The BSE crisis and the reaction of Norwegian consumers

Geir W. GUSTAVSEN

Cahiers d'économie et sociologie rurales, n° 50, 1999

Geir W. GUSTAVSEN*

L'effet de l'ESB sur la demande de viande bovine en Norvège

Résumé — L'éventuelle existence d'une relation entre la maladie de la vache folle et la maladie de Creutzfeldt-Jakob a sérieusement entamé la confiance du consommateur quant à la garantie sanitaire de la viande bovine dans la plupart des pays européens en 1996.
L'industrie norvégienne de la viande bovine n'a pas été exposée à l'ESB et, compte tenu des importations limitées, le risque de contamination y est relativement faible.
Cependant, en raison d'une demande croissante de viande bovine, des prix à la baisse et d'une production constante, les importations ont eu tendance à augmenter au cours des dernières années. Ce changement, conjugué aux informations diffusées par les médias à propos de l'ESB, pourrait affecter la consommation norvégienne de viande de bœuf.
Trois façons d'examiner si l'information médiatique concernant l'ESB en 1996 a eu un effet sur la demande de viande bovine en Norvège sont ici présentées. Un modèle à correction d'erreur pour la demande de viande de boeuf est estimé à partir de données quadrimestrielles, de 1984 à 1995. Il est utilisé pour prévoir la demande de viande bovine pour chacune des 3 périodes de 4 mois de 1996. Les écarts constatés entre les prévisions et les ventes enregistrées au cours de chaque période se situent dans l'intervalle attendu.
Le modèle est ensuite réestimé sur toute la période, 1996 inclus.
Un test prédictif de Chow est utilisé pour tester l'hypothèse de stabilité du modèle lorsque les nouvelles observations sont prises en compte : celle-ci n'est pas rejetée. Enfin, une variable muette est incluse dans le modèle pour tester la présence de changements dans l'élasticité-prix directe et l'élasticité-dépense. Là-encore, le test de stabilité n'est pas rejeté. Ainsi, ni le modèle de prédiction, ni le test de Chow, ni le test basé sur la variable muette n'indiquent que les informations diffusées par les médias concernant la relation ESB/maladie de Creutzfeld-Jacob aient suscité une perte de confiance chez le consommateur en 1996.

Mots-clés :
viande bovine, ESB, économétrie, Norvège

The BSE crisis and the reaction of Norwegian consumers

Summary *— A forecast model examined the influence of the BSE crisis in 1996 on Norwegian consumers' beef demand pattern. The Norwegian beef industry has not been exposed to the BSE and due to restricted imports the risk of eating BSE contaminated meat is relatively small in Norway. However, due to increased demand for beef together with lower prices and constant production the beef imports have increased in recent years. Together with information in the media about BSE this change might have affected the Norwegian beef consumption. An error correction model is used to predict the demand for beef. The predictions for 1996 together with a Chow predictive test and a dummy variable test do not indicate that the BSE crises affected beef consumption in Norway. Changes in real prices of beef and other meats and in consumption expenditure were found to explain changes in beef consumption.*

Key-words:
beef demand, BSE, econometrics, Norway

* *Norwegian Agricultural Economics Research Institute, Box 8024 Dep, 0030 Oslo, Norway.*
e-mail: geir.gustavsen@nilf.no

The author thanks Maury Bredahl, Anne M. Jervell, Ann-Christin Sørensen, the editor of the journal, and two anonymous referees for useful comments. Any remaining errors or omissions are the sole responsibility of the author.

CONCERN over a possible link between the mad cow disease and Creutzfeldt-Jakob disease led to a significant loss in consumer confidence in the safety of beef throughout much of Europe in 1996. The Norwegian beef industry has not been exposed to the BSE syndrome, and due to the restricted import the risk of eating BSE contaminated meat is relatively small in Norway. (However, due to increased demand for beef together with lower prices, increased income among the consumers and nearly constant production, the import has increased.)

