ARTICLE

GROCERY PRICES IN THE EURO AREA: FINDINGS FROM THE ANALYSIS OF A DISAGGREGATED PRICE DATASET

This article analyses the functioning of the Single Market and the determinants of price level differences across the euro area based on the main findings of an ESCB group of economists established to investigate a unique disaggregated dataset of grocery prices across euro area countries.

The results illustrate the presence of significant border effects, as prices vary substantially more across countries than within countries. In terms of factors determining price level differences across countries, there is strong evidence of market segmentation. It is shown that, in addition to consumer habits, structural features, specifically the competitive situation at the producer and retail levels, have an impact on prices and price dispersion. The analysis also sheds light on other aspects that are relevant for understanding inflation dynamics within and between countries, such as the potential implications for inflation measurement arising from the appearance of new products and retail outlets.

Overall, the analysis shows that further reform efforts that enhance entry into and improve contestability in goods markets and the distributive trades would contribute to a deepening of the Single Market.

1 INTRODUCTION AND BACKGROUND

This article draws on a newly available dataset on grocery prices in the euro area, and follows up on the Eurosystem's Structural Issues Report (SIR) 2011 on "Structural features of distributive trades and their impact on prices in the euro area".[1] That report discussed the role of the distributive trades sector, which acts as the main interface between producers of consumer goods and consumers. The aim of the report was to analyse the structural features – particularly the degree of competition and regulatory aspects – of the distributive (i.e. wholesale and retail) trades sector and their impact on price developments in the euro area. Among the main findings was a considerable degree of price dispersion across the euro area, with evidence of a "border effect" among euro area countries, i.e. prices vary more across countries than within countries.

The findings of the 2011 SIR suggested that there was ample scope for further improving the Single Market and that further progress in improving effective competition in the distributive trades sector could help narrow price differentials: however, a number of key issues in that report could not be fully addressed owing to the lack of suitable data. First, regarding the Single Market, while the finding of the continued existence of strong border effects appeared robust, the analysis was indirect. Second, although there was some interaction between retail concentration and price dynamics, the impact of concentration on price levels could not be analysed. Lastly, although the report was able to document the emergence of discounters and private labels (i.e. own-branded products), it was not able to provide an indication of the possible impact of these structural changes on inflation measurement.

This article uses a proprietary disaggregated grocery price dataset[2] **to investigate some of these key issues.** In particular, the article seeks to: (a) achieve a better understanding of the stylised structural features of euro area grocery prices; (b) examine and quantify the degree of price dispersion and the magnitude of border effects within the euro area; (c) investigate the factors,

1 "Structural features of distributive trades and their impact on prices in the euro area", Task Force of the Monetary Policy Committee of the European System of Central Banks, *Occasional Paper Series*, No 128, ECB, Frankfurt am Main, September 2011. See also the article entitled "Structural features of the distributive trades sectors and their impact on euro area price developments", *Monthly Bulletin*, ECB, October 2011.

2 The proprietary data were obtained from Nielsen, an international market information and measurement company. The data are generally collected from barcode scanners.

in particular the role of competition, that determine price level differences across countries; and (d) provide some indication of the possible impact of structural developments in the distributive trades on inflation measurement.[3] After describing the dataset, the article looks at some potential determinants of price level differences among euro area countries. It analyses the potential impact of the appearance of private label goods and structural shifts in store formats on the measurement of HICP inflation. The pass-through of VAT changes into consumer prices is also analysed.

The data used in this article consist of around 3.5 million observations on the price and quantity of individual products sold over the period 2009-11, disaggregated across a number of dimensions (including countries, regions, products, brands, pack sizes and store types). Prices of individual products are proxied by unit values (including VAT), i.e. calculated as total sales value over a given period divided by quantity of the product sold, while quantities are available in terms of both number of packages sold and "equivalised" units of content sold (e.g. litre, kg, etc.).[4] The richness of the data lies in their multidimensionality: they cover 13 euro area countries[5] – for which 70 regions and approximately ten kinds of store can be identified – as well as 45 product categories[6], with details on four brands per product category, three stock-keeping units per brand and data on private label aggregates. The sample period spans primarily 2009-11, with 98.6% of monthly observations spanning the 37-month period from November 2008 to November 2011. While the dataset is rich and complex and has an overall estimated market coverage rate of around 75%-85%, it is unbalanced (i.e. not all information is available across all dimensions).[7] The data were found to be representative, as they are highly congruent with both detailed country CPI data and detailed PPP data obtained from Eurostat, after controlling for pack size.

2 EURO AREA GROCERY PRICE DISPERSION WITHIN AND ACROSS COUNTRIES[8]

Although there is some empirical evidence of a reduction in price dispersion over a longer time period in the euro area,[9] during the period under review (2009-11) price differences remain substantial across a range of goods, with evidence of only limited convergence (see Box 1).

Notwithstanding their highly disaggregated nature, the data used here present the challenge, when investigating price dispersion, of considerable heterogeneity across product categories in different countries. Brands and specifications of products sold can differ substantially.

3 In order to benefit from country-specific expertise, an expert group of economists from across the ESCB was brought together to analyse the dataset. This article draws on the work and findings of this group.
4 Prices excluding VAT have been calculated using information on VAT rates for each product category in each country.
5 The countries covered are Belgium, Germany, Estonia, Ireland, Greece, Spain, France, Italy, the Netherlands, Austria, Portugal, Slovenia and Slovakia (i.e. all euro area countries except Cyprus, Latvia, Lithuania, Luxembourg, Malta and Finland).
6 (1) 100% fruit juice; (2) all-purpose cleaners; (3) automatic dishwasher detergent; (4) baby food; (5) beer; (6) stock; (7) butter; (8) carbonated soft drinks; (9) cat food; (10) ready-to-eat cereals; (11) chewing gum; (12) chocolate; (13) cigarettes; (14) ground coffee; (15) instant coffee; (16) condoms; (17) deodorant; (18) nappies; (19) dog food; (20) fabric softener; (21) frozen fish; (22) ice cream; (23) strawberry jam; (24) laundry detergent; (25) margarine; (26) refrigerated milk; (27) UHT milk; (28) olive oil; (29) panty liners; (30) paper towels; (31) pasta/spaghetti; (32) frozen peas; (33) tinned peas; (34) rice; (35) shampoo; (36) shaving preparations; (37) sugar; (38) toilet tissue; (39) toothpaste; (40) tinned tuna; (41) vodka; (42) sparkling water; (43) still water; (44) soups; (45) whiskey.
7 This reflects the fact that the underlying data come from country offices, each with different ways of reporting the data. For example, regions or equivalised data are not reported for some product categories in some countries, etc.
8 This section draws from Reiff, A. and Rumler, F., "Within and cross-country price dispersion in the euro area", *Working Paper Series*, No 1742, ECB, Frankfurt am Main, November 2014; Kulikov, D., "Law of One Price in the euro area: an empirical investigation using Nielsen disaggregated price data", Working Papers of Eesti Pank 10/2014; Petroulas, P. and Kosma, T., "Analysing price level differences in the euro area", *Working Paper Series*, ECB, Frankfurt am Main, forthcoming.
9 See, for example, Faber, R.P. and Stokman, A.C.J., "A Short History of Price Level Convergence in Europe", *Journal of Money, Credit and Banking*, Vol. 41, No 2-3, March-April 2009, pp. 461-477.

