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National food security: a framework for public policy and international trade

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Abstract:

This paper does not set out to redefine and re-explain the food security concept, but to look into the links between food security and international trade. First, we propose a conceptual framework to sum up the relationships between food security, international trade and public policies. Second, we check whether the widely used food security indicators are really suited to monitoring the impacts of government interventions and external trade shocks on the food security level. We use the Bonilla Index as our food security indicator throughout this analysis of the impact of national policies on food security.

Introduction

Food security is a major concern, especially for developing countries where a large percentage of the population lives in rural areas and the agricultural sector represents a substantial weight in the economy.

First coined in the mid-1970s, food security is a multi-dimensional concept as shown by the many attempts to define it (Maxwell and Smith, 1996; Clay, 2002). Food security has been analysed at many levels (individual, household, regional, national and global) over time, but food security at one level does not guarantee food security at another level. The FAO has the definition that, "Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life," (World Food Summit, 1996). This definition includes four components: physical availability, economic access, stability of access and adequate utilisation.

The food security issue has come to the fore in recent years with the 2007-2008 food crisis and agricultural price volatility. For decades before, the focus was more on producers with lower incomes due to lower agricultural price trends. The 2007-2008 price hike turned attention to poor consumers as

food riots erupted in many developing countries. Low-income countries are particularly vulnerable to agricultural price surges.

This paper does not set out to redefine and re-explain the food security concept, but to look into the links between food security and international trade. First, we propose a conceptual framework to sum up the relationships between food security, international trade and public policies. Second, we check whether the widely used food security indicators are really suited to tracking the impacts of government interventions and external trade shocks on the food security level.

1. Conceptual framework for food security

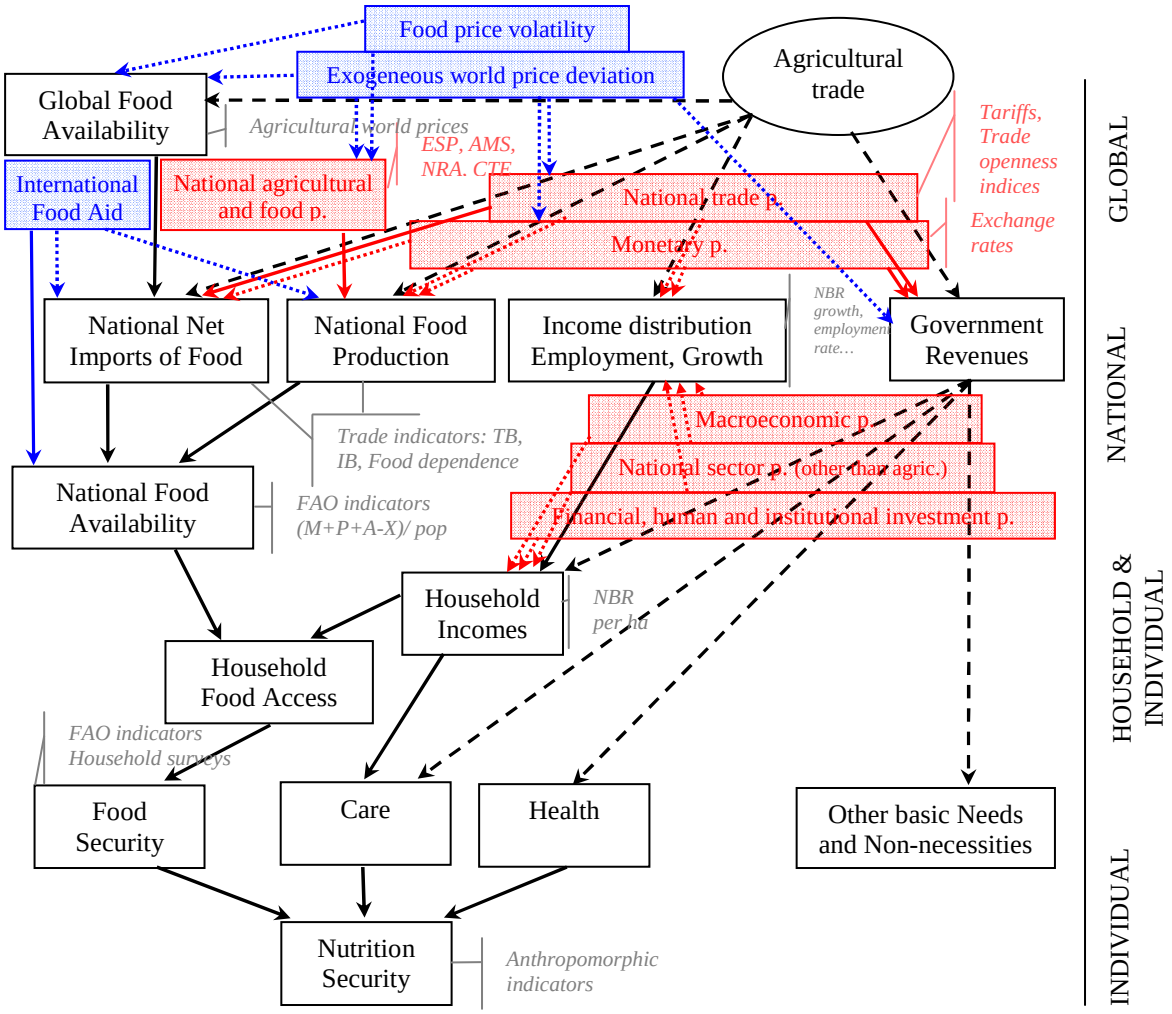
1.1. Extending the Diaz-Bonilla framework (2000)

