First draft 01-03-2023

An empirical analysis of the purchases of soft fruit in Scotland

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Abstract

The production of soft fruits in Scotland, the main fruit category produced in the country, has a marked seasonality. In addition, the availability of soft fruit depends on imports from the rest of the UK and abroad (i.e., EU and non-EU countries) during the entire year. The purpose of this paper is to update the evidence of a previous analysis (Revoredo-Giha et al., 2011) regarding the purchases of soft fruit in Scotland. There are three main motivations on the topic: (1) the Scottish Government interest about the country's dependence on fruit from elsewhere; (2) whether the expansion of the domestic supply of soft fruit may increase the quantity demand for it, and therefore, getting consumers closer to the health-related recommendations and (3) to what extent consumers' purchases of soft fruit follow locality and seasonal patterns. For the empirical work we used time series constructed from the Kantar Worldpanel dataset for the period 2013 to 2021. Besides a descriptive analysis where we consider the origin of soft fruit purchased in Scotland, we pursued two further analyses: one was a seasonality analysis, and another was an estimation of an incomplete demand system by socioeconomic groups augmented by seasonal and trend terms. The results indicated that the share of Scottish soft fruit as a proportion of the total purchases is still modest and the purchases of soft fruit are still highly seasonal despite the possibility of getting out-of-season imported soft fruit; however, some of them show an increasing trend. Although strawberries, the main produced soft fruit from Scotland, are price sensitive and inelastic, raspberries price elasticities are above one showing more reaction to prices and possibilities to increase consumption if prices decrease.

Keywords: Demand for soft fruits, Scotland, Seasonality
JEL Code: Q110 Agriculture: Aggregate Supply and Demand Analysis; Prices

I. Introduction

The production of soft fruits in Scotland, the main fruit category produced in the country, has a marked seasonality. In addition, the availability of soft fruit depends on imports from the rest of the UK and abroad (i.e., EU and non-EU countries) during the entire year.

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This paper aims to update the evidence of a previous analysis (Revoredo-Giha et al., 2011) regarding the purchases of soft fruit in Scotland. The main conclusion of that study, which was based on data for the 2006-09 period, is that the purchases speak of a demand that it is very seasonal (peaking during summer and decreasing significantly during winter) and can be identified despite that the presence of substantial imports that complement the UK seasonality (e.g., from Spain, Holland, Egypt). As regards the locality of the purchases of purchases, it was clear that the Scottish provenance represent a relatively small proportion of the purchases of soft fruit in Scotland. The Scottish demand was satisfied with soft fruit from the rest of the UK and from abroad. Furthermore, only in the case of strawberries and raspberries it was found Scottish purchases; for blackberries and blueberries only produce from the of UK and from abroad was found in the sample.

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For the empirical work we used time series constructed from the Kantar Worldpanel dataset for the period 2013 to 2021. Besides a descriptive analysis where we consider the origin of soft fruit purchased in Scotland, we pursued two further analyses: one was a seasonality analysis, and another was an estimation of an incomplete demand system by socioeconomic groups augmented by seasonal and trend terms.

The results indicated that the share of Scottish soft fruit as a proportion of the total purchases is still modest and the purchases of soft fruit are still highly seasonal despite the possibility of getting out-of-season imported soft fruit; however, some of them show an increasing trend. Although strawberries, the main produced soft fruit from Scotland, are price sensitive and inelastic, raspberries price elasticities are above one showing more reaction to prices and possibilities to increase consumption if prices decrease.

The structure of the paper is as follows: It starts presenting the methodology used for analysis, followed by the results and discussion and ends with some conclusions.

II. Methodology

II.1 Data

For the analysis we used the Kantar Worldpanel dataset for the period 2013 until 2021. Time series were created using it and produced 117 observations of 4-week "months". The series were broken by supermarket, different soft fruits (blackberries, blueberries, cherries, grapes, raspberries, strawberries and other soft fruits) and four origins: Scottish, Rest of the UK, EU origin and Rest of the world. The fact that the data were broken down by origin meant that we could

evaluate the importance of local produce. The prices used in the analysis were unit values.

II.2 Seasonal models

In terms of seasonality, for comparison purposes three seasonality models were estimated: (1) dummy variable model; (2) the trigonometric seasonal model and (3) the sawtooth seasonal model (Gilbert et al., 2017). The analysis also considered whether exiting the European Union affected the seasonal patterns. This was done using dummy variables for different periods (e.g., after 2021).

The representation of seasonality in a price series considers three components (notation are from Gilbert et al., 2017): trend, seasonal factors and irregular variation:

$$\mathrm{p_{ym}} = \mu_{ym} + s_m + \varepsilon_{ym}$$

Where p_{ym} is the series in month m in year y in logs, $\mu_{ym}$is the trend, $s_1 \ldots s_{12}$ are a set of 12 seasonal factors and ε_{ym} is a disturbance (κ is the intercept for the first 4-week month). The trend used was a quadratic trend. The seasonal factors can be estimated from the regression:

$$\mathrm{p_{ym}} = \kappa + \gamma_0 t + \gamma_1 t^2 + \sum_{j=2}^{13} \delta_j z_{mj} + \varepsilon_{ym}$$

The linear trend approach assumes that prices are trend stationary, i.e., that they revert to a deterministic trend. However, economic theory does not provide any basis to suppose that food price trends are constant. One way to allow for a variable trend is to estimate the trend as a centred moving average, which can vary from month to month:

$$\mu_{ym} = \frac{1}{12}\left[\sum_{j=-5}^{5} p_{y,m+j} + \frac{1}{2}\left(p_{y,m+6} + p_{y,m-6}\right)\right]$$

As noted in Gilbert et al. (2017) the dummy variable approach to measuring the seasonal gap is highly parametrized and has the advantage that it does not pose many restrictions on the data, but it requires a large number of parameters (twelve in this with 13 four-weeks months).

Two alternative models are the trigonometric seasonality model and the sawtooth function. The trigonometric seasonality model used here – in which the seasonal pattern is defined by a pure sine wave follows the version in Gilbert et al. (2017), which considers two parameter sinusoidal trigonometric seasonality representation is:

$$s_m = \alpha cos\left(\frac{m\pi}{6}\right) + \beta sin\left(\frac{m\pi}{6}\right)$$

With trending data, the estimating equation is:

$$\Delta p_{ym} = \gamma + \Delta s_m + u_{ym}$$

$$\Delta p_{ym} = \gamma + \alpha \Delta cos\left(\frac{m\pi}{6}\right) + \beta \Delta sin\left(\frac{m\pi}{6}\right) + u_{ym}$$

The equation is estimable by least squares. The seasonal factor s_m may be re-expressed as a pure cosine function:

$$s_m = \lambda \, cos\left(\frac{m\pi}{6} - \omega\right)$$

where $\lambda = \sqrt{\alpha^2 + \beta^2}$ and $\omega = tan^{-1}\left(\frac{\alpha}{\beta}\right)$. The parameter λ measures the amplitude of the seasonal cycle and implies a seasonal gap of 2λ.

Although, the trigonometric specification is parsimonious, it is restrictive in the shape implied by the trigonometric functions. An alternative parametric specification is a sawtooth function in which the variables fall sharply and then rise at a steady rate through the remainder part of the year. Suppose the peak seasonal factor of λ occurs in month m* and that the price falls by the seasonal gap of 2λ to $-\lambda$ in the harvest month m* + 2. The seasonal factor then rises steadily by an amount $\frac{\lambda}{5}$ over the reminder of the year. Conditional on knowing the peak price month m*, the amplitude parameter λ may be estimated from the regression.

$$\Delta p_{ym} = \gamma + \Delta s_m + u_{ym} = \gamma + \lambda \Delta z_m(m^*) + u_{ym}$$

Here $\Delta z_m(m^*)$ is equal to -1 if m=m*+1 or m=m*+2 and 1/5 otherwise. As in Gilbert et al. (2017) the estimation was performed considering a grid search choosing the value for m* which gives the maximum R^2 statistic.

III.3 Incomplete demand system model

To compute the demand elasticities, the demand system used was the Linquad model, which starts from a quasi-expenditure function which considers quadratic terms in prices (LaFrance 1990, 1991, 1998). One of the most useful properties of the LinQuad quasi-expenditure function is its complete characterization of the included goods with regards to prices and income. This result from the duality theory of incomplete demand systems allows exact welfare measures to be obtained from the quasi-indirect utility function (LaFrance 1991). The quasi-expenditure function is given by:

$$\varepsilon(\mathrm{p}, \mathrm{q}, \mathrm{z}, \theta) = \mathrm{p}'\alpha + \mathrm{p}'\mathrm{A}\mathrm{z} + 0.5\mathrm{p}'\mathrm{B}\mathrm{p} + \delta(\mathrm{z}) + \theta(\mathrm{q}, \mathrm{u}, \mathrm{z})\mathrm{e}^{\gamma'\mathrm{p}}$$

where p is the vector of deflated prices, $\mathrm{p_i}/\bar{\mathrm{p}}$, where $\bar{\mathrm{p}}$ is an average price index (in this case the consumer price index), z is a set of shifters such as relevant other prices or lagged demand, $\delta(\mathrm{z})$ is an arbitrary real valued function of all

variables in z, $\theta(q, u, z)$ is the constant of integration and α, A and B are the parameters to be estimated.
Applying Shepherd's lemma (i.e., differentiating with respect to prices) to the quasi-expenditure function generates Hicksian demands of the form:

$$x = \alpha + Az + Bp + \gamma[\theta(q, u, z)e^{\gamma' p}]$$

Solving the LinQuad expenditure function for $\theta(q, u, z)e^{\gamma' p}$, and replacing expenditure with m for income, gives the final Marshallian demand specification of LinQuad model (LaFrance, 1990).

$$x = \alpha + Az + Bp + \gamma[m - p'\alpha - p'Az - 0.5p'Bp - \delta(z)]$$

The quadratic term in prices increases the flexibility in Slutsky symmetry removing the restrictions that constrain the preference ordering of a linear system. The LinQuad quasi-expenditure function is a second order Taylor series approximation to any arbitrary expenditure function.

