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The case of organic food

Stimulating green production through the public procurement of final products – the case of organic food

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Abstract

This paper adds to the scarce literature on the empirical economic evaluation of the costs and the effect from stimulating environmentally friendly production by public procurement. Green public procurement (GPP) is increasingly promoted as a policy tool to increase environmentally friendly production by both the European Commission and individual EU member states. Action has not at least been called for to increase the area of organically farmed land through the consumption of organic food. This study evaluates with detailed data the budgetary costs and potential limitations associated with stimulating an input in primary production with the consumption of final goods. By decomposing food consumption into different food categories, we found that both the cost and the effect from GPP critically depends on which food items procurers choose to buy. Additionally, we found that the prospect of stimulating organically farmed land by GPP inversely depends on yield growth as less farmland is needed to produce organic food as yields per hectare increase. Finally, our study illustrates that the leakage of funds from public procurement to domestic organic farmers hampers the cost effectiveness of GPP.

Keywords: Public procurement, organic food, price transmission

JEL classification: H57, Q2, Q11, Q58

1. Introduction

Public procurement is increasingly proposed and implemented as a policy instrument to reach societal goals. It has for instance been launched as a tool for the uptake and diffusion of innovations (Edquist and Zabala-Iturriagagoita, 2012). So-called innovation procurement is for example promoted by the

European Commission with the object of to shape markets and create markets and "foster the market uptake of innovative products, services and works".[1] A usual avenue is public procurers stipulating and considering environmental criteria in their contracts with suppliers, so called Green Public Procurement, henceforth GPP. It is increasingly becoming an established approach of conducting environmental policy in the world and arguably most so in industrial countries (see Testa et al. [2012] and Testa et al. [2016]). In 2014, as many as 30 out of 32 surveyed OECD countries had developed strategies or policies to implement GPP (OECD, 2015). The starting point for using GPP was according to Testa et al. (2012) the shaping of Agenda 21 at the International Conference of Environment and Development in Rio de Janeiro in 1992.

GPP has especially been proclaimed as an important environmental policy instrument in the EU and among its member states. The European Commission has for example stated that "Public procurement can shape production and consumption trends as a significant demand from the public for "greener" goods will create or enlarge markets for environmentally friendly products and services. By doing so, it will also provide incentives for companies to develop environmental technologies." (EC Commission, 2008). Since public procurement accounts for approximately 15 % of the GDP in EU states and OECD countries, the purchasing power *per se* has been put forward as a motive for using public procurement as an environmental policy instrument both among policy makers and scholars (Testa et al., 2016). GPP is for instance proclaimed as a potentially vital policy instrument in a Swedish Government Official Report due to its sheer size (SOU, 2013). Although the outcome from GPP critically depends on the market settings as well as private demand (Marron, 1997), research regarding economic aspects of GPP is scarce (Lundberg et al. (2015).

Public procurement of organic food products has been widely applied and called for at different governmental levels in the EU in order to expand organic farmland. The regulation for organic agriculture and food products was set in 1991 with EEC 2092/91 (The European Council, 1991) and replaced in 2007 by EC 834/2007 (The Council of the European Union, 2007). Organic farming is a

[1] See Innovation procurement | Internal Market, Industry, Entrepreneurship and SMEs (europa.eu).

broadly subsidized farming production system in the EU through the Common Agricultural Policy that is promoted as an environmentally and animal friendly form of food production where minimum requirements are set for producing and market organic products at all stages of production. The objectives are foremost related to organic farming production system, particularly limiting the use of chemical pesticides and prohibiting mineral fertilizers in order to safeguard biological diversity and a responsible use of energy and natural resources such as soil and water as well as promoting animal welfare. It should be noticed that the perception that organic agriculture is environmentally superior is disputed in the literature (Meemken and Qaim, 2018; Toumisto et al., 2016) although there are evidence suggesting that organic farming has been generally positive for biodiversity in Sweden.[2]

The EU Commission recommends that the procurement of organic food constitute a core criterion for Green Public Procurement.[3] In "Farm to Fork Strategy" launched by the EU Commission in 2020, public procurement is mentioned as an important tool to increase demand and so reach the objective of at least 25 % of the agricultural land under organic farming in the EU by 2030 (European Commission, 2020). Schemes for procuring organic food products are widely adopted across EU members (Neto and Caldas, 2017). The demand among households and public procurers has made the market for organic food one of the major markets for environmentally friendly labelled products. In EU-28 the retail sales value of organic food equaled 37.4 billion euros while the area of organic farmland constituted 13.4 million hectares or 7.5 % of all agricultural land in 2018 (European Parliament, 2020). Between, 2012 and 2018, organic farmland increased with 33.7 % while retail sales increased with as much as 79.8 % (ibid). Although organic farmland has increased significantly, the growth rate lags behind the expansion of consumption.