When the BSE crises in the UK became a media event in Norway in March 1996, the Norwegian government and the Norwegian meat Co-operative quickly informed consumers that Norway did not import beef from the UK or other countries in which the beef might be contaminated by BSE. Beef has not been imported from the UK since about 1980. In 1992 when the only importer of meat was the meat Co-operative, they made a decision not to import beef from the UK because of the problem with the BSE. The Co-operative feared the consumers' reactions if they should sell contaminated meat. Even if the illness was at that time not thought to affect human beings, the sale of British meat in Norway could affect the confidence in Norwegian beef. In the supermarkets and the restaurants you can not tell the origin of the meat. Before 1995 the main import of beef came from the other Scandinavian countries. In 1995 the import regime was changed due to the WTO agreement. After this year Botswana was the biggest exporter of beef to Norway. The total import of beef was about 1000 tons per year in the years from 1987 to 1994. In 1995 the import increased to about 3000 tons and in 1996 it was 5000 tons.

Together with the information in the media about BSE this change might have affected the Norwegian meat consumption. Nearly every day in the beginning of 1996 the newspapers and the television showed photos of contaminated animals in the UK and this may have impacted upon the consumers. In spite of the insistence of the Norwegian industry that the beef in Norway was safe, consumers might have been afraid that the meat might have been imported from a high risk area or smuggled into the country.

The effects of the BSE crises on beef consumption patterns have not been widely analysed in the litterature. Burton and Young (1996 and 1997) estimated systems of meat demand equations. To measure the impact of the media coverage of BSE on meat demand in UK they incorporated a media index based on the number of UK newspaper articles which referred to BSE. Their conclusion is that the media information of BSE reduced the budget share of beef both in the short and the long run. Latouche *et al.*, (1998) conducted a survey in Rennes (France) to analyse consumer behaviour towards meat after the BSE crises: Measuring

the willingness to pay they concluded that there is a growing demand for safe products. Hadjikani and Seyed-Mohammad (1997) conducted surveys to show how the media coverage of the BSE crises affected Swedish consumers. They made one survey in May 1996 and another in August-September 1996, when the intensity and magnitude of the media coverage were less. Their results indicate more mistrust towards meat with origin close to England. The mistrust was against other English products as well as meat. When the media coverage dropped, the mistrust against English products dropped too. A Swiss study (Morabia *et al.*, 1999) concluded that the Geneva women changed their dietary habits from beef towards chicken in 1996.

In this paper three methods of capturing the effects of BSE on the aggregate demand for beef in Norway are used. A forecast model which is estimated with data from 1984 to 1995 is used to make forecasts for beef sale in 1996. The forecasts are discussed and the results are compared with the recorded sale in that period. The second method is using a Chow predictive test to test if inclusion of the data for 1996 in the model make the parameters unstable. The third method consists in including a dummy variable to check if the own price elasticity, the expenditure elasticity and a trend term has changed in 1996. Neither of the tests indicates that the information concerning the BSE in the media in 1996 had any effect on the Norwegian beef demand pattern.

The paper proceeds as follows. First the data is described and the error correction model used for forecasting the beef demand is presented. Then the model is utilised for demand forecasts for beef and these results are discussed. After that, the Chow test and the dummy variable tests are performed and discussed. Finally, the reasons why the Norwegian consumers' beef consumption was not affected by the BSE scandal are discussed.

Model and data

A prediction model has been used to examine the influence of the BSE crisis in 1996 on Norwegian consumers demand pattern. An error correction framework is used to construct a simple demand model for beef which takes account of seasonal variations. Four-monthly wholesale data for the period 1984 to 1995 was used in the estimation of the prediction model. The forecast model is estimated on the basis of four-month periods (instead of quarterly periods which is more common) to capture the structure of the Norwegian meat demand. Easter, when the demand for pork shifts upwards due to eating traditions, is always in the first four-month period, and summer, which is barbecue season, is treated in the second four-month period. The prices and the households'

consumption expenditure are shown in figure 1. The development of the sales of beef, pork and lamb are shown in figure 2.

