The effects of competition, liquidity and exports on markups: Evidence from the UK food and beverages sector

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Abstract: This study investigates the pricing decisions of the UK food and beverages sector over 2007-2016. The markup model formulated by Hall (1988) and Roeger (1995) is employed where market power is expressed in terms of pricing decisions reflected by the difference between the price level and the marginal cost of production. The analysis is conducted under three steps: the first step estimates the markup ratio of the UK food and beverages sector over 2007-2016; the second step provides the price-cost margin of the 32 4 digit level NACE Rev.2 constituent industries over 2007-2016; and the last step tests the relationship between cross-sectional estimates of market power and the structural effects of concentration, liquidity and exports over 2009, 2011, 2015 and 2016. The results suggest the presence of imperfect competitive conduct in the sector, while the three structural effects appear to have a significant influence on the pricing decisions of the UK food and beverages industries.

Keywords: Markup ratio, UK, Food and beverages sector, Concentration, Liquidity, Hall-Roeger approach.

JEL Classifications: L16, L13, L66, D43, E31

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1. Introduction

The empirical literature of investigating the presence and extent of market power in various industries has been focused on the OECD countries over the recent years (Christopoulou and Vermeulen, 2012; Afonso and Costa, 2013; Polemis and Fotis, 2016). The UK is considered to be amongst the strongest economies in this group as the value of nominal GDP is the fifth largest across the globe. The financial crisis of 2008 restricted production and demand in many economies which led to the introduction of contractionary fiscal policies (Batini et al., 2012; Bird and Mandilaras, 2013). The UK was amongst those economies that implemented such policies in order to achieve particular fiscal targets, thus causing a decrease in aggregate demand (Farnsworth, 2011; O'Hara, 2015). As a result, production was expected to fall and alter the market conditions in various industries.

According to the World Bank database (2016a), the most influential industries in the UK economy are the service and manufacturing industries. In particular, the service industry accounts for 78% of gross value added, while the manufacturing industry accounts for 11%. The latter industry is the eleventh strongest industry across the world and contributes approximately 54% to UK exports. Consequently, the manufacturing industry is of crucial importance to the economic activities of the UK as many primary consuming needs are satisfied by manufacturing products. For this reason, the price level charged by producers is of great importance to consumers given that many products do not have immediate substitutes and thus, their consumption is necessary.

The pricing decisions of the UK manufacturing industry have been investigated by several studies, such as Görg and Warzynski (2003, 2006), under which they identified a significant but low degree of overpricing behaviour. According to the theory of perfect competition, there is no evidence of overpricing decisions and thus, market power, when the selling price is equal to the marginal cost of production. The aforementioned studies utilize this particular concept in order to identify the degree of imperfect competition in the UK manufacturing industry. However, a significant limitation lies on the fact that the manufacturing firms are grouped into 2-digit ISIC aggregated sectors. An empirical analysis of this kind cannot identify the pricing decisions and behaviour of constituent industries or even individual firms.

On the other hand, there are hardly any studies that extend the analysis of market power to a disaggregated level. In particular, the food and beverages sector is the most influential sector in the UK manufacturing industry as it accounts for 22% of gross manufacturing value (Prodcom, UK, 2016). For this reason, the pricing behaviour of the constituent industries should be investigated in order to obtain a solid outcome on how firms tend to behave in the UK manufacturing sectors.

The price level and the cost of production are considered to be key elements of identifying the competitive structure in various markets. Competition tends to increase output growth by enhancing economic activity through increased production and consumption. This way, firms will increase their sales and innovation can be used as a tool of attracting additional customers. Consequently, there is a need of market indicators reflecting pricing and production decisions that can estimate the degree of market power in various industries.

The methodology presented by Hall (1988) and Roeger (1995) is going to be used in the present study to investigate the market structure in the UK food and beverages sector over 2007-2016[3]. In particular, it is employed under a three-step step approach as presented by Rezitis and Kalantzi (2011). The first step estimates the price-cost margin for the food and beverages sector over the period 2007-2016. The second step provides the markup ratios for

[3] This period is very crucial to the UK economy as three major effects occurred: the global financial crisis in 2008, the implementation of austerity policies initiated in 2010 and the EU referendum that took place in 2016.

the constituent 32 4-digit NACE Rev.2 food and beverages industries of the panel data set individually. Lastly, the third step identifies the relationship between the cross-sectional markup ratios obtained by the second step and the effects of concentration, liquidity and exports.

The main contribution of this study is to identify the price-cost margin exercised by the UK food and beverages industries and test whether their relationship is significant with the aforementioned structural effects. For this reason, this paper aims to complement the empirical literature of pricing decisions and identify whether market concentration, liquidity constraints and exports can influence those decisions.

This paper is organised as follows: Section 2 includes the empirical literature review of the price-cost margin approach; Section 3 provides the model formulation and data analysis; Section 4 presents and discusses the empirical results; and section 5 offers a conclusion.

2. Literature Review

One of the major contributions in the empirical literature of pricing decisions has been made by Hall (1988) utilizing the assumption that under perfect competition the price level charged by firms is equal to the marginal cost of production. Hall showed that the nominal growth rate of the Solow Residual does not depend on the nominal growth rate of capital productivity, meaning that the calculation of the price-cost margin can be achieved without observing the marginal cost of production.

Roeger (1995) extended this particular framework by incorporating elements that eliminate the unobservable productivity shock from the price-cost margin calculation, providing an unbiased estimate of market power denoted in terms of pricing decisions. Thereby, the markup ratio is expressed as the difference between the growth rate of value added and the growth rate of inputs.

The empirical formulation developed by Hall (1988) and Roeger (1995) corresponds to the Hall-Roeger approach and it is employed by many studies to investigate the pricing decisions of various sectors operating in the manufacturing industry. In particular, there are several studies that investigated the price-cost margin in the United States manufacturing industry. Shapiro (1987) and Norrbin (1993) estimated a positive price-cost margin exercised by the US manufacturing sectors suggesting that the market structure corresponds to imperfect competition. Mazumder (2014) supports the presence of countercyclical and falling markups since the 1960s because the price-cost margin depends on the share of manufacturing imports. For this reason, the increase of foreign competition over the years forced the US firms to adjust their price level downwards, thus converging to perfect competition.

Moreover, Martins et al. (1996) applied the Hall-Roger approach in 14 OECD manufacturing sectors over 1970-1992. The findings support the persistence of positive price-cost margins across the industries, thus validating the presence of imperfect competition. Bloch and Olive (2003) studied the pricing decisions in the manufacturing sectors of the United Kingdom, Germany, the United States and Japan over 1970-1991. They found that the pricing decisions of industries with high concentration are more likely to be influenced by competing foreign prices in contrast with low concentrated domestic-oriented industries that charge a lower selling price.

