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Finnish Salmonella Control Program – Efficiency and Viability in Food Safety Promotion

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Abstract

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By committing to follow an EU Commission approved national program Finland received so called *additional guarantees* from the EU. These guarantees allow it to require respective salmonella protection levels from similar products imported to the country. In order to continue the program its economic efficiency has to be thoroughly evaluated.

The objective of FCSP is that no more than 1 % of the animals and meat should be contaminated with Salmonella at the national level. Respectively, at the abattoir or meat cutting plant level the goal is 5 % . These quite strict objectives were reached well in 1995-2001. The industry is responsible for running the program in practice. National authorities have their emphasis in co-ordination, collecting of data and supervision. The costs of the program are almost fully carried by the industry.

This paper evaluates the efficiency and viability of FSCP as a whole. It can be concluded, that money used running the program is well-spent: health benefits produced, estimated either using a cost-of-illness type of calculations or a willingness-to-pay measure from a consumer survey are many times larger than the costs of the program. In the end it can be concluded that FSCP is a good example of economically viable tool for sustaining public health.

Key words: *food safety, salmonella control, policy evaluation*

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1. Introduction

When Finland joined the European Union in 1995, country's extraordinary good salmonella situation in animal husbandry was acknowledged, and the EU granted Finland a special permission to run her own, quite strict salmonella control program in meat and egg production. This program is called the Finnish Salmonella Control Program (FSCP). In practice, the permission granted by the EU also allowed Finland to demand the same level of Salmonella protection from a variety of imported products.

Salmonella, like other so called zoonotic agents, is transmittable from animals to humans directly from contaminated animals or people or via contaminated foods. Importation of foodstuffs with high level of transmitting zoonotic contaminants risks not only a single consumer consuming the particular food, but also other consumers and livestock production in the country. Thus, the question is not only quality of a single commodity, but rather a question of public health and in some cases profitability of certain animal production lines. FSCP is a tool for maintaining the good Salmonella situation and for managing risks in food consumption caused by Salmonella. The program covers primary production, abattoirs and meat cutting plants of the Finnish supply chain.

When granting the permission for the program, EU also required the program to be closely followed and evaluated in order to determine its effectiveness and economic viability. The follow-up is especially important since such a control program could be viewed as a (technical) trade barrier by exporters. For the importer the problem is twofold: 1) trade of foodstuffs with countries having lower food safety standards unequivocally increases possibilities of disease outbreaks in an importing country, but also 2) disease control programs could be blamed to act as trade barriers. Without proper public health and economic justifications, such a program could violate the principle of common market between all the EU countries.

Besides the requirements given by EU, it is important for a country to assess the efficiency and economic aspects of such a program. Not only the economic effects of the program are important, but it is also important to clarify whether its citizens really desire this kind of health protection.

The subsequent evaluation of the FSCP has been carried out in several parts. First, Maijala (1998) and Maijala et.al. (1998) evaluated costs of the program by calculating the out-of-pocket administration costs. The benefits were calculated as cost savings using a cost-of-illness type of method (COI) added with potential market losses foregone. However, the COI approach has its own shortcomings as it (i) accounts only for direct, "market losses", and (ii) the approach values the losses with the market value only, and does not take into account personal preferences. Therefore, the benefit analysis was redone by calculating a willingness-to-pay (WTP) value using a contingent valuation (CV) survey (Peltola et.al., 2001). Additionally, incentive structure of FSCP was discussed in a report by Maijala & Peltola (2000b), potential trade effects were studied in a paper by Peltola (2001) and effects of the interventions in broiler production were also studied by Ranta & Maijala (2001).

In this study, we present the costs and benefits of the FSCP. The main aim of this study is:

- *to describe the operational structure of the Finnish Salmonella Control Program (FSCP).*
- *to present the results from efficiency and viability analysis of the program,*

In the next section, the current Salmonella situation in Finland is reviewed. In the third part, the structure of the program is laid out. The economic benefits and costs are presented in the fourth part. Finally, discussion of the results concludes the paper.