For example, types of rice sold vary greatly between countries (e.g. boiled, risotto, paella, etc.). By contrast, for other products, such as nappies, the leading brand tends to be the same across most countries. There can be several reasons for this diversity, including a) the historical presence of brands, b) differences in domestic preferences, and c) regulations in product markets which may hinder the introduction of new brands. Moreover, the data available only cover a time span (2009-11) that includes a period of considerable economic stress in the euro area. For these reasons, the specific price differentials for individual products and countries reported in Box 1 should be considered as indicative. Furthermore, price is only one aspect of interest to consumers; other relevant features may be choice, quality and innovation.[10]

10 In this context, see a recent (October 2014) study prepared for the European Commission entitled "Study on the economic impact of modern retail on choice and innovation in the EU food sector", which examines whether increased concentration (of food retailers/food brand manufacturers) or other factors (such as shop type/size, private label penetration, socio-demographic characteristics) have affected choice and innovation for the consumer in European shops. (http://ec.europa.eu/competition/sectors/agriculture/overview_en.html).

Box 1

CROSS-COUNTRY PRICE DIFFERENTIALS

While there is considerable heterogeneity across product categories with regard to price level differences across countries, there are some common features. Namely, among the products and countries in the dataset, many products in Germany, Spain and the Netherlands tend to be relatively cheap, while they are relatively expensive in Belgium, Ireland and Greece (see Table). For other countries, the rankings are more mixed across product categories.

However, some caveats should be borne in mind when using this dataset to compare price levels across countries. First, the products covered are food, personal and healthcare grocery goods; other categories, such as unprocessed food, energy, durable consumer goods or services, are not represented. Second, the sample period covers 2009-11. While some price adjustments occurred during this period in some euro area countries, additional adjustments may have been made since. Lastly, although broadly consistent, the coverage of store types differs across countries. Nonetheless, the broad features identified tend to hold for a variety of product subsamples that may be considered broadly comparable. They also hold for a very narrow subset of products that have been identified as being an exact match across countries.

During the period under review, there is substantial price dispersion with only limited convergence. The highly diverse unit prices across countries for the product categories under investigation can be seen when the median unit price difference is compared with the euro area average over time, while the median unit price difference across countries shows limited convergence. In fact, the median prices excluding VAT have shown convergence towards the euro area average only in Ireland, Greece and Austria. For branded goods, Ireland and Greece have become less expensive, with a cumulative drop of 3 and 6 percentage points respectively compared with average prices over the period 2009-11, while branded goods in Austria have become less cheap by a total of 2 percentage points (see Table).[1] It should be noted that the brand-level data on prices and volumes show that Ireland and Greece tend to be either the most

1 By contrast, countries such as Belgium and Slovakia show diverging tendencies. Moreover, if unit prices including VAT are compared, the median unit price for some countries no longer converges.

Median difference from euro area average price level (excl. VAT)

(percentages)

Countries	All goods including private label		Branded goods only	
	2009	2011	2009	2011
BE	4	7	18	19
DE	-20	-20	-11	-10
EE	-21	-20	-13	-12
IE	23	17	35	32
GR	10	5	23	17
ES	-14	-13	-3	-3
FR	-4	-3	3	5
IT	-8	-10	2	0
NL	-21	-21	-15	-15
AT	-15	-11	-5	-3
PT	-23	-22	-11	-11
SI	10	11	13	12
SK	-19	-23	-11	-15

Sources: Nielsen and Eurosystem staff calculations.
Note: Excluding tobacco and alcohol products.

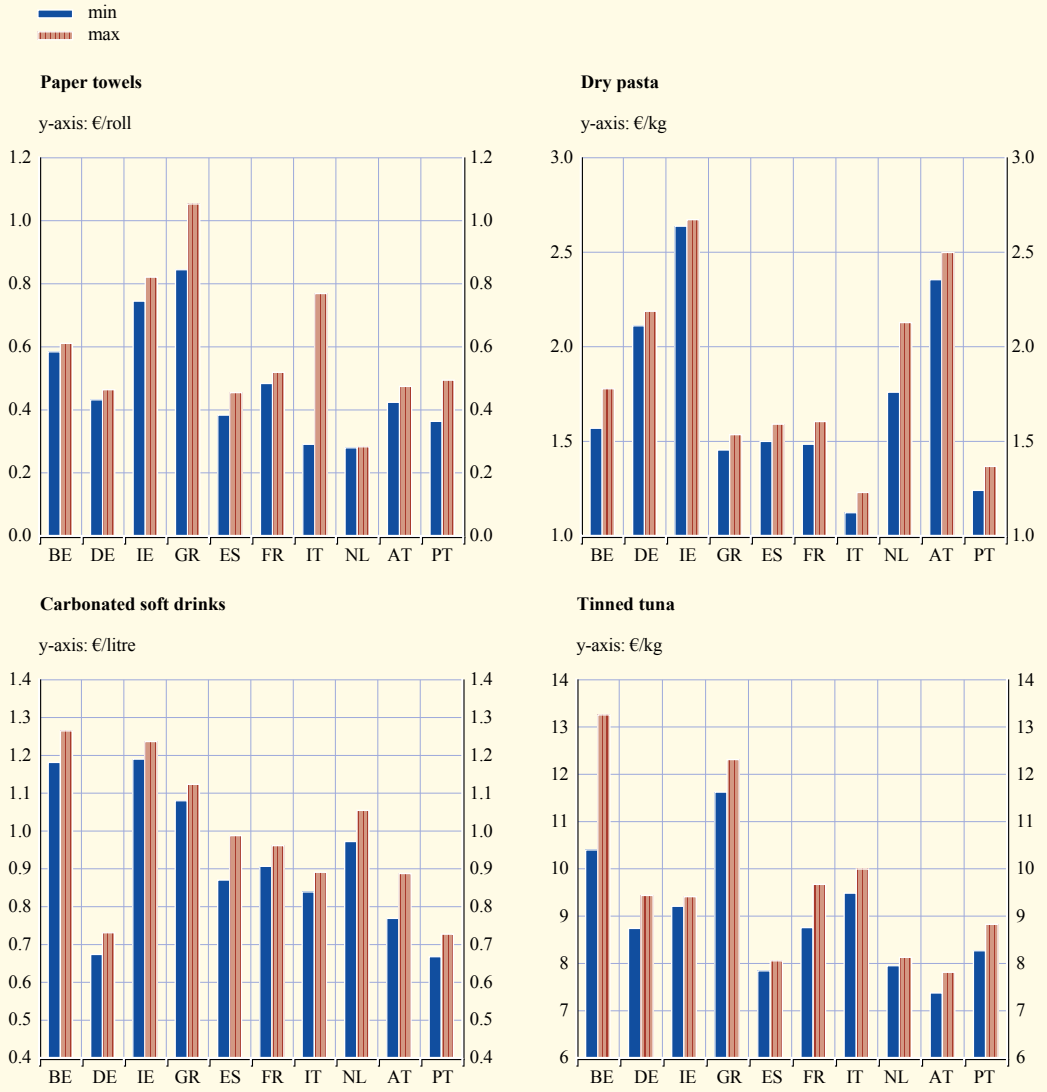
expensive or among the most expensive countries in a majority of the product categories, while Germany and Spain tend to be among the least expensive countries. This is consistent with observed differences in producer market characteristics. Namely, Greece and Ireland tend, on balance, to have higher market shares for the leading brand in most of the product categories, thus implying higher monopoly power and higher mark-ups. At the same time private label goods tend to have low shares of the market in these countries. By contrast, Germany and Spain seem to be characterised by significantly lower market shares for the leading producers and a significantly higher share of private label products. Consumer behaviour also seems to differ. On average, Greek and Irish consumers tend to buy smaller pack sizes and have lower consumption intensities of the products included in the data, while German and Spanish consumers display the opposite behaviour. For a more detailed discussion of possible factors underlying price differentials, see Section 3 of this article.