Molnár and Bottini (2010) investigate the degree of market power in the manufacturing and service industries of a number of OECD European countries over 1993-

2006. The estimates suggest that competition is more persistent in the sectors of the Scandinavian countries (excluding Sweden) and the United Kingdom, and lower in the sectors of Central European countries (see Polemis, 2014c). Christopoulou and Vermeulen (2012) also identified the presence of imperfect competition in the industries of several European countries, concluding that the manufacturing industry on average is more competitive compared to the service industry.

Nevertheless, Polemis and Fotis (2016) contradict these findings arguing that there is no evidence of imperfect competition in the majority of manufacturing and service sectors of the Eurozone, the US and Japan over 1970-2007. The main reason of this outcome refers to the openness of the constituent sectors to internationalisation and deregulation which results in low markup ratios due to intense competition. Amador and Soares (2014) provided evidence of market power in the Portuguese labour and product markets formulating a data set of 350,000 firms over 2006-2009. They found that high bargaining power results in higher price levels, thus suggesting that downward wage rigidity results in persistent higher price-cost margins.

Rezitis and Kalantzi (2011, 2012a, 2012b, 2013, 2016) carried out a similar study for the Greek food and beverages sector and the manufacturing industry overall. Their findings support the presence of relatively high markups across the manufacturing sectors and over time, thus suggesting that the Greek manufacturing industry operates under imperfect competitive conduct. Polemis (2014a, 2014b, 2014c) also verified this outcome by concluding that the Greek manufacturing industry exhibits positive markups but it is less competitive compared to the service industry.

Similar studies have also been developed for the UK manufacturing industry in recent years. In particular, Görg and Warzynski (2003) tested the markup dynamics over 1990-1996 and found that exporting firms tend to charge a higher markup ratio compared to non-exporting firms even if they face foreign competition. A reason for this behaviour refers to product differentiation as product heterogeneity may be preferable to consumers even if the selling price is higher reflecting the cost of innovation. Görg and Warzynski (2006) also provided evidence that the price-cost margin gradually declined over 1989-1997 due to the industry's exposure to foreign competition given the implementation of the Single European Market (SEM) in 1992. As a result, it can be concluded that the UK manufacturing industry has been experiencing positive price-cost margins over time, but their value is relatively low and close to perfect competition.

Overall, the aforementioned studies support the presence of imperfect competition across many sectors through overpricing decisions. This shows that firms are able to exercise their market power on their pricing decisions in order to acquire additional profits. Consequently, social welfare is inefficient because consumer surplus is exploited. In this context, the Hall-Roger approach is a sufficient tool to investigate the pricing decisions and thus, the degree of market power in several sectors.

3. Model formulation and data

3.1. Empirical model

The model employed in this study corresponds to the Hall (1988) and Roeger (1995) approach in order to obtain unbiased estimates of market power expressed in terms of pricing decisions. In particular, an industry is assumed that faces a production function subject to constant returns to scale. It produces output (y_t) according to a homogeneous production function f utilizing three inputs: intermediate inputs (m_t)[4], labour (l_t) and capital (k_t)

$$y_t = \theta_t f(m_t, l_t, k_t) \tag{1}$$

where θ_t is a total factor productivity index (Hicks neutral productivity term) capturing technological progress over time and t denotes the time interval. Consequently, the final formulation capturing the price-cost margin of the industry as utilized by Rezitis and Kalantzi (2011) is the difference between the following equations:

$$\Delta Y_t = \left(\frac{\Delta y_t}{y_t} + \frac{\Delta p_t}{p_t}\right) - \left(\frac{\Delta k_t}{k_t} + \frac{\Delta u_t}{u_t}\right) \tag{2a}$$

$$\Delta X_t = a_{mt}\left[\left(\frac{\Delta m_t}{m_t} + \frac{\Delta pm_t}{pm_t}\right) - \left(\frac{\Delta k_t}{k_t} + \frac{\Delta u_t}{u_t}\right)\right] + a_{lt}\left[\left(\frac{\Delta l_t}{l_t} + \frac{\Delta w_t}{w_t}\right) - \left(\frac{\Delta k_t}{k_t} + \frac{\Delta u_t}{u_t}\right)\right] \tag{2b}$$

where $a_{m_t} = pm_t m_t / p_t y_t$ is the share of intermediate inputs in output, pm_t refers to the price of intermediate inputs, $a_{l_t} = w_t l_t / p_t y_t$ reflects the share of labour expenses in output, w_t is the wage rate, p_t is the price level of output and u_t is the user cost of capital. ΔY_t reflects the growth rate of output per unit of capital, and ΔX_t represents the growth rate of intermediate inputs and labour expenses per unit of capital.

This formulation is employed to estimate the price-cost margin in the UK food and beverages sector and industries over 2007-2016 and to identify the degree of market power exercised through pricing decisions. The difference between the growth rates of (2a) and (2b) reflects the markup ratio exercised in the industry. When that value is equal to unity, it denotes that output grows exactly equal to production costs and thus, the industry is under

[4] As intermediate inputs we refer to the goods and services used in the intermediate process to produce the final product. Raw materials, semi-finished goods and energy can be considered as some of those inputs.

perfect competition. Any value above unity suggests that the price level is not equal to the marginal cost of production.

Nevertheless, the Hall-Roeger approach has been mainly criticised over the exclusion of any unobservable productivity shocks. As reflected by equations (2a) and (2b), only the growth rates of output and inputs are included in the markup estimation. De Loecker and Warzynski (2012) take into account a production function without assuming constant returns to scale and they allow for serially correlated unobserved productivity shocks affected by firm decisions[5]. In addition, they estimate the markup model in levels and not in first differences, thus increasing the accuracy of the estimates. For this reason, they compare and contrast the results with Hall's model finding a downward bias of the latter model equivalent to 12%. This shows a comparison between the growth rates might underestimate the price-cost margin[6].

Even if such limitations apply, the Hall-Roeger model has been employed across the literature due to its computational simplicity and its inclusion of the price and volume of output and inputs. Also, it allows for firm-level data to be taken into account which extends market analysis to disaggregated industries[7]. For this reason, it has spread across industrial organisation and international trade analyses, thus rendering it a reliable tool of market structure investigation even if unobservable productivity shocks are not taken into account[8].

[5] Recent studies, such as Bellone et al. (2016) and De Loecker et al. (2016) also employ a similar methodology where the markup estimation depends on the elasticity of output with respect to inputs and the share of input expenditures on total value added.

[6] An additional markup formulation employed by Braun and Raddatz (2016) calculates the price-cost margin as the rate of change between labour cost and total value added. Even if the value of intermediate inputs is included, this indicator lacks the growth dynamics of the Hall-Roeger approach and the inclusion of the user cost of capital.