Diaz-Bonilla *et al.* (2000) take the traditional definition of food security and propose a conceptual framework for food security, adapted from Smith (1998), which displays the multiple links and interactions between trade and food security at each level (from individual to global level).

Diaz-Bonilla & Ron (2010) demonstrate the key role played in national food security levels by: i) agriculture, a major sector in most developing countries where food security is at risk; ii) domestic agricultural and food trade policies prompting agricultural price deviations that have opposite effects on net buyer *versus* net seller households; and iii) trade policies in developed and developing countries that affect the domestic and foreign agricultural markets, since WTO regulations have little influence on the use of trade policy tools. They also suggest considering the positive effects on employment and poverty alleviation of suitable macroeconomic policies in other areas such as agricultural, financial, human and institutional concerns.

This section proposes extending Diaz-Bonilla and Ron's framework further to bring out the links between food security, national food policies and food security indicators. Our contribution takes two angles. First, we present an overview of the main food security indicators used for each level. Second, we identify the national policies that could have an effect on food security and analyse whether they do indeed have an impact on the indicators. The analyse focuses on the national level and does not develop the aspects of individual and household food access.

Figure 1. An updated/extended conceptual framework for food security



Source: Diaz-Bonilla *et al.* (2000) revised by Laroche Dupraz and Huchet Bourdon with corresponding indicators (in *italics*), national policies (in red) and exogenous determinants (in blue). "p.": policies.

1.2. Food security indicators

A review of the body of food security literature turns up a range of indicators for the different levels.

One of the most well-known national indicators is probably the FAO Prevalence of Undernourishment Indicator. This is expressed as the share of the population that does not meet the minimum food energy requirement. National food availability is calculated using aggregate data on the sum of food imports, domestic production and international food aid minus food exports and divided by the population. This can be converted into calories, for example, to find average available calories per capita in each country. The indicator is hence available at individual level. Although this kind of indicator has the advantage of covering long periods for the largest panel of countries, it does raise problems of consistency with other approaches (De Haen *et al.*, 2011, Masset, 2011). IFPRI draws on the FAO

indicator to compute the Global Hunger Index, which covers the proportion of underweight under-fives and the mortality rate for under-fives. Yet although this indicator provides more information by combining utilisation with availability and access, it still concentrates on the national level.

Other indicators are obtained from household food consumption surveys and anthropometric measures at individual level. These measurements have the advantage of providing disaggregated data, but call for a large database. They also have to do with much more than just national food policies since they take in the people's health, transport, logistics, national and infra-national distributive infrastructures and the overall wealth of the population. They hence relate to the "macroeconomic policies", "national sector policies (other than agricultural)" and "financial, human and institutional investment policies" mentioned in Figure 1. Those policies impact on national growth, household income, health and care at national and individual levels. We will not develop these issues further in this paper. In addition, no one of these undernutrition indicators alone provides the means needed to assess the trade vulnerability of national food security due, for example, to food dependence on imports or a lack of external trade resources to finance food imports.

At global level, the agricultural price index is an accurate indicator of global food availability: rising prices point to a deficit of supply and excess of demand, i.e. falling world food security. This explains why the question of world food security re-emerged in 2008 following the agricultural price surge.

The world agricultural price surge in 2007-2008 showed that developing countries, particularly Africa, are constantly at risk of chronic food crisis. Food riots, rocketing prices and concerns about the future effects of climate change have led some to claim that food security is improved by agricultural trade liberalisation, because only trade can offset local market shortcomings and provide consumers with commodities at low prices. Timmer (2010) suggests that the best way to prevent food crises in the long run is to invest in "agricultural productivity and policies on behalf of stable food production and prices" rather than "trying to cope afterwards with the food crisis impact on the poor."[1]

To be more specific, agricultural and food imports play a key role in food security in low-income countries. Indeed, dependence on imports for food may raise a food security problem in the case of sudden price hike putting up the national food bill. The national state of food availability in the form of food imports and domestic food production is therefore crucial information.