The Slutsky substitution matrix (i.e., Hessian matrix of the derivative of the expenditure function with respect to prices) is given by:

$$S = B + [m - p'\alpha - p'Az - 0.5p'Bp - \delta(z)]\gamma\gamma'$$

The symmetry of the Slutsky matrix is determined by B. Note that B is not necessarily symmetric so symmetry is a testable hypothesis; however, it is a property that can be imposed on the system. The matrix of price effects is given by (from which the Marshallian price elasticities can be computed):

$$\frac{\partial x}{\partial p'} = B + \gamma[\alpha - Az - p'B]$$

The Marshallian own and cross-price elasticities (e_{ii} and e_{ij}) are:

$$e_{ii} = \left[v_{ii} - X_i\left(\epsilon_i + \sum_j v_{ij}p_j\right)\right]\left(\frac{p_i}{x_i}\right)$$

$$e_{ij} = \left[v_{ij} - X_i\left(\epsilon_j + \sum_k v_{jk}p_k\right)\right]\left(\frac{p_j}{x_i}\right)$$

There are no restrictions on individual income coefficients. The income effects are given by (from which the income elasticities can be computed):

$$\frac{\partial x}{\partial m} = \gamma$$

Therefore, the income elasticities are:

$$n_i = \gamma_i \frac{m}{x_i}$$

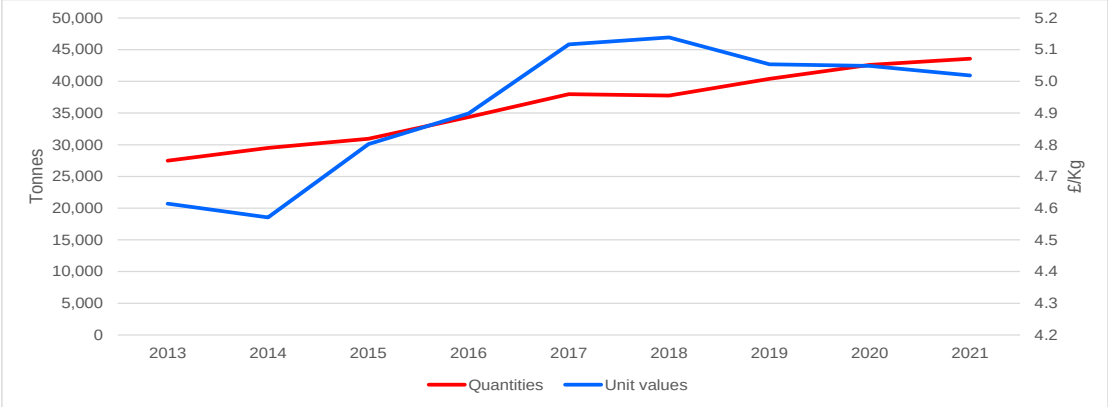
The Hicksian elasticities can be obtained from the Slutsky matrix.

III. Results

III.1 Descriptive analysis

Figures 1 shows the evolution of quantities of soft fruit and unit values. Quantities purchased show a steady increasing trend, whilst unit values increased from 2014 to 2018, to decrease slightly after that. Table 1 shows the importance of the different soft fruits in terms of the total expenditure and quantities. In both cases, grapes are favourite soft fruit representing in 2021 32.2 per cent in terms of expenditure and 50.7 per cent in terms of quantities.

Figure 1 - Scotland: Soft fruit - Evolution of quantities purchased and unit values



Source: Own elaboration based on Kantar Worldpanel data.

Table 1 - Expenditure and quantities shares of soft fruits (percentages)

	2013	2014	2015	2016	2017	2018	2019	2020	2021
Expenditure									
Blackberry	1.9	1.8	1.8	2.1	2.3	2.5	2.4	2.6	2.4
Blueberry	11.6	11.0	12.8	14.1	13.5	14.9	15.8	15.5	15.5
Cherries	4.4	5.9	5.7	5.2	5.1	5.0	4.5	3.9	4.7
Grapes	43.5	42.2	37.8	36.0	35.3	35.6	32.7	33.0	32.2
Raspberry	8.2	9.5	11.5	13.3	13.7	14.1	15.2	14.9	14.6
Strawberry	29.7	28.9	29.4	28.4	28.9	27.0	28.6	28.8	29.3
Others	0.7	0.7	0.9	0.9	1.1	0.9	0.8	1.3	1.3
Quantities									
Blackberry	1.0	0.9	0.8	0.9	1.1	1.2	1.1	1.1	1.0
Blueberry	5.3	5.5	6.9	7.4	7.2	7.8	8.4	8.2	8.5
Cherries	3.6	5.1	4.7	4.1	4.3	4.1	4.1	3.2	3.8
Grapes	56.4	55.4	51.2	51.5	49.8	52.3	50.3	51.8	50.7
Raspberry	3.6	4.0	5.3	5.6	6.3	6.5	7.2	6.9	6.8
Strawberry	29.6	28.7	30.4	29.9	30.6	27.4	28.3	27.8	28.3
Others	0.4	0.4	0.7	0.7	0.8	0.6	0.6	0.9	0.9

Source: Own elaboration based on Kantar Worldpanel data.

Table 2 presents the share by origin of each one of the soft fruits. As mentioned in Revoredo-Giha et al. 2011, the proportion of soft fruit purchased coming from

Scotland is limited. Note that this might be due to the fact that some of the Scottish fruit is marketed as British.

The figures of Table 2 also show the importance of the EU and rest of the world origins in each one of the soft fruit categories. With the exception of strawberries and raspberries, where the Scottish and Rest of UK origins are important (which represented in 2021 36 per cent and 24 per cent, respectively) in all the other cases the adding up of the EU origin and the rest of the work is about 90 per cent.

Table 2 - Expenditure and quantities shares of soft fruits by origin (percentages)

		2013	2014	2015	2016	2017	2018	2019	2020	2021
Based on expenditure (%)										
Blackberry	Scottish	0.0	0.5	2.8	2.4	3.1	3.2	4.9	4.2	3.1
	Rest UK	35.8	31.2	17.3	24.9	9.8	11.3	14.4	15.6	8.7
	EU	5.6	6.4	23.9	2.2	.0	.0	2.1	14.9	15.6
	Rest world	58.6	61.9	56.0	70.4	87.0	85.5	78.6	65.3	72.5
Blueberry	Scottish	0.0	0.0	0.0	0.0	1.3	0.8	0.7	0.2	0.0
	Rest UK	2.6	6.2	1.8	2.9	.5	5.6	2.4	1.1	.0
	EU	31.5	28.0	22.6	17.6	13.0	19.2	13.8	10.1	7.2
	Rest world	65.9	65.8	75.7	79.6	85.2	74.4	83.1	88.5	92.8
Cherries	Scottish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
	Rest UK	6.4	6.9	10.0	7.7	3.7	8.2	11.5	10.1	14.2
	EU	21.8	25.3	13.9	14.1	23.8	27.5	30.2	33.0	31.2
	Rest world	71.8	67.8	76.1	78.2	72.4	64.3	58.4	56.9	53.6
Grapes	Scottish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Rest UK	.3	.3	.3	.3	.3	.5	.2	.0	.1
	EU	10.0	13.6	21.1	33.9	35.6	29.0	28.4	16.6	14.6
	Rest world	89.7	86.1	78.6	65.8	64.1	70.5	71.3	83.3	85.3
Raspberry	Scottish	1.1	1.9	2.5	9.2	4.6	3.9	1.8	2.0	2.6
	Rest UK	38.8	49.9	23.9	26.0	35.8	34.3	22.6	22.2	21.6
	EU	39.1	31.1	30.1	16.8	12.8	15.4	17.0	17.1	15.1
	Rest world	21.1	17.2	43.5	47.9	46.8	46.4	58.5	58.6	60.7
Strawberry	Scottish	4.0	1.4	2.4	1.6	3.5	4.9	4.7	3.4	5.4
	Rest UK	56.2	49.9	32.9	48.6	37.4	44.9	37.4	33.5	31.6
	EU	19.2	18.1	32.5	19.5	15.4	12.3	33.3	37.6	41.1
	Rest world	20.6	30.6	32.1	30.4	43.7	37.9	24.6	25.5	21.9
Others	Scottish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Rest UK	20.4	23.1	23.0	15.4	10.3	17.4	17.3	17.5	26.4
	EU	9.1	11.7	10.6	21.2	19.7	7.7	22.9	18.7	5.8
	Rest world	70.5	65.2	66.5	63.4	70.0	74.9	59.8	63.8	67.8

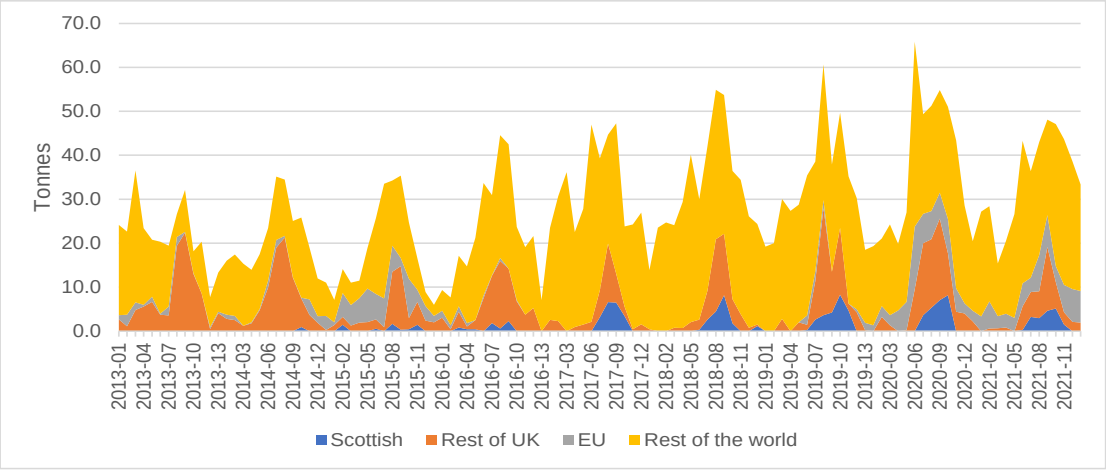
Source: Own elaboration based on Kantar Worldpanel data.