Price dispersion remains even when controlling for quality differences. In order to control – at least in part – for effects stemming from quality differences that may be reflected in prices, the unit prices of branded market leaders are also considered. By definition, market leaders in each region tend to have a broad consumption base and are characterised by good quality. They offer, in the eyes of the consumer, reasonable value for money. Moreover, for several product categories the market leaders across countries are the same producers (offering the same products). Nevertheless, even in this case the mean and median price difference between the cheapest and most expensive regions across the euro area countries is a full 220% and 181%, respectively. The price differences remain substantial, even in a comparison of the 25th and 75th percentiles.[2]

Price differences suggest markets may be segmented as they reflect data aggregated geographically (across urban and rural areas) and, as such, do not, in general, reflect a single expensive or cheap location. It would be more understandable if such price differences

2 This country-specific clustering of prices may also reflect the impact of possible territorial supply constraints. It should be noted that the country rankings in terms of most/least expensive do not generally change, even if unit prices include VAT.

Minimum and maximum unit price (excl. VAT) for selected products for market leading (at region level) brands



Sources: Nielsen and Eurosystem staff calculations.
Note: Based on average unit prices of market leaders of branded products over the period under review. Results are similar when VAT is included.

existed between, for example, a store in the most expensive part of a large city and a store in a less affluent, primarily rural, district. Instead, it is generally the case that, when prices outside the inter-quartile (i.e. 25th to 75th percentile) range are disregarded, some countries do not figure. For example, in the case of paper towels, there are no prices from Greece (the most expensive country) or from the Netherlands (the cheapest country) inside the inter-quartile range (see Chart). Indeed, for several product categories, a country-specific price clustering is often observed, irrespective of whether or not (i) the market leader is the same across regions within a country, or (ii) the market leader is the same across countries – indicating that markets may be segmented.

Table 1 Border effect in the euro area (within versus cross-country dispersion of unit price (excluding VAT)) *Coefficients of variation*

Country/product samples	across countries	within countries
EMU 13*, all products	0.37	0.05
EMU 10**, branded products	0.28	0.03
EMU 10, branded products, market leaders***	0.29	0.06
Identical products	0.20	0.04

Sources: Nielsen and Eurosystem staff calculations.
*EMU 13 includes all countries in the sample of the Nielsen dataset; **EMU 10 excludes Estonia, Slovenia and Slovakia; ***Market leaders are defined as the brand within each region that has the largest quantity share for each product category.

Notwithstanding the caveats regarding the measurement of price dispersion, the regional dimension of the dataset makes it possible to obtain a more robust indication of the border effect than was feasible heretofore: cross-country dispersion is significantly higher than cross-regional variation within countries, suggesting substantial border effects in the euro area. This result confirms the indirect evidence of border effects reported in the SIR 2011, which used purchasing power parity (PPP) data (see Box 2 for a comparison). Price dispersion of unit prices is investigated by using coefficients of variation, defined as the standard deviation of a unit price for a product over the mean unit price for that product. Cross-country price dispersion is about five to seven times higher than within-country price dispersion, irrespective of whether one considers the full sample of products or varieties of product subsamples that may be broadly comparable or even identical (see Table 1). For the full range of products in the dataset (including private label goods), the average unit price dispersion is 37% across countries, compared with an average price dispersion of about 5% across regions within a country. Even for the set of identical products, the average unit price dispersion for the exact same product is 20% across countries and 4% within countries.

Box 2

BORDER EFFECTS – EVIDENCE FROM PPP DATA

This box considers evidence on border effects from another data source – Eurostat's purchasing power parity (PPP) dataset. Detailed product-level data, derived from so-called "Quaranta tables" that are used to validate raw price data and for quality control purposes, are utilised. This exercise has three benefits. First, it demonstrates the congruity of the disaggregated price dataset utilised in the rest of this article. Second, it illustrates that the border effect documented in the SIR 2011 using data from 2009 is still present in updated data (from 2012 and 2013). Third, it allows for a comparison with the same product types (food and beverages) and with another product group (home and garden, such as home electronics, paint, toys).[1]

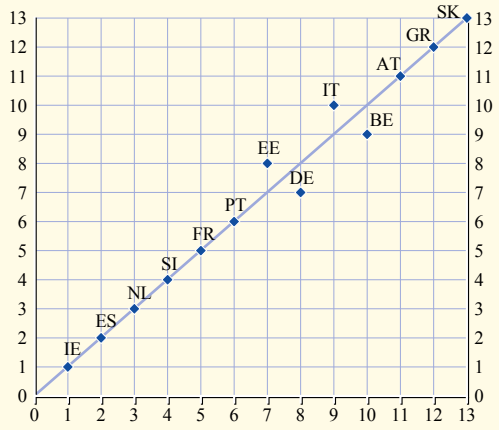
Despite substantial methodological differences, the two (disaggregated grocery price and PPP) datasets are highly congruent. Although the PPP dataset generally only includes data collected in capital cities (with some exceptions)[2], Charts A and B show that for two selected product types (a well-known ready-to-eat cereal brand and refrigerated milk), the ranking of prices across countries is almost identical to that seen in the disaggregated price dataset used in the main

1 These product categories are an important element of consumers' goods baskets. Food accounts for 20% of the overall HICP, while home and garden products account for around 13%, which is almost half of the non-energy industrial goods component. In addition, they concern strongly traded product categories and are therefore good test cases for the impact of national borders.
2 In Germany, data are collected for four cities (Berlin, Bonn, Karlsruhe and Munich).

Chart A Rank of prices – cereals ready to eat (specific brand)

x-axis: rank grocery price data
y-axis: PPP rank

◆ rank: cheap-expensive

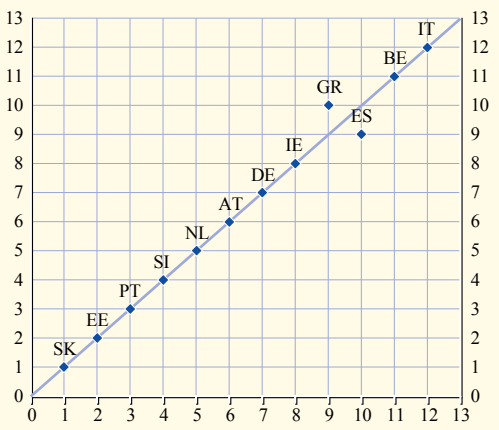


Sources: Eurostat PPP database, Nielsen and Eurosystem staff calculations.

Chart B Rank of prices – milk (refrigerated)

x-axis: rank grocery price data
y-axis: PPP rank

◆ rank: cheap-expensive



Sources: Eurostat PPP database, Nielsen and Eurosystem staff calculations.

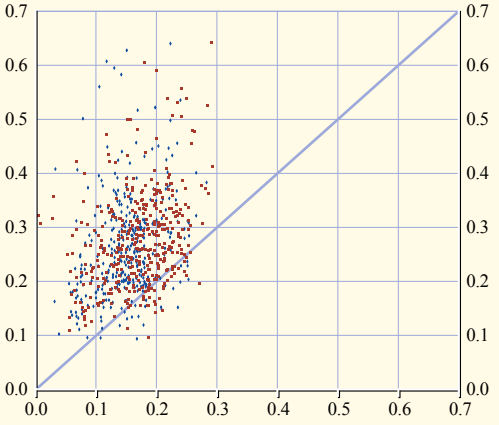
text of this article. Although there are some deviations, these tend to be relatively minor and may relate to technical factors, such as pack size preferences across countries (see Section 3 of this article for a more detailed discussion).