This paper adds to the literature on the empirical economic evaluation of GPP by estimating the impact of and budgetary costs associated with using GPP to promote organic farming in Sweden. Sweden stands out as the country in the EU with the most ambitious goals for both public procurement and organic farming. The Swedish Government set in 2006 the goal that 25 % of all public procured food should be

[2] Rundlöf and Smith (2006) and Carrié et al. (2018) support that is better than conventional farming for biodiversity in Sweden.
[3] See for example http://ec.europa.eu/environment/gpp/pdf/toolkit/food_GPP_product_sheet.pdf .

organic by the end of 2010 as a measure to fulfill the goal that 20 % of all agricultural land should be organic the same year (Swedish Government, 2005). The goals were revised in 2017 which states that the public consumption goal is 60 % and the production target to 30 % and both goals should be fulfilled by 2030 (Swedish Government, 2017). The Swedish consumption goals have been politically regarded as a prerequisite for fulfilling the production goals and there is hence an explicitly stated rationale to use public procurement as an environmental policy instrument. One object of the public consumption is to stimulate economies of scale in marketing and processing, and so lower the price and broaden the assortment of organic products. The consumption goals are therefore expected to stimulate private consumption of organic food partly by increasing the availability of organic products on the private market, partly by setting an example for households in their choice of products.

Although the consumption goal set by the Swedish government is not legally binding, municipalities and counties who are the major public procurers of food and beverages have responded to it by either explicitly mimicking it, stating a modified version of it or merely referring to the goal as a motivator (Jörgensen, 2012). The government goal should be interpreted as a main promoter but not as the sole incentive for the public procurers to choose organic food. Municipalities and counties have for instance set even more ambitious consumption goals and procured far larger shares of organic food than the governmental goal and the share of organic food shows a steady growth path since the goal was launched in 2006.[6] In 2019 the share of organic food of all publically procured food was estimated to 39 % corresponding to a sales value of 3.6 billion SEK (Ekoweb, 2020). The share of organic farmland has meanwhile increased to 20.4 % and is in the EU only surpassed by Austria and Estonia. The retail sales has parallel firmly increased and equaled 19.3 billion SEK in 2019 corresponding to 7.4 % of all food sales in retail (Statistics Sweden, 2020). Sweden has so next to Denmark the highest retail sales of organic food per capita in the EU (Statista, 2019).

GPP should be considered as the main but not as the sole policy initiative to increase the consumption of organic food. Public authorities have recurrently funded marketing efforts of organic food directed to

[6] The major municipality Malmö stad have for instance stated that they aim to buy food that is nothing but organic by the end of 2020 (Malmö stad, 2020).

both households as well as public and private catering. The government has also subsidized export initiatives of organic food. There is hence an explicit effort by the government to stimulate the demand for organic food both domestically and abroad by other policy initiatives.

In this paper we empirically explore and stress the augmented indirect aspects of GPP when the prospect is to increase the supply of an individual production factor organic farmland by the purchase of finalized goods, i. e. food. When public procurers as other consumers buy organic food they pay a price premium for the quality organic. The price premium consumers are willing to pay in turn increase the supply of organic farmland by creating a market value for organic at the farm level. We do so first by measuring how much of the market value for organic at the consumer level reach and provide a stimulus for domestic organic farming. It serves as comparison regarding what public procurers and other consumers pay for the food being organic and what domestic farmers receive for their produce being organic and not conventional. Additionally, we decompose the consumed organic food according to the degree different food categories are coupled to domestic organic farmland. The decomposition is then used to estimate the costs and prospects for increasing domestic organic farmland by GPP. As organic farmland is an input in organic farming and not a measure of farm output, we also relate the effect from consumption on yields, i. e. the actual supply. Our study relates to Lindström et al. (2020) who used data on counties' public procurement and found that public procurement of organic food in Sweden stimulates organic farming in surrounding counties. The study does however not address the implicit aspect of GPP or reveal the budgetary costs associated with using public procurement to convert farmland to organic farming production system.

The paper proceeds as follows. We first present the data used in our study in section 2. Thereafter, section 3 illuminates the indirect aspect of performing GPP by exploring what the consumers pay for organic food products and what domestic organic farmers receive for practicing organic farming. Section 4 illustrates the growth of organic farmland and measures the effect of GPP on domestic organic farmland. Finally, section 5 ends the paper with a discussion and discussion.