It should be noted that in the case of raspberries and strawberries the domestic proportions were higher in 2013 and they have steadily decreased. It is important that this is not a consequence of the UK exiting the European Union. Moreover, whilst on some of the soft fruit categories (e.g., grapes) rest of the world share has partly replaced the EU share, in other categories (e.g., blackberries) it has been just the opposite.

III.2 Seasonality analysis

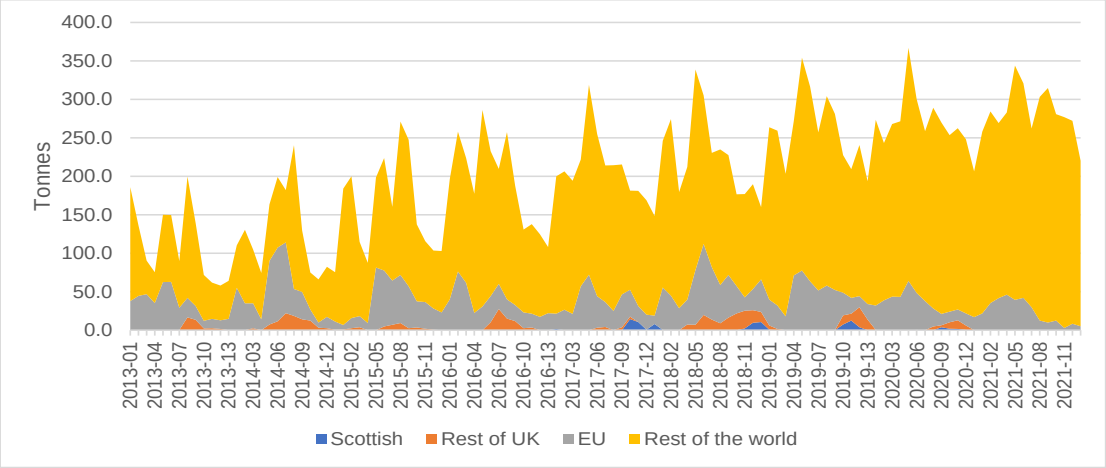
Figures 2 to 7 show the evolution of quantities purchased by different soft fruits by origin. Clearly all of them show a strong seasonal component, whilst only some of them show, in addition, a trend component.

Figure 2: Purchases of blackberries according to origin



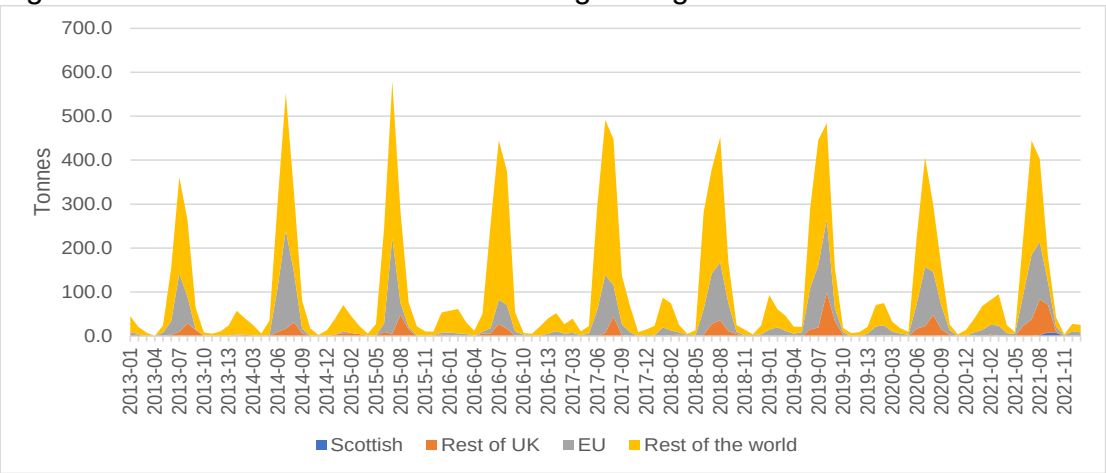
Source: Own elaboration based on Kantar Worldpanel data.

Figure 3: Purchases of blueberries according to origin



Source: Own elaboration based on Kantar Worldpanel data.

Figure 4: Purchases of cherries according to origin

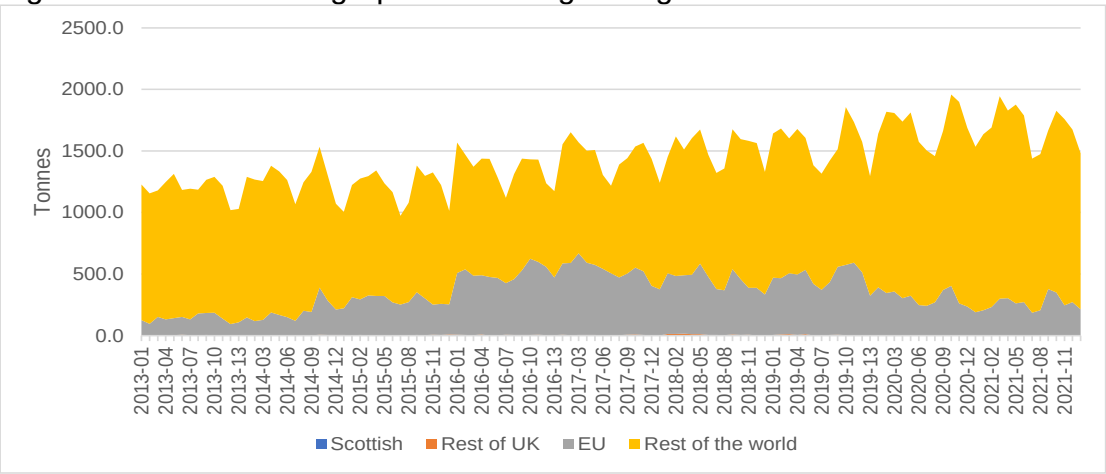


Source: Own elaboration based on Kantar Worldpanel data.

Table 3 to 5 presents the seasonality and trend results. Based on the R square statistics, trend and seasonality represent an important part of the behaviour of

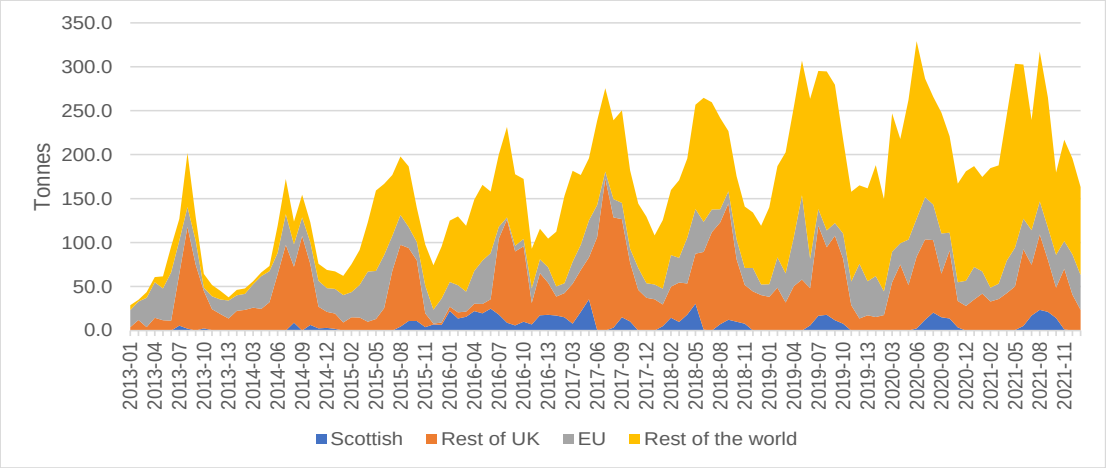
the series. However, the three seasonal model fit differently the data (quantities and unit values.

Figure 5: Purchases of grapes according to origin



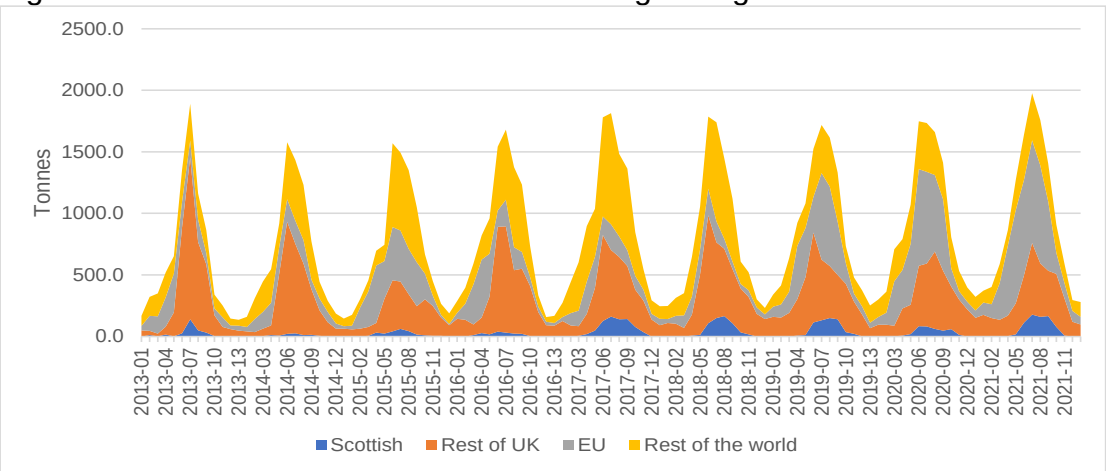
Source: Own elaboration based on Kantar Worldpanel data.

Figure 6: Purchases of raspberries according to origin



Source: Own elaboration based on Kantar Worldpanel data.

Figure 7: Purchases of strawberries according to origin



Source: Own elaboration based on Kantar Worldpanel data.