The meat prices (deflated with the consumer price index) were relatively stable from 1984 to 1992. After that they started to decline. The price of beef was 15.2 percent lower in 1995 than in 1992. The price of pork was 22.9 percent lower and the price of lamb was down 13.3 percent. The downward trend in the meat prices from 1992 was politically decided. In Norway the maximum wholesale prices are decided in yearly negotiations between the farmers organisations and the government. To prepare for increasing international competition for foodstuff and a possibly new GATT/WTO agreement the government decided in 1991 that the Norwegian food prices had to be reduced.

Recession hit Norway in 1986 and private real expenditure of the households started to fall in that year. It did not catch up to pre-recession level until 1993. The sale of beef started to rise in 1993 due to the lower prices and increased income among the consumers. The sale of beef was 11.5 percent higher in 1995 than in 1992.

Figure 1.
Real prices of beef, pork, and lamb, and the households' consumption expenditure (1984.1=1)

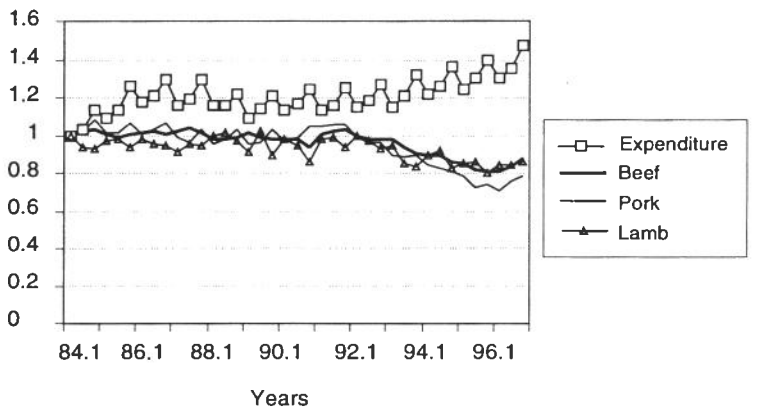
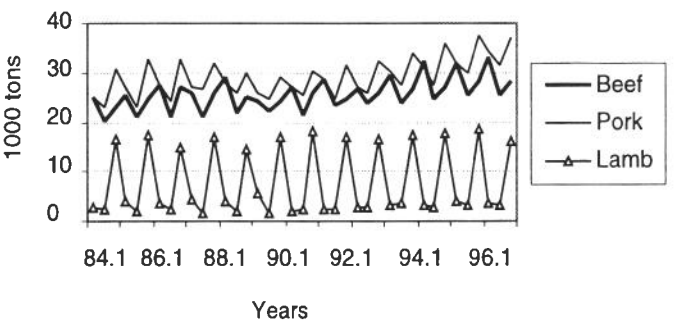


Figure 2.
Sales of beef, pork, and lamb



Error correction models are widely used in applied econometrics. The work of Davidson *et al.* (1978) to model aggregate consumption in the UK has had important influence on time series econometrics. To take account of seasonality they used seasonally differenced variables and they included an error correction mechanism in their model to correct for the deviation from the long run equilibrium. Their work contributed to development of cointegration analysis and the relation between cointegration and error correction models. These models are extensively described in Banerjee *et al.* (1993). The use of seasonal integration and tests for seasonal cointegration are described in Charemza and Deadman (1992).

The following error correction model is utilised to forecast the future beef demand in Norway (with *t*-values below the parameters):

$$\widehat{\Delta_3 x_{1t}} = \underset{(-2,86)}{-0,74}\,\Delta_3 p_{1t} + \underset{(0,94)}{0,17}\,\Delta_3 p_{2t} + \underset{(0,65)}{0,17}\,\Delta_3 p_{3t} \cdot D_{3t}$$

$$+ \underset{(3,30)}{0,62}\,\Delta_3 \exp_t - \underset{(-4,45)}{0,81}\,[x_{1,t-3} - 7,95 - 0,16\,D_{1,t-3}$$

$$+ 0,08\,D_{2,t-3} + 0,39\,p_{1,t-3} - 0,76\,\exp_{t-3}]$$

where:

Δ_3 = the third difference operator (the difference of the variable between this period and the same period one year ago),

x_{1t} is the natural logarithm of the sale of beef (in tons) in period t,

p_{1t}, p_{2t}, p_{3t} are the natural logarithms of the prices of beef, pork and lamb respectively in period t,

exp_t is the natural logarithm of the total private expenditure of the Norwegian households,

and D_1, D_2 and D_3 are dummy variables for the three four-month periods. The prices and the total expenditure are deflated by the consumer price index. The seasonal dummy D_{3t} appears with the price of lamb because lamb is mainly consumed in the slaughtering season which takes place in the autumn. In the first and the second season there is not fresh lamb available.

The equation was estimated by the Engle-Granger (1987) two-step procedure: First the static long run equation (in brackets) was estimated using the method of ordinary least squares (OLS). Dickey-Fuller tests on the residuals rejected the null hypotheses of unit roots, hence they indicated that the variables were cointegrated in season. The residuals were lagged three periods and put into the model. This equation was then estimated by OLS. The purpose of modelling the first static equation with fewer explanatory variables than the equation was to estimate on only stationary variables. Dickey-Fuller tests performed on the residuals of the long run equation rejected the null hypotheses of stationarity

when the prices of lamb and pork were included. Table 1 shows the statistics from the estimation.

Table 1. Test statistics for the error correction model for beef demand

$\%MAE$	R^2_{adj}	DW	Q	Q^*	λ
3.2	0.56	1.94	12.02	16.97	4.79

Critical values (5 % significance level):
DW: $d_L = 1.16$, $d_U = 1.80$ $\quad Q, Q^*$: $\chi^2\,(15) = 25.0$ $\quad \lambda$: $\chi^2\,(5) = 11.07$

The percentage mean absolute error ($\%MAE$) is the mean difference (in percent) between the actual and the predicted value of the sale in a static simulation (one-period forecasts) on the data from 1984 to 1995. R^2_{adj} is R^2 adjusted for degrees of freedom and DW is the Durbin-Watson statistic. The Box-Pierce statistic Q and the Box-Ljung statistic Q^* can be used to test for autocorrelation for a given order. The null hypotheses of no autocorrelation is rejected if $Q, Q^* > \chi^2\,(m)$, where m is the number of lags the residuals are tested for. λ is the test statistic for the Breusch-Pagan test for heteroscedastisity. The null hypotheses about homoscedastic error terms is rejected on a 5 %-level if $\lambda > \chi^2\,(n-1)$. n is the number of parameters in a regression of normalised residuals on possible heteroskedastic terms.

From the error correction model we can see that the own price elasticity, the expenditure elasticity and the error correction term are all significantly different from zero and they all have the expected sign. An own price elasticity of -0.74 and an expenditure elasticity of 0.62 seem reasonable. The cross-price elasticities between pork and beef and between lamb and beef are not significantly different from zero. But these are kept in the prediction model because we have reasons to suppose that the prices of pork and lamb contribute to explaining changes in the demand for beef.

Table 1 shows that a static simulation on the data from 1984 to 1995 gave a mean difference between the actual and the predicted values of the sale of beef of 3.2 percent. DW, Q and Q^* all indicate that autocorrelation is not a problem in the equation for beef. The Breusch-Pagan test did not reject the null hypothesis of homoscedastisity.

The model predictions for 1996

The model has been implemented in the programming language Visual Basic to give predictions for future beef demand in Norway. The users of the program have to give the prices of beef, pork and lamb as input to the model in the prediction period. The model also demands the consumer price index and private consumption for the same period. The maximum prices of beef, pork and lamb in Norway are decided by yearly negotiations between the government and the farmers' organisations. The Norwegian Meat Co-operative which regulates the market for

meat has a market share of about 80 percent. According to the market conditions they decide the price levels below the maximum prices. Hence, endogenity of the prices is no problem in the demand model.

