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RISK ANALYSIS TO EVALUATE IDENTIFICATION AND RECORDING SYSTEMS FOR PIGS IN BELGIUM

Saatkamp, H.[1],Huirne, R., Dijkhuizen, A., Geers, R.

Une étude d'analyse de risque est présentée comprenant l'incertitude et l'attitude du décideur vis-à-vis du risque. L'étude a été centrée sur le remplacement possible dans le futur du système actuel d'identification et d'enregistrement des porcs en Belgique. Les résultats ont montré des différences dans le choix préféré entre les décideurs au niveau (supra) national et les éleveurs. Il a été conclu que pour un remplacement réalisable sur le plan économique par un système électronique d'identification et d'enregistrement, l'utilisation de démarches supplémentaires est un prérequis.

INTRODUCTION

Large-scale innovations usually involve considerable investments. Therefore, *a priori* economic evaluation of the decision alternatives can be helpful for decision making. In most cases, computer simulation can be applied, and preferably a risk analysis should be included to take account for uncertainty and risk attitude of decision makers. This paper aims at presenting such an analysis with respect to national identification and recording (I&R) systems.
I&R systems aim at recording all relevant data with respect to movements and inventory mutations to, from and within a particular population. In turn, information provided by the I&R system can be valuable for many activities within animal husbandry, particularly for contagious disease control. In the present study, two I&R systems were evaluated for the Belgian situation: (1) EMDC: *E*artags with in most cases *M*anual recording, user-friendly *D*ocuments and *C*omputerized data storage (this is the current Belgian system), and (2) TEC: *T*ransponders with *E*lectronic recording and data transfer and *C*omputerized data storage (this I&R system is based on electronic identification with the use of transponders). Currently, I&R systems are mainly used for the control of Classical Swine Fever (CSF). Therefore, the study focused in particular on this application.

STOCHASTIC EFFICIENCY

In most cases, exact information on the risk attitude of the decision maker is hard to obtain. To facilitate decision making in such circumstances, the concept of stochastic efficiency was developed. If at least something about de decision maker's preference is known or can be assumed, stochastic efficiency techniques can provide a distinction between efficient (i.e., preferable) and dominated sets of decision alternatives.
The coefficient of absolute risk aversion (r(y) or RAC) is a measure for the decision maker's risk attitude. It is derived from the decision maker's utility function for wealth u(y). If r(y)<0, the decision maker is said to be risk-prefering, whereas r(y)=0 implies risk-neutrality. Higher (positive) values of r(y) coincide with an increase in risk-aversion.
Elicitation of u(y), and hence of r(y), is in most cases difficult and costly. However, Stochastic Dominance with Respect to a Function (SDRF) techniques require only information about the interval within which r(y) lies. In principal, the analist is free to choose these intervals, which should of course correspond with the kind of decision maker's risk attitude (s)he has in mind. Meyer (1977) developed a solution method which requires the finding of a utility function u(y) which satisfies

$$r_1(y) <= -u''(y)/u'(y) <= r_2(y) \quad (1)$$

and minimizes

$$\int_{-\infty}^{\infty} [G(y) - F(y)]u'(y)\,dy \quad (2)$$

The latter equation equals the difference between the expected utilities of outcome distributions F(y) and G(y). If for given bounds of r(y), the minimum of this difference is greater than zero, then F(y) is preferred to G(y). If the difference equals zero, indifference occurs.

MATERIAL AND METHODS

The evaluation included the above mentioned I&R systems: EMDC and TEC. Two categories of application were considered: CSF control (currently the most important one) and others, so-called attributable co-use of the system. The impact of both systems on CSF control was studied using epidemiological and economic simulation models. It was assumed that the current control practices were applied with both systems. Input data were obtained (where possible) from previous outbreaks in Belgium and from estimates from CSF experts.
The evaluation procedure included three subsequent steps: (1) Stochastic simulation of CSF epidemics using both I&R systems in three regions (with high, medium and low pig-densities respectively). This resulted in Cumulative Density Functions (CDF) for losses due to a CSF epidemic (L_{CSF}); (2) Stochastic simulation of the yearly losses due to CSF and the costs for I&R (YLC_{CSF}) for Belgium, expressed also as CDFs; (3) Stochastic efficiency analysis of the CDFs for YLC_{CSF}, using Stochastic Dominance with Respect to a Function (SDRF) techniques (Goh et al., 1989).

