Deutsche Bank Research

Risk management in agriculture

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Towards market solutions in the EU

Volatility in agriculture is expected to increase – production volatility, mostly driven by climate change as well as price volatility, due to higher production volatility, a tight supply/demand balance, volatile energy prices, and other factors.

The responsibility to manage risks is increasingly in farmers' hands. The EU's Common Agricultural Policy is undergoing major reform towards greater market orientation. Tighter budgets as well as environmental and trade considerations have led to the reduction of market interventions. The post-2013 CAP is currently being discussed along those lines.

Agricultural producers will need to rely more heavily on market-based tools. We investigated the main risk management tools available for EU farmers pre-dominantly in the light of their effectiveness to stabilise their income – also taking into account, wherever possible, their impact on the environment and their effect on food security. EU farmers will benefit from a growing variety of private risk management tools in the future. Most likely, they will increasingly use financial derivatives and insurance products.

The derivatives market is still limited in Europe but developing, and the potential is significant. Public support may encourage the use of derivatives to cope with price volatility by promoting training on these products, ensuring availability of information and ensuring judicious regulation: this will be essential so that commodity derivatives keep serving their purpose of price discovery and hedging.

The insurance market is also expected to develop, to cope with production risk and mitigate financial risk. The current insurance level in the EU is generally insufficient to smooth major income reductions in bad years.

For the sake of environmental sustainability, thus long-term food security, it is important to reward farmers for delivering public goods: biodiversity, water quality and availability, air quality, soil functionality, climate stability, etc. Key to shifting to a more sustainable agriculture (until other actions are taken to price these externalities), payments for the provision of public goods can also contribute to stabilising farmers' income.

All in all, public policy could be most useful in increasing the risk management ability of farmers. Any extension of the public safety net will reduce the incentives for farmers and other agents along the food supply chain to manage their risks effectively through derivatives, private insurance or on-farm strategies like production diversification. Policies need to empower farmers to take their own risk management decisions and to have access to a diversity of instruments and strategies. More direct interventions are likely better kept as a means of last resort and restricted to measures which do not act at the expense of the rest of the world or of environmental sustainability.

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Content

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1. Agricultural risk management in context

Risk management in agriculture is important on several grounds: even if reducing farming risk does not always improve farmers' welfare, failure to manage risks has direct repercussions on farmers' incomes, market stability and potentially food security. The latter is mostly relevant in developing countries, but also for the most deprived in the EU, in case temporary short supply leads to dramatically higher prices.

Increased probability of losses

The two main risks faced by farmers – yield volatility and price volatility – are expected to rise. Indeed, on one hand, climate change will drive an increased occurrence of extreme weather events which will negatively affect yields. On the other hand, long-term supply/demand imbalances are expected worldwide, due to structural factors: increased demand – driven by population and income growth – combined with scarcity of water, arable land and energy[1]. Tight stocks are likely to lead to increased price variability.

Greater market orientation of agricultural policy means more responsibility for farmers

At the same time, the common agricultural policy (CAP) of the European Union has been undergoing reforms which have significantly reduced the extent of market interventions. Tighter budgets, environmental and trade considerations have resulted in an increased market orientation of the CAP, which is set to increase further. The Health Check was set up in 2008 to simplify and streamline the CAP and remove restrictions on farmers, helping them to better respond to signals from the market and adapt to new challenges. This implies that the responsibility to manage the risks formerly absorbed by price and market support policies is increasingly in farmers' hands. Any discussion of the CAP after 2013 should therefore include a reflection on which options are available to farmers and the food chain for coping with risk.

The objective of this paper is to review the instruments available for risk management in agriculture in the European Union and to assess their impact in terms of their effectiveness in stabilising farmers' incomes. At the same time, EU policies and practices connected to agriculture have significant impact on other dimensions. First, the future of agriculture is closely connected to the state of the environment (in terms of biodiversity, water availability and quality, greenhouse gas emissions, soil and air quality), which is both a major input and a valuable output of agriculture, as well as a "public good". Secondly, the main function of agriculture is to provide a basic need of the Earth's inhabitants, food. As a major food producer and exporter, the EU contributes to global food security and has an impact on developing countries' agricultural markets.

We therefore investigate the main risk management tools available to EU farmers predominantly in the light of their effectiveness in stabilising their income, but also take into account, wherever possible, their impact on the environment and developing countries.

In the following section, we review the main risks facing farmers as well as current risk management practices in Europe. The third section discusses risk-related policy measures, both the classical tools and the newer concept of payments to farmers for delivering public goods. In the fourth section, we examine the two main market tools for farmers to manage risks: futures markets to deal with price

[1] For more on this topic, see Schaffnit-Chatterjee (2009).

risk and insurance markets to deal mostly with production risk. The last section summarizes and gives further recommendations.

2. Agricultural risks

Risk may be defined as the potential deviation between expected and real outcomes. While this deviation may be positive or negative, a negative outcome has greater importance from a practical point of view and is usually the focus of decision-makers. In this paper, we consider risk management as the range of techniques and tools which can be applied in order to avoid or minimize losses and to utilize opportunities.

2.1 Many dimensions of agricultural risk

Various sources of risks, interconnected

Farmers face a number of risks which are often interconnected. Five types of risk are generally considered in agriculture, according to their sources:

— *production risks*, concerning variations in crop yields and livestock production, affected by a range of factors: weather conditions/climate change, pests, diseases, technological change as well as management of natural resources such as water

— *price and market risks*, associated with variability in output price (mostly), also input price variability and integration in the food supply chain (with respect to quality, safety, new products, etc.)

— *regulatory risks* connected with the impact of changes in agricultural policies (e.g. subsidies, regulations for food safety and environmental regulations) or trade policies: a change in government action, which is at odds with what farmers expected, may have a negative impact on their income

— *technological risks* associated with the adoption of new technologies

— *financial risks* resulting from different methods of financing the farm business, subject to credit availability, interest and exchange rates, etc.

— *human resource risks*, associated with unavailability of personnel.

Rating sources of risk
Survey of farmers rating factors from 1 (no effect on farming) to 7 (major effect)

Sources: Székely and Pálinkás (2009), DB Research

1

Price risk and production risks are usually considered the most important in agriculture (see Chart 1) and are discussed below. Policies are part of the solution in addressing these risks but are also associated with regulatory risks.

Diversification, vertical integration and saving: on-farm strategies

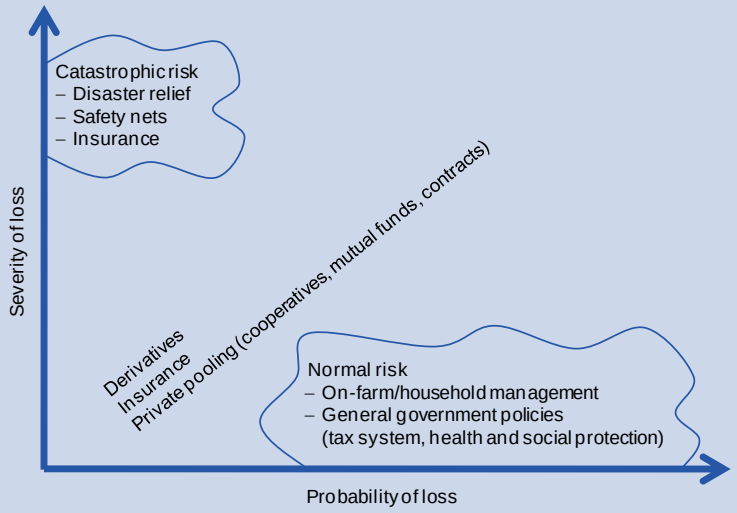
Apart from being categorised according to their sources, risks can be classified according to the frequency of the occurrence of negative events and the magnitude of their impact. Risk management starts with decisions on the farm and at the household level: which outputs to produce, how to allocate land, which inputs and techniques to use. Diversification of activities on and off-farm normally contributes to reducing risk. The level of the farmer's integration in the food supply chain also affects the degree to which the farmer is impacted by price volatility. Vertical integration – when the farm controls a commodity across two or more levels of activity – typically reduces risks associated with a variation in quantity and quality of inputs (backward integration) or outputs (forward integration). Vertical integration is more common in the livestock sector (integration backward into feed manufacturing) or in the fresh vegetables sector (integration forward into sorting, assembling and

packaging). Accumulating financial reserves is obviously another simple risk management strategy.

Risks associated with frequent events which do not cause large losses, such as “normal” fluctuations in prices and production, are managed on the farm. Events which are infrequent but lead to severe damage to a whole region (e.g. floods, droughts or disease outbreaks) typically fall under the catastrophic risk layer, for which market solutions have played a less important role, mostly due to high public involvement. Between these two layers, financial markets and insurance provide solutions.

Frequency, severity, interconnectedness are important dimensions in assessing risk

A map of risk-management tools for agriculture



Sources: DB Research, OECD (2009 a)

The level of interconnectedness is also important: it is of relevance, for instance, for insurance or policy purposes, whether only a few farms are affected (idiosyncratic risk) or whether it is a large number of farms (systemic risk). Risks affecting a big population at the same time, like droughts or floods or price shocks, are more difficult to manage inside the sector.

Farm level vs. aggregate variability: the spatial aggregation bias

In assessing the risks faced by producers, it is important to keep in mind that aggregated data can be misleading by underestimating the farm-level production risk. Indeed, a favourable yield in one location is typically offset by an unfavourable yield in another location, leading to a lower yield variability at the aggregate level than at the farm level. This “spatial aggregation bias” is much smaller for price variability since the spatial integration of output markets equalises output prices across locations[2].