Table 3 - Trend and seasonality analysis of soft fruit quantities purchased and unit values

	Quantities						Unit values					
	Blackberries	Blueberries	Cherries	Grapes	Raspberries	Strawberries	Blackberries	Blueberries	Cherries	Grapes	Raspberries	Strawberries
Trend												
Trend	0.0035	0.02	0.0205	0.00	0.0287	0.01	0.0078	0.00	0.0002	0.00	0.0002	0.00
t	1.0227	7.93	3.4127	5.36	15.0946	5.11	7.9861	0.00	0.0621	2.43	0.2502	2.17
Trend2	0.0000	0.00	-0.0001	0.00	-0.0001	0.00	-0.00005	0.00	0.0000	0.00	-0.00001	0.00
t	1.0190	-3.29	-2.5550	0.37	-9.0603	-2.23	-5.6905	-0.60	0.2142	-5.23	-0.8674	-0.21
Seasonality												
Intercept	2.2858	4.10	2.7623	6.87	3.5494	4.94	2.2060	2.45	2.1533	1.30	2.5198	1.91
t	17.0218	50.10	11.7159	266.91	47.6417	71.51	57.3490	48.67	20.2861	83.82	90.4435	74.20
Month 2	0.2694	0.58	0.8246	0.23	0.0463	0.23	0.0006	-0.27	-0.1335	-0.03	0.0016	-0.08
t	1.8374	6.44	3.2030	8.01	0.5687	2.99	0.0138	-4.99	-1.1520	-2.02	0.0536	-2.67
Month 3	0.3736	0.60	0.5349	0.25	0.1579	0.59	-0.0247	-0.30	-0.0971	-0.03	-0.0173	-0.24
t	2.5492	6.72	2.0784	8.79	1.9421	7.89	-0.5893	-5.52	-0.8381	-1.85	-0.5682	-8.68
Month 4	0.4761	0.37	0.0243	0.23	0.2922	0.94	-0.0303	-0.12	-0.0298	-0.03	-0.0284	-0.41
t	3.2497	4.09	0.0945	8.36	3.5952	12.49	-0.7220	-2.10	-0.2572	-1.79	-0.9349	-14.50
Month 5	0.3660	0.31	-1.4109	0.25	0.4447	1.29	0.0183	-0.04	0.1856	-0.04	-0.0487	-0.47
t	2.4987	3.51	-5.4865	8.99	5.4724	17.17	0.4371	-0.65	1.6035	-2.08	-1.6030	-16.90
Month 6	0.5942	0.79	-0.3713	0.25	0.5926	1.56	0.0098	-0.25	-0.0279	-0.05	-0.0824	-0.40
t	4.0577	8.84	-1.4441	8.89	7.2943	20.72	0.2333	-4.54	-0.2410	-2.71	-2.7131	-14.26
Month 7	0.9048	0.71	2.1261	0.14	0.7159	2.07	-0.0443	-0.23	-0.4487	-0.04	-0.1241	-0.48
t	6.1809	7.98	8.2719	5.02	8.8140	27.52	-1.0566	-4.26	-3.8780	-2.08	-4.0849	-17.24
Month 8	0.9338	0.47	2.7193	0.03	0.7943	2.13	-0.0876	-0.16	-0.6221	-0.06	-0.2322	-0.50
t	6.3804	5.31	10.5819	1.05	9.7827	28.29	-2.0886	-2.98	-5.3773	-3.44	-7.6465	-17.99
Month 9	1.1195	0.71	2.4946	0.10	0.8247	1.95	-0.2417	-0.35	-0.5002	-0.08	-0.2582	-0.51
t	7.6504	8.01	9.7094	3.46	10.1588	25.94	-5.7654	-6.37	-4.3248	-4.46	-8.5040	-18.27
Month 10	1.0677	0.54	1.2854	0.21	0.7167	1.72	-0.2332	-0.27	-0.1822	-0.09	-0.2447	-0.50
t	7.2972	6.00	5.0038	7.42	8.8290	22.86	-5.5640	-4.95	-1.5756	-5.51	-8.0606	-17.66
Month 11	0.7963	0.19	-0.3719	0.27	0.4191	1.14	-0.1126	0.00	-0.1164	-0.09	-0.1410	-0.30
t	5.4434	2.19	-1.4479	9.54	5.1643	15.19	-2.6880	-0.07	-1.0065	-5.58	-4.6454	-10.84
Month 12	0.6310	0.13	-1.6605	0.23	0.1262	0.72	-0.0437	0.05	-0.2163	-0.08	-0.0409	-0.14
t	4.3133	1.50	-6.4656	8.12	1.5554	9.56	-1.0431	0.97	-1.8710	-4.58	-1.3485	-5.10
Month 13	0.3139	0.13	-0.9277	0.12	0.0681	0.19	-0.0105	0.04	0.0901	-0.02	-0.0296	0.00
t	2.1460	1.42	-3.6124	4.16	0.8396	2.57	-0.2506	0.72	0.7796	-1.47	-0.9756	-0.06
R^2	0.66	0.84	0.88	0.88	0.91	0.96	0.69	0.62	0.50	0.68	0.71	0.93

Source: Own elaboration based on Kantar Worldpanel data.

Table 4 - Trend and trigonometric seasonality

Series	Name	Mean	Intercept	t	Trend	t	Trend^2	t	Seasonal parameters				λ	2λ	Obs.	R^2
									α	t	β	t				
Quantities	Blackberries	3.23	2.8967	32.02	0.0036	1.01	0.0000	0.89	-0.2080	-4.97	-0.3821	-9.08	0.435	0.870	117	0.60
Quantities	Blueberries	5.24	4.5387	63.65	0.0163	5.84	-0.0001	-2.44	-0.2467	-7.47	-0.0155	-0.47	0.247	0.494	117	0.69
Quantities	Cherries	3.80	3.2135	9.00	0.0199	1.42	-0.0001	-1.12	-0.8464	-5.12	-0.7199	-4.34	1.111	2.222	117	0.30
Quantities	Grapes	7.26	7.0483	243.90	0.0034	3.03	0.0000	0.22	-0.0083	-0.62	0.0320	2.38	0.033	0.066	117	0.61
Quantities	Raspberries	4.99	3.9501	80.76	0.0288	15.06	-0.0001	-9.10	-0.3154	-13.93	-0.2597	-11.42	0.409	0.817	117	0.90
Quantities	Strawberries	6.43	6.0563	117.27	0.0092	4.55	0.0000	-2.15	-0.8063	-33.73	-0.5891	-24.53	0.999	1.997	117	0.94
Unit values	Blackberries	2.40	2.1427	76.07	0.0078	7.10	0.0000	-4.99	0.0064	0.49	0.0927	7.07	0.093	0.186	117	0.57
Unit values	Blueberries	2.27	2.2938	49.48	0.0002	0.10	0.0000	-0.45	0.0981	4.57	0.0041	0.19	0.098	0.196	117	0.17
Unit values	Cherries	2.02	1.9865	24.42	0.0002	0.06	0.0000	0.23	0.1087	2.88	0.1923	5.08	0.221	0.442	117	0.24
Unit values	Grapes	1.23	1.2516	115.42	0.0010	2.26	0.0000	-4.81	0.0010	0.19	0.0308	6.10	0.031	0.062	117	0.59
Unit values	Raspberries	2.41	2.4233	122.34	0.0001	0.17	0.0000	-0.67	0.0522	5.69	0.1096	11.90	0.121	0.243	117	0.62
Unit values	Strawberries	1.68	1.5971	61.70	0.0014	1.42	0.0000	-0.08	0.2289	19.10	0.0986	8.19	0.249	0.498	117	0.81

Table 5 - Trend and sawtooth seasonality

Series	Name	Mean	Intercept	t	Trend	t	Trend^2	t	Seasonal parameter		m*	2λ	Obs.	R^2
									λ	t				
Quantities	Blackberries	3.23	2.7809	23.83	0.0054	1.19	0.0000	0.36	0.5902	4.74	12	1.180	117	0.35
Quantities	Blueberries	5.24	4.4862	55.41	0.0171	5.48	-0.0001	-2.56	0.3976	4.60	12	0.795	117	0.61
Quantities	Cherries	3.80	3.2287	7.69	0.0207	1.27	-0.0001	-0.99	-0.3753	-0.87	13	-0.751	117	0.03
Quantities	Grapes	7.26	7.0256	264.87	0.0038	3.66	0.0000	-0.15	0.1582	5.59	12	0.316	117	0.67
Quantities	Raspberries	4.99	3.8853	42.38	0.0299	8.44	-0.0002	-5.23	0.3739	3.82	12	0.748	117	0.67
Quantities	Strawberries	6.43	5.8870	30.67	0.0120	1.62	-0.0001	-1.00	1.0161	4.96	12	2.032	117	0.22
Unit values	Blackberries	2.40	2.1541	64.44	0.0077	5.94	0.0000	-4.24	-0.0558	-1.63	13	-0.112	117	0.39
Unit values	Blueberries	2.27	2.3115	48.32	0.0002	0.08	0.0000	-0.39	-0.1796	-3.69	10	-0.359	117	0.12
Unit values	Cherries	2.02	2.0257	22.31	-0.0001	-0.02	0.0000	0.21	-0.2276	-2.47	11	-0.455	117	0.06
Unit values	Grapes	1.23	1.2610	104.43	0.0008	1.76	0.0000	-4.17	-0.0425	-3.30	12	-0.085	117	0.50
Unit values	Raspberries	2.41	2.4360	79.88	0.0001	0.07	0.0000	-0.45	-0.0879	-2.82	13	-0.176	117	0.09
Unit values	Strawberries	1.68	1.6288	31.93	0.0013	0.66	0.0000	0.04	-0.2792	-5.38	11	-0.558	117	0.25

From the three models the overparameterized seasonal dummy model is the one with the best fit.

