EUROPEAN UNION SUBSIDIES: A CATALYST FOR EPIDEMIC DISEASE MARKET LOSS INSURANCE?

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Improper risk financing solutions for market losses may withhold farmers to punctually participate during an epidemic in so-called "vaccination-to-live strategies." This paper shows that although market losses are not straightforward to insure, loss parameters can be assessed. It also demonstrates that recently introduced EU subsidies can act as a catalyst for agriculture-related risks that are difficult to insure, thereby promoting more efficient eradication strategies, including "vaccination-to-live." Findings of this paper are useful for policy makers and chain actors to jointly design risk-sharing solutions for market losses.

Public concerns over destroying large amounts of animals spurred policy makers to adopt so-called "vaccination-to-live" strategies to control future outbreaks of livestock epidemics (Hop et al., 2012). This strategy, also known as protective vaccination, includes destruction of infected and contact herds coupled with simultaneous vaccination of susceptible herds within a certain radius. Under this strategy, products from vaccinated animals are not destroyed, but marketed "as usual" (European Commission, 2003). In the Netherlands, contingency plans foresee protective vaccination for future outbreaks of classical swine fever (CSF) and foot and mouth disease (FMD). Yet after nearly ten years of debates, the question of selling products from vaccinated animals remains unresolved, with policy makers recently associating market losses from vaccination with entrepreneurial risk. Nevertheless, public-private solutions to finance these losses may be needed for farmers not to frustrate vaccination programs. Similar arguments have been put forth to find public-private financing solutions for direct losses (Meuwissen et al., 2003a).

Market losses can result from supply and demand distortions arising from special heat treatments applied to meat stemming from vaccinated animals. They can also result from consumer concerns over the safety of products from vaccinated animals. Market disruptions are expected for non-vaccinated regions, as well, though little is known about the size of market losses under protective vaccination regimes. In epidemics where stamping-out or suppressive vaccination strategies were deployed, market losses were only described in qualitative terms.

For instance, Vrolijk and Poppe (2008) state that in November 1988, about six months after the end of the CSF-epidemic, "prices came at the lowest levels after the Second World War Market". Huirne et al. (2002) estimated that more than half of the FMD farm-level losses arriving from business interruption came after the epidemic ended. With regard to AI, Mourits et al. (2008) state that substantial income losses were incurred by multiple partners of the supply chain.

The limited information about the size of risk and the catastrophic nature of market losses hinder the design of a viable public-private risk financing solution. In this context, this paper aims to discuss the insurability of market losses in general, to elicit expert judgments on the expected size of market losses, and to review the experience of re-allocating EU subsidies to facilitate insurance uptake for catastrophic risks in agriculture.

The insurability of market losses is assessed along the set of idealised conditions from the viewpoint of the insurer (Rejda, 1998). For reasons of completeness also the already covered direct losses are included as well as business interruption losses. For the latter, for some sectors and in some member states private insurance already exists (Van Asseldonk et al., 2006).[1] With regard to the to date experience of using EU premium subsidies for catastrophic insurance, assessments focus on the Netherlands and address extreme weather as well as disease insurance.

Insurability of epidemic disease losses

Before a risk can be financed with a pooling system, certain basic requirements must be fulfilled (Rejda, 1998). Each item is addressed below, both in a general context as well as with a focus on the various damage components of livestock epidemics (Table 1). Not all idealised conditions hold for the various loss components, with problems arising due to the number conditions. Yet this does not mean that a pooling system is impossible, since the

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[1]. In the Netherlands, pig farmers could insure business interruption damage from CSF and FMD outbreaks through a mutual (founded in 2002). In 2012, the mutual was discontinued due to lack of interest (Meuwissen et al., 2013).

problems can be partially overcome with a sound design of the risk sharing tool, as discussed below.

**Table 1. Extent to which loss components of livestock epidemics
in a protective vaccination framework fulfil risk pooling requirements**

	Veterinary losses	Business interruption	Market losses
There must be a large number of exposure units	++	++	++
The loss must be accidental and unintentional	+	+	-
The loss must be determinable and measurable	+	+	--
The loss should not be catastrophic	-	+	--
The probability of loss must be calculable	+	+	-
The rates must be economically feasible	+	++	-

Scale applied: -- = requirement violated; - = requirement somewhat violated; + = requirement somewhat fulfilled; ++ = requirement fulfilled.

