Cost-benefit analysis of private certification schemes for animal welfare during long-distance transport in the European Union

C.P.A. van Wagenberg[1], E.B. Oosterkamp[1], M.A.P.M. van Asseldonk[1] and W.H.M. Baltussen[1]

[1] *LEI Wageningen UR, P.O. Box 29703, 2502 LS, Den Haag, the Netherlands*

Corresponding author: Coen van Wagenberg. Tel.: +31 (0)317 484558. E-mail: coen.vanwagenberg@wur.nl

Paper prepared for presentation at the 148th seminar of the EAAE, "Does Europe need a Food Policy?", Brussels, Belgium, date as in: 30 November – 1 December, 2015

Cost-benefit analysis of private certification schemes for animal welfare during long-distance transport in the European Union

Abstract

Long-distance transport of live animals is common practice within the European Union (EU). With Council Regulation (EC) No 1/2005 the EU implemented legislation for animal welfare during transport. However, incidents compromising animal welfare still occur. Private certification schemes for animal welfare during long-distance transport could complement current public enforcement. This study determines the viability of such private certification schemes using a cost-benefit analysis. A partial budget model is developed that includes economic benefits due to improved animal welfare and additional operational, investment, certification and public inspection costs for transport companies and control posts for cattle, pigs, horses and sheep. Overall results reveal that the additional benefits exceed costs. However, at the species level, benefits exceed total costs only for calves and lambs, whereas benefits are lower than costs for horses, adult cattle, adult sheep and pigs. Outcomes are most sensitive to the assumed benefits of improved animal welfare and costs of public inspections.

Introduction

About 40% of intra EU animal transports is long-distance transport (Baltussen *et al.*, 2009), meaning that its travelling time exceeds eight hours. In 2008, 15% to 18% of the intra-EU trade in meat and animals consisted of sheep, pigs and cattle to be slaughtered in other member states (ZMP, 2008). Council Regulation (EC) No 1/2005 is the EU's legislative core for animal welfare during animal transport. This regulation

sets minimum requirements for fitness for transport, loading densities, journey and resting times, availability of water and feed, equipment such as a truck, transport organisation and driver. If traveling time exceeds 24 hours for pigs or horses, and 29 hours for cattle or sheep, a stop at a so called control post is mandatory. A control post is a location approved by the competent authorities where animals are unloaded, receive food and water, and can rest for 24 hours before the journey continues. Council Regulation (EC) No 1255/97 sets minimum requirements for such control posts.

Risk factors for animal welfare during long-distance transport are: too high loading density, insufficient climate control, transport companies not taken the shortest route, and insufficient water supply (WUR *et al*., 2013). After implementing Council Regulation (EC) No 1/2005 in 2007, the percentage of the transported animals with lameness, injuries, or dehydration decreased or remained the same, and the numbers of animals reported 'dead on arrival' and observed unfit for travel decreased significantly (Baltussen *et al.*, 2011). The EU Commission concluded that most of the problems appeared to be related to poor compliance with the Regulation (Commission, 2011).

Private quality-based systems can improve compliance. They have shown to be more effective and more efficient than mere public systems in achieving food quality and safety requirements, industrial safety, and environmental protection (Holleran *et al.*, 1999; Unnevehr and Jensen, 1999; Coglianese and Lazer, 2003). Lai *et al.* (2003) show that social norms induced firms to comply with pollution standards even with low public penalties for non-compliance. In an experiment Tyran and Feld (2006) find that self-imposed law improved compliance with the law, because self-imposing resulted in people expecting others to comply with the law and people tend to comply

if they expect many others to do so. The audit of the Dutch Competent Authority reports that compliance with a private animal transport scheme is almost four times higher among participants compared to non-participants (NVWA, 2012). Compliance is related to administrative requirements as well requirements effecting animal welfare. Lower mortality rates and less ambulatory problems during transport can consequently decrease economic losses (Guise and Penny, 1989; Boleman *et al.*, 1998; Speer *et al.*, 2001; Ritter *et al.*, 2009). Ritter *et al.* (2009) estimated that in 2006 the US pork industry lost USD 46 million because of dead and non-ambulatory pigs during transport. Economic losses due to animal transports in the EU are not known to the authors.

The purpose of this study is to quantify benefits and costs of the private certification schemes for animal welfare during long-distance transport that are developed in the Control Posts 1 and 2 projects (www.controlpost.eu). See for a detailed description of the scheme for animal welfare during long-distance transport Nielsen *et al.* (2013) and for the scheme on control posts Nielsen (2013) and Nielsen *et al.* (2013). In short, the transport scheme reflects the requirements of the Council Regulation (EC) No 1/2005. The scheme for control posts requires upgrading for (un)loading of animals and housing compared to Council Regulation (EC) No 1255/97. Other costs due to the participation in the schemes include additional checks and audits and more administration. These checks and audits are complementary to those provided through public inspection. Benefits may result from the improved welfare. As a default we define a scenario without private schemes (the *Reference Scenario*). Three other scenarios reflect different participation rates by transporters and control posts in the schemes, i.e. at a high, medium and low level (referred to as *Scenario 1, 2* and *3)*.

