Chapter 6

Choice of Policy Instruments and Impacts on Land Use and the Food Industry

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CHAPTER 6

CHOICE OF POLICY INSTRUMENTS AND IMPACTS ON LAND USE AND THE FOOD INDUSTRY

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Introduction

The natural disasters we commonly think of include droughts, floodings, or large-scale pest attacks. A common feature of such natural disasters is sudden and unexpected crop losses. From an economics perspective, however, it could be more fruitful to frame yield losses in monetary terms. The primary reason for choosing this slightly different research angle is that bumper crops also constitute challenges for the food industry and farmers. Unexpected high yields tend to lower commodity prices, which in turn may adversely affect farm profitability and, hence, the long-term sustainability of primary production. For the food industry, things are more complicated: the local food industry benefits from low commodity prices for its own inputs, but faces severe challenges if processed foods from other regions are less costly.

With a focus on unexpected variability of crop revenues instead of crop losses, the emphasis becomes more on (economic) risk reduction. Skoufias (2003) lists similar perspectives in a survey paper. Still, some may argue that severe crop losses are more challenging than unexpected high yields as primary producers are left with nothing, while unexpected high yields only lead to lower farm incomes, but at least leave people with something to eat. This reasoning holds for subsistence-oriented farming systems, but for modern (market-based) farming, unexpected income variation and risk are important issues.

Local markets contribute in reducing farm level risks in the following way: high yields and the corresponding lower prices, or low yields and the corresponding high prices stabilise farm incomes. The same self-correction is necessarily not in place if local markets are integrated with larger markets as low local yields do not automatically lead to higher local prices for farmers. For consumers, however, the benefits of integrated markets are clear:

trade reduces prices and price variability, which in turn lowers consumer food expenditures and reduces uncertainty related to food expenses.

Designing policies to secure the welfare of consumers and to provide stable and low commodity prices for the food industry and high and stable prices for farmers is no straight-forward task. Add natural disasters to this picture and matters become even more complicated.

This paper looks at the following policy measures for reducing the negative effects of crop and income losses: crop and income insurance, futures market, acreage payment, and price support. The main method used is review of central literature on reducing crop and income losses.

Crop and income insurance are amongst the most interesting policy options for stabilising incomes and reducing risk exposure, for primary producers in particular. Land use may also particularly affect risk if existing policies lead to farmers taking too much risk. An example of this is from the flood-prone zones along the Mississippi River, where heavily government-subsidised crop insurance leads to more crop production (mainly cotton) in arable land that is sensitive to flooding than what would otherwise have been the case (Browne et al., 1992). In years with no flooding, yields are high, leading to cotton surpluses and deflated prices, and posing challenges for other cotton producers.

Other relevant policy instruments include acreage payment and price support. The latter is perceived as particularly problematic in terms of risk impacts if it leads to the same kind of farm level choices as in the aforementioned Mississippi River cotton case.

This paper is organised as follows: Section 2 deals with risk at the farm level, while Section 3 discusses risk for the food processing industry. Consumer risk issues, which basically entail low and stable food prices, are briefly dealt with in Section 4. Section 5 summarises.

Farm Level Risk

A well-known approach in dealing with risk in finance is diversification through portfolio management. Portfolios are commonly partitioned into risk classes, and most investors want some of their portfolios to be low risk even though this implies sacrificing some returns on investments. The possibilities for financial diversification are further accentuated as financial investments can take place at various geographical locations.

Primary production in agriculture is somewhat different as most farms are located within certain areas. Natural disasters that affect one field or installation are therefore likely to affect nearby fields or installations. For some productions, like animal husbandry, spreading production facilities is a well-known strategy to reduce the impacts of fires, isolate outbreaks of diseases, etc. In such cases, expected marginal gains are compared with expected marginal costs, i.e. well in line with standard microeconomic theory.

Applying the diversification principles from portfolio management by engaging in multiple productions is not without costs, as noted by Dercon (2002), and Abson, Fraser, and Benton (2013). There are several reasons for this. First, economies of scale tend to vanish. Second, it requires operators to be knowledgeable in multiple areas, which may entail substantial extra costs of acquiring the necessary knowledge. Still, we see many farmers diversifying, but frequently do this by coupling productions that either utilise production capital for longer periods of the year than the growing season of a single crop or engaging in productions that utilise positive externalities from one production to another, like the soybean–corn rotation. Some crop rotations also allow for more efficient utilisation of parts of the production equipment like tractors and storage facilities, or help to even out peak labour periods. While such micromanagement twists increase profitability and reduce price risk, they do little to reduce the risks associated with many natural disasters.