Large number of exposure units. Ideally, there should be a large group of roughly similar (but not necessarily identical) exposure units that are subject to the same peril or group of perils. The loss can then be spread over all participants in the underwriting class (Rejda, 1998). Although the susceptibility for a specific disease agent differs across types of livestock production, these discrepancies can be easily addressed by setting up specific pools, or through premium differentiation. Additional risk-determining factors include the animal and herd densities, the incidence of wildlife that may be carriers, and the proximity of airports and seaports as sources of infection. The expected size of epidemics varies across areas, as well, depending largely on animal and herd densities. Differentiating premiums according to the location of a farm is likely to increase interest in insurance among farmers from outside hazard-prone areas, thereby giving the insurer potential for risk spreading.

Accidental and unintentional loss. In an ideal situation, the loss would be fortuitous and outside the participant's control, thereby preventing moral hazard (Rejda, 1998). With moral hazard, exposure units change their behaviour in a manner not predicted by the owner of the system after signing the contract — for example, by becoming more careless (Arrow, 1996).

A livestock farmer can influence the expected probability of the herd becoming infected. Factors that influence this probability include the sanitary barriers and hygiene on the farm, the number of animal contacts and whether stock is purchased from sources with known health status or from markets and dealers. A farmer's influence on the size of risk is likely to cause problems of adverse selection and moral hazard in an insurance scheme. Adverse selection can be minimized by differentiating premiums according to measurable risk factors. Moral hazard can be minimized with contract specifications on "due diligence" and with deductibles. Moreover, establishing an appropriate legal framework covering epidemic fraud (with appropriate penalties) reduces incentives to be dishonest.

Governments can also influence losses through the control strategies they deploy. Governments decide on — and are held responsible for — the control measures taken during an epidemic. Relatively extensive movement standstills and elaborate protective vaccination programs are effective strategies to eradicate an epidemic. Veterinary costs decrease at the expense of market losses. Therefore, transparent and systematically-applied control measures

are necessary. Governments and insurers must also reach agreements about the control strategies to be applied under various circumstances in order to avoid debates on this issue during an epidemic.

Determinable and measurable loss. "Determinable" means that the amount of loss can be limited and clearly expressed if a certain expense is within the defined loss. "Measurable" means that the loss is financial and that its amount can be determined, either through calculation or estimation. Compensation of the veterinary costs can be based either on a pre-set animal value or actual market value at the moment of culling. The indemnity for business interruption losses should be based on the actual incurred loss or a proxy of the loss (for example, indemnity could be based on duration times average gross margin). Quantifying market losses *a priori* is fairly cumbersome and can be problematic, since there are hardly any claim experiences available. Linking expert elicitations to simulation studies, as described by Longworth et al. (2012a, b), seems useful in this respect.

Not catastrophic. In order to make the pooling technique workable, a large proportion of the exposure units must not incur losses at the same time. With systemic or correlated risks, multiple participants can suffer losses at the same time (Skees and Barnett, 1999). Livestock epidemics generally involve many farms at the same time, and a massive protective vaccination program only amplifies this problem. Problems arise with respect to pooling within a year, as adequate reinsurance capacity is not typically available when the scale of systemic risk is large (Jaffee and Russell, 1997; Miranda and Glauber, 1997). The capital market is also not well acquainted with epidemic disease risks. Losses resulting from a decrease in product market value are therefore difficult to transfer. Limited subsidies may be justified in order to encourage private markets to design risk-sharing solutions (Arrow, 1996; Meuwissen et al., 2003b). In the European Union, such subsidies have been available since 2009, as discussed below.

Calculation of probability of loss. To set an appropriate rate, one must accurately calculate the cumulative distribution function of both the frequency and severity of losses (Rejda, 1998). Historical data on disease outbreaks and associated damage figures are too scarce to derive the cumulative distribution function, and may not be fully relevant if, for instance, the control measures have changed. Historical data on the probability of protective vaccination being applied, and the circumstances under which this would happen, remain scarce. Nevertheless, risk models estimating the impact of outbreak scenarios can be helpful.