Method and materials

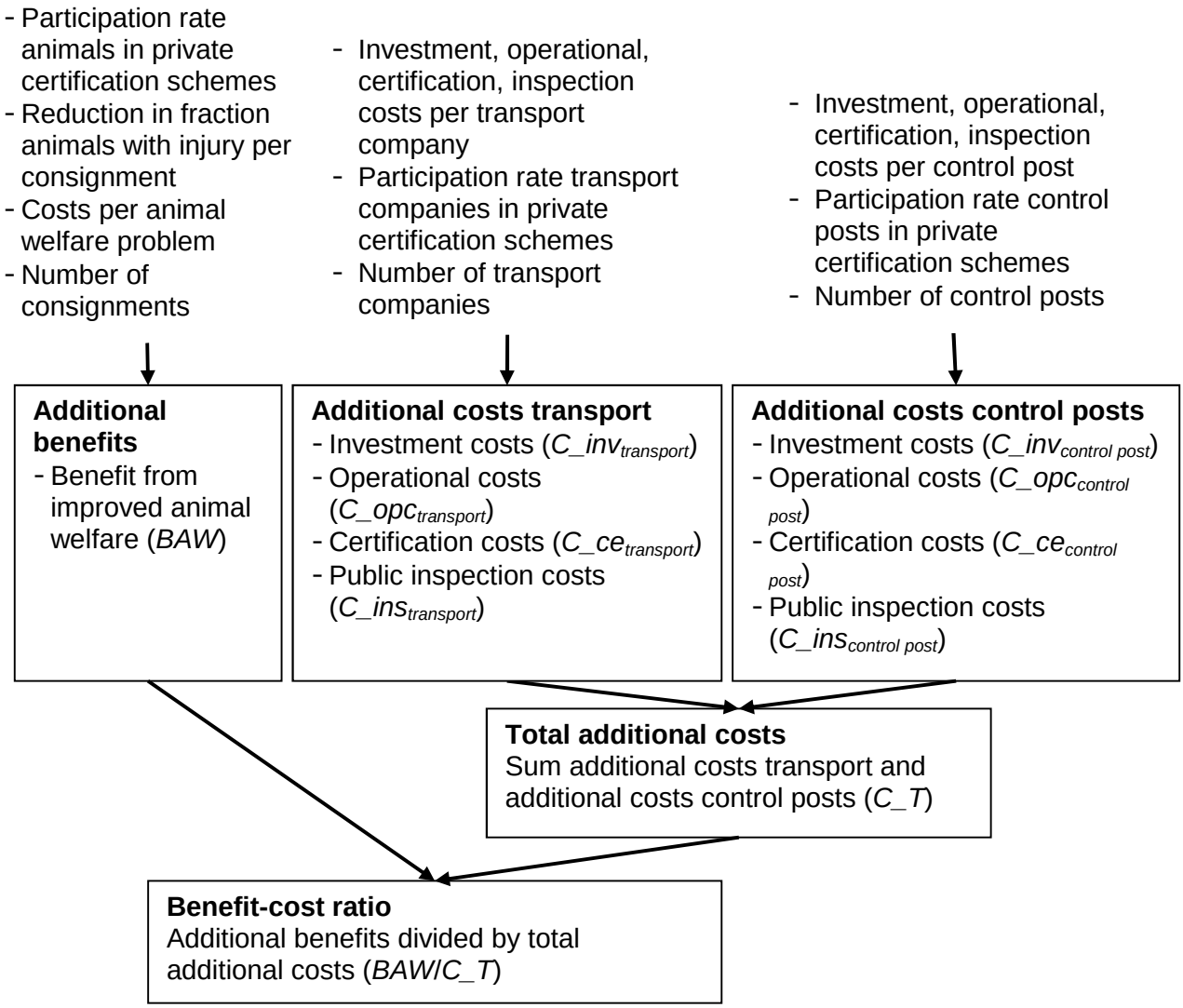
The benefits and costs of the private certification schemes are calculated using a using a cost-benefit analysis (CBA) and following the partial budgeting approach. This approach is based on the principle that a small change can eliminate or reduce some costs, eliminate or reduce some returns, cause additional costs to be incurred and cause additional returns to be received. The net effect of the change is the sum of the positive economic impact minus the sum of the negative economic impact (Dijkhuizen and Morris, 1997). A CBA is a systematic process for calculating and comparing benefits and costs of a project, a decision or a government policy to provide a basis for comparison of different options (Romijn and Renes, 2013). In a CBA, benefits and costs are expressed in money terms. We determine the annual additional benefits and additional costs of the private certification schemes developed in the Control Posts 1 and 2 projects for the different scenarios. The overall economic impact of animal transport per scenario is determined without distributing benefits and costs among chain participants.

Model description

The model includes additional economic benefits due to improved animal welfare and additional costs for transport companies and control posts because of the certification schemes (Figure 1). Improved animal welfare is operationalised as a reduction of animal welfare problems and originates from better compliance with animal welfare rules of transport companies and control posts participating in the private certification schemes. Additional costs can comprise operational, investment, certification and public inspection costs. A benefit-cost ratio higher than one indicates that the

additional revenues due to animal welfare are higher than additional costs. Vice versa, if the benefit-cost ratio is lower than one additional costs exceed the additional benefits.

Figure 1. *Conceptual model to calculate benefits and costs of transport companies and control posts due to private certification schemes for animal welfare during long-distance transport.*



Joint benefits of improved animal welfare were stemming from transport companies and control posts because both could not be distinguished. Annual additional benefits of improved animal welfare *BAW* were calculated as:

$$BAW = \sum_{a=1}^{A}\left(An_a \times Part_{a,sch} \times \sum_{w=1}^{W}\left((Fr\_awp_{a,w,no\_sch} - Fr\_awp_{a,w,sch}) \times C\_awp_{a,w}\right)\right) \quad (1)$$

Where

a = index for animal type: *a* = 1, …, *A*;

An_a = total number of animals of type *a* transported more than eight hours in a year;

$C\_awp_{a,w}$ = cost of animal welfare problem *w* for animal type *a* (€/welfare problem *w*/animal type *a*);

$Fr\_awp_{a,w,s}$ = proportion of animals of type *a* with welfare problem *w* with scheme *s*;

$Part_{a,sch}$ = participation rate of animals of type *a* in private certification scheme *sch* (%);

s = index for private certification scheme, can take two values:

s = *sch* if animal transported within the private certification scheme or,

s = *no_sch* if no private certification scheme;

w = index for animal welfare problem: *w* = 1, …, *W*.