The border effect as documented in the SIR 2011 in food, beverage and tobacco products has remained largely unchanged. Chart C shows the variation in prices within countries/capital cities and across countries/capital cities in the countries of the euro area for 400 detailed food, beverage and tobacco products in both 2009 and 2012. The impact of national borders is clearly visible, since the variation of prices is almost always larger across countries than within countries. This result also holds if only named brands are considered; this allows us to control for potential quality differentials. The SIR 2011 also confirmed that this larger variation across borders was not the mere

Chart C Dispersion of food and beverage prices within and across countries

x-axis: within countries (cities)
y-axis: across countries (cities)

◆ all products 2009
■ all products 2012

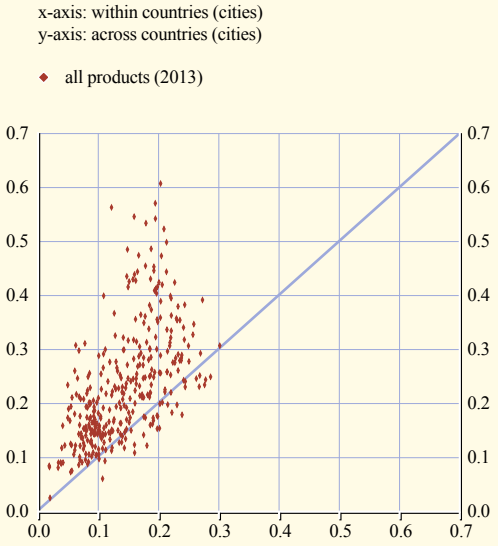


Sources: Eurostat PPP database, Nielsen and Eurosystem staff calculations.

result of geographical distance, as while price dispersion across four (fairly near) capital cities is lower than the euro area average, it is much higher than across four large German cities that are geographically much further apart. Thus, the findings of Reiff and Rumler[3] – that although distance matters, borders matter more – appear to be robust.

In addition to confirming the previous analysis for food and beverages, the updated PPP data also provide compelling evidence for a border effect when it comes to home and garden products (e.g. home electronics, paint, toys) – see Chart D. These products arguably provide for an even better test case for the existence of a border effect, as they more often tend to have named brands, are highly tradable/traded and local preferences might be a less important factor influencing prices than in the case of food products. Again, it is the case that price variation across countries is much higher than within countries, both for all products together and for named brands only. Also, the charts for the Benelux countries and the German cities (not reported) provide qualitatively similar results.

Chart D Dispersion of home and garden product prices within and across countries



Sources: Eurostat PPP database, Nielsen and Eurosystem staff calculations.

Overall, the analysis of the PPP dataset strongly supports the conclusions arrived at through the investigation of the disaggregated price data.

3 Reiff, A. and Rumler, F., op. cit.

Overall the data indicate that (a) there is considerable price dispersion across countries, even when specific brands are considered, and (b) price dispersion is substantially higher across countries than within countries (i.e. strong border effects exist).

3 FACTORS EXPLAINING GROCERY PRICE LEVEL DIFFERENCES[11]

Some price variation can be explained by distance – even within an individual country – but cross-country borders impact more. This is demonstrated when estimating a distance-based relative price equation which also controls for borders. The results show that the greater the distance between two regions, the greater the relative price variation but also that there is always a discrete, large jump in observed relative price differences at the border. By way of example, for the subset of identical products, it is estimated that relative prices differ by approximately 1% on average between two locations that are 100 km apart but within the same country. By contrast, if two locations are 100 km apart and are separated by a border, then relative prices differ by approximately 19.5%. Changes in relative prices also depend positively on distance, i.e. the closer the two locations, the more prices co-move. However, even in this case there is a discrete jump at the border.

11 This section draws from Reiff, A. and Rumler, F., op. cit.; Petroulas, P. and Kosma, T., op. cit.; and Ciapanna, E. and Rondinelli, C., "Retail market structure and consumer prices in the euro area", *Working Paper Series*, No 1744, ECB, Frankfurt am Main, December 2014.

Price level differences and the associated border effects can be partly explained by observable factors. These include VAT differences between countries (see Box 3), income differences (measured as GDP per capita), regional unemployment as a share of the labour force and regional population density. However, even after controlling for these factors in a regression, the estimated border effect remains significant.[12]

Price dispersion across countries may also be affected by the relative state of the business cycle. Upon regressing price dispersion on a European business cycle indicator, a variable capturing the spread of the business cycle position and a lagged dependent variable, it becomes evident that business cycle conditions have important effects on European price dispersion. Specifically, the estimates indicate that European price dispersion tends to be pro-cyclical – higher during upturns and lower during downturns – and is sensitive to diverging business cycle conditions. In this respect, the time period of investigation is also significant for the estimated border effects.

12 One reason may be that estimated border coefficients are biased upwards as the distribution of prices differs across countries. By using the disaggregated grocery price dataset it is estimated that cross-border price dispersion can be inflated by as much as 25% if cross-country differences in price distributions are not taken into account. See Gorodnichenko, Y. and Tesar, L.L., "Border Effect or Country Effect? Seattle May Not Be So Far from Vancouver After All.", *American Economic Journal: Macroeconomics*, 1(1), 2009, pp. 219-241.

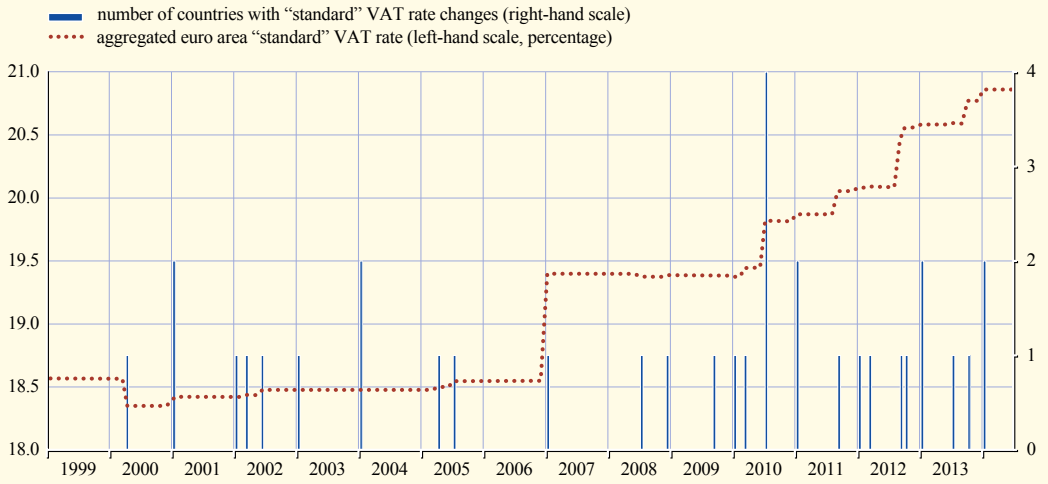
Box 3

THE PASS-THROUGH OF VAT RATE CHANGES INTO CONSUMER PRICES[1]