So the food trade balance (food exports minus food imports) gives a country net food trade position as net exporter or importer. However, this indicator provides no information on access to food.

Diaz-Bonilla *et al.* (2000) suggest considering instead the ratio of total exports to food imports as a useful indicator of access to world food supply by individuals countries (the Bonilla Index thereafter).

[1] A third view defended by the food sovereignty movement is that long-term food security cannot depend on food imports, but must be built on the development of domestic production with enough barrier protection to shelter it from world price fluctuations and unfair trading (Laroche Dupraz and Postolle, 2013).

This Bonilla Index (BI) is a consistent indicator of national capacity to finance food imports from exports. In this way, it provides an interesting indicator to track the vulnerability of food security to trade in net food-importing countries and developing countries. This index is sensitive to variations in

- Volumes of food imports and total exports, because food imports reveal domestic food needs not covered by domestic production, and total exports represent domestic trade performance and competitiveness;
- The value of food imports and total exports; these values depend on world price trends and their expression in local currency *via* the exchange rate.

2. National policies affecting food security and their indicators

We have indentified three main types of national policies associated with food production and international trade: i) agricultural and food policies affect the domestic production and consumption situation; ii) trade policy determines the environment in terms of protection from international competition; and iii) monetary policy (especially exchange rate variations) can alter the cost of imports and earnings from exports (across all agricultural and other sectors). These policies hence affect food security. In this section, we present an overview of the available indicators used to measure the level of these policies and their respective impact on economic agents, identifying the extent to which these indicators can (or cannot) be used to assess impacts on food security.

2.1. Agricultural trade and domestic support policies

National trade policies cover border import and export taxes (tariffs) and subsidies. The effects of such trade policies on domestic supply, imports and the economic welfare of producers and consumers are well known (Krugman, 2012): these tools impact on the relative competitiveness of domestic production compared to the world market. A protective policy (high agricultural tariffs) has positive effects on domestic supply, but negative impacts on domestic consumers. Given that agricultural commodities are the basis for food, such a policy applied to the agricultural sector is conducive to self-sufficiency, but may not promote food security where domestic supply is not sufficient or not suited to the domestic population's food needs. At the same time, applied tariffs (resp. subsidies) bring in resources (resp. generate costs) for national budgets. This impact on government revenues may contribute to (resp. threaten) the funding of domestic policies that directly or indirectly promote an increase in household incomes and hence individual food security or that promote national investment in health and education. An open market (i.e. low or zero tariffs) is positive for urban consumers, but could discourage domestic producers from developing their supply if they cannot compete with international competition. So an open market has a positive effect on food security in that it facilitates domestic access to international agricultural supply, but it can also have a negative impact on domestic supply and increase food dependence on imports, which is a problem especially in the case of high world food prices and a price surge.

Moreover, trade openness may be an important component for developing countries. Many empirical studies show that more outward-looking countries post higher economic growth in the long run (e.g. Edwards, 1998; Dollar and Kraay, 2004; Huchet-Bourdon *et al.*, 2013). There is no one clear definition of trade openness, but it is usually represented by the trade dependence ratio. This ratio generally corresponds to the combined weight current-value imports and exports in the country's gross domestic product (Frankel and Rose, 2002; Dollar and Kraay, 2004).

Applied and bound agricultural tariffs indicate the national level of protection (agricultural *versus* global) and national trade openness, but the relationship with food security is not direct. It depends, in particular, on the international trade situation: low, decreasing agricultural prices *versus* high, increasing world prices.

Agricultural domestic support measures are also taxes (if negative) or subsidies (if positive) applied to outputs or inputs. Like trade border measures, positive coupled domestic support (like price support or production payments) introduces a gap between a higher domestic price and a lower world price. This is not the case with decoupled domestic support, which is not expected to have such a distortive effect on agricultural prices. As a result, positive domestic support, if coupled, has similar effects to border tariff protection, i.e. a positive impact on domestic supply and a negative effect on domestic demand. However, the impact on government revenue is not the same: price support is directly financed by domestic consumers, while subsidies are charged to the national budget.

Positive domestic support and tariff protection encouraging domestic supply may both have a negative distortive impact on the world price. This is why the use of border measures and domestic support measures has been regulated by the WTO in the agricultural sector since the Uruguay Round Agricultural Agreement (1994) in order to limit the negative impact of agricultural support on world agricultural prices. However, although WTO rules are binding on major developed countries, which have had to reform their agricultural policies to comply, most developing countries are not similarly bound for two reasons. First, most developing countries have developed very low agricultural support levels (often even negative in the 1970s or 1980s). Second, WTO reduction commitments for developing countries are much lower than for the developed countries. Note that WTO regulations are only designed to counter negative agricultural world price distortions. There are no rules to restrict support measures that have positive effects on world prices, such as export restraints or import subsidies.

