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A Typology for Price-related Food and Nutrition Risks and Policy Responses

D8.2 paper and database

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INTERDISCIPLINARY RESEARCH PROJECT
TO EXPLORE THE FUTURE OF GLOBAL
FOOD AND NUTRITION SECURITY

A Typology for Price-related Food and Nutrition Risks and Policy Responses

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and supplementary material

Abstract

This paper takes a closer look at price-related food insecurity by looking at commodity prices instead of the national food price indices which are under suspicion of being not representative for poor consumers. A typology is developed that distinguishes between general price instability, seasonal price instability, and price uncertainty. The typology provides an indication of the potential of policy instruments to reduce food price volatility. The paper provides a description to the database which is the product of the analysis.

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1. Introduction

By the definition of the Food and Agricultural Organization (FAO), food and nutrition security (FNS) refers to the four key dimensions availability, accessibility, utilization, and stability of food (FAO, 2006). As prices are an easy-to-observe indicator for current supply and demand conditions, stable and low prices are required to satisfy two of these dimensions, namely availability and stability. Therefore, price surges and volatility are indicators for food security risks. Several related works point to the linkages between food price volatility, measured with the food component of national consumer price indices, and acute and chronic malnutrition as measured by anthropometric data (Kalkuhl et al. 2013, Mujahid and Kalkuhl 2014).

This paper takes a closer look at price related food insecurity by looking at commodity prices instead of the national food price indices which are under suspicion of being not representative for poor consumers. A typology is developed that distinguishes between general price instability, seasonal price instability, and price uncertainty. The paper provides a description to the database which is the product of the analysis. The database can be used as motivation for case country selection (e.g. as part of the FOODSECURE project), but may also serve as input for further analysis as we also provide volatility estimates for a wide range of markets and countries; for instance to analyze the impact of food price volatility on FNS. A particular focus is directed to the vulnerability of countries to the transmission of international food price spikes into domestic markets. This is certainly related to a country's dependency on food imports. The resulting implications are also discussed.

Furthermore, we provide an overview of policy responses to price instability related food insecurity. The collection of policies largely draws from the existing literature (Demeke et al., 2014; Kalkuhl et al., 2015). The country typology highlights whether a particular type of country choses the same policy to reduce consumer price volatility and to improve FNS. A literature review on policy assessment evaluates the effectiveness of these policies on a general note, as far as possible. At the same time, we discuss which policies are recommended for a particular type of country based on experience and economic theory.

2. Data and methodology

The typology with respect to price related food insecurity is based on three indicators. First, national food price volatility measured as the extent of commodity price fluctuations in domestic food markets. Second, price transmission from international into domestic food markets which captures the risk of importing volatility from international food prices. Third, trade status defining whether a country is importer, exporter, or trade-switcher. This relates to a country's vulnerability to international price surges.

Possible methods to compute and estimate food price volatility are discussed in Kalkuhl et al. (2013) and Kornher (2014). The literature broadly distinguishes between conditional and unconditional volatility. The former is estimated conditional on past realization of volatility. In this way it accounts for so-called volatility clusters. This implies periods of high (low) volatility tend to follow periods of high (low) volatility. On the other hand, unconditional volatility computes the extent of price fluctuations within a specific time period. Kornher (2014) shows that both conditional and unconditional volatility measures yield to very similar results when comparing volatility across countries considering long and short periods of observations. Therefore, we restrict the analysis to unconditional volatility as it is fairly easy to compute. In contrast, it seems of relevance to distinguish between *expected seasonality* in prices as result of seasonality in supply, an observed characteristic in many developing countries (Kaminski, 2014), and *irregular volatility*. A possible method is to decompose a price series in its regular and irregular components using unobserved component models (UCM) (Kornher, 2014). The outcome of the decomposition is an expected time-invariant seasonal movement of prices and irregularities as the deviation of actual price realizations from its expected level. Following the methodology by Kornher (2014), three types of volatility are considered:

- *General volatility* is calculated as standard deviations of log-returns over a period:

$$Vol = \sqrt{Var}\left[\log\left(\frac{p_t}{p_{t-1}}\right)\right]$$

- *Seasonal volatility* is the expected percentage range between maximum and minimum price during a calendar year:

$$Vol = E\left[\frac{\max_m P_m - \min_m P_m}{\min_m P_m}\right]$$

- *Price uncertainty* is calculated as standard deviation of monthly deviations from expected prices determined by the UCM:

$$Vol = \sqrt{Var}[P_t - E[P_t]]$$

The second indicator applied in the typology measures the extent to which international price movements transmit into domestic food markets. International price transmission has been identified as one of the main causes of food price surges in developing countries in the period between 2007 and 2008. One should bear in mind that high price transmission is not an indicator for food insecurity *per se* but rather an indicator for the vulnerability of a country to international price risks. High transmission elasticities are typically associated to high market integration and large trade volumes; both tend to stabilize domestic prices over longer periods (Kornher et al. 2015). Nevertheless, market integration makes a country prone to (rather rare) international price shocks which are beyond the policy domain of national governments. The difficulty of governments to respond to international price shocks may explain the occurrence of national food riots associated with international food price dynamics (Bellamere, 2014). However, most available studies find mixed evidence for a strong connection between international and domestic market prices (Minot, 2011; Baquedano and Liefert, 2014). This is likely due to the inadequacy of available methods to capture asymmetric adjustment processes, but also the result of large transaction costs that make up to 60 per cent of the market prices. Kalkuhl (2014) applies a general auto-regressive distributed lag (ADL) model to make transmission independent of prevailing co-integration between international and national food prices. The short-run transmission elasticity is computed as the sum over the individual coefficient estimates for the past three months.[2] To account for multiple international reference prices, the model is applied to a number of international prices. Thus:

[2] If joint significance of the coefficients is not given, the elasticity is set to zero.

- *Transmission* to country *i* is calculated as the maximum transmission elasticity (η_{ij}) across regressions over all international reference prices (*j*):[3]

$$Transmission = \max_{j} \eta_{ij}$$

Volatility and transmission is based on monthly food prices taken from the ZEF Commodity Price Database that combines existing multinational sources, such as FAO GIEWS, WFP VAM, and FEWS.NET, with data from national statistical agencies. The volatility indicator is based on market level prices, while transmission is computed using national average retail prices.

The last FNS indicator is not based on an analysis of prices. Instead, a country's trade status captures the vulnerability to international price volatility. The underlying assumption is that the more countries import, the stronger they are hurt when international prices spike. This is the result of an increase in the food import bill. In contrast to importers, exporters and trade-switchers are not dependent on imports and will be less affected by international volatility (Kornher et al., 2015). Generally, self-sufficiency should not be equated with FNS. Therefore a country's trade status is considered to be linked to price instability related food insecurity, yet not to FNS in general. The analysis is limited to cereals which account for the largest share of caloric intake and are commonly traded. A country is considered to be a cereal exporter if its exports exceed its imports in every year since 2000. Likewise, countries whose imports have exceeded exports in every year are declared importers. Countries with varying cereal trade balances are classified as trade-switchers. The group of importers is the largest. Therefore, importers are sub-classified by the ratio of cereal imports over domestic cereal production:

- *Import dependency* is computed as the average import to production ratio over the period from 2000 to 2011:

$$\overline{IMP} = \frac{1}{12}\sum_{y}^{12} \frac{IMP_y}{Prod_y}$$

Table 1. Data sources

[3] The indicator can be considered as an upper bound transmission estimate.