2. Data sources and data compilation

We use various sources of data to empirically assess the budgetary costs and impact of increasing organic farmland by public procurement. Data on land use for organic farming the years 2006-2019 have been collected in the annual publications by the Swedish Board of Agriculture. From the same source we have collected data on yields and constructed the annual average yield as the unweighted average of yields for the main organic farm crops: winter wheat, oats and grass (pasture and silage).

We calculate the market value for organic at the farm level with the help of several data sources. The Swedish Board of Agriculture provides annual farm prices and delivered volumes for both organic and conventional dairy products and eggs. Besides eggs and milk there are no official statistics regarding the market prices for organic produce at the farm level. We are though able to estimate the market value for organic for other branches of production the year 2018 by using several other data sources. Agrovektor (2019) on an assignment of the Swedish Board of Agriculture reports the market value for organic for fruit and vegetables as well as pork, bovine and poultry for that particular year. The market value for lamb and sheep is calculated using slaughter prices for lamb and sheep found at the biggest slaughterhouse's webpage (HKScan, 2021) and slaughter weights registered by the Swedish Board of Agriculture (2021). Annual prices for grains are found in the trade journal Jordbruksaktuellt (Jordbruksaktuellt, 2019). We only include the production of grains that is used for food production as fodder is used as an intermediate in the production of meat, eggs and dairy products. Including the market value for organic fodder would hence result in double counting as we include the market value for organic animal products.[8]

Various data sources are utilized for estimating the sales value of organic food, i. e. the consumption of organic food. Retail sales, which constitute roughly three quarters of all organic food sales most years, have been provided by Statistics Sweden in 136 sub-categories. We disregard the sales of organic fish products since fish is not associated with farming. The data do not however include beverages with a alcohol higher content than 3.5 percent alcohol by volume - beverages that are only sold by the

[8] We assume that the quantity of grains for human consumption equals the forecasted demand by the interest group for organic farmers Ekologiska Lantbrukarna (Ekologiska Lantbrukarna, 2019).

government monopoly retailer Systembolaget. The omission has though likely a minor impact on the results as only 7.3 percent of the organic beverages sold by Systembolaget the years 2014-2017 was of Swedish origin according to our compilation. Most of the sales instead consists of imported organic wine. The public procurement value of organic food is found in the annual reports by the non-profit association Ekomatcentrum as well as the annual reports published by the trade press Ekoweb. Ekoweb also provides data for the total sales of organic food in other sales channel as private catering services and direct sales by farms. We assume that the sales according to food categories in catering services mirrors retail sales with the exception that public caterings and other caterings buy comparable large amounts of organic dairy products. The major dairy Arla Foods has for instance repeatedly stated that it sells as much as a third of its organic produce to public procurers although public procurement constitutes less than 20 percent of all sales of organic food.[9]

The disaggregated sales data enables us to categorize the share of consumption that may originate from Swedish organic farmland. We can hence determine the share of consumption that may influence Swedish organic agriculture. These food products are labelled *coupled consumption* as they may originate from Swedish farmland although they must not be as some products are imported while products that cannot originate from domestic farmland are labeled *decoupled consumption.* The latter category consists of food products based on rice, sugar, many fruit and vegetables, coffee and produce cultivated indoors as mushrooms and fresh herbs. We also categorize s*trongly coupled consumption*, which equals *coupled consumption* minus the consumption based on horticultural produce and horticultural crops and root vegetables. The rationale for excluding these food products from the category is that only 0.5 % of the organic farmland is cultivated with them although as much as 20 % of the *coupled consumption* is based on horticultural products and root vegetables. *Strongly coupled consumption* hence only includes food based on the major agricultural produce meat, dairy products, oilseeds and grain products.

[9] See for instance (Ekoweb, 2014).

We calculate the price premium and so market value for organic at the consumer level in 2018 by using two price surveys. The retirement organization PRO collects most years in-store-prices on food products across Sweden. The organization registered prices for fifteen products, both the organic and conventional variants in 829 retail stores nationwide. The Swedish Society for Nature Conservation in 2015 compared the prices of organic and conventional variants of 24 food items in four major retail stores in Stockholm (Swedish Society for Nature Conservation, 2015). Although the latter survey only covers a small sample of stores in a narrow geographical area it enables us to include prices for a wider range of commodities in the major food categories fresh fruit and vegetables as well as meat. [10] The price premiums in the Swedish Society for Nature Conservation survey are adjusted according to the geographical price dispersion in the 2018 PRO price survey as well as inflation adjusted according to the PRO price surveys in 2015 and 2018. Due to an overlapping of food products in the surveys, we use 35 items with corresponding prices for the organic and conventional variety. A full list of the included food items with associated price premiums is presented in the Appendix.