Various actions to take, strategies, providers

In connection to this, there is also a categorisation according to the actions taken to tackle the various types of risks. Farmers can try to reduce the likelihood of an adverse event occurring (through technology for instance). Alternatively, they can mitigate it: reduce the potential impact of an adverse event by reducing the farm’s exposure beforehand. In the absence of reducing and mitigating, farmers have to cope with the adverse event once it has occurred (supported for instance through direct payments or revenue/income insurance).

[2] OECD (2010).

Strategies to mitigate include:

— risk transfer (e.g. to derivatives market),

— risk pooling (e.g. in insurance),

— diversification in production (different activities or different crops).

Different risk categories also require different providers: banks, insurance companies, governments or public private partnerships, and some risks are best managed on the farms by the farmers themselves.

Various objectives of risk management, potentially conflicting

Different agents have different objectives in managing risk. These objectives may be conflicting, depending on their target (food producers, or buyers of food or feed). Some agents may focus on stabilising food prices, others directly on stabilising farmers' incomes. Price volatility is a concern both at the macro level of governments (e.g. trade bill and inflation) and at the micro level, for producers and consumers. A drop in commodity prices during growing season is negative for farmers but tends to benefit consumers. Conversely, high prices adversely affect consumers whose food expenditures represent a high share of household income. This is a rather rare occurrence in developed countries (although it happens) and their governments are more concerned about the impact of price fluctuations on producers (who also tend to be well-organised as a lobby). Their policies tend to protect farmers from falling prices. When food price volatility increases, the risk premium attached to investments in agriculture also increases: this tends to lower the rate of investment and in turn the rate of agricultural growth, it also affects the whole food supply chain, and potentially food security.

A menu of farm risk management tools

	Farm/household/community	Market	Government
Risk reduction	Technological choice	Training on risk management	Macroeconomic policies Disaster prevention (flood control) Prevention of animal diseases
Risk mitigation	Diversification in production Crop sharing	Futures and options Insurance Vertical integration Contracts in production or marketing Spread sales (over the year) Diversified financial investment Off-farm work	Tax system income smoothing Counter-cyclical programmes Border and other measures in the case of contagious disease outbreak
Risk coping	Borrowing from neighbours/family Intra-community charity	Selling financial assets Saving/borrowing from banks Off-farm income	Disaster relief Social assistance Agricultural support programs

Sources: OECD (2009a), DB Research 2

Various instruments with interactions: substitutability or complementarity

The above table lists various tools available for risk management in agriculture, according to strategy type and provider. It is important to keep in mind the interactions among instruments. As discussed below, some tools crowd out the use of others, by reducing the marginal gains to the farmer. For instance, the safety of some insurance schemes reduces the use of production diversification; or the existence of a strong coverage in revenue insurance reduces or even eliminates the demand for price hedging. Conversely, some tools complement each other: additional crop insurance coverage

can generate more demand for price hedging[3]. Given these important interactions among risk management tools, a single instrument cannot be considered in isolation from the existence of other instruments.

2.2 Production risk

Production risk is the risk associated with production losses. For crops, common causes of yield risk include weather events (drought, excess moisture, hail, freeze and flooding), crop pests and disease. On-farm strategies can help to reduce the magnitude of the yield risk associated with some of these perils, e.g. judicious crop selection, improved seeds, pesticides and irrigation. (It is useful to keep in mind that agricultural inputs can be risk-reducing, of course, but also risk-increasing – for instance the use of some chemical inputs may reduce the occurrence of low yields while increasing yield variability overall). Livestock production losses are much less frequent than crop production losses, and tend to be due to disease outbreaks, weather-related perils or predators. The main instrument considered to tackle production risk in general is insurance.

Short-term/private and long-term/collective risk reduction objectives often in conflict

When assessing production risk, it is also important to note the frequent conflict between short-term/private risk reduction and long-term/collective risk reduction. For instance, irrigation[4] reduces a farmer's risk of losing crop to drought while bringing the risk of chronic over-abstraction or salinisation, if used on a large scale by numerous farmers: both are negative for agriculture and the larger context in the long term. The fight against diseases provides another example. A farmer's use of pesticides on crops or of sanitary products for livestock obviously reduces his risk of losing crop or animals. However, a widespread use of the same product increases the risk of the emergence of a resistant pest causing much larger losses.

Production risk likely on the rise

Production risk is likely to grow, due to climate change[5] and globalisation. Indeed, we expect a higher incidence of extreme weather events. Globalisation is also likely to drive an increased frequency of pest or disease outbreaks. Some consider that cross compliance measures with respect to agro-chemicals may also increase yield risk: e.g the Nitrate directive, or the Water directive requiring less spraying in the vicinity of water. It can also be argued that these measures will give incentives to use agro-chemicals more judiciously or to find alternatives (e.g. crop rotation), thus potentially reducing yield risk.

2.3 Price risk

Price risk refers to variability in output prices and in input prices.

Lower importance of input price risk

Input price risk: shorter horizon, but, mostly driven by variability of oil prices, may be on the rise

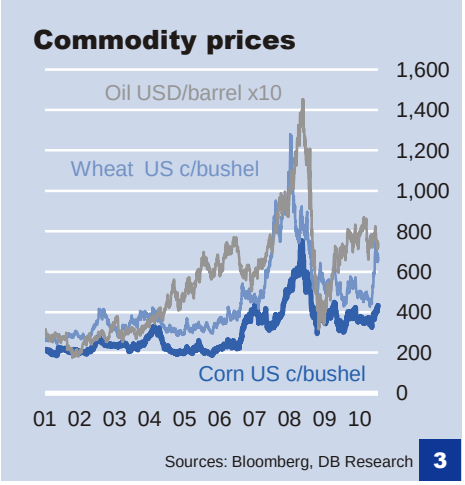
In crop agriculture, input price risk has been given considerably less attention in the literature, and has been considered less substantial than output price risk and yield risk (see Chart 1, for example). It normally does not translate into return variability of the same magnitude[6]. Moreover, the time window of input price risk is shorter: fertilizer and input costs are usually incurred within a few months of the onset of production, whereas the uncertainty around output price and yield usually remains for at least six months.

3 OECD (2009a).
4 Heymann et al. (2010).
5 Kahn and Zaks (2009), Heymann (2007).
6 OECD (2008).

However, the magnitude of input price fluctuations can be significant and there is no system in place to hedge against input prices (although there is the possibility of storing some items on the farm). Input price risk is still significant and may be overlooked.

Variability in fuel prices and in fertilizer prices appear to be the main components of input price variability in crop production, partly because fuel and fertilizer amount to most of the input costs in conventional agriculture, and partly because, as commodities themselves, they are subject to price fluctuations like all other commodities. These variabilities are expected to increase, in line with increased volatility of energy prices.

As to the livestock sector, input costs amount predominantly to feed costs. The following discussion on output price risk for crops thus covers most of the issues pertaining to input price risk for the livestock sector.



Output price variability driven by a range of factors

Output price risk arises due to the biological lag inherent in agricultural production. Obviously, producers must make production decisions months (even years for tree crops) before they have a product to sell, before the actual crop prices are known. During this period, output prices may change dramatically in response to shocks in supply and demand. This may put farmers in a difficult situation if commodity prices decrease drastically during the production and marketing cycle.

Price changes mostly due to changes in supply and demand as well as low stock levels

Many factors contribute to price changes, as witnessed during the food commodity price spike of 2007/2008. Income and population growth, rising energy prices, and subsidised biofuel production have contributed to surging consumption of agricultural products. At the same time, productivity and output growth have been impaired by natural resource constraints, underinvestment in rural infrastructure and agricultural science, farmers' limited access to agricultural inputs and weather disruptions. While speculation has been mentioned as a driver of price increases, the issue has been heavily debated but there is no conclusive evidence that speculation drove prices up (more on this on p. 21). The consumption of cereals had also been consistently higher than production in previous years, which had reduced stocks. Stocks play a critical role indeed through their cushioning effect: low levels of stocks are associated with high price volatility[7]. Macroeconomic factors also impact the volatility of agricultural prices, e.g. variability in inflation rates, exchange rates and interest rates.

Slow responses to price shocks, both on the demand and the supply sides

The effect of shocks on the agriculture and food system is compounded by low elasticities of both supply and demand. Indeed, since food is an essential product with no substitute (apart from alternative foods), demand responses to price increases are typically low (until, for the poorest of all, it translates into hunger). Supply responses are also very low short-term, until production decisions can be made for the next season or more land brought into or taken out of production.

Various types of price variability

Historical volatility, future price volatility, implicit volatility

Price variability is complex in nature and is often captured as price volatility, which can be defined in several ways. It refers to movements in prices of a certain periodicity: the period can be a day, a month, a season or a year. Volatility can also be considered

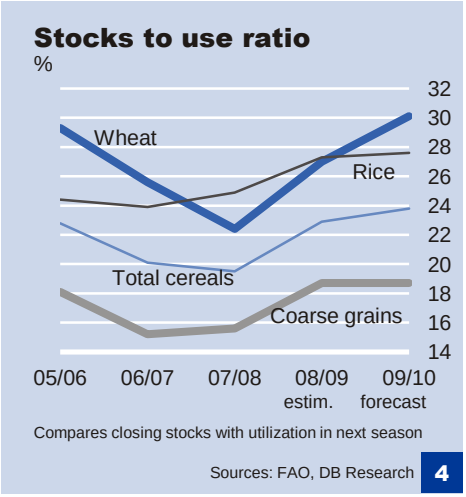
[7] Balcombe (2009), OECD-FAO (2010).

as being made up of high and low frequency components, which may be useful to distinguish[8]. A common measure of volatility is the coefficient of variation (ratio of standard deviation to its average value) of a historical price series with a given frequency. Historical volatility may also be defined as the annualised standard deviation of the percentage change in daily settlement prices. Some prefer to focus on the "uncertainty component" of volatility: given that some variability can be predicted (on the basis of seasonal variation or business cycles, for instance), they are concerned about not overstating the degree of uncertainty. Therefore, they restrict volatility to the unpredictable price movements. There are also measures of implicit volatility, which represent the market's expectation of how much the price of a commodity is likely to move.