[7] Levinsohn (1993) and Harisson (1994) applied micro-level production data to the Hall model.

[8] As Görg and Warzynski (2003, 2006) employed the Hall-Roeger approach, it would be useful to adopt the same methodology and compare the markup estimates in the UK food and beverages sector.

Consequently, the main objective of the analysis is to investigate whether the 4-digit level industries of the panel set have been exercising their market power on their pricing decisions. The first step estimates the Hall-Roeger equation for the UK food and beverages sector over 2007-2016 to obtain the markup ratio exercised in the market. For simplicity, it is assumed that

$$\Delta Y_t = \mu \Delta X_t + \varepsilon_t \qquad (3)$$

where μ reflects the price-cost margin of the sector over the time period and ε_t is the error term of the equation. The estimated parameter μ takes into account the whole panel of the constituent industries separately in order to obtain an aggregate estimation for the sector.

The second step employs the cross-section specification of Hall-Roeger approach by estimating the markup ratios for every constituent industry individually over 2007-2016. As a result, equation (3) is transformed into

$$\Delta Y_t = \sum_{i=1}^{N} \mu_i DS_i \Delta X_t + \varepsilon_t \qquad (4)$$

where μ_i is the markup ratio of each 4-digit level industry i and DS_i is a cross section dummy variable (i=1,..,N denotes the number of the constituent industries) which is set to one for industry i and zero otherwise. This variable allows the estimation of potential individual effects reflected by the food and beverages industries on the sectorial price-cost margin obtained in the first step.

The third and last step of this study presents the markup formulation under which the markup ratios estimated for the food and beverages 4-digit level industries are tested with respect to three structural effects. Those effects refer to industrial concentration, liquidity and exports which are considered to be of great importance to pricing decisions (Bloch and Olive, 2003). In particular, the markup formulation is provided by

$$\mu_i = c + c_1 h_i + c_2 es_i + c_3 lr_i + c_4 xp_i + v_i \quad (5)$$

where c is the constant term, h_i is the Herfindahl-Hirschman index (HHI) of each 4-digit level industry i expressed as the sum of squares of the market share of each constituent firm in terms of turnover[9], es_i reflects the ratio of each industry's establishments to the number of total establishments in the sector, lr_i denotes the liquidity ratio of each industry i expressed as the sum of net current assets over the sum of current liabilities of each firm[10], xp_i is the intensity of exports of each industry denoted as the ratio of exports to operating revenue and v_i is the independent error term of the formulation. The former measure is used to obtain the value of market concentration and identify whether there is a significant effect on the price-cost margin. It is expected that industries with higher concentration will exhibit a higher markup ratio as they can increase their revenue given their market share.

The second variable is included in equation (5) in order to support the concentration effect in terms of establishments. Theoretically, as the number of firms increases in the market, competition tends to be more intensive by lowering the price level and thus, the price-cost margin[11]. The third measure captures the effect of liquidity in the pricing decisions of firms. In particular, the liquidity ratio is formulated as the ratio of current assets minus any stock, work in progress and finished products over the current liabilities of the constituent firms[12]. Consequently, it reflects the net current assets that firms can liquefy in order to meet their current liabilities. This indicator is considered to express the short-run behaviour of any

[9] See Konings et al. (2005) and Feenstra and Weinstein (2010) for more information on the index formulation.
[10] This indicator has been formulated according to the indications of Makaw and Maksimovic (2013).
[11] However, the number of establishments may not reflect this particular outcome because concentrated sectors with a limited number of firms may own a significantly high number of establishments. For this reason, the establishments ratio is used as a measure of market concentration rather than a proxy of the number of firms (see Rezitis and Kalantzi, 2011).
[12] Net current assets are defined as the sum of trade debtors, bank and deposits, group loans (asset), directors' loans, other debtors, prepayments, deferred taxation and investments. Current liabilities is the sum of trade creditors, short term loans, corporation tax, dividends, accruals and def. inc., social securities and VAT, and other current liabilities.

firm if it is called to meet its current liabilities immediately[13]. For this reason, net current assets are considered to be a crucial factor in pricing decisions as available liquidity may affect the price-cost margin[14].

The last parameter of equation (5) is the intensity of exports of each industry individually. Görg and Warzynski (2003) supported that export-oriented firms tend to charge a higher price-cost margin due to the competitive advantage enjoyed by product differentiation. Therefore, the present study intends to investigate the validity of this claim over 2009, 2011, 2015 and 2016 and conclude whether exporting firms exercise their market power on their pricing decisions. If a similar outcome is obtained, then exporting firms may have the option to adjust their price level to various challenges that may face in international markets by offsetting short-run revenue losses with their available liquid assets.

3.2. Data

Table 1: Market characteristics of the constituent 32 4-digit NACE Rev.2 industries.

4-digit NACE Rev.2 industries	No. of establishments	Size of industry (% of turnover)	Industrial concentration	Current assets/ current liabilities	Export share	Import share
1011	416	7.7%	7.1%	1.808	9%	6%
1012	175	5.4%	17.6%	2.148	1.6%	3%
1013	670	6.6%	3.8%	1.859	2.4%	8.5%
1020	382	3.4%	5.4%	1.571	5.8%	8%
1031	69	2.2%	10.8%	1.562	1.1%	1.2%
1032	51	0.3%	34.2%	0.937	0.5%	1.7%

[13] Also see Braun and Raddatz (2016) on how liquidity constraints influence the price-cost margin.

[14] It is expected that firms with higher liquidity ratio will tend to charge a higher price-cost margin as they can offset any loss in consumer demand with liquid assets (Lane, 2012). However, if economic uncertainty prevails, the primary aim of firms could be their long-run sustainability and survival. For this reason, even firms with relatively high net current assets may tend to charge a lower price-cost margin in order to prevent any loss in consumer demand and thus, any loss in revenue.

1039	515	4.8%	6.1%	1.607	1.6%	5.7%
1041	57	0.9%	11.5%	1.287	2.1%	4.8%
1051	459	8.6%	7.3%	1.579	7.9%	6.3%
1052	297	0.4%	46%	1.666	0.6%	0.5%
1061	177	4.5%	8.3%	1.547	4.8%	2.3%
1071	3,037	7.4%	5.3%	1.418	1.4%	1.2%
1072	278	4.2%	21.6%	1.538	4.4%	3.4%
1073	30	0.1%	36.6%	1.063	0.3%	1.1%
1081	7	0.9%	35.5%	1.836	0.8%	1.4%
1082	422	4.5%	12.4%	4.277	5.8%	6.1%
1083	85	2.5%	21%	1.417	3.8%	2.4%
1084	198	1.9%	13.1%	5.023	1.8%	1.9%
1085	143	2.9%	19%	2.917	6%	15.2%
1091	350	5.1%	5.9%	2.195	3.4%	0.9%
1101	298	5.7%	50%	2.763	27.9%	3.1%
1102	476	0.2%	40%	2.345	0.1%	10.5%
1103	88	1.4%	17%	1.872	0.3%	0.4%
1105	1,223	9.4%	38.2%	1.601	3.3%	1.1%
1106	29	0.6%	26.3%	0.838	1%	0.1%
1107	469	7.5%	9.9%	1.637	1.7%	2.7%
Total	10,401	100%	-	-	100%	100%

Source: FAME database and IBIS World reports.