Source	Data items	Link
FAOSTAT	Trade and production data	http://faostat.fao.org/
ZEF Commodity Price Database	Wheat, maize, and rice prices at retail level	n.a.
Kalkuhl (2014)	Transmission elasticities	n.a.
World Bank Food Policy Monitor	Food policies	http://www.worldbank.org/en/topic/poverty/food-price-crisis-observatory#5
FAPDA		http://www.fao.org/economic/fapda/fapda-web-based-tool/en/

The indicators are used to create a typology of price related food insecurity for developing countries and to visualize the results by mapping the indicators across countries. Following Pieters et al. (2014) and Mujahid and Kalkuhl (2014), we do not make use of the indicators in form of a continuous variable. Instead, countries are assigned to specific quintiles according to their relative position in the global sample. The five quintals refer to 'very low', 'low', 'medium', 'high', and 'very high' (for quintiles 1 to 5, respectively).

Volatility and transmission is computed for up to three commodities per country. In case prices for multiple commodities are available, the average quintile over all commodities is calculated. The resulting average quintile is divided into three categories. High volatility/transmission countries exhibit an average quintile of 4 to 5. Respectively, low volatility countries have an average quintile score up to 2, while medium volatility countries have a score between 2 and 4. In this way, countries are classified with respect to general volatility, seasonal volatility, and price uncertainty. In contrast, the trade status classification is done using thresholds rather than quintiles. A country is considered to be a cereal exporter if its exports exceed its imports in every year since 2000. Likewise, countries whose imports have exceeded exports in every year are declared importers. Importers are sub-classified according to their degree of import dependency. The thresholds applied are *less than 50 %, 50-75%, and above 75 %*.

We then categorize volatility and transmission for these countries using combinations of the indicators. Countries are categorized as suffering from *high transmission* and *high volatility*

when transmission and volatility are high. We also map divergences between the different volatility indicators.

For the typology on policy responses, most data is taken from the World Bank Food Policy Monitor and from FAO's FAPDA Policy Tool. Both collect information on different types of policies by country and commodity. In this analysis, we count policies by their occurrence and do not consider the duration period of the policy. The choice of policy variables considered is based on the empirical analysis in Kornher et al. (2015).

3. Typology on price-related FNS indicators

This section visualizes some key characteristics and patterns of the database and the typology. The tables and maps are based on the database which is related to this document.

At first, from volatility analysis it is known that international food prices are in most cases less volatile than domestic prices. Further, there are notable differences between commodities and across continents. The empirical evidence, illustrated in Table 2, shows highest volatility levels for maize and in Africa for all important staples: rice, wheat, and maize (Kornher, 2014). The seasonal gap is lowest for rice, while its seasonal volatility is higher owned to multiple harvest periods.

Table 2. Volatility across regions (mean values)

	Africa	Asia	Latin America
1. General volatility			
Rice	6.7	6.3	5.9
Wheat	9.7	9.4	6.1
Maize	13.4	10.2	9.1
2. Seasonal range			
Rice	8.9	8.2	6.4
Wheat	13.8	9.2	7.9
Maize	27.3	11.3	16.7
3. Irregular volatility			
Rice	3.6	3.0	2.8
Wheat	5.2	5.1	2.7
Maize	6.4	5.8	4.1

The country typology is developed based on the indicators outlined above. This section employs geographical mapping of the various indicators and emphasizes on similarities and abnormalities.

Before turning to the geographical patterns, Table 2 - 4 show the correlation among indicators by commodity.

Table 3. Spearman rank correlation Matrix (wheat)

	1	2	3	4
1. General volatility	1			
2. Seasonal volatility	0.88**	1		
	(0.00)			
3. Irregular volatility	0.71**	0.5**	1	
	(0.00)	(0.00)		
4. Transmission	0.79**	0.88**	0.39**	1
	(0.00)	(0.00)	(0.00)	

*Note: Significance levels are in parentheses, * p<0.05, ** p<0.01*

Table 4. Spearman rank correlation Matrix (rice)

	1	2	3	4
1. General volatility	1.00			
2. Seasonal volatility	0.6**	1		
	(0.00)			
3. Irregular volatility	0.87**	0.43**	1	
	(0.00)	(0.00)		
4. Transmission	0.34**	0.25**	0.2*	1
	(0.00)	(0.00)	(0.02)	

*Note: Significance levels are in parentheses, * p<0.05, ** p<0.01*

Table 5. Spearman rank correlation Matrix (maize)

	1	2	3	4
1. General volatility	1.00			
2. Seasonal volatility	0.89**	1		
	(0.00)			
3. Irregular volatility	0.87**	0.7**	1	
	(0.00)	(0.00)		
4. Transmission	0.37**	0.43**	0.13	1
	(0.00)	(0.00)	(0.23)	

*Note: Significance levels are in parentheses, * p<0.05, ** p<0.01*

While the Pearson correlation coefficient measures the linear dependence between the values of the different indicator variables, the Spearman rank correlation coefficient measures the correlation between the rank of each country across the different indicators. The latter is in particular useful if the relationship is monotone but non-linear. The correlation coefficients are further tested against the null hypothesis of zero correlation.

As expected, the correlation among the different volatility indicators is very high. Moreover it is to note that the correlation between volatility and transmission is also positive and significant. Notable, the correlations for wheat are extremely high. This hints at a relationship between international and domestic volatility since wheat is the most internationally traded commodity.

Table 6 depicts the top ten and bottom ten countries for each indicator. Interestingly, many countries appear multiple times (for multiple commodities) in the top ten, inter alia Zimbabwe, Malawi, Togo, Mozambique, and Tajikistan (for volatility) as well as Ethiopia, Haiti, Bangladesh, Madagascar, Kenia, and the Gambia (for transmission).

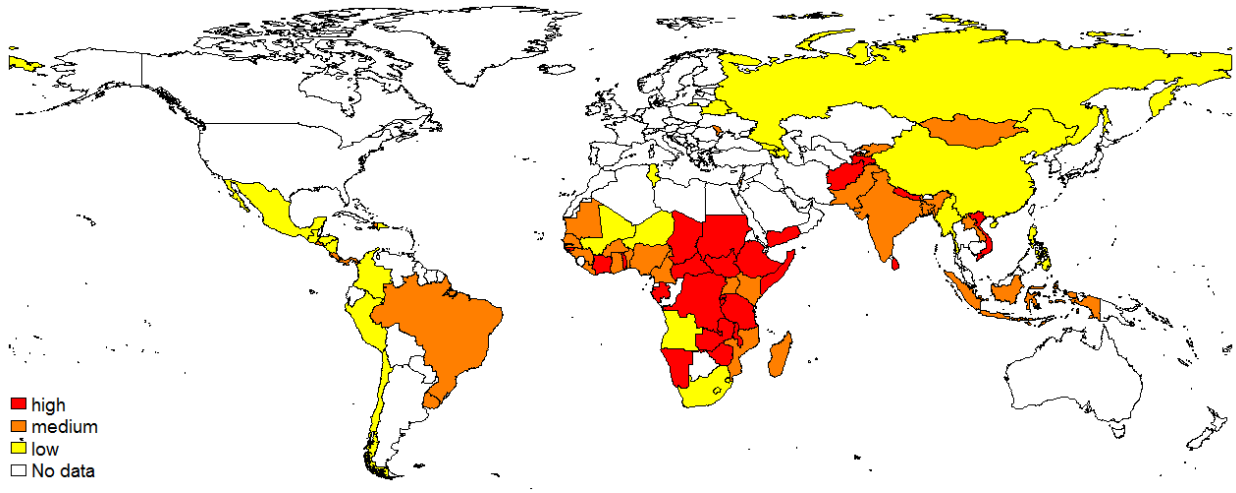
Table 6. Country rank for each indicator