3. The market value transmission to organic farmers

The quality organic creates a substantial market value by inferring a considerable consumer price premium that many consumers are willing to pay. How much of the market value that stimulate organic farmland crucially depends on the market value transmission from consumers to farmers. The transmission depends on costs and margins in intermediate stages of processing and distribution, but above all whether the food products are based on domestic agricultural produce or not. The market value organic farmers receive spurs however not only the cultivation of organic farmland but also animal husbandry in organic farming. Although fodder costs are the largest additional costs in organic animal farming compared to conventional farming, extra costs for animal husbandry is not negligible.[11] Based on enterprise budgets for production activities compiled by agricultural experts we for instance find that 8.5 %, 22.8 % and 40.6 % of the additional costs associated with organic dairy production, pork

[10] We exclude two items from the PRO survey - frozen cod as it is not related to agriculture and yellow pea soup as the organic unlike the conventional variety does not include pork meat.

[11] It should also be noticed that most organic food is labelled according to the statues of KRAV, which imposes additional restrictions on farming not at least concerning animal welfare.

production and egg production, respectively, can be attributed to animal welfare regulations.[12] The market value transmission, and hence stimuli, hence ultimately depends on which organic food items procurers choose to buy.

It is possible to illuminate the cost and the indirect feature of GPP by approximating the consumer market value for organic and to what degree it is transferred to domestic organic farmers the year 2018. In 2018, excluding fish products and beverages with a high alcohol content, organic sales totaled 21.6 billion SEK. Retail sales constituted the major part with 17.6 billion SEK while public procurers bought organic food for 3.1 billion SEK. We estimate the market value for organic at the consumer level by calculating the overall price premium for organic. We use the price premiums for the 35 individual food items in retail which are presented in the Appendix. We calculate the price premium in ten food category according to the classification by Statistics Sweden as

$$(1)\ Price\ premium_c = \frac{\sum_{i=1}^{n} price\_premium_i \times sales\_value_i}{\sum_{i=1}^{n} sales\_value_i}$$

where *c* stands for food category and *i* for food item.

Table 1: The weighted price premiums across and weights in retail in 2018

Food categories	*Price premium*	*Weight*
Bread and cereals	40.1 %	6.9
Eggs	49.2 %	6.5
Meat	46.1 %	5.5
Dairy products	22.8 %	14.7
Oils and fats	21.9 %	4.7
Fruit	10.4 %	21.6
Vegetables	66.8 %	19.8
Coffee, cocoa and tea	9.1 %	6.0
Other food products	33.6 %	11.3
Non-alcoholic beverages	10.0 %	3,0
Total	33.2 %	100.0

Note: Based on own calculations.

[12] Based on cost of production calculus by Länsstyrelsen Västra Götalands Län (2019) (diary and pork production) and Svenska Ägg (2010) (egg production).

Price premiums differ widely across the food categories, from just about 9 percent for *Coffee, tea, cocoa* and *Fruits* to almost 67 percent for *Vegetables* as shown in *Table 1*. The three food categories *Fruit*, *Vegetables* and *Dairy products* dominate the organic food sales with about 56 % of all retail sales. The comparable low price premium for fruits, 10.4 %, is explained by the low price premium of 9.4 % for bananas – the single biggest organic food item with a corresponding sales value of roughly 2.5 billion SEK or ten percent of all sales of organic food.

We assume that the price premiums are representative for all sales of organic food products including public procurement. Comparing price premiums for individual food items in Jörgensen (2012) with the PRO survey corresponding year (the year 2011) suggests that price premiums are at least as high in public procurement. The PRO price surveys allow us to check whether the price premium in 2018 is representative back to 2010. We calculate a weighted price premium based on the prices of five major organic food items: bananas, milk, eggs, coffee and table margarine. Although it is a small sample, the sales value covers more than 30 % of the total sales value of organic food. The calculation suggests that the price premium has dropped by a third since the years 2010 and 2012 although the price premium was somewhat higher in 2018 compared to 2015 and 2017. The price premiums were therefore likely comparable low in 2018.

