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Technical Barrier Effects of a Food Safety Measure – a Case of Finnish Salmonella Control Program

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Abstract— **In this paper, indirect costs of Finnish Salmonella Control Program (FSCP) due to its trade effects are evaluated. FSCP is a part of Finnish biosecurity policies intended to shield Finnish food supply and consumption chain from salmonella outbreaks. The program directly increases costs of importing by e.g. requiring costly certificates for imports. Additionally, it may cause anxiety to suppliers of imports as there are added uncertainties in the import process. As similar requirements apply to domestic suppliers, the program should not be thought of as a technical trade barrier (TBT), however, it may affect trade flows indirectly and effects may be assessed in a similar manner as those of TBT's. The evaluation of the trade effects is performed using a combined price wedge-gravity approach and they are quantified as tariff-equivalents. After determining the tariff equivalent, sensitivity results are provided as some of the parameter values used in the calculation are difficult to observe directly.**

Keywords— **International trade, biosecurity, welfare analysis**

I. INTRODUCTION

One of the main aims of EU is to guarantee free movement of goods and services in Europe. Such a process tends to equalize food safety practices as well as the level of food safety of different countries. In special cases, e.g. due to reasons of human health or animal welfare, there may be exceptions that allow member states to follow stricter rules and request special procedures for imports. Due to a concern that such a special food safety policy could cause similar effects as a technical trade barrier, it has been required that such policies have to be approved by the EU.

This was exactly the case when Finland joined into EU. One of the main concerns in Finland was how to maintain the exceptionally good level of food safety concerning e.g. salmonella prevalence in the country. The low level of salmonella infections in the Finnish food sector resulted from food safety work done already since 1960's. Those general efforts including certain specific measures already in place were desired to be continued when joining to the EU. As a result the Finnish Salmonella Control Program (later on FSCP or the program) was developed, and officially approved by the Commission in 1995. The program, supported by some complementary measures, aims to maintain low incidence of salmonella in the Finnish food sector also in the future years.

The question is whether protective effects of the program partly shield producers from import competition. The main purpose of this paper is to conceptualize potential trade effects accruing from FSCP and to illuminate practical significance of those effects by numerical calculations. Besides the trade effects themselves, the study extends the cost evaluation in general by providing a better understanding of the indirect costs of the program. The study results can also serve as assistance in the on-going WTO negotiations when discussing more generally about potential trade barrier effects of SPS regulations.

Measuring trade barrier effects is a particularly complex task as documented in Orden and Roberts (1997), and one framework suggested for the analysis is by Roberts et al. (2001). Beghin & Bureau have (2001) explored the issue further seeking methods to quantify the effects. Using definitions presented in Beghin & Bureau (2001), FSCP should not be called a non-tariff-barrier, NTB. However, it still may have certain trade effects and can be evaluated in those terms.

The trade effects of the FSCP have been earlier conceptualized by Peltola (2001) using a partial equilibrium model, categorized as "a risk-assessment-based cost-benefit measure" approach according to Beghin & Bureau (2001). The calculations in the study showed only non-significant trade effects from the program. However, the calculation of trade-effect was merely illustrative, and a more thorough analysis is called for. In the present analysis trading costs e.g. transportation and transaction costs of the FSCP are analyzed more carefully. Also, a strict homogeneity assumption of goods is relaxed, which allows imperfect substitution of domestic and imported goods to be accounted for.

The study follows an approach used by Yue et al. (2006) utilizing the newly developed method, a combination of the traditional price-wedge approach and a more recent gravity equation. Two other recent papers in the same genre applying gravity approach for evaluating the border effect are the studies by Olper & Raimondi (2005) and Chevassus-Lozza et al. (2005) assessing the significance of the OECD membership and European Union membership respectively as definitions of the market area.

The paper starts with the introduction. This is followed by a brief general discussion on evaluation of trade effects of SPS measures and then by presenting analytics used in the paper. Presentation of analytics includes description of price-wedge gravity method and brief summary of welfare analysis. Then current salmonella situation and the control program itself are briefly reviewed. Numerical simulations follow using the real market data. In the end, discussion and conclusions follow.

