Measures ensuring the food quality on retail markets: experimental perspective

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Abstract: Due to the ongoing problems with the quality of foods in European markets, the public authorities try to take some measures, which would reduce the amount of substandard food products offered to consumers in retailing. Three such measures – the higher frequency of quality checks conducted by public authorities, the imposition of some import barriers on the foodstuffs from countries known for their frequent breaches of quality standards in the food industry and the establishment of an information platform serving for the public pillorying of poor quality food – are studied in this paper. The experimental policy analysis was used as the research method. The results obtained show that only the higher frequency of quality checks can improve the situation of consumers. This measure is also effective in punishing the dishonest retailers, while not harming the honest ones.

Key words: experimental economics, experimental policy analysis, food quality & safety, market for "lemons"

One of the assumptions of perfect competition (i. e. of effective market environment) is that all market subjects have perfect information about all relevant issues, including the quality of traded goods. A situation when this assumption is not valid was, from the theoretical point of view, firstly analysed by George Akerlof (1970) in his seminal paper "The Market for Lemons: Quality Uncertainty and the Market Mechanism." According to the Akerlof's famous "lemons model," there is a serious threat that under such information conditions, the low-quality products will drive the high-quality ones out of the market, which can eventually lead even to the very dissolution of such a market. Despite the fact that this statement, in general, was not confirmed by the empirical studies, such as Bond (1982), Sultan(2006) or Offer(2007), and that the concepts of "signalling" and "screening", which should equalize the asymmetry between subjects and therefore overcome the "lemons outcome", were described in the literature later (Lofgren et al. 2002), it is evident that the information asymmetry about quality remains to be one of the big problems of real markets.

Our analysis focused only on the issue of standard goods markets (and therefore it is abstracted from the labour or insurance markets, which were analysed by Akerlof as well). According to the classical typology of product's characteristics invented by Darby and Karni (1973), there are three main types of goods qualities. Search quality, which can be observed by the consumer even prior to the purchase of the product, experience quality, that can be assessed by the buyer after the use of the goods and credence quality, which cannot be judged by the ordinary consumer at all. It is obvious that the information asymmetry problem arises especially in case of the goods where the two latter types of qualities are numerous and/or important. The uninformed buyer then faces the risk of purchasing a product of low-level of the two hardly observable qualities (a "lemon" in Akerlof's terminology) for the price of a high-quality one (a "cherry").

As stated by Foss (1996), Raynaud et al. (2005) or Gao et al. (2010), foodstuffs are undoubtedly goods where the experience and credence attributes play a crucial role, for example taste is a typical experience quality. What is more, even the qualities closely linked to the food safety belong to the two problematic groups. With many types of foodstuffs, their freshness cannot be judged directly in the shop (e. g. due to its packaging), but only during the consumption. The content of food as well as the techniques used in its production (for example, how many pesticides were used in growing the crop or what fodder the

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livestock were fed by) then belong to the credential attributes – the ordinary consumer can hardly recognize which ingredients the food is made of and he/she has definitely no chance to find out whether all health requirements were fulfilled in the course of the whole manufacturing process.

Threats to consumers resulting from these facts are reflected in the measures adopted by public authorities in several ways. The simplest possible reaction resulting directly from the economic theory (see Golan et al. 2001 or Caswell and Mojduszka 1996) is the invention of the obligatory food labelling, which is intended to provide consumers with some necessary information about the food content. Another way of protecting the consumers' health is to set some standards (regarding both the content of the final foodstuff and the acceptable procedures in manufacturing process) that must be met by the producers.

The measures mentioned above are implemented to a large extent in the European Union. Nevertheless, despite all of these measures, there has been a great number of problems with the foodstuffs throughout the Europe recently.

Even if we leave aside some extreme scandals when the market was entered by seriously harmful or even lethal foodstuffs, such as the E-coli epidemic in Germany in 2011 or the methanol poisoning scandal in the Czech Republic in 2012, which are fortunately relatively rare, there are still much more frequent cases when the consumers are "only" sold products the content of which does not correspond to their labels or/and is undesirable for the human consumption. The Irish pork scandal in 2008, the food from Poland containing the technical salt in 2012 or the Pan-European horsemeat scandal in 2013 can be given as the most noticeable examples, but there is literally a large number of smaller problems of this kind throughout the Europe every month.