	General volatility			Seasonal volatility			Price uncertainty			Transmission		
	wheat	rice	maize	wheat	rice	maize	wheat	rice	maize	wheat	rice	maize
Highest												
1	ZWE	TJK	ZWE	ZWE	BDI	MWI	ZWE	TJK	ZWE	ETH	ETH	MWI
2	COD	TCD	CIV	ETH	MWI	COD	COD	TCD	CIV	GMB	IDN	ETH
3	SDN	TZA	TJK	SDN	TJK	MOZ	SDN	TGO	TJK	IND	RWA	HTI
4	ETH	MWI	MWI	COD	COD	BEN	GAB	TZA	NAM	HTI	GMB	AFG
5	GAB	BDI	COD	GAB	GIN	ZWE	NPL	MOZ	MRT	LKA	HTI	MDG
6	AFG	TGO	TGO	TJK	TZA	ZMB	ETH	MWI	GMB	KEN	AFG	LKA
7	MRT	GIN	NAM	URY	LKA	GHA	TJK	NPL	COD	TJK	BEN	BGD
8	NPL	MOZ	MOZ	MRT	MDG	CIV	NGA	BDI	TGO	BGD	MDG	CMR
9	SLV	HTI	BEN	HTI	NPL	TGO	AFG	CRI	GIN	KGZ	PHL	MRT
10	TJK	COD	GMB	NGA	TCD	NIC	MRT	COD	TZA	CMR	KEN	GMT
Lowest												
10	KEN	DOM	SEN	KEN	BRA	MRT	GEO	NIC	CPV	CHN	CHN	MRT
9	UGA	PHL	CPV	GTM	IND	PAN	NER	URY	MLI	MEX	COL	GTM
8	GEO	NIC	PAN	TUN	NER	SEN	MNG	TUN	HND	GEO	GEO	URY
7	GTM	COL	SLV	ARM	DOM	DOM	AZE	PHL	SLV	AZE	MMR	HND
6	ARM	MMR	CRI	CHN	RUS	CRI	TUN	PER	DOM	BRA	PER	AZE
5	NER	TUN	GTM	AZE	PER	PHL	ARM	RUS	GTM	ARM	MEX	GEO
4	RUS	PER	PHL	RUS	TUN	CPV	RUS	GTM	PHL	MMR	AZE	MNG
3	TUN	RUS	PER	NER	NIC	CHN	PER	MMR	CRI	MNG	GAB	MEX
2	PER	GTM	CHN	PER	CHN	PER	CHN	CHN	PER	PER	BRA	MMR
1	CHN	CHN	MEX	MOZ	GTM	MEX	MOZ	COL	CHN	CRI	DOM	CRI

Note: ISO3 is used for country codes

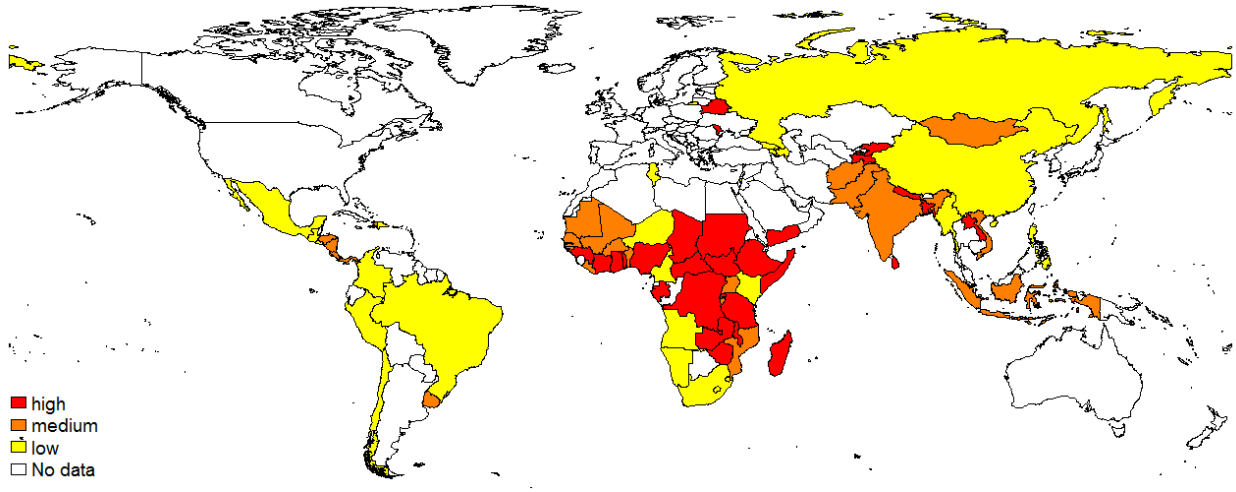
Figures 1–5 show the geographical maps for different volatility and transmission indicators. It becomes visible that all types of volatility are highest in central and eastern Africa. In contrast, transmission is rather lowest in Africa and high transmission countries can be found on each continent (Figure 5). Noteworthy, there are some countries that exhibit high seasonal price instability or high irregular volatility (price uncertainty), but no high general price volatility. This pattern is most visible in western Africa (Figure 4).

Figure 1. General food price volatility across countries



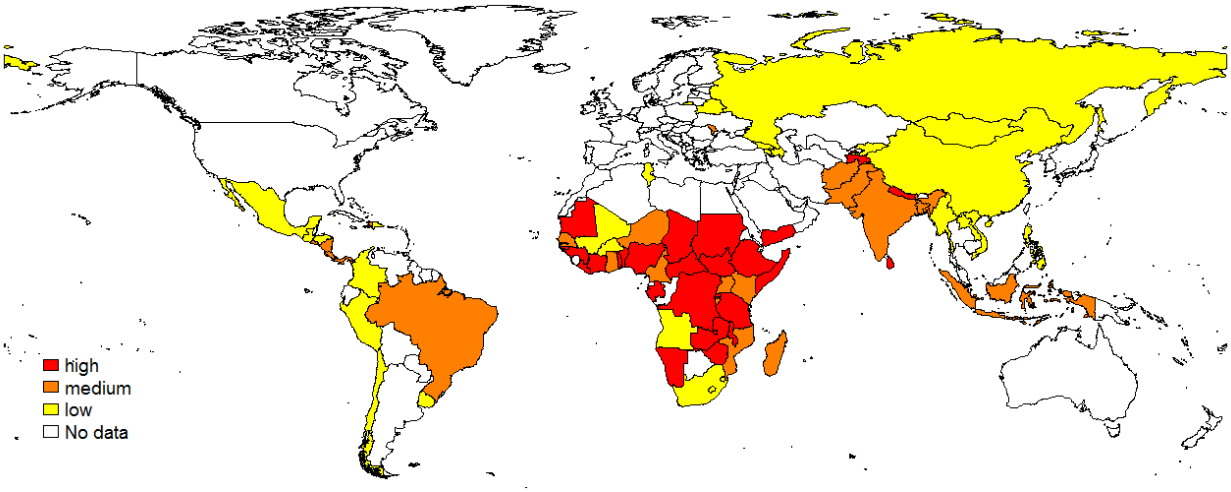
Source: Own elaboration based on data from ZEF Commodity Price Database
Note: General volatility is calculated as standard deviations of log-returns