II. EVALUATION OF TRADE EFFECTS OF SPS MEASURES

Roberts et al. (2001) have suggested a framework for analyzing technical trade barriers. Beghin & Bureau (2001) explore the issue further seeking methods to quantify trade effects of TBT's and continue by presenting three different types of definitions for non-tariff-barriers, NTBs. The first one defines a measure to be an NTB if a governmental practice or devise impedes the entry of and discriminates against imports. The second type of definition emphasizes, that a policy should not be seen as a barrier if it has only an incidental effect on trade and whose principal objective is to correct market inefficiencies. Such definitions may be "tested" by evaluating whether the welfare effects of the policies are positive. A third way to define NTBs is to evaluate whether the measure would have been different was it made for domestic purposes alone.

In a policy evaluation net benefits of the policies have to be calculated and these net benefits have to be compared to a situation without the policy. Risks and uncertainties associated with such policies tend to make analysis of biosecurity policies more complicated than standard economic policy analysis (MacLaren, 1997). Finnish Salmonella Control Program, as well as other food safety programs and similarly quarantine programs widely used e.g. in Australia (Tanner, 1997; Tanner & Nunn, 1998) require additional control and screening of foodstuffs.

Well-designed food safety programs can provide essential protection to consumers and are thus justified in principle. However, in the same time programs may hinder trade and directly work against free movement of goods and services, and can thus act as TBT's. James and Anderson (1998) quoting Corden (1974, p. 28) emphasize, how in case of distortion, the appropriate correction should be made as close as possible to the point of the problem. In case of imports with potential negative by-products (microbes, animal/plant diseases), the optimal policy is thus not an outright ban of imports, but rather an adoption of measures to reduce the risk of disease importation or the damage if it is imported e.g., required quarantine and/or required pre-shipment inspections. This is exactly the case with the FSCP.

This paper analyzes the trade-effects of the FSCP using a combination of price-wedge and gravity approaches accounting for trading costs and potential imperfect substitution of domestic and imported

goods. As such, the paper follows an approach used by Yue et al. (2006) and Anderson and van Wincoop (2004) and Head and Mayer (2002). In this manner, border measures of trade barriers and transportation costs between trade partners can be better measured and decomposed. Similarly, a strict homogeneity assumption of goods can be relaxed. In case of gravity equation, we use the simple constant elasticity of substitution (CES) model to account for the heterogeneity of goods in consumers´ preferences (Yue et al. 2006). The consumer utility maximization problem is

$$\text{Max } U(D,I) = (\alpha D^{\rho} + (1-\alpha) I^{\rho})^{1/\rho} \qquad (1)$$

$$\text{s.t. } p_D D + p_I I = M\,, \qquad (2)$$

where domestic and imported goods are D and I, respectively. Their prices are marked by p_D and p_I, which are a market clearing equilibrium price for the domestic good, and an exogenous world price for the imported good. M denotes income, and consumer preferences are represented by α (domestic goods preferred when α > ½). The elasticity of substitution is represented by σ, where $\sigma = 1/(1-\rho)$. Furthermore, the associated Marshallian demand functions are

$$D(p_D, p_I, M) = \left(\frac{\alpha}{p_D}\right)^{\sigma} \frac{M}{\alpha^{\sigma} p_D^{1-\sigma} + (1-\alpha)^{\sigma} p_I^{1-\sigma}} \qquad (3)$$

and

$$I(p_D, p_I, M) = \left(\frac{1-\alpha}{p_I}\right)^{\sigma} \frac{M}{\alpha^{\sigma} p_D^{1-\sigma} + (1-\alpha)^{\sigma} p_I^{1-\sigma}} \qquad (4)$$

.

The subsequent indirect utility function is

$$V(p_D, p_I, M) = M\left(\alpha^{\sigma} p_D^{1-\sigma} + (1-\alpha)^{\sigma} p_I^{1-\sigma}\right)^{\frac{1}{\sigma-1}}, \qquad (5)$$

and the corresponding expenditure function is

$$e(p_D, p_I, u) = u\left(\alpha^{\sigma} p_D^{1-\sigma} + (1-\alpha)^{\sigma} p_I^{1-\sigma}\right)^{\frac{1}{\sigma-1}}. \qquad (6)$$

The importing price, p_I, can be decomposed as $p_I = p_{CIF}(1 + t + t_{TBT}) + t_R$, where p_{CIF} is the observed CIF price of I (including insurance and freight, etc.), t is the tariff rate, t_{TBT} is the tariff equivalent of the TBT or SPS measure, and t_R is the per-unit transportation and transaction cost from the harbour to the wholesale internal market. The CIF price can be further decomposed into an export price from originating country and an international transportation component.