The authorities, therefore, try to tighten up the existing consumer protection regulations or to come up with new ones in order to eliminate these ongoing problems, or at least to reduce their occurrence. The crucial question is, which (if any) of the proposed or already implemented measures really have the potential to solve the problem of the substandard goods entering the food markets. The aim of this paper is to contribute to this discussion by investigating the efficiency of three such measures, which have intensively been debated in public lately:

(a) The fact whether the foodstuffs offered in the shops are in compliance with the standards required by the law as well as whether they fulfil the promises made by their seller (and are therefore not promoted through false advertising) is usually checked by some responsible public authority. The first possible reaction to food scandals is therefore **to increase the frequency of these quality checks.** To achieve a higher frequency of checks is, for example, the underlying goal of the European Commission's Proposal 2013/0140 (COM), which was formulated in response to the repeated food scandals in the EU.

(b) There can be some countries where the health, safety and quality regulations during the whole manufacturing process are not so thoroughly observed and effectively enforced. Producers in these countries can then produce food which is, on the one hand, very cheap but, on the other hand, its quality and safety can be rather questionable. So that the retailers are not tempted to import these products of questionable quality at a bargain price and offer them to the domestic consumers (and realize the extraordinary profits in the end), **the public authorities can either directly ban imports from such countries or at least make it difficult by imposing some taxes on it or setting some complicated procedures which the imported goods have to go through**. Such procedures will then mean additional costs for the importers and reduce the advantageousness of such practices. This measure was used, for example, in 1997, when the European Commission (1997) imposed a ban on the Bangladeshi shrimps because they were suspected not to have been produced in compliance with the HACCP system. A similar action was lately demanded by the Federation of the Food and Drink Industries of the Czech Republic (2012), which wanted the Czech government to ban the imports of Polish foodstuffs that had been accused of being cheap but substandard.

(c) The information disadvantage of buyers can be reduced by **some information platform where the consumers can share their experience with the particular goods**, especially with the "lemons" they have bought. As an example, there can be given the web portal called "Food Pillory" established in the Czech Republic jointly by the Ministry of Agriculture and the Czech Agriculture and Food Inspection Authority (2012).

In this article, the efficiency of these three possible measures as well as their impact on the markets are investigated using the approach of the experimental policy analysis.

MATERIAL AND METHODS

Experimental policy analysis

The experimental policy analysis approach is based on the methodology of experimental economics. The researcher creates an economic experiment which represents the issue in question and where the variable treatments of the experiment stand for the investigated measures of the economic policy. The experiment is then carried out with the real agents (usually university students – see Friedman and Cassar 2004 or Friedman and Sunder 1994) and its outcomes dependent on the particular variable treatments are assessed to judge the effects of the particular measures of economic policy. Concurrently, in compliance with the Friedman's (1966) methodology of positive economics, it is not necessary (and not even possible) to construct a perfectly accurate representation of the real problem, but to develop an experimental environment which enables to give answers that are "good enough" (for example, Friedman and Cassar 2004).

We based our experimental environment suitable for our research on the existing experimental studies which dealt with the information asymmetry about the quality and the environments presented in them. From the relevant studies, the work of Miller and Plott (1985) dealing with the concept of signalling and its impact on the equilibrium in the "lemons" markets is the oldest one. Another experimental research conducted during the eighties was realized by Lynch et al. (1986). Their research can serve as an example of using experiments for the purposes of economic policy, as the intention of this study was to provide the US Federal Trade Commission with the information about the functioning of the "lemons" markets. Holt and Sherman (1990) studied the effect of the price advertising on the "lemons" market. Cason and Gangadharan (2002) investigated the effect of signalling and also extended the standard "lemons" market by the sellers' opportunity to certify the quality of their goods. Wolf and Myerscough (2007) gave buyers the possibility to give a public feedback on the price-performance ratio of the purchased goods. Eriksson and Simpson (2007) used the apparatus of the auctions with asymmetric information for the behavioural research – they investigated whether honesty plays some role in the decision making. Tsao et al. (2006, 2009) concentrated on the signalling as well, using the real brands as signals. Wilson and Zillante (2010) studied the outcomes of the "lemons" market under different information conditions and auction mechanisms.

Experimental environment created for our research was partly inspired by all the papers cited above, but most of all it was based on the work of Lynch et al. (1986) as well as on the simple "lemons" experiment invented by Holt and Sherman (1999) for the educational purposes. These environments were modified in two main ways.

Firstly, the posted-offer auction usually used in this type of experiments, where the seller sets some price and the product is either sold exactly for this price or not at all, was replaced by the Dutch one. The reason for this change is that the descending bidding is a better approximation of pricing in the retail sector – the seller sets (based on his/her knowledge of the market) some price for which he/she is willing to sell the product. Nevertheless, in case there is nobody who is prepared to purchase it for such a price, the seller can reduce the price and try to offer it again.