2. Salmonella situation

Salmonellosis is a disease caused by *Salmonella* Enterica bacterium, which originates from animal or human faeces. In most cases the bacteria are transmitted to humans via contaminated foodstuffs. Small children and elderly are the most sensitive to *Salmonella*. Common symptoms include a-few-days lasting fever and diarrhea. About 10 % of those infected develop a so-called reactive arthritis lasting a couple of months. The excretion of Salmonella in faeces usually ceases in about a month, however, a small number of those infected will become chronic asymptomatic Salmonella carriers (MMMEEO, 2000). Zoonotic diseases like salmonella transmit via contaminated food as well as

directly through infected animals or other humans. Therefore, their management is very complex involving public health issues besides simple quality issues of privately consumed food.

Finland has exceptionally broad data, dating back more than 30 years, on the infections caused by different types of *Salmonella sp.* In 1995-1999, the number of salmonella infections has fluctuated only slightly; on average 3,000 cases per year, as compared to approximately 4,600 cases per year during 1990-1994. The majority of the infections (80-90%) are contracted abroad. The seasonal fluctuation of salmonellosis has been similar over 1995-1999; the incidence both of imported and domestic cases is highest in late summer. The majority of salmonella infections originate from the most popular tourist resorts visited by Finns. In addition to favorable natural conditions that help preventing Salmonella, continued food safety work over last decades has helped in keeping Salmonella well controlled. In 1995-1999, only five annual Salmonella outbreaks on average were reported (MMMEE0 2000, National Public Health Institute 2000).

The history of Finnish salmonella control extends to the 1960's. The control system has been organized jointly through voluntary industry mechanisms and mandatory rules and regulations. For example, for over 40 years the Feeding stuff Act has been applied in Finland to detect Salmonella in the feed stuffs. Institutional design, especially locality of Finnish food markets, has been indirectly

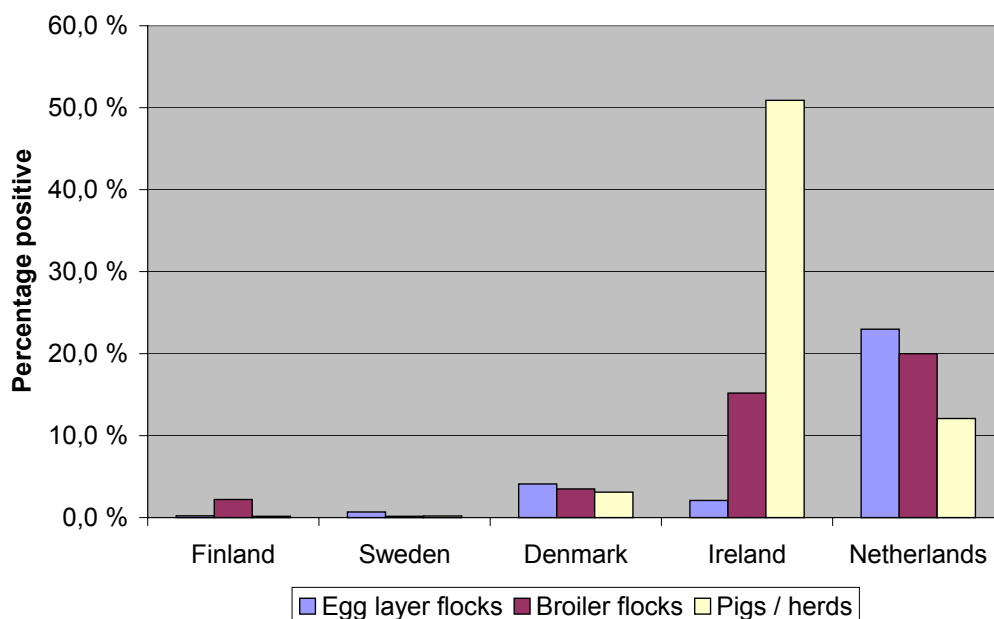


Figure 1. The results of salmonella programs in some EU member states in 1999 (EC 2001).

supporting the formal food safety work. Before the EU-membership, tight border control based on quotas and tariffs ensured practically all the main foodstuffs to be domestically produced. Resulting from tight domestic production control and negligible imports, the salmonella situation was good when Finland joined the EU. As a result of the FSCP, and serious commitment of farms and production plants together, the salmonella situation in Finland has remained internationally very good. In the graph below, the salmonella situation of several countries is presented (Figure 1).