Global and domestic markets

Price transmission from global markets to domestic markets is affected by the level of trade and the extent to which the trade environment is managed domestically (if measures such as those described in Section 3 are in place). For markets more open to trade, volatilities in domestic prices are close to those on international markets. (In 2007/2008, about 19% of the wheat produced was traded globally, 10% and 7% of coarse grains and rice, respectively.) So a price shock to a crop like wheat tends to spread globally and the magnitude of price risk for a commodity will tend to be similar for producers worldwide.

The relationship between price fluctuations and trade levels is complex. A closed market, although less affected by external shocks – e.g. a global recession –, is highly vulnerable to an internal shock, e.g. a drought. An open market is obviously directly affected by the instability of global markets, but can "share" its risk world-wide, which has a stabilising effect on prices.



Outlook for price volatility

Future price volatility will depend on a number of factors, including variabilities in supply and demand and responsiveness to these variabilities (elasticities of supply and demand).

The supply/demand balance will be key. The increasing demand (for food, feed and fuel) combined with long-term resource scarcity trends (of water, arable land and energy) points toward a tight balance. This is a particular concern at times when global stocks are low and likely indicate a rise in volatility, although it is difficult to distinguish between price trend and volatility.

In the context of climate change, extreme weather events are expected to be more frequent. This and other factors affecting yields (mentioned in 2.2) will contribute to increased price volatility.

Moreover, food prices and oil prices are linked increasingly closely, due to the use of agricultural crops for energy production and agricultural production's reliance on energy inputs. A potential increase in volatility in energy markets (also in a context of tight supply) would likely spill over into food markets.

Future price volatility likely to be high

The CAP will also not protect or stabilise prices of products such as cereals, milk and beef in the future. Prices of these products may show larger fluctuations than in the past.

Technological progress and trade liberalisation, by allowing faster and greater responses to shocks, are expected to reduce the volatility of food prices downward but this is unlikely to be enough to balance out the other factors.

[8] Roache (2010).

EU agriculture in numbers

People

- 13.6 m people directly employed (incl. forestry and fishery)
- 5m people additionally in the agri-food industry
- 8.6% of total EU employment
- 7% of farmers are under 35 years old
- 4.5 m farmers will be 65 by 2020

Farms

- agriculture occupies 47% of the EU's territory
- 15% of which in mountainous areas
- small farms remain predominant and are particularly important in the delivery of public goods
- average farm size: 12.6 ha

Production

- 4% of the EU's GDP
- generates EUR 337 bn in production
- EU: world largest producer of food and beverages

Trade

- EU: world's leading exporter of agricultural goods (17% of global trade, against 19% in 2000)
- net importer of agricultural goods: EUR 88 bn (20% of world agricultural imports)

All in all, agricultural markets are expected to experience high price volatility in the future[9]. A few factors will determine the extent to which EU farmers will be affected by world price volatility. Volatility in exchange rates will have an impact – especially the USD-EUR exchange rate, since most agricultural commodities are traded in US dollars. As discussed earlier, the level of diversification of the farms' production will also influence farmers' vulnerability. Of course, the income level also plays a major role in farmers' ability to cope with high volatility.

Key agricultural statistics per member state

	Share of agriculture in GDP	Share of employment in agriculture, forestry, hunting and fishing	Utilised agricultural area (UAA)	UAA per holding
	%	%	1,000 ha	ha
	2008	2008	2008	2007
EU-27	1.2	5.4	178,813	12.6
BE	0.6	1.8	1,374	28.6
BG	5.5	7.5	5,101	6.2
CZ	0.8	3.3	3,551	89.3
DK	0.7	2.8	2,695	59.7
DE	0.6	2.2	16,926	45.7
EE	1.4	3.9	802	38.9
IE	0.9	5.7	4,200	32.3
GR	2.5	11.4	3,984	4.7
ES	2.2	4.3	25,657	23.8
FR	1.4	3.1	29,385	52.1
IT	1.7	3.8	13,338	7.6
CY	1.7	4.3	148	3.6
LV	1.3	7.9	1,825	16.5
LT	2.3	7.9	2,672	11.5
LU	0.3	1.8	131	56.8
HU	2.5	4.5	5,790	6.8
MT	1.0	2.0	10	0.9
NL	1.3	2.8	1,933	24.9
AT	1.0	5.6	3,171	19.3
PL	2.2	14.0	15,608	6.5
PT	1.3	11.5	3,733	12.6
RO	6.0	28.8	13,717	3.5
SI	1.1	8.6	492	6.5
SK	1.0	4.0	1,936	28.1
FI	0.6	4.6	2,296	33.6
SE	0.4	2.1	3,076	42.9
UK	0.5	1.4	15,263	53.8
EU-25	1.2	4.3	159,995	16.8
EU-15	1.1	3.4	127,160	22.0

Sources: European Commission, DB Research 5

2.4 Risk management practices in Europe

Historical focus on tackling yield variability changing

For decades, several developments predominant in European agriculture have been relevant for farm income variability:

- weather-driven yield variability was coupled with a steady increase in average yields, driven by technological innovations,

[9] OECD-FAO (2010), Matthews (2010).

— relatively stable prices were also following an increasing trend, due to CAP market interventions,

— farmers have increased their participation in off-farm income (e.g. agro-tourism).

As a result of what was needed, agricultural risk management tools in Europe have mostly focused on yield variability (marketing excess production, technological innovation and yield insurance) and have neglected price stabilization tools, such as futures and forward contracts, options and storage management. In line with the CAP reform, it is now expected that an increasing number of private tools will develop to manage price variation[10].

Volatility of farm incomes on the rise

In agriculture, the profit margin is shrinking[11]. (This is partly due to the fact that farmers have to invest to realise a higher level of productivity and a larger scale of production.) With a small margin, even a small change in prices will result in relatively strong fluctuations of incomes. The fluctuation of prices and yields combined with a smaller margin and a higher volume of production per farm lead to an increased volatility in incomes. This is an incentive to resort to effective risk management tools.

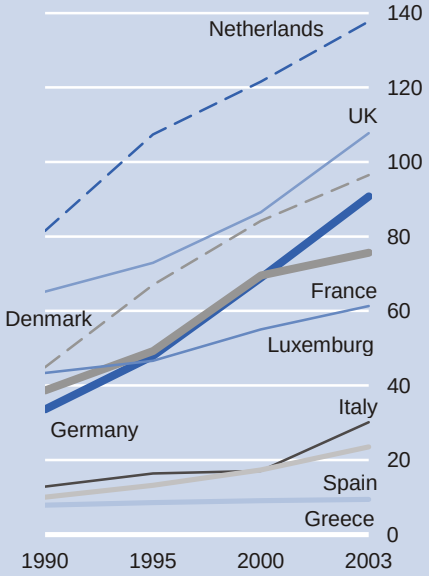
Insurances and financial reserves currently at the top

As part of an EU project[12], agricultural producers in five EU countries (Germany, Hungary, Poland, the Netherlands and Spain) were surveyed about their perceptions (Chart 1) and practices (Chart 7) around risk management. It came out that as a group, the farmers surveyed manage risk by predominantly using property and crop insurances, holding financial reserves and avoiding credit, followed by vertical integration and marketing contracts. Whereas avoiding credit is equally important in all countries (used by around 40% of the farmers surveyed), there were marked differences among countries. These differences stem from both distinct risk environments in the various countries (in terms of policy and yield) and various farm characteristics. (For instance, larger farms tend to resort more to crop and livestock insurance, smaller farms often need to supplement income by off-farm employment[13]).

In Germany and Spain, crop insurance is used more than in other countries (by 60 to 70% of farmers). This is partly explained by a high level of public subsidies in Spain (49%) and in Germany may reflect a coverage which is basic in single insurance[14] as well as an overall propensity to resort to insurance. Marketing contracts are important in Germany (50%), Hungary and Poland. Off-farm investment is more frequently practiced in Germany (50%) than in the other four countries, as well as off-farm employment (40%). Livestock insurance is significantly higher in the old Member States (around 40%) than in the newer ones. Hedging is used slightly more often in Germany but is still used very rarely (5%).

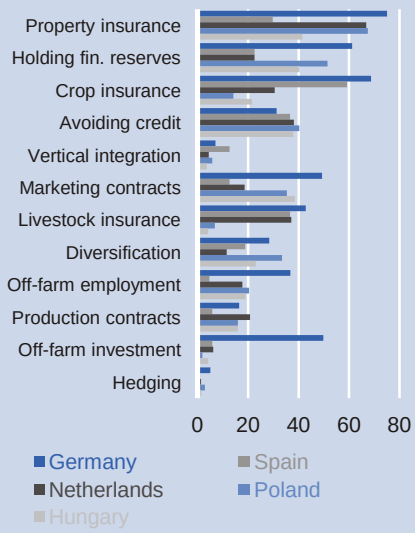
A comparison with data relating to farmers in the USA[15] showed that holding financial reserves, participating in government programmes, insurance and engaging in diversification and forward contracting

Drastic structural changes
Average farm size, ESU



Sources: Vrolijk (2009), DB Research 6

Risk management in use
% of respondents using the instrument



Sources: Szekely and Palinkas (2009), DB Research 7

[10] Cafiero et al. (2007).
[11] Vroljik et al. (2009).
[12] „Design and economic impact of risk management tools for European agriculture“ reported on in Meuwissen et al. (2008).
[13] OECD (2010).
[14] Bielza et al. (2009).
[15] USDA (1999), Szekely and Palinkas (2009).

are important risk management strategies both in the US and in the EU. A notable difference between Europe and the US is that hedging is far more popular among American farmers than among their European peers (around 60% of large-scale Corn Belt farmers reported using hedging in the early 1990s and 20% of all US farmers). Various reasons for this gap (farm size, security from the CAP, history) are discussed in 4.1.