The dataset is obtained from the FAME, the AMECO, the World Bank databases and the IBISWorld reports. The sample comprises of annual data on 32 4-digit level NACE Rev.2

classification industries over 2007-2016, as presented in Table A1 of appendix[15]. The number of firms taken into consideration in this sample is 1,560 across the UK and all of them satisfy the requirement of available nominal data for the estimation of equations (3)-(5)[16].

For the output variable, operating revenue or turnover is used, as total value added does not allow the inclusion of intermediate inputs used in the production process. The cost of labour is denoted by the wages and salaries variable and labour is captured by the number of employees. The variable of intermediate inputs is reflected by the cost of sales as it corresponds to the direct costs attributable in the production process[17]. Finally, the user cost of capital is formulated as

$$u_t = [(i - \pi_e) + \delta]F_t \tag{6}$$

where $(i - \pi_e)$ is the real interest rate, F_t is the deflator of fixed asset investment for total economy and δ refers to the depreciation rate which is set equal to 5% across all industries[18] (Martins et al., 1996). The observations for this variable have been obtained by the AMECO and the World Bank databases over 2007-2016 and have been fixed across the sample. Thereby, the Hall-Roeger approach and the markup formulation will shed light to the pricing decisions of the UK food and beverages industries and how they are influenced by the structural effects of concentration, liquidity and exports.

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[15] The dataset includes firm-level balance sheets, profit and loss accounts and financial ratios of the constituent UK food and beverages firms.

[16] The FAME database contains information of companies registered at Companies House in the UK and it covers company financials, corporate structures, information on shareholders and subsidiaries with up to 10 years of history. It includes 7 million companies across the UK, where 200,000 companies are in a summary format. However, given that only large companies are obliged to report to Companies House, information about turnover, assets and employment of medium and small firms may not be available.

[17] In particular, the cost of sales includes the cost of materials and services employed in the production process, excluding any indirect expenses such as distribution costs.

[18] An alternative specification of δ could refer to the firm-specific depreciation ratios calculated by the depreciation costs available in the FAME database (see Molnár and Bottini, 2010).

4. Empirical results and discussion

4.1. Hall-Roeger model estimates

The econometrics process is conducted under three steps which aim to present evidence of the price-cost margin exercised by the UK food and beverages industries and test whether pricing decisions are influenced by the structural effects of concentration, liquidity and exports. In particular, the first step employs the Hall-Roeger approach to estimate the markup ratio of the whole food and beverages sector over 2007-2016, thus obtaining an aggregate value of market power. The second step utilizes the cross-sectional specification to investigate the price-cost margin charged by the 32 4-digit level industries individually over 2007-2016. Lastly, the third step tests the relationship between the markup ratios obtained by the previous step and the structural effects of concentration, liquidity and exports. The main aim of this step is to identify whether market concentration, liquidity constraints and exports intensity contribute to market power acquisition reflected in the pricing decisions of the constituent firms.

Table 2: Diagnostics test results of the two Hall-Roeger approaches for the UK food and beverages sector.

Food and beverages	Hall-Roeger model	Hall-Roeger cross-sectional model
Estimation technique	FGLS	FGLS
Pesaran scaled test (LM)[a]	27.418** [0.00]	8.545** [0.00]
Hausman test[b]	0.021 [0.88]	-
White test[c]	55.500** [0.00]	12.806 [0.89]
Likelihood Ratio test[d]	114.17** [0.00]	21.812 [0.57]
Wooldridge test[f]	57.187** [0.00]	96.183** [0.00]
Breusch and Godfrey test (LM)[e]	29.860** [0.00]	60.582** [0.00]

F-statistic	7095.38** [0.00]	4995.8** [0.00]

Notes: The numbers in brackets indicate *p-values.*
[a] H_0: Cross-sectional independence (OLS) versus H_1: Cross-sectional dependence (Random Effects Model).
[b] H_0: Random Effects Model versus H_1: Fixed Effects Model.
[c] H_0: Homoskedasticity versus H_1: Heteroskedasticity of unknown form.
[d] H_0: Homoskedasticity ($\sigma_1{}^2 = \cdots = \sigma_T{}^2 = \sigma^2$) versus H_1: Heteroskedasticity (at least one $\sigma_t{}^2 \neq \sigma^2$), where σ^2 is the variance of normal distribution.
[e] H_0: No first order serial correlation versus H_1: First order serial correlation.
[f] H_0: No serial correlation versus H_1: Serial correlation of at least $k=2$ order.
* Significant at the 5% level of significance.
** Significant at the 1% level of significance.

Table 2 presents the diagnostic tests conducted for the Hall-Roeger approach and in particular, for equations (3) and (4). The whole panel set of the UK food and beverages industries is taken into account in order to identify any problems occurring in the data set. The first test refers to Pesaran's scaled (LM) test (Pesaran, 2004) as corrected by Pesaran, Ullah and Yamagata (2008). This test identifies the presence of cross-sectional dependence across the panel entities and thus, whether a random effects model is more suitable compared to the pooled OLS estimation technique without any individual effects. The results are significant for all equations, suggesting that cross-sectional dependency strongly persists in the panel data set of this study. For this reason, the pooled OLS estimator will not result in correct inferences due to the presence of contemporaneous correlation and thus, the random and fixed effects models will have to be employed[19].

The test developed by Wu (1973) and Hausman (1978) examines whether the random or the fixed effects model is more suitable to the Hall-Roeger approach. In particular, the null hypothesis assumes the absence of correlation between the explanatory variables and the individual effects; however, there exists correlation between those effects and the error term of each equation. For this reason, the random effects model is estimated by employing the generalized least squares (GLS) to take into account the latter presence of serial correlation.

[19] See Tables A2 and A3 in appendix for the cross-sectional dependence, panel unit root and cointegration tests.

On the other hand, the fixed effects model assumes the presence of correlation between the regressors and the individual effects, which is the alternative hypothesis of this test. The estimation technique of the fixed effects model corresponds to the least squares dummy variable (LSDV) technique which takes into account that form of correlation. Consequently, the Hausman test compares those two models in order to conclude which one is more suitable to the data set. The results for this study suggest that the random effects model is more preferable for equation (3), while the fixed effects model is chosen for the cross-sectional specification (4).