3. The structure of the FSCP

The current policy, largely based on the Finnish Salmonella Control Program (FSCP), aims to maintain the existing favorable situation. FSCP covers all the serotypes of salmonella, not only *Salmonella* Enteritidis and *Salmonella* Typhimurium, as is common in many other European countries. A same type of program can only be found in Sweden and Norway. (MMMEEEO, 2000).

In case of imports, aforementioned additional guarantees require beef, pork and poultry meat and eggs, as well as live poultry and breeding eggs to be analyzed for Salmonella before they are imported to the country. Imports from other member states of the EU are checked at their first destination in Finland for certificates of salmonella analysis with negative results. If Salmonella is detected, the lot must be returned to the country of origin or destroyed. Only some raw materials entering to processing plants and being used as inputs in products undergoing heat treatment are freed from this rule (MMMEEEO, 2000). In a case of lots entering from a third country, a veterinary border inspection must be performed on the border. If Salmonella is detected, the lot is returned or rejected.

The domestic salmonella sampling covers grandparent, parent and production flocks of broilers, turkeys and layers as well as their hatcheries. The control of beef and pork production is based on sampling at slaughterhouses (lymph nodes and surface swab samples) and at cutting plants (crushed meat samples).

If salmonella is detected on a farm or in a processing plant, control measures always take place. Restrictions on animal products purchased and sold follow automatically, similarly as constraints on use of salmonella contaminated products. Cleaning, disinfection and slaughtering of animals are also part of the salmonella eradication measures. Additionally, there must be an epidemiological report produced pointing out the potential source of the contamination. Production farms are freed from the restrictions only after they are proved to be Salmonella-free again (MMMEEEO, 2000; MMMEEEO, 2001).

The objective is that the incidence of Salmonella throughout the country would be less than 1 % in the animals or meat samples at cutting plants. The objective is 5 % for single abattoirs or cutting plants. The aforementioned objectives have been reached well in 1995-2000 (MMMEEEO, 2000; MMMEEEO, 2001). The costs of the program are almost fully carried by the industry, national organizations only have a responsibility for inspection and supervision of processors own-checking systems, for some studies concerning suspected salmonella cases and for producing the monthly and annual reports of the results.

The operational structure of FSCP was analyzed by Maijala & Peltola (2000b) for its incentive effects. Salmonella and negative consequences of Salmonella infections were evaluated in a *public good – externality* framework. It was pointed out that FSCP is quite well-designed in order to account for potential problems due to market imperfections caused by imperfect information and by public good character of food safety work. The program has provisions for taking into account e.g. free-rider problems in provision of public goods.

4. Economic Benefit and Cost Estimates

To start with, it can be noted, that health benefits of FSCP (without a monetary measure) are believed to be significant. Health effects of FSCP on broiler primary production have been evaluated in a simulation study by Ranta & Maijala (2001). With an assistance of a mathematical

simulation model, the effect of an intervention used in the program, i.e. elimination of salmonella positive breeding flocks, were quantitatively assessed.

Using a probabilistic transmission model a predictive distributions were derived for a true number of infected broiler flocks instead of the number of detected salmonella positive broiler flocks. In the first case, the 95% probability interval of the posterior predictive true flock prevalence under current, favorable Salmonella situation was estimated to be 0.9-5.8%. In turn, if the detected positive breeder flocks were not removed, the true flock prevalence at the time of slaughter would have been 1.3-17.4%.

Secondly, in a scenario with one infected grandparent flock in the beginning of laying phase, the respective measures were 1.0-5.9% with the removal and 2.8-43.1% without the removal. Such a sizable impact appears to be a significant change in flock health even without a monetary valuation in this stage. Further studies on the effect of the removal of salmonella positive breeder flocks on public health are going on. Such simulation results will be used in studying further the potential losses borne from animal health problems due to zoonotic agents.