2.2. Exchange rate policies

A number of studies have focused on the impact of macroeconomic factors, such as the exchange rate, on the agricultural sector. The policy relevance of linkages between macroeconomic policy, the exchange rate and US agriculture was first described by Schuh (1974, 1976) following the collapse of

Bretton Woods. Gardener (1981), Chambers and Just (1981) show that the exchange rate was a major determinant of US agricultural prices. Orden (1986, 2002) demonstrate the decisive role of the exchange rate in agriculture. Gilbert (2010) highlights the role of the exchange rate in the food price increase. Baffes and Dennis (2013) conclude that food commodity prices respond in a mixed manner to exchange rate movements: the exchange rate has a huge effect on rice, but a moderate impact on soybeans and wheat. They explain the greater rice elasticity by the fact that the United States plays only a marginal role in the rice market.

When studying the exchange rate, a distinction can be made between the nominal and the real exchange rate. The nominal exchange rate (NER) is the rate at which one currency is sold for another. The real exchange rate is the exchange rate adjusted for changes in the prices of imports P_M (measured in foreign currencies) and exports P_X (measured in domestic prices). In other words, it is adjusted for the terms of trade (Sloman *et al.*, 2012). The real exchange rate (RER) can be defined as:

$$RER = NER \cdot \frac{p_M}{p_X}$$

where NER is the nominal exchange rate defined as the number of national currency units needed to have one unit of foreign currency.

If a country's export prices rise faster than the foreign currency prices of its imports, its real exchange rate will depreciate. The real exchange rate gives an idea of the volume of imports a country can acquire from selling a given quantity of exports; it is a competitiveness index.

Exchange rate policies can have both a direct impact on a country's food supply and an indirect impact on domestic producer and consumer prices. Changes in the foreign exchange rate may affect not only agricultural product prices, but also inputs such as fertilisers and fuel that play an important role in the agricultural sector.

The foreign exchange rate determines the relative prices of traded goods versus non-traded goods. Most agricultural commodities are internationally traded goods. An increase in the price of food commodities will benefit producers and may reduce the food security of net food purchasers.

Currency depreciation reduces the price of local currency and in turn drives down the price of domestic production in the short term, which increases its competitiveness internationally. This depreciation strengthens demand for local currency and limits supply in foreign currencies. It thus supports higher prices. This is favourable to domestic producers at the expense of domestic consumers, who have to endure a higher level of domestic prices expressed in the local currency unit.

The theoretical foundations for the analysis of the impact of currency depreciation on trade are found in the J-Curve effect. In the short run, a depreciation/devaluation raises imported food prices in the local currency, leading to a deterioration in the trade balance. Since there are some delays in contract

transactions, the value of imports increases in the short run relative to the value of exports. This leads to a deterioration in food security in the short run. Importers then have to bear a loss of competitiveness since the foreign prices are higher than the domestic prices. They adjust their traded quantities: the volume of imports is adjusted downward while local production is probably increased to satisfy demand. The final long-run effect is expected to be a net improvement in the trade balance. The magnitude depends on the price elasticity of demand for food imports. Similarly, the lower price of exported products in foreign currency may drive up foreign demand for domestic products. Domestic producers will try to satisfy this demand by supplying more products. This increase in supply depends on the price elasticity of the supply of exports.

However, when it is not possible to increase domestic production, especially in low-income countries, such a depreciation may drive down food availability, raising food insecurity even in the long run. Indeed, many developing countries have a food trade balance deficit: they are net food importers. In this case, the negative effect of depreciation (the price effect of the J-Curve) on the terms of trade can outweigh the positive effect. This means that if a country wanted to depreciate its currency, it would have to do so before its trade balance deteriorated too far.[2] However, an overvaluation policy has a positive effect on urban consumers, giving them greater import purchasing power, while domestic producers suffer a lack of competitiveness against imports.

Exchange rate levels, along with volatility and the exchange rate regime, may play a role in food security but the link is not yet well understood. The country's ability to solve the imbalances depends on the exchange rate regimes. In many developed countries, the exchange rate floats freely with the market forces of supply and demand. However, governments of many developing countries have decided to keep the exchange rate fixed.