Feasible rates. The farmer must be willing to pay the rate, but research shows that people typically have problems in assessing the probability and potential magnitude of such risks (Kunreuther, 1976). Because of such cognitive failure, farmers' willingness to pay for insurance is less than the actual premium required (Skees and Barnett, 1999). However, there are business interruption coverages that compensate farmers at times of an outbreak (Van Asseldonk et al., 2006). In this context, effective risk communication remains crucial.

Elicited size of market losses

Expert judgments on the size of market losses originate from 2004. During that time, i.e. in the aftermath of the 1997/98-CSF, 2001-FMD and 2003-AI epidemics, policy makers and chain actors were jointly assessing the expected impact of protective vaccination. Expert panels were interviewed sector-wise, i.e. one panel for the pig sector, one for the dairy sector and one for the beef, veal, sheep and goat sector. Experts were from private companies as well as from public organizations. Groups ranged from 4 (dairy panel) to ten experts (pig panel). As a point of reference, participants were first presented with price data from the 2001 FMD epidemic during which suppressive vaccination was applied. They were then asked to estimate aggregate market loss percentages, i.e. we did not ask experts to differentiate between various market loss items, chain participants, or time frames. Percentages were

assessed in an FMD context and specified with regard to farm-gate price levels (only for dairy and white veal, factory-gate and slaughterhouse-gate prices were used respectively).

Table 2 shows the results of the expert elicitations. For vaccinated animals, expected market losses are especially high for pork, including piglets and hogs, and some white veal, including an expected price decline of 75% and 80%, respectively. With regard to pigs and hogs, the Netherlands, as a net exporter, is expected to see severe supply and delivery problems, and would incur high costs of temporarily storing large amounts of labelled meat. High loss percentages for veal mainly arise from the necessity to sell meat without bones after vaccination; normally, 80% of white veal is sold with bones. Similar arguments apply for marbled veal, as well as meat from sheep and goats. For the percentage of meat already deboned under normal circumstances, prices are mostly expected to decline to world market levels for matured meat from vaccinated animals (which is 35% below normal market prices). With respect to dairy, experts expect lost markets to be reflected by a price decline of about 10% of the default price**.** (However, in the event of a large epidemic with extensive vaccination zones, they expect prices to even decrease by 20%.

Table 2. Elicited market loss parameters for protective vaccination in the Netherlands[1]

	Default price[2]	Vaccinated animals (8 months)[3]		Other animals in affected region (length of epidemic)[3]		Animals in non-affected regions (8 months)[3, 4]	
		Production affected (%)	Price impact (%)	Production affected (%)	Price impact (%)	Production affected (%)	Price impact (%)
Dairy[5]	0.57/kg	100	-10	100	-10	80/20	-8/-15
Beef	2.50/kg	100	-35	100	-5	15	-5
Piglets (25 kg)	41.50/ piglet	100	-75	100	-20	100	-15
Hogs (110 kg)	1.27/kg	100	-75	100	-20	100	-15
Marbled veal[6]	2.62/kg	80/20	-60/-35	100	-10	15	-5
White veal[6]	5.65/kg	80/20	-80/-55	100	-65	100	-25
Sheep & goat[6]	2.25/kg	80/20	-60/-35	100	-15	15	-5

1. Protective vaccination includes destruction of infected herds, limited pre-emptive culling of contact herds, and emergency vaccination of all susceptible herds in a 2-km zone around infected herds. Vaccinated animals and their products are marketed. Estimations are for foot and mouth disease epidemics in the Netherlands.

2. Farm-gate prices. Only for dairy and white veal other prices are used, i.e. factory-gate and slaughterhouse-gate prices respectively.

3. Period during which market losses occur.

4. Includes non-vaccinated animals from affected region from end of epidemic until abandoning of restrictions at the national level (8 months).

5. The 80/20 difference relates to percentage of produce normally delivered to Dutch and EU markets (80%) and other markets (20%).