The purchases of soft fruit are highly seasonal despite the possibility of getting out-of-season imported soft fruit. However, there are important differences in the case of strawberries and raspberries (the two major soft fruit produce in Scotland); whilst on the former there is an increase trend, the seasonality was basically the same, in the latter, imports of raspberries reduced to some extent the seasonality. Brexit was not found important to affect the trend and the seasonality.

III.3 Demand elasticities

Due to the best fit, the demand model was augmented with dummy seasonals. The results of the regression are presented at the end in the Annex section.

The demand models were estimated by socioeconomic groups (reported gross annual household income groups). The estimated elasticities are presented in Tables 6 to 9.

The results indicate that (for all groups) excepting grapes, prices and most of the total expenditure elasticities are significantly different than zero. This indicates that changes in prices will affect the quantity demanded for the soft fruits; however, with the exception of raspberries, which showed an above one elasticity, all the other cases showed own price elasticities lower than one (in absolute values).

Interestingly, the elasticities for the three socioeconomic groups for strawberries are fluctuate between -0.25 and -0.38, which indicate that a substantial decrease in the price by 50 per cent would only increase the quantities consumed/purchased of strawberries by 12.5 per cent or 19.0 per cent depending on the group.

The effect of income is a much more significant driver than prices is (total grocery expenditure in this case) as all the expenditure elasticities are above one.

The above results point out that the expansion of the domestic supply might not have an effect on the domestic consumption of soft fruit, due to the fact that most of the supply come from abroad and the proportion of the domestic supply is relatively small. Moreover, the domestic supply does not have the potential to affect domestic prices (open economy with imports), therefore one would not expect a price effect.

The current decrease in purchasing power (which translate into a decrease on groceries expenditures) may have a significant effect on the quantities purchased in Scotland.

Table 6 - Group 1 (£0 to £29,000)

	Marshallian price elasticities							Expenditure
	Blackberry	Blueberry	Cherries	Grapes	Raspberry	Strawberry	Other soft fruit	elasticities
Blackberry	-0.9257	0.3193	-0.0985	0.9014	0.5163	-0.8493	-0.0518	0.5443
	(.2753)	(.2225)	(.0795)	(.0638)	(.3747)	(.1282)	(.1198)	(.3948)
Blueberry	0.4640	-0.8487	-0.0030	0.1047	0.1504	-0.0022	0.0032	0.8527
	(.0758)	(.084)	(.0339)	(.0104)	(.0819)	(.0298)	(.0425)	(.1275)
Cherries	-0.9952	-0.9129	-0.8683	0.1134	-0.2112	1.6882	-0.2037	2.5601
	(.0803)	(.0976)	(.072)	(.0083)	(.0719)	(.1215)	(.0758)	(.2517)
Grapes	0.1321	0.0326	-0.0038	0.0007	0.3067	0.0064	0.1058	0.3289
	(.0092)	(.0039)	(.0148)	(.0049)	(.0214)	(.0017)	(.0088)	(.0534)
Raspberry	0.3291	0.2142	-0.1409	0.8605	-1.3186	-0.1977	-0.1290	0.8466
	-0.1096	-0.1003	-0.0408	-0.0662	(.0921)	-0.0439	-0.0539	(0.1611)
Strawberry	0.0125	-0.1445	-0.3080	0.0036	-0.1575	-0.2619	-0.0960	2.0679
	-0.0028	-0.0154	-0.0242	-0.0013	-0.0107	(.0208)	-0.0074	(0.1092)
Other soft fruit	0.3545	-0.5651	0.0076	2.8108	-0.3878	-1.3057	-0.1791	0.9169
	(.4136)	(.3332)	(.1155)	(.2491)	(.464)	(.1905)	(.1741)	(.5775)

Note: Standard errors in parenthesis under the coefficients.

Table 7 - Group 2 (£30,000 to £49,999)

	Marshallian price elasticities							Expenditure
	Blackberry	Blueberry	Cherries	Grapes	Raspberry	Strawberry	Other soft fruit	elasticities
Blackberry	-0.0803	-0.1090	0.0327	0.2450	-0.0927	-0.1856	-0.1059	1.1603
	(.0705)	(.1843)	(.0849)	(.0316)	(.2637)	(.1924)	(.0787)	(.3209)
Blueberry	0.3445	-0.8311	-0.0760	0.3922	0.3035	0.2251	0.0531	0.0683
	(.0513)	(.0745)	(.0368)	(.0298)	(.0589)	(.0468)	(.0294)	(.103)
Cherries	-0.7028	-0.6383	-1.0004	0.5207	-1.0198	1.5904	-0.0471	2.0539
	(.0689)	(.0596)	(.0671)	(.0421)	(.0926)	(.1058)	(.0684)	(.2977)
Grapes	0.1694	0.0680	-0.0147	-0.0593	0.3839	-0.0011	0.0781	0.0859
	(.0101)	(.0056)	(.0077)	(.0393)	(.0252)	(.0018)	(.0138)	(.0771)
Raspberry	0.4867	-0.0315	-0.0418	0.7345	-1.0798	0.0769	-0.0790	0.4883
	-0.0971	-0.0726	-0.0492	-0.0568	(.0752)	-0.0468	-0.0423	(0.1297)
Strawberry	0.0985	-0.0549	-0.3071	0.0032	-0.1267	-0.2452	-0.1982	1.7529
	-0.0104	-0.0037	-0.0236	-0.0009	-0.0083	(.018)	-0.0130	(0.1306)
Other soft fruit	-0.8571	0.8187	0.0756	0.1903	1.6962	-2.8945	-0.2294	-0.3952
	(.4694)	(.3512)	(.1651)	(.1461)	(.5573)	(.327)	(.1521)	(.7067)

Note: Standard errors in parenthesis under the coefficients.

Table 8 - Group 3 (£50,000 to above)

	Marshallian price elasticities							Expenditure
	Blackberry	Blueberry	Cherries	Grapes	Raspberry	Strawberry	Other soft fruit	elasticities
Blackberry	-0.2945	-0.7056	-0.1271	-0.9627	0.2164	0.2981	0.0337	1.5359
	(.123)	(.2081)	(.0859)	(.0821)	(.3099)	(.2502)	(.0799)	(.3637)
Blueberry	0.4414	-0.9571	-0.1138	0.0833	0.2368	0.1775	0.0694	0.7988
	(.0894)	(.0686)	(.0276)	(.0075)	(.0635)	(.0447)	(.0324)	(.156)
Cherries	-0.1751	-1.5790	-0.9085	1.2586	-2.2900	2.5599	-0.0167	2.2967
	(.1142)	(.1228)	(.1034)	(.0925)	(.1994)	(.2022)	(.1119)	(.3764)
Grapes	0.1165	0.0582	-0.0030	0.0012	0.3893	-0.0129	0.0493	0.2061
	(.0097)	(.0058)	(.009)	(.0013)	(.0239)	(.0039)	(.0108)	(.0537)
Raspberry	0.4975	-0.0963	-0.0730	0.4295	-1.0590	-0.2281	-0.0262	1.1761
	-0.1045	-0.0651	-0.0374	-0.0312	(.118)	-0.0322	-0.0372	(0.1840)
Strawberry	0.0151	0.0301	-0.3718	0.0135	-0.0897	-0.3755	-0.0632	1.7541
	-0.0060	-0.0053	-0.0256	-0.0022	-0.0074	(.0265)	-0.0050	(0.1077)
Other soft fruit	-0.6469	-0.5270	0.0392	-1.4485	-0.7848	1.0540	-0.1483	3.5757
	(.4835)	(.4456)	(.1687)	(.1589)	(.6028)	(.4432)	(.1225)	(.6683)

Note: Standard errors in parenthesis under the coefficients.

Table 9 - Group 4 (refused to answer or do not know)

	Marshallian price elasticities							Expenditure
	Blackberry	Blueberry	Cherries	Grapes	Raspberry	Strawberry	Other soft fruit	elasticities
Blackberry	-0.9291	0.5356	-0.0561	-0.0270	-0.1606	-0.7729	0.0312	0.3425
	(.2329)	(.2002)	(.0971)	(.0951)	(.3601)	(.2529)	(.0963)	(.2437)
Blueberry	0.0003	-0.6167	-0.0487	1.0104	-0.5381	0.1956	-0.0512	0.6917
	(.0668)	(.0796)	(.0434)	(.0722)	(.1017)	(.0784)	(.0439)	(.1153)
Cherries	-0.1327	-0.8749	-0.7583	2.1238	-1.0957	0.8244	-0.1147	-0.0427
	(.1623)	(.1163)	(.1143)	(.1293)	(.2789)	(.2353)	(.1157)	(.3767)
Grapes	0.0721	-0.0371	0.0400	0.0059	0.3624	-0.0898	-0.0185	0.4893
	(.0123)	(.0104)	(.0085)	(.0075)	(.0183)	(.0092)	(.0143)	(.066)
Raspberry	0.3057	0.3366	-0.0714	0.1647	-1.4327	0.3899	-0.0879	0.5087
	-0.1013	-0.0666	-0.0433	-0.0406	(.1462)	-0.0655	-0.0449	(0.1145)
Strawberry	0.4565	0.2003	-0.2580	0.0930	0.1554	-0.5850	-0.1097	0.7488
	-0.0308	-0.0143	-0.0162	-0.0078	-0.0163	(.036)	-0.0068	(0.0965)
Other soft fruit	1.1391	-0.1971	-0.0971	1.4132	-1.4087	0.3245	-0.0903	1.9576
	(.429)	(.3526)	(.1706)	(.2071)	(.6116)	(.4692)	(.1512)	(.4299)

Note: Standard errors in parenthesis under the coefficients.

IV. Final remarks

The results indicated that the share of Scottish soft fruit as a proportion of the total purchases is still modest and the purchases of soft fruit are still highly seasonal despite the possibility of getting out-of-season imported soft fruit; however, some of them show an increasing trend.

Moreover, eating just local soft fruit would imply to constraint the consumption of soft fruit, even during the Scottish produce season.

Although strawberries, the main produced soft fruit from Scotland, are price sensitive and inelastic, raspberries price elasticities are above one showing more reaction to prices and possibilities to increase consumption if prices decrease.