Use of new instruments perceived unattractive – Interest in hedging increases with farm size

The farmers sampled in the EU survey were also asked about their future risk management plans[16]. It was observed that most respondents intend to stick to the risk management methods they currently use. Polish farmers are willing to try new, previously not used instruments. In particular, they show great interest in hedging (60% of them). The data were also analysed according to the economic size of the farm and the type of activity (crop, livestock or mixed). Starting to use new instruments seems equally unattractive across the different size and activity groups. A notable feature, however, is that interest in hedging increases with the size of the farm. Around 30% of farmers of medium and large-sized holdings plan to get involved in hedging, as opposed to 15% of holders of smaller farms.

In the next sections, we review the relevant risk management instruments available in the EU. We investigate their effectiveness to stabilise farmers' incomes, as well as their impact on the environment and developing countries.

3. Public risk management tools

In this section, we first review the classical market management tools used to stabilise agricultural prices or incomes. We then discuss the more recent idea of rewarding farmers for delivering public goods.

The EU's main approach to food price instability has been to stabilise income without affecting prices. The rationale for this approach was not to interfere with the natural equilibrium resulting from the law of supply and demand (as demand increases, the price goes up, which motivates an increase in supply, bringing the price back to normal). However, the EU has used price control mechanisms in the past.

3.1 EU policies to stabilise markets and prices

Government policies aim to stabilise international price fluctuations by border policies, stock holding policies and price intervention schemes. Implemented mostly to provide price support, market regulation in the EU also affects price stability. The range of market intervention measures available under the CAP is significantly smaller than it used to be but the following measures remain[17].

Trade intervention measures

Import tariffs are widely used, and bound upwards by the Uruguay Round Agreement on Agriculture (URAA) from 1994. The EU is free to adjust its tariffs within these bounds. As an example, the tariff on cereals was lowered to zero during the 2007-2008 price spike, so that EU domestic prices increased less than prices on world markets. This measure had obvious consequences on developing

[16] Meuwissen et. al (2008).
[17] Matthews (2010).

countries since EU farmers were able to feed their cattle at the expense of the world's poor struggling to afford enough food.

Export subsidies are also restricted by the URAA, with ceilings on total expenditure on export subsidies as well as on the quantity of subsidised exports. This expenditure has fallen sharply along with the increase in world prices. The EU implemented export refunds for dairy products and pigmeat after the collapse in prices following the spike of mid-2008. Export subsidies have had negative impacts on developing countries when EU-sponsored "cheap" commodities competed with local production in these countries.

Trade restrictions are ineffective for all in the long term

Although a country's import/export restrictions may bring some short-term relief to selected farmers/domestic consumers, economic analysis clearly shows that their overall impact on the domestic economy and on the rest of the world is negative[18]. Moreover, border protection tends to shift price variability to world markets. There is some evidence that the EU may forego the use of export subsidies after 2013. Trade liberalisation would increase the chances of developing countries having a more competitive agricultural sector – especially in combination with efforts to include smallholders in the global food supply chains.

Price support

Direct public intervention may take place in the EU for purchasing and withdrawals. Fixed-price purchases are applied only for certain products (soft wheat, butter and milk powder) and in quantities determined in advance. A tendering procedure may allow higher quantities at a price determined by the Commission. Withdrawal procedures may be applied under certain conditions by producer organisations in the fruit and vegetable sector.

Price support: minimal effectiveness…

Price support has been found to have a low effectiveness in that the price reduction it achieves is mostly captured by other agents of the full supply chain (input suppliers, processors and distributors, land-owners), but little by the farmers it is supposed to help[19].

… and perverse effects: on developing countries, …

Price support mechanisms also present a number of drawbacks. First, they mask price signals to producers: setting prices higher than natural market prices is likely to lead to surplus production – like in the 1970s and 1980s, when it was disposed of through export subsidies and dumping.

… the environment, …

Additionally, raising prices, thus incomes, in proportion to production means that larger producers benefit more. (This issue is more acute in countries where the distribution of land or production is heavily skewed.) This also gives an incentive to intensify production, which – if done in excess, especially on fragile land – may have a negative effect on the environment (soil quality, biodiversity, etc.).[20.] The trade-off between economies of scale and environmental damage needs to be weighed up with great care.

… and consumers

Finally implementing price support for farmers implies raising prices to consumers, which puts poorer consumers at a disadvantage.

More indirect price support may also take place. **Aid for private storage** may be encouraged through targeted aid for butter, meat, sugar and olive oil. The products remain the property of the storers and no restriction applies at the end of the storage period.

[18] For more on trade regulations and their impact, see Schaffnit-Chatterjee (2010).
[19] See OECD-FAO (2010).
[20] See OECD-FAO (2010).

Subsidies to promote internal consumption are still used for some dairy products: processing aid is in place for some categories of skimmed milk. While these indirect public support tools are useful, it could also be beneficial to encourage their private use (financed by the sector).

International market stabilisation policies

The focus of this paper is on European agricultural producers, but in the context of a more open trade system, it is sometimes desirable to act at the international level. In the absence of stocks, fluctuations in world prices reflect the global supply and demand position for individual commodities. In order to stabilise international prices, some advocate a mechanism to ensure that stocks are built up during periods of low prices and released during high-price periods.

Past attempts to establish international commodity agreements going back to the 1940s have not been very successful at stabilising prices, or at being implemented at all[21]. Following the 2007-2008 food price crisis, numerous proposals have been put forward regarding the establishment of reserves, including an internationally coordinated strategic reserve system for foodgrains[22]. The establishment of a virtual reserve is an innovative plan proposed by von Braun and Torero[23] in order to moderate prices: participating countries would commit funds to intervene, if needed, in the grain futures markets (by selling contracts to deliver the commodity) until futures and spot prices have stabilised.

Internationally managed stock-holding: potential relief in extreme cases

Maintaining a strategic reserve involves dealing with the challenges of determining optimum stock levels and coping with the uncertainties the reserve may cause in the market place. An international arrangement involving a combination of reserves poses the extra challenge of building an “intelligence unit” that would provide information to a decision-making body yet to be determined[24]. Although the implementation of a reserve system is very tricky and will interfere with market decisions, it may provide much-needed relief (to farmers’ incomes and to the world hunger situation) in case of emergencies.

Biofuel support may be considered to some extent as an alternative to stock-holding for corn, sugar cane and vegetable oil crops, and thus a way to stabilise prices of agricultural products. Indeed, in case of (anticipated) food shortage leading to extreme prices, a suspension of the biofuel mandate can re-direct the crops towards food use, thus benefiting price stabilization. Of course, a prompt switch is not always practical, although there have been examples in the past[25]. As mentioned above, biofuels have been recognised as contributing to increasing price volatility in agricultural markets because of their substitution effect with other fuels.

3.2 Classical EU policies to cope with income instability

A sharp decline in production or prices of one or a few major agricultural commodities may lead to income distress for farm households, if the instability has not been dampened otherwise or the risk effectively transferred. Some measures have been available

[21] For more on this, see Matthews (2010).
[22] Von Braun and Torero (2009), Wright (2009).
[23] Von Braun and Torero (2009).
[24] Torero and von Braun (2010).
[25] In the Summer of 2008, Texas opted out of biofuel standards, and redirected corn crop towards food use as crops were being planted.

to stabilise farm revenue or farm income, spreading the losses over the general population through the public budget.

Current direct payments lack legitimacy

Direct payments (mostly as SFP Single Farm Payment) now make up a substantial part of farm incomes, with variations across countries, farm systems and farms. These payments are deemed effective in increasing farm welfare but are not as effective in reducing income variability as subsidising risk market instruments.[26] Clearly, SFPs lack legitimacy overall and are very likely to be reduced in the post-2013 CAP. Some arguments mentioned above for price support hold here as well: direct payments in their current form are biased towards big producers and tend to favour intensive agriculture, especially in Western Europe. (The new Member States currently apply a flat rate to all farmers in the system, but the smallest/poorest farmers are out of the system.)

Compensation schemes tend to reduce farmers' responsibility in reducing or mitigating risk

About 50% of public aid for disaster in the EU is given for natural disasters which are insurable in countries providing yield insurance.
Source: Bielza (2009)

Ad-hoc payments or calamity funds exist in most countries. Calamity funds are public funds run by national or provincial governments – sometimes receiving contributions from the private sector, collected in the form of levies to production, to premiums, etc.) They are provided every year by the government and mobilised under the declaration of catastrophes. The main advantage of these funds over ad-hoc aids is that they avoid major distortions to the government budget. However, these public aids have a major caveat: their perverse effect on farmers' risk appetite. Indeed, if farmers are aware of an existing safety net, they have less incentive to reduce either the risk of losses or the farm's exposure before-hand. As a result, their actions and choices (disease control, crop selection) may not be as judicious as if they were bearing the full consequences of any adverse event. In some countries, there are no public fund payments if insurances are available (e.g. Austria, Greece, Portugal, Spain and Sweden – in France only if the insurance has reached a significant diffusion level)[27].