Moreover, the presence of heteroskedasticity is tested by employing the likelihood ratio test and White's test (White, 1980), while the presence of serial correlation is obtained by running the Wooldridge test (Wooldridge, 2002) and the Breusch and Godfrey (LM) test (Breusch, 1978; Godfrey, 1978). The presence of heteroskedasticity is identified only in equation (3) for the aggregate food and beverages sector; however, serial correlation persists in both equations, thus implying that the least squares estimator will provide inefficient estimates. For this reason, the feasible generalized least squares (FGLS) estimator is employed for equations (3) and (4) in order to take into account the presence of heteroskedasticity and serial correlation and provide robust estimates (Rezitis and Kalantzi, 2011).

Alternative estimation techniques could be taken into account, such as the Generalised Method of Moments (GMM) employed by several studies (Klette, 1999; Wooldridge, 2009; De Loecker and Warzynski, 2012). The advantage of the GMM estimator compared to FGLS lies on the inclusion of instruments to take into account the presence of endogeneity if correlation emerges between the dependent variable and at least one of the explanatory variables. For this reason, equations (3) and (4) are re-estimated under the GMM estimation technique to check the robustness of the final results[20].

Table 3: Markup estimations for the UK food and beverages sector.

Parameters	Hall-Roeger model	Parameters	Hall-Roeger cross-sectional model
μ	1.120** [0.00]	μ_{1011}	1.191** [0.00]
		μ_{1012}	1.007** [0.00]
		μ_{1013}	1.087** [0.00]
		μ_{1020}	1.041** [0.00]
		μ_{1031}	1.060** [0.00]
		μ_{1032}	1.188** [0.00]
		μ_{1039}	1.193** [0.00]
		μ_{1041}	1.033** [0.00]
		μ_{1042}	1.227** [0.00]
		μ_{1051}	1.149** [0.00]
		μ_{1052}	1.275** [0.00]
		μ_{1061}	1.115** [0.00]
		μ_{1062}	1.019** [0.00]
		μ_{1071}	1.108** [0.00]
		μ_{1072}	1.129** [0.00]
		μ_{1073}	0.977** [0.00]
		μ_{1081}	1.184** [0.00]
		μ_{1082}	1.098** [0.00]

[20] See Table A4 in appendix.

	μ_{1083}	1.279** [0.00]
	μ_{1084}	1.125** [0.00]
	μ_{1085}	1.038** [0.00]
	μ_{1086}	1.333** [0.00]
	μ_{1089}	1.375** [0.00]
	μ_{1091}	1.115** [0.00]
	μ_{1092}	1.189** [0.00]
	μ_{1101}	1.800** [0.00]
	μ_{1102}	0.963** [0.00]
	μ_{1103}	1.194** [0.00]
	μ_{1104}	1.147** [0.00]
	μ_{1105}	1.418** [0.00]
	μ_{1106}	1.094** [0.00]
	μ_{1107}	1.335** [0.00]

Notes: The numbers in brackets are p-values.
* Significant at the 5% level of significance.
** Significant at the 1% level of significance.

Table 3 presents the price-cost margin estimates for the UK food and beverages industries over 2007-2016. In particular, the aggregate value for the whole sector estimated by equation (3) is equal to 1.12, which is higher than unity. This shows that the growth rate of output of the sector over 2007-2016 exceeds the growth rate of inputs by 12%, thus reflecting a positive markup ratio consistent with imperfect competitive conduct[21]. Relatively, this value is lower compared to other food and beverages sectors (Bottasso and Sembenelli, 2001; Christopoulou and Vermeulen, 2012; Amountzias, 2017) but it is consistent with the findings

[21] This outcome is consistent with several studies for various economies. Imperfect competitive conduct has been identified by Boyle (2004) in the Irish manufacturing industry; Dobbelaere (2004) in the Belgian manufacturing industry; Dobrinsky et al. (2004) in the Hungarian and Bulgarian manufacturing industries; and Wilhelmsson (2006) in the Swedish food and beverages sector.

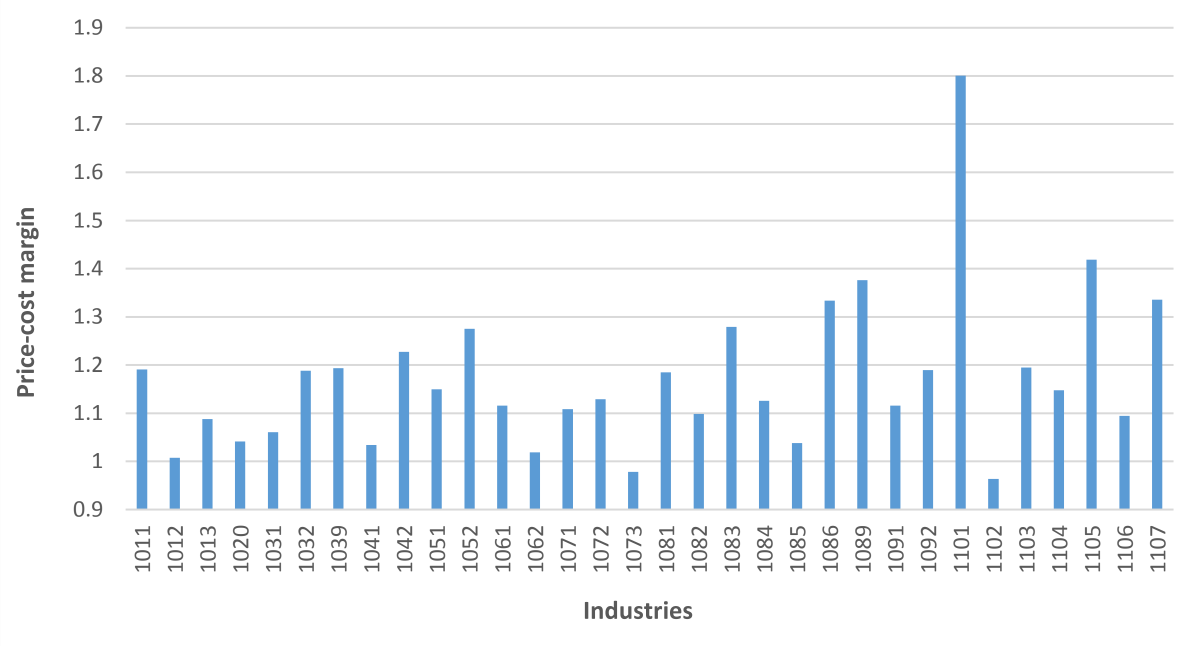
of Görg and Warzynski (2003, 2006). The markup ratio of the UK food and beverages sector over 1989-1997 is 1.121 which is almost identical with the estimated value of this study. This means that the markup ratio of the sector has remained quite steady over the years equal to 12%[22].