Besides the health benefits, economic benefits are evaluated. The benefits and costs of the program can be divided into direct and indirect effects and on the other hand, into market and non-market effects. Direct market costs and benefits are clearly the easiest ones, whereas indirect non-market effects are the most arduous ones to determine. Often it tends to be, that costs of some action (correction of a negative externality) are easier to determine, whereas benefits of such an action can largely consist of non-market benefits and thus are 1) hard to sum up and additionally 2) it is difficult to put a euro-value on them.

The main sources of costs were thought to be borne from direct costs in coordination and inspection and supervision of the FSCP in general. Other, indirect costs were due to e.g. changes in private industry production methods and adjustments in their processes. Still another indirect cost type is potential consumer loss in form of higher prices or lesser availability of certain products due to diminished imports (trade barrier effects). The main benefits are health benefits and their derivatives. In case of humans these can still be divided into market benefits (having a price tag) and to non-market benefits (fear, uncertainty, etc.). In case of domesticated animals, often only production losses and subsequent monetary losses are taken into account. For agricultural producers and for the industry as a whole another significant benefit may come through improved reputation of products.

In the first two evaluations (Maijala, 1998; Maijala et.al., 1998) costs of the program were calculated as the out-of-pocket costs from the point of view of administration i.e., only direct (administrative) costs were included. The benefits were calculated using a cost-of-illness (COI) type of method (see e.g. Kuchler and Golan 1999). The cost of illness values the program benefits as the work-days-saved, the work-loss foregone and the costs for health care of the cases. Clearly, the costs appear somewhat underestimated from a point of view of an individual firm thinking of e.g. costs due to clean-ups and adjustments due to a contamination, however improved production methods and reputation should (partly) compensate potential adjustment costs.

So called *market adjustment* was also included into the analysis. This is based on an assumption, that in case of high level of domestic Salmonella, domestic products would loose their preferable status and that would result in 10% decreased demand. Such a demand loss foregone due to a good Salmonella situation has been calculated as a benefit of the FSCP from a point of view of the state and agricultural sector. See *the table 1* for a break-down of the costs and benefit calculation in case

of egg production. The net benefits of the program are calculated by summing up the values of the fourth, “the difference” column.

	With FSCP	Without FSCP		
Samples and veterinary costs	196 058 €	0 €		
			Difference	cost-benefit ratio
health care costs	37 343 €	224 057 €	186 714 €	1,0
testing, market supervision and work against epidemic	638 877 €	3 782 900 €	3 144 023 €	16,0
value of days-away-from-work	137 551 €	825 304 €	687 754 €	3,5
insurance costs and other costs on a farm	0 €	148 800 €	-148 800 €	-0,8
costs from pull-backs of food products	5 000 €	30 000 €	25 000 €	0,1
supervision work by authorities e.g., feed market adjustments	31 750 €	21 750 €	-10 000 €	-0,1
	0 €	8 157 345 €	8 106 667 €	41,3

Table 1. A summary of annual costs and benefits of FSCP in egg production.

According to the analyses, the direct costs of the FSCP in egg production have been 196 058 €, and for meat production 890 461 €, respectively. The net benefits of the salmonella control in meat production were estimated to be 4 793 953 € – 229833120 €. For egg production the benefits were calculated to be in the range of 3 884 691 € – 11991358 € (Maijala, 1998; Maijala et.al., 1998). Large range in benefit estimation results from two different assumptions in market adjustments: 1) with no adjustment, and 2) with 10% reduction both in prices and consumption due to a worse food safety situation. Reported per household, the estimated benefits were about 3.5 € annually

The cost-benefit ratio for egg production with market adjustments was 61.2 and without market adjustments 19.8. The cost-benefit ratios for meat production were 258.1 and 5.4, respectively. Whichever market adjustment assumption was adopted, the FSCP appears very viable.

Using the COI method, the calculations are quite straight forward, however the approach has several shortcomings e.g., it accounts only for direct, “market losses” and overlooks losses incurring to off-market e.g. elderly. Secondly, the COI approach values the losses with the market value only, not taking into account personal preferences. Therefore, benefit estimation was redone using a theoretically more solid willingness-to-pay (WTP) approach (Peltola et.al., 2001). WTP was estimated using a contingent valuation (CV) survey. Earlier contingent valuation studies applied on food safety question are by e.g. Lin and Milon (1995) and Henson (1996). Henson (1996) values reductions in the risk of encountering salmonella from pork and poultry in United Kingdom.