3.3. Payments for delivering public goods

An alternative to stabilising farmers' income is increasingly discussed. It is based on the fact that farmers also deliver public goods. These benefits are not transmitted through prices, delivered as a side-effect benefiting society as a whole, outside the producer/ consumer exchange. Public goods are defined in economics as goods that are:

— non-rivalrous: the consumption of the good by one individual does not reduce availability of the good for consumption by others.

— non-excludable: no one can be effectively excluded from using the good.

A wide range of public goods in agriculture, mostly environmental…

In many ways, agriculture is like other economic sectors: a large number of producers participate in a range of markets for food, feed, fuel and fibres. At the same time, agriculture is particular in that it is a sector where the provision of public goods is particularly prevalent. There is indeed a wide range of public goods associated with agriculture[28], most of which are environmental: agricultural landscapes, farmland biodiversity, water quality, water availability,

[26] See for instance OECD (2010) and Cafiero et al. (2007).
[27] There are high ad hoc payments in France (EUR 1.167 million over 2000-2005) and low payments in Spain (EUR 22.5 million over the same period), but annual subsidies for insurance are higher in Spain (EUR 230 million/year) than in France (EUR 5 million per year) Bielza et. al. (2008).
[28] Cooper et al. (2009), Birdlife et al. (2010).

soil functionality, air quality, climate stability (in terms of greenhouse gas emissions or in terms of carbon storage), etc. (There are also social public policy objectives associated with agriculture: food security, rural vitality, and animal welfare/health in the farm.)

The delivery of public goods which are positive externalities of agriculture is not to be confused with the reduction of environmental damage – which is a negative externality. Agriculture like numerous other industries is, of course, in a position to decrease this external cost, but the concept of public goods goes beyond this in that it addresses the issue of external benefit[29].

… in undersupply…

There is evidence of undersupply of public goods associated with agriculture – as expected by economic theory: since collective societal welfare is improved without the providers having a way to monetise the benefit, less of the good will be produced than would be optimal for society as a whole. Relevant EU-wide indicators providing a measure of the state of the environment point to a deterioration over time, even if there are exceptions (e.g. regional improvements in soil and air quality). For instance, individual indicators point to an ongoing decline in the populations of farmland birds, high rates of soil erosion by water and wind, a depletion of soil organic matters, high levels of water abstraction, particularly in water stressed areas, etc.[30]

… which threatens a range of socio-economic benefits

In certain regions of Europe, attractive agricultural landscapes, the presence of farmland biodiversity and historical features provide opportunities for a variety of economic activities such as rural tourism and recreation, speciality products and foods, and are an attractive location for the establishment of businesses.

Environmentally beneficial agricultural management

Certain forms of agricultural management influence the degree to which public goods are provided, e.g. the agricultural land use, the farming systems, the structure of the farm, the agricultural infrastructure, including patterns of drainage and irrigation. Three main clusters of farming practices may be deployed in order to secure environmental benefits[31]: practices less intrusive on the environment, practices leading to improvements in energy efficiency as well as reductions in greenhouse gas emissions, and practices designed to address a specific environmental concern (like the use of buffer strips or reduced tillage). For instance, High Nature Value farming systems (e.g. extensive livestock system and low-intensity permanent and arable crops) consistently provide a high level of public goods by playing a key role in maintaining biodiversity.

A high cost of policy inaction, not only for the environment

A few macro-level studies have estimated the monetary value of environmental goods and services and the cost of policy inaction[32]. They indicate that these monetary values may be very large, as well as the welfare losses associated with their degradation. This points towards a significant public interest in securing sustainable levels of environmental public goods provided by agriculture – including through farming systems with lower yields and higher labour requirements, struggling to compete in a market not pricing externalities.

Environmental regulation as a firm baseline

Support for the maintenance of environmentally beneficial farming systems is part of the solution in addressing the undersupply of

[29] As an illustration, one may consider wildlife habitat or landscape: if a factory is shut down, the environment will clearly benefit, if a farm is shut down, the environment may gain but may also lose (depending on the farming practices).
[30] See for instance Commission of the European Communities (2009b).
[31] Cooper et al. (2009).
[32] Cooper et al. (2009), Sukhdev (2009).

public goods and the existence of externalities. Policies can be useful in giving incentives to farmers to apply environment-friendly practices and in increasing the economic viability of low-intensity farms. Payments for delivering public goods, while aiming at ensuring the supply of these goods, can also help to stabilise farmers' incomes – at least until externalities are priced in the system (e.g. according to the polluter-pays principle). These payments also need to be supported by strong legislation to reduce environmental damage, e.g. laws on the correct use of pesticides and fertilizers as well as water extraction[33].

Transparent and addressing important challenges of the future

Rewarding farmers for delivering public goods also has the potential to provide a clearer link between the support farmers receive from taxpayers and the value they generate for citizens. This new tool is thus likely to gain legitimacy. Another asset is that it addresses challenges expected to gain in importance in the future (depletion of natural resources in an age of increased demand), by supporting farming systems which are vital to achieve environmental security (watershed management, carbon storage, biodiversity) and thus long-term food security.

In Section 3, we have reviewed various aspects of government intervention to stabilise agricultural markets, from classical to more recent approaches, aimed at directly reducing the risks faced by farmers. Other government policies and programmes have an indirect effect by supporting the market mechanisms discussed in the next section.

4. Market-based risk management tools

Farmers can transfer the risk of price instability through derivatives markets. Insurance markets are used to cope mostly with production risk and mitigate financial risk.

4.1 Hedging price risk with derivatives

Farmers have to make decisions about what and how to produce long before the nature and volume of the harvest is known, at a time when the future crop price is uncertain.

Forward contracts

A simple instrument available to deal with price risk is a forward contract (also called cash contract): farmers and buyers of agricultural output agree in advance on the terms of delivery regarding quantity and price (either fixed, or in line with futures prices). With this type of contract, the farmer foregoes the opportunity of achieving a higher price on the open market but partially shifts price risk to the processor. There are two broad categories of forwards.

Marketing and production contracts

A production contract usually gives the buyer of the commodity (a processor) considerable control over the production process. The farmer also depends largely on only one buyer, and incurs the risk of losing his outlet after the contract ends. In a marketing contract, the farmer retains full responsibility for production management, and has an opportunity to differentiate his products from mass production[34].

[33] Birdlife et al. (2010), Heymann et al. (2010).
[34] Bielza et al (2008).

Counter-party risk

Inherent to these cash contracts is counter-party risk: the risk for the producer that the buyer may not show up or not pay on time (and for the buyer that the producer may not deliver the commodity as called for in the contract). These default risks are considered reasonable, and cash forward contracting is used extensively in the USA, offered by the commodity vendors. Time management is another advantage of these contracts: during the busy harvesting season, farmers often do not have enough time to sell their products. On the down side, it may require high transaction costs to find the potential buyer and negotiate the terms of the forward contract[35].

Futures contracts

A futures contract is a forward contract traded on an organised exchange (and not over-the-counter), standardised in terms of quantity, quality, and delivery time and location. (Futures markets were originally developed in the Middle Ages to meet the needs of farmers and merchants). A farmer hedging his price sells a futures contract when planting his crop, but typically does not deliver the commodity at the end of the contract. He buys rather a futures contract for the same delivery date, thus undoing his position and sells later on the cash market. (For example, if a farmer, through his/her broker and trader, sells a corn contract in May for December delivery, his or her position may be offset by buying a December corn contract at any time before the end of the delivery period in December.) Indeed, the major motive in trading futures is to hold a temporary position for hedging, not to physically deliver (or acquire) a commodity. It is also cheaper for producers to deliver through normal channels.

Basis risk as well as margin requirements

By using a futures contract, the farmers reduce their risk but retain "basis risk", measured by the difference between the cash price and the futures price. Buyers and sellers of futures are also required to make margin deposits with their brokers to guarantee their respective commitments. On top of this initial margin, there is a variation margin: if the price of the contract moves against the farmer, he gets a margin call from his broker to post additional margin to cover the loss so that a minimum margin is maintained. This maintenance margin is usually somewhat lower than the initial margin, which is typically 5-10 percent of the underlying value of the contract. All in all, hedging involves costs that appear modest compared with the risk reduction for most farmers[36].

Futures prices and spot prices converging most of the time

The basic link between the prices of the futures contract and the underlying cash market is the "cost of carry" (e.g. storage plus insurance) until the expiration of the contract. According to this link, supply and demand factors affecting prices in cash markets should be transmitted to the futures markets, so that futures and spots converge at the end of the settlement period. Historically, the relationship between the cash and futures markets has been fairly constant with predictable seasonal variation. However, futures prices at the expiration period have lately tended to be well above spot prices in the US, leading to basis risk. No problem regarding convergence has been observed on European futures markets for food commodities, but a debate is going on regarding the causes and consequences of the lack of convergence.[37].

[35] OECD (2010).
[36] USDA (1999).
[37] Commission (2009a).

Futures: effective in reducing price risk, and useful for price discovery

Futures markets are recognised as an effective way for farmers to reduce price risk, on top of sending important signals regarding future prices. Their use provides certainty of income for food producers, and certainty of costs for processors, distributors and retailers. Some governments encourage farmers to use futures markets, mostly by providing information and technical advice (e.g. Mexico provides subsidies to farmers who buy commodity options on United States futures markets).

Options

Options: some unused potential

Options on futures provide a further possibility to cover price risk, for some commodities. Options give the right to sell a futures contract or to buy one, at a "strike" price. Thus, options truncate the probability distribution of price at the strike price and provide protection against adverse price movements (low spot price for sellers/put holders, high spot price for buyers/call holders). At the same time, an option allows the option holder not to exercise it, and profit from favourable movements (high prices for put options and low prices for call options). Farmers can use put options to create a floor price for their produce.