We calculate the overall weighted price premium in the same manner by weighting the prices premiums for each food category according to their sales in value,

$$(2)\ \ Price\ premium_{overall} = \frac{\sum_{c=1}^{10} price\_premium_c \times sales\_value_c}{\sum_{c=1}^{10} sales\_value_c}$$

and find that the weighted price premium in retail equals 33.2 %. As catering services buy comparable much organic dairy products we find that the weighted price premium in public procurement and other sales channels are somewhat lower, equalizing 29.3 %. The weighted price premium in 2018 for all sales therefore equals 32.2 %. The price premium, excluding value-added taxes, would therefore imply an additional cost for overall consumption of organic food, compared to conventional food products, of 5.26 billion SEK and for GPP alone 0.69 million SEK - an amount that can be interpreted as a possible transfer of means and stimulus to Swedish organic farming by households and GPP.

Next, we measure how much domestic organic farmers are paid for practicing organic instead of conventional farming by using the data on price premiums and production at the farm level as well as the estimation provided by Agrovektor (2019). In total, our estimation suggests that organic farmers gained 1.06 billion SEK in 2018 from the market for practicing organic and not conventional farming as shown in *Table 2*. In comparison, the farm subsidy for organic farming totaled 644 million SEK corresponding year. Dairy producers and egg producers gained the largest market value shares, a total of 647 million SEK. An amount that corresponds to 60 % of all market value for organic at the primary stage. A considerable part of the additional market value organic farmers gain for their produce therefore also help them to cover the additional costs in animal husbandry.

Table 2: Market value for the quality organic at the farm level in 2018

Branch of production	Million SEK
Dairy	388
Meat and poultry	100
Grains and oilseeds	112
Fruit and vegetables	200
Eggs	259
Sum	*1,058*

The rate of the price premium transmission from the Swedish food market to Swedish organic farmers was therefore as low as 20.2 % (1.06/5.26). It should as well be considered the upper bound for two reasons. First, we have discarded any export revenues that farmers may gain for their farm produce. Export sales are though comparable small to retail and public procurement and constituted about 1.2 billion SEK where coffee and jams with no association to Swedish organic farming comprised roughly of a third.[19] Second, the market value transmission may be overestimated as the sales of organic beverages with a high alcohol content (more than 3.5 volume percentage) was excluded from the

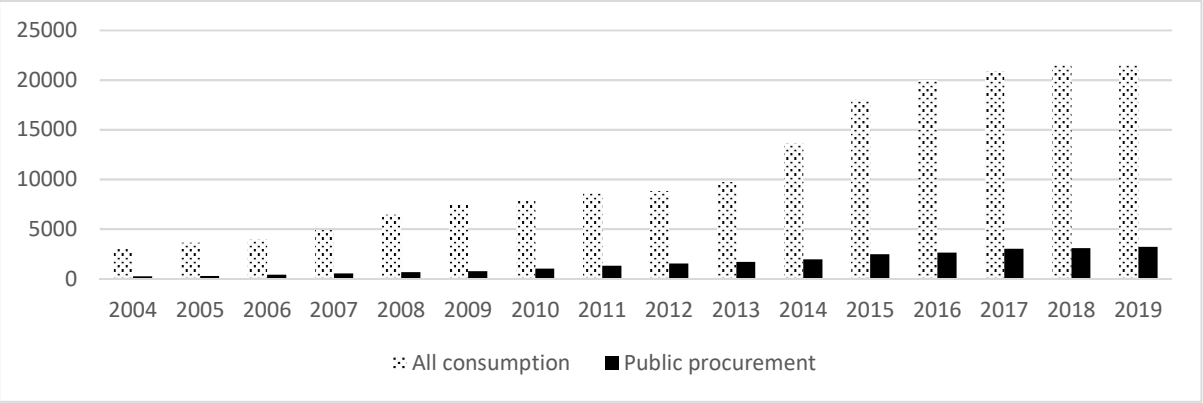
[19] The calculation of the sales value of alcoholic beverages is based on the sales report by Systembolaget while an estimation of the export value in 2017 is found in OrganicSweden (2018). There is no cultivation of organic sugar beets in Sweden.

calculation. The sales of high alcoholic organic beverages of Swedish origin in 2018 equaled though only about 420 million SEK excluding taxes.[20]

4. The growth and effect on organic farmland

The estimated rate of market value transmission in 2018 suggests that a major part of the price premium, the market value, at the consumer level leaks to other economic stakeholders than farmers along the supply chain. How much domestic organic farmers gains for their practice may though differ across time as consumption changes. By combining the sales data from Ekomatcentrum, Statistics Sweden and Ekoweb we find that the nominal value of total consumption of organic food (fish products and alcoholic beverages excluded) has increased by 625 % over the years 2004-2019 (Figure 1). The growth corresponds to 505 % in real value or an annual growth rate of 11.4 %. Public procurement has meanwhile more than ten folded and corresponds individual years to between 8 % and 18% of all consumption of organic food.