6. The 80/20 difference relates to percentage of produce normally not deboned (80%) and deboned (20%).

Elicited loss percentages in the other columns of Table 2 — for non-vaccinated animals in affected regions and for animals in non-affected regions — are generally much lower, though substantial losses are expected in some sectors. For instance, experts from the pig sector expect that 100% of piglets and hogs in non-affected regions would face lower prices, for the same reasons as mentioned above. Dairy experts also expect considerable losses in non-affected regions, as the percentage of dairy products normally exported to third countries (20% and, in this case, outside the European Union) is supposed to face severe problems due to decreased demand. In general, all sectors in non-affected regions are believed to face market losses. Experts do not believe these regions would benefit from the occurrence of an epidemic, as was temporarily the case during the 1997/98 CSF epidemic in the Netherlands.

EU premium subsidies for agricultural insurance

After many years of debates among opponents and proponents of EU support for agricultural insurance, Article 68 of EC 73/2009 opened the pathway for EU contributions to insurance schemes (European Commission, 2009). More specifically, the regulation supports premiums for weather and disease insurance. It is also possible to receive support for setting up mutual funds, and for the compensation paid by such funds to farmers for losses suffered. Approval of Dutch and EU governments is required to obtain support. A 30% deductible must also be implemented, and subsidies are to be paid directly to involved farmers.

So far, insurers in the Netherlands have applied for the premium subsidies rather than the other types of support available. Moreover, it has been mutuals (not commercial insurers) who have actually applied for premium subsidies (Meuwissen et al., 2013). As shown in Table 3, these mutuals cover greenhouse and field crops, fruits, and breeding and rearing stages of the broiler chain. (Although the European Union had already approved broiler insurance and support, the price risk coverage was ultimately not provided by the broilers mutual, as members could not agree on the exact scope of the insurance — e.g. whether it should apply exclusively to farmers in restriction zones or to the Netherlands as a whole.)

Lack of commercial interest may arise from uncertainty surrounding the subsidies. After CAP reforms, they are likely to move from Pillar 1 (production support) to Pillar 2 (rural development), and it is not entirely certain what the impact of this transfer will be.

Table 3. Insurance schemes in the Netherlands using EU premium subsidies[1]

Insured commodities	Perils to which subsidy applies	Premium subsidies *since*
Greenhouse and field crops	Multi-peril weather risks	2010
Fruits	Multi-peril weather risks	2010
Broilers (breeding and rearing)	Market losses AI epidemics	(2012)[2]

1. Premiums are subsidised up to 65%. Support originates from EU (75%) and Dutch (25%) governments.

2. Subsidy for AI-losses was approved in 2012, but coverage was finally not provided by the mutual.

Discussion and conclusions

Designing insurance solutions for market losses is a challenge plagued by uncertainties. Will protective vaccination actually be applied? How will the market respond? From a risk management perspective, it is important to find solutions in order to provide farmers with the necessary incentives to punctually participate in vaccination programs.

This paper illustrated that market losses are not easy to insure, as they do not fulfil all conditions of an insurable risk. The size of the risk and its catastrophic nature are especially problematic. At the same time, we demonstrated that insight into the potential size of losses can be obtained, and that EU subsidies recently became available to facilitate the design of schemes. Loss assessments show that market losses can be substantial for pigs and white veal calves, in particular. Although figures originate from 2004, marketing channels have remained fairly unchanged since then.

Results are useful in bringing policy makers and chain actors together once again. The 2009 introduction of EU subsidies is expected to enhance and accelerate this process, since, as the broiler mutual demonstrated, price impacts of livestock epidemics are eligible for subsidies. However, experience in the Netherlands also demonstrated that EU subsidies for agricultural insurance are not yet widely applied. They could be steered by the relative

newness of the subsidies, and the uncertainty about CAP reforms and the related repositioning of insurance subsidies.

If chain actors and policy makers want to make progress in developing insurance for market losses, "peace time" seems to be the best time to do so. This paper clearly identifies major difficulties, the sectors that should be prioritised, and the role that subsidies could play as a catalyst for difficult-to-insure risks in agriculture.

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