Additional operational costs depend on the number of consignments. Only very long-distance transports (more than 24 hours for pigs and horses and 29 hours for cattle and sheep) need to break the journey at a control post and incur operational costs of control posts. Annual additional operational costs *C_op* were calculated as:

$$C\_op = \sum_{a=1}^{A}\left(\frac{An_a \times Part_{a,sch}}{An\_t_a}\right) \times C\_opc_{1,sch} + \sum_{a=1}^{A}\left(\frac{An\_vlt_a \times Part_{a,sch}}{An\_t_a}\right) \times C\_opc_{2,sch} \quad (2)$$

Where

An_t_a = number of animals in one consignment for animal type *a*;

An_vlt_a = number of animals of type *a* per year transported more than 24 hours (pigs and horses) or 29 hours (cattle and sheep);

$C\_opc_{o,sch}$ = additional operational costs of organisation type *o* for one consignment with the private certification schemes *sch* (€/organisation type *o*);

o = index for organisation type: *o*=1 for transport company and *o*=2 for control post.

Annual additional investment costs *C_inv* were calculated by discounting the additional initial investment amount Inv_o for organisation of type *o* due to participating in private certification scheme *sch*, using the formula:

$$C\_inv = \sum_{o=1}^{2}\left(Inv_o \times Org_o \times Part_{o,sch} \times (0.5 \times P\_i + P\_m_o + P\_d_o)\right) \quad (3)$$

Where

Org_o = number of organisations of type *o*;

$Part_{o,sch}$ = participation rate of organisation type *o* in private certification scheme *sch* (%);

P_d_o = annual depreciation percentage for organisation type *o* (%);

P_i = annual interest percentage (%);

P_m_o = annual maintenance percentage for organisation type *o* (%).

Annual additional certification costs *C_ce* for transport companies and control posts depended on the number of companies of type *o* participating in the private certification schemes *sch* and the annual certification costs C_ce_o per participating company of type *o,* and were calculated as:

$$C\_ce = \sum_{o=1}^{2}\left(Org_o \times Part_{o,sch} \times C\_ce_o\right) \quad (4)$$

where

C_ce_o = annual certification costs for organisation type *o* (€/organisation)

Annual additional public inspection costs C_ins_1 for transport companies are calculated based on public inspections per consignment, and C_ins_2 for control post based on a public inspections per control post. Total annual additional inspection costs *C_ins* were calculated as:

$$C_{ins} = C\_ins_1 + C\_ins_2 = \sum_{a=1}^{A}\left(\frac{An_a \times Part_{a,sch}}{An_{t_a}}\right) \times C\_ins\_s_1 + Org_2 \times Part_{2,sch} \times C\_ins\_s_2 \quad (5)$$

Where

C_ins_o = additional costs of public inspection for organisation type *o* (€ / organisation);

$C\_ins\_s_o$ = additional costs of 1 public inspection for organisation type *o* (€ / inspection / organisation);

Total annual additional costs *C_T* were the sum of annual additional operational costs *C_op*, investment costs *C_inv*, certification costs *C_ce* and public inspection costs *C_ins*. The benefit-cost ratio was annual benefits *BAW* divided by total annual additional costs *C_T*.

Model parameters and assumptions

Participation rate. Because the participation rate of transport companies and control posts in the private certification schemes is difficult to predict, we use a scenario analysis for three possible participation levels. These levels reflect the broad range of possible values for participation in practice. Schemes close to the regulatory level may result in high or medium level compliance. In scenario 1 all slaughterhouses will demand suppliers to be certified as a 'licence to deliver' and the participation rate was set at 95%. This is based on the examples of the 90% and higher participation rate of Dutch pig producers in the two Dutch certification schemes for pork production, Dutch "Integrale Keten Beheersing Nederland Varkens" and "Integrale Keten Beheersing Varken" (Vlees.nl, 2014), and the 90% participation rate of the UK pig production in the "Red Tractor Assurance scheme" (Red Tractor Assurance, 2013). In scenario 2, participation rate was set at 60%. This was based on the 50% participation of German cattle farmers in the German certification "QS system" (WUR *et al.*, 2013), the 65% participation of the UK lamb producers in the "Red Tractor Assurance scheme" (Red Tractor Assurance, 2013) and the former Dutch transport scheme Quality systems Livestock Logistics (QLL). In these cases only part of the slaughterhouses demands suppliers to be certified. In scenario 3, only a minority comprising of front-running companies adopt the private certification schemes for improved management information, reduced time to solve problems and reduced

administration in the long run (Holleran *et al.*, 1999). The participation rate was set at a randomly chosen low value of 20%

In the calculations, a participation rate of x% implies that x% of transport companies and x% of the control posts participates in the schemes, x% of transported animals is transported within the schemes, and x% of visits to control posts are via participating control posts.