Now from the utility maximization we know that the marginal rate of substitution equals to the relative price of the substitute goods or

$$MRS = \frac{MU_D}{MU_I} = \frac{p_D}{p_I} = \frac{p_D}{p_{CIF}(1 + t + t_{TBT}) + t_R}, \qquad (7)$$

where MRS is the marginal rate of substitution, and MU_j indicated the marginal utility of good j. This can be used for solving the t_{TBT} by first deriving the MRS from the objective function and then substituting that into the MRS function. The equivalence between the price-wedge measure t_{TBT} and the TBT holds D/I constant. The ad valorem tariff equivalent is a function of the relative cost of the two goods, their volumes, the elasticity of substitution, the preference parameter, internal transaction and transportation cost, and ad valorem border tariff:

$$t_{TBT} = \frac{p_D}{P_{CIF}} \frac{(1-\alpha)}{\alpha} \left(\frac{D}{I}\right)^{\frac{1}{\sigma}} - 1 - t - \frac{t_R}{p_{CIF}}. \qquad (8)$$

According to Yue et al. (2006) if goods D and I are known to be poor substitutes (presumption of small σ), the TBT estimate will be very sensitive to the value of σ and parameter and to chosen reference prices and quantities. However, if goods D and I are known to be very close substitutes, the tariff estimate of the TBT will be much less sensitive to pinning down the exact elasticity of substitution, and to reference data volumes D and I. Sensitivity to chosen reference prices and reference parameter will still be important and larger than 1 in absolute value. Sensitivity to changes in internal transportation or transactions costs and the tariff rate will depend on their initial values and could be large for protected and poorly integrated sectors.