Table 2 shows the input data to the model and the results from the model prediction of beef sale in 1996. As input data are used the recorded prices and the total private expenditure in 1996 (both deflated with the consumer price index). The table shows the real prices for the three four-month periods of the year and the growth in the variables from the same period last year. The same is shown for the aggregate private expenditure in 1996. The model forecasts for beef and the recorded beef sale follow. At the bottom of the table the level and the percentage differences between the predicted and recorded sale (error) is reported.

Table 2. **Real prices of beef, pork and lamb, total expenditure, forecasted and recorded beef sale and the difference between the forecasts and recorded sale**

	1. period 1996		2. period 1996		3. period 1996		The year 1996	
	Level	Δ %	Level	Δ %	Level	Δ %	Level	Δ %
Price beef	34.8	-4.0	35.8	2.1	37.5	8.1	36.0	1.7
Price pork	26.7	-8.3	28.3	4.8	29.4	6.3	28.2	0.8
Price lamb	39.9	-0.3	39.6	-1.7	40.6	8.2	40.4	5.5
Expenditure	128.7	4.9	134.2	3.9	145.5	5.2	408.4	4.7
Forecasted beef sale	32.8	3.3	26.3	3.7	29.5	4.5	88.5	3.8
Recorded beef sale	33.2	4.7	25.3	-0.1	28.9	2.6	87.4	2.6
Error	-0.4	-1.3	1.0	3.8	0.5	1.9	1.1	1.2

The prices in level are in NOK/kg, total expenditure of the households are in billions of NOK. The forecasted and recorded sales are in 1000 tons. Δ% is the growth in prices, expenditure and sale from the same period the year before. The error term is the difference between the forecasted and recorded sale (in 1000 tons and %).

The model forecasted that the sale of beef would grow 3.3 percent in the first period of 1996, 3.7 percent in the second period and 4.5 percent in the third period. This would give an increased 3.8 percent in 1996 compared to 1995. The recorded sales grew 4.7 percent in the first period, declined 0.1 in the second period and grew 2.6 percent in the third period. This is a difference between the predicted and recorded sale of – 1.3 percent, 3.8 percent and 1.9 percent. In sum the sale of beef increased by 2.6 percent in 1996. In total for 1996 the error was 1.2 percent. From the table we can see that the real price for beef increased in 1996. This price increase contributed to a negative effect on the sale. The increased prices of pork and lamb (in the third period) gave the opposite effect on beef. The increased total expenditure among the households contributed to a higher level in the beef sale of 1996. In the forecast model the partial effects of the changed value of the variables on the change in the sale of beef is approximately given by:

(% change in sale of beef) =
*(elasticity of variable on sale of beef) * (% change in explaining variable)*

Table 3 gives the approximate partial effects of the prices, consumption and the error correction term on the forecasts of the sale of beef in 1996. From the table we can see that the decline in the price of beef in the first period contributes with 3 percent increased sale in the model prediction. The price of pork has a downward effect of 1.5 percent, private consumption gives an upward shift in the model prediction of 2.9 percent and the error correction term gives the prediction a partial downward shift of 1 percent. The negative error correction contribution in the first period of 1996 is due to the sale in the first period of 1995 which was below the long run path. In the second period the error correction term shifts the prediction 2,0 percent and in the third period the partial effect of the error correction mechanism is 4,9 percent. In the last period this effect contributes to dampen the large negative effect of the own price of beef.

Table 3. The partial effects on the forecasts of the changes in the prices of beef, pork and lamb and the effects of the households' real expenditure and the error correction mechanism (in %)

	Price beef	Price pork	Price lamb	Expenditure	Error correction
1. period 1996	3.0	-1.5	0	2.9	-1.0
2. period 1996	-1.5	0.8	0	2.3	2.0
3. period 1996	-5.6	1.1	1.0	3.0	4.9

The difference between the model predictions and the recorded sale is relatively small in the three periods in 1996. The model predicted a higher demand than recorded in the last two periods. This can lead us to believe that all the information about the BSE and the Creutzfeldt-Jakob Disease in the two last periods in 1996 had effect on the consumption of beef after all. But as table 1 shows, the mean percentage error in the estimating period was 3.2 percent. A model predicting a sale of 3.8 and 1.9 percent more than the recorded sale is within the expected range. Part of the over prediction in the last two periods was caused by the error correction term which had a very large effect, especially in the third period.