According to the OECD 2009a, the literature is not conclusive about the effectiveness of option contracts. This probably has to do with the cost to buy and with the fact that options limit the down-side without affecting the upside: benefits of risk aversion are hard to quantify.

Futures in the EU: a developing market

Hedging used much more in the USA

Forwards, futures and other derivatives are used much less in the EU than in the USA, for several reasons. First, public market management instruments have been more broadly available in the EU. As mentioned in 2.4, with the CAP providing security, farmers have had little incentive to turn towards market-based risk management tools to deal with price risk; rather, the expectation has been that the consequences of adverse events on farmers' incomes will be borne by taxpayers. Another reason is the higher level of consolidation of farming in the USA, especially for the big commodities: in the EU, grains are still often grown by small undercapitalised farms, which are much less inclined to use financial innovation. Larger farms tend to use more risk management strategies in general, but this holds especially true for hedging[38]. Additionally, Americans have a longer history of trading soft commodities on exchanges. It takes time to adopt financial innovation.

[38] USDA (1999).

Futures in practice

A simple example

A wheat producer wishes to reduce his income uncertainty by selling a futures contract at planting time. He is not concerned about yield risk (he irrigates, etc.) and hedges a quantity equal to actual output, which he offsets at harvest time.

Futures price per tonne at planting time is EUR 200 per tonne. He expects a harvest basis of EUR -10, giving an expected cash price of EUR 200 plus EUR -10, or EUR 190 per tonne. Two senarios are illustrated in the table below: a EUR 15 price decrease between planting and harvest, and a EUR 15 price rise. In both cases, the realised harvest basis is EUR -10, as expected. With hedging, the return per tonne is EUR 190 in both cases. It can be calculated as (1) the futures price at planting time plus the harvest basis or (2) the cash price

Effects of hedging on a wheat grower's return per tonne

Price per tonne (EUR)

	Price decrease scenario	Price increase scenario
Cash price expected at harvest	190	190
Cash price realised at harvest	175	205
Futures price at planting	200	200
Futures price at harvest	185	215
Futures return to the producer	15	-15
Net price realised with hedging	190	190

More realistic scenarios

A wheat producer has a 200 hectar farm. His return from a cash sale at harvest (with no short hedge) ranges from EUR -42,400 to EUR 70,000 across the six scenarios. Now the farmer decides to hedge in the spring. He anticipates that his output will not likely fall below 800 tonnes and considers his optimal hedge to be 16 contracts (at 50t per contract). At harvest time, he lifts his short hedge by buying back his futures contract, and sells his cash crop in the marketplace. He receives the proceeds from the cash sale of the crop (less production costs of EUR 110,000) plus the gains or losses associated with the futures transaction (less commission charges of EUR 480). With hedging, his returns spread only between EUR -14,480 to EUR 29,520 and their standard deviation is one-third of what it is without hedging.

Returns to a cash sale at harvest and a futures hedge

Scenario	Production	Harvest cash price	Spring futures	Harvest futures	Revenue from crop	Net return from cash sale at harvest	Net return with hedging	Difference in returns
	Tonnes	EUR per tonne	EUR per tonne	EUR per tonne	EUR	EUR	EUR	EUR
1	1,200	65	125	75	78,000	-32,000	7,520	39,520
2	1,200	150	110	160	180,000	70,000	29,520	-40,480
3	1,000	70	130	80	70,000	-40,000	-480	39,520
4	1,000	165	125	175	165,000	55,000	-14,520	-40,480
5	800	85	145	95	65,800	-42,000	-2,480	39,520
6	800	170	130	180	136,000	26,400	-14,480	2,720
Average net return						6,167	5,687	-40,480

200 hectare farm with yields of 6, 5 and 4 tonnes per ha
Cost of Production: EUR 110,000
Producer sells 800 tonnes of futures or 16 contracts
Producer pays EUR 30 per contract for brokerage: EUR 480 total

Source: DB Research (adapted from USDA)

As a result, the main futures markets for agricultural commodities are located in the US, the benchmark for several commodities (especially wheat and corn) being the Chicago Mercantile Exchange (CME) – which absorbed the Chicago Board of Trade in 2007. In the EU, the main agricultural contracts are traded on Euronext in Paris (milling wheat, rapeseed, corn) and Liffe (London International Financial Futures Exchanges) (cocoa, coffee, sugar, feed wheat). There are also a few minor futures markets (e.g.in Germany, Hungary, the Netherlands). Commodity traders are more prone to use futures markets for hedging and price discovery on European-

based exchanges today than they were before successive reforms of the CAP have significantly reduced guaranteed prices.

Major European agricultural futures and option markets

Commodity	Exchange	Futures		Options	
		Volume	Open Interest	Volume	Open Interest
		Jan-Jun 2010	Jun 2010	Jan-Jun 2010	Jun 2010
Cocoa	London	1,656,171	196,423	441,206	261,355
Coffee	London	1,364,905	85,950	168,589	42,464
White Sugar	London	1,030,852	68,492	17,657	11,816
Feed Wheat	London	48,005	10,905	129	108
Wheat	Paris	1,126,216	102,351	282,815	196,640
Corn	Paris	74,177	8,337	3,762	2,640
Rapeseed	Paris	451,528	62,231	85,907	58,432
Malting barley	Paris	1,320	836	310	310

Sources: Futures Industry Association, DB Research 8

Some limitations, which can be overcome

Futures markets have the following limitations:

— Basis risk (the risk that the change in the price of a hedge may not match the change in the price of the asset it hedges) can be a serious obstacle to some farmers' participation. Trading costs may be an issue as well, although futures contracts incur lower transaction costs than forward contracts[39]. Some governments have provided subsidies towards the cost of futures contracts (e.g. Mexico provides subsidies to farmers who buy commodity options on United States futures markets).

— Derivative markets are not available for all commodities. However, this is changing rapidly.

— The quantities specified in the contracts may not be within the scale of many smaller producers. But financial intermediaries such as brokers can provide help here or an organisation of farmers trading as a group.

— Derivatives markets are still relatively new and there is still a lack of understanding. More information and training are necessary. Governments may encourage farmers to use futures markets by providing information and technical advice.

On speculation and prices

Role of derivatives in the recent price hikes likely minor

There is concern that derivative markets for agricultural products promote a speculation which undermines the right to food. The impact of speculation on food prices is indeed a hotly debated topic, with two schools. Some are convinced that speculators on futures markets for food commodities created a price bubble. Others argue that speculators help to smooth and stabilise the movement of prices over time. Various studies investigated the issue with varying models, data and methods[40]. They conclude that there is no or little evidence that speculation drove up prices, but strong evidence for causality in the opposite direction: speculation generally follows market fundamentals and price development, even if it does not mean that all speculators at all times are price followers[41].

39 OECD (2010).
40 See for instance Kappel et. Al (2010), Roache et. Al (2010), Robles et al. (2010).
41 Kappel et al. (2010).

A continuum between pure risk avoidance and pure speculation…

There is also no clear-cut distinction between the various actors on commodity future markets: the hedgers who want to protect themselves from price risks (e.g. farmers and agri-business buyers), and the speculators/investors who want to make a profit from bets on future price movements – who are necessary counterparts for hedgers[42]. (Since hedgers' positions usually do not cancel each other out, the functioning of the futures requires a party willing to accept the risk in exchange for an expected profit.) In fact, there is rather a continuum between pure risk avoidance and pure speculation.

… with a potential for excesses

This brings of course the possibility of positions distorting the normal functioning of the market, for instance due to their sheer size. Such speculation can have grave consequences for farmers and consumers and is, in principle, unacceptable.

Transparency and regulation in order to avoid excesses are called for

All in all, it is important for the good functioning of the food chain that commodity derivatives keep serving their initial purpose of price discovery and hedging, to cope with price volatility. We advocate more transparency in general. More regulation in the derivatives market overall will be helpful in avoiding excesses. One might also consider some of the specificities of agricultural commodities. A regulatory environment promoting markets' efficiency and ensuring financial stability will benefit the clients of the service providers and may be a competitive advantage for financial centres[43].

Outlook for derivatives

The use of derivatives is likely to grow in Europe with the further decrease of public market management tools. Public intervention may also encourage this trend, by promoting training on derivative products, by ensuring availability of information and by having an appropriate supervision regime in place. The EU may also consider means to make the tool more attractive to smallholders, although they have the possibility to join forces through risk-sharing co-operatives.

An increase in trading volumes will make futures markets in Europe more efficient. They are likely to appeal more to large farmers producing commodities although cooperatives may increasingly recognise them as an attractive tool to reduce their income variability.

4.2 Agricultural insurance

Given that crop yields and livestock production are sensitive to weather conditions and other hazards, there is an obvious demand for insurance in the agricultural sector.

Insurability of agricultural risks

Some independence among events and adequate information are prerequisite for insurability

In order for a risk to be insurable, some conditions are required[44]:

— Enough information needs to be available on the risky events in order to evaluate their probability of occurrence and the expected loss (with associated financial costs) which may ensue. Calculating the correct premium requires an estimation on the risk distribution.

[42] Investors are also speculators but they are sometimes differentiated since their time-horizon is long-term: they regard commodities as assets, like equities, bonds, real estate, etc.

[43] Kern (2010).

[44] Bielza et al. (2009). OECD (2009a).

— The information has to be widely available among the agents in the market so that the potential for moral hazard and adverse selection is minimized. (Moral hazard refers to an individual's change in behaviour following the purchase of an insurance policy, resulting in a potential increase of the magnitude and/or probability of a loss the individual incurs. Adverse selection occurs when the insured has more information than the insurance provider, which may lead to a risk level in the insured population which is higher than in the total population used to set the insurance premium).

