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High price premiums as barriers to organic meat demand? A hedonic analysis considering species, cut and retail outlet*

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Rigid price setting and high organic price premiums have been perceived as major purchase barriers to organic meat products. While emerging price and product differentiation have been reported for organic products in other categories, empirical evidence for the organic fresh meat market is lacking. We estimate a hedonic pricing model based on German household scanner data for fresh red meat and poultry purchases from 2012 to 2014. We derive and test for differences in organic price premiums across distribution channels, species and product type. Our results indicate significant variation in organic premiums, which range from 14 per cent for minced beef to 108 per cent for chicken breasts, and are considerably lower than previously reported estimates. We also find substantial overlaps in the distributions of conventional and organic prices for selected products. Our results suggest that high price premiums can no longer serve as the dominant explanation for low market shares of organic red meat. Marketers and policymakers may instead communicate the benefits of organic meat over conventional premium alternatives more clearly or increase the availability of organic meat.

Key words: Germany, hedonic analysis, household scanner data, meat, organic, price premiums.

JEL classifications: D12, D22, L11, L81

1. Introduction

Meat consumption has increasingly been subject to political debates due to its adverse effects on the environment and health, as well as concerns over animal welfare (Lusk 2011; Willet *et al.* 2019). In Germany, scientific advisory councils to the government have pointed out the negative impacts and lack of social acceptance of current farming practices (SRU 2012; SAB 2015). A representative consumer survey conducted by Forsa (2020) illustrates the

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scepticism over meat. While only 5 per cent and 1 per cent state to eat strictly vegetarian and vegan, respectively, 55 per cent consciously avoid meat sometimes. Some consumers – especially the younger and higher-educated – turn to plant-based meat and dairy alternatives at least once a day (5 per cent) or once a week (11 per cent). A share of 50 per cent look for the (EU) organic label 'always' or 'most of the time' when shopping (Forsa 2020). Hence, one would expect many of those consumers who aim to eat more sustainably, but do not want to go completely meatless, to turn to organic meat as an alternative.

Regulated by the EU Council Regulation (EC) No 834/2007, organic animal production faces stricter constraints than its conventional counterparts. Among others, the maximum stock size is tied to the farm area to preserve soil and water, feedstuff must be mostly organic, preferably from the same farm, and animals must have more space and access to open air and grazing areas. Non-curative surgery or prophylactic antibiotic usage is prohibited (BMEL 2021; EC 2021; TI 2021). Compared with conventional animal production, organic production has been credited for increased water protection, soil fertility, biodiversity and slightly higher animal welfare (Sanders and Heß 2019). No advantages exist regarding greenhouse gas emissions (Pieper and Michalke 2020).

Despite stated consumer interest and reported benefits, organic meat still represents a niche in Germany. In 2019, organic shares in household meat purchases were 2.6 per cent for red meat, 1.8 per cent for poultry and 1.6 per cent for processed meat products (AMI 2020a; b). An oft-cited reason for this citizen–consumer gap is the large price premiums of organic over conventional food products (Rödiger and Hamm 2015; Aschemann-Witzel and Zielke 2017). Such price differences have been reported to be especially high for meat (products) (Schröck 2013) and have been claimed to act as major purchase barriers (e.g. Spiller 2001; Plassmann and Hamm 2009; Van Loo *et al*. 2010).

One explanation for high organic price premiums includes the large differences in production costs between organic and conventional meat (Beukert and Simons 2006; Ökolandbau 2019). A second reason is higher costs in slaughtering, processing and distributing organic meat due to the separation of flow of goods and a lower degree of specialisation (Beukert and Simons 2006). Third, retailers may hesitate to stimulate organic product sales through price promotions or low-price strategies (Spiller 2001). Potential reasons include fear of negative price-quality irradiations, unprofitable price wars or procurement problems. Also, retailers imitating the high price strategy of organic pioneers and normative pressure from stakeholders in the organic sector may play a role (Spiller 2001; Hamm and Aschemann 2007). Finally, consumers are regarded as 'picky', preferring only select cuts. In the conventional sector, high-grade parts such as chicken breast sold fresh at retail outlets therefore have to subsidise other parts of the carcass sold at declining margins into other regions (EU, third country markets) or other

channels (large-scale consumers, processed meat, pet food) (Thies and Efken 2020). This effect is amplified for organic meat, where less-demanded cuts can only be sold as conventional meat (Korbun *et al*. 2004; Quaing 2017).

Example statements for magnitudes of organic meat price premiums can be found in the Scientific Advisory Board's report on socially acceptable husbandry practices (SAB 2015). Assumed premiums are at 200 per cent for organic poultry (p.74), 100 per cent for organic meat (p.80), and 100 per cent to 300 per cent for products offering higher animal welfare. Except for a comparison of select chicken breast products (p.296), these numbers are not supported by empirical evidence.

At the same time, research suggests that high organic price premiums may no longer serve as the dominant explanation for low market shares. Price ranges of individual food categories have been found to be wide for both conventional and organic segments with considerable overlaps (Hamm and Wild 2004; Hamm *et al*. 2007). Organic prices are often comparable to the prices of premium conventional products (Stumm 2004; Hamm *et al*. 2007). Hamm *et al*. (2007) advise caution with estimates of organic price premiums based on averages for broad categories, which is definitely advisable for meats, where conventional prices vary across, for example, species, retail cut, store type or brand.

The previous discussion suggests that there is a lack of empirical evidence regarding the existence and the magnitude of price differences between conventional and organic meat. Given the controversial debate on adverse environmental and health effects, as well as concerns over animal welfare, there is a need for robust insights on whether high organic price premiums still serve as a plausible explanation for low organic market shares. If this is no longer the case, the question arises, which alternative obstacles prevail and which marketing and policy instruments exist to appropriately address them. Against this background, this article addresses the following research questions: (i) Do organic premiums exist and, if yes, what is their magnitude? (ii) Do organic (and conventional) premiums differ across different product and market factors? (iii) How are conventional and organic prices distributed and how strongly do they overlap?

We aim to answer these questions using household scanner data from the Gesellschaft für Konsumforschung (GfK) for fresh red meat and poultry purchases from 2012 to 2014. We isolate the organic premium by means of a hedonic price model, regressing purchase prices on a binary organic indicator and controlling for other product characteristics (package weight, species and cut) and market factors (vending type and distribution channel). We test for differences in organic premiums across product and market factors by introducing a set of interaction terms with organic. Additionally, we analyse conventional and organic price dispersions for select products to consider heterogeneity in more detail. Our results will inform the discussion on high price premiums as a major purchase barrier to organic products. Depending

on the results, we discuss alternative explanations, market potential, and marketing and policy implications.