Figure 2. Sesonal food price volatility across countries



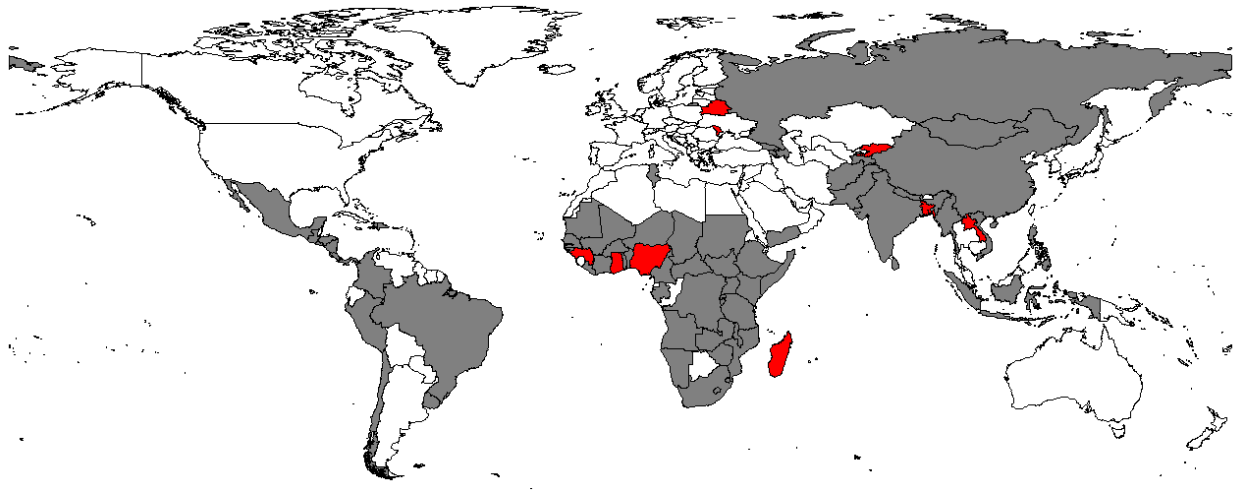
Source: Own elaboration based on data from ZEF Commodity Price Database
Note: Seasonal volatility is the expected percentage range between maximum and minimum price during a calendar year

Figure 3. Irregular volatility (price uncertainty) across countries



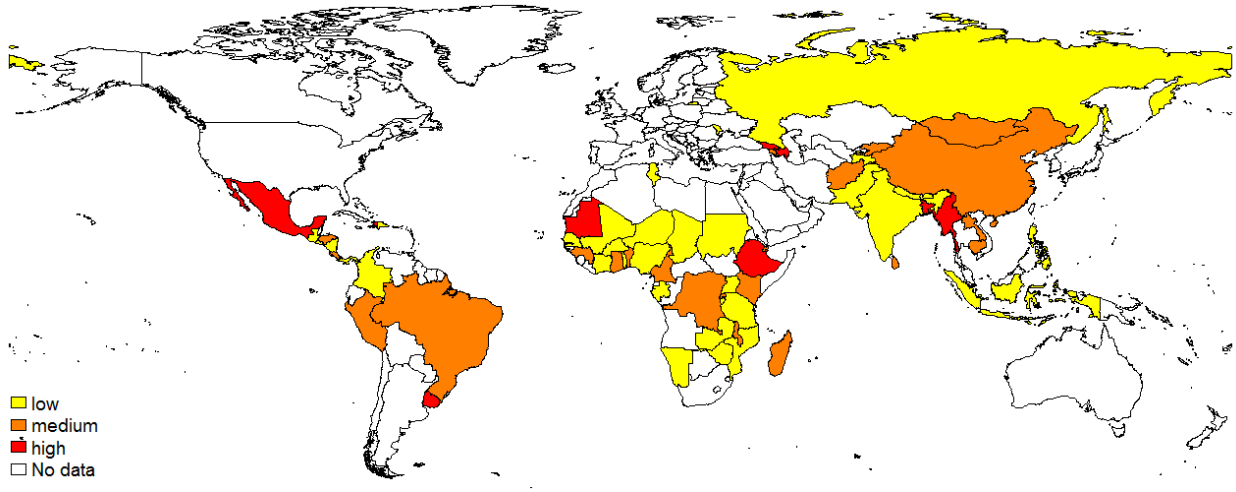
Source: Own elaboration based on data from ZEF Commodity Price Database
Note: Price uncertainty is calculated as standard deviation of monthly deviations from expected prices determined by the Unobserved Component Model

Figure 4. High seasonal volatility without high general volatility



Note: Red shaded countries are affected.
Source: Own elaboration based on data from ZEF Commodity Price Database

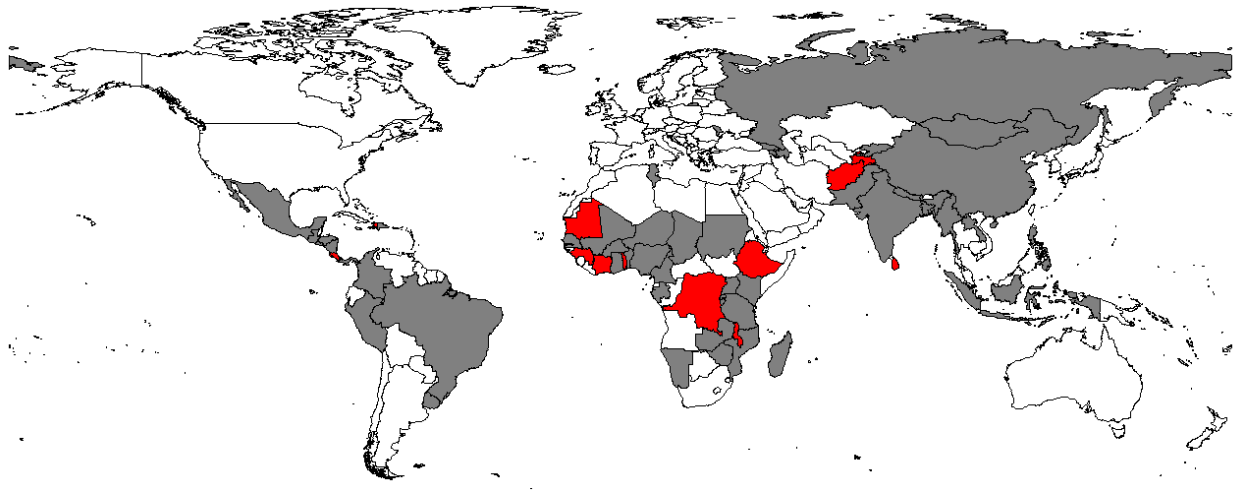
Figure 5. Transmission of international prices into domestic food markets



Note: Quintiles are computed based on the maximum transmission for a number of international references prices; for a detailed description see Kalkuhl (2014).
Source: Own elaboration based on Kalkuhl (2014).

Figure 6 depicts similarities between transmission and volatility indicators. Accordingly, Afghanistan, Cote d'Ivoire, Congo (Dem. R.), Costa Rica, Ethiopia, Guinea, the Gambia, Haiti, Sri Lanka, Mauritania, Malawi, Togo, and Tajikistan are characterized by high transmission and high volatility for at least one commodity.