The tests for BSE

The Chow prediction test can be used to check the stability of the regression coefficients. We want to check if the inclusion of the observations in 1996 bring instability to the model. To perform this test we have to estimate the regression model to the data set 1984 to 1996. Then we estimate the model to the data set 1984 to 1995.

The test statistic

$$F = \frac{(RSS - RSS_1)/n_2}{RSS_1 / (n_1 - k - 1)}$$

has an F-distribution with d.f. n_2 and n_{1-k-1} where:

n_1 = the number of observations from 1984 to 1995 (= 33 observations),

n_2 = the number of observations in 1996 (= 3 observations),

k = the number of explaining variables,

RSS = the residual sum of squares from the regression based on $n_1 + n_2$ observations,

RSS_1 = the residual sum of squares from the regression based on n_1 observations.

The F-statistic was calculated to $F = 0{,}24$. From the F-tables with d.f. 3 and 27 we find that the 5 % point is approximately 2,95. Thus at the 5 % level of significance, we do not reject the hypothesis of stability.

An F-test with dummy variables was used to check if data indicates any change in the own price and expenditure elasticity of beef in 1996 and if a negative shift in demand for beef happened that year. A dummy variable, *Dum*, which has the value 0 in the period 1984 to 1995 and the value 1 in the three periods in 1996 was introduced[1].

The terms

$\beta_0 \,.\, Dum,$

$\beta_1 \, \Delta_3 \, p_{1t} \,.\, Dum,$

$\beta_4 \, \Delta_3 \, \exp_t \,.\, Dum$

were added to the error correction model and the model is then:

$$\Delta_3 x_{1t} = \beta_0 \,.\, Dum + (\alpha_1 + \beta_1 \,.\, Dum)\, \Delta_3 p_{1t} + \alpha_2 \, \Delta_3 p_{2t} + \alpha_3 \, \Delta_3 p_{3t}$$
$$\,.\, D_{3t} + (\alpha_4 + \beta_4 \,.\, Dum)\, \Delta_3 \exp_t + \alpha_5 \left[x_{1,t-3} - \varphi_1 - \varphi_2 D_{1,t-3} \right.$$
$$\left. - \varphi_3 D_{2,t-3} - \varphi_4 p_{1,t-3} - \varphi_5 \exp_{t-3} \right] + u_t$$

where the α's are the price elasticities, the expenditure elasticity and the error correction parameter. The φ's are the parameters from the cointegration/long run regression (The cointegration regression, in brackets, is performed on the same observations as the cointegration regression in the forecast model. The long run parameters in the two models therefore have the same values). β_0 is a stochastic trend, β_1 is the change in the price elasticity for beef and β_4 is the change in the expenditure elasticity for beef. u_t is a supposed white noise error term. To test if the own

[1] To capture any possible BSE effect on beef demand it was also tried to set the dummy variable as:

a) 1 in the first and the second period in 1996 and 0 elsewhere

b) 1 in the second and third period in 1996 and 0 elsewhere

The results from the test with these values on the dummy variable did not alter the conclusions from the tests.

price elasticity and the expenditure elasticity for beef have changed in 1996, the new model was first estimated with data from 1984 to 1996 with the restrictions imposed. Then the new model without the restrictions $\beta_0 = \beta_1 = \beta_4 = 0$ imposed is estimated.

An F-statistic may bee used to test simultaneously if the elasticities or the constant term have changed in 1996:

$$F = \frac{(RSS_1 - RSS_2)/k}{RSS_2 / (n - k - 1)}$$

where:

RSS_1 = the residual sum of squares of the model with restrictions,

RSS_2 = the residual sum of squares of the model without the restrictions,

n is the number of observations from 1984 to 1996 (= 36),

and k is the number of new parameters (= 3).