The effect of income is a much more significant driver than prices is (total grocery expenditure in this case) as all the expenditure elasticities are above one.

The demand analysis points out that the expansion of the domestic supply might not have an effect on the domestic consumption of soft fruit, due to the fact that most of the supply come from abroad and the proportion of the domestic supply is relatively small. Moreover, the domestic supply does not have the potential to affect domestic prices (open economy with imports), therefore one would not expect a price effect.

The current decrease in purchasing power (which translate into a decrease on groceries expenditures) may have a significant effect on the quantities purchased in Scotland.

There are further work to do such as testing the presence of seasonal unit roots as in the case of Arnade et al. (1998, 2005, 2015).

V. References

Arnade, C., Pick, D., & Gehlhar, M. (2005). Testing and incorporating seasonal structures into demand models for fruit. Agricultural Economics, 33, 527-532.

Arnade, C., & Pick, D. (1998). Seasonality and unit roots: the demand for fruits. Agricultural Economics, 18(1), 53-62.

Arnade, C., & Kuchler, F. (2015). Measuring the impacts of off-season berry imports (No. 1477-2016-121093).

Gilbert, C. L., Christiaensen, L., & Kaminski, J. (2017). Food price seasonality in Africa: Measurement and extent. Food policy, 67, 119-132.

Kuchler, F., & Arnade, C. (2016). Consumers' welfare and off-season produce imports. European Review of Agricultural Economics, 43(4), 585-608.

LaFrance, J. T. (1990). Incomplete Demand Systems and Semilogarithmic Demand Models. Australian Journal of Agricultural Economics 34(August): 118-131.

LaFrance, J. T. (1991). Consumer's Surplus versus Compensating Variation Revisited. American Journal Of Agricultural Economics 73(December): 1496-1507.

LaFrance, J. T. (1998). The LINQUAD Incomplete Demand Model. Working paper, Department of Agricultural and Resource Economics, University of California, Berkeley.

Nzaku, K., Houston, J. E., & Fonsah, E. G. (2010). Analysis of US Demand for fresh fruit and vegetable imports. Journal of Agribusiness, 28(345-2016-15289), 163-181.

Revoredo-Giha, C., Leat, P. M., Kupiec-Teahan, B., & Lamprinopoulou-Kranis, C. (2011). How Local and Seasonal is the Consumption of Soft Fruit in Scotland? (No. 353-2016-18090).

Annex

Table A1 - Expenditure and quantities purchased of soft fruits

	2013	2014	2015	2016	2017	2018	2019	2020	2021
Expenditure (£ '000)									
Blackberry	2,426.8	2,459.7	2,727.4	3,494.6	4,505.6	4,798.3	4,843.5	5,537.2	5,322.1
Blueberry	14,766.0	14,867.7	19,059.2	23,774.5	26,310.3	28,868.0	32,296.0	33,346.9	33,822.3
Cherries	5,634.2	7,947.0	8,453.3	8,728.7	10,000.8	9,787.7	9,226.8	8,448.6	10,178.2
Grapes	55,141.2	56,889.1	56,186.2	60,693.3	68,499.2	69,065.9	66,661.5	70,986.8	70,422.9
Raspberry	10,414.8	12,777.2	17,083.8	22,402.1	26,680.5	27,377.7	31,013.7	31,999.3	32,002.3
Strawberry	37,624.0	38,993.6	43,725.3	47,843.7	56,230.2	52,496.8	58,352.2	61,971.1	64,111.5
Others	886.1	949.3	1,330.0	1,480.6	2,096.0	1,696.7	1,707.2	2,838.8	2,741.2
Quantities ('000 Kg)									
Blackberry	285.7	266.1	247.7	293.3	407.7	443.7	431.4	476.3	451.6
Blueberry	1,470.1	1,631.7	2,144.7	2,529.1	2,718.4	2,950.0	3,379.9	3,509.9	3,688.0
Cherries	988.0	1,496.4	1,450.7	1,414.8	1,634.2	1,551.7	1,671.5	1,372.2	1,635.1
Grapes	15,502.5	16,335.2	15,828.4	17,698.3	18,915.6	19,751.4	20,298.9	22,090.2	22,076.4
Raspberry	981.9	1,193.8	1,646.4	1,941.2	2,387.0	2,470.6	2,925.0	2,949.2	2,975.6
Strawberry	8,151.6	8,456.8	9,406.7	10,273.8	11,625.4	10,366.9	11,421.5	11,843.0	12,344.9
Others	119.3	131.2	215.1	231.8	291.4	235.4	257.2	368.6	388.6

Source: Own elaboration based on Kantar Worldpanel data.

Table A2 - Expenditure and quantities purchased of soft fruits by origin

		2013	2014	2015	2016	2017	2018	2019	2020	2021
Expenditure (£ '000)										
Blackberry	Scottish	.0	12.7	77.6	84.0	140.1	152.8	236.3	233.6	166.5
	Rest UK	868.4	767.4	471.8	871.6	443.7	543.5	698.2	862.7	462.8
	EU	136.7	156.5	651.8	77.8	.0	.0	100.3	825.5	832.0
	Rest	1,421.6	1,523.1	1,526.2	2,461.3	3,921.8	4,102.0	3,808.7	3,615.5	3,860.8
Blueberry	Scottish	.0	.0	.0	.0	349.2	227.4	222.3	60.6	.0
	Rest UK	384.6	918.4	337.0	677.9	127.7	1,626.3	789.1	381.2	.0
	EU	4,652.4	4,168.9	4,301.5	4,172.6	3,414.4	5,550.7	4,460.3	3,378.1	2,447.3
	Rest	9,729.0	9,780.4	14,420.	18,923.	22,418.	21,463.	26,824.	29,527.	31,375.
Cherries	Scottish	.0	.0	.0	.0	.0	.0	.0	.0	99.2
	Rest UK	361.5	548.2	844.0	670.8	374.6	805.0	1,059.5	855.9	1,449.6
	EU	1,229.5	2,011.0	1,177.1	1,233.5	2,383.6	2,690.7	2,781.9	2,785.2	3,178.8
	Rest	4,043.2	5,387.9	6,432.2	6,824.4	7,242.6	6,292.0	5,385.4	4,807.5	5,450.6
Grapes	Scottish	.0	.0	.0	.0	.0	.0	.0	.0	.0
	Rest UK	143.4	148.9	165.9	178.1	201.8	364.4	165.2	27.5	49.1
	EU	5,517.3	7,761.0	11,851.	20,590.	24,415.	20,018.	18,941.	11,811.	10,289.
	Rest	49,480.	48,979.	44,169.	39,925.	43,881.	48,682.	47,554.	59,147.	60,083.
Raspberry	Scottish	109.7	243.2	430.6	2,064.7	1,228.0	1,071.9	569.2	653.5	833.0
	Rest UK	4,038.6	6,371.5	4,083.5	5,835.6	9,562.9	9,379.5	7,022.4	7,116.6	6,915.7
	EU	4,073.1	3,970.7	5,142.6	3,774.3	3,401.8	4,218.1	5,265.6	5,469.5	4,818.7
	Rest	2,193.4	2,191.8	7,427.0	10,727.	12,487.	12,708.	18,156.	18,759.	19,434.
Strawberr	Scottish	1,521.0	530.2	1,069.8	742.7	1,970.8	2,564.6	2,746.3	2,135.3	3,452.8
	Rest UK	21,137.	19,474.	14,385.	23,228.	21,027.	23,578.	21,850.	20,742.	20,233.
	EU	7,212.1	7,054.4	14,217.	9,350.7	8,676.4	6,449.5	19,412.	23,318.	26,363.
	Rest	7,753.8	11,934.	14,052.	14,521.	24,555.	19,904.	14,343.	15,775.	14,061.
Others	Scottish	.0	.0	.0	.0	.0	.0	.0	.0	.0
	Rest UK	181.1	219.4	305.3	228.2	216.6	295.1	295.2	497.6	723.0
	EU	80.4	111.2	140.8	313.7	413.0	130.4	390.9	529.5	160.1
	Rest	624.6	618.7	884.0	938.8	1,466.3	1,271.1	1,021.1	1,811.8	1,858.0
Quantities ('000 Kg)										
Blackberry	Scottish	.0	1.0	5.8	6.3	19.6	18.5	23.7	24.2	17.7
	Rest UK	96.0	87.7	49.8	71.2	40.0	53.3	69.6	85.0	46.6
	EU	12.3	14.6	60.5	6.1	.0	.0	8.5	68.2	66.9
	Rest	177.4	162.9	131.5	209.7	348.1	371.9	329.6	298.9	320.4
Blueberry	Scottish	.0	.0	.0	.0	34.1	22.0	23.9	6.8	.0
	Rest UK	36.3	93.9	35.6	70.2	14.0	146.9	67.1	33.1	.0
	EU	408.8	523.9	490.3	420.7	424.0	619.9	539.5	405.2	305.6
	Rest	1,025.0	1,014.0	1,618.8	2,038.2	2,246.3	2,161.2	2,749.3	3,064.8	3,382.4
Cherries	Scottish	.0	.0	.0	.0	.0	.0	.0	.0	17.1
	Rest UK	62.7	72.3	100.9	57.7	54.1	86.9	173.6	108.6	212.3
	EU	241.3	454.3	279.6	162.4	328.8	420.2	499.8	422.8	506.0
	Rest	684.0	969.8	1,070.2	1,194.7	1,251.2	1,044.6	998.0	840.8	899.7
Grapes	Scottish	.0	.0	.0	.0	.0	.0	.0	.0	.0
	Rest UK	34.0	38.8	48.9	58.3	57.5	101.8	61.8	4.9	7.3
	EU	1,775.5	2,476.7	3,735.7	6,576.2	6,826.4	5,785.0	6,195.6	3,936.4	3,415.1
	Rest	13,693.	13,819.	12,043.	11,063.	12,031.	13,864.	14,041.	18,149.	18,653.
Raspberry	Scottish	10.5	22.8	43.1	203.2	125.6	115.5	59.7	67.2	82.5
	Rest UK	405.8	590.3	419.3	529.2	891.2	845.4	678.7	690.0	661.1
	EU	347.0	350.3	461.4	301.2	276.0	354.1	475.8	468.9	441.5
	Rest	218.6	230.4	722.6	907.6	1,094.1	1,155.6	1,710.8	1,723.1	1,790.5
Strawberr	Scottish	274.6	98.5	237.7	172.5	746.8	599.3	614.0	372.1	717.4
	Rest UK	4,166.8	3,757.5	2,653.9	4,341.1	3,775.1	4,408.5	4,173.5	3,859.6	3,598.8
	EU	1,672.5	1,557.2	3,163.2	2,160.0	1,724.1	1,261.2	3,601.2	4,399.1	5,245.8
	Rest	2,037.7	3,043.7	3,351.8	3,600.2	5,379.4	4,097.9	3,032.8	3,212.2	2,782.9
Others	Scottish	.0	.0	.0	.0	.0	.0	.0	.0	.0
	Rest UK	34.3	39.6	83.2	56.2	63.6	76.5	100.1	125.3	173.8
	EU	9.0	11.3	24.7	70.4	63.4	25.2	54.0	74.0	27.3
	Rest	76.0	80.2	107.3	105.2	164.5	133.7	103.1	169.3	187.5

Source: Own elaboration based on Kantar Worldpanel data.