A risk-reducing feature that is often neglected is the self-correction of markets. When yields are low, prices tend to be high or vice versa. This works particularly well for local or regional markets but may not have the same impact with international trade: high yields somewhere else lead to lower farm gate prices.

While micro-level adjustments in farm operations may lower risks and increase profits, they do little to counter the effects of location-specific natural disasters, with the exception of productions that are time-wise separated. Moreover, local market self-correction may be of little value if most of the production volume is wiped out due to flooding, earthquake, or other natural disasters. We therefore need other mechanisms in place to maintain farm incomes and livelihood of farm households. In the following sub-sections, I address crop insurance, futures market, producer price support, and acreage payment.

Crop Insurance

For insurance to work, the item to be insured needs to be insurable, i.e. the item is well defined, the cause of the damage is known, and the damage one insures against is known and finite (Varian, 1992). Crop insurance meets these criteria: the crop is known, the

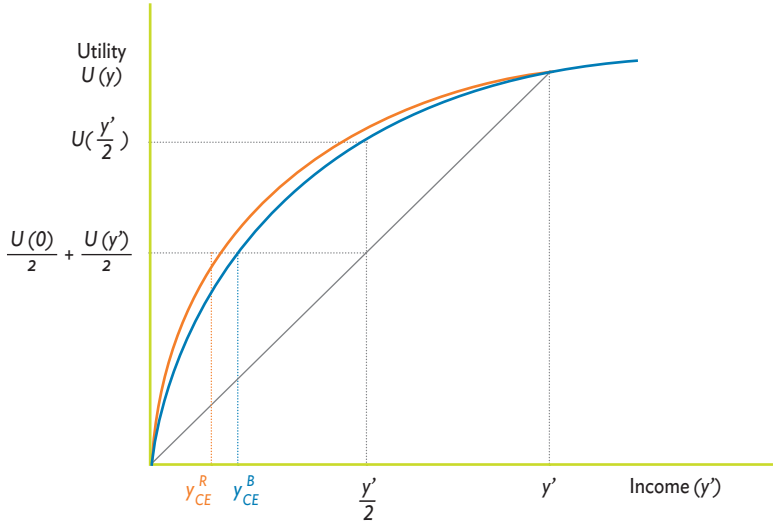
cause of the damage (hail, loss of rainfall, etc.) can be specified, and a clear baseline (normal yields or a percentage of normal yields) exists and is known.

I have already mentioned the market disruptions caused by subsidised insurance in the Mississippi flood area. That does not invalidate fair-priced insurance that farmers pay for an actuary-assessed insurance where insurance suppliers make normal profits from their investments. There are two driving forces behind insurance:

1 Economic agents are averse to risk, implying that they are willing to pay a premium to reduce the consequences of bad outcomes, like if your house burns.
2 Risk can be pooled, that is when one insured house burns, it is not devastation for the house owner, but it is highly unlikely that many houses insured in the same country will burn at the same time.

Figure 1 illustrates point (1). To make the sketch clearer, assume that an economic agent wants to insure against a situation where all his or her income in a period is lost, and that there is a 50% chance this bad event will happen.

Figure 1: A Risk-averse Economic Agent's Maximum Willingness to Pay for Insurance



Source: Pratt (1964).

Should the good event happen, the economic agent keeps all of his or her income. Being averse to risk, this agent has a concave von Neumann-Morgenstern expected utility function in income. The blue curved line denotes the expected utility function for a risk-averse agent. Let y' denote the income in the good state, i.e. the agent keeps all income, and 0 be the income under the bad state. With equal probability of the good state and the bad state taking place, the mean utility of the two states is given by $1/2U(0) + 1/2\,U(y')$, while the utility of the mean income of the good state and the bad state equals $U(\frac{y'}{2})$. If this agent can insure against the bad state, the maximum willingness to pay for insurance – the risk premium – is

$$RP = \frac{y'}{2} - y^{B}_{CE}$$

where y^{B}_{CE} denotes the certainty equivalent given the initial (blue) curve. If this agent were more risk averse, the expected utility function would be more curved (for example, as depicted in the red curve), and the risk premium would increase to $\frac{y'}{2} - y^{B}_{CE}$. This basic example of insurance does not completely match the most common cases of crop insurance, but the basics are the same. A key issue in the insurance literature is that to reduce the risk for moral hazard, i.e. that agents do not take sufficient care to avoid the bad state, the insurance contract becomes more expensive, the higher share of the damages that are to be covered by the insurer in the event of the bad state. Most crop insurance schemes today therefore involve partial coverage (Vercammen, 2000). Still, one observes that the possibility of buying insurance also changes agents' actions. For example, Claassen et al. (2017) found that federal crop insurance in the US affected crop selection and crop rotation towards more risky cropping strategies.