2. Previous work on organic premiums for meat

The ongoing interest in the magnitude of organic price premiums is mirrored by numerous studies. Studies based on hedonic analyses for the United States include Jaenicke and Carlson (2015) for carrots, soup, coffee and milk; Carlson and Jaenicke (2016) for 17 different food products; Smith and Huang (2009) and Kiesel and Villas Boas (2007) for milk; Huang and Lin (2007) for fresh tomatoes; and Waldrop and McCluskey (2017) for wine. European examples comprise Schröck (2014) for cheese; Corsi and Strøm (2013), Abraben and Grogan (2017) and Fanasch and Frick (2020) for wine; and Ankamah-Yeboah and Nielsen (2016) for salmon. Griffith and Nesheim (2013) showed how the hedonic approach can be used to retrieve lower and upper bounds of WTP for organic meat based on large consumer baskets.

Some of these studies provided evidence that organic price premiums vary across time or season (Kiesel and Villas Boas 2007; Carlson and Jaenicke 2016), market factors and retail channels (Schröck 2014; Jaenicke and Carlson 2015), geographical location (Huang and Lin 2007; Chang and Lusk 2010), product type (Smith *et al.* 2009), production method (Chang *et al.* 2010) and the presence of multiple certifications (Waldrop *et al.* 2017).

Table 1 lists existing hedonic analyses for meat and meat products, indicating that empirical evidence on organic price premiums for meat is limited. In the United States, Boland and Schroeder (2002) found small organic premiums for wholesale prices of 11 primary beef cuts and Schulz and Schroeder (2012) reported a high organic price premium of $2.98/lb. for beef steaks. Gschwandtner and Ribeiro (2019) found an organic price premium of 135 per cent for chicken meat in the United Kingdom. Other existing hedonic studies for meat in Europe investigated protected geographical identifications in Galicia (Loureiro and McCluskey 2000) and country-of-origin labelling in the United Kingdom (Hussein and Fraser 2018). Both studies did not include the organic attribute as a covariate.

While empirical evidence on variation in organic price premiums for meat across product attributes and market factors is scarce, available studies suggest that investigating differentiated premiums is important. Boland and Schroeder (2002) report organic premiums to vary across different steak cuts. They found small positive organic premiums for rib eye, gooseneck and knuckle and negative premiums for top butt and inside round. Dennis (2020) computed average organic premiums for select beef, pork and chicken cuts in the United States. He found premiums to vary across species, with chicken garnering the highest premiums, followed by pork and finally beef. Premiums were found to be higher for higher-priced beef cuts.

Two studies have provided evidence for variation in premiums for origin labels and branding across meat cuts. Loureiro and McCluskey (2000) found

Table 1 Hedonic studies for meat

No.	References	Country	Category	Data source	Key attribute	Findings
1	Loureiro and McCluskey (2000)	Spain (Galicia)	Veal	Survey of 157 families on meat consumption, 31 March to 1 June 1997 (n = 962)	PGI label, interacted with meat cut	PGI label has a price premium of 32 pesetas/kg (0.21 US-$/kg). Premiums for PGI are significant only for higher-priced products.
2	Boland and Schroeder (2002)	United States (Midwest)	Primary beef cuts	Data for 630 beef cattle sales from producer cooperatives, 05/1996–12/1999	Production and processing attributes, **organic**	No significant effect of organic.
3	Parcell and Schroeder (2007)	United States	Pork and beef retail cuts	Meat Panel Diary, NPD Group, 2,000 households surveyed twice/month, 1992–2000	Product and retail factors	Brand premiums vary across private, national and store brands and across meat cuts carrying the same brand name.
4	Schulz *et al.* (2012)	United States	Retail steak products	Retail scanner data, 01/2004 to 03/2009	Brand, breed, **organic**, others	Organic garners a premium of 2.98 US-$/lb. relative to non-organic.
5	Hussein and Fraser (2018)	United Kingdom	Fresh and processed meat	Aggregated market data, Kantar World Panel, 02/2010–01/2015	Country-of-origin label	No difference between English, Irish and British origin. Undeclared origin has a negative premium of 2 £/kg relative to British origin.
6	Gschwandtner *et al.* (2019)	United Kingdom	Chicken meat	2016 Household scanner data, Kantar World Panel	**Organic**	Implicit marginal price of 135% (6.36 US-$/kg) for the organic attribute.
7	Dennis (2020)	United States	Select beef, pork and chicken cuts	Advertised price data, USDA-Agricultural Marketing Service, 12/2018–01/2020	**Organic**	Organic premium for boneless chicken breast was 194% and 63% for a boneless ribeye steak. Organic premiums appear larger for lower-than for higher-priced products.

that premium veal cuts achieved higher price premiums if they carry the protected geographical indication (PGI) label in Galicia. The authors concluded that the label provided additional value when the meat was bought on special occasions for which consumers seek higher quality products in terms of either sensory characteristics or image. Parcell and Schroeder (2007) found brand premiums to be higher for steak and premium cuts but not for minced meat.

The previous discussion highlights the importance of accounting for differences in organic price premiums for food in general and meat in particular. For the fresh meat market in Germany, three observations suggest that distribution channel, species and product type warrant particular attention.

First, assortment and price strategies across supermarkets, discounters or traditional butcher shops for conventional and organic meat have been shown to be heterogeneous (Aertsens and Mondelaers 2009). Whereas discounters follow an 'every-day-low-price (EDLP)' strategy for conventional meat, supermarkets pursue a 'high–low (HiLo)' pricing strategy to stimulate store traffic (Mihr 2014; Roeb 2014). For organic meat, discounters tend to emulate their EDLP approach, while supermarkets apparently position organic meat as a high price premium product (Knuff 2017). Butcher shops, direct marketers or farmers' markets attract consumers who value taste, quality and freshness, and are less price-sensitive (Hensche and Schleyer 2007; Schulze and Spiller 2008a). At the same time, these smaller outlets might incur higher processing and marketing costs. We assume that differences in both conventional base prices and pricing strategies for organic meat lead to diverging premiums across distribution channels.

Second, organic premiums may vary across meat cuts of different price ranges and attributes. This follows from the discussion over the issue of high-graded cuts subsidising lower-price cuts, where we expect a more pronounced effect for organic compared with conventional premiums. While important for marketing considerations, the literature has mostly neglected consumer preferences for different meat cuts and their relation to extrinsic product attributes such as organic or origin. Existing studies mostly dealt with general species or specific cuts such as steaks (Scozzafava *et al*. 2016).

Third, we expect pronounced differences in organic premiums across species. The gap in production costs between organic and conventional meat has been reported to be smaller for beef (0.50 euro per kg carcass weight) than for pork (1.00 euro per kg carcass weight) (Beukert and Simons 2006; Ökolandbau 2019). Organic–conventional cost differences for poultry and especially chicken production can be assumed to be even higher due to significant differences in efficiency and growth rates. For example, fast-growing high-intensive conventional breeding lines reach their slaughtering weight after 38 days, while it takes approximately 70 days for slow-growing breeds used in organic chicken production (Ökolandbau 2020), increasing costs for feed, labour and housing.