Figure 6. High volatility and high transmission

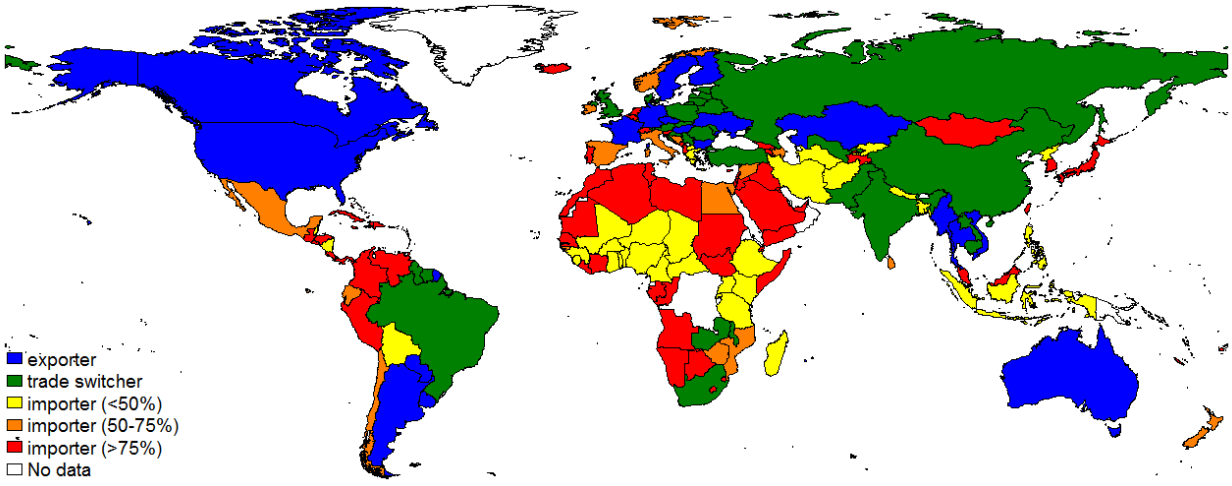


Note: Selected countries are high transmission and high volatility countries for at least one commodity; red shaded countries are affected.
Source: Own elaboration based on data from Kalkuhl (2014) and Kornher (2014).

Last, we consider a country's trade status which is a rough proxy for national food availability impacts of international price shocks. Figure 7 illustrates that import dependency is widespread phenomena for many developing countries, in particular in Africa and Latin America. This is of importance insofar as transmission of international volatility is significantly higher for food importers (see Figure 8). Thus, in the long-run more than 50 percent of international volatility is transmitted to importing countries.[4]

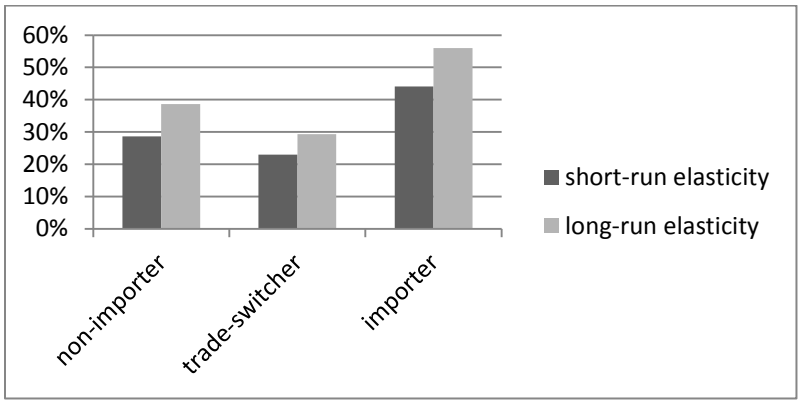
Figure 7. Trade status for cereals by country

[4] The analysis controls for other explanatory variables and persistence of volatility.



Note: Import ratio is computed relative to domestic cereal production.
Source: Own elaboration based on data from FAOSTAT.

Figure 8. Volatility transmission by trade status



Note: Non-importers are exporters and trade-switchers combined; exporters alone contain too few observations.
Source: Kornher et al. (2015).

4. Typology of policy responses to price shocks and volatility

The various policy responses to the food crisis in 2007/2008 and 2011 are thoroughly discussed in the price volatility literature (Kalkuhl et al. 2015). On the other hand, little is known about the effectiveness of different instruments to combat volatility or to mitigate consequence of price fluctuations. In the following, the most common policy measures are discussed and evaluated based on empirical research findings based on Kornher et al. (2015) and on the literature review in Kalkuhl et al. (2015). These instruments are: import and export regulation, price stabilization

through public storage, and last risk management and fortification of market institutions. General production oriented policies are not considered since they aim at increasing production in the long-run rather than impacting on volatility in the short and medium-run.

4.1 Trade policies

Contrary to long-term oriented trade policies that typically aim at revenue generation or protection of domestic producers, short-term trade intervention seeks to manipulate domestic prices. Here, we consider the latter motive only – the case of anti-cyclical trade policy as a response to international price spikes. As in most countries import tariffs and export taxes are the status-quo, it is important to distinguish between changes in the status-quo policy regime and effects of import and export policies in the long-run.

4.1.1 Import tariffs and subsidies

Import taxes protect producers by competitiveness of national products. Nevertheless, international prices impact on domestic market prices whenever a significant share of national consumptions arises from imports. In times of international price spikes, a reduction or abolition of tariffs reduces border prices and lowers market prices for consumers. A re-introduction of import tariffs, to reduce volatility by strengthening self-sufficiency, is only effective in the long-run.

4.1.2 Export restrictions

Export taxes, quotas, and complete bans are all applied to guarantee sufficient domestic supply which in turn reduces market prices. This takes profit opportunities away from producers and traders. Therefore, these policies are mainly used for a relatively short period to calm down prices. Otherwise, disincentives to production and trade will reduce domestic supply in the long-run.

4.1.3 Negative externalities and general trade liberalization

In a globalized world, many countries are linked through food trade and depend on imports to satisfy national demand (See Figure 7). So, export restrictions of country *i* also have

consequences on country *j* as long as the exporter carries significant weight in international trade. Thus, national policies cannot be considered in isolation, and positive effects on the domestic economy need to be weighed against negative externalities for other countries.

4.2 Public storage

The seasonality and stochasticity of production makes storage an effective instrument to transfer supply to future periods and to guarantee food availability at all times. In this way, prices are stabilized across time. In market economies, the competitive storage model predicts that private market actors will find the optimal stock levels to smooth prices over time.[5] However, interest rates and thus, costs of storage, or often very high in developing countries leading to low stock-to-use levels and therefore to strong intra-annual price fluctuations. In addition, insurance markets are usually incomplete and do not allow a sufficient risk management. In consequence, increasing total storage through public stocks can be a welfare enhancing policy instrument (Gouel 2013).

4.2.1 Price stabilization

Generally, price stabilization through public storage can benefit both producers and consumers. Therefore, public storage can be found under producer and consumer oriented policies. In buffer stock scheme, the public food storage company purchases from farmers at predetermined floor prices whenever the market does not offer higher prices. Thus, additional demand increases market prices. On the other side, public distribution (at subsidized or market prices) takes place whenever market prices exceed a predetermined ceiling. In this way, additional supply reduces price levels. The operations of the buffer stock require sufficient monetary funding, while large stocks tie a significant share of the public budget. Furthermore, public intervention in the market crowds-out private market activity (Gouel 2013).

4.2.2 Subsidized food distribution / strategic reserve

[5] Optimality is in general not achieved if consumers are risk averse and insurance markets for consumers against price shocks are missing (Gouel 2013). In this case, the competitive storage model predicts stocks that are too low from a social optimum perspective which can be addressed, for example, by subsidies for private storage.

Apart from price stabilization that works in both directions to increase and decrease market prices, public stocks can also be used as a strategic reserve that is aimed at overcoming supply shortages only. In this instance, food is distributed to the vulnerable at subsidized prices whenever an emergency situation is identified. This situation is usually triggered by price levels or national supply figures. Public food distribution demands available distribution channels via safety net programs including targeting of the poor. Its impact on domestic prices is low due to the small size of the strategic reserve and the targeted release to the vulnerable population.

4.3 Risk management/ institutions

In this category of policies, we include instruments that aim at improving the quality of markets and at reducing transaction costs. These policies do often not directly affect market prices, but foster institutional quality. Besides, the impacts are primarily observable in the medium to long-run (Kalkuhl et al., 2015).