Secondly, three variable treatments representing the discussed measures were added.

Experimental environment

There were 5 sellers (identified by letters A–E) who stood for the retailers and 5 buyers (α–ε) who stood for the consumers in every session. Sellers and buyers were seated at the opposite sides of the class and record sheets were handed to them. They were forbidden to communicate with each other during the whole experiment, i.e. all decisions were made in privacy. The game consisted of 6 rounds. In each round, each seller offered one product, choosing either a product meeting the quality standards ("standard" in short) or a substandard one. The first option meant the costs c for him/her; $c \in \{25, 30, 40, 45\}$, these values were rotated among the five sellers during the five rounds of experiment. The costs stood for the price for which the retailer, who is in the food market usually only a middleman, could buy this product from its original producer (who did not appear in the experimental environment at all, as he/she is irrelevant to the analysis of the discussed topic). In the last round all sellers had $c = 35$. If he/she chose the substandard product, his/her costs were only $l \times c$, where the reduction coefficient l was the first variable treatment with two levels, $l = 0.6$ and $l = 0.8$.

The size of l stands for the potential measure (b). Its lower level represented the situation when the retailers could purchase substandard products at a bargain

price from the countries with less severe standards, while the higher level stood for the situation when such imports were either banned (which means that the retailer has to buy the substandard goods for a higher price elsewhere) or burdened by some tariffs or bureaucratic procedures. Concrete values of the parameter were separated widely as recommended by Friedman and Cassar (2004, p. 33), so as to achieve a clear differentiation between the both possibilities.

Every seller also set two boundary prices, the starting price (i.e. the highest one) and the lowest acceptable one, because the products were bid to the buyers by the experimenter via the Dutch auction. The aim of the seller in the experiment was to maximize the sum of his/her surpluses (= *contract price* – *c*) throughout all the 6 rounds.

After all of the sellers had made their decisions, any product could be put to the quality test. The probability that the product of i^{th} seller would be checked in j^{th} round was the second variable treatment with two levels, p_{ij} = 0.05 and p_{ij} = 0.25. The check meant that the auctioneer investigated whether the product was a standard or substandard one. In the first case, the result was reported to all consumers, while in the latter not only was the result reported to all concerned, but also the substandard product was excluded from the auction in this round. The higher level of p_{ij} is the representative of a) measure.

When the quality checks had finished, the non-excluded products proceeded to the auction. The auctioneer verbally bid all products available at the current price. If some price was the lowest acceptable one for some seller, it was pointed out by the auctioneer. For example, the auctioneer said: "A, B and E offer their products for 37, as for E it is the last bid..." and so on.

In each round, each buyer had some reservation price ***r*** representing the utility of its consumption for him/her. Reservation price $r \in \{30, 35, 40, 45, 50\}$, these values rotated among the five buyers during the five rounds of experiment, while in the last round all buyers had r = 40. Every buyer could purchase one product per round. The aim of the buyer in the experiment was to maximize the sum of his/her surpluses (= *r* – *contract price*) throughout all the 6 rounds. Nevertheless, he/she gained this surplus only if the purchased product was a standard one. If he/she bought a substandard one, the surplus equalled zero.

In other words, the substandard products in the experiment did not represent the extreme case of a lethally harmful food (their involuntary consumers were not excluded from the rest of the experiment), but only the more common case of the foodstuffs of an inappropriate quality as discussed in Chapter 1.

However, such a design could have led to the unduly risky behaviour when rational buyers would have purchased even the most "suspicious" products (e. g. offered at an extremely low price or by the seller who was known to have sold substandard products in the previous rounds) – it would have been better to buy such a product and gain probably zero than buy nothing and certainly gain zero. So as to avoid it, there was one more rule – if some buyer did not purchase anything, he/she got one quarter of the lowest surplus gained by the other buyers in this round. Therefore, the buyer who considered purchasing a "suspicious" product faced the following choice – to take a risk and buy it, which means he/she got either the higher surplus (if the purchased product was standard one) or nothing (if it was a substandard one), or not to purchase it and gain a certain but lower surplus.

So as to make a purchase, the buyer had to raise his/her hand and announce, for example: "I am buying at 36 from A." The auction finished when there was no product left in the market – i. e. when every product had been either sold or ended up outside the market, because nobody wanted to buy it for its lowest bid price. After the end of the auction, the results of every seller and buyer were calculated and imparted to the participants. It meant that at that moment, every buyer found out whether he/she had purchased a product of standard or substandard quality. This information was either passed on only to the buyer concerned or the experimenter informed everyone, e.g.: "β has purchased a substandard product from A in the last round." Whether the post-auction information about traded substandard products was ***private*** or ***public*** was the third variable treatment related to the measure c). If the post-auction information was ***public***, there was a platform suitable for sharing the information among consumers, while if it was ***private,*** there was no spread of such information.