The assumed variations in organic premiums are accounted for in the empirical model presented in Section 4 by interaction terms of the organic indicator with the discussed product and market factors. Additionally, we will investigate detailed price distributions for conventional and organic meats in Section 5.3 to obtain insights into heterogeneity in purchase prices and the potential market demand for select organic cuts.

3. Data on German fresh meat purchases

We use household scanner data for fresh meat and poultry purchases in Germany covering 2012 to 2014 from the Gesellschaft für Konsumforschung's (GfK) ConsumerFresh Panel (GfK 2012-14). Participating households are equipped with a handheld scanner and scan barcodes of all grocery purchases made on a daily basis. For non-packaged food items, households scan codes from a codebook with pictures and examples for a variety of items (e.g. various types of fresh produce or fresh meat). Participants report the weight and expenditure of individual purchases along with product and purchase attributes such as animal species, product type, over-the-counter (OTC) vs. self-service purchases, distribution channel, and organic vs. conventional production. The data contain purchase information for the full range of retail outlets for meat, including butcher shops, farmers' markets and direct marketers. The raw data set contained 1,486,582 observations from 21,656 households. We purged outliers of extremely low prices (<0.45 €/kg, 4 observations dropped) and extremely high prices (>80 €/kg, 8 observations dropped) and dropped observations with missing values for socio-demographics and attitudes. While we lost 6,641 households (30.7 per cent), these accounted only for 115,195 or 7.8 per cent of all purchases. Our final data set contained 1,371,387 purchase observations from 15,015 households.

Table 2 provides frequencies, organic shares and median prices across different product characteristics (farming type, species, product type) and market factors (distribution channel, vending type). In line with earlier reports, only 1.37 per cent of all meat purchases fall into the organic category. Pork meat accounts for the largest number of purchases with a share of 49.8 per cent. The remaining species were ranked in the following order: beef (14.2 per cent), chicken (14.0 per cent), mixtures of pork and beef (11.2 per cent) and turkey (7.9 per cent). Other red meat (e.g. veal, lamb) and other poultry (e.g. duck and goose) products make up less than 2 per cent of all purchases.

Figures for distribution channels mark discounters as major players in the fresh meat segment with a share of 39.3 per cent of all purchases. With supermarkets and hypermarkets accounting for 25.2 per cent and 20.8 per cent, respectively, standard retail formats account for about 85 per cent of all purchases for fresh meat in the data. In contrast, butcher shops account for

Table 2 Frequency, organic share and median prices across meat product characteristics

	Freq.	Perc.	Organic share (%)	Price (euro/kg)			
				Conventional		Organic	
				Median	SD	Median	SD
Farming type							
Conventional	1,352,638	98.63	–	5.98	3.66	–	–
Organic	18,749	1.37	–	–	–	8.02	5.28
Species							
Pork	682,579	49.77	0.87	5.58	2.50	8.99	3.97
Beef	194,808	14.21	2.08	7.98	5.53	8.97	4.62
Pork/beef mixed	154,136	11.24	3.83	4.58	1.71	7.97	1.79
Other red meat †	23,049	1.68	0.52	13.90	7.94	22.29	9.27
Chicken	191,474	13.96	0.84	6.13	2.64	15.00	8.21
Turkey	107,915	7.87	0.93	6.77	2.44	15.32	5.15
Other poultry †	17,426	1.27	0.83	5.16	5.14	10.00	4.56
Distribution channel							
Discounter	539,117	39.31	1.18	5.58	2.47	7.97	1.23
Supermarket	346,381	25.26	1.08	6.35	4.30	10.99	6.53
Hypermarket	284,940	20.78	0.40	4.99	2.97	7.97	4.17
Butcher	153,248	11.17	2.42	7.99	4.67	9.90	4.59
Other ‡	47,701	3.48	7.92	6.99	5.25	11.40	6.42
Product type							
Minced, raw	240,670	17.55	3.88	4.58	1.55	7.97	1.95
Processed minced	128,922	9.40	1.00	5.00	2.61	7.30	1.94
Roast	91,290	6.66	1.58	5.99	2.82	10.70	3.25
Diced	83,859	6.11	0.65	5.98	2.22	10.82	3.34
Chops	124,700	9.09	0.99	5.97	3.51	9.89	4.69
Processed chops	40,343	2.94	0.26	5.90	2.33	10.99	3.72
Steak	106,812	7.79	0.99	6.98	4.44	9.89	4.43
Breast	177,709	12.96	1.12	6.73	2.28	19.34	6.21
Fillet	45,454	3.31	1.18	9.60	7.89	17.90	6.63
Other product type†	331,628	24.18	0.36	5.58	4.11	9.90	4.90
Vending type							
Self-service	901,060	65.70	1.20	5.50	2.81	7.98	5.30
Over-the-counter	470,327	34.30	1.68	6.96	4.67	9.90	5.19

Source: Authors' presentation based on GfK data from 2012 to 2014.
†For items subsumed under *Other red meat*, *Other poultry* and *Other product type*, see Appendix S1.
‡Other distribution channels comprise direct marketers and farmers' markets.

only 11 per cent of purchases. Regarding product type[1], the top five sellers are raw minced meat (17.6 per cent of purchases), poultry breast (13.0 per cent), processed minced meat (9.4 per cent), chops (9.1 per cent) and steak (7.8 per cent). High shares of these product types reflect the importance of convenience and time saving in today's meal preparation (Spiller and Schulze 2008). Two-thirds of all purchases come from self-service shelves mirroring

[1] We aggregated the numerous different products in the raw data into more manageable categories based on average price, quality level, retail cuts, and similar preparation style and consumption occasion. These aggregates and their single components are depicted in Appendix S1.

the decreasing importance of over-the-counter sales since the early 2000s (Lenders 2007).

The organic shares within single categories are close to the overall organic share of 1.37 per cent with some exceptions. Within species, the highest organic shares are captured by pork/beef mixtures (3.8 per cent) and beef (2.1 per cent). Regarding distribution channels, other outlets generate a high organic share of 7.9 per cent and butcher shops of 2.4 per cent. While discounters and supermarkets have organic sales shares of 1.2 per cent and 1.1 per cent, respectively, only 0.4 per cent of meat purchased in hypermarkets is organic, indicating the minor role organic meat plays in their business strategy (Aertsens *et al.* 2009). Across product types, raw minced meat has a high organic share of 3.9 per cent. Roasts (1.6 per cent), breast (1.1 per cent) and fillet (1.2 per cent) are close to the average; all other product types range below.

