	(7.259)
Lagged Log Population	4.480	4.258	3.303	3.924	3.824	4.650
	(3.611)	(3.113)	(3.583)	(3.070)	(3.074)	(3.304)
Lagged Polity	0.0461	0.0111	0.0159	0.0718	0.0268	0.0421
	(0.613)	(0.612)	(0.615)	(0.612)	(0.612)	(0.612)
Lagged Log Agri value added	-12.16	-11.91	-12.16	-9.730	-11.76	-12.62
	(9.975)	(9.958)	(9.978)	(10.12)	(9.983)	(10.01)
Lagged GATT Uruguay Round	11.66	12.18	10.95	10.55	11.02	11.58
	(8.001)	(7.989)	(7.962)	(7.914)	(7.928)	(7.916)
Lagged EU membership	-25.17**	-25.20**	-24.28**	-23.99**	-24.37**	-25.79**
	(12.15)	(12.01)	(12.01)	(11.98)	(11.99)	(12.14)
Lagged Inflation	-1.699	-1.788	-1.809	-1.783	-1.763	-1.550
	(4.237)	(4.227)	(4.229)	(4.225)	(4.229)	(4.244)
Lagged Log GDP per capita	0.480	0.615	0.441	0.404	0.415	0.329
	(6.988)	(6.988)	(6.990)	(6.983)	(6.991)	(6.991)
Constant	-106.5	-103.6	-83.05	-101.2	-94.10	-107.6
	(119.3)	(114.3)	(120.2)	(113.8)	(113.8)	(115.5)
Observations	832	832	832	832	832	832
Standard errors in parentheses						
*** p<0.01, ** p<0.05, * p<0.1						

The following control variable has a significant effect on the change of the level of agricultural protection:

Lagged EU membership: It is shown that entering the European Union has a significant negative effect on the level of agricultural protection. Thies and Porche (2007) expected that adopting the Common Agricultural Policy would lead to an increased level of the Nominal Rate of Assistance so when a country enters the EU, the NRA would increase.

There are two main reasons for the decreasing level of NRA after entering the EU. First, Anderson (2009) shows that the NRA in the EU decreased over the period of analysis, after entering this declining level of agricultural protection continues. Second, a technical reason for a negative

magnitude, is that most EU payments are decoupled and are paid in the form of income support. These decoupled, non-product specific payments are not included in the commodity specific NRA, but only in the general NRA. Therefore a part of the support is not measured and this could bias the result as shown in table 5.2.

The results in table 5.2 show that there is no significant impact of large scale natural disasters on the change in NRA for rice.

Results Tobacco

The estimated impact of the overall count variable and the selected individual natural disasters for the agricultural non-food commodity tobacco is shown in table 5.3.

Table5.3 Estimation results for tobacco

VARIABLES	All_dum2	drough_dum	flood_dum	wildf_dum	temp_dum	storm_dum
Lagged NRA	15.87	15.75	16.47	15.69	15.67	15.73
	(14.35)	(14.34)	(14.32)	(14.29)	(14.35)	(14.37)
All count variable,t	3.603					
	(11.74)					
Drought cv,t		-9.311				
		(24.80)				
Flood cv,t			26.23			
			(26.47)			
Wildfire cv,t				0		
				(0)		
Extreme temp cv,t					2.022	
					(36.59)	
Storm cv,t						1.193
						(21.63)
Lagged Gov. Expenditures	3.330*	3.365*	3.499**	3.320*	3.317*	3.322*
	(1.741)	(1.744)	(1.744)	(1.735)	(1.742)	(1.742)
Lagged Rural population	1.181	1.185	1.364	1.163	1.158	1.166
	(1.106)	(1.106)	(1.120)	(1.101)	(1.110)	(1.106)
Lagged Log Openness	-14.69	-15.11	-15.69	-15.28	-15.13	-15.14
	(19.06)	(18.97)	(18.91)	(18.90)	(19.17)	(19.15)
Lagged Log Population	-10.77	-11.25	-11.31	-10.99	-10.94	-10.96
	(16.63)	(16.63)	(16.57)	(16.56)	(16.65)	(16.63)
Lagged Polity	0.689	0.707	0.636	0.704	0.706	0.702
	(1.395)	(1.394)	(1.391)	(1.390)	(1.395)	(1.395)
Lagged Log Agri value addec	13.52	13.65	12.39	12.95	13.16	13.13
	(24.97)	(24.97)	(24.82)	(24.82)	(25.19)	(25.13)
Lagged GATT Uruguay Rounc	4.012	5.747	4.783	4.997	4.795	4.896
	(17.70)	(17.51)	(17.35)	(17.35)	(17.79)	(17.51)
Lagged EU membership	0	0	0	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)
Lagged Inflation	-0.139	-0.744	-0.314	-0.299	-0.305	-0.298
	(5.367)	(5.471)	(5.325)	(5.324)	(5.345)	(5.344)
Lagged Log GDP per capita	9.562	9.722	12.59	9.206	9.139	9.276
	(20.53)	(20.54)	(20.72)	(20.43)	(20.54)	(20.55)
Constant	4.180	12.33	-15.27	15.67	14.62	13.46
	(277.3)	(274.9)	(275.7)	(273.9)	(275.5)	(277.8)
Observations	148	148	148	148	148	148
Standard errors in parentheses						
*** p<0.01, ** p<0.05, * p<0.1						