Participants and data description

To sum up the experimental environment, there were 3 variable treatments, each with 2 levels, which meant 8 possible combinations in total. Each combination was played four times so as to obtain a sufficient data sample, which means 320 participants (they were unique, nobody took part in the game repeatedly) and 20 players for each role in each combination.

Every player made the same decision six times during the experiment, but only the data from the first 5 rounds were taken into account. The last round was left out to avoid the "effect of the end", which is a well-known effect in the experimental practice (for example Friedman and Cassar 2004, p. 71). In other words, 100 figures for each particular decision in each existing variant of the experiment were entered into the data analysis.

The participants were undergraduate and graduate students and they were rewarded according to their performance in a way which was in compliance with the Vernon Smith's (1976) induced value theory. The bonus points to the microeconomic exam were used as the reward medium, as they have the same (Li 1991) or even a better (Grossman and Komai 2006) effect than the real monetary reward. The MATLAB software was used for the data processing and analysis, 5% was set as the significance level.

Limitations of the method used

The chapter dealing with the used method should not conceal the fact that, as any experimental research, even the study presented in this paper faces some methodological limitations. The exhausting discussion about the disadvantages and weaknesses of the experimental economics would, of course, far exceed the aim and scope of this paper, but this subchapter at least discusses the main controversial points arising in our particular research.

First of all, despite being the standard practice in the experimental research, using of students as representatives of the whole population can raise questions about the external validity of such research. The main problematic point regarding the research presented in this paper is the issue of risk attitude, which is definitely an important factor influencing the behaviour of both the sellers and the buyers in the markets with asymmetric information. At the same time, this characteristic is widely claimed to be age-dependent. Such dependency, supposing it really exists, could then limit the explanatory power of the obtained results in predicting the reaction of the whole society (containing all age groups) to the implementation of the particular measures.

Nevertheless, the existing studies dealing with the effect of ‚age on the risk attitude are rather ambiguous – Sinha (1992) and Albert and Duffy (2012) reported that the risk aversion rises with the age, while according to Harrison et al. (2007), the dependency is opposite, and Charness and Villeval (2007) found no dependency at all. To conclude, there is no clear and deterministic dependency between the age of an agent and his/her risk attitude. Its development throughout the life probably depends mainly on the particular experience of each individual, as suggested by Dillenberger and Rozen (2013), and it could be therefore negative as well as positive. Therefore, there is no reason to assume that the experiment conducted with students should produce some systematically biased results, which cannot be applied on the behaviour of other age groups in the economy (but at the same time, it is important to stress out that the obtained results can be valid only "in average," not necessarily for every particular man or woman).

Another limitation of the presented research lies in the fact that the experimental environment always represents only some limited part of the reality while abstracting from the wider frame. Therefore, it did not study, for example, the impact of the particular measures on the original producers of food, the increase of the costs (both direct and indirect ones), which would be caused by the implementation of the discussed measures, and many other issues. In the practical policy making, such issues should, of course, be taken into account by the public authorities as well, but it is not possible to cover all of them using the experimental policy analysis approach, because the ultimate experiment constructed to contain all of them would be too complex to be realizable.

On the other hand, this approach is typical of the whole general economic theory and it is therefore not a specific weakness of the method used in our research – every model is only a simplified representation of the reality and the experimental environment is no exception. As such, it is designed to describe one particular problem, for analysing other issues, it would be necessary to create different environments or to use a completely different method.

RESULTS AND DISCUSSION

As the idea of the three measures mentioned above is to protect the consumers by means of discouraging the retailers from offering substandard food, the first question which had to be answered was whether any of the variable treatments in the experiment could decrease the number of sellers who tried to rip the buyers off by selling them a "lemon." For the purposes of data analysis, this question was expressed as the following three null hypotheses:

H0a: The percentage of sellers offering substandard products if p_{ij} = 0.25 equals the percentage of sellers offering substandard products if p_{ij} = 0.05.

H0b: The percentage of sellers offering substandard products if l = 0.8 equals the percentage of sellers offering substandard products if l = 0.6.