Number of transport companies and control post. Although in the period 2005-09 more than 10 000 transport companies received approval for long-distance transport (Baltussen *et al.*, 2011), the actual number of active transport companies is much lower. It is estimated that a maximum of 1,000 companies carry out long- distance transports. In a sensitivity analysis the impact for 5% (i.e. 500) and 1% (i.e. 100) of transport companies carrying out long-distance transports is calculated, while the total number of consignments remains the same. All 122 control posts that are in operation in 2013 are included in the calculations.

Transported animals. The number of animals transported intra-EU over eight hours, the number of very-long-distance consignments over 24 hours for pigs and horses and over 29 hours for cattle and sheep, and the average number of animals per consignment were kept constant in all scenarios (Table 1).

Table 1. *Number of animals transported over eight, 24 (pigs and horses) or 29 hours (cattle and sheep) in the EU and average number of animals per consignment.*

Animal type	Number of animals transported ≥eight hours[a]	Number of animals transported ≥ 24/29 hours[a]	Average number of animals per consignment[b]
Adult cattle	117 473	5 659	24
Older calve	1 448 091[c]	262 901	60
Young calve	384 797[c]	69 860	400
Finisher pig	1 900 316	34 649	200
Piglet	6 613 909	456 303	960
Adult horse	32 967	4 559	18[d]
Adult sheep	2 721 553	104 341	500
Lamb	1 408 084	53 984	750

[a] Source: Traces 2011.
[b] Source Baltussen *et al*. (2010).
[c] Young calves were all cattle transported to the Netherlands and Belgium not classified as 'slaughter' in Traces 2011; the remainder were assumed to be older calves.
[d] Horses need 1.75 m^2 per horse and at least a length of 2.5 m. Because the width of a truck of 35 m^2 is less than 2.5 m, the horses are stationed diagonally, and we estimated that 18 horses can be placed in the truck.

Welfare problems and costs. The animal welfare measurements executed in the Control Post 1 and 2 projects are used to reflect the animal welfare situation during transport, after the introduction of the schemes. The measurements are based on Welfare Quality protocols for animals during transport, arriving at control posts, and are described in WUR *et al*. (2014). Table 2 gives the five animal welfare problems from these protocols that are included in this study. Death of animals during transport for slaughter is a major factor indicating welfare and death rates increase with distance (Malena *et al*., 2007). The protocols also contain water shortage as a parameter, but it is expressed as shortage of water supply in the trucks and not as animal welfare measurement. Therefore, we do not include water shortage in this study. For non-scheme participants, we extrapolate the proportion of welfare problems using the findings of the audit report of the Dutch Competent Authority NVWA about the Dutch transport scheme Quality systems Livestock Logistics (QLL) and findings from official animal welfare checks in Austria. The NVWA audit report

showed non-compliance in 20.3% of consignments (13 out of 64 consignments) amongst non-QLL participants, almost four times higher than the 5.5% (32 out of 578) for QLL participants (NVWA, 2012). This gives reason to assume that the proportion of animals with welfare problems of non-certified transport companies is twice that of certified companies for each type of welfare problem, for all animal types. We conduct a sensitivity analysis where the proportion of welfare problems of non-certified transport companies was three quarters and twice its default size. In Austria, 25.2% (325 out of 1 292) of detected non-compliances during animal transport is related to animal suffering (DG Sanco, 2011). In the model the ratio in non-compliance between paper work and welfare problems is the same at all participation rates.

Table 2. *Percentage (%) of animals per welfare problem type and animal type for the situation with the private certification schemes for animal welfare.*

	Type of welfare problem[a]				
Animal type	**Respiratory**	**Wounds**	**Lameness**	**Other severe problems**	**Death**
Adult cattle	0	0	0	0	0
Older calve	0	0	0.20	0.20	0
Young calve	0.20	0.10	0.10	2.40	0.10
Finishing pig	0.50	3.70	0.40	0.20	0.10
Piglet	0.13	0.95	0.10	0.05	0.03
Adult horse	0	0	0.30	0	0
Adult sheep and lamb	0.10	0	0.10	0	0.10

[a] Source: WUR *et al.,* (2014). Respiratory problems: highest score of animals shivering, panting or animals with hampered respiration; Wounds: score 2 wounds; Lame during unloading; Dead: in truck plus dead in resting pen; Other severe: highest score diarrhoea or rectal prolapse in pen.

Costs incur as a result of respiratory problems are not well known. For production animals long term effects of welfare problems during transport are under study (Transport voor kalveren project, 2016) for slaughter animals the effect on meat quality of respiratory problems caused by transport is unknown.. In this study, the effects are set at zero (Table 3). Costs for wounds are assumed to be limited for production animals since they recover after transport. For slaughter animals, costs of wounds consist of a 0.5 % reduced carcass value because bruised tissue had to be rendered. Wounds in cattle and sheep resulted in an additional loss of half the commercial value of the hide (€33 for cattle and €9 for sheep). In case of lameness, production animals (piglets and calves) are assumed to be culled on arrival. Incurred costs are based on the animal's value and disposal costs. Lame slaughter animals are slaughtered on arrival instead of in the normal slaughter process, resulting in €2 per animal additional labour costs compared to a normal slaughtered animal. In addition, part of the meat has to be rendered. For cattle this is estimated at 15 kg, equal to a 5.4% value loss, and for pigs at 10 kg, equal to 11.0% value loss. Cost of rendered meat due to lameness for horses is set at a 5.4% value loss, while for sheep and lambs this is set at 11.0%. Slaughter animals with severe problems are assumed to be slaughtered on arrival resulting in €2 additional slaughter costs. Production animals with rectal prolapse are assumed be culled or, in case of diarrhoea and are separated until healed, which resulted in additional labour and less growth. The total economic effect is assumed to be half the value of the animal. Mortality costs are based on animal values and disposal costs. In a sensitivity analysis we analyse the impact of double and half of all aforementioned costs.