— The corresponding risks for different agents need to have some degree of independence (be idiosyncratic). Systemic risks, which are highly correlated, cannot easily be pooled and may generate large losses, thus large liabilities for the insurer. (The high correlation of agricultural prices makes them generally more suitable for futures and options markets than for insurance markets).

Re-insurance

In order to avoid high premiums unaffordable to farmers, systemic risks (potentially leading to large scale losses) are re-insured by the insurance company in the international market, or guaranteed by the state. Comprehensive agricultural insurances schemes are usually supported by the public sector. However, on top of being expensive, excessive involvement from a government providing ad hoc disaster payments stifles the development of insurance products.

Adaptable farming vs. government intervention (potentially leading to excessive risk exposure)

As mentioned earlier, such government intervention is also likely to reduce the likelihood that farmers actively reduce and mitigate risk. With a comfortable public buffer in place, they may be seduced by the potentially high return which a successful growing season for the wrong crop in the wrong place would bring, even if highly unlikely. For instance, they may plant water-intensive crops in drought-prone areas, plant on flood plains, practice a monoculture more vulnerable to pests, etc.

Various types of insurance for individual farms

Single-risk or multi-peril, whole farm yield insurance, revenue or income insurance

The farmer pays a premium to buy the insurance, thus acquiring a contract which, in the case of adverse events, gives him the right to an indemnity – of an amount linked to some calculation of the losses. These can be specific events, in the case of **single-risk insurance** (e.g. hail and/or fire) or a certain number of meteorological events (e.g. including frost) for a **combined risk** insurance. **Yield insurance** covers yield losses for a given crop due to any meteorological event. **Multi-peril insurance** covers situations when production falls below a threshold level. Livestock insurance covers mainly non-epidemic diseases and accidents.

Whole-farm yield insurance refers to all the crops produced by the farm: the farmer is entitled to the indemnity only if global production drops below a certain threshold (not just one field).

Revenue insurance combines yield and price insurance, and is based on the total value of the farmer's production. **Income insurance** takes also into account the costs of production. It is only applied in the US so far.

Various levels of state intervention

The more comprehensive the insurance scheme, the more it tends to be supported by the state. (All examples of multi-peril crop insurance in the world are government-funded.) The budgetary implications can be significant.

Mutual stabilisation funds

Risk-sharing cooperatives

Mutual (stabilisation) funds provide a way for a group of producers to share risk. A loss incurred by a member will be fully or partially compensated through the collected money available in the fund according to predefined rules (often with an additional collection from participants). Established on private initiative, these are mainly set up either for a specific sector or a specific region.

The difference between a mutual fund and a mutual insurance scheme (also a non-profit cooperation based on self-help) is the legal nature of the institution: For mutual insurance there is a legal title of compensation, and the premiums are calculated on an actuarial basis (as opposed to a fixed amount independent of risk).

The advantage of these risk-sharing cooperatives is that farmers often know each other, which reduces moral hazard and adverse selection. Drawbacks are limited resources, especially in the fund's early years, and interconnectedness: a farmer may at the same time incur a loss and have to contribute to the fund to cover other farmers' losses. Re-insurance or cooperation with other regions may help counter this problem.

Index insurances for a whole area

Area index (yield or revenue) or indirect index, based on a meteorological indicator or satellite imagery

Index insurances are based on a common index for an area, as opposed to the types described above for individual farms where losses are evaluated on the field[45]. The index may be direct, like the statistical yield for the year in a predefined area, or the average yield/revenue in that area. Indirect-index insurance is based on a meteorological indicator (e.g. rainfall, dry soil days, moisture, accumulated frost, etc.) or satellite images. Index-based weather insurance products, also called weather derivatives, fall in this category, even if they can also be considered as an over-the-counter traded option (see below).

Index insurance refers to a different approach to insuring crop yields altogether: instead of requiring independent risk to exits, it actually works best for the individual farmer if the risk is correlated. Area index insurance has been experienced for some years in Brazil, Canada, US or India. India and Canada have also developed weather insurance products, and Canada insurance based on satellite imagery.

Numerous advantages of index insurance over multi-peril insurance…

Index contracts offer several advantages over traditional forms of farm-level multi-peril crop insurance. The absence of both moral hazard and asymmetry of information as well as low administrative costs (no inspections of individual farms necessary) translate for the farmer into higher coverage levels. No limit needs to be imposed on the farmer's liability since he has no influence over an outcome resulting in payments. Since they are standardised and transparent, index insurance contracts can be traded in futures markets. They can also be used as reinsurance, to transfer the risk of widespread correlated agricultural production losses.

… and a few limitations

Limitations of index insurance include the following. Basis risk occurs if the insured losses are too loosely correlated with the index. (Since compensations are granted not for the actual loss of an individual, but for the loss indicated by a parameter, a farmer that did not suffer a loss could potentially benefit from compensation. Conversely, a farmer suffering damage may not be fully compensated.) The feasibility of index insurance also depends

[45] Bielza et al. (2008).

critically on objective and accurate measurement of the index. Precise modelling is also required in order to forecast the probabilities of various index measures. Finally, insurance companies can rarely afford to offer index insurance without adequate re-insurance.

Specific features of indirect index insurance

Indirect index insurance offer specific advantages over area index insurance. Monitoring is even easier and potentially cheaper. The quality of historical series of meteorological data may be better than for area yield data (e.g. in developing countries). Scarcity or excess of rainfall are among the main causes of yield decrease in many regions. A specific disadvantage of indirect index insurance is that reproducing the real risk incurred by the individual farmer is subject to more errors.

Weather index products: not quite insurance, not quite derivatives, but a potential to develop

Weather-index-based insurance products are also called weather derivatives since they "can be brokered as an insurance contract or as an over-the-counter traded option[46]". Given that compensations are not paid on real losses that need to be checked by experts on the field, these products can also be sold outside the insurance sector, by banks and other financial institutions. They differ, however, from traditional commodity price derivatives in that the underlying is not a traded good.

The pricing of weather derivatives is usually based on actuarial calculations, since the traditional Black-Scholes algorithms do not seem to be appropriate for these products. This makes the market less transparent and increases transaction costs[47].

All in all, weather index insurance products offer good potential, even if the market has not yet developed.

Outlook for index insurance

A role for banks to manage correlated risk and better cater to the farmer's need

As systems to measure events causing widespread problems are becoming more sophisticated, the indexing of major events may be easier and accepted by capital markets. The basic advantage of merging index insurance into banking is that a bank can use these contracts to manage correlated risk. This will put the bank in a position to help the farmer manage basis risk: if the individual incurs an independent loss when the index insurance does not pay, he may borrow money from the bank to smooth that shock. This may be an effective way to circumvent the major concern associated with index insurance (the real possibility that an individual incurs a loss without being eligible for payment).[48]

Insurance systems in the EU[49]

The level of risk experienced by EU farmers is very heterogeneous, varying from country to country and according to farm type and farm size. The development of agricultural insurance in each country is linked to the risk level but also to the policy supporting the insurance system.

Insurance development and government involvement correlated

Single-risk insurance (mostly hail) is well developed in Europe. Usually, private companies insure only hail and fire, and as the government increases its involvement in insurance, more comprehensive coverage is provided. Yield insurance provides coverage against all the main climatic hazards, but plant diseases and plagues are usually not covered. This requires ascertaining the

46 Reported in Bielza (2008).
47 Bielza et al. (2008).
48 Bielza et al. (2008).
49 Bielza et al. (2009).

cause of the loss, as opposed to the US "Multiple Peril Crop Insurance", for which damages are simply calculated as the difference between guaranteed and actual yield. The European insurance system is associated with higher loss-adjustment costs but no moral hazard.

Only one or two major players in each EU country

The insurance system in the EU-27 varies considerably from one country to the other in terms of market penetration, premium rates, loss ratio (ratio of indemnities to premium) and level of subsidies. However, most countries share the feature that there are few market players with one or two companies dominating the very specific sector of agricultural insurance. Promoting competitiveness could result in lower insurance costs and better access for farmers.

A few data on EU insurance

- Insured: 23% of field crops production value
- Premium rates : 4% of the insured value
- Total premium amount per year: EUR 1.5 billion
- Annual public subsidy: EUR 500 million (32% of total premiums)
- Annual indemnities: EUR 1 billion
- Average loss ratios: 60% to 75%

Source: Bielza (2009), DB Research

In comparison, insurance in the US is provided by 17 private companies, working in agreement with the USDA. About 45% of field crops production value are insured. The average premium rate is close to 9%, much higher than in Europe, mostly because of a wider coverage through revenue or yield insurances as opposed to single-peril insurances. Government support to insurance (premium subsidies, funds for the administrative costs, re-insurance) amounts to 72% of the total premiums (66% in Canada, 32% in the EU).

The following table summarizes various aspects and implications of potentially implementing an EU-wide system of agricultural insurance, according to the different types of insurance presented above.

Rating insurance risk management tools (1=minimum, 5=maximum)

	Single risk or multi-peril	Yield	Whole-farm yield	Income/ revenue	Area-index arable crops only	Indirect-index	Public reinsurance
Prone to welfare losses due to information asymmetries	2	2	3	2	3	4	1
Incentives for miss-reporting actual losses	1	2	3	3	2	1	1
Incentives for excessive risk exposure	3	2	4	3	3	4	2
Cost effectiveness (utility/public expenditure)	4	3	3	4	2	2	2
Compatibility with other EU policies	3	2	2	2	1	2	2
Complementarity with privately offered instruments (1: complement, 5: substitute)	1	3	3	4	4	2	1
Vulnerability to rent-seeking	4	3	3	4	2	2	2
Reliance on large re-insurance costs	1	2	3	3	4	2	3
Administrative complexity	3	4		5	4	4	3

Sources: Meuwissen et al. (2008), DB Research 9

Outlook for insurance

The current insurance level in the EU is generally insufficient to smooth major income reductions in bad years, although many Member States have worked on further developing insurance in the last few years (by increasing the risks covered and by covering new crops and livestock). An indication of this gap is the amount of ad-

hoc aids still transferred by governments: over EUR 900 million (probably strongly underestimated by lack of information[50]).