H0c: The percentage of sellers offering substandard products if the post auction information is ***public*** equals the percentage of sellers offering substandard products if the post-auction information is ***private.***

The one-sided alternative hypotheses were:

H1a: The percentage of sellers offering substandard products if p_{ij} = 0.25 < the percentage of sellers offering substandard products if p_{ij} = 0.05.

H1b: The percentage of sellers offering substandard products if l = 0.8 < the percentage of sellers offering substandard products if l = 0.6.

H1c: The percentage of sellers offering substandard products if the post auction information is ***public*** < the percentage of sellers offering substandard products if the post-auction information is ***private.***

As the data in this case came from an alternative distribution, three two-sample proportion tests comparing the expected values of the percentages of the sellers offering substandard goods were conducted in order to test these hypotheses. Also the bootstrap method based tests were conducted. Their results are recorded in Table 1.

As can be seen from the results obtained variable treatments (a) and (b) could prevent sellers from offering "lemons", while the variable treatment (c) showed definitely no potential in this regard. Let us interpret the results for the purposes of real economic policy – the retailers will be less tempted to try to rip off the consumers by selling substandard foodstuffs to them if the quality checks conducted by some public authorities are more frequent and/or if the possibilities of buying some substandard foodstuff from the producer for an extremely low price and then selling it to the consumer for a standard price are eliminated. On the other hand, providing some information platform for consumers to express and share their views on the substandard foodstuffs and their sellers will hardly have any effect.

However, the experimental policy analysis should not end with the results in Table 1. The fact that some measure can discourage retailers from offering substandard foodstuffs actually does not mean that it will automatically be beneficial to the consumers. It is possible that the implementation of such a measure will have some side effect on the market environment, which will influence the situation of the buyers in just the opposite direction. The net effect of such measure on the buyers can therefore be neutral too, or even negative.

So as to investigate the impact of the seemingly effective measures on the buyers in the whole complexity, the buyers' surpluses according to variable treatments $\boldsymbol{l}$ and $\boldsymbol{p_{ij}}$ were studied. Two null hypotheses were formulated:

H0d: Buyers' surpluses if p_{ij} = 0.05 equal buyers' surpluses if p_{ij} = 0.25.

H0e: Buyers' surpluses if l = 0.6 equal buyers' surpluses if l = 0.8.

The corresponding one-sided alternative hypotheses were:

H1d: Buyers' surpluses if p_{ij} = 0.05 < buyers' surpluses if p_{ij} = 0.25.

H1e: Buyers' surpluses if l = 0.6 < buyers' surpluses if l = 0.8.

The populations were tested for normality using the Kolmogorov-Smirnov test. Although there was a great deal of data, the normality was rejected. Therefore, we decided to perform not only the two sample t-tests, but also the bootstrap method based tests to compare the expected values of buyers' surpluses by the particular variable treatments. Their results are noted in Table 2.

The results show that only the higher frequency of quality checks could really improve the overall situation of the buyers. The other variable treatments evidently caused some side effect(s), which counter-

Table 1. Test results for Hypothesis 1

	Populations' mean (std.)		Distribution		*P*-value of the test		Result
Hyp.	1st	2nd	1st	2nd	two-sample proportion	bootstrap	
H0a	0.305 (0.461)	0.365 (0.482)	alternative	alternative	0.036	0.0386	rejected
H0b	0.255 (0.436)	0.415 (0.493)	alternative	alternative	8.17E-07	0	rejected
H0c	0.348 (0.477)	0.323 (0.468)	alternative	alternative	0.773	0.7866	cannot reject

Source: authors' own computation

Table 2. Test results for Hypothesis 2

	Populations' mean (std.)		KS normality test		*P*-value of the test		Result
Hyp.	1st	2nd	1st	2nd	two-sample *t*-test	bootstrap	
H0d	2.518 (4.211)	3.243 (5.016)	Non-N	Non-N	2.14E-40	0.0124	rejected
H0e	2.933 (5.212)	2.828 (3.999)	Non-N	Non-N	0.625	0.6267	cannot reject

Source: authors' own computation

balanced the positive impact of the lower amount of substandard products entering the market.

For the purposes of the policy analysis it is, of course, useful to identify the nature of this side effect(s). We can assume the following facts. Firstly, the surplus of the buyer is *(r – contract price)* if the product is standard, and zero if it is substandard; in other words, if a buyer purchases a substandard product, its contract price will have no effect on his/her surplus. Secondly, the distribution of the buyers' reservation prices is the same for both levels of the variable treatment. Thirdly, the amount of substandard products sent to the markets by sellers was lower when $l = 0.8$. Based on these three facts, there is only one possible side effect which can explain the absence of the positive impact of $l = 0.8$ on the buyers' surpluses – the higher level of l had to be associated with the rise of the contract prices paid for the high-quality products. The rise of their contract prices then ceteris paribus meant lower values of differences *(r – contract price)* gained from purchasing the quality products, which balanced the positive impact of a lower amount of zero surpluses caused by the substandard goods.