A t-test showed that none of the dummy parameters were significantly different from zero. The F-statistic was calculated to $F = 0.13$. From the F-tables with d.f. 3 and 32 we find that the 5 % point is approximately 2.90. Thus at the 5 % level of significance, we do not reject the null hypothesis that the parameters have not changed.

Discussion

Why did not the BSE crisis change the beef consumption pattern in Norway when that happened in other European countries? Firstly, there has not been detected any cases of BSE in Norway so the consumer could have confidence in Norwegian beef. Secondly, the Norwegian government and the meat Co-operative quickly informed the consumers that Norway did not import beef from countries with BSE. Thirdly, except from radiation in sheep after the Chernobyl accident in 1986 and scrapie in sheep in 1996[(2)], there have not been major food scares in Norway. The case of scrapie in 1996 may have had some influence on the econometric results, but probably not on the conclusions. In 1996 the sale of lamb dropped 12 percent from 1995 levels, but the sale in 1995 was very high. The prices of lamb increased 7 percent from 1995 to 1996 and that may have contributed to the lower sale as well.

(2) In the summer and autumn of 1996 a few cases of scrapie in some Norwegian sheep herds was discovered. The meat Co-operative ensured that they would not sell any sick animals. All infected sheep herds and herds which had been in contact with infected herds were slaughtered. It was stated by experts that scrapie has existed in Europe for 250 years and no link has been established between scrapie and any disease in human beings.

Finally, and perhaps most important, there is the question of trust. The consumer is not able to find out enough about the quality of the meat by looking at it or smelling it. The concept of quality is partly tied to the degree of information about individual products. When such information is lacking, consumer behaviour will be based on trust. In a discussion of food safety, Nygård and Storstad (1998) argue that if the consumers are to buy the food, they have to have trust in the producers, the political authorities and the controlling experts. The producers and the distribution link have to present products that are in keeping with official regulations and that are not dangerous. In addition, the consumer must trust the authorities to have a set of regulations and controls that can provide sufficient safety and security. And there has to exist confidence in the experts' evaluation of risks that are the basis for quality.

According to a survey conducted by a public opinion institute (MMI, 1997), the Norwegian consumers seem to have a very high confidence in the Norwegian food producers. 70 percent of the Norwegian population think that Norwegian agricultural products are of high quality while 27 percent think the products are of average quality. 85 percent think that Norwegian products are safer to eat than imported products. Only 15 percent thought that the origin of food products are not important for their safety.

The trust in the agricultural sector is high because of the small scale production with high degree of public support and very good animal health. A report by the Norwegian Veterinary Association states that the health in Norwegian domestic animals is very good (Skjerve *et al.*, 1996). As an example there were found yearly between 600 and 1 600 cases of salmonella infections during the period 1983-1996. 70 percent of the cases had origin outside the country, 7 percent were from sources inside the country, while the source of origin for the remaining 23 percent were unknown. In Norway it is rare getting sick from eating infected food.

Comparative research concerning trust to the political system and the controlling authorities shows that the Norwegians are more confident to the "system" compared to other countries (Listhaug and Wiberg, 1995). In a comparative study of eight western democracies Listhaug (1998), using data from 1995-1996, found that Norwegians have more trust in the government and national assembly than the other countries in the study [3].

Final remarks

Three ways of examining if the media information about BSE in 1996 had any effect on the beef demand pattern in Norway are presented in this paper. An error correction model for beef demand esti-

[3] The eight countries in this study were Norway, Sweden, Finland, Germany (West), Swizerland, Spain, Australia, and the USA.

mated on four-month data from 1984 to 1995 is presented. The model is then utilised to make forecasts for beef demand in the three four-month periods in 1996. The differences between the forecasts and the recorded sale in these periods are within the expected range. Then the model is re-estimated with the prices, expenditure and beef sale for 1996 included. A Chow predictive test is performed to check if inclusion of the new observations cause any instability to the regression parameters. The null hypothesis of stability in the regression parameters is not rejected. Finally a dummy variable is included in the model to check if the own price elasticity has changed, if the expenditure elasticity has changed or if inclusion of a stochastic trend explains anything new in 1996. The tests performed did not reject the null hypothesis of no change in the elasticities and the trend in 1996. Thus, neither the forecast model nor the Chow test or the dummy test indicate that the information in the media about the connection of BSE with Creutzfeldt-Jakob disease led to a large enough loss of consumer confidence in 1996 to affect aggregate consumption of beef in Norway.