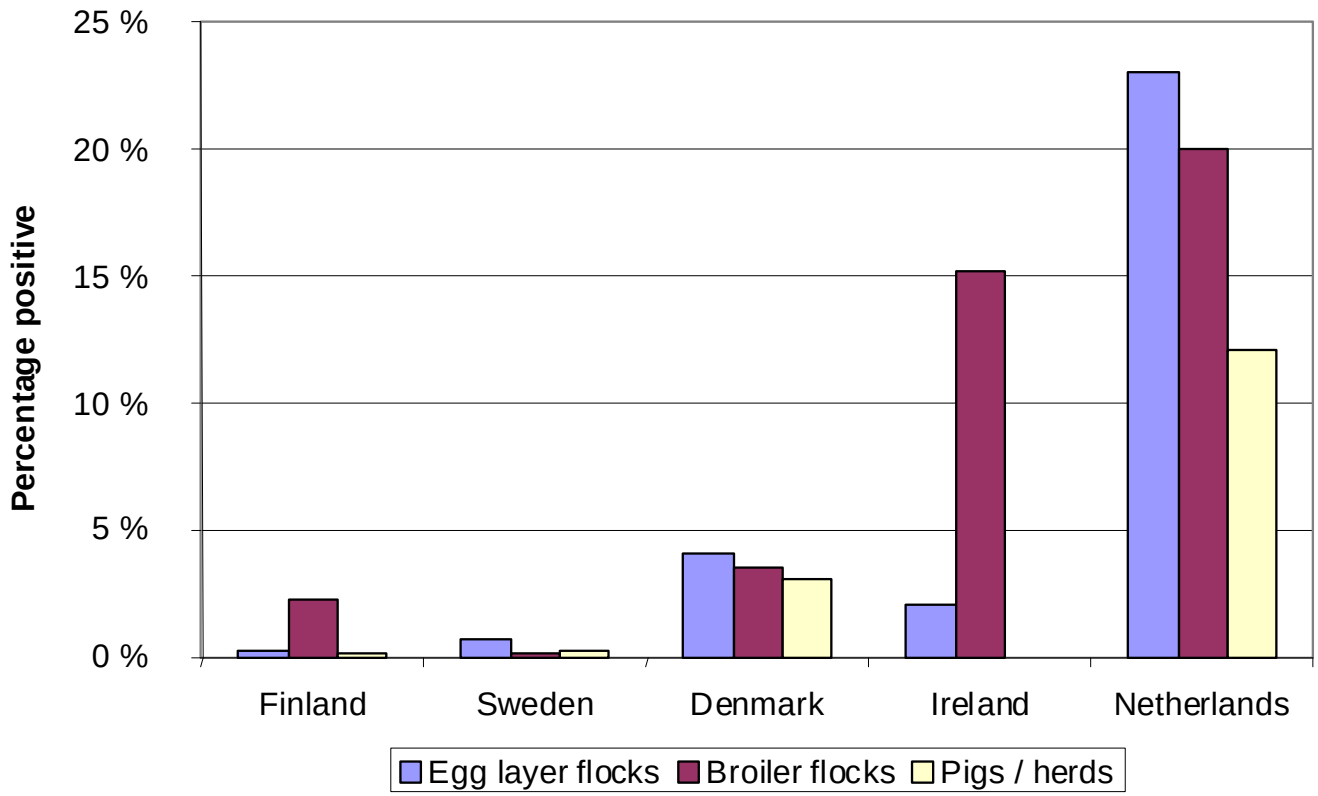

Fig. 1 Positive Salmonella occurrencies in some EU member states

III. FINNISH SALMONELLA CONTROL PROGRAM AND THE REASONING

Before the EU-membership, tight border control based on quotas and tariffs ensured practically all the main foodstuffs to be domestically produced in Finland. Resulting from tight domestic production control and negligible imports, the salmonella situation was good when Finland joined the EU. The Finnish Salmonella Control Program (FSCP) aims to maintain the good situation covering all main animal production lines: pork, beef, poultry, and also the products thereof e.g. meat and eggs. A same type of program can only be found in Sweden and Norway. The programs were granted due to the very exceptionally good salmonella situation in these countries (MMMEEO, 1999). Figure 1. illustrates the Salmonella situation in few EU member states

Based on the FSCP, Finland may 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. Only some raw materials entering to processing plants and being used as inputs in products undergoing heat treatment are freed from this rule (MMMEEO, 1999). Foodstuffs of animal origin delivered 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. 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.

IV. EMPIRICAL ESTIMATES OF TBT EFFECT

Evaluation of potential trade effects of the program is the main aim of this study. The data needed for the analysis were collected from various sources. Volume and value data on Finnish imports of beef, pork and broiler over the period 2001-2003 are obtained from Eurostat Comext database. The analysis uses an 8-digit product-level data based on the Harmonized System (HS) Trade Classification[1]. Volume data is compiled in metric tons, and value data in thousands of euros. The value used here is the value at which goods were sold by the exporter including the cost of transportation and insurance, and freight to the frontier of the importing country (c.i.f. valuation).

The domestic prices and quantities and the retail margins for meat products are based on the marketing margins calculated at the MTT Agrifood Research Finland (Mäkelä and Niemi 2004). Marketing margins by MTT indicate the share of the retail price going to each sector along the supply chain: farmer, processing and retail trade as well as government taxes. The retail margins computed for beef and pork are simply the difference between a retail price and a retail-equivalent wholesale value. In 2002 the retail margins for beef and pork were 27% and 33%, respectively (Mäkelä and Niemi, 2004). In case of broiler the retail margin of pork is used in the calculations that follow.

Availability of parameters for consumer preference for domestic/foreign goods, α, and for the elasticity of substitution, σ, are more difficult to come up with. Therefore, after calculation of tariff equivalents, a sensitivity analysis is made for those parameters. For a transportation and transaction cost, t-R, measuring border effect, a conservative amount of 10% is used. For instance, Anderson & van Wincoop (2004) and Yue et al. (2006) have used a median estimate of 55%.

V. WELFARE EFFECTS

Welfare analysis was conducted by constructing four different scenarios. In the first one the program does not affect the demand, and the rest assign different demand responses towards abolishment of the program. Scenarios 2 and 3 predict 1% and 3%

[1] For the purpose of this study, the product headings are aggregated as follows: beef (HS 0201, 0202), pork (HS 0203) and broiler (HS 02071). Beef, pork and broiler imports come partly from the EU and partly from outside of the EU (75%-25%, 99.8%-0.2%, 50%-50% respectively). The prices used are weighted accordingly.