To test whether the logical analysis conducted above is correct, the following null hypotheses were formulated:

H0f: Contract prices paid for standard products if $l = 0.6$ equal contract prices paid for standard products if $l = 0.8$.

H0g: Contract prices paid for substandard products if $l = 0.6$ equal contract prices paid for substandard products if $l = 0.8$ (this hypothesis was added to obtain a detailed overview of the development of prices).

The one-sided alternative hypotheses were:

H1f: Contract prices paid for standard products if $l = 0.6$ < contract prices paid for standard products if $l = 0.8$.

H1g: Contract prices paid for substandard products if $l = 0.6$ < contract prices paid for substandard products if $l = 0.8$.

The two two-sample *t*-tests and the two bootstrap method based tests comparing the expected values of the contract prices paid for standard and substandard products were performed to test these hypotheses. Their results are noted in Table 3.

Results in Table 3 clearly confirm that if the market cannot be entered by extremely cheap, substandard goods, it also leads to the price increase of the standard products. The most likely explanation is that in case of $l = 0.6$, the consumers observed the existence of some products which were available even for very low prices, without knowing that these products were necessarily of a substandard quality (because the buyers did not know the distribution of the costs among the sellers). Therefore, they were not prepared to buy some other goods for much higher prices. The sellers of "cherries" had to respond to this situation by setting the lowest acceptable prices of their products really low, so that their goods were competitive in the market. On the contrary, if $l = 0.8$, the sellers of standard goods did not have to compete with the extremely cheap, substandard products and could therefore set higher prices.

Let us sum up the results obtained so far and interpret them for the purposes of the consumer protection policy. From the three investigated measures, providing a platform by which the information about the

Table 3. Test results for Hypothesis 3

	Populations' mean (std.)		KS normality test		*P*-value of the test		Result
Hyp.	1st	2nd	1st	2nd	two-sample *t*-test	bootstrap	
H0f	37.456 (3.880)	38.238 (3.907)	Normal	Normal	0.0294	0.0243	rejected
H0g	34.205 (4.012)	37.473 (4.537)	Non-N	Normal	1.930E-06	0	rejected

Source: authors' own computation

substandard foodstuffs can be disseminated among consumers shows no potential to discourage sellers from offering substandard goods at all. On the one hand, the increase of the prices for which the sellers can buy substandard products from manufacturers can reduce the number of substandard foodstuffs entering the market, but, on the other hand, it causes the price increase of the standard food as well, which counterbalances the positive effect of the measure. Only the higher frequency of the public quality checks shows the desired effect. This measure is therefore the only one that can be recommended to the public authorities to implement if they intend to improve the situation of consumers.

Nevertheless, the experimental policy analysis would not be complete without investigating the impact of the recommended measure on the opposite side of the market – the retailers. Let us divide the retailers into two groups: the dishonest ones who are trying to rip consumers off by selling substandard foodstuffs to them, and the honest ones who serve the consumers by offering food of the appropriate quality to them. Then it is evident that the implemented measure should ideally punish the members of the first group while not harming the members of the other one. The reason for this statement is not only moral but there is a practical dimension as well. If the proposed measure really affects only the dishonest retailers, the rest of the branch may support it, which definitely makes its successful implementation easier for the public authorities.

Before declaring the higher frequency of quality checks to be the optimal response to the food quality problems, the effect of this measure on both the mentioned groups of sellers in the experiment is definitely worth studying. The surpluses of both the honest and misbehaving sellers were investigated to find out whether they depend on the variable treatment p_{ij}. The following null hypotheses were formulated:

H0h: Surpluses of the sellers offering substandard products if $p_{ij} = 0.25$ equal surpluses of the sellers offering substandard products if $p_{ij} = 0.05$.

H0i: Surpluses of the sellers offering standard products if $p_{ij} = 0.25$ equal surpluses of the sellers offering standard products if $p_{ij} = 0.05$.

The alternative hypotheses were:

H1h: Surpluses of the sellers offering substandard products if $p_{ij} = 0.25$ < surpluses of the sellers offering substandard products if $p_{ij} = 0.05$.

H1i) Surpluses of the sellers offering standard products if $p_{ij} = 0.25$ < surpluses of the sellers offering standard products if $p_{ij} = 0.05$.