An interpretation of this result may refer to the nature of competitive conduct. As many industries are subject to high competition (Harris and Ogbona, 2001), the price level adjusts to changes in the cost of inputs maintaining the markup ratio to a fixed value. Moreover, the effects of internationalisation and the implementation of the Single European Market (SEM) resulted in higher competition across the European Union forcing the pricing decisions of firms to be close to their marginal cost of production. This intuition is validated by Christopoulou and Vermeulen (2012) who provide evidence of an average EU markup ratio equal to 11% which is very close to the one of the UK food and beverages sector.

An additional factor which have affected both production and pricing decisions corresponds to the intense competition of the retail industry and particularly, of the supermarkets. Hollingsworth (2004) and Seaton and Waterson (2013) argue that aggressive price reductions are employed by retail firms as a mean of competition to increase their market share. Consequently, manufacturing firms face squeezed levels of revenue and profitability as reductions in the selling price are transferred to the purchasing costs of intermediate manufacturing inputs. This may leave insufficient incentives to domestic producers to keep on operating in the market, as uncertainty and unforeseen liabilities may not be satisfied, thus dropping entrepreneurial activity and production overall.

[22] Bellone et al. (2016) estimate a markup equivalent to 1.09 for the agro-food sector. This shows that even if the Hall-Roeger methodology disregards productivity shocks, competitive conduct in this sector is very intense.

Figure 1: Price-cost margin estimates for the 32 UK food and beverages industries over 2007-2016.



Source: Estimations of equation (4).

The individual price-cost margin estimates obtained by the cross-sectional Hall-Roeger approach are presented in the second column of Table 3 and in Figure 1. The aim of this step is to identify the pricing behaviour of the 4-digit level industries over 2007-2016, which is the main contribution of this analysis to the literature of market power. In particular, the lowest markup ratio is charged by the industries of manufacture of pasta, noodles, couscous and similar farinaceous products (i.e. 1073) and of wine from grape (i.e. 1102). The price-cost margin is below but very close to unity, thus suggesting perfectly competitive conduct.

On the other hand, the highest value is charged by the industries of manufacture of spirits (i.e. 1101) and of beer (i.e. 1105) which is equal to 1.80 and 1.41 respectively. This means that the highest price-cost margin charged in the food and beverages sector amounts for an 80% price markup over the cost of production. The remaining industries exercise a lower markup ratio which is consistent with the aggregate value of the sector. Consequently, the cross-sectional approach validates the argument that the majority of the UK food and beverages industries charge a positive price-cost margin, reflecting imperfect competitive conduct.

As it is presented in figure 1, the food industries of the sector tend to charge a lower price-cost margin on average compared to the beverages counterpart. However, the industries with the highest and lowest markup are part of the latter segment. In particular, the industry of distilling, rectifying and blending of spirits (i.e. 1101) charges the highest price-cost margin equal to 1.80. According to Amienyo (2012) and Doherty (2016a), this industry heavily relies on international trade due to the quality of spirits and particularly, of Scotch whiskey which has dominated the global markets. The exports to revenue ratio is the highest in the UK manufacturing industry overall equal to 78.4% with increasing demand coming from Taiwan and India.

On the other hand, the industry of manufacture of wine from grape (i.e. 1102) experiences the lowest markup ratio in the whole sector equivalent to 0.96, suggesting that output has been growing slightly slower than inputs over 2007-2016. This is justified by the low profitability level of the constituent firms forcing them to innovate in order to acquire a higher market share in both domestic and international markets. According to Amienyo (2012) and Doherty (2016b), one of the major drawbacks of wine manufacturers is the weather conditions in the UK. Given the colder climate compared to Mediterranean countries, the quality of wine is poorer compared to those countries. For this reason, the UK wine market is one of the largest importers as the volume of imports approximately account for 97% of domestic demand. However, over the last years, the warmer weather conditions and product differentiation (i.e. sparkling wine) boosted revenue due to higher consumer confidence and disposable income.

Overall, the UK food and beverages sector exhibits an aggregate price-cost margin equal to 1.12 which notes the presence of imperfect competitive conduct. The individual estimates of the constituent industries vary over 0.96-1.80, thus capturing the pricing decisions of the food and beverages firms[23]. For this reason, the third and last step of this study is going to test whether the structural effects of concentration, liquidity and exports contribute to the markup ratios charged by the UK food and beverages industries.

4.2. Markup formulation

Table 4. Estimates of the markup formulation for 2009, 2011, 2015 and 2016.

Markup formulation	2009	2011	2015	2016
Constant term	0.054 [0.67]	0.012 [0.93]	-0.129 [0.38]	-0.067 [0.61]
Herfindahl-Hirschman Index	0.211** [0.00]	0.212** [0.00]	0.177** [0.00]	0.173** [0.00]
Establishments ratio	0.132** [0.00]	0.136** [0.00]	0.144** [0.00]	0.102** [0.00]
Liquidity ratio	-0.187* [0.04]	-0.143* [0.01]	0.032 [0.72]	0.344* [0.02]
Exports intensity	0.102* [0.02]	0.083* [0.03]	0.105* [0.04]	0.094* [0.04]
Estimation technique	WLS	WLS	GLS	WLS
Breusch Pagan Godfrey test[a]	10.23* [0.03]	10.78* [0.02]	8.28 [0.08]	9.49* [0.04]
White test[b]	23.39* [0.04]	24.68* [0.03]	22.03 [0.07]	23.76* [0.04]
Durbin Watson test[c]	2.38	2.43	2.91	2.47
Bresuch and Godfrey test (LM)[d]	1.34 [0.50]	2.22 [0.32]	7.24* [0.02]	3.22 [0.19]

[23] De Loecker et al. (2016) provide evidence in favour of a more downward rigid behaviour reflected by the price level compared to marginal cost, thus increasing the price-cost margin.

F-statistic	35.92** [0.00]	55.16** [0.00]	30.18** [0.00]	35.43** [0.00]

Notes: The numbers in brackets indicate *p-values.*

[a] H_0: Homoskedasticity versus H_1: Heteroskedasticity of known form $(\sigma_t{}^2 = h(a_1) = \sigma^2)$, where σ^2 is the variance of normal distribution.

[b] H_0: Homoskedasticity versus H_1: Heteroskedasticity of unknown form.

[c] If $d \geq 2$ there is no evidence of first order positive serial correlation in the error term, where d is the value of the Durbin Watson test.

[d] H_0: No serial correlation versus H_1: Serial correlation of at least $k=2$ order.

* Significant at the 5% level of significance.