Natural disasters pose some challenges for (2), pooling of risk, because flooding or an earthquake may affect all households in an area. This implies less scope for mutual insurance, i.e. members of a community insuring each other. That is also one of the reasons for the emergence of insurance companies as we know them today, covering several regions.

Moreover, that is seldom the case with multiple insurance companies with wide geographical coverage. In addition, insurance companies have other tools at their disposal to lower the risks associated with geographically correlated disasters. Here, reinsurance is the most common solution, i.e. an insurance company buys stakes in objects insured by other insurance companies. For example, the offshore oil and gas platforms in the North Sea are often reinsured as few single insurance companies would survive the financial burden of a sudden loss in the magnitude of €20+ billions.

Governments usually self-insure as they have so many insurable objects. The Norwegian government, for example, self-insures. But for large installations like its offshore oil

installations, even Norway buys insurance at the international markets despite its €900 billion sovereign fund. Crop insurance is not of same magnitude as the above examples, but reinsurance is still important to deal with geographically concentrated or correlated damage.

Crop insurance comes in different versions: yield loss insurance and revenue loss insurance. Producers can insure against single or multiple causes for damages. Revenue loss insurance is, for example, particularly relevant for unexpected price declines caused by (global) high yields or dumping of products on the international markets. For such events, there also exist other instruments, most notably in futures markets, which I discuss in the next section. In the case of natural disasters, yield loss insurance is the most relevant. Here, the insurance is paid to the insured farmers based on the difference between actual and normal yields (the baseline yields), usually with some downward adjustment in the baseline as yields tend to fluctuate even in the absence of natural disasters.

Crop insurance is not a new construct. As early as 1938, the US introduced its first federal crop insurance programme. It has been revised several times, most recently in 2011, in the wake of increased knowledge about insurance and insurance markets, the existence of other risk-mitigating instruments like the futures markets, better understanding of disaster scenarios, and the emergence of private crop insurance schemes. Similar developments have taken place in other countries, most notably Canada which got its government crop insurance programme only one year after the US. Several countries, like India, currently require farmers who have state loans to take out crop insurance.

There is a growing literature on crop insurance. For our purposes, the strand of literature on integrated markets and risk (Miranda and Glauber, 1997; Miranda and Vedenov, 2001) is particularly relevant. Crop insurance markets are rapidly evolving (see, for example, Skees 2008a, 2008b) and becoming more present even in developing countries. For example, Skees et al. (2008) deal with crop insurance in Viet Nam. Weather-indexed crop insurance is gaining much attention due to possible climate changes. Crop insurance is probably even more applicable for smallholder farmers in developing countries given their less access to futures markets. Jensen and Barrett (2016) discuss how to overcome some of the difficulties of using index insurance in developing countries related to poor base data, coverage and quality of the insurance, and making insurance affordable for the rural poor. Their findings are quite optimistic, given the shortcomings, in particular, of other policies to reduce risk in agricultural production in developing countries. A recent CGIAR research programme for indexed weather insurance directed towards developing countries points to the same direction as Jensen and Barret's (2016).

This is an area where substantial growth is expected with several private initiatives on the risk and insurance consultancy side being launched in recent years. Global Ag Risk is one example of such an initiative. Such firms are now leading the development of new risk-mitigation strategies and insurance possibilities. These developments do not remove the demand for government initiatives, particularly in poorer developing countries where many smallholder farmers face difficulties getting credit (to buy insurance) and transaction costs are usually quite high.

Futures Markets

In futures markets, agents typically contract to buy or sell a certain amount of a commodity to an agreed price at a certain time into the future. This lowers risk to the agents as they secure the price for some of the quantities they plan to buy or sell at future time.

Options increase the flexibility of such forward contracts and come in two basic variants:

- A put option gives the owner the right, but not the obligation, to sell the underlying asset (a commodity or futures contract) at the contracted price on or before the expiration date of the option.
- A call option is the converse of a put option, as the owner of a call option has the right, but not the obligation, to buy the underlying asset at the contracted price on or before the expiration date of the option.