1.

decrease in demand, respectively. The last scenario has drastic 10% drop in demand to illustrate a sudden disease outbreak. Furthermore, if the program has some effects in domestic markets, the more justified it is to assume that demand also responds to it. Overall welfare effect is further divided to consumer and producer surpluses. Determination of welfare effects are depicted in figure 2. Here the welfare loss in the first scenario is traditional deadweight loss presented by lighter gray and black areas combined. In scenarios where demand responds to the program, darker gray and black areas combined present the increase in welfare that program causes. Thus the overall welfare in these latter scenarios is left ambiguous because it depends on the difference between lighter and darker gray areas.

The amounts in the following tables present welfare increases that would result from increased trade due to prorgram abolishment. It should be noted that any welfare effects for producers or consumers in domestic markets are not taken into consideration. Relevant reference study for domestic effects is cost-benefit analysis by Maijala and Peltola (2000) and some comparison for these results could be done in later studies. Corresponding demand and supply elasticity values used in simulation were literature estimates: -0.23 and 0.25 for beef, -0.3 and 0.15 for pork, and -0.25 and 0.5 for broiler.

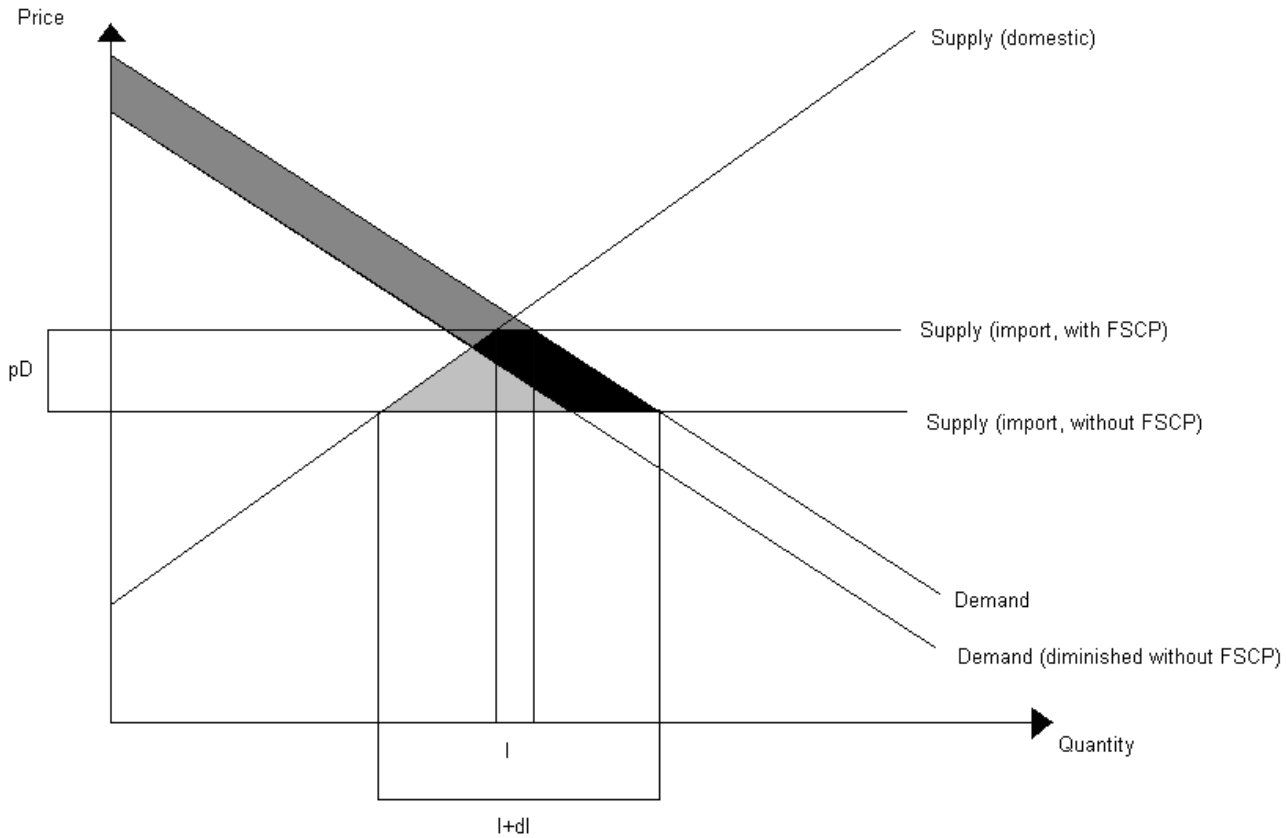

Fig. 2 Determination of welfare loss when demand is affected by FSCP

In table 1, the overall effects of the whole meat sector are presented for the average parameter values. Negative values in table present the occasions where the abolishment of the program would cause welfare losses. Already in the case where demand response is only 1%, there are some years for which the abolishment of the program would have caused welfare losses. In the drastic scenario, losses are already notable. Still it is interesting to note that the effects are almost completely detrimental for consumers when only few extreme cases are not considered. The effects for separate meat products do not have great differences other than broiler being more stable through the years. The results that were not meaningful from theoretical point of view (e.g. negative tariff rate) were omitted and are denoted in tables with asterisks. More detailed results are available upon request.

Results of the sensitivity analysis for the overall welfare effects with different parameter values in year 2005 is presented in table 2. As we can see results are relatively sensitive already with small changes in parameter values.