In Europe, value added taxes (VAT) play an important role in consumer prices. Most countries have a standard rate of VAT somewhere between 15% and 25%.[2] Furthermore, in recent years a number of countries have changed (mostly increased) their VAT rates. This is due in large part to the impact of the financial crisis and budgetary pressures, but has also occurred in the context of a shifting of the tax burden away from labour towards indirect consumption-type taxes. The Chart illustrates that the average euro area standard rate remained relatively constant between 1999 and 2007, at around 18.5%, although there were some country-specific changes. In January 2007 there was a large jump owing to the 3.0 percentage point change in the German standard rate of VAT from 16.0% to 19.0%. Thereafter, the average rate remained relatively stable for about three years, at slightly below 19.5%. However, since the economic crisis in 2008 there have been a cluster of VAT rate changes and the aggregate standard rate has increased to over 20.5% (as at 1 July 2014). Since the launch of EMU in 1999, there have been approximately 30 VAT rate changes, of which two-thirds have occurred since the economic crisis. Clearly, it is of interest to policy-makers to understand how these changes are passed through into consumer prices.[3]

1 This box draws from Meyler, A., "VAT pass-through: is there any value-added in a disaggregated cross-country and cross-product analysis?", *Working Paper Series*, ECB, Frankfurt am Main, forthcoming.
2 For a useful overview of existing VAT rates in the European Union and how these have changed over time, see http://ec.europa.eu/taxation_customs/taxation/vat/how_vat_works/rates/ and in particular the document "VAT Rates Applied in the Member States of the European Union", which is updated twice a year in January and July – http://ec.europa.eu/taxation_customs/resources/documents/taxation/vat/how_vat_works/rates/vat_rates_en.pdf.
3 In addition to VAT rate changes, VAT rates may also have an impact on price level differences across countries (see Sections 2 and 3). In the dataset there is a wide range of (standard and reduced) VAT rates across countries and products. For example, in Estonia and Slovakia, the standard VAT rate is applied to nearly all of the products included in the dataset, whereas in Belgium, Spain, the Netherlands and Slovenia, it is applied to fewer than 40% of the products.

Synthetic euro area VAT standard rate and number of VAT standard rate changes



Sources: European Commission and Eurosystem staff calculations.

Assessing the degree of pass-through of VAT rate changes is challenging, particularly when focusing on individual country data. This is because, in some countries, VAT rates changed a number of times in relatively quick succession and more recent VAT rate changes have occurred in a challenging macroeconomic environment which may confound the effect of VAT changes with other developments. To a large extent the country-specific studies estimating the pass-through of VAT rate changes rely on individual HICP subcomponents with long time series of available data.[4] These approaches are not possible in the case of the dataset used here as the data sample is too short. An additional problem is that prices change for reasons other than VAT rate developments. In this regard, work from the Eurosystem Inflation Persistence Network showed that although prices may change relatively infrequently on average, when they do change they tend to do so by large steps both upwards and downwards (around 10% on average).[5] In this context, the effects of VAT rate changes of the magnitude 0.5-2.0 percentage points are not easy to detect.

One alternative approach to estimating the pass-through of VAT rate changes is the so-called difference-in-differences approach, which takes advantage of the additional information from the dataset both across countries and across product categories. That is, differences in price developments of "treated" groups (products/countries where the VAT rate changed) and "control" groups (products/countries where the VAT rate did not change) are analysed to estimate the impact of VAT rate changes.[6] The sample period covered by the dataset allows us to investigate VAT rate changes in six countries: Estonia, Greece, Ireland, Spain, Portugal and Slovakia.

4 See, for instance, "A preliminary assessment of the effect on inflation of the increase in value added tax rates", *Quarterly Report on the Spanish Economy*, Economic Bulletin, Box 4, Banco de España, October 2010; Karabalis, N. and Kontelis, E., "Indirect tax increases and their impact on inflation in 2010-2012", Economic Bulletin, No 38, Bank of Greece, 2013, pp. 7-20; and Doliak, M., "Dopad januárového zvýšenia DPH na spotrebiteľské ceny (The impact of January's VAT increase on consumer prices)", BIATEC (Banking Journal), Ročník 19, No 7, National Bank of Slovakia, September 2011.

5 "Inflation persistence and price-setting behaviour in the euro area: a summary of the IPN evidence", *Occasional Paper Series*, No 46, ECB, Frankfurt am Main, June 2006.

6 For another example of this methodology applied to these data, see Meriküll, J. and Rõõm, T., "One currency, one price? Euro changeover-related inflation in Estonia", *Working Paper Series*, No 1732, ECB, Frankfurt am Main, September 2014.

On average, the results suggest that around one-third to one-half of a VAT rate change is passed through in the month of the rate change. Thus, in the context of the economic crisis and heightened competition, some of the impact of the VAT rate changes may have been absorbed by margins. The estimation results also suggest that, among branded goods, the estimated pass-through of VAT rate changes is lowest for the market leader. These results are broadly in line with theoretical expectations that firms with lower margins are obliged to pass through changes, but those with some degree of monopoly power may absorb some of the changes.[7]

Although the relatively low precision and high uncertainty of the individual estimates need to be borne in mind, the analysis of VAT rate pass-through exploiting cross-country and cross-product information has provided some insight regarding food and personal care goods prices. To extend the results to other categories (e.g. services prices), a more systematic availability of micro consumer price data would be useful.

7 For a fuller discussion see Fullerton, D. and Metcalf, G.E., "Tax Incidence", *Handbook of Public Economics*, Vol. 4, ed. Alan J. Auerbach and Martin Feldstein. Amsterdam: Elsevier, 2002.

Nonetheless, the overall conclusion that there are significant border effects within the single currency area is robust when controlling for distance, for the differences in the distribution of individual prices and for diverging business cycle positions across countries.

One possible explanation of protracted differences in price levels across countries lies in market segmentation (i.e. price discrimination), which may be related to differences in retail market concentration, competition between producers, bargaining power allocation between producers and retailers, differences in consumer habits and differences in local costs such as wages and rents.

Retail market structure may have an impact on price levels, albeit in a complex manner. On the one hand, increased retail market concentration (or less competition) "downstream" or closer to the consumer – i.e. at the store and parent company levels – is associated with higher prices. On the other hand, increased retail concentration "upstream" or closer to the producer – i.e. at the buying group level – is associated with lower prices.[13,14] Whether the downstream or upstream effects dominate is largely an empirical question. A statistically significant upward impact on prices from increased concentration (lower competition) at the parent company level is found by regressing price levels on regional concentration indices.[15] By contrast, the indications of a downward impact on prices arising from higher concentration at the buying group level are not robust across product categories. On balance, the results suggest that a lower degree of regional competition (higher concentration) at the parent company level is associated with higher prices.

13 A buying group is an organisation of retailers that combines the bargaining power of its members in order to be able to purchase goods at a more advantageous rate than might be achieved through individual negotiation.

14 See Ciapanna, E. and Colonna, F., "The effect of retail sector concentration on prices and SME performance in Italy", 2011, mimeo.

15 These findings are based on econometric investigations where the following equation was estimated at the regional level: $\ln p_{ij} = a_i + b_k + \alpha H^{BGj} + \beta H^{PCj} + \zeta X_j + \varepsilon_{ij}$ where the dependent variable is the average price level (net of the VAT and in natural logs) for good i sold in region j and the main explanatory variable is the Herfindahl-Hirschman Index (HHI), computed at the buying group (H^{BGj}) and at the parent company level (H^{PCj}). Other control variables are included in the vector Xj and are comprised of regional dummies, regional population density, regional per capita GDP and the regional unemployment rate.