Figure 1: Consumption of organic food, million SEK



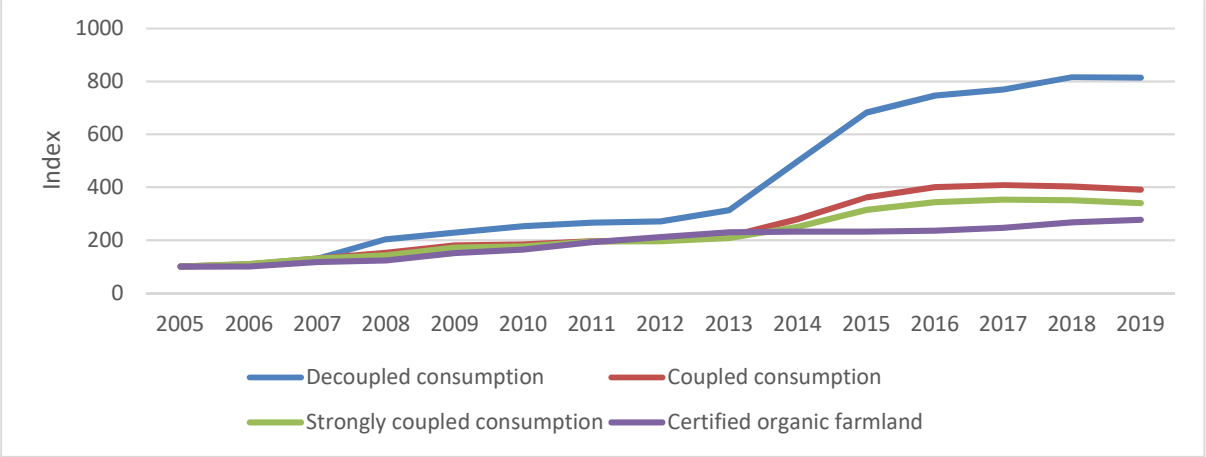
Note: Consumption is in nominal value excluding fish products and value-added taxes.

One plausible explanation for the divergence is that the composition of the food basket has changed over time. *Figure 2* showing that the consumption growth path for the various compositions of consumption between 2005 and 2019 reveals that that is the case. Decoupled consumption has had an annual growth

[20] Own calculation based on the published sales by Systembolaget on the internet. All sales are published according to country of origin.

rate as high as 15.0 % while the coupled consumption meanwhile has experienced a more modest growth rate of 9.5 %. The share of coupled consumption of overall consumption has therefore decreased from 74 % to 58 %. The *strongly coupled consumption* has the slowest annual growth rate of 8.5 %. The estimated market value transmission in 2018 is thus probably lower compared to previous years.

Figure 2: Development of organic farmland and consumption in real value



The annual growth rate of organic farmland the same period is 7.0 % and was hence even lower than the growth rate of strongly coupled consumption. The divergence between the growth rates of organic farmland and organic food consumption mainly took place from 2013 until 2016 when the consumption experienced its biggest growth, it more than doubled, while organic farmland only increased by 2.7 %. It is not only consumer preferences but also supply issues that determines the composition of the food basket. The supply of organic agricultural produce is indeed rigid in a timeframe of two years due to the mandatory waiting period stipulated for conducting organic farming. There was for instance according to the organic farmers' association a considerable shortages of organic agricultural produce the period 2013-2016 (Ekologiska Lantbrukarna, 2014 and Ekoweb, 2017). There are hence some years significant supply shortages of domestic produce that partly can be attributed to the waiting period.

We apply statistical methods to better understand the development. The data on annual sales of organic food and organic farmland the years 2004 until 2019 make it possible to econometrically estimate the effect of consumption on organic farmland. We make multiple regressions utilizing the division of

consumption according to what extent it is coupled to domestic organic farming. Organic farmland is regressed on the consumption of organic food according to,

$$(3)\ orghectares_t = \alpha + \beta consumption_{i_{t-2}} + \delta subsidy_t + \varepsilon_t$$

where *i* and *t* denotes time and food category respectively. The decomposition therefore enables us to measure the effect on farmland according to the choice of food products. Consumption is lagged two years, because it takes two years before farmers can sell their produce as organic after they have started organic farming. Our assumption is thus that it takes two years for farmers to respond to current demand. Consumption is hence predetermined and we so avoid problems with any endogeneity.[23] With the implementation of the Swedish Rural Development Programme 2007-2013 and onwards, and especially from 2009 and onwards, non-certified organic farming received a significantly smaller subsidy compared to certified organic farming. The major change was that it became less profitable to cultivate uncertified grassland. Given that the changes had fully been implemented in 2009 and as it takes approximately two years for the farmer to certify farmland and animals as organic, our assumption is that the policy shift had the biggest impact from 2009 and onwards. We choose to include the shift in the subsidy scheme with a dummy variable that takes the value one from 2009 and onwards. The shift in the farm payment for organic farming production system is not modeled with a continuous variable as it is difficult to quantify the subsidy as the payment differs across crops and various animal types.