The last two columns of Table 2 show the median prices for conventional and organic meat. The difference between the overall median prices for organic and conventional fresh meat is 2.04 euros, translating into a percentage premium of 34 per cent. Conventional price patterns indicate strong price differentiation across species, distribution channels, product type and vending forms. Organic prices vary even more, suggesting major differences in organic price premiums depending on the product and market factors. Using these medians to calculate percentage premiums gives a range from 12 per cent for beef to 188 per cent for chicken breast. However, since the market and product attributes are potentially correlated with each other (e.g. discounters and supermarkets have a higher share of either chicken breast or raw minced meat) and with the organic share, price premiums calculated this way will be biased. Therefore, it is necessary to isolate each variable's effect on the observed prices paid in the market based on a hedonic model.

4. Hedonic price analysis

4.1 Theoretical basis

We base our analysis on Lancaster's (1966) characteristics approach, which assumes that consumers derive utility from the individual attributes of the goods they consume. A product is defined by a vector of n attributes $z = (z_1, z_2, \cdots, z_n)$, locating available products in a multidimensional characteristic space (Rosen 1974). Consumer utility maximisation and producer profit maximisation considering these attributes yield a product price as a function of the characteristic vector z: $p(z) = p(z_1, z_2, \cdots, z_n)$. The hedonic price function $p(z)$ traces the market exchanges of numerous differentiated products with varying combinations of attributes. It represents a joint envelope of multiple consumers' value functions and multiple producers' offer functions in characteristic space (Rosen 1974). The first derivative of p with

respect to z_i yields the implicit price of attribute i ($p_i = \partial p(z)/\partial z_i$), representing the effect that the presence of an additional unit of the i th attribute has on the product price. These implicit prices indicate producer marginal costs of providing an attribute and consumer marginal willingness to pay for it, but not global consumer willingness to pay (WTP) for a certain attribute level (Rosen 1974).

4.2 Hedonic model specification for fresh meat

We specify a hedonic model in which the observed price of purchase i of household h at time t is a function of product characteristics and market factors. Product characteristics include organic production, package weight, species and product type; market factors comprise vending type and distribution channel. The specification is given by Equation (1), where the subindices *iht* are omitted for readability:

$$\begin{aligned} Price = {} & \beta_0 + \beta_1 \cdot Organic + \boldsymbol{\beta_2'} \cdot \boldsymbol{Species} + \boldsymbol{\beta_3'} \cdot \boldsymbol{Channel} \\ & + \boldsymbol{\beta_4'} \cdot \boldsymbol{ProductType} + \beta_5 \cdot OTC + \beta_6 \cdot Weight \\ & + \boldsymbol{\delta_1'} \cdot \boldsymbol{Species} * Organic + \boldsymbol{\delta_2'} \cdot \boldsymbol{Channel} * Organic \\ & + \boldsymbol{\delta_3'} \cdot \boldsymbol{ProductType} * Organic + \delta_4 \cdot OTC * Organic \\ & + \boldsymbol{\gamma_1'} \cdot \boldsymbol{State} + \boldsymbol{\gamma_2'} \cdot \boldsymbol{Year} + \boldsymbol{\gamma_3'} \cdot \boldsymbol{Month} + \vartheta \\ with\ \vartheta_{iht} = {} & \eta_h + \epsilon_{iht} \end{aligned} \tag{1}$$

Price is the price of individual meat purchases in euro/kg; *Organic* is a binary variable for organically produced meat; *Species* is a vector of binary variables indicating the species (reference category is Pork); *Channel* is a vector of binary variables for the distribution channel (reference Discounter); and *ProductType* is a vector of binary variables indicating the product type (reference raw minced meat). The binary variable *OTC* indicates whether a purchase was made over the counter or in self-service (reference). We expect meat sold over the counter to be more expensive as it is related to higher labour costs (e.g. arrangement, preparation, service) (Heimig 2014; Gempel 2018) and higher customer valuation (e.g. freshness, quality and trust) (Schulze and Spiller 2008b).

To quantify and test for differentiated organic premiums across species, distribution channels, product type and vending type, we introduced a set of interaction variables between *Organic* and each product attribute (*Species*∗*Organic*; *Channel*∗*Organic*; *ProductType*∗*Organic*; *OTC*∗*Organic*).

We added *Weight* (the quantity of each purchase in kg) to control for price discounts or surcharges with increasing package size (Parcell and Schroeder 2007; Abdulai and Kuhlgatz 2009). *State* is a vector of binary variables for each federal state to account for regional differences in prices and product choice. *Year* and *Month* are sets of year and month dummy variables that

capture price and demand variation over time due to holidays and seasonal effects. The error term ϑ_{iht} is assumed to consist of a household-specific effect η_h and an identically and independently distributed random error ϵ_{iht}.

4.3 Estimation

Due to a strongly right-skewed distribution of the price data, we used a semi-logarithmic functional form for the model in Equation (1) with the natural logarithm of purchase prices (ln*Price*) as the dependent variable.[2] Moreover, estimates from the logarithmic version provided the advantage of a straightforward computation of percentage premiums. As the data come as an unbalanced household panel, we assumed the error term ϑ_{iht} to consist of a household-specific effect η_h and a random error ϵ_{iht}. *F*-tests for the null hypothesis that all η_h are jointly zero led to the rejection of a pooled model and suggested explicitly accounting for the panel structure. Modified Wald's tests for groupwise heteroscedasticity (Greene 2000; Baum 2001) indicated that error terms were not identically distributed across households. Therefore, we used robust standard errors clustered within households. Tests of overidentifying restrictions (Arellano 1993; Wooldridge 2002; Schaffer and Stillman 2006) indicated a fixed-effects (FE) model as the most appropriate. Therefore, the final model is a fixed-effects panel model with robust standard errors clustered at the household level.

A concern over hedonic regressions with large sets of binary attribute variables is multicollinearity (Costanigro and McCluskey 2011). Given the large number of observations and a majority of coefficients being highly significant, we did not regard multicollinearity as a major problem. We ran separate regressions for red meat and poultry, first, because they can be regarded as different market segments. A second reason was that the available cuts for poultry (only 'chicken breast/beef fillet' and 'other') were incompatible with those for red meat.

4.4 Computation and interpretation of price premiums

When modelling Equation (1) in a semi-logarithmic functional form, the percentage premium of an attribute z is:

$$Prem_z = \left(e^{\beta_z} - 1\right) \cdot 100\%, \tag{2}$$

where β_z is the coefficient of the respective dummy variable. Each $Prem_z$ gives the percentage price premium of an attribute category relative to the reference

[2] Because the extant theory does not give much guidance on specific functional forms, many applications of hedonic analyses use Box–Cox transformations of the dependent variable of the form $Y^{\lambda} = \frac{Y^{\lambda}-1}{\lambda}$ and test for deviations from linear or loglinear models (Costanigro and McCluskey, 2011). Our explorations in this direction yielded estimates of λ close to zero (0.03), thus very close to the loglinear model used in Equation (1).

category. For example, $Prem_{Beef}$ indicates the percentage price premium of beef over pork, *ceteris paribus*.
Computing and interpreting organic premiums $Prem_z^{Org}$ is different:

$$Prem_z^{Org} = \left(e^{\beta_1+\delta_z} - 1\right) \cdot 100\%, \tag{3}$$

where β_1 is the coefficient of *Organic*, and δ_z is the coefficient of the interaction term between attribute z and *Organic*. Each $Prem_z^{Org}$ gives the price premium of the organic version of a product with an attribute z relative to the conventional version of a product with an attribute z. For instance, $Prem_{Beef}^{Org}$ indicates the percentage price premium of organic beef over conventional beef, *ceteris paribus*.