These results suggest that appropriate competition-enhancing policies (for example, the removal of zoning restrictions, retail outlet size restrictions or population-based restrictions) might benefit consumers by lowering prices.

In view of the evidence of both microeconomic (market structure, consumer attitudes) and macroeconomic (position in the cycle) determinants of price differences, it is important to try to holistically account for as many factors as possible at the same time. This is done by regressing relative prices on possible explanatory variables split into four main categories.[16]

1. Competition in the producer market, which is captured by: (a) the relative quantity share of the market leader, which can be seen as a relative measure of monopoly power; (b) the relative quantity share of other brands that are not the market leaders; and (c) the relative quantity share of private label products.

2. Consumer attitudes, which are measured by: (a) consumption intensity, calculated as the number of units sold per person per month in a location;[17] and (b) consumer cost indifference, measured as the average pack size (while there is a negative relationship between pack size and unit price, it is still the consumer's choice which pack size to buy).

3. Retail market concentration indices for: (a) the parent group level, and b) the buying group level.[18]

4. Other regional variables which may be important for determining price levels, such as (a) local costs such as wages and rents, (b) GDP per capita, (c) the unemployment rate, (d) population density, (e) VAT rates, and (f) a dummy variable capturing promotions.[19]

The results suggest that there is scope for lowering price dispersion (and lowering prices in some countries) by implementing product market reforms that aim to reduce the rents of the incumbent producers (i.e. the market leaders) and ease the potential entry and growth of new producers (increasing competition) – see Table 2. Significant effects on prices from retail market concentration are also found that depend on the level of aggregation (buying group vs. parent group), confirming that relevant policies regarding retail structures may indeed be beneficial for consumers. Perhaps reflecting the labour-intensive nature of this sector, differences in wages of low-skilled workers are also found to be important in explaining observed price differences, as are differences in rents (albeit not as robustly). The variables capturing the macroeconomic environment (such as regional GDP per capita, population density, unemployment) do not seem as important at the regional level, while VAT differences are significant in explaining price differences across countries. Finally, the variables capturing consumer attitudes (willingness

16 The relative price equation estimated is set up whereby the unit price of a brand for a specific product in a region is expressed relative to the unit prices of the minimum price location (based on the market leaders in each location). All explanatory variables are expressed in similar relative terms and quantity-based variables are instrumented with their third lag to avoid simultaneity.

17 For example, Italy has a relatively high consumption intensity of pasta. Therefore, the price of pasta may be more important to, and monitored more by, Italian consumers compared with the price of, say, strawberry jam.

18 Measured as Herfindahl-Hirschman indices calculated at 5 km radii which are then averaged up to the regions.

19 Promotions are defined as a price that drops by more than 6.25% (implying a 25% reduction in a week, which is a typical promotion period) in a month and increases by more than 6.25% in the next. Time dummies and dummies controlling for product equivalising units are also included.

Table 2 Variables explaining price differences relative to minimum price location

Variables	sign	Mechanism
1 – Product market competition		
1a – market leader share	+	increased monopoly power
1b – other brands share	−	increased competition
1c – private label share	−	increased competition
2 – Consumer attitudes		
2a – consumption intensity	−	increased consumer attention
2b – consumer cost indifference	−	increased consumer awareness
3 – Retailer competition		
3a – retail Herfindahl-Hirschman index (HHI) parent company level	+	reduced competition
3b – retail Herfindahl-Hirschman index (HHI) buying group level	−	countervailing producer power
4 – Other control factors		
4a – wages of low-skilled workers	+	increasing cost
4b – rents of retail shops	+	increasing cost
4c – GDP per capita	+ *(n.s.)*	income effect
4d – unemployment rate	− *(n.s.)*	income effect
4e – population density	− *(n.s.)*	scale economies
4f – VAT	+	pass-through
4g – promotion dummy	−	lower actual prices

Source: Eurosystem staff calculations.
Note: n.s. denotes not significant at the 10% significance level.

to consume private label goods, preferred pack sizes, etc.) are significant and economically meaningful. In this respect it is important to educate and inform consumers, stressing that their habits may affect prices.

4 POTENTIAL IMPLICATIONS OF CHANGES IN THE GROCERY RETAIL STRUCTURE FOR INFLATION MEASUREMENT [20]

The potential for bias in inflation measurement has long been recognised. The Boskin Commission Report (1996)[21] highlighted four main sources of possible bias: (i) product substitution bias, which occurs with a fixed-weight consumption basket that fails to reflect the fact that consumers tend to substitute less expensive goods for more expensive goods when relative prices change; (ii) outlet substitution bias, which occurs when shifts to lower price outlets (e.g. discounters) are not adequately captured; (iii) quality change bias, which occurs when improvements in the quality of products are either estimated inaccurately or not at all; and (iv) new product bias, which occurs when new products are introduced into the consumption basket in a sufficiently timely manner. Another source of possible inflation measurement error is the lack of weighting at the elementary index level.[22]

20 This section draws from Gabor, E. and Vermeulen, P., "New evidence on elementary index bias", *Working Paper Series*, No 1754, ECB, Frankfurt am Main, December 2014; McQuade, P., "Substitution to private label products: Evidence from euro area retail scanner data", paper presented to the 2014 European Economic Association Annual Congress, 25-29 August, Toulouse, France.

21 "Toward a More Accurate Measure of the Cost of Living", *Final Report to the Senate Finance Committee from the Advisory Committee to Study the Consumer Price Index,* December 1996.

22 For a more detailed discussion of these factors, see also the box entitled "Potential measurement issues in consumer price indices", *Monthly Bulletin*, ECB, April 2014.

Evidence of the magnitude of inflation measurement bias in euro area countries is relatively scarce and generally relates to the late 1990s. Examples of studies considering new outlet bias are: Lequiller (1997) for France, who suggests a range of 0.05 percentage point to 0.15 percentage point per annum; Hoffmann (1998) for Germany, who argues that the effect is "unlikely to exceed 0.1 percentage point annually"; and Covas and Silva (1999) for Portugal, who, using Portuguese micro data, found that the effect had changed over time, ranging between 0.25 and 0.50 percentage point per annum.[23]

More recent work on the subject of inflation measurement highlights the uncertainty surrounding estimates of inflation measurement bias in terms of both sign and magnitude and the fact that these estimates may vary over the business cycle.[24] Linz (2009) discusses the impact of a new weighting system on German inflation which gives a higher weight to discounters than previously and results in upward revisions to inflation owing to the pass-through of commodity price shocks. Handbury et al. (2013), using Japanese scanner data for grocery prices, find an upward bias on average over a long time period, which eventually turns from being positive to negative. Greenlees and McClelland (2011), using data from the United States, find that that the upward impact on prices from improved item quality offsets most of the downward impact of lower-priced outlets. Lastly, Kryvstov (2013), using Canadian data, argues that quality bias is not an important source of potential mismeasurement of CPI inflation in Canada.