The two two-sample *t*-tests and the two bootstrap method based tests comparing the expected values of the surpluses of the honest and misbehaving sellers were performed to test these hypotheses. Results can be seen in Table 4.

As obvious from Table 4, the higher frequency of quality checks reduces the average surplus of the dishonest sellers and at the same time, it does not negatively affect the surpluses of the honest ones. In other words, it fulfils both the requirements mentioned above. Together with its desired effect on the buyers' side of the market, it is possible to conclude that this measure seems to be an optimal response to the problems with the quality of foodstuffs on retail markets.

CONCLUSION

Quality and safety are the key attributes of food for the consumers in Europe (compare Horská et al. 2011 or Grunert et al. 2005). This paper studied the effectiveness of three measures supposed to help ensuring the quality of foodstuffs entering the retail markets.

Because of the limitations discussed in the subchapter in question, the obtained results must be interpreted cautiously. Nevertheless, with respect to those reservations, the following conclusion can be drawn from our results. If the public authorities want to implement some measure ensuring the quality of foodstuffs in the retail markets, increasing the frequency of quality checks will be the only option with

Table 4. Test results for Hypothesis 4

	Populations' mean (std.)		KS normality test		*P*-value of the test		Result
Hyp.	1st	2nd	1st	2nd	two-sample *t*-test	bootstrap	
H0h	5.549 (6.492)	7.048 (6.778)	Non-N	Non-N	0.033	0.0325	rejected
H0i	5.162 (5.352)	4.697 (5.531)	Non-N	Non-N	0.837	0.8388	cannot reject

Source: authors' own computation

the potential for fulfilling such an intention. Not only is it effective in protecting consumers, but it also has the desired effect on retailers, while the other two examined measures must be declared ineffective for these purposes.

Another question is whether the costs caused by the increase in the frequency of quality checks would be acceptable for the society, in other words, whether the people would allow the public authorities to spend the necessary financial means on the additional quality checks in exchange for the higher level of food safety. Answering this question is definitely an inspiring topic for a further research.

REFERENCES

Akerlof G.A. (1970): The market for "lemons": quality uncertainty and the market mechanism. Quarterly Journal of Economics, *84*, 488–500.

Albert S.M., Duffy J. (2012): Differences in risk aversion between young and older adults. Neuroscience and Neuroeconomics, *1*: 3–9.

Bond E.W. (1982): A direct test of the "lemons" model: the market for used pickup trucks. The American Economic Review, *72*: 836–840.

Cason T.N., Gangadharan L. (2002): Environmental labeling and incomplete consumer information in laboratory markets. Journal of Environmental Economics and Management, *43*: 113–134.

Caswell J.A., Mojduszka E.M. (1996): Using informational labelling to influence the market for quality in food products. American Journal of Agricultural Economics, *78*: 1248–1253.

Darby M.R., Karni E. (1973): Free competition and the optimal amount of fraud. Journal of Law and Economics, *16*: 67–88.

Dilenberger D., Rozen K. (2013): History-Dependent Risk Attitude. Cowles Foundation Discussion Paper No. 1763. Yale University, New Haven.

Eriksson K., Simpson B. (2007): Deception and price in a market with asymmetric information. Judgment and Decision Making, *2*: 23–28.

European Commission (1997): Commission Decision Concerning Certain Protective Measures with Regard to Certain Fishery Products Originating in Bangladesh. Official Journal of the European Communities. Available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:1997:214:0046:0046:EN:PDF

European Commission (2013): Proposal 2013/0140 (COM). Available at http://ec.europa.eu/dgs/health_consumer/pressroom/docs/proposal-regulation-ep-council_en.pdf

Federation of the Food and Drink Industries of the Czech Republic (2012): Potravinářská komora je znepokojena "solnou aférou" v Polsku. (Federation of the Food and Drink Industries is worried about the "salt affaire" in Poland.) Available at http://www.foodnet.cz/polozka/?jmeno=Tiskov%C3%A1+zpr%C3%A1va+5.3.+2012+-+Potravin%C3%A1%C5%99sk%C3%A1+komora+je+znepokojena+%E2%80%9Esolnou+af%C3%A9rou%E2%80%9C+v+Polsku&id=32398

Foss K. (1996): Transaction costs and technological developments: the case of the Danish fruit and vegetable industry. Research Policy, *25*: 531–547.

Friedman D., Cassar A. (2004): Economics Lab: An Intensive Course in Experimental Economics. Routledge, London; ISBN 0-203-38738-4.