Crop yield insurance is most likely unviable without government support, and subsidising crop yield insurance appears effective in reducing income variability, if limited[51]: otherwise the crowding-out effect of other tools becomes predominant. The use of insurance is also prone to numerous undesirable effects such as excessive risk exposure, mis-reporting, information asymmetries and rent-seeking by insurance companies. Index-based insurance products have relative advantages and are best suited for homogeneous areas, where farms have correlated yields. Given the heterogeneity of climates and geography in many European countries, they may be more useful for re-insurance, at the aggregate level, than at the farm level. But banks may get more involved, providing farmers with ways to manage basis risk.

The EU may opt for further supporting insurance as one way to stabilise farmers' income. At the same time, settling for a homogeneous common insurance system does not seem advisable given the high diversity of risks and of socioeconomic backgrounds in the EU[52]. The EU can also encourage the development of national systems by facilitating the composition of databases, providing public re-insurance and establishing a common regulatory framework.

5. Concluding remarks

The variability of farm income depends on the variability of prices, yields, costs and support, but also on the co-variability among all these factors and the diversification in production. Within a variety of situations in the different countries, we expect EU farmers to experience more price and yield variability in the future, due to a changing global context as well as the gradual dismantling of the classical market management tools of the CAP.

It is an open question whether the EU or member states should address increased volatility for farmers. Some argue that farmers, just like other business people, have to adapt to the supply and demand context and constantly make choices between larger returns with more risk and lower but more stable returns. Others argue that the agricultural sector is a special one requiring public support, given its role in addressing a basic human need (for which no substitute is available): securing an adequate supply of food in a sustainable way, which means protecting the environment, animals, and addressing climate change.

Public policy to increase the risk management ability of farmers

All in all, it has been demonstrated that public policies always crowd out private risk management instruments. Moreover, they hinder the discovery of the natural market price, potentially preventing necessary adjustments to a changing market environment. An important role for public policy is, however, to empower farmers to take their own informed risk management decisions among a diversity of instruments and strategies.

50 Bielza et al. (2009).
51 OECD (2010).
52 Bielza et al. (2009).

More direct interventions: a last resort, and not at the expense of the rest of the world or of environmental sustainability

More direct interventions are likely better kept as a means of last resort and restricted to measures which do not stabilise markets for EU producers at the expense of the rest of the world or of environmental sustainability. Supporting market risk management instruments has the advantage of encouraging farmers to participate financially in their risk management, thus potentially reducing their income variability.

Increased use of derivatives…

It is almost certain that, given the decline in public support, market-based risk management tools will play an increasing role. Futures and other derivatives will be increasingly used to hedge price risk. The EU can encourage their acceptance by providing training and education to farmers, by ensuring availability of market information, by having a suitable supervision regime in place, and potentially by promoting their use among risk-sharing co-operatives.

… and insurance

Insurance will also be increasingly used to mitigate yield risk. Growing insurance portfolios are expected to increase the effects of risk-pooling and reduce the cost of reinsurance. Index-based insurance tools will also contribute to more hazards being insurable. The public sector may support the use of insurance among farmers by providing re-insurance or minimally subsidizing the premium of crop yield insurance: enough to make it affordable, but not too much in order to avoid irresponsible behaviour (e.g. planting unsuitable crops). It would also be beneficial for member states to increasingly require that farmers contract insurance to be eligible to compensation payments in case of crises or catastrophes.

Stabilising incomes and addressing environmental externalities by remunerating the provision of public goods

Rewarding farmers through payments for providing public goods is key to addressing the challenges of the future: promote sustainable agriculture, thus long-term food security, by supporting farming systems associated with high environmental standards of production. Designed to remunerate services rendered by the agricultural sector for which no price is paid on the market, these payments also contribute to cover risk. Additionally, the possibility of pricing externalities in the system should be further investigated (by using the polluter-pays principle, for instance by penalising the producers or the types of produce associated with the most inefficient use of natural resources).

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Bibliography

Alizadeh, Amir and N. Nomikos (2005). Agricultural reforms and the use of market mechanisms for risk management. Study commissioned by the Futures and Options Association. London. Cass Business School and FOA. March 2005.

Auer, Josef (2003). Weather derivatives heading for sunny times, Deutsche Bank Research. Current Issues. Frankfurt.

Balcombe, Kevin (2009). The nature and determinants of volatility in agricultural prices. Technical Report, report to the FAO.

Bielza Diaz-Caneja, Maria, C.G. Conte, F.J. Gallego Pinilla, J. Stroblmair, R. Catanero and C. Dittman (2009). Risk management and agricultural insurance schemes in Europe. Joint Research Centre. European Communities. Luxembourg.

Bielza Diaz-Canela, Maria, C.G. Conte, R. Catanero and F.J. Gallego Pinilla (2008). Agricultural Insurance Schemes II: index insurances. Joint Research Centre. European Communities. Italy.

BirdLife International. EEB, EFNCP, IFOAM, WWF Proposal for a new EU Common Agricultural Policy. March 2010.

Cafiero, Carlo, F. Capitanio, A. Cioffi and A. Coppola (2007). Risk and crisis management in the reformed European agricultural policy. In Canadian Journal of Agricultural Economics 55. 419-441.

Commission of the European Communities (2009a). Agricultural commodity derivative markets: the way ahead. Commission staff working document. Brussels. October 28, 2009.

Commission of the European Communities (2009b). Composite report on the conservation status of habitat types and species as required under Article 17 of the habitats directive. Brussels.

Cooper, Tasmin, Hart Kaley and Baldock, David (2009). Provision of public goods through agriculture in the European Union. Institute for European Environmental Policy. December 2009.

Heymann, Eric (2007). Climate change and sectors: Some like it hot! Deutsche Bank Research. Current Issues. Frankfurt am Main.

Heymann, Eric, Lizio, D. and M. Siehlow (2010). World water markets. Deutsche Bank Research. Current Issues. Frankfurt am Main.

Kahn, Bruce and D. Zaks (2009). Investing in agriculture: Far-reaching challenge, significant opportunity. Deutsche Bank Climate Change Advisors. http://www.dbcaa.com/research

Kappel, Rolf, R. Pfeiffer and J. Werner (2010). What became of the food price crisis in 2008? Aussenwirtschaft, 65(I). P. 21-47. Zurich.

Kern, Steffen (2010). Global financial centres after the crisis. Current Issues. Deutsche Bank Research. August 2010. Frankfurt am Main.

Matthews, Alan (2010). Perspectives on addressing market instability and income risk for farmers. Paper presented at a joint AES and SFER conference on “The common agricultural policy post 2013”. March 2010. Edinburgh.

Meuwissen, M., Marcel Asseldonk and Ruud Huirne (2008). Income Stabilisation in European Agriculture. Wageningen Academic Publishers.

OECD (2008). An assessment of risk exposure in agriculture – A literature review. Working Party on Agricultural Policies and Markets. December 2008. Paris.

OECD (2009a). Risk management in agriculture – A holistic conceptual framework. Working Party on Agricultural Policies and Markets. March 2009. Paris.

OECD (2009b). An overview of risk-related policy measures. Working Party on Agricultural Policies and Markets. March 2009. Paris.

OECD (2010). Farm level analysis of risk and risk management strategies and policies. Paris.

OECD- FAO (2010). Agricultural Outlook 2010-2019. June 2010. Paris.

Roache, Shaun K. (2010). What explains the rise in food price volatility? International Monetary Fund Working Paper. May 2010.

Robles, Miguel, Torero M. and von Braun, J. (2009). When Speculation matters. International Food Policy Research Institute. Issue Brief 57. February 2009. Washington, D.C.

Schaffnit-Chatterjee, Claire (2009). The global food equation Deutsche Bank Research. Current Issues. Deutsche Bank Research. September 2009. Frankfurt am Main.

Sukhdev, Pavan et al. (2008). The economics of ecosystems and biodiversity http://ec.europa.eu/environment/nature/biodiversity/economics/pdf/d1_summary.pdf

Székely, Csaba and Péter Pálinkás (2009). Agricultural risk management in the European Union and the USA. Studies in Agricultural Economics No.109. P.55-72.

Torero, Maximo and von Braun, J. (2010). Alternative mechanisms to reduce food price volatility and price spikes. Paper presented at the International Food & Agricultural Trade Policy Council. May 2010. Barcelona.

USDA (1999). Managing Risk in Farming: Concepts, Research, and Analysis. Market and Trade Economics Division and Resource Economics Division. Economic Research Service. U.S. Department of Agriculture. Agricultural Economic Report No. 774. March 1999.

Von Braun, Joachim and M. Torero (2009). Implementing the physical and virtual food reserves to protect the poor and prevent market failure. Policy Brief 10. International Food Policy Research Institute. February 2009. Washington, D.C.

Vrolijk, Hans, C.L.A.M. de Bont, H.B. van der Veen, J.H. Wisman and K.J. Poppe (2009). Volatility of farm incomes, prices and yields in the European Union. LEI Wageningen UR. The Hague. August 2009.

Wright Brian (2009). International grain reserves and other instruments to address volatility in grain markets. The World Bank. Policy Research Working paper 5028. August 2009.

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