5. Estimated price premiums for fresh meat

5.1 Hedonic results for red meat

Table 3 presents the results of the hedonic regressions for logarithmic red meat prices. The explanatory power of the model is quite good with an overall R^2 of 47 per cent and an explained 'within' variation of 39 per cent. The first panel of the table shows the estimated direct effects of attributes (β_Z) on meat prices, which are highly significant throughout. The results for interaction effects (δ_Z) in the second panel are mixed, with some insignificant estimates, likely due to the low number of observations for specific cases (e.g. red meat from other species).

The last two columns depict the percentage premiums for meat characteristics in the conventional segment ($Prem_z$) and corresponding organic premiums ($Prem_z^{Org}$). The results show significant and clearly differentiated premiums across species, distribution channels and product types both for conventional and for organic meat.

5.1.1 Conventional premiums

In the conventional segment, beef commands a premium over pork of +49.4 per cent, topped only by other red meats such as veal and lamb (+112.6 per cent). Across distribution channels, large retail formats price conventional meat at almost the same level. Relative to discounters, supermarkets have a premium of +5.3 per cent and hypermarkets demand −5.5 per cent less on average. In contrast, butcher shops achieve a high premium of +23.6 per cent. Fresh meat products sold over-the-counter demand a price premium of 9.3 per cent relative to the same products sold from self-service shelves. Finally, we found price discounts for larger quantities with the average price per kg decreasing by 10.6 per cent for every increase in package size by 1 kg.

Table 3 Results of FE hedonic regression for red meat, 2012–2014; dependent variable ln Price

	Direct effects		Interactions with organic		Conventional premiums	Organic premiums
	β_Z	SE	δ_Z	SE	$Prem_z$	$Prem_z^{Org}$
Organic	0.314*	0.017				**36.9**
Species (Ref: pork)						
Beef	0.401*	0.003	−0.182*	0.017	**49.4**	**14.2**
Pork/beef mixed	0.104*	0.003	0.088*	0.017	**11.0**	**49.6**
Other red meat	0.754*	0.006	−0.095	0.045	**112.6**	24.5
Distribution channel (Ref: discounter)						
Supermarket	0.052*	0.003	0.176*	0.016	**5.3**	**63.3**
Hypermarket	−0.057*	0.003	0.092*	0.014	**−5.5**	**50.1**
Butcher	0.212*	0.005	0.074*	0.020	**23.6**	**47.4**
Other	0.122*	0.007	0.129*	0.020	**12.9**	**55.8**
Product type (Ref: minced, raw)						
Processed minced	0.151*	0.004	−0.035	0.024	**16.3**	32.2
Roast	0.180*	0.003	0.070*	0.018	**19.7**	**46.9**
Diced	0.300*	0.002	−0.008	0.015	**35.0**	35.9
Chops	0.304*	0.003	−0.026	0.018	**35.5**	33.5
Processed chops	0.358*	0.004	−0.050	0.043	**43.0**	30.2
Steak	0.448*	0.003	−0.006	0.024	**56.5**	36.2
Fillet	0.752*	0.004	0.094*	0.023	**112.1**	**50.4**
Other product type	0.221*	0.004	0.007	0.031	**24.8**	38.0
Vending type (Ref: self-service)						
Over-the-counter	0.089*	0.003	−0.169*	0.015	**9.3**	**15.7**
Weight	−0.112*	0.003			**−10.6**	
Constant	1.359*	0.042				
N	1,054,572 (14,827 households)					
R^2	Within = 0.39; Between = 0.63; Overall = 0.45					
Pooled vs. FE:	$H_0 : \eta_h = 0$ for all h		F-statistic = 16.24		P-value = 0.000	
Test for groupwise heteroscedasticity:	$H_0 : \sigma_h^2 = \sigma^2$ for all h		$\chi^2 = 6.8e{+}36$		P-value = 0.000	
Test on FE vs. RE:	$H_0 : E(X_{iht} \cdot \eta_h) = 0$		Sargan–Hansen = 2317.09		P-value = 0.000	

Note: *Significance at the 0.1 per cent level. Regression additionally controls for year, month and state fixed effects. Robust standard errors clustered at the household level. Bold values highlight price premiums based on significant regression coefficients.
Source: Authors' presentation based on GfK data from 2012 to 2014.

5.1.2 Organic premiums

The price premium for meat sourced from organic production is estimated at 36.9 per cent at reference levels (raw minced, pork, self-service shelves and discounters). The organic price premium for beef of 14.2per cent, calculated as $\left(e^{0.314-0.182}-1\right)\cdot 100\%$, is much lower than that for pork. Pork/beef mixtures have an organic premium of +49.6 per cent. These differences are likely to be driven by lower base prices for pork, relative to which the organic premium is higher compared with more expensive beef.

Results show considerable variation in organic price premiums across distribution channels. Supermarkets demand the highest organic premium (63.3 per cent), followed by other outlets (farmers' markets, direct marketers, 55.8 per cent), hypermarkets (50.1 per cent) and butcher shops (47.4 per cent). Discounters come in last with an organic premium of 36.9 per cent. These results point to different competitive strategies for organic meat. While discounters seem to emulate their EDLP strategy as well for organic meat, supermarkets apparently use organic meat as a differentiated high-quality product. The difference compared with organic varieties is therefore not as high as in supermarkets.

Across product types, we only found roasts (+46.9 per cent) and fillets (+50.4 per cent) to have a significantly higher organic premium over the base estimate of 36.9 per cent for raw minced meat. These results are in line with findings from Loureiro and McCluskey (2000), Parcell and Schroeder (2007) and Scozzafava *et al.* (2016) who report higher price premiums or WTP for extrinsic attributes such as organic, geographical indications or branding for higher-priced meat cuts. From a supply-side perspective, higher organic premiums for roasts and fillets may be necessary to subsidise lower-price cuts, which need to be sold into other regions, marketing channels and the conventional segment.

5.2 Hedonic results for poultry

Table 4 presents the hedonic regression results for poultry. The model explains 45 per cent of the overall variation in log prices and 40 per cent of the within-household variation. Again, all β_Z values are highly significant, whereas the organic interaction terms only point to some significant differences in organic price premiums.