The exchange rate regime plays a key role. In the case of a fixed exchange rate, the authority (government or central bank) is expected to intervene whenever there is an imbalance between domestic currency supply and demand on the foreign exchange markets in order to maintain the rate. This will lead to changes in the money supply. If the rate is below equilibrium, the national currency appreciates. To prevent this, the central bank increases the money supply by providing currency. This increase in the money supply brings down the interest rate, discouraging financial inflows and deteriorating the financial account. On the other hand, it may boost aggregate demand and hence raise imports and deteriorate the current account. The expected overall effect of appreciation is a deterioration in the balance of payments. In the case of a floating exchange rate, exchange rate changes should automatically correct any balance-of-payments disequilibrium. Depending on the

[2] This analysis deals only with the trade balance. It does not consider capital flows, which become important with liberalisation. Developing countries with external deficits would finance it with a debt in foreign currency (mostly in dollars or in euros). Any depreciation in the national currency would raise its debt servicing. A fuller picture should consider the balance of payments.

exchange rate regime, floating or fixed, we talk about depreciation or devaluation. Between these extremes, there are a number of intermediate regimes.

Note that the exchange rate level and the exchange rate regime appear to be necessary to understand trade competitiveness trends, but the overall effect on food security has to be analysed by combining knowledge of the international agricultural trade situation and domestic support policies. Domestic prices for internationally traded agricultural inputs and outputs can also be distorted by tools other than the exchange rate: taxes and trade controls set by national governments to raise revenue or protect certain domestic output.

2.3. Measuring global agricultural support

Agricultural support points to the impact of general government measures to support agricultural producers' earnings by raising domestic prices vis-à-vis world market prices (in the form of domestic price support and import tariffs) and by granting direct and indirect subsidies to the agricultural sector. There are a number of national agricultural support indicators. The OECD calculates annual Producer Support Estimates (PSEs) for OECD members. The PSEs compute the level of annual transfers to agricultural producers across all support policy measures.[3] PSEs have been assessed with great accuracy and are updated annually for the OECD countries and more recently for the emerging economies. Yet PSEs are calculated on the basis of agricultural policy only.

The World Bank has also estimated agricultural incentive distortions more broadly by assessing the Rate of Assistance for a large panel of countries. This calculation is fairly similar to the PSE in its consideration of agricultural policy, but it is also designed to factor in the indirect effects of other sector policies (e.g. industrial tariffs) and macroeconomic policies (e.g. the exchange rate) on the agricultural sector. Krueger *et al.* (1988) hence estimate the impact on agriculture of general and agricultural policies put in place by 18 developing countries in different geographic regions over the 1975-1984 period. The direct effect is measured by the difference between the producer price and the border price adjusted for transport, storage, distribution and other marketing costs. The indirect effect comprises the impact of fiscal policies, industrial protection policies and the overvaluation of the exchange rate, which distort agricultural product prices compared with other product prices. The authors find that, in almost all cases, the combined direct effects are equivalent to a tax on exportable products (approximately 11% on average) and a subsidy for imports (approximately 20% on average). The indirect effects also tax agriculture (approximately 27%) and dominate the direct effects, even when these direct effects are directed towards helping the domestic agricultural sector. Anderson (2009, 2010) coordinated a huge survey for the World Bank in 2009 to evaluate the nominal rate of

[3] The Aggregate Measurement of Support (AMS), on which WTO members' domestic support reduction commitments are based in agricultural negotiations (amber box), is inspired by the same logic as the PSE, but excludes from its calculation decoupled support and the minimum authorized support "*de minimis*" i.e. 5% of agricultural production for developed countries and 10% for developing countries. AMS is a political indicator decided on by WTO member states.

assistance (NRA) trend in 75 developing and developed countries for a number of periods ranging from 1955 to 2006-2007. He notes that from 1975-1979 and 2000-2004, much progress was made by reducing the anti-agricultural and anti-trade biases of policy especially in Africa: substantial reforms reduced the burden of taxation on export cash crops in particular (cocoa, coffee and cotton), groundnuts, beef, rice and sugar. The last updated NRA data (Anderson and Nelgen, 2012) add six developed countries and three additional years (2008-2010), taking in the 2008 price surge year. In this updated database, the only exchange rate-induced indirect effect covered is the case where a government imposes and manages to maintain a different exchange rate for imports and exports that actually has an especially distortive effect on the agricultural sector. The "straightforward" overvaluation is disregarded, unlike in previous calculations, because the authors consider that such an overvaluation has a similar effect on imports and exports of all products and that the particular impact on agriculture is negligible.

The NRA provides an overall indicator of the impact of domestic policies (agricultural and others) on agricultural producers. It is available for 81 countries in all the world's geographic regions. Exchange rates, where available, provide information on national trade competitiveness trends. Yet food security indicators do exist, and one of them, the Bonilla index, specifically deals with trade and domestic support policies. However, the analysis of the links between domestic policy and national food security indicators needs to be taken forward to understand how the determinants of food security interact, in particular by differentiating market context (falling, low *versus* rising, high agricultural prices) and national agricultural trade position (net food importer/exporter).