Table A-3: Linquad regressions

Parameters	Socioeconomic groups							
	£0 to £29,000		£30,000 to £49,999		£50,000 to above		Unknown	
	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
A01	-94.239000	-1.16	122.170000	4.79	1439.600000	15.92	3021.900000	17.32
A02	1518.500000	9.73	2160.700000	12.90	-853.590000	-12.16	1848.200000	12.74
A03	896.880000	12.77	779.320000	12.13	2020.800000	13.18	4595.400000	15.64
A04	1881.300000	12.40	751.550000	14.37	1819.300000	13.42	2747.500000	15.70
A05	1741.300000	13.19	637.410000	12.22	1313.700000	13.26	5189.800000	16.12
A06	175.460000	7.59	141.860000	9.65	26.849000	3.20	651.430000	10.33
A07	-4290.400000	-11.16	1705.600000	9.87	-106.840000	-4.27	-4010.400000	-14.90
B0101	-121.810000	-1.12	177.490000	4.88	2058.500000	15.92	4323.100000	17.32
B0102	-801.290000	-2.81	-1685.800000	-7.62	179.450000	1.57	-558.460000	-2.09
B0103	-1391.500000	-5.12	-2282.800000	-15.16	1547.900000	12.48	-1327.600000	-6.43
B0104	-4456.400000	-12.61	-2409.400000	-12.87	610.040000	3.85	-1960.000000	-7.88
B0105	-1533.700000	-8.98	-1426.000000	-13.43	493.360000	3.45	-855.630000	-3.94
B0106	456.360000	1.82	1067.300000	11.03	374.630000	2.55	960.080000	3.28
B0107	390.890000	1.29	1178.000000	5.50	828.140000	4.48	-152.020000	-0.61
B0108	3956.800000	13.85	2061.000000	11.07	874.910000	5.62	1851.100000	8.25
B0109	2958.600000	7.16	3078.500000	14.11	3144.400000	17.42	52.907000	0.17
B0110	1557.500000	3.26	1359.700000	4.67	2053.800000	12.10	-39.877000	-0.11
B0111	1266.400000	5.33	-320.370000	-1.89	1152.700000	7.94	-688.500000	-4.26
B0112	-525.520000	-1.99	-134.800000	-0.57	558.540000	5.36	-489.580000	-3.70
B0113	-2509.400000	-9.09	-4739.100000	-17.58	520.160000	5.20	-2132.900000	-8.55
B0114	131.110000	7.45	20.955000	1.53	-20.802000	-2.54	45.992000	3.32
B0201	2023.600000	9.73	3087.800000	12.91	-1218.600000	-12.15	2643.100000	12.75
B0202	2366.100000	5.67	2676.400000	16.04	1941.900000	16.91	-4320.300000	-16.54
B0203	3826.300000	12.19	-3666.200000	-17.00	-2259.200000	-12.27	-5085.100000	-17.44
B0204	-5760.000000	-11.85	-467.480000	-5.13	206.130000	2.46	-1581.700000	-9.34
B0205	13658.000000	14.70	10580.000000	14.49	9069.400000	14.16	11188.000000	14.79
B0206	3872.800000	14.68	-3465.500000	-12.65	2763.000000	14.58	2054.300000	9.43
B0207	-8780.000000	-14.79	-2225.800000	-16.96	-5750.400000	-13.96	-8140.000000	-15.62
B0208	11023.000000	13.74	7130.300000	15.28	2017.300000	14.99	-1593.400000	-3.32
B0209	-7294.400000	-10.38	-2597.900000	-11.46	-3433.300000	-13.81	-3382.000000	-13.30
B0210	-11092.000000	-13.82	1346.100000	9.31	-4408.000000	-15.26	-4097.300000	-11.88
B0211	2191.300000	6.20	-4009.200000	-13.31	3098.800000	12.34	2151.000000	9.04
B0212	283.040000	0.86	598.140000	6.07	642.930000	9.81	-5138.900000	-9.29
B0213	-7258.400000	-13.13	-5233.200000	-12.97	-6528.700000	-13.22	-15223.000000	-17.18
B0214	369.380000	7.31	313.510000	8.57	234.710000	5.34	255.140000	5.26
B0301	1192.800000	12.80	1111.300000	12.14	2884.600000	13.19	6564.800000	15.65
B0302	5865.900000	12.14	2000.500000	13.38	2750.900000	13.11	6119.500000	15.91
B0303	1187.600000	6.56	188.120000	3.99	1006.600000	8.86	4500.200000	9.50
B0304	-769.960000	-6.41	-4017.800000	-13.12	-1909.000000	-12.37	-2995.700000	-14.72
B0305	-12318.000000	-11.14	-4408.100000	-11.76	-9494.700000	-12.49	-21338.000000	-14.19
B0306	-5052.300000	-10.43	-4810.500000	-12.23	-2044.700000	-13.06	-6887.200000	-15.32
B0307	11226.000000	11.08	9600.600000	12.25	10129.000000	12.60	27110.000000	14.48
B0308	12018.000000	11.91	6378.600000	12.87	7726.000000	13.45	22971.000000	15.77
B0309	-11365.000000	-11.81	-5896.700000	-13.25	-6148.000000	-13.16	-17170.000000	-15.54
B0310	-2372.300000	-12.47	-556.690000	-13.36	-730.880000	-8.49	-4582.100000	-11.40
B0311	-5565.900000	-11.74	-2106.800000	-12.42	134.090000	5.70	-2352.500000	-15.49
B0312	779.170000	5.88	832.860000	13.84	-1531.900000	-7.83	-4048.700000	-10.17
B0313	-711.170000	-11.39	1198.600000	14.11	-1100.700000	-11.68	-1778.700000	-10.02
B0314	-178.950000	-1.49	44.021000	0.53	-138.600000	-2.40	192.930000	1.93
B0401	2511.700000	12.40	1075.500000	14.37	2601.800000	13.43	3930.800000	15.70
B0402	2451.400000	12.53	1193.900000	11.73	663.670000	14.00	6810.600000	15.38
B0403	722.580000	7.21	370.350000	17.54	1468.500000	12.69	1087.400000	12.94
B0404	2147.200000	14.08	337.420000	18.13	-43.043000	-5.70	1867.900000	12.56
B0405	1108.600000	6.59	-596.180000	-14.91	-1619.000000	-12.57	-880.560000	-15.60
B0406	-2206.800000	-11.48	289.000000	9.67	-356.110000	-11.18	-1415.400000	-13.56
B0407	-377.220000	-4.36	-374.290000	-7.86	-784.840000	-10.87	-4805.200000	-14.10

(Continued)