The following control variable has a significant effect on the change in the level of agricultural protection:

Lagged Government expenditures as percentage of GDP: It is shown that when in the previous year the government expenditures are one percentage point higher, the change of the NRA increases with around 3.3 percentage points. It shows that when a government plays a large role in an economy, it will increase the level of protection as well. A reason could be that a large government crowds out private initiatives like in the agricultural insurance market, and therefore, has an incentive to support agricultural producers.

The results in table 5.3 show that there is no significant impact of large scale natural disasters on the change in NRA for tobacco.

Results Wheat

The estimated impact of both the overall count variable) and the selected individual natural disasters for the agricultural food commodity wheat is shown in table 5.4.

Table 5.4 Estimation results for wheat

VARIABLES	all_dum2	drough_dum	flood_dum	wildf_dum	temp_dum	storm_dum
Lagged NRA	4.153	4.480	4.438	3.873	5.063	4.194
	(4.448)	(4.436)	(4.432)	(4.470)	(4.457)	(4.454)
All count variable,t	-2.708					
	(2.977)					
Drought cv,t		4.740				
		(12.21)				
Flood cv,t			-7.726			
			(5.695)			
Wildfire cv,t				-38.74		
				(36.89)		
Extreme temp cv,t					30.70	
					(24.26)	
Storm cv,t						-3.631
						(5.433)
Lagged Gov. Expenditures	0.728	0.680	0.692	0.692	0.692	0.723
	(0.668)	(0.670)	(0.667)	(0.667)	(0.667)	(0.668)
Lagged Rural population	0.238	0.186	0.233	0.217	0.171	0.224
	(0.252)	(0.248)	(0.249)	(0.248)	(0.248)	(0.251)
Lagged Log Openness	3.354	2.609	3.994	2.215	2.807	3.013
	(7.455)	(7.413)	(7.477)	(7.420)	(7.410)	(7.436)
Lagged Log Population	3.335	1.698	3.822	1.986	1.593	2.725
	(3.256)	(2.891)	(3.179)	(2.846)	(2.854)	(3.105)
Lagged Polity	-0.131	-0.0963	-0.0564	-0.132	-0.140	-0.148
	(0.586)	(0.589)	(0.588)	(0.586)	(0.586)	(0.588)
Lagged Log Agri value added	1.262	1.233	2.170	0.581	1.750	0.921
	(5.577)	(5.580)	(5.613)	(5.616)	(5.587)	(5.604)
Lagged GATT Uruguay Round	-18.38***	-19.36***	-18.39***	-18.66***	-19.62***	-18.74***
	(6.504)	(6.474)	(6.470)	(6.465)	(6.457)	(6.479)
Lagged EU membership	-14.47*	-13.29*	-14.06*	-13.97*	-12.73*	-14.30*
	(7.733)	(7.656)	(7.657)	(7.663)	(7.663)	(7.759)
Lagged Inflation	2.808	2.815	2.744	2.787	2.831	2.863
	(2.449)	(2.451)	(2.448)	(2.448)	(2.448)	(2.452)
Lagged Log GDP per capita	7.679*	7.225*	7.348*	7.587*	6.959*	7.689*
	(4.137)	(4.113)	(4.109)	(4.122)	(4.116)	(4.162)
Constant	-159.8*	-123.7	-169.1*	-129.5	-121.2	-147.2
	(96.99)	(91.01)	(95.32)	(90.37)	(90.49)	(94.95)
Observations	1,158	1,158	1,158	1,158	1,158	1,158
Standard errors in parentheses						
*** p<0.01, ** p<0.05, * p<0.1						