In the benefit estimation by Peltola et.al. (2001), the main question in the WTP survey was: “*What is the value (willingness-to-pay) Finnish households set to high level salmonella control warranting relatively low possibility to encounter salmonella in the food eaten in Finland*”. Besides the WTP value itself, the study also investigated attitudes and opinions of consumers towards the food safety questions: which questions are considered important and which are given a low priority, i.e. is salmonella a great concern to consumers.

The CV survey was successful and results consistent with our expectations. According to the survey, people considered food safety issues important. It was also reassuring, that those respondents which considered salmonella to be quite an important food safety issue, had considerably higher WTP than others. The range of WTP alternatives given in the survey affected the mean WTP, but the median WTP was quite robust and therefore used in reporting the results.

As a median the respondents stated that they would be ready to spend an additional 3.3-8.3 € (on average roughly 5.8 €) per month to finance the current level salmonella control in Finland if it was otherwise to be ceased. Annually, this would be about 70 €. The value was approximately the same as the one found in the pilot study for this survey in May 2000 (Majjala & Peltola, 2000a).

Respondent's initial view of the Finnish Salmonella situation affected the WTP significantly. Every respondent was inquired in the beginning of the survey how concerned s/he is about Salmonella. Later this "level of concern" and the WTP were cross-evaluated. As preliminarily expected, those consumers most concerned about Salmonella were also ready to sacrifice the largest monetary amount (a bit above 22 €) in order to keep FSCP running. The WTP decreased together with the "level of concern" so that those stating to have "no idea" about the Salmonella situation, stated the lowest WTP (about 6.8 €).

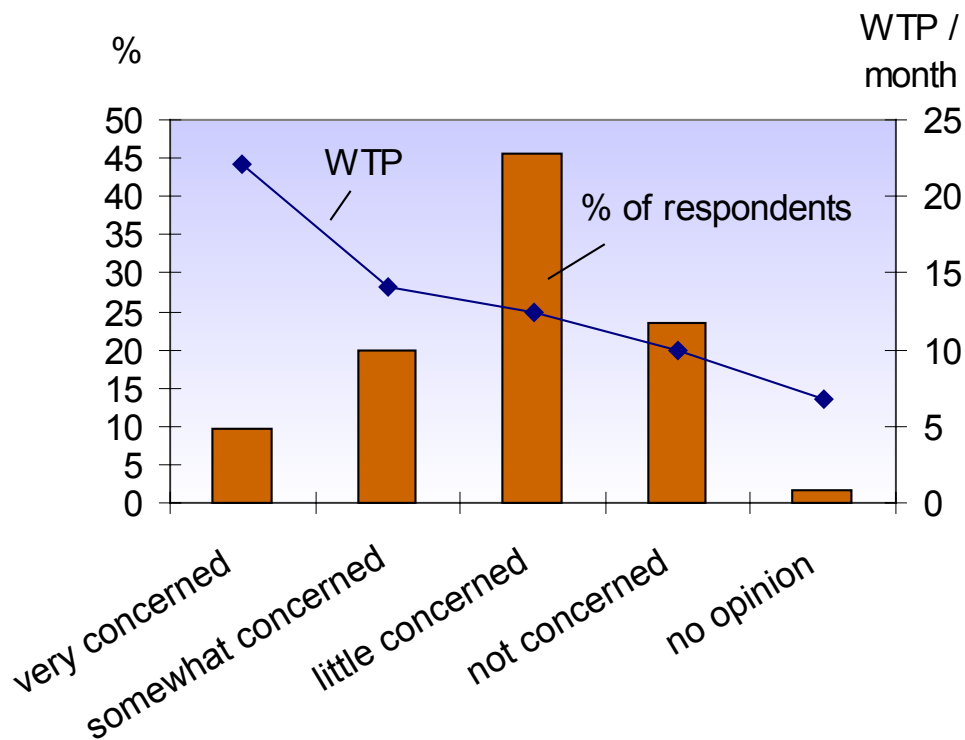


Figure 2. The effects of respondents' views of Finnish salmonella situation on their WTP (monthly WTP, €/household).