There is as expected evidence across the regressions that the shift in subsidy payment has increased certified organic farming by providing a substantial shift from non-certified to certified organic farming. The estimates where all organic farmland is included, regressions I and II, suggest that the major subsidy scheme change increased certified organic farmland by a little more than 125,000 hectares.

[23] The presence of autocorrelation is tested for and rejected across all regressions.

Table 1: Regression results – absolute values

Variables	(I) All organic farmland	(II) All organic farmland	(III) Organic farmland excluding horticulture	(IV) Organic horticultural farmland
Consumption_t-2				
All	12.0***			
Coupled		22.0***		
Strongly coupled			34.3***	
Coupled horticultural crops				0.40
Subsidy09	130,580***	124,478**	113,854***	348
Constant	241,944***	223,880***	201,722***	1,632***
No. observations	14	14	14	14
R^2	0.94	0.94	0.95	0.53

Notes: *** for p<0.01,** for p<0.05 and * for p<0.10. Robust standard errors.

Column I in Table 1 shows that an additional consumption of one million SEK increases organic farmland by 12.0 hectares, equivalent to about 83,300 SEK per hectare. If the price premium equals the calculated price premium of 32.3 % in 2018 it would imply that it costs taxpayers about 20,000 SEK to increase organic farmland by one hectare by GPP. In regression II we only include the coupled consumption, i.e. only consumption that may have an effect on domestic farmland. An increased consumption with one million SEK then generates organic farmland with 22 hectares, which lowers the cost per hectare to about 11,000 SEK. The effect (cost) does hence as expected increase (decrease) significantly, when we disregard consumption that cannot have an impact on domestic farmland. Column III reports the estimates from the regression where we only include the *strongly coupled consumption*, i.e. only food based on major produce as grains and animal products, and where the land cultivated with horticultural crops and root vegetables has been excluded from the regression. Increasing consumption with one million SEK then increases organic farmland significantly more, by 34.3 hectares, which lowers the cost of converting farmland by consumption to approximately 7,000 SEK per hectare. The coefficients of interest become as shown in column IV insignificant when we only include organic farmland cultivated with horticultural produce and root vegetables and consumption based on horticultural products and root vegetables that may be of domestic origin.

So far, we have not explicitly modeled the effect of GPP on organic farmland in our reference regressions as the sales to public procurement and retail sales are indeed highly correlated (correlation equals 0.98). It is hence difficult to disentangle the effect from GPP and other consumption. However, we have tested if GPP *per se* spurs organic farmland more than private consumption by introducing the share of GPP of overall consumption in the regressions (results are presented in the appendix). We narrow the sample period to 2009-2019 in order to avoid multicollinearity and find a weak support for that a larger share of GPP of overall consumption increases organic farmland. The effect wears off when we only include strongly coupled consumption. In conclusion, an additional public procurement of one million SEK increases organic farmland by arguably more than 12 hectares due to the comparable large amount of organic dairy products in public procurement, but less than 34 hectares.

The paths of certified organic farmland and consumption suggest an inelastic supply of organic farmland in terms of consumption. It hence seems to take more and more consumption in order to increase organic certified farmland by one hectare. We take the logs of organic certified farmland and consumption in order to estimate the elasticity of supply of organic farmland in terms of consumption. Regression results are presented in Table 2. The coefficient in column I shows that the elasticity of supply of organic certified farmland accordance to all consumption is 0.32, which is similar but somewhat lower than the estimated elasticity of 0.40 in Lindström et al. (2020). The supply response in terms of overall consumption is thus indeed inelastic reinforcing the notion that the costs have increased to convert farmland by consumption. The cost increase can though have been moderated by a lower price premium. We further systematically investigate the causes for the inelastic supply of organic farmland. When we only include the coupled consumption, the estimate increases to 0.38 as illustrated in column VI. The gradual shift of consumption towards imports thus partially explains the inelastic supply and so the weakening relation between consumption and organic farmland. In column VII results are presented for the strongly coupled consumption which excludes organic farmland for the cultivation of horticultural crops. The elasticity then increases more, to 0.43. A larger share of consumed horticultural produce as vegetables and fruit of the coupled consumption has hence as expected lowered the supply response. The results hence lend support to the notion that the market value transmission has gradually declined.