** Significant at the 1% level of significance.

The markup formulation is estimated for 2009, 2011, 2015 and 2016 as those years are of crucial significance to the UK economy. In particular, the Herfindahl-Hirschman index (HHI) and the ratio of establishments capture market concentration in each industry individually in terms of turnover and manufacturing units respectively. The estimates are significant and positively signed for each year. This outcome suggests that industries with higher concentration tend to charge a higher price-cost margin. This is consistent with the findings of Konings and Vandenbussche (2005)[24] and Konings et al. (2005) suggesting that firms enjoying a relatively high market share will reflect their power on their pricing decisions which will result in a higher price-cost margin. Other studies investigating the effects of markups in various markets also draw similar conclusions on how competitive conduct is developed (Domowich et al., 1988; Badinger, 2007; Bellone et al., 2016)[25].

The estimates of both measures are stable over the years with the HHI ranging over 0.17-0.21 and the ratio of establishments over 0.10-0.14. This outcome indicates that firms owning the largest share in each market tend to increase their price-cost margin according to their market share and establishments. An interpretation of such behaviour may refer to the implementation of austerity policies over 2010-2011. As growth became slower over 2011-

[24] Although the authors did not include the HHI in the final results, their findings point to the same outcome.

[25] It is also worth mentioning that similar studies such as Pontuch (2011) and Braun and Raddatz (2016) find that industries with limited competition tend to charge a higher markup. However, limited competition is calculated as the average of the price-cost margin of an industry in a country, thus neglecting the role of concentration. For this reason, the HHI has been chosen over alternative indicators.

2015, firms were more reluctant to increase their price level in order to maintain consumer demand to a satisfactory level even if they had the ability to pass cost increases to the selling price (World Bank, 2016b).

The second effect refers to liquidity expressed as the ratio of net current assets over liabilities. This indicator reflects the ability of firms to satisfy their current liabilities with the available net current assets in the short-run which can be liquefied immediately[26]. This can also be viewed as an indicator of short-run liability based solvency ratio which highly depends on whether current liabilities exceed net current assets. It is expected that firms exhibiting higher liquidity ratios will be able to charge a higher price-cost margin given that they can offset any losses in consumer demand with sufficient liquidity cushions[27]. However, if uncertainty prevails in the economy and future expectations are not very optimistic then firms may choose to invest in liquid assets in order to be prepared for any unforeseen circumstances and thus, minimize their losses.

The estimates that capture the relationship between the markup and liquidity ratios suggest that both behaviours have been adopted by the UK food and beverages industries. The values range over -0.18 and 0.34 capturing an inelastic but significant effect of liquidity on pricing decisions. The inverse relationship between the price-cost margin and available liquidity validates the findings of several studies arguing that industries facing financial constraints are more likely to increase the selling price to acquire additional revenues (Chevalier and Scharfstein, 1995, 1996; Campello, 2003; Lane, 2012; Braun and Raddatz, 2016). Such decision is consistent with a profit-seeking behaviour under which firms try to extract consumer surplus from their customers given the degree of future uncertainty.

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[26] This indicator has been formulated according to Makaew and Maksimovic (2013).

[27] This is similar to the leadership effect discussed by Olive (2008) under which profitable firms have the ability to pass cost increases on the selling price due to sufficient profit cushions.

However, the positive value obtained for 2016 contradicts the aforementioned findings, but it is consistent with Bottasso and Sembenelli (2001) and Busse (2002). The main argument is that firms facing financial constraints are more likely to engage in price wars. This behaviour intends to attract customers through a lower selling price level and thus, increase their market share and revenues. Moreover, firms with lower liquidity constraints will be able to charge higher prices as any unexpected losses in consumer demand can be covered by liquidity reserves. This outcome suggests that as the UK economy overall shows encouraging signs of growth, speculative behaviour may be adopted by particular firms in order to increase their profits[28].

Consequently, over 2009 the UK food and beverages industries with the highest liquidity ratio appear to be consistent with the precautionary motive as they tend to demand liquidity to respond to potential risks by sustaining a lower markup ratio (Kimball, 1991). However, over 2016 those industries behave according to the speculative motive as they wish to exploit consumer surplus through a higher price-cost margin in order to increase net current assets and thus, be prepared over a future fall in consumer income.

The third and last effect corresponds to whether export-oriented firms tend to charge a higher price-cost margin. Görg and Warzynski (2003) showed that firms with higher value of exports to turnover ratio correspond to such behaviour suggesting that international trade may provide market power in domestic markets due to high degree of efficiency. The estimates of this study verify this claim as the elasticity of markup ratio with respect to exports intensity ranges over 0.08-0.10. This outcome is consistent with the findings presented by Bernard et

[28] A complementary behaviour to this process may refer to the acquisition of market share through lower price-cost margins. If a lower price level results in increased revenue due to additional demand, then firms might force their competitors to exit the market resulting in additional power and liquidity. Thereby, they will be able to hold more money as precaution to unforeseen circumstances (Rotemberg and Saloner, 1986).

al. (2003) and De Loecker and Warzynski (2012) who argued that exporters charge on average a higher price-cost margin compared to the remaining firms[29].

This outcome occurs because firms charge higher markup ratios in international markets where consumers may have different needs and characteristics. According to O'Hara (2015), austerity policies resulted in slower income and demand growth in the UK economy over 2011-2015. For this reason, export-oriented industries may have tried to substitute part of domestic demand through the exploitation of consumer surplus in the international markets[30]. Moreover, as exporting firms operate in various different markets and try to adjust to particular market characteristics, they become more productive and innovative to satisfy the needs of consumers. This intuition is supported by the studies of Baumers et al. (2016) and De Loecker (2007) showing that the productivity gap between exporters and domestic firms keeps on increasing over time. For this reason, such actions may increase the price-cost margin in order to capture these types of investment[31].

Overall, the results validate the claims of Görg and Warzynski (2003, 2006) that the UK food and beverages sector behaves under imperfect competitive conduct over 2007-2016 exhibiting a price-cost margin equal to 12%. Moreover, the underlying model allows for individual heterogeneity in the pricing decisions of the constituent 32 4-digit level industries. The estimates are consistent with overpricing decisions with the exception of three industries (i.e. 1012, 1073, 1102) who appear to behave according to perfect competition. Lastly, the effects of concentration and exports exhibit a positive relationship with the markup ratio,

[29] See Melitz and Ottaviano (2008) for an extended theoretical analysis capturing the relationship between exports and markup ratios.
[30] Bernard et al. (2003) argued that more efficient producers face lower costs than their competitors allowing them to set higher markup ratios.
[31] Also see Taymaz and Yilmaz (2015) for a similar analysis in the Turkish manufacturing industry using export intensity as well as import penetration ratios to capture their effect on the markups charged by the constituent sectors.

whilst the elasticity of pricing decisions with respect to liquidity is negative over 2009 and 2011, but positive over 2016.