Agricultural commodities belong to a commodity group where futures markets and options have become an important way of reducing risk, particularly for food processing firms. For further details on futures markets and options, see, for example, Pindyck (2001) for a general overview on energy markets or Scnepf (2006) for an overview on agricultural commodities.

Price Support

Producer price support has also been heralded as a way to reduce risk. Such support distorts trade to quite a large extent, and most researchers view this as harmful to market development (see, for example, Xiao et al., 2001; Orden et al., 2011). The Global Trade Analysis Project's website is probably the place to go for further references on this.

The risk impacts from such support under natural disasters have not been much researched. However, it seems reasonable to conclude that as they inhibit market development, they also increase the risks associated with natural disasters. The rationale

behind this reasoning is that well-functioning markets tend to reduce consequences of natural disasters as trade channels are well established, implying that it becomes easier to get food into crisis areas. The World Bank (2001) argues along the same lines, but is not so explicit on the damaging effects on natural disaster readiness from commodity price support. Sound macroeconomic policies and liberalised trade are, however, amongst the more general risk-mitigating strategies listed by the World Bank (2001). On the other hand, price support increases farm incomes which, in turn, reduces poverty, one of the key factors for preventive measures and coping strategies. Price support will influence land use in the sense that more land will come under cultivation (Romstad, 2008). The main driver behind this result is that price support makes agriculture more profitable.

Acreage Payment and Other Less Market-distortive Policies

Acreage payment does not affect food commodity markets to the same extent as price support. Possible beneficial impacts from such payment include increased farm income and hence, poverty reduction. However, acreage payment could also increase risks if it leads to farming on areas that otherwise may not be profitable to farm like steep hills or high-frequency flooded areas. Impacts from farm support policies vary and depend on many factors like possibilities for off-farm work, wages in other sectors of the economy, etc. Romstad (2004) provides an overview.

Farm-level Measures and their Impacts on the Food Industry

Crop insurance reduces financial risks to farmers, making it more profitable for them to invest in production, which means increase in yields. This may appear a bit counter-intuitive as insurance is usually thought off as lowering effort due to moral hazard. However, the moral hazard effects under natural disasters are minor, partly because agents cannot influence the occurrence of natural disasters, and partly because crop insurance, like other insurance, does not involve full compensation.

Price support leads to higher production volumes due to increased use of farm inputs like fertilisers, that increase yields, and due to increased acreage. Hence, commodity prices fall for the food processing industry.

The impacts of acreage support are more mixed. More acreage coming under cultivation increase agricultural production, but as these are marginal lands, the increase in production volumes is modest. For time-constrained farmers, the extra yields from the additional

low-productive acreage may be offset by a decline in the yields on the acreage originally cultivated due to less time spent on it.

Risk for the Food Processing Industry

Stable and predictable supplies of inputs are key to any industry. For the food processing industry, stability entails both quantity and quality of farm deliveries and predictable input prices. Industries that are well integrated in larger markets and with sufficient infrastructure (roads, communications) are usually better equipped to deal with natural disasters.

On the market side, futures are found to lead to more stable commodity prices and hence reduce price risks. There have been questions raised on the price-stabilising properties of futures in the presence of index funds, particularly those related to the food price hikes in 2007–2008. Irwin and Sanders (2011) checked this issue and found that there were no statistically significant linkages between periodic high commodity prices and entrance of index funds in that period. They concluded that the price-stabilising properties of futures markets remain as other factors were more important such as major crop failures in several important food-producing regions coupled with increased demand for biofuels from biofuel requirements in the US and the EU, and an overall increase in food demand due to increased prosperity, particularly in China and Southeast Asia.

The food retail sector has changed considerably in the last few decades. Consumer demand has grown for fresh products and variation on packaging size depending on household size. Moreover, many stores have limited storage space due to higher property values and increased demand for fresh foods. These changes also influence the food processing industry, where production is done in smaller batches (freshness) and are increasingly made according to the specifications of the food retail chains (van Donk, 2001). 'Just in time' and 'just right' have come to the food sector. I have yet to find a paper that analyses the effects of these changes in logistics in the food industry on the vulnerability to natural disasters. There is, however, a substantial literature on supply chain management in general and in light of 'just in time'.