3. Impact of national policies on food security: link between indicators

3.1 The Bonilla Index to assess domestic food security

The purpose of this section is to analyse the economic mechanisms that shed light on the relationship between national policy indicators (agricultural support, trade and exchange rate) and national food security. With this in mind, we use the Bonilla Index (BI) to assess national food security (Diaz-Bonilla and Ron, 2010).

(1) $$BI = \frac{m^{value}}{X^{value}} = \frac{m \cdot p_m}{X \cdot p_X}$$

with m^{value}: value of food imports; X^{value}: value of total exports;

m: quantity of food imports; X: quantity of total exports;

p_m, p_X : domestic aggregated price (in local currency) for food imports and for total exports.

The Bonilla Index assessment finds that food security improves when the BI decreases and deteriorates when the BI increases. Contrary to the food trade position (food net importer/exporter), the BI concerns the relative food imports bill to total export performance, hence pointing up the role of

international trade and its effects on national food security. In the following analysis, we focus on the food sector, assuming the relative stability, *ceteris paribus*, of the total export sector, at least in the short term.

In order to highlight world food prices in the equation (in foreign currency), we introduce the exchange rate. With the BI formula written this way, we can analyse the effects of food price and exchange rate deviations on the food security index.

$$(2) \qquad BI = \frac{m \cdot P_m \cdot E_I}{X \cdot p_X}$$

with P_m: world price for food imports;

E_I : nominal exchange rate, i.e. the number of national currency units needed to have one unit of foreign currency: 1 foreign currency unit = E_I domestic currency unit.

Border measures (export and import taxes and subsidies) and domestic support have direct impacts on the BI as they introduce a deviation between world and domestic food prices. The Nominal Rate of Assistance (NRA) index on importable food products, as calculated by the World Bank (Anderson *et al.*, 2009, 2012), provides information on the effects of agricultural policy domestic support and border measures.

$$(3) \qquad BI = \frac{m \cdot P_m \cdot (1 + NRA^m) \cdot E_I}{X \cdot p_X}$$

with NRA^m: Nominal rate of assistance assessed for importable food products.

This equation highlights the main determinants of food security identified in previous sections: the world price P_m (and its possible volatility), the level of national or trade policies applied to the food imports sector (NRA^m), and the exchange rate policy with the nominal exchange rate E_I.

3.2 Impact of NRA^m and E_I deviations on the BI

In the very short term, in an environment of relative agricultural price stability, we observe that:

- In the event of the depreciation (/appreciation) of the local currency to the foreign currency, E_I rises (falls). The BI then automatically rises due to the increase (/decrease) in the cost of food imports expressed in the local currency, with a negative (/positive) effect on national food security.

- If NRA^m increases (/decreases), for example due to higher (/lower) food import tariffs or domestic food production subsidies, the BI automatically increases (/decreases) due to the price rise for imported food, with a negative (/positive) effect on national food security.

In the longer term, the estimated effects of E_I and NRA^m on food security are not so clear because other local currency depreciation (/appreciation) or an increase (/decrease) in agricultural support may improve (/undermine) domestic agriculture competitiveness and encourage (/discourage) domestic food production, having a negative (/positive) impact on food import demand *m* and driving down (/driving up) the BI with a positive (/negative) impact on food security by reducing (/increasing) food dependence on imports.

An interesting line of future research would be to analyse these two contrasting effects in developing countries, especially net food importers, to see whether governments should intervene to maintain the rate whenever there is an imbalance between domestic currency supply and demand on the foreign exchange markets.

3.3. Impact of price volatility on food security

This section tests the consistency of the framework in the event of an exogenous shock on the international market such as a sudden price surge (as in 2008) or price drop and, more generally, the impact of price volatility on food security.

The price volatility debate was reopened following the 2007-2008 price rise as farmers' earnings and consumer purchasing power suddenly looked uncertain, putting food security at risk. Recent years have seen two peaks in world prices for cereals and other major food commodities: once in 2007-2008 and a second time in 2010-2011. And prices have generally remained at a higher level than during the period from the 1980s to the early 2000s. There may be a number of reasons for this trend such as a growing imbalance between food demand and supply, the rise in oil prices, exchange rate movements and trade restrictions.

This phenomenon is more of a concern in developing countries where a large proportion of household income goes on food. Households in these countries therefore face a drop in real income and greater uncertainty should agricultural prices suddenly shoot up. Developing countries suffer from a lack of agricultural productivity and weak infrastructures.