4.3.1 Market information

Information about market prices as well as supply and demand patterns is crucial to all market participants. In particular farmers and traders in remote areas have little access to knowledge on prevailing market conditions. Agricultural market information services make price information accessible (even in remote areas) via mobile phone text messages sent to subscribers. Price and market information also allow farmers to participate in agricultural trading (Courtois and Subervie, 2015).

4.3.2 Commodity exchanges, risk management and insurance

Farmers are prone to many risks related to their produce (e.g. drought, flood, price spikes). In the industrialized world, agricultural exchanges allow these farmers, but also traders, to hedge their price risk by forward contracting. In the same manner, insurance can compensate farmers for losses in consequence of weather events or low market prices. Through effective risk management instruments, investment in agriculture can be increased. Public policy can help to

establish private sector initiatives or directly offer insurance and risk management tools to farmers (e.g. warehouse receipt system) (Demeke et al., 2012).

4.3.3 Infrastructure

Transportation costs are a major obstacle to market integration in many developing countries. Thus, infrastructure plays a key role to stabilize market prices through inter-regional trade. From a policy perspective, this implies investment in road, railway, and port infrastructure.

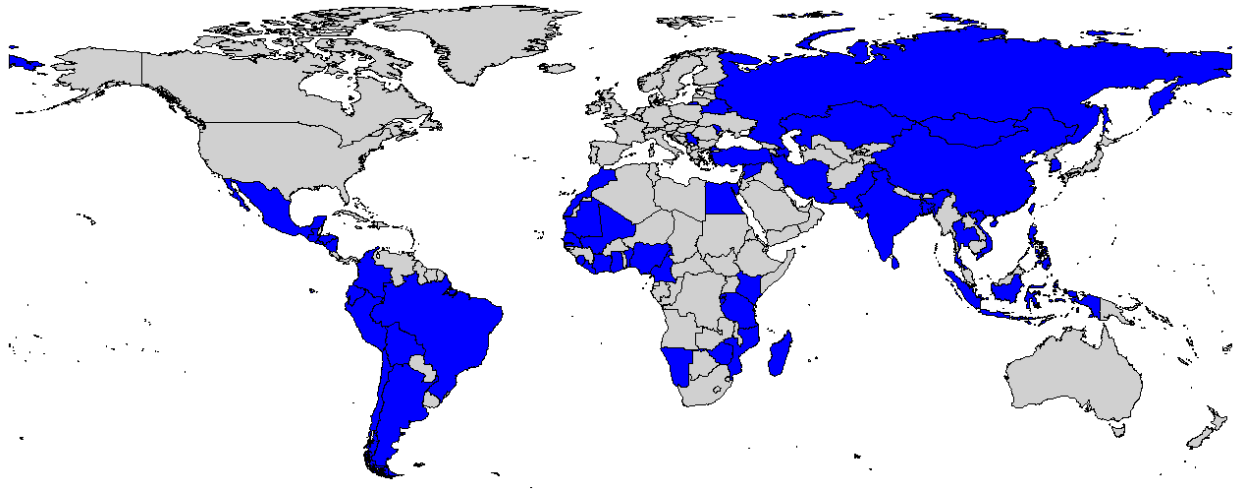
4.3.4 Economic freedom and contract enforcement

Last, economic freedom and contract enforcement are classical determinants for the attractiveness of investment. Investment in agriculture is important to increase productivity and to decrease the costs of storage for farmers and traders.

4.4 Policy responses across countries

Trade policies were the most common policy interventions during the food crisis period between 2007 and 2012. In total 63 countries applied either changes in import duties or export regulations or both of them. More precisely, 55 countries changed their import tariffs during the respective period at least once and 34 countries regulated imports in form of quotas, taxes, or complete bans. 26 countries did both. The data by country is given in Figure 9 and Figure 10.

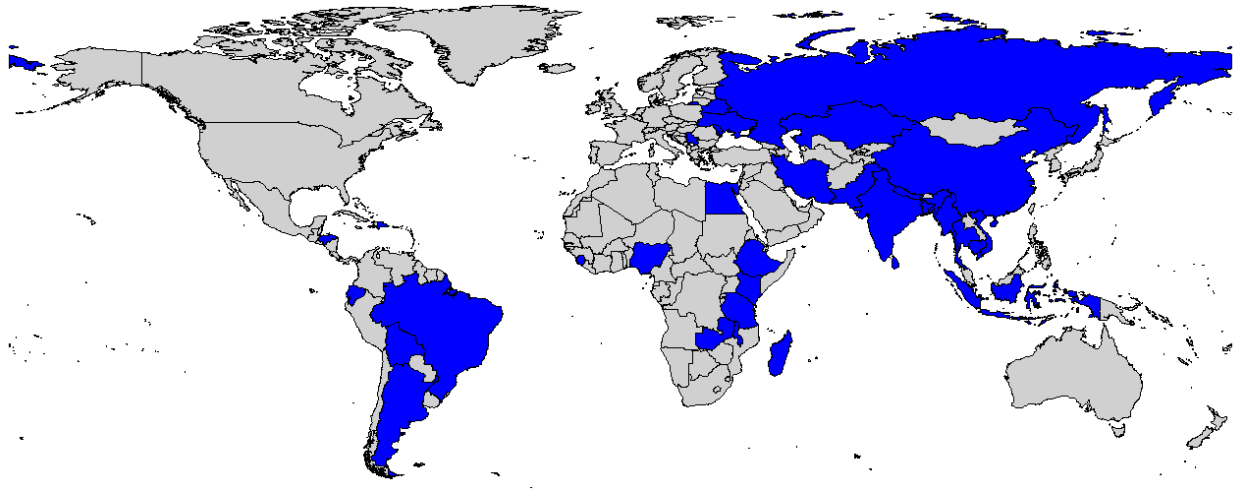
Figure 9. Countries changing import tariffs (2007-2012)



Note: Blue shaded countries used policy instrument.
Source: World Bank Food Policy Monitor (2014).

Changes in import tariffs are very prominent in Latin America, South and Central Asia, as well as western and eastern Africa. Although there is a large overlap between export restriction and changes in import tariffs, there are some notable differences between Figure 9 and Figure 10. Namely, West African countries have not used export restrictions with few exemptions. Similarly, only Brazil, Bolivia, Argentina, Dominican Republic, Honduras, and Ecuador imposed export restriction among Latin American countries. In Asia, the big exporters Thailand and Vietnam applied export restrictions, but did not change import tariffs. It is not surprising that export restrictions are mainly implemented by non-importers. Changes in import tariffs are also very common among these countries, but more widespread among food importers.