5.2.1 Conventional

Relative to chicken, turkey achieves a premium of 12.3 per cent and other poultry products (e.g. goose and duck) command 35.9 per cent more on average. Supermarkets and hypermarkets show small premiums relative to discounters of 14.0 per cent and 3.4 per cent, respectively. Butcher shops have a high premium of 54.4 per cent over discounters, followed by other outlets with a premium of 37.1 per cent. Comparable to premium cuts for red meat, conventional poultry breasts or fillets generate a large premium of 44.7 per cent. Estimates for vending type and weight were not significant.

5.2.2 Organic

The organic price premium at reference categories of chicken, other parts, discounters and self-service is 49.9 per cent, considerably exceeding the premiums for pork and beef. This result reflects the strong differences in costs between organic and conventional chicken production, which is much more

Table 4 Results of FE hedonic regression for poultry, 2012–2014; dependent variable ln Price

	Direct effects		Interactions with organic		Conventional premiums	Organic premiums
	β_Z	SE	δ_Z	SE	$Prem_z$	$Prem_z^{Org}$
Organic	0.405*	0.050				**49.9**
Species (Ref: chicken)						
Turkey	0.116*	0.002	−0.254*	0.025	**12.3**	**16.3**
Other poultry	0.307*	0.009	0.168	0.076	**35.9**	77.2
Distribution channel (Ref: discounter)						
Supermarket	0.131*	0.005	0.026	0.054	**14.0**	53.8
Hypermarket	0.033*	0.004	0.079	0.080	**3.4**	62.2
Butcher	0.434*	0.011	−0.257*	0.044	**54.4**	**15.9**
Other	0.315*	0.011	−0.086	0.060	**37.1**	37.6
Product type (Ref: other product type)						
Breast	0.364*	0.003	0.330*	0.027	**43.9**	**108.4**
Vending type (Ref: self-service)						
Over-the-counter	−0.019	0.006	−0.060	0.030	−1.9	41.1
Weight	−0.213*	0.004			−19.2	
Constant	1.510*	0.028				
N	316,815 (13,604 households)					
R^2	Within = 0.40; Between = 0.49; Overall = 0.45					
Pooled vs. FE:	$H_0 : \eta_h = 0$ for all h		F-statistic = 8.61		P-value = 0.000	
Test for groupwise heteroscedasticity:	$H_0 : \sigma_h^2 = \sigma^2$ for all h		$\chi^2 = 1.2e{+}37$		P-value = 0.000	
Test on FE vs. RE:	$H_0 : E(X_{iht} \bullet \eta_h) = 0$		Sargan–Hansen = 1251.41		P-value = 0.000	

Note: *Significance at the 0.1 per cent level. Regression additionally controls for year, month and state fixed effects. Robust standard errors clustered at the household level. Bold values highlight price premiums based on significant regression coefficients.
Source: Authors' presentation based on GfK data from 2012 to 2014.

pronounced than the respective cost spreads for pork and beef production (Beukert and Simons 2006; Ökolandbau 2020). Turkey has a considerably lower organic premium of 16.3 per cent, while the results for other poultry products are not significant.

Organic premiums for poultry also vary considerably across distribution channels. While supermarkets and hypermarkets reveal organic premiums of 53.8 per cent and 62.2 per cent, respectively, these are not significantly different from those observed for discounters at 49.9 per cent. In contrast, the organic premium for poultry demanded by butcher shops is much lower (15.9 per cent). Regarding product type, we found high organic price premiums of 108.4 per cent for breast or fillet cuts. This result is most likely driven by consumer preferences for convenience and the associated price–cost calculations of producers who are often able to sell only breast parts of organically reared poultry at a premium.

5.3 Price dispersion analyses

The results of the hedonic models provide insights into distinct organic premiums across distribution channel, species and product type. Despite the strong level of disaggregation, these estimates still have to be interpreted at means. For heterogeneous consumers and differentiated supply, it is additionally worthwhile to compare the price of the previously purchased conventional product with the price of its organic equivalent (Hamm *et al.* 2007). Figure 1 plots price distributions for select meat cuts across channels for conventional and organic to allow more detailed insights.

Conventional price ranges are narrow for discounters and hypermarkets and wider for supermarkets, butcher shops and other outlets. In the organic segment, the data lack sufficient purchases of chicken breast, beef roast and pork fillet in discounters, hinting at a low degree of penetration. Prices for the more frequently purchased organic minced meat vary little in discounters. Supermarkets reveal a wide distribution of prices for most organic cuts that are similar or higher than those paid in butcher shops and other outlets. Contrary to earlier analyses (Spiller 2001), we find that supermarkets do price flexibly for organic meats.

The ranges of conventional and organic prices have considerable overlaps. This is especially the case for beef cuts, supermarkets, butcher shops and other outlets, but less so for chicken breast and discounters. These overlaps indicate that many consumers have paid a price for conventional meat at which the organic counterpart would have generally been available.

To investigate the potential demand for organic meat cuts, Table 5 depicts the proportion of conventional purchases with a price equal or higher than the median of the corresponding organic product.[3] We compare a baseline where we use unchanged conventional prices with two scenarios, where we increase these conventional prices by 10 per cent and 30 per cent, reflecting the range of WTP for organic meat reported by literature (Van Loo *et al.* 2014). At butcher shops, for instance, 12.0 per cent of minced beef purchases, 11.8 per cent of beef roast purchases and 7.0 per cent of pork fillet purchases have been made at prices at or above the medians of each product's organic price range. Lower but still substantial overlaps exist for other outlets and supermarkets. For chicken breast and discounters, conventional and organic price ranges are more segregated. Assuming a WTP of 30 per cent for organic, the share of congruent price observations increases, resulting in a total share of 14.6 per cent for beef roasts, 9.0 per cent for minced beef and 9.1 per cent for pork fillet.

[3] To control for regional price differences, we adjusted the prices as follows: We separately regressed prices for organic and conventional meat on a set of federal state dummies. Adjusted prices were then computed as the intercept plus the predicted residual of these regressions.