The following control variables have a significant result on the growth of the level of agricultural protection:

Lagged GATT Uruguay Round: During the negotiations in the GATT Uruguay Round agricultural protection was on the bargaining table. Thies and Porche (2007) show that most governments decreased their level of protection after the WTO agreement. This is confirmed by the results found, there is a significant negative effect. For the years after the WTO negotiations, the change of the NRA decreases with almost 20 percentage points.

Lagged EU membership: It is shown that entering the European Union has a significant negative effect on the level of agricultural protection. Thies and Porche (2007) expected that adopting the Common Agricultural Policy would lead to an increased level of the Nominal Rate of Assistance so when a country enters the EU, the NRA would increase. At the results for rice a (technical) explanation is provided.

Lagged Log GDP per capita: This specific control variable was included to check the development paradox. The existence of the development paradox is proven. Increasing income gives increasing support for the agricultural sector. Theoretical proof can be found in section 2.2.

6. Conclusions and discussion

6.1 Conclusions

This study tries to answer three different research questions. The first question is about why there is agricultural protection for food and non-food agricultural commodities. Theory provides six reasons for agricultural protection: Theory of collective action, vulnerability of agricultural producers, rural bias, shocks, development paradox and price/income support. Thereby agricultural non-food commodities contribute significantly to export revenues.

The second research question investigates the reconstruction of the Nominal Rate of Assistance, as created by the World Bank. This NRA measures the difference between the price of a domestic product and what it would be under free trade. The NRA exists of two parts: domestic support and border support. The border support part measures the impact of an import subsidy, import tax, export subsidy and export tax. These trade distortions influence the price of a domestic product and could explain why there is a difference between domestic price and world market price. The non-governmental reasons for price differences are filtered out by constructing the NRA. Examples of these reasons are the real exchange rates, quality differences, domestic trading cost, the processor-wholesaler-costs and level of market integration. Domestic support measures could be subsidies by local or regional governments. For products that are not traded internationally it is also possible to measure the level of support, although it is not possible to compare domestic prices with world market prices. To measure for non-traded agricultural commodities the governmental support, the domestic price elasticities are used to measure the impact of distortions.

The last question that has been answered is: What is the impact of natural disasters on protection of food and non-food agricultural commodities? The reason for governments to differ between these commodities, is that non-food agricultural commodities could generate foreign exchange, used for reconstruction materials. Supporting food agricultural commodities could increase food security.

Table 5.1 to 5.4 show the results for four commodities, two non-food (tobacco and cotton) and two food commodities (rice and wheat). In general there is no significant effects of natural disasters on agricultural protection (with the exception of extreme temparatures and cotton) and that there are also no significant differences between food and non-food agricultural commodities.

6.2 Discussion

This study shows that there is no significant impact of natural disasters on the level of protection of food and non-food agricultural commodities. this research has some caveats.

Firstly, although the NRA is constructed and calculated for different commodities and different countries, the product-specific NRA does not take all support measures into account. It is shown that decoupled and income payments are only measured by the general NRA. So, when investigating government reactions for specific commodities, decoupled payments are not taken into account, and therefore, the actual protection could be underestimated. Furthermore, the NRA does correct for quality differences, internal trading costs and international trading costs, but it is difficult to understand how exactly. Although the product-specific NRA does not measure every form of assistance, the alternatives have the same problems. The NRA has as advantage that it incorporates a large amount of countries and commodities and is therefore particularly useful for this study.

Secondly, the commodities in this research (cotton, tobacco, rice and wheat) are selected because of their worldwide production and consumption and the fact that these commodities are traded internationally. Maybe by selecting other commodities results would have been different. However, the widespread availability of the selected commodities, makes it is possible to give a general conclusion about the impact of natural disasters on agricultural protection for food and non-food agricultural commodities.

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