A quick comparison reveals that when WTP calculations are used the benefit estimations appear clearly larger than those from earlier COI calculations. The clearly higher values resulting from the WTP study are as expected: as the consumer WTP accounts for considerably broader benefits than the COI-method used in the earlier studies.

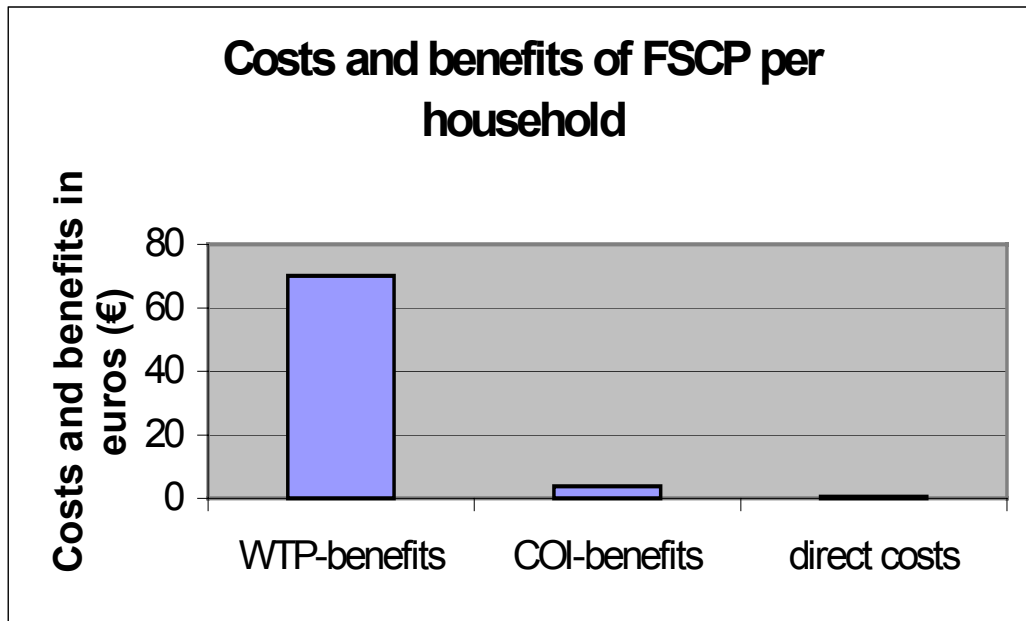


Figure 3. Annual cost and benefits estimations per household

As a whole, the benefit valuation done in this study strengthens the results from the two earlier study (Maijala, 1998; Maijala et.al., 1998). The benefits were also compared to the cost of the salmonella program. Maijala (1998) and Maijala et.al (1998) found the direct cost of the program to be about 0.5 € per household annually. The comparison further supports the notion that the FSCP has created relatively large net benefits, and from this point of view is quite a viable method of regulation (see the figure 3.).

The whole supply chain and consumers themselves were seen to be responsible for the food safety work. However, when asked who should pay for the food safety work, it was clear that the industry had the main financial responsibility and the consumers were seen to have the least responsibility. If needed, the respondents would also be ready to adjust their eating or food preparation behavior in order to avoid Salmonella. However, the more typical (Finnish) was the habit required to be changed, the less people were willing to do it.

Indirect trade effects of the FSCP were briefly studied by looking at changes in consumer and producer welfare using traditional welfare analysis (Peltola, 2001). The mechanism of the FSCP may hinder food imports to Finland and thus FSCP potentially causes welfare losses by decreasing trade flows. In case of salmonella control, these positive "spillover" effects on human health are one of the main outcomes goals of the FSCP. Therefore, benefits from the FSCP are expected, however, quantification of them may be difficult.

The empirical calculations done do not lend support to significant trade losses. In the nearby countries, practicing large scale food exporting the prices of food stuffs are not clearly below the Finnish prices. Similarly, the producer prices of beef, pork and eggs e.g. in Denmark and Germany, the prices are about on the same level as in Finland. The wholesale prices used in the study were more difficult to determine, but e.g. in case of eggs in Germany, the price difference again did not seem to be significant.