Table 1 Overall welfare effects for the meat sector

Overall welfare loss (mill. €)

	Total 0%	PS 0%	CS 0%	Total 1%	PS 1%	CS 1%
2000	*	*	*	*	*	*
2001	14.8	-135.8	150.5	-15.1	-135.8	120.7
2002	64.3	-436.9	501.1	31.5	-436.9	468.3
2003	85.2	-555.0	640.2	51.5	-555.0	606.5
2004	30.8	-271.3	302.1	-0.4	-271.3	270.8
2005	25.1	-232.3	257.4	-5.7	-232.3	226.5

	Total 3%	PS 3%	CS 3%	Total 10%	PS 10%	CS 10%
2000	*	*	*	*	*	*
2001	-73.9	-135.8	61.9	-270.3	-135.8	-134.5
2002	-33.1	-436.9	403.8	-248.7	-436.9	188.1
2003	-14.7	-555.0	540.3	-236.0	-555.0	319.0
2004	-61.9	-271.3	209.3	-267.3	-271.3	4.0
2005	-66.5	-232.3	165.8	-269.4	-232.3	-37.1

Table 2 Sensitivity analysis for welfare effects

Total welfare losses (mill. €)

alfa	0.5	0.5	0.5	0.55	0.55	0.55	0.6	0.6	0.6
sigma	lo	ave	hi	lo	ave	hi	lo	ave	hi
0 %	301.4	165.2	101.0	82.7	25.1	*	*	*	*
1 %	260.8	128.7	66.8	48.8	-5.7	*	*	*	*
3 %	180.9	56.6	-0.7	-17.8	-66.5	*	*	*	*
10 %	-86.1	-183.9	-225.9	-240.4	-269.4	*	*	*	*

VI. DISCUSSION

In this study, trade effects of the Finnish Salmonella Control Program were evaluated using a combined price wedge – gravity approach. The study is basically a simulation producing estimates of tariff equivalents for the FSCP in case of beef, pork and broiler trade. The study shows, that given perfectly legitimate parameter values for preferences and conservative estimates for internal transportation and transaction costs, the barrier effect appears realistic and reacts in a plausible way to changes in main parameters. These estimates for tariff equivalents were used in welfare analysis, in which the benefits of the program were evaluated.

As a mechanism, the price wedge – gravity approach appears somewhat similar as the traditional approaches relying on differences in domestic and import prices. However, it is a step forward as it allows a better calculation of trading costs and as it allows heterogeneity in preferences. However, when applying the mechanism, the lack of data may cause trouble and one may need to rely on simulations as was the case also in this analysis.

The welfare analysis delivered mixed results: the program clearly distorts trade when demand does not respond to program. With moderate demand response, it becomes hard to say whether effects are positive or negative. Furthermore, the results of welfare analysis are quite sensitive for changes in parameter values.

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