Figure 10. Countries applying export restrictions (2007-2012)

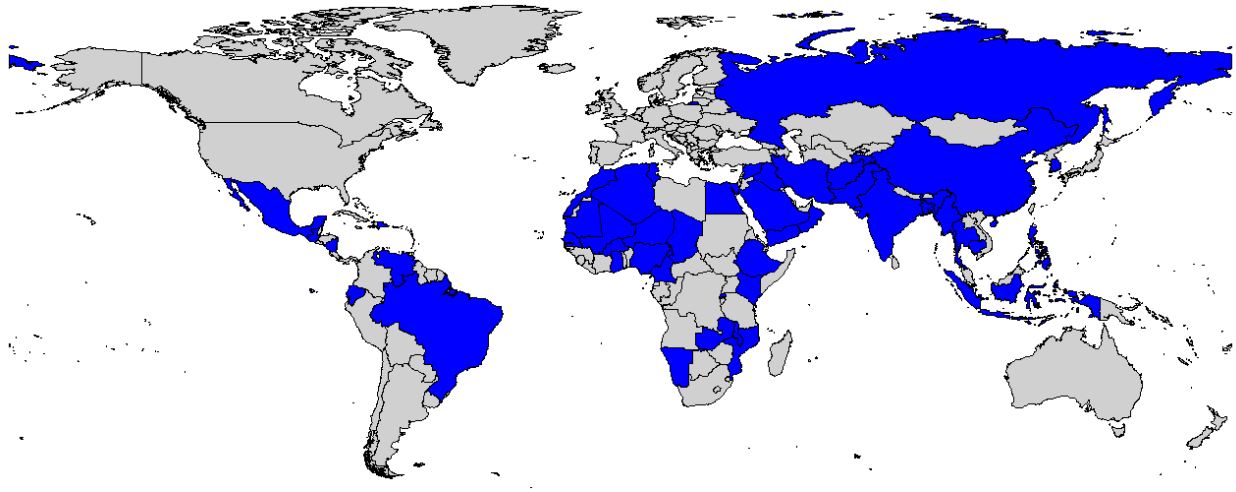


Note: Blue shaded countries used policy instrument.
Source: World Bank Food Policy Monitor (2014).

In total, 56 countries are reported to undertake public storage in form of either a strategic reserve or buffer stock scheme. Many of these countries only implemented their reserve during the observation period (FAPDA, 2014). Geographically, public stocks are mainly used in western and eastern Africa as well as the whole of Asia (Figure 11). In Latin America, only Brazil, Venezuela, Ecuador, Guatemala, Dominican Republic, Mexico, and Nicaragua use public storage to reduce price volatility. Noteworthy, a distinction between buffer stock scheme for general price stabilization and strategic reserve for food distribution during crisis is difficult. In many countries, the legal framework and the tasks of the national food companies are not clearly assignable to either of the categories. Furthermore, the extent of market intervention, measured by the share of public activity in total grain trading, is impossible to quantify for a large number of countries since national stocking agencies are often not transparent with regard to their market activity. Kornher et al. (2015) categorize countries as high intervention countries based on qualitative research.[6]

Figure 11. Countries with public storage

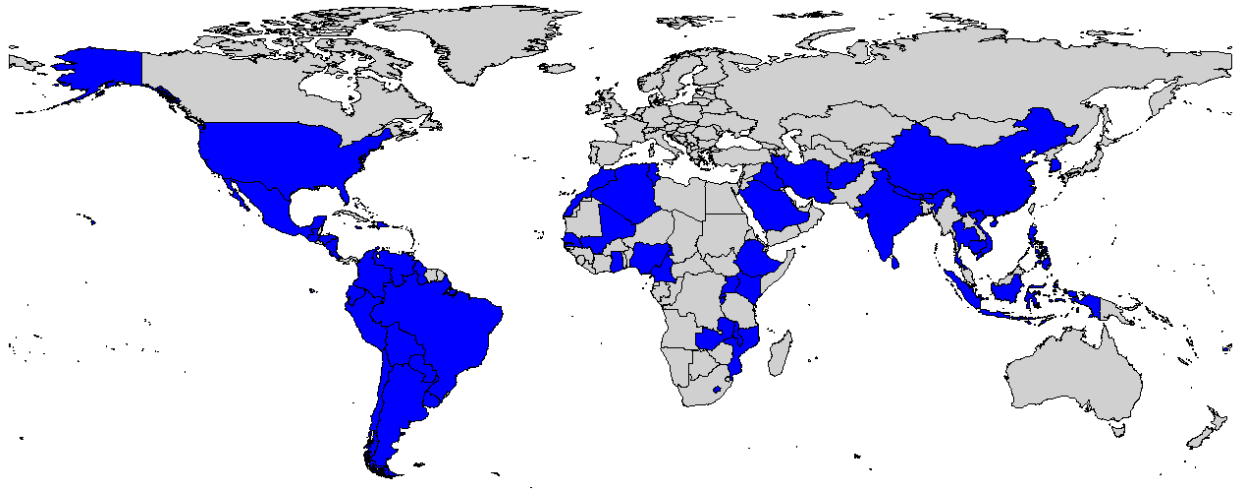
[6] These countries are: Burkina Faso, Bangladesh, Brazil, China, Egypt, Ethiopia, India, Indonesia, Kenya, Cambodia, Mali, Myanmar, Malawi, Nepal, Pakistan, Philippines, Russia, Thailand, Turkey, Vietnam, Zambia, and Zimbabwe. Note, the sample does not include all countries.



Source: FAPDA (2014).

Last, Figure 12 presents a map including a labelling for countries that used policies to strengthen risk management and institutional quality during the observation period which include policy measures as discussed in Demeke et al. (2012). In total 47 countries are reported to have used such policies. Interestingly, this type of policies was widespread in Latin America. The remaining countries lie in western and eastern Africa, the Maghreb area, Middle East, and South and Southeast Asia.

Figure 12. Countries strengthening risk management and institutions



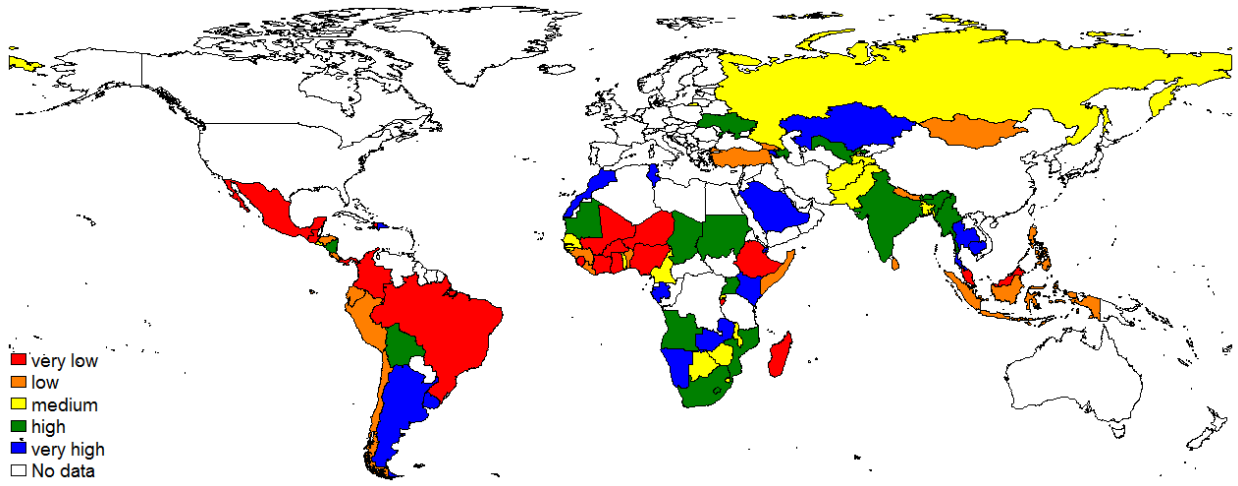
Source: FAPDA (2014).

4.5 Effectiveness of policy responses

In this section we want to shed some light on the empirical evidence with regard to the policies discussed in the previous part. The influence of trade policy change on price volatility is well researched. For changes in import tariffs the effects are clear. A change in transactions costs directly affects consumer prices. In this way, importers can successfully mitigate price spikes, however, only by the extent they can reduce the tariff. In line with latter, Aker et al. (2011) find suspension of rice import duties in West Africa to be insufficient to completely buffer price increases. As opposed to this, the price stabilization effect of export restrictions is well acknowledged (Martin and Anderson, 2012; Kornher et al., 2015). Temporary export barriers are an effective tool for exporters and trade-switcher, but not for food importers (Kornher et al., 2015). Apart from the direct effects on domestic price volatility, export restrictions of major exporters also affect international prices. This negative externality was identified during the world food crisis in 2007/2008. Martin and Anderson (2012) estimate the effect of national export restrictions on international price increases to be between 30 (wheat) and 45 (rice) percent. Therefore, it cannot be generally recommended to employ export restrictions considering the severe consequences to food import dependent countries.