Table 3. *Costs per type of welfare problem per animal type (€/affected animal).*

Animal type	Destination	Type of animal welfare problem[a]			
		Wounds	Lame-ness	Other severe problems	Death
Adult cattle	Slaughter	36	37	2	701
Older calve	Production	0	894	450	894
Young calve	Production	0	134	67	134
Finishing pig	Slaughter	0.6	13	2	135
Piglet	Production	0	42	21	42
Adult horse	Slaughter	2	22	2	422
Adult sheep	Slaughter	10	11	2	114
Lamb	Slaughter	10	10	2	101

[a] Prices per animal from KWIN (2013) except for broutards (350 kg). In the latter case the price of 2.48 € per kg is taken from the 'Beheerscomité dierlijke producten: Rundvlees' of the Belgium Department of Agriculture and Fischeries (21/02/2013). This is a modest price level as in Germany prices of young bulls are 3.50 € - summer 2014 ; Disposal costs in the Netherlands by Rendac in 2014. Disposal costs in the Netherlands are not subsidised and represent the real costs of disposal.

Operational costs. No additional operational costs are assumed for transport companies, because the certification system follows legal requirements. Certified control posts have to apply more and better bedding material and better cleaning than control posts without the scheme (Nielsen, 2013), resulting in additional operational costs of €10 per consignment for each animal type. In a sensitivity analysis we calculate the impact of additional operating costs of a control post of €5 and €15 per consignment.

Investment costs. For transport companies the private certification scheme has no animal welfare requirements above those of Council Regulation (EC) No 1/2005, resulting in no additional investments. For control posts the average additional investment to comply with requirements in the private certification scheme amounts to €120 000 (Gebresenbet *et al.*, 2010). Half this amount is for inventory and half for the building's structure. This investment is an upper estimate, because it also includes extension and biosecurity measures for some control posts. In a sensitivity

analysis we calculate the impact of investments of €50 000 and €100 000. Depreciation is set at 7% per year, maintenance at 3% and interest rate at 5%. For depreciation and maintenance this 1 to 1.5% percent point higher compared to normal stables (KWIN, 2013)., because of the higher number of cleaning and disinfecting activities at control posts

To identify if the economic impact of the private certification systems differs between animal types, investment costs need to be assigned to animal types. Because many transport companies and control posts handle more than one animal type, this is not straightforward. In a sensitivity analysis we assign investment costs of control posts to animal types based on the proportion of very-long-distance consignments per animal type in the total number of very-long-distance consignments. These consignments have travelling times over 24 or 29 hours, depending on animal type.

Certification costs. For certification a transport company receives a start-up/renewal audit in year one, followed by surveillance audits in year two and three, and two spot checks per year (Nielsen *et al.*, 2013). Annual certification costs are based on a three year participation fee of €250, and €700 is accounted for each audit and spot check. This results in average annual certification costs of €2 200 for a transport company. Certified control posts receive similar audits as transport companies, but spot checks are not conducted (Nielsen, 2013). Annual certification costs are based on a three year participation fee of €250 and costs of €800 per audit. Annual certification costs for a control post amounted to €900. A sensitivity analysis is conducted by setting certification costs at 75% and 125%.

In a sensitivity analysis we assign certification costs of control posts to animal types based on the proportion of very-long-distance consignments per animal type in the total number of very-long-distance consignments. For transport companies we used the number of long-distance consignments (transport time from eight to 24 or 29 hours, depending on animal type).

Public inspection costs. In the scenarios the public inspection frequency and audit format are the same for certified and non-certified control posts and transport companies, resulting in no additional, public inspection costs. However, public inspection could be more efficient on certified companies, if the certifying organisations exchange information with public authorities on compliance with the scheme and legislation. In that case, public control could take the results of private certification into account and reduce inspection time or frequency. The Dutch Competent Authority NVWA allowed the checking animals' fitness for travel in the pigs' housing shortly before loading for members of the QLL private scheme, whereas the animals of non-participants could only be checked during loading. Checking in the pigs' housing reduced public inspection time with half an hour per consignment, resulting in a €70 reduction of inspection costs per consignment for each animal type. In a sensitivity analysis we calculated the impact of this €70 reduction.

Results

Table 4 shows additional economic benefits and costs of the private certification schemes for long-distance animal transport in the EU for the different participation rates of Scenario 1, 2 and 3. Values represent the difference between the analysed

private certification scenario and Reference scenario. In Scenario 1 the benefit-cost ratio is 1.32, indicating that additional benefits exceed additional costs. Benefits due to a reduction of animal welfare problems are estimated at €5.3 million per year.