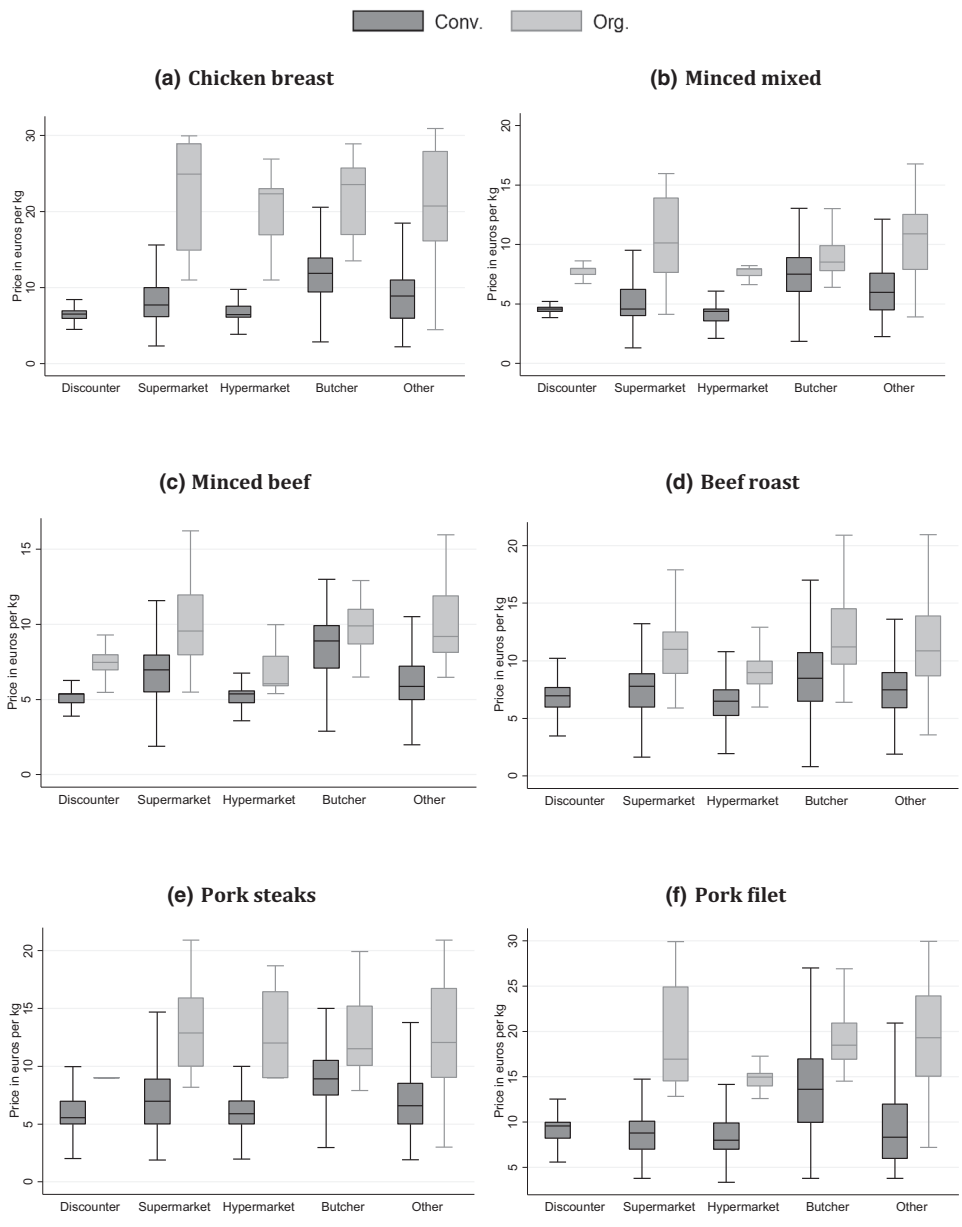

Figure 1 Price distributions of select cuts across channels for conventional and organic. *Note*: Illustration shows standard boxplots with minimum, 25th, 50th and 75th percentiles, and maximum. Outliers are excluded. Source: Authors' presentation based on GfK data from 2012 to 2014.

6. Discussion and conclusion

The main objective of this paper was to investigate the magnitude of and variation in organic price premiums for fresh red meat and poultry. While the Scientific Advisory Board considered premiums in the range of 100–300 per

Table 5 Percentage share of (virtual) conventional purchase prices above median organic prices

		Chicken breast	Minced mixed	Minced beef	Beef roast	Pork steaks	Pork fillet
Discounter	Base	n.a.	0.0	0.2	n.a.	0.3	n.a.
	WTP 10%	n.a.	0.1	0.2	n.a.	0.4	n.a.
	WTP 30%	n.a.	0.1	0.5	n.a.	2.7	n.a.
Supermarket	Base	0.0	0.2	2.3	4.0	1.0	2.7
	WTP 10%	0.1	0.3	3.2	7.0	1.9	6.0
	WTP 30%	0.1	0.7	7.3	13.3	6.6	13.2
Hypermarket	Base	0.0	0.4	5.7	2.2	0.3	1.9
	WTP 10%	0.0	0.6	7.2	4.3	0.3	2.5
	WTP 30%	0.5	1.0	11.0	13.6	0.9	4.7
Butcher	Base	0.3	6.3	12.0	11.8	5.5	7.0
	WTP 10%	1.2	14.9	24.7	17.3	10.0	15.6
	WTP 30%	5.1	35.5	53.6	31.1	26.5	33.2
Other	Base	0.1	0.5	5.2	6.7	3.3	2.0
	WTP 10%	0.3	1.7	9.0	10.3	5.7	6.1
	WTP 30%	1.3	5.3	17.2	18.4	11.2	11.9
Total	Base	0.0	0.5	2.8	3.9	0.9	2.1
	WTP 10%	0.1	1.1	4.5	6.7	1.6	4.3
	WTP 30%	1.7	2.6	9.0	14.6	5.3	9.1

Note: Numbers show the proportion of conventional purchases at a price $\geq$ the median organic price for the same cut. WTP 10 per cent and WTP 30 per cent consider an increase in the conventional prices by 10 per cent and 30 per cent.
Source: Authors' presentation based on GfK data from 2012 to 2014.

cent (SAB 2015), our estimates based on revealed preference data suggested much lower and more differentiated price premiums. Organic premiums of low-priced cuts for beef (raw minced) start at 14.2 per cent, for pork (raw minced) at 36.9 per cent, for turkey (other parts) at 16.3 per cent and for chicken (other parts) at 49.9 per cent. Premiums for medium-priced cuts (chops or steak) range from 35 per cent to 60 per cent and for high-priced cuts go up to 108.4 per cent for chicken breast.

Although these premiums are still higher than most estimated WTP values for sustainability claims on meat of around 10–30 per cent (Van Loo *et al.* 2014), they are unlikely to act as a major purchase barrier. We found substantial overlaps in the distributions of conventional and organic prices paid by households for select cuts across distribution channels. Adding a virtual WTP of 30 per cent to conventional prices yielded respectable shares of households prepared to pay prices above the median organic price, for example 9.0 per cent for minced beef, 14.6 per cent for beef roast and 9.1 per cent for pork fillet. An important exception was the poultry segment, where both premiums and price distributions indicated substantial price differences between organic and conventional. These results raise the question, which other barriers to higher organic shares exist and which implications follow for marketing and policy design.