[1] Katholieke Universiteit Leuven, Labo Agrarische Bouwkunde, Kardinaal Mercierlaan 92, B-3001 Heverlee, Belgium

RESULTS AND DISCUSSION

Theory advocates a risk-neutral attitude for decision makers at the (supra-) national level. This implies, that the mean values of YLC_{CSF} are the most suitable criterion for comparison. In Table I, desciptive statistics for YLC_{CSF} are presented. It can be seen, that with a percentage of attributable co-use of at least 50% for both systems, the TEC system is favourable to the EMDC system. A lower percentage than 50% would soon result in a preference for the EMDC system. E.g., the YLC_{CSF} of the TEC system with 25% attributable co-use (mBFr 1,370) are higher compared to the figure with 0% attributable co-use for the EMDC system (mBFr 1,279).

Table I

Descriptive simulation statistics of YLC_{CSF} for two I&R systems (EMDC and TEC) and five levels of attributable co-use (0, 25, 50, 75 and 100 %)* (amounts in mBFr; 1 US$ equals approximately 35 BFr)

I&R system	% Attributable co-use	Minimum	Mean ± Std.Err.	Maximum
EMDC	0	218	1,279 ± 23	4,072
	25	164	1,225 ± 22	3,891
	50	109	1,169 ± 22	3,827
	75	55	1,113 ± 22	4,732
	100	0	1,069 ± 22	4,115
TEC	0	922	1,607 ± 13	3,692
	25	692	1,370 ± 13	3,004
	50	461	1,145 ± 13	2,952
	75	231	911 ± 13	2,248
	100	0	688 ± 13	2,127

*These percentages reflect the degree of yearly operational costs of the I&R system which are attributed to other applications

In contrast, for decisions at the farm level, a certain degree of risk-aversion should be taken into account, as most farmers tend to be (slightly) risk averse. For this reason, different intervals for RAC were defined, varying from normal risk-preferent to extremely risk-averse. The corresponding CDFs for YLC_{CSF} between decision alternatives were analysed using SDRF techniques (Goh et al., 1989). In the present study however, such shifts did not occur within the relevant intervals of RAC. Table II therefore, refers to all relevant RAC-bounds. The table shows, that if farmers bear only 20% of the total yearly losses due to CSF (YL_{CSF}), which is currently the case, the EMDC system would be prefered in almost all cases, except when 100% attributable co-use is presumed for the TEC system. However, in case 65% of the YL_{CSF} would be borne by the farmers, 75% of attributable co-use of the TEC would be sufficient for a preference for this system (such a situation is imaginable as a result from privitisation of contagious disease control).

In conclusion, differences in preference were observed between decision makers at the (supra-) national level versus farmers. The former would be more favourable to the TEC system than the latter. Differences in risk attitude did not cause any significant preference shifts between farmers. For a more detailed description of the study reference is made to Saatkamp (1996).

Table II

Results of SDRF-analysis on $YLC_{CSF,f}$ (yearly losses due to CSF plus costs of I&R for farmers) for two I&R systems (EMDC and TEC), five levels of attributable co-use (0, 25, 50, 75 and 100 %) and two levels of yearly losses due to CSF for farmers ($YL_{CSF,f}$) (20% and 65%). Dominance of the TEC system is denoted by +, dominance of the EMDC system by -

	Comparison with 20% of YL_{CSF} for farmers					Comparison with 65% of YL_{CSF} for farmers				
TEC	EMDC					EMDC				
	0*	25	50	75	100	0	25	50	75	100
0*	-					-				
25	-	-				-	-			
50	-	-	-			+	-	-		
75	+	+	-	-		+	+	+	+	
100	+	+	+	+	+	+	+	+	+	+

* These figures indicate the percentages attribuable co-use for the EMDC (horizontal) and TEC (vertical) systems respectively

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