***Table 4**. Additional benefits due to animal welfare and costs and benefit-cost ration for private certification Scenario 1, 2 and 3 compared to the Reference scenario with public inspection (in €1 000 per year).*

	Scenario (Participation rate)		
	1 (95%)	**2 (60%)**	**3 (20%)**
Adult cattle			
Benefits animal welfare	0	0	0
Operational costs	2	1	0
Older calve			
Benefits animal welfare	3 192	2 016	672
Operational costs	42	26	9
Young calve			
Benefits animal welfare	1 039	656	219
Operational costs	2	1	0
Finishing pig			
Benefits animal welfare	385	243	81
Operational costs	2	1	0
Piglet			
Benefits animal welfare	409	258	86
Operational costs	5	3	1
Adult horse			
Benefits animal welfare	4	3	1
Operational costs	2	2	1
Adult sheep			
Benefits animal welfare	134	85	28
Operational costs	2	1	0
Lamb			
Benefits animal welfare	109	69	23
Operational costs	1	0	0
All animal types			
Benefits animal welfare	5 272	3 330	1 110
Investment costs control posts	1 739	1 098	366
Operational costs	57	36	12
Certification costs control posts	104	66	22
Certification costs transport companies	2 090	1 320	440
Benefit-cost ratio	1.32	1.32	1.32

Annual investment costs in control posts are €1.8 million, annual certification costs are €2.2 million and other additional costs €57 are thousand per year. Since the efficiency of scale is considered to be negligible, identical benefit-cost ratio are derived under Scenario 2 and 3, but the absolute levels of the additional benefits and costs differs. Large differences in benefits are observed between the animal types. The largest benefit due to improved animal welfare is found for young and older calves. The highest additional costs are found for older calves.

Sensitivity analysis

Sensitivity analysis was conducted on (1) an alternative number of long-distance transport companies, (2) alternative proportions of animals with animal welfare problems caused by non-certified companies, (3) alternative costs of animal welfare problems, (4) alternative investment costs for a control post, (5) alternative additional operating costs for a control post, (6) alternative certification costs, (7) alternative public inspection costs, and (8) assigning investment and certification costs to animal types. For the scenario with 95% participation, the results are especially sensitive to the economic gain due to improved animal welfare (Table 5). Economic benefits from improved animal welfare result from both a decrease in prevalence of animal welfare problems and the economic consequence of a type of animal welfare problem. In addition, alternative costing levels for public inspections affect outcomes substantially. The other scenarios with lower participation rates show similar sensitivities.

***Table 5**. Sensitivity analyses for the scenario with 95% participation rate (in €1 000 per year).*

Sensitivity analysis	Difference compared to baseline[a]					Benefit-cost ratio
	Revenue animal welfare	Investment costs	Other additional costs	Certification costs	Public inspection costs	
1 Number transport companies (100)	-	-	-	-1 881	-	2.50
Number transport companies (500)	-	-	-	-1 045	-	1.79
2 Welfare problems without scheme (1.5 times problems with scheme)	-2 636	-	-	-	-	0.66
Welfare problems without scheme (3.0 times problems with scheme)	5 272	-	-	-	-	2.64
3 Costs of welfare problems (0.5 x baseline)	-2 636	-	-	-	-	0.66
Costs of welfare problems (2.0 x baseline)	5 272	-	-	-	-	2.64
4 Investment costs control post k€50	-	-1 014	-	-	-	1.77
Investment costs control post k€100	-	-290	-	-	-	1.42
5 Operational costs control post €5	-	-	-28	-	-	1.33
Operational costs control post €15	-	-	28	-	-	1.31
6 Certification costs (75%)	-	-	-	-549	-	1.53
Certification costs (125%)	-	-	-	549	-	1.16
7 Lower public inspection costs (€70 / consignment)	-	-	-	-	-3 398	8.91

[a] Baseline in Table 4.

Assigning the investment and certification costs to animal types reveals large differences in benefit-cost ratio between animal types (Table 6). For young and older calves and lambs the benefits from improved animal welfare exceed additional costs, because of the high benefits in animal welfare. For the other animal types costs exceed benefits, with the benefit-cost ratio for adult cattle and horses being close to zero.

***Table 6**. Benefits due to animal welfare, additional costs (in €1 000 per year) and benefit-cost ratio per animal type for the scenario with 95% participation rate.*

	Animal type							
	Adult cattle	**Older calve**	**Young calve**	**Finish-ing pig**	**Pig-let**	**Adult horse**	**Adult sheep**	**Lamb**
Benefits animal welfare	0	3 192	1 039	385	409	4	134	109
Operational costs	2	42	2	2	5	2	2	1
Investment costs	69	1 275	51	50	138	74	61	21
Certification costs	204	929	63	392	290	163	96	57
Benefit-cost ratio	0.00	1.42	8.96	0.87	0.94	0.02	0.84	2.41

Discussion

Cost-benefits analysis

In this study, we use a CBA to monetize the reduction of animal welfare problems. It should be noted that the reduction of animal welfare problems in itself is a gain. The monetization of animal welfare problems in the CBA is limited to productions aspect of the animals. Also, other benefits, lower biosecurity risks, increased consumer premiums, gains in social responsibility, possibility of firms to become preferred suppliers and a better harmonisation of EU legislation, are not included in the model.

Certified long-distance animal transport with more stringent hygiene measures may reduce incidence and spread of diseases, such as infectious bovine rhinotracheitis and bovine virus diarrhoea in cattle, Q-fever in cattle, sheep and goats and porcine reproductive and respiratory syndrome in pigs. To quantify the effects of biosecurity related activities at control posts and the increased compliance due to the certification schemes further studies are needed that include the benefits and costs of biosecurity measures on control posts and during transport.

Benefits arising from price premiums in the consumer market for meat derived from certified transported animals are not included in the model, because the requirements in the certification schemes are set only slightly above the regulatory

level. However, transport firms and control posts could use the certification schemes to become a preferred supplier of the meat processing industry or retail organisations for which animal welfare is more important because of, for example, corporate social responsibility. This requires consumer pressure. Participation rates will be highest if the schemes become a license-to-deliver. Here consensus among market parties is a precondition.

In the sensitivity analysis investment and certification costs were assigned to animal type based on the number of consignments per animal type. A more accurate assignment of investment and certification cost of each control post and transport company to animal types could improve the benefit-cost ratio per animal type. For example, on control posts and transport companies that handle more animal types, the investments specifically needed for each animal type could be identified.