Price hikes can have mixed effects in terms of food security. High food prices could be viewed as an opportunity for producers. They could drive an increase in food production, improving the physical availability of and access to food and raising producers' incomes. Yet at the same time, the cost of consumption goes up such that, under the hypothesis of stable food aid, economic access to food is reduced (Diaz-Bonilla and Ron, 2010). Moreover, many producers are net food buyers (being mostly small farmers, livestock producers and artisanal fishers in the developing countries). The main impacts of price volatility on producers and consumers are seen in the uncertainty surrounding income, investment decisions and access to food. There are many ways in which international price fluctuations channel through to domestic markets, depending on the country (and its domestic policies)

and the agricultural products concerned (Baffes and Gardner, 2003; Meyer and von Cramon-Taubadel, 2004; Greb *et al.*, 2012). Price transmission from international prices to domestic prices can be limited for a number of reasons including previously analysed policies such as trade, exchange rate policy and other domestic policies, as well as other factors like infrastructure and transportation costs.

So rising prices may benefit producers by raising their profits, but be to the detriment of consumers by cutting their purchasing power. However, even in the case of producers, the opportunity depends on the producers' ability to really produce more. They may face obstacles such as poor access to credit and low productivity.

The question as to whether it is the price surge or its volatility that is important is an open debate. Price volatility is high on the agenda of many governments and became a G20 priority in 2011 when the G20 launched the Agricultural Market Information System, which monitors food commodity markets and acts as an early warning system for volatile prices (OECD, 2011).

A number of empirical studies have set out to measure agricultural price volatility to determine whether it is higher than in the past (Huchet-Bourdon, 2011). Gilbert (2006) shows that agricultural price volatility was low in the 1960s, higher in the 1970s and, despite falling back in the second half of the 1980s and the 1990s, has since remained higher than its 1960s level. Gilbert and Morgan (2010) track 19 products over the 1970-2009 period and conclude that volatility has by and large been lower over the two last decades, with the exception of rice. They also find that volatility over the three-year period from 2006 to 2008 is in line with this historical pattern. Balcombe (2009) finds persistent volatility in agricultural price series. Sumner (2009), however, studies wheat and maize price data over an extended period from 1866 to 2008 and finds that the three years from 2006 to 2008 represent one of only a handful of periods when prices have been above the post-war trend, the last period before that being in the 1970s. Huchet-Bourdon (2011) studies eight agricultural products over the 1957-2009 period and finds no general growth trend in price volatility over the past 50 years. Her statistical analysis shows that price volatility in the recent 2006-2009 period was higher than in the 1990s, but, in general, not higher than in the 1970s with the major exception of wheat, maize and rice. This high cereal price volatility may have important implications for food security, since rice is the most consumed agricultural product in many poor countries.

One repercussion could be that the national government implements corrective policies by changing the local currency value and/or the level of domestic support in order to offset the effects of an agricultural price deviation. As shown by Equation (3), it is theoretically possible to offset a rise (resp. fall) in P_m and keep BI stable by increasing (resp. reducing) E_I and/or NRA^m. For example, it is easy to understand why so many net importing countries were anxious to temporarily lift their import tariffs (and hence reduce NRA^m) to offset the surge in world food prices (i.e. increasing P_m) in 2008 and thus limit the deviation in the BI in order to maintain an adequate food security level. Research on the 2008

food crisis is currently assessing the scale of the impact of such corrective policies on the food security index.

Conclusion

The assessment of the impacts of the different food security determinants is a complicated matter. The impact of an increase in world food price changes on agricultural output, for instance, depends on the extent to which the international commodity price changes are passed onto the national agricultural economy and on the country's capacity to develop its own agricultural production. This latter factor may depend on whether countries have a comparative advantage in agriculture or not (UNCTAD, 2009). So food security depends not only on domestic agricultural and cross-border agricultural trade policies, but also on exchange rate trends.

The purpose of this contribution is to shed light on the economic linkages between the main determinants of food security we have identified and the national level of food security as defined by the Bonilla Index. We observe firstly that immediate effects differ from long-term effects and secondly that it is always necessary to understand whether domestic policy measures cause the effect or are designed following an external shock.

Further avenues of research are to test these theoretical relationships between food security, agriculture, trade and exchange rate policies using short- and long-run empirical data. Available data can be used to compare a broad panel of developing, developed and transition countries from 1995 to 2010. Such a study taking in the 2008 food crisis can retrospectively analyse this episode and assess the effect of domestic measures in countries responding to a surge in food prices. This is the focus of ongoing research.

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References

Anderson K. (Edited by), 2009. Distortions to Agricultural Incentives – A Global Perspective, 1955-2007, *The Palgrave MacMillan/The World Bank*, 644p.

Anderson K., 2010. Krueger/Schiff/Valdes revisited: agricultural price and trade policy reform in developing countries since 1960. *Policy Research Working Paper Series* 5165. The World Bank.

Anderson K. and Nelgen S., 2012. Updated National and Global Estimates of Distortions to Agricultural incentives, 1955 to 2010, spreadsheet at www.worldbank.org/agdistorsions, World Bank, Washington DC, March.