Parameters	Socioeconomic groups							
	£0 to £29,000		£30,000 to £49,999		£50,000 to above		Unknown	
	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
B0408	-166.990000	-1.96	-570.520000	-15.11	-365.290000	-17.03	4635.400000	15.30
B0409	173.630000	8.95	73.890000	6.12	2813.300000	11.99	961.120000	9.49
B0410	5311.200000	11.82	1556.900000	12.83	3579.900000	13.27	7205.700000	14.57
B0411	-566.910000	-11.72	732.490000	15.46	-245.010000	-11.22	1957.200000	12.14
B0412	-3545.000000	-11.19	-1695.900000	-12.85	-2978.600000	-12.67	-5927.700000	-14.26
B0413	-7947.100000	-11.56	-3485.700000	-12.88	-4595.400000	-12.94	-13303.000000	-14.10
B0414	1252.000000	4.49	1686.700000	9.34	688.300000	6.08	1166.900000	5.02
B0501	2326.800000	13.20	914.130000	12.24	1880.100000	13.27	7421.500000	16.13
B0502	-1166.400000	-9.51	-995.140000	-16.83	-644.190000	-4.90	1856.700000	9.68
B0503	1808.200000	10.26	2344.200000	17.18	2969.600000	13.11	4303.600000	13.35
B0504	1237.700000	13.74	645.740000	5.63	326.030000	3.27	5223.500000	13.56
B0505	5298.600000	10.87	3646.500000	11.95	-818.710000	-8.67	11083.000000	17.29
B0506	-6358.400000	-15.41	-1718.200000	-12.58	-1868.900000	-16.20	5879.900000	8.24
B0507	-9094.100000	-13.16	-2166.600000	-10.29	-2908.000000	-12.70	714.730000	2.64
B0508	12706.000000	13.98	560.650000	5.41	2552.100000	13.72	7109.700000	12.88
B0509	5538.700000	14.16	3107.900000	14.42	-411.620000	-6.27	3792.600000	9.10
B0510	-708.250000	-3.60	44.803000	0.37	416.610000	3.27	-4891.400000	-14.55
B0511	-7470.700000	-14.75	-3086.300000	-14.77	-3771.000000	-12.48	-2872.500000	-11.00
B0512	-1153.600000	-3.57	-43.537000	-0.48	1670.400000	13.26	-8882.000000	-17.27
B0513	-12873.000000	-12.61	-1412.100000	-9.95	175.180000	4.30	-8541.100000	-10.43
B0514	557.360000	12.03	262.990000	7.14	134.640000	3.76	270.340000	6.29
B0601	228.650000	7.56	199.990000	9.65	33.887000	2.90	921.010000	10.30
B0602	-2785.800000	-11.40	-1159.500000	-12.43	-1458.400000	-12.67	-3996.700000	-15.81
B0603	-1578.700000	-10.46	-345.500000	-9.34	-854.670000	-12.45	-2658.000000	-12.42
B0604	319.620000	7.79	873.500000	14.23	206.030000	5.22	393.780000	6.39
B0605	2104.800000	9.72	169.380000	5.52	1438.400000	11.55	3652.900000	11.85
B0606	4131.100000	11.26	2869.300000	12.59	2021.000000	12.97	6908.100000	15.43
B0607	1331.400000	14.27	-252.550000	-9.97	433.080000	14.30	325.970000	9.44
B0608	-2620.500000	-13.57	-583.680000	-13.84	-507.130000	-13.49	-2727.300000	-15.86
B0609	4053.000000	11.85	1717.500000	12.75	2087.700000	13.28	6906.200000	15.30
B0610	179.060000	12.47	-527.370000	-13.48	-168.660000	-8.70	-678.730000	-15.33
B0611	489.900000	13.34	89.073000	10.69	-836.900000	-11.80	-1830.400000	-14.33
B0612	-1750.500000	-14.00	-1285.000000	-13.63	-1000.800000	-14.32	-1884.900000	-15.96
B0613	-865.250000	-9.09	-1027.300000	-11.95	-553.490000	-12.64	-2339.000000	-14.26
B0614	-559.250000	-6.96	170.730000	0.61	180.630000	1.17	1003.200000	4.00
B0701	-5715.200000	-11.15	2440.100000	9.88	-150.160000	-4.20	-5728.600000	-14.90
B0702	-257.970000	-1.12	358.060000	5.81	1873.400000	16.78	2117.000000	5.90
B0703	-1274.800000	-5.04	-2422.100000	-11.42	1884.300000	8.25	2535.500000	7.36
B0704	-822.840000	-4.02	-1907.600000	-17.11	2229.300000	11.27	2490.800000	6.21
B0705	1111.300000	2.57	3484.000000	14.51	2251.200000	6.29	5284.100000	11.30
B0706	6535.400000	14.02	4922.400000	17.07	1121.600000	5.88	5858.000000	14.45
B0707	2019.800000	6.10	2543.600000	6.52	-1674.600000	-8.03	1900.700000	5.79
B0708	783.430000	2.26	2448.600000	9.58	-1570.000000	-15.78	3818.400000	11.12
B0709	117.900000	0.53	-717.420000	-5.14	275.670000	4.98	4148.200000	10.60
B0710	586.870000	1.31	-896.510000	-3.63	1052.500000	3.63	3589.200000	14.75
B0711	1850.600000	5.99	217.350000	1.25	115.170000	0.66	1312.300000	4.74
B0712	3701.100000	10.74	2373.700000	8.11	805.980000	4.68	3329.400000	12.33
B0713	8072.200000	15.50	7664.600000	17.40	3051.500000	18.68	3240.000000	10.24
B0714	75.220000	4.21	76.662000	4.87	-16.831000	-1.75	4.399000	0.22
C0101	-31.145000	-6.74	8.388300	2.87	10.177000	4.73	20.970000	8.01
C0102	362.250000	1.40	-101.750000	-0.69	-304.380000	-3.57	277.270000	2.56
C0103	-145.490000	-1.25	36.617000	0.42	-68.811000	-1.57	-40.537000	-0.60
C0104	3063.400000	14.06	552.070000	7.69	-1118.100000	-11.66	-50.820000	-0.34
C0105	519.760000	1.32	-67.944000	-0.37	75.676000	0.70	-81.456000	-0.48
C0106	-1853.100000	-6.62	-271.790000	-0.99	208.340000	1.16	-765.420000	-3.06
C0107	-72.186000	-0.39	-82.221000	-1.05	26.134000	0.65	23.109000	0.36
C0201	3493.800000	6.06	1407.500000	6.65	1642.600000	4.97	-21.269000	-0.09

(Continued)

Parameters	Socioeconomic groups							
	£0 to £29,000		£30,000 to £49,999		£50,000 to above		Unknown	
	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
C0202	-7235.100000	-10.19	-3887.400000	-11.12	-4105.800000	-14.16	-2667.100000	-8.14
C0203	-49.101000	-0.14	-460.400000	-2.06	-624.060000	-4.25	-276.230000	-1.20
C0204	2533.100000	10.04	5248.000000	13.15	935.360000	11.04	11902.000000	13.97
C0205	973.330000	1.56	1227.000000	5.14	858.130000	3.73	-2009.700000	-5.43
C0206	-81.503000	-0.17	1885.900000	4.80	1290.100000	3.87	1438.100000	2.45
C0207	132.260000	0.28	319.280000	1.93	409.910000	2.47	-226.420000	-1.02
C0301	-5610.400000	-12.47	-1564.900000	-10.20	-248.700000	-1.48	-278.770000	-0.81
C0302	-5831.400000	-9.47	-1620.900000	-10.52	-2753.800000	-12.57	-2092.400000	-7.34
C0303	-6800.500000	-12.04	-3120.000000	-14.89	-1945.000000	-8.82	-2375.100000	-6.65
C0304	1931.600000	14.47	3569.600000	12.46	5917.600000	13.74	14912.000000	16.36
C0305	-1508.500000	-3.54	-2153.700000	-10.94	-3304.400000	-11.49	-2302.800000	-3.89
C0306	19488.000000	13.95	6850.800000	15.12	7541.300000	12.66	3638.900000	3.50
C0307	-1477.700000	-2.39	-17.605000	-0.09	22.661000	0.10	-344.790000	-1.00
C0401	7729.000000	13.93	4926.000000	15.60	2227.400000	12.17	1928.800000	5.39
C0402	1872.600000	6.76	2224.900000	11.22	1104.600000	7.74	-2094.400000	-5.34
C0403	-369.980000	-0.30	-631.580000	-1.90	-110.130000	-0.44	1596.700000	4.38
C0404	-5.597000	-0.07	75.492000	3.02	-1.048700	-0.03	-12.874000	-0.46
C0405	17486.000000	13.92	11114.000000	15.10	7243.300000	16.26	9808.600000	19.54
C0406	651.310000	2.90	-85.952000	-0.80	-525.950000	-3.46	-5502.400000	-9.79
C0407	9622.000000	12.71	3345.200000	5.98	1379.900000	4.87	-558.720000	-1.01
C0501	1950.500000	2.97	1625.300000	4.92	1360.000000	4.79	906.960000	2.97
C0502	1355.500000	2.02	-153.350000	-0.54	-413.140000	-2.01	1056.100000	4.54
C0503	-1195.200000	-3.49	-204.880000	-0.83	-306.400000	-2.10	-330.910000	-1.71
C0504	16768.000000	12.98	8143.300000	12.92	3694.200000	13.72	1572.300000	3.82
C0505	-7944.100000	-14.24	-3634.300000	-14.34	-2811.400000	-8.96	-4365.900000	-9.90
C0506	-2507.900000	-4.54	520.340000	1.59	-1270.500000	-7.12	2443.800000	5.92
C0507	-1077.100000	-2.25	-335.870000	-1.67	-45.633000	-0.32	-355.660000	-1.85
C0601	89.694000	0.89	1074.600000	8.68	253.930000	3.09	7182.600000	14.71
C0602	-6029.100000	-9.44	-1526.000000	-13.47	-390.120000	-6.15	2877.000000	14.71
C0603	-13969.000000	-12.65	-7165.400000	-13.12	-6867.200000	-14.34	-6213.600000	-15.88
C0604	-206.440000	-3.68	-13.423000	-0.71	110.120000	2.55	4320.100000	11.39
C0605	-6587.800000	-12.51	-2143.100000	-14.47	-1100.400000	-12.83	2051.300000	9.22
C0606	-17957.000000	-12.40	-8261.600000	-13.39	-9683.900000	-14.05	-19694.000000	-16.26
C0607	-3592.200000	-13.73	-3719.700000	-17.07	-742.450000	-11.32	-2328.900000	-15.47
C0701	254.870000	0.85	-324.390000	-1.81	-152.730000	-1.32	425.170000	2.62
C0702	-464.940000	-1.72	358.820000	2.33	-174.340000	-1.42	-132.480000	-0.86
C0703	5.921000	0.05	42.190000	0.45	7.516700	0.13	-60.001000	-0.62
C0704	6656.600000	11.26	238.050000	1.30	-1136.500000	-9.30	1746.100000	6.68
C0705	-295.140000	-0.87	639.900000	3.04	-183.910000	-1.30	-560.010000	-2.40
C0706	-1984.300000	-6.86	-2259.200000	-8.85	499.010000	2.34	249.820000	0.67
C0707	-184.200000	-0.98	11.373000	3.11	5.946100	1.71	6.210300	0.95
I01	0.000018	1.38	0.000051	3.62	0.000052	4.22	0.000011	1.41
I02	0.000203	6.69	0.000018	0.66	0.000282	5.12	0.000176	6.00
I03	0.000447	10.17	0.000276	6.90	0.000323	6.10	-0.000006	-0.11
I04	0.000611	6.17	0.000160	1.11	0.000374	3.84	0.000990	7.42
I05	0.000159	5.26	0.000105	3.77	0.000305	6.39	0.000109	4.44
I06	0.002077	18.94	0.001776	13.42	0.002109	16.29	0.000849	7.76
I07	0.000021	1.59	-0.000010	-0.56	0.000082	5.35	0.000053	4.55
Log-Likelihood	-9081.70		-8576.20		-8362.81		-8536.21	
Obs.	116		116		116		116	