In this study investment amounts for control posts were retrieved from Gebresenbet *et al. (*2010). However, part of these investments were related to biosecurity and extension. The baseline results of investment costs can therefore be seen as a worst case scenario. In the sensitivity analysis lower investment costs for control posts were addressed resulting in a higher revenue-cost ratio.

For many model parameters, objective data is lacking and thus uncertainty is considerable. For such parameters we used expert estimation. Although the sensitivity analysis provided an indication of alternative values, this was only done one parameter at a time. Because of these uncertainties, the absolute results of this study should be regarded as indicative only.

Model parameters were based on average benefit and cost levels across the EU. However, price and costs levels differ across the EU. The model could be improved by adding detailed data per region. In regions with lower (higher) price levels, both

animal welfare revenues and additional costs would be lower (higher). Although this could change absolute revenues and additional costs, we expect that it will not have a large effect on the benefit-cost ratio.

For young and older calves and lambs, animal welfare revenues exceeded additional costs. However, even in these livestock sectors unequal distribution of benefits and costs along the chain could be an obstacle for participation in the private certification schemes. For example, when the animals' owners receive the economic benefits of improved animal welfare and the transport company and control post bear the additional costs. Incentives need to be developed that would induce all stakeholders in long-distance animal transport to participate in the certification schemes.

Certification scheme

Public inspection visits could be organized more efficiently by using results from inspections and audits of the private schemes. Adjustment in public inspection time is shown to have a large impact on the benefit-cost ratio, if the requirement is relaxed that because every transport of more than eight hours has to be examined during loading. The Dutch Food Safety Authority NVWA experienced that inspection time for checking fitness for long-distance transports could be reduced by half an hour per consignment by checking in the animals' housing shortly before loading instead of during loading, without reducing the actual inspection time per animal. One of the conditions to allow animal inspections before loading was that the transport company was QLL certified. However, recognition of the scheme this was lifted in 2014 due to insufficient improvement of animal welfare of the transport companies participating in the QLL scheme (Tweede Kamer, 2013). To justify adjustments in public control,

private certification schemes need to be well assured and public and private parties need to be willing to exchange audit and inspection information of participants. Further research is needed to determine what kind and level of control in the private certification schemes is necessary to lower public inspection activities without compromising animal welfare. For example, more unannounced inspections would add to the schemes' credibility but would also increase certification costs. This could be necessary to be able to reduce the public inspection offsetting additional costs.

For horses, adult cattle, adult sheep and pigs, benefits of animal welfare improvement are lower than total additional costs. For companies dealing with these animal types, the willingness to participate in a private certification scheme can be expected to be lower, than for companies dealing in animal types were benefits exceed costs. An EU-wide demand of buyers of animals for the certification schemes as a 'licence to deliver' could aid in realizing high participation rates in these and other sectors.

In this study, we analyse the benefits and costs that results from private certification schemes developed in the Control Posts 1 and 2 projects (Nielsen, 2013; Nielsen *et al.*, 2013). Improved public control in the EU may also result in improved animal welfare. This would require more harmonized control and sanctioning across EU member states. To what extent animal welfare can be improved by a better public control in the EU remains for further research.

Welfare problems and transport

An important assumption is about the proportion of animals with welfare problems per scenario. Prevalence of welfare problems used in this study is measured at transport companies complying with the provisional requirements of the private

certification schemes (WUR *et al.*, 2014). Prevalence at non-certified transports was not measured in the Control Post projects and is not available in literature. Based on general results of public inspections and the Dutch Food Safety Authority NVWA, it is estimated that the proportion of animals with animal welfare problems for non-certified companies was about twice as high as those of certified companies. The sensitivity analysis shows that results are quite sensitive to this model parameter. Further research is needed to establish the actual level of animal welfare problems during long-distance transport for transport companies without the private certification schemes.

Based on journey distances from the EU transport database Traces, Baltussen *et al.* (2011) estimated that for 50% of the horse transports with a declared journey time between 18 till 24 hours, in reality would have lasted longer than 24 hours and therefore should have stopped at a control post. With the private certification schemes firmly in place, such non-compliance could be expected to be lower and therefore more transports would pass by control posts. Because almost all control posts are functioning below full capacity (Gebresenbet *et al.*, 2010), this should be possible without additional investments for extension. To what extent this would increase transport costs and control post costs is for further research.

Conclusion

Overall benefits due to improved animal welfare from private certification schemes for animal welfare during long-distance transport in the EU exceed total additional costs. The benefit-costs ratio differs between animal types. The benefit-costs ratio for young and older calves and lambs is larger than one, indicating that the willingness to participate in a private certification scheme would be higher for companies dealing

with these animal types than for companies dealing with horses, adult cattle, adult sheep and pigs that face benefit-costs ratios below one. Outcomes are especially sensitive to the prevalence of animal welfare problems and the costs of public inspections.

Acknowledgments

This research was conducted in the project “Development of EU wide animal transport certification system and renovation of control posts in the European Union”, which was funded by European Community (Grant Agreement no. SANCO/2011/G5/CRPA/SI2.610274) and the KB-15 theme “Healthy and safe food in chain perspective” of Wageningen UR funded by the Dutch Ministry of Economic Affairs.

References

Baltussen W, Gebrensbet G and de Roest K 2011. Study on the impact of (EC) Regulation 1/2005 on the protection of animals during transport. Final report of Specific Contract N° SANCO/2010/D5/S12.574298, IBF International Consulting, Brussels, Belgium.