5. Concluding remarks

The present analysis extended the investigation of market power in the UK food and beverages sector by employing the markup model of Hall (1988) and Roeger (1995). The inclusion of cross-sectional individual effects in the panel sample provides evidence of the price-cost margin charged by the 32 4-digit level NACE Rev.2 industries over 2007-2016 which is the main contribution to the empirical literature of market power. Overall, the majority of the industries appear to exhibit a markup ratio close to perfect competition as the value of the whole sector is 1.12 suggesting that the growth rate of output exceeds the growth rate of inputs by 12%. Moreover, more concentrated and export-oriented industries tend to charge a higher markup ratio while available liquidity seems to have a different effect on pricing decisions over the years.

The aforementioned results show that competition, liquidity constraints and export orientation are three structural elements that significantly influence the pricing decisions of the UK food and beverages firms. However, there are still many factors that must be taken into account in order to provide a fuller picture of the production and pricing decisions of the sector. In particular, it would be important to test the cyclicality of markups in the sector as has been presented by Braun and Raddatz (2016). If markups tend to be either procyclical or counter-cyclical, then it would also be useful to test whether liquidity constrained or export orientated firms tend to follow a similar behaviour with the whole sector.

Moreover, indicators of productivity can also be taken into account in order test whether the suggestions of relevant studies such as De Loecker (2007) and Bellone et al. (2016) hold in the UK food and beverages sector. Finally, the present analysis can also be conducted under the scope of quality differentiation and how innovative firms can shape their market share according to the quality of their products (De Loecker and Warzynski, 2012). If those factors are added in the model, then the present findings for the whole sector will be bolstered.

Overall, the current analysis supports the significant contribution of exporting industries in the pricing decisions of the UK food and beverages sector and according to economic conditions, liquidity plays an important role in the formulation of the markup ratio.

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Appendix

Table A1: Classification of industries according to NACE Rev.2 classification.

1011	Processing and preserving of meat
1012	Processing and preserving of poultry meat
1013	Production of meat and poultry meat products
1020	Processing and preserving of fish, crustaceans and molluscs
1031	Processing and preserving of potatoes
1032	Manufacture of fruit and vegetable juice
1039	Other processing and preserving of fruit and vegetables
1041	Manufacture of oils and fats
1042	Manufacture of margarine and similar edible fats
1051	Operation of dairies and cheese making
1052	Manufacture of ice cream
1061	Manufacture of grain mill products
1062	Manufacture of starches and starch products
1071	Manufacture of bread; manufacture of fresh pastry goods and cakes
1072	Manufacture of rusks and biscuits; manufacture of preserved pastry goods and cakes
1073	Manufacture of macaroni, noodles, couscous and similar farinaceous products
1081	Manufacture of sugar
1082	Manufacture of cocoa, chocolate and sugar confectionery
1083	Processing of tea and coffee

1084	Manufacture of condiments and seasonings
1085	Manufacture of prepared meals and dishes
1086	Manufacture of homogenised food preparations and dietetic food
1089	Manufacture of other food products nec
1091	Manufacture of prepared feeds for farm animals
1092	Manufacture of prepared pet foods
1101	Distilling, rectifying and blending of spirits
1102	Manufacture of wine from grape
1103	Manufacture of cider and other fruit wines
1104	Manufacture of other non-distilled fermented beverages
1105	Manufacture of beer
1106	Manufacture of malt
1107	Manufacture of soft drinks; production of mineral waters and other bottled waters

Source: *FAME* database.

Table A2: Pesaran's cross-section dependence and panel unit root tests.

Variables	CD test	Unit root test
ΔY_t	61.772** [0.00]	-8.913** [0.00]
ΔX_t	60.729** [0.00]	-9.606** [0.00]
h_t	5.629** [0.00]	-2.332* [0.04]
Δh_t	-	-12.56** [0.00]
es_t	6.125** [0.00]	1.001 [0.51]
Δes_t	-	-4.478** [0.00]
lr_t	7.187** [0.00]	-3.630** [0.00]
Δlr_t	-	-15.32** [0.00]
xp_t	13.272** [0.00]	-1.550 [0.20]
Δxp_t	-	-14.97** [0.00]

Notes: The null hypothesis of Pesaran's (2004) CD test is cross-sectional independency. The null hypothesis of Pesaran's (2007) refers to the presence of a unit root in the panel series. The numbers in brackets are p-values.
* Rejection of the null hypothesis at the 5% level of significance.
** Rejection of the null hypothesis at the 1% level of significance.

Table A3: Westerlund's (2008) cointegration test for the Hall-Roeger models.

Equation (3)	
DH_g	13.282** [0.000]
DH_p	16.911** [0.000]
Equation (4)	
DH_g	15.116** [0.00]
DH_p	17.945** [0.00]

Notes: DH_g denotes the group mean Durbin-Hausman statistic and DH_p is the panel statistic. The bandwidth selection M_i corresponds to the largest integer less than $4(\frac{T}{100})^{2/9}$ as proposed by Newey and West (1994) which is equal to 2. The values in brackers are p-values.
** Rejection of the null hypothesis at the 1% level of significance.

Table A4: Markup estimations under the GMM estimation technique.

Parameters	Hall-Roeger model	Parameters	Hall-Roeger cross-sectional model
μ	1.154** [0.00]	μ_{1011}	1.213** [0.00]
		μ_{1012}	0.967** [0.00]
		μ_{1013}	1.088** [0.00]
		μ_{1020}	1.003** [0.00]
		μ_{1031}	1.065** [0.00]
		μ_{1032}	0.997** [0.00]
		μ_{1039}	1.197** [0.00]
		μ_{1041}	1.058** [0.00]
		μ_{1042}	1.226** [0.00]
		μ_{1051}	1.151** [0.00]
		μ_{1052}	1.525** [0.00]
		μ_{1061}	1.110** [0.00]
		μ_{1062}	1.224** [0.00]
		μ_{1071}	1.108** [0.00]
		μ_{1072}	1.130** [0.00]
		μ_{1073}	1.025** [0.00]
		μ_{1081}	1.185** [0.00]
		μ_{1082}	1.102** [0.00]
		μ_{1083}	0.999** [0.00]
		μ_{1084}	1.077** [0.00]
		μ_{1085}	1.189** [0.00]
		μ_{1086}	1.317** [0.00]
		μ_{1089}	1.372** [0.00]

	μ_{1091}	1.114** [0.00]
	μ_{1092}	1.240** [0.00]
	μ_{1101}	1.431** [0.00]
	μ_{1102}	1.217** [0.00]
	μ_{1103}	1.113** [0.00]
	μ_{1104}	1.123** [0.00]
	μ_{1105}	1.420** [0.00]
	μ_{1106}	1.037** [0.00]
	μ_{1107}	1.170** [0.00]

Notes: The numbers in brackets are p-values.
* Significant at the 5% level of significance.
** Significant at the 1% level of significance.