Baffes, J., and B. Gardner, 2003. The Transmission of World Commodity Prices to Domestic Markets under Policy Reforms in Developing Countries. *Journal of Policy Reform*, 6 (3), 159-180.

Baffes J. and Dennies A., 2013. Long-term drivers of food prices, *The World Bank Policy Research* Working Paper WPS6455.

Chambers, R.G. and Just R.E., 1981), "Effects of exchange rate changes on US agriculture: a dynamic analysis, *American Journal of Agricultural economics*, vol.63, p. 32-46.

Clay, E. 2002. *Food Security: Concepts and Measurement*, Paper for FAO Expert Consultation on Trade and Food Security: Conceptualising the Linkages Rome, 11-12 July 2002. Published as Chapter 2 of Trade Reforms and Food Security: conceptualising the linkages. Rome: FAO, 2003.

De Haen H., Klasen S., Qaim M., 2011. What do we really know? Metrics for food insecurity and undernutrition. *Food Policy* 36 pp760-769.

Diaz-Bonilla, E., M. Thomas, S. Robenson and A. Cattaneo, 2000. Food security and trade negotiations in the world trade organization : a cluster analysis of country groups. *Trade and Macroeconomics, WP* No 59. Washington, D.C. : *IFPRI* (December). http://www.cgiar.org/ifpri/divs/tms/dp.htm

Diaz-Bonilla E. and Ron J-F., 2010. Food Security, Price Volatility and Trade : Some Reflections for Developing Countries, *International Center for Trade and Sustainable Development, Issue Paper* n°27, 57 p.

Dollar, D. and Kraay, A., 2004. Trade, Growth, and Poverty. *The Economic Journal*, 114, February, 22-49.

Edwards, S., 1998. Openness, productivity and growth: what do we really know?. *The Economic Journal*, 108, March, 383-98.

Frankel, J. and Rose, A., 2002. An Estimate of the Effect of Common Currencies on Trade and Income. *The Quarterly Journal of Economics*, 117(2), 437-66.

Greb, F., Jamora, N., Mengel, C., von Cramon-Taubadel, S. and Würriehausen, N., 2012. Price transmission from international to domestic markets, Georg-August-Universität Göttingen, *Discussion paper N° 125*,September.

Herrmann M., 2009. Food security and agricultural development in times of high commodity prices, *UNCTAD Discussion paper*, n° 196.

Huchet-Bourdon M., 2011. Agricultural commodity price volatility: an overview, *OECD Food, Agriculture and Fisheries Working Papers*, No. 52, OECD Publishing

Huchet-Bourdon M., Le Mouël C. and Vijil M., 2013. The relationship between trade openness and economic growth : some new insights on the openness measurement issue , EcoMod Conference, 1-3 July, Prague.

Krueger A.O., M. Schiff and A. Valdès., 1988. Agricultural Incentives in Developing Countries: Measuring the Effects of Sectoral and Economywide Policies. *The World Bank Economic Review*. Vol. 2. No. 9: 255-271.

Krugman P. R., Obstfeld M. and Mélitz M., 2012. International economics: theory and policy, Pearson Education, 9th edition, 736 pages.

Laroche Dupraz C. and Postolle A., 2013. Food sovereignty and agricultural trade policy commitments: How much leeway do West African nations have? *Food Policy* n°38, 2013, pp115-125, http://10.1016/j.foodpol.2012.11.005.

Masset E., 2011. A review of hunger indices and methods to monitor country commitment to fighting hunger, *Food Policy*, 36, 102-108.

Maxwell, S., 1996. Food security: a post-modern perspective. *Food Policy*. 21 (2): 155-170.

Meyer, J., and S. von Cramon-Taubadel, 2004. Asymmetric Price Transmission: A Survey. *Journal of Agricultural Economics*, 55 (3), 581-611.

OECD 2011. Price volatility in Food and Agricultural Markets: policy responses, report by FAO, IFAD, IMF,OECD, UNCTAD, WFP, the World Bank, the WTO, IFPRI and the UN HLTF, 2 June

Orden D., 1986. Agriculture, Trade and macroeconomics: the US case, *Journal of Policy Modeling*, 8(1), p. 27-51.

Orden D. (2002), "Exchange rate effects on agricultural trade", Journal of agricultural and applied economics, 34 *(*2), 303-3 12

Smith L.C., 1998. Can FAO's measure of chronic undernourishment be strengthened? *Food Policy* 23 (5) 425-445.

Schuh G.E., 1974. The exchange rate and US agriculture. *American Journal of Agricultural Economics*, 56, 1-13.

Schuh G.E., 1976. The new macroeconomics of agriculture. *American journal of agricultural Economics*, 58, 802-11.

Timmer C.P., 2010. Reflections on food crises past. *Food Policy* 35, 1-11.

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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