Baltussen W, Rossi R, Doorneweert B, Vrolijk H, Oudendag D and de Smet A 2010. Livestock transportation: a model for ex-ante policy analysis. Paper presented at The 9th Wageningen International Conference on Chain and Network Management, 26 - 28 May, Wageningen, The Netherlands.

Baltussen WHM, Spoolder HAM, Lambooij E and Backus GBC 2009. Sustainable production: transporting animals or meat? In Agriculture: Food, Fiber and Energy for the Future (eds. H H.Guither, JL Merry and CE Merry), pp. 635-647, Burton & Mayer Printers & Lithographers, Menomonee Falls, WI, USA.

Boleman SL, Boleman SJ, Morgan WW, Hale DS, Griffin DB, Savell JW, Ames RP, Smith MT, Tatum JD, Field TG, Smith GC, Gardner BA, Morgan JB, Northcutt SL, Dolezal HG, Gill DR and Ray FK 1998. National beef quality audit-1995: survey of producer-related defects and carcass quality and quantity attributes. Journal of Animal Science 76, 96-103.

Coglianese C and Lazer D 2003. Management-based regulation: prescribing private management to achieve public goals. Law & Society Review 37, 691-730.

Dijkhuizen AA and Morris RS 1997. Animal Health Economics. 1st ed. Postgraduate Foundation in Veterinary Science, University of Sydney, Sydney, Australia.

Gebresenbet G, Baltussen W, Sterrenburg P, de Roest K and Engstrøm Nielsen K 2010. Evaluation of the feasibility of a certification scheme for High Quality control posts. Final

report of project SANCO/D5/2005/SI2.548887, IBF International Consulting, Brussels, Belgium.

Guise HJ and Penny RHC 1989. Factors influencing the welfare and carcass and meat quality of pigs 1. The effects of stocking density in transport and the use of electric goads. Animal Production 49, 511-515.

Holleran E, Bredahl ME and Zaibet L 1999. Private incentives for adopting food safety and quality assurance. Food Policy 24, 669-683.

Lai C-C, Yang C-Y and Chang J-J 2003. Environmental regulations and social norms. International Tax and Public Finance 10, 63-75.

Nielsen KS 2013. Pilot certification system with relevant documents. Deliverable 3.4 project under grant agreement no. SANCO/2010/D5/CRPA/SI2.578062, Centro Ricerche Produzioni Animali Spa Reggio Emilia, Italy.

Nielsen KS, Di Fede E, Baltussen W, Oosterkamp E and De Roest K 2013. Certification scheme handbook. Deliverable 4.3 project under grant agreement no. SANCO/2011/G3/CRPA/SI2.610274, Centro Ricerche Produzioni Animali Spa Reggio Emilia, Italy.

NVWA 2012. Auditrapport Quality systems livestock Logistics 2012. Nederlandse Voedsel en Waren Autoriteit, Utrecht, The Netherlands.

Red Tractor Assurance 2013. Annual review 2012. Assured Food Standards, London, UK.

Ritter MJ, Ellis M, Berry NL, Curtis SE, Anil L, Berg E, Benjamin M, Butler D, Dewey C, Driessen B, DuBois P, Hill JD, Marchant-Forde JN, Matzat P, McGlone J, Mormede P, Moyer T, Pfalzgraf K, Salak-Johnson J, Siemens M, Sterle J, Stull C, Whiting T, Wolter B, Niekamp

SR and Johnson AK 2009. Review: transport losses in market weight pigs: I. a review of definitions, incidence, and economic impact. The Professional Animal Scientist 25, 404-414.

Romijn G and Renes G 2013. Algemene leidraad voor maatschappelijke kosten-batenanalyse. CPB/PBL, Den Haag, the Netherlands.

Speer NC, Slack G and Troyer E 2001. Economic factors associated with livestock transportation. Journal of Animal Science 79, E166-E170.

Transport voor kalveren (2016). http://www.wageningenur.nl/nl/project/Transport-voor-kalveren-1.htm

Tweede Kamer 2013. Kamerstuk 26991 nr. 363. Tweede Kamer, The Hague, the Netherlands.

Tyran J-R and Feld LP 2006. Achieving compliance when legal sanctions are non-deterrent. Scandinavian Journal of Economics 108, 135-156.

Unnevehr LJ and Jensen HH 1999. The economic implications of using HACCP as a food safety regulatory standard. Food Policy 24, 625-635.

Vlees.nl 2014. Kwaliteit en controle: IKB - Integrale Keten Beheersing. Retreived on 5 November 2014, from http://www.vlees.nl/dossiers/kwaliteit/kwaliteit-en-controle/.

WUR, ICT, CRPA, IDELE, IFIP, FLI, IRTA and NAGREF 2013. A report describing the results of the literature search including an overview of certification schemes and conclusions from the stakeholders consultation. Deliverable 2.1 project under grant agreement no. SANCO/2011/G3/CRPA/SI2.610274, Centro Ricerche Produzioni Animali Spa Reggio Emilia, Italy

WUR, ICT, FLI, IRTA, IDELE, IFIP, NAGREF and CRPA 2014. Overview of datasets for cattle, horses, pigs and sheep. Deliverable 2.4 project under grant agreement no. SANCO/2011/G3/CRPA/SI2.610274, Centro Ricerche Produzioni Animali Spa Reggio Emilia, Italy.

ZMP 2008. Marktbilanz Vieh und Fleisch 2008. ZMP Zentrale Markt- und Preisberichtstelle GmbH, Bonn, Germany.