6.1 Marketing implications

Smaller organic premiums in butcher shops and overlaps in organic and conventional price ranges in butcher shops, other outlets and supermarkets suggest considerable market potential for organic meat at prevailing prices. The exploitation of this potential may be hindered by competition from differentiated conventional meat products offering individual animal welfare and sustainability attributes such as 'regional', 'husbandry on straw' or 'access to fresh air'. Butcher shops in particular attract demand from consumers who value meat quality and regional production (Becker 2000; Schulze and Spiller 2008a). An assignment for marketing would be to communicate the benefits of organic vis-à-vis premium conventional alternatives more clearly (see also Hamm *et al*. 2007). While organic has clear advantages regarding water protection, soil fertility or biodiversity, animal welfare and climate benefits are comparable to premium conventional meat (Sanders and Heß 2019; Pieper *et al*. 2020). Consumers appear to focus on animal welfare in their meat demand, while results for environmental consciousness (apart from the ubiquitous climate debate) are mixed (SAB 2015, p.75). A challenge for research is to investigate whether and how communication can make the benefits of organic meat production more visible.

Realising the market potential suggested by the overlapping prices may further be hindered by a low degree of market penetration. The major question here is whether consumers buying premium conventional products have the organic alternative readily accessible. This is arguably not the case for butcher shops and direct marketers, which are often too small to provide both conventional and organic meat. These suppliers would have to convert entirely from conventional to organic, a step associated with high risks and uncertainty such as ensuring stable procurement from organic farmers and maintaining a sufficiently large customer base.

Our data indicate that especially discounters seem to list few meat cuts in organic quality (mostly minced meat or chops), which are priced modestly above conventional offerings but at narrow ranges. Limited shelf space and a restricted number of stock-keeping units in discounters make substantial growth of the organic meat range parallel to conventional meat unlikely. A potential marketing strategy is to slowly increase the share of meat with selected sustainability attributes (but not necessarily organic) in the overall assortment – anticipating developments in consumer behaviour and future regulation – without abandoning the claim to offer the lowest prices. This is what we currently observe for hard discounter Aldi, which pledged to exclusively sell meat from high animal welfare production from 2030 onwards (ALDI 2021).

A more differentiated picture emerges for supermarkets, where we find a higher availability of organic meat cuts with marked price variation and overlaps with conventional prices. It appears that the lack of retail price

strategies for organic products – as described by Spiller (2001) – is no longer valid with regard to organic meat. However, household scanner data do not allow definite conclusions on the degree of distribution of organic (or also animal welfare) meat products. An important research gap remains, how prices are set across supermarket chains, store formats (small vs. large), market environment (region, urban vs. rural), type of meat products, brands and private labels.

An important result is that high-priced cuts such as roasts or fillets within red meats and breasts in the poultry segment command higher organic premiums. The implication for marketing is to position premium cuts (such as fillet or steaks) as 'special' or 'treats' for weekends or special occasions, where cooking is a leisure activity together with family and friends (Spiller and Schulze 2008) and meat still plays an important role regarding representation motives (Biermann and Rau 2020).

An open question is whether a similar positioning can work for non-premium cuts such as minced meat, whole chickens or even processed meat products. We find substantial organic price premiums for raw minced meat and most other types of red meat around 37 per cent and for other poultry parts at 50 per cent. Raw minced meat in particular has the highest organic share in our data (3.9 per cent) and shows substantial overlaps between conventional and organic prices. These results suggest that demand for organic meat (products) exists beyond select premium cuts. An implication would be to develop a consistent marketing concept that communicates the benefits of organic production, especially for lower-price cuts and processed meat products addressing widespread consumer demand for convenient and easy-to-prepare products (Spiller and Schulze 2008; Hubert 2014). Such a concept would appeal to a larger segment of consumers located in the medium price range and partly alleviates joint-production issues of exclusive marketing of premium cuts.

6.2 Policy implications

The result of substantial differences in premiums across retail formats for conventional fresh meat provides evidence for the strong price competition among discounters and full-range grocers (Mihr 2014; Roeb 2014). Low prices for fresh conventional meat set by large food retailers are a major driver of high organic premiums and have been subject to public debate. After the Federal Minister of Food and Agriculture termed extremely low poultry prices 'obscene' and saw a 'moral obligation' of retailers (Tagesspiegel 2021), her ministry announced reviewing policy options such as advertising bans for price discounts on meat or tightening the law on selling below purchase costs (BMEL 2020).

However, low prices for meat provide no rationale for legislative intervention per se, as long as there is no monopoly and below-purchase-cost sales are effectively prevented. Market failures providing such rationales

– also distorting the costs of different meat production systems – may rather be found in negative externalities related to, for example, water pollution or underprovision of animal welfare as a public good. Regulatory approaches that are better suited in both cases comprise stricter requirements for animal husbandry practices or treatment of pollutants. As these measures affect marginal costs, prices for conventional meat will increase, narrowing the gap in organic premiums. An open question for future research is, how strongly conventional prices will be affected and which role price–cost margins and price transmission play.

Another policy instrument related to meat consumption is carbon taxation to internalise costs of greenhouse gas emissions from animal production, especially from ruminants. Given a similar emission potential of organic and conventional meat production (Pieper *et al*. 2020), prices of both segments would be affected. The effect on the organic premium would depend on the tax design and may be increasing (for value-added taxes with stronger price increases for expensive organic or premium conventional meat) or decreasing (for excise taxes with a constant tax rate per CO_2 equivalent). An interesting open question is how such a carbon tax would affect substitution behaviour between organic and conventional meat.

6.3 Limitations and future research avenues

The current study is subject to some limitations that may be addressed in future research. First, the organic shares in the data used here compare well with those given for 2019 in Introduction. However, the most recent numbers for 2020/21 indicate considerable growth rates of organic red meat and poultry (AMI 2021). While we perceive this trend as a confirmation of our main results, future research may investigate drivers and robustness of this development using more recent data. Second, our household scanner data preclude analysing explicit pricing strategies for meat by retailers, because products were defined generically according to species–cut combinations and individual retail stores (where price strategies would be observed) were not identifiable explicitly. Future research may use retail scanner data instead, which allow to trace dynamic retailer pricing for specific products over time and provide the basis for estimating detailed price elasticities for fresh meat to study consumer price sensitivity for organic and conventional meat products. Finally, the discussion on higher organic premiums for high-priced cuts (breast, fillets) has pointed to open questions regarding other important quality attributes such as brand, sensory characteristics, and consumer motives and corresponding expectations towards organic meat. Using experimental and qualitative approaches, future research could investigate how these important attributes affect consumer attitudes and choices.

Conflict of interest

The authors have no conflict of interest to declare.

Data availability statement

The data that support the findings of this study are proprietary data from Gesellschaft für Konsumforschung (GfK), Nuremberg, Germany. The authors are not allowed to publicly share these data due to contractual agreements. Interested researchers may access the data on-site at the Technical University of Munich with permission from GfK.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Appendix S1. Classification of single retail cuts.