In the final part of the paper the reasons why the Norwegian beef consumption pattern did not change in 1996 are discussed. Firstly, no cases of BSE in Norway have been detected so the consumer could have confidence in Norwegian beef. Secondly, Norway does not import beef from countries with BSE infected herds. Thirdly, except from radiation in sheep after the Chernobyl accident in 1986 and scrapie in sheep in 1996 there have not been any major food scares in Norway. Finally, the Norwegians seem to have trust in the producers, the political authorities and the controlling experts.

REFERENCES

BANERJEE (A.), DOLADO (J.), GALBRAIT (J. W.) and HENDRY (D. F.), 1993 — *Co-integration, error correction, and the analysis of non-stationary data,* New York, Oxford University Press Inc.

BURTON (M.) and YOUNG (T.), 1996 — The impact of BSE on the demand for beef and other meats in Great Britain, *Applied Economics*, 28, pp. 687-693.

BURTON (M.) and YOUNG (T.), 1997 — Measuring meat consumers' response to the perceived risks of BSE in Great Britain, *Risk Decision and Policy*, 2(1), pp. 9-18.

CHAREMZA (W. W.) and DEADMAN (D. F.), 1992 — *New Directions in Econometric Practice: General to Specific Modelling, Cointegration, and Vector Autoregression,* Elgar Publishing Limited, England.

DAVIDSON (J. H.), HENDY (D. H.), SRBA (F.) and YEO (S.), 1978 — Econometric modelling of the aggregate time-series relationships between consumers' expenditure and income in the United Kingdom, *The Economic Journal*, 88, pp. 661-692.

ENGLE (R. F.) and GRANGER (C. W .J), 1987 — Cointegration and error correction: representation, estimation and testing, *Econometrica*, 55, pp. 251-76.

HADJIKANI (A.) and SEYED-MOHAMMAD (N.), 1997 — The media and consumer perception in a loosely coupled international market system: the case of mad cow disease, *Journal of Euromarketing,* vol. 6(4), pp. 69-96.

LATOUCHE (K.), RAINELLI (P.) and VERMERSCH (D.), 1998 — Food safety issues and the BSE scare: some lessons from the French case, *Food Policy,* vol. 23, n° 5, pp. 347-356.

LISTHAUG (O.) and WIBERG (M.), 1995 — Confidence in political and private institutions *in :* KLINGEMANN (H. D.) and FUCHS (D.) (eds.), *Citizen and State*, Oxford University Press.

LISTHAUG (O.), 1998 — Confidence in political institutions: Norway 1982-1996, Paper presented at The World Values Surveys Stockholm Workshop, Trondheim, NTNU.

MORABIA (A.), BERNSTEIN (M. S.), HÉRTIER (S.) and BEER-BORST (S.), 1999 — A Swiss population-based assessment of dietary habits before and after March 1996 'mad cow disease' crises, *European Journal of Nutrition*, 53, pp. 158-163.

MMI, 1997 — Kjennskap og holdninger til norsk landbruk, Oslo, Markeds-og mediainstituttet.

NYGÅRD (B.) and STORSTAD (O.), 1998 — De-globalization of food markets? consumer perceptions of safe food: the case of Norway, *Sociologia Ruralis,* vol. 38(1), pp. 35-53.

SKJERVE (E.) *et al.*, 1996 — Matvarekvalitet, dyrehelse og internasjonal handel; risiko forbundet med en økt import av levende dyr, kjøtt og andre dyreprodukter fra EØS-området og andre land, Oslo, Den Norske Vetrinærforeningen.