Friedman D., Sunder S. (1994): Experimental Methods: A Primer for Economists. Cambridge University Press, Cambridge; ISBN 0-521-45682-7.

Friedman M. (1966): The methodology of positive economics. In: Essays in Positive Economics. University of Chicago Press, Chicago; ISBN 978-0226264035.

Friedman M. (1953): Essays in Positive Economics. In: The Methodology of Positive Economics. University of Chicago Press, Chicago, pp. 3–43.

Gao Z., Schroeder T., Yu X. (2010): Consumer willingness-to-pay for cue attribute: the value beyond its own. Journal of International Food and Agribusiness Marketing, *22*: 108–124.

Golan E., Kuchler F., Mitchell L. (2001): Economics of Food Labelling. Journal of Consumer Policy, *24*: 117–184.

Grossman P.J., Komai M. (2006): Incentivizing Experiments: Monetary Rewards versus Extra Credits. Economics Faculty Working Papers. St. Cloud State University..

Grunert K.G. (2005): Food quality and safety: consumer perception and demand. European Review of Agricultural Economics, *32*: 369–391.

Harrison G.W., Lau M.I., Rutström E.E. (2007): Estimating risk attitudes in denmark – a field experiment. The Scandinavian Journal of Economics, *109*: 341–368.

Holt CH., Sherman R. (1990): Advertising and product quality in posted-offer experiments. Economic Inquiry, *28*: 39–56.

Holt CH., Sherman R. (1999): Classroom games: a market for lemons. Journal of Economic Perspectives, *13*: 205–214.

Horská E., Ürgeová J., Prokeinová R. (2011): Consumers' food choice and quality perception: comparative analysis of selected Central European countries. Agricultural Economics – Czech, *57*: 493–499.

Charness G., Villeval, M.C. (2007): Cooperation, Competition and Risk Attitudes: An Intergenerational Field and Laboratory Experiment. Discussion Paper Series,

Discussion Paper No. 2574. Institute for the Study of Labour, Bonn.

Li Y. (1991): Tests for a Reward Medium Effect on Experimental Outcomes. Discussion Paper 91-11. Department of Economics, University of Arizona, Tucson.

Lofgren K.G., Persson T., Weibull J.W. (2002): Markets with Asymmetric Information: The Contributions of George Akerlof, Michael Spence and Joseph Stiglitz. The Scandinavian Journal of Economics, *104*, 195-211.

Lynch M., Miller R., Plott CH.R., Porter R. (1986): Experimental Studies of Markets with Buyers Uncertainty of Quality before Purchase: When do "Lemons" Drive out High Quality Products? Federal Trade Commission, Washington D.C.

Miller R.M., Plott CH.R. (1985): Product quality signaling in experimental markets. Econometrica, *53*: 837–872.

Ministry of Agriculture of the Czech Republic, Czech Agriculture and Food Inspection Authority (2012): Food pillory project information. Available at http://www.potravinynapranyri.cz/info/en/docDetail.aspx?docid=1049856&docType=ART&nid=12065

Offer A. (2007): The mark-up for lemons: quality and uncertainty in American and British used-car markets c. 1953–73. Oxford Economic Papers, *59*: 38–48.

Raynaud E., Sauvee L., Valceschini E. (2005): Alignment between quality enforcement devices and governance structures in the agro-food vertical chains. Journal of Management and Governance, *9*: 47–77.

Sinha T. (1992): Are Older People More Risk Averse? School of Business Discussion Papers, Paper 32. Bond University, Gold Coast.

Smith V. (1976): Experimental economics: induced value theory. American Economic Review, *66*: 274–279.

Sultan A. (2006): Lemons in the used car market: an empirical investigation. Southwest Business and Economics Journal, *14*: 51–60.

Tsao H., Leyland F.P., Berthon P. (2006): An experimental study of brand signal quality of products in an asymmetric information environment. Omega – The International Journal of Management Science, *34*: 397–405.

Tsao H., Campbell C., Farshid M., Chakrabarti R. (2009): Lemon-Aid: Brand as a Signal for Quality – A Classroom Game. In: ANZMAC 2009 Proceedings [online]. Available at http://www.duplication.net.au/ANZMAC09/Papers.html (accessed 10-20-2013).

Wilson B.J., Zillante A. (2010): More information, more ripoffs: experiments with public and private information in markets with asymmetric information. Review of Industrial Organization, *36*: 1–16.

Wolf J.R., Myerscough M.A. (2007): Reputations in markets with asymmetric information: a classroom game. Journal of Economic Education, *38*: 393–405.

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