A number of features of the disaggregated price dataset used in this article enable an analysis of the cross-country evidence on possible inflation measurement issues for the euro area. First, as information both on market shares and average prices is available across store types, the possible implications for inflation measurement of structural changes in retail formats can be considered (see Box 4). Second, when constructing consumer price indices, price differences between private label and branded goods are usually implicitly attributed entirely to quality differences (thus the price level shift which occurs when consumers turn to cheaper private label products is not taken into account); however, indirect empirical evidence on the substitution between private label and branded goods using the disaggregated grocery price data suggests that this may not entirely be the case.[25] Lastly, as data are available on the volume of sales as well as the average unit price of these sales, the possible impact of the lack of weighting at the elementary index level on consumer price indices can be considered. One caveat is in order: as data are available only for selected grocery goods, it is not possible to draw conclusions about the potential for mismeasurement of overall inflation. Nonetheless, important insights may be obtained and areas for further research identified.

The noteworthy differences in price levels across different store types (even when controlling for composition effects) and structural changes in store formats (notably the emergence of discounters and the relative decline of traditional store types) could have implications for

23 See Lequiller, F., "Does the French Consumer Price Index Overstate Inflation?", *Série des documents de travail de la Direction des Etudes et Synthèses Économiques*, Institut National de la Statistique et des Études Économiques, August 1997; Hoffmann, J., "Problems of Inflation Measurement in Germany", Discussion Paper, 1/98, Economic Research Group of the Deutsche Bundesbank, February 1998; and Covas, F. and Santos Silva, J., "Outlet substitution bias", *Economic Bulletin*, Banco de Portugal, September 1999.

24 See Linz, S., "Weighting of Outlet-types and Regions – a new Weighting System for the German Consumer Price Index", *Paper prepared for the 11th Meeting of the International Working Group On Price Indices*, Ottawa Group, 2009; Handbury, J., Watanabe, T. and Weinstein, D.E., "How Much Do Official Price Indexes Tell Us About Inflation?", *NBER Working Paper Series*, No 19504, October 2013; Greenlees, J.S. and McClelland, R., "New Evidence on Outlet Substitution Effects in Consumer Price Index Data", *The Review of Economics and Statistics*, Vol. 93, No 2, May 2011, pp. 632–646; and Kryvstov, O., "Is There a Quality Bias in the Canadian CPI? Evidence from Micro Data", *Working Papers*, No 2013-24, Bank of Canada, July 2013.

25 An increasing substitution between private label and branded goods was also estimated for non-stressed countries over the same period. For further evidence, see also Lamey, L., Dereersnyder, B., Dekimpe, M.G. and Steenkamp, J., "How Business Cycles Contribute to Private-Label Success: Evidence from the United States and Europe", *Journal of Marketing*, Vol. 71, 2007.

inflation measurement. Such structural changes may imply mismeasurement in official inflation statistics if the price level differences between store types do not only reflect quality differences in the retail service provided (as is normally assumed when new outlets enter the samples) or if price changes differ across outlet types and statistical offices are slow to reflect the changing importance of different outlet types in the outlet weights used. Differences in market share and price dynamics are found across store types. Most noticeably, over the period 2009-11, both the relative price and relative market share of discounters increased slightly. These two effects counteract each other. Overall, over the period considered, the net impact on measured inflation does not seem to be economically significant, at less than 0.1 percentage point of the annual inflation rate.[26] The negligible impact may be due to the fact that, over the sample period considered, the potential upward bias arising from a substitution effect away from discounters owing to an increase in their relative prices was being counteracted by a downward bias arising from a market share effect as discounters became more attractive in the context of the slowdown in economic activity.

Prices for private label goods are, on average, substantially lower than those for branded goods – see Box 4. Combined with the evidence of substitution between private label and branded goods this suggests implications for inflation measurement. Estimates show that private label goods and branded goods are substitutes – thus resulting in an upward bias – but also that private label goods have seen larger price increases than branded goods over the sample period, which, when combined with an increased market share (the share of private label goods has increased during the economic slowdown), results in a downward bias. A priori, the overall net effect is ambiguous.

26 Hausman and Leibtag (2009) estimate for the United States that the outlet substitution effect (together with new outlet bias) is significant and might even reach 18% of the measured inflation rate (in other words, suggesting that the CPI is overestimated by 0.42 percentage point per annum). See Hausman, J. and Leibtag, E., "CPI Bias from Supercenters: Does the BLS Know that Wal-Mart Exists?", *NBER Working Paper Series*, No 10712, August 2004.

Box 4

STRUCTURAL SHIFTS IN STORE FORMATS AND THE EVOLUTION OF PRIVATE LABEL GOODS

This box provides a descriptive overview of two noteworthy developments relating to grocery prices in the euro area, namely the evolution of store formats and the emergence of private label goods.

Store formats

Structural shifts in grocery retail and differences in price evolutions across store types need to be taken into account when measuring inflation. There is considerable heterogeneity across countries in terms of the structure of grocery retail, reflecting a combination of factors, such as historical legacies, societal preferences, socio-geographical factors and regulatory conditions. Even so, there has been a widespread increase in the market share of discounters, while shares for smaller grocers and specialist retailers have fallen (see also the SIR 2011). Furthermore, there tend to be substantial differences on average in the price levels found across the different store types for the product categories investigated. All other things being equal, discounters generally tend to be cheapest, followed by hypermarkets and large supermarkets, with small supermarkets,

traditional stores and other store types (such as pharmacies and specialised outlets) being, on average, more expensive.[1]

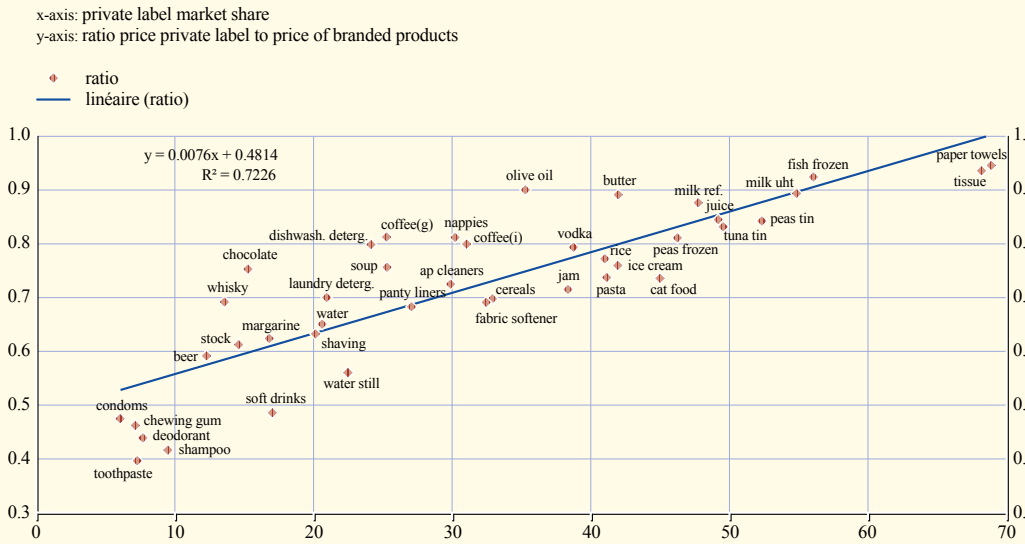
Private label goods

Similarly, growth of private label goods also needs to be reflected in inflation measurement. Partially in response to, but also as a result of, the emergence of discounters, private label (or own label) brands by retailers themselves have emerged. As reported in the SIR 2011, the market share of private label goods has been increasing steadily in the euro area and, more generally, the penetration of private label goods in the market for packaged food is higher in western Europe than in any other geographical region.