Measures discussed in this general literature include interim storage, redundant suppliers, increased flexibility and responsiveness in the supply chain, and pool or aggregate demand (Chopra and Sodhi, 2004). Several of these measures are not well suited for the food sector. For example, interim storage is inconsistent with the increased demand for freshness. Still, this literature provides valuable insights that are also applicable for the food sector. Not all food items need to be fresh, and by separating perishable and easy-to-store products, parts of the risks can be mitigated. One reason for this is that transport

volumes can be reduced in the event of a natural disaster as only perishable products are transported until the infrastructure is repaired or becomes usable again.

New firms have extra options available to them. A feature that seems to have been somewhat neglected in the past is location from a supply chain perspective, i.e. the availability of multiple transport routes to maintain the inflow of critical inputs for production to continue.

The main message from this session is that market integration, futures, and some supply chain management measures reduce risk in case of natural disasters, and that one needs to examine location issues to a larger degree than what has been done previously.

Consumer Risk

Poverty and poorly developed institutions remain the main determinants for the impacts the public at large get from natural disasters. A study of death tolls from natural disasters verifies this (Kahn, 2005). The main message is that economic growth and more equitable distribution of wealth are the key policy measures to reduce the impacts on society of natural disasters, coupled with mature markets with well-developed logistics. Markets and logistics are key factors to be able to supply food under natural disasters, particularly if the disaster is a complete food production failure in a region. Some disasters, like severe drought in a region, evolve slowly. This gives ample time to put the proper safety measures in place. Other disasters, like floodings and earth slides, occur with far less warning times and are hence also more difficult to safeguard against.

Even when the above-mentioned market and logistics conditions are satisfied, natural disasters may lead to severe disruptions like absence of electricity or limited communications, which may affect short-term food supplies. Households can reduce the immediate consequences of such events by following the old advice of having some non-perishable foods and reserve cooking facilities available until assistance arrives.

Consumer concerns related to the food sector include food security, i.e. there is enough food at affordable prices, and food safety, i.e. one does not get (acutely) sick from consuming the food. Depending upon the type of natural disaster, both issues can be important. Ample food supplies are, however, of limited value, without access to suitable drinking water.

Food security is strongly linked to the food sector's possibilities to meet consumer demand, which is greatly augmented through markets and sufficient logistics. Barrett

(2010) provides a recent and non-technical overview, and Falcon and Naylor (2005) provide some long-term perspectives. There is also a vast literature on emergency aid and its impacts that I will not address in this paper.

Antle (2001) provides a general economic overview of food safety. Food safety issues under natural disasters are more complicated as one often cannot see if the food is safe to eat or not. Breakdown of infrastructure, particularly electricity, may adversely affect food storage. For some types of food, this implies rapid loss of quality and, in some cases, that the food quickly becomes unsafe to eat. Smart labelling is one way of letting consumers know if perishable foods have passed their expiration date.

From a consumer perspective, however, the welfare losses of temporarily not being able to eat certain foods in case of a natural disaster are believed to be minor. The main issue is to supply consumers with sufficient food so they can survive until matters normalise.

Concluding Comments

Poverty and poorly developed political institutions tend to aggravate the negative impacts of natural disasters. Long-term policies to alleviate poverty are key to risk mitigation and minimising welfare losses from natural disasters.

Well-functioning and integrated food markets are the key measure in dealing with the most pressing food issue – supplying enough food – during a natural disaster. Natural disasters may be sudden (like an earthquake or a landslide) or evolve gradually (like severe drought). For gradually evolving crises, there is more time to prepare, and for many such crises, the necessary infrastructure for markets to work is in place. Sudden natural disasters are more demanding. Again, the main focus must be on providing consumers with sufficient food supplies until the crisis situation normalises.

Regarding impacts of natural disasters on farmers and the food processing industry, suitable measures to reduce the negative economic impacts of natural disasters exist provided that well-functioning markets and proper logistics are in place: crop insurance for farmers, and futures markets for food processing firms.

Crop insurance reduces the economic risks associated with agriculture, and will therefore make it more profitable to invest in agriculture. This will cause production volumes to increase.

Risk mitigation and risk sharing are essential in modern economics (Schlee, 2001), and crop insurance and futures markets are two instruments that spread risk under natural disasters while allowing markets to work.

Other instruments like producer price support or acreage payment increase farm incomes, but may adversely affect resource allocation. Producer price support is also likely to distort commodity markets, and hence be counterproductive. The effect of acreage support on production volumes is likely to be minor and could, in some cases, even be negative if the yield gains from new marginal land under cultivation is less than the yield losses from less attention put on the original acreage under cultivation.

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