Next, storage is found to be very critical to reduce domestic price instability (Kornher et al., 2015). Empirically, it is very difficult to distinguish between public and private stocks. Kornher et al. (2015) identify no impact of public storage on price stabilization after controlling for the level of stocks. This implies storage is important regardless whether private or public actors do it. Therefore, countries with low private storage should consider public interventions to increase national storage in order to stabilize prices. In contrast, country-level studies as Mason and Myers (2013) and Jayne et al. (2008) conclude that the national food reserve agencies in Zambia and Kenia were successful in dampening price variability. This makes it apparent that the effects are case dependent. Further, the institutional capacity may vary across countries. A soundly managed reserve may be effective to combat price instability, while mismanagement and corruption cause complete inefficacy of the intervention. Looking at cereal stocks (normalized as stock-to-use ratio), makes it visible which countries possess lower stocks in international comparison. These countries have great potential to achieve higher price stability by increasing stocks, but are also currently highly vulnerable to price volatility. This is the case for West Africa and Latin America (Figure 13).

Figure 13. Mean stock-to-use ratios across countries



Source: FAO GIEWS (2014).

Last, we consider risk management and market oriented policies. Low institutional quality is often referred as one of the major causes of market instability. The rising of mobile phones and increasing mobile penetration across developing countries reduced transaction costs in recent years substantially. In line with this, price volatility can be diminished significantly and at high margins by strengthening institutional quality (Kornher et al., 2015).[7] Indeed, apart from stocks institutional quality is the most effective instrument to stabilize prices as presented in Table 7. Figure 14 maps institutional quality across countries. From this, it can be seen that (very) low institutional quality is found in Africa with only a handful exemptions. This indicates a high scope of improvement of institutions in these countries which in order to achieve commodity price stabilization.

Table 7. Relative importance of explanatory variables

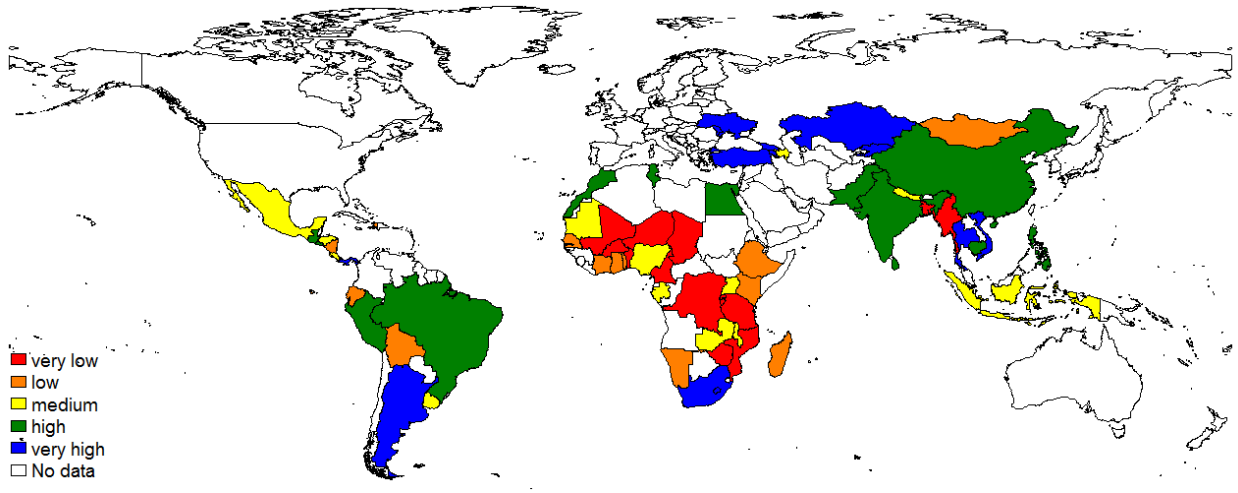
	Short term		**Long term**	
	Min	**max**	**Min**	**Max**
Vol int price	**17%**	**22%**	**25%**	**32%**
Production	**-2%**	**-7%**	**-4%**	**-10%**
Stocks	**-22%**	**-48%**	**-33%**	**-70%**

[7] Institutional quality is measured as an equally weighted average between road infrastructure, mobile penetration, economic freedom, and the presence of an agricultural commodity exchange in the country.

Export restrictions	**-14%**	**-15%**	**-21%**	**-22%**
Int. export restrictions	**1%**	**4%**	**1%**	**5%**
Share in reg trade	**-35%**	**-38%**	**-51%**	**-55%**
Money growth rate	**2%**	**5%**	**3%**	**7%**
Market institutions	**-17%**	**-22%**	**-25%**	**-32%**

Source: Kornher et al. (2015).

Figure 14. Market institutions across countries



Source: Kornher et al. (2015).
Note: Market institutions are calculated as an equal weighted index that captures quality of roads, economic freedom, mobile penetration, and the existence of a commodity exchange.

5. Conclusions

This typology aims to identify countries with food and nutrition security risks related to international and domestic markets. Price volatility is related to the stability dimension of food availability – sudden price increases signal periods of low availability. In the typology, we first identify countries with volatile food prices. We decompose volatility into an (anticipated) regular seasonal component and into irregular volatility – both imply temporarily food shortages but have different causes and demand for different policies. Grouping countries according to their degree of price transmission and import dependency identifies states that might be vulnerable to

sudden international crises – although high market integration tends to reduce volatility in general.

Additionally, we elaborated different policy responses of countries to reduce domestic volatility, insulate international price shocks and to improve risk management. The underlying assessment of these policies is largely based on Kalkuhl et al. (2015) and the empirical work in Kornher et al. (2015). The typology hints at countries with large potential to reduce volatility according to several policy instruments. A cautionary note, however, is in order: The effectiveness of a specific policy is also context-dependent and influenced by the domestic institutional setting. Thus, increasing stock levels in countries with low stock-to-use ratios is not always the best option to improve food and nutrition security. The typology therefore cannot serve as ready-to-implement policy catalogue. Rather, it can motivate in-depth and case-study analysis in particular policies that are indicated to have a large impact on reducing volatility.

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FOODSECURE
FOR POLICIES THAT MATTER

The FOODSECURE project in a nutshell

Title	FOODSECURE – Exploring the future of global food and nutrition security
Funding scheme	7th framework program, theme Socioeconomic sciences and the humanities
Type of project	Large-scale collaborative research project
Project Coordinator	Hans van Meijl (LEI Wageningen UR)
Scientific Coordinator	Joachim von Braun (ZEF, Center for Development Research, University of Bonn)
Duration	2012 - 2017 (60 months)

Short description

In the future, excessively high food prices may frequently reoccur, with severe impact on the poor and vulnerable. Given the long lead time of the social and technological solutions for a more stable food system, a long-term policy framework on global food and nutrition security is urgently needed.

The general objective of the FOODSECURE project is to design effective and sustainable strategies for assessing and addressing the challenges of food and nutrition security.

FOODSECURE provides a set of analytical instruments to experiment, analyse, and coordinate the effects of short and long term policies related to achieving food security.

FOODSECURE impact lies in the knowledge base to support EU policy makers and other stakeholders in the design of consistent, coherent, long-term policy strategies for improving food and nutrition security.

EU Contribution	€ 8 million
Research team	19 partners from 13 countries

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