In case of beef, some potential effects can be found, however, their real significance is questionable. In case of pork welfare calculations are sensitive to assumptions about processing margins in world market. With imported pork processing margins equaling to margins in Finland trade may not

exist, but were the margins lower, the trade may exist given the producer prices behind the imports. The trade on eggs may produce some market benefits to consumers outweighing the losses of the producers. However, given the low level of welfare gains and the real danger of importation of increased Salmonella in Finland, the practical significance of the welfare gains seem negligible. However, one has to remember, that given imports are more contaminated compared to domestic production, any increase in imports always increases the risk of disease outbreak. In the analysis, only indirect market effects of the FSCP due to increased imports are calculated.

In the end it should be mentioned, that the costs of the FSCP are almost fully carried by the industry. State organizations only have a responsibility for inspection and supervision of processors own-checking systems. For some studies concerning suspected salmonella cases and for producing the monthly and annual reports of the results state organizations also have a role.

5. Discussion

According to the analysis the FSCP appears quite profitable. Were the benefits estimated using a COI method or using a WTP from a contingent valuation survey they are clearly larger than direct costs. However, according to the trade analysis, the program does not seem to cause price discrepancies between Finland and other countries on the products in question.

- 1) One reason to good performance of the program may lay in its structure. The program was designed using a layman's economic sense in the first place, mainly based on insights by veterinarians and authorities in the Ministry of Agriculture and Forestry. According to the earlier qualitative and structural analysis of the program, the design of the program is successful: it has a logical structure, and incentives given encourage different players to work together in order to maintain high food safety standards in the supply chain.
- 2) The program itself has a broad coverage applying to all main livestock production lines. In addition to the FSCP, there exists a Feed Stuffs Act, which applies to feed production. This regulation strongly supports the rules and standards laid down by the FSCP. Additionally, industry has its own, voluntary mechanisms which still further support the regulations set by state authorities.
- 3) Another issue is the good starting point for the food safety work in Finland. Given historically high Finnish standards of food safety, setting up a program to support the situation is not prohibitively expensive. The situation would be different was the starting point much lower. In such a case there would need to be a (large) initial investment in order to step up the food safety on a new level. FSCP type of program for maintaining the standards could be launched only after such an initial investment.

The good salmonella situation can also be seen as an inheritance from the past generated through high border control and low amounts of imports. High border control caused higher product prices and thus some consumer losses during the 1970's and 1980's. In turn, this was a cost both for Finnish consumers and for potential food exporters in other countries. However, historically the safety of food was never a point in restricting trade, rather the improved safety was born as a by-product from the border protection.

- 4) Effects on imports and foreign trade seem not to be alarming if even significant. Welfare effects of potentially diminished imports due to FSCP were briefly analyzed. According to that analysis, no significant effects could be found. On the other hand, increased trade of food stuffs with countries

with lower food safety standards unequivocally increases possibilities of disease outbreaks in an importing country. Therefore, the situation can be looked at as a problem of international trade with consumption externality affecting agents in the importing country. From this point of view, additional food safety trade measures may well be justified instruments.

5) The viability analysis presented here has been concentrating mainly on direct costs and benefits of the program. Even as such the work has been quite demanding as many of the benefits mentioned are include non-market elements and thus are not priced on the market. Although some of the non-market benefits have been valued, there still exist several indirect costs and benefits which we have not been able to measure. For those values expert estimates have been used, or they have been estimated to be zero and thus been dropped from the analysis. WTP valuation produced clearly larger benefits compared to COI calculation earlier. This is logical, as WTP covers much broader spectrum of benefits than a simple COI calculation.

6) Besides the sheer money values of FSCP the Finnish consumers were surveyed about some other issues connected to (food safety) risks in everyday life. According to the survey, consumers are interested in food safety and they are quite well aware food safety risks of everyday life. According to consumer responses, all the parts in the supply chain are responsible in the provision of food safety work. However, financing of the food safety work should all be laid on the industry, say most of the respondents.

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