There are substantial price differences between private label and branded goods. The data suggest that these are around 35% on average. However, these differences decline slightly over the sample period. At the same time the market share of private label goods has increased. The discount of private label goods relative to branded labels varies across countries, and is largest for Slovenia, Belgium and Greece and smallest for Italy and the Netherlands. The share of private label goods is relatively low in Estonia, Italy and Greece, and relatively high in Germany and Spain.

Across product categories, a noteworthy feature of private label goods prices is the positive relationship between their share of the market and their price relative to branded goods. Product categories with a relatively small share of private label goods have a large discount

Ratio of private label to branded goods prices and private label market share (2009-11)



Sources: Nielsen and Eurosystem staff calculations.
Note: coffee(g) = ground coffee; coffee(i) = instant coffee; ap cleaners = all-purpose cleaners; milk ref. = refrigerated milk.

1 Price differences vis-à-vis discounters, controlling for the composition of goods sold, range on average from 1% up to 17% depending on store type. It should be noted that apparent price differences are larger if the composition of goods (such as the share of private label goods, premium brands, etc.) is not controlled for.

relative to branded products (see Chart). This is due to the nature of the goods as well as consumer perceptions.[2] For instance, consumers appear to perceive little difference between private label goods and branded goods for products such as paper towels and tissue paper and therefore (i) are willing to consume private label goods, resulting in a high market share for private labels, and (ii) will not pay a large premium for branded products, resulting in a relatively low discount for private labels. On the other hand, for personal care products, such as deodorants, shampoo, condoms and toothpaste, consumers appear to place greater emphasis on brands and therefore (a) are not willing to consume private label goods, resulting in a low market share, and (b) are willing to pay a substantial premium for branded products.

While the net competition effects of private label goods may be unclear a priori,3 an increase in the market penetration of private label goods will exert downward pressure on price levels, as such goods are generally cheaper (other things being equal).[4]

However, determining the impact of increased market shares for discount stores and private label brands on inflation measurement is more challenging and cannot be assessed ex ante. On the one hand, to the extent that price differences are not entirely the result of quality differences, it would imply an upward bias in inflation measurement. On the other hand, although the price of private label goods is, on average, lower than for branded goods, the rate of change in unit prices has been higher for private label goods than for branded goods over the sample period for the goods in the dataset. With an increasing market share, this could suggest some downward bias. Which effect dominates may vary over time and could depend, to some extent, on the business cycle.

2 In general, goods which are relatively generic or "commoditised" are more likely to be offered as private label goods (e.g. canned and packaged food products, tissues and kitchen towels, etc.), while goods which have a higher degree of product differentiation and/or for which advertising or quality is of great importance (e.g. cosmetics, alcoholic drinks, baby food, etc.) tend to exhibit a lower level of private label penetration. J. Steenkamp et al. report that private label brand penetration is highest for certain categories of food and beverage and household products, but lower for many personal care products. In addition, they report that in countries where consumers have low trust in firms and institutions, private label penetration is likely to be low. See Steenkamp, J., Geyskens, I., Gielens, K. and Koll, O., "A global study into drivers of private label success", commissioned by AIM – European Brands Association, 2004.

3 The existence of private label goods may offer consumers more choice and may counteract the bargaining power of the producers of large brands. However, a high penetration of private label goods might give retailers excessive market power, particularly if competition in the retail sector itself is insufficiently high. In addition, smaller brands might get squeezed out of the market by a combination of large branded and large private label goods. Thus, the overall effect on competition is not straightforward. For a more detailed analysis, see "The impact of private labels on the competitiveness of the European food supply chain", European Commission, 2011.

4 The 2004 study by J. Steenkamp et al. (op. cit.) found that "aggregated across all FMCG (fast moving consumer goods) categories, manufacturer brands are priced higher than private labels in all regions", but noted that the price premium varies by a substantial amount across countries and products.

Considering the issue of weighting at the elementary index level, it is known that the choice of index formula for measuring consumer price inflation matters.[27] Official consumer price indices are generally constructed by a weighted aggregation of lower level index aggregates, where weights are based on expenditure information. However, at the level of individual products, for example different brands of the same product, usually no expenditure weights are available and the basic price indices for finely defined products (so-called elementary indices) are usually constructed using unweighted averages of price observations. For example, to construct a coffee price index, statistical offices normally construct an unweighted price average based on a sample of different brands, although they might sell at quite different and unknown quantities. The use of unweighted

27 For an early exposition of this issue, see Silver, M., "Elementary Aggregates, Micro-indices and Scanner Data: Some Issues in the Compilation of Consumer Price Indices", *Review of Income and Wealth*, International Association for Research in Income and Wealth, Vol. 41, No 4, December 1995, pp. 427-438.

Table 3 Summary of inflation measurement analyses

Issue	Effect
Store format	On average, evidence of negligible and insignificant upward CPI bias. Small net effect perhaps due to substitution away from store formats with higher price increases being counteracted by income, where consumers turn to stores that are cheaper – but have higher price increases.
Private label goods	Indirect evidence points to potential upward CPI bias (as estimates show that private label goods and branded goods are substitutes and private label goods have relatively larger price increases) being counteracted over the sample by a market share effect (share of private label increasing owing to economic slowdown). The net effect is ambiguous.
Elementary weighting	Weighting at the elementary level can substantially change measured inflation both upwards and downwards both at the elementary level and at a more aggregated level, compared with using unweighted elementary aggregates. However, the effects are not systematic.

price averages to construct lower level indices of finely defined products is not so much made by choice but by necessity. This begs the question of whether the absence of expenditure weights at the lower levels of aggregation matters for inflation measurement.[28]

The data used in this article allow for an investigation of the index level issue, as expenditure (sales) shares can be calculated at the elementary level, and a comparison of unweighted and weighted price indices for individual products indeed finds that weighting at the elementary level may have significant effects. These effects may be both positive and negative. Furthermore it seems that, although these effects do not offset each other upon aggregation, there is no systematic positive or negative effect across countries, products and aggregation levels. Thus, while weighting at the elementary level can substantially change measured inflation, the mismeasurement can be both upwards and downwards and the net effects are not systematic.

Overall, the analysis illustrates that there is considerable uncertainty, not only in terms of the magnitude but also of the direction of potential biases in inflation measurement (see Table 3). For instance, developments in the period 2009-11 suggest that, although relative prices for private label goods and discounters were increasing, they also increased their share of the market. While this combination may be due in part to the effect of the economic crisis, it suggests that the upward bias discussed in the literature cannot be assumed, but must be assessed empirically. In this context, ongoing work by the European Statistical System to investigate the information content of scanner data and its use in official price statistics is welcome.[29]

5 CONCLUSIONS

Overall, the analysis underscores the need to maintain progress with reform efforts that enhance entry into and improve contestability in the consumer goods industries and distributive trades. The analysis of the dataset containing disaggregated information on grocery prices across euro area countries has provided a number of unique and valuable insights into grocery prices in the euro area. In particular, the results highlight substantial deviations from the law of one price and strong market segmentation along national borders, implying that there is

28 Note that this question is different from the issue of whether there may be a bias at the elementary index level owing to the typical substitution behaviour of consumers, as discussed for example in the Boskin Commission Report.

29 For an overview of recent work by European statistical institutes in this area, see papers presented at the "Workshop on Scanner Data for HICP", hosted by Statistics Portugal, Lisbon, from 26 to 27 September 2013: http://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_sem_lista&tipo=r&detalhe=165101941

much progress still to be made in developing the Single Market. Price level differences are shown to be a function of the structure in retail and producer markets, where the competitive situation is of particular importance, but where consumer behaviour also has a role to play.