Table 2: Regression results - elasticities

Variables	(V) Ln all organic farmland	(VI) Ln all organic farmland	(VII) Ln organic farmland excluding horticulture	(VIII) Ln organic farmland excluding horticulture	(IX) Ln yield adjusted organic farmland excluding horticulture
Ln consumption_t-2					
All	0.32***				
Coupled		0.37***			
Strongly coupled			0.43***		
Strongly coupled, real				0.48***	0.76***
Subsidy09	0.26**	0.26**	0.25**	0.25**	0.24**
Constant	9.93***	9.58***	9.19***	8.74***	6.56***
R^2	0.93	0.93	0.93	0.93	0.96

Notes: *** for p<0.001,** for p<0.01 and * for p<0.05. Robust standard errors.

Price inflation of food has increased more than the general inflation, an average inflation rate of 1.9 % compared to 1.0 % for the economy in general. The consumption growth is therefore somewhat lower in terms of volume than in terms of real value according to the general inflation. We therefore deflate the strongly coupled consumption with the price inflation of food in order to measure changes in consumption (of strongly coupled consumption) according to volumes. The elasticity then increases to 0.48 as presented in column VIII. There is hence evidence that the high price inflation of food has decreased the supply response when consumption is adjusted to the general inflation. The comparable high food price inflation has therefore *ceteris paribus* increased the marginal cost of increasing organic farmland by GPP. The inelastic supply response does however persist. Finally, we inflate the organic farmland by the annual average yield growth that has prevailed during the period in order to provide an accurate measure of the supply growth as organic farmland is an input in the production in organic farming and not a measure of supply *per se*. We multiply the organic farmland with the average yield growth to get the expected growth of supply by expanding organic farmland.[24] The supply elasticity then significantly increases to 0.76 (column IX). An F-test shows that the coefficient is not statistically

[24] The average annual growth over the period 2003-2017 was on average around 2.7 %.

different from one (p-value 0.007), hence we cannot reject that supply is unit elastic when we only include consumption coupled to the major domestic organic crops and adjust for food price inflation as well as yield growth.

5. Summary and discussion

GPP is by design an indirect policy instrument as it targets supply by demand. In this context the implicit aspect of the policy instrument is further amplified as GPP not targets supply pe se but the supply of an individual production factor land by procuring finalized goods. The indirectness is manifested as only a small fraction of the market value for organic at the consumer stage is disseminated to the cultivation of organic farmland. The major part of the market value for organic is channeled to organic production abroad, covers costs and margins along the supply chain as well as costs associated with organic animal husbandry. The market transmission and so the effect on domestic organic farming however substantially depends on procurers' choice of food products. The results therefore suggest that it is more efficient to call for a high share of organic food in some individual food categories but not for food in general.

We find a low elasticity of supply on a par with Lindström et al. (2020). Our study strongly suggests the changed composition of consumption as a rationale for the gradually weakened link between consumption and organic farmland. Our study therefore can provide an insight on the effect of GPP when the good is only loosely connected to the environmental goal that is coupled to the purchase. The study can therefore provide an answer to the question posed by Lundberg and Marklund (2013) for which kind of markets GPP shall be applied. The low elasticity supply is though not only attributed to consumption changes. Our results also shows that the effect of consumption on organic farmland has worn off due to yield growth.

One novelty with our study is that it provides a cost estimation for the conversion of farmland to organic with GPP. Our measure can be considered as the lower bound as we do not consider other costs than the price premium that comes with organic food. Additional costs are likely present. Jörgensen (2012) for instance found that the procurement of organic food inflicted additional search and administrative costs

on the procurement process while Lundberg and Marklund (2018) shows that the procurement process is complicated in the sense that the consumption goal leaves the optimum levels of nutrition and organic farmland undetermined. We find that the cost equals somewhere between7,000-20,000 SEK per hectare depending on what food items are bought. Given that public procurement buys comparable much Swedish produce, the cost is likely lower than the upper bound.

If public consumption stimulates private consumption, the effect from GPP on organic farmland may though be greater than our estimation suggests. Marron (1997) shows that a stimulus of private consumption prevails if scale economies are sufficiently large while increasing marginal costs and a price elastic private demand counteracts the effect from GPP on green production. Jörgensen (2012) found though that the possibility of GPP to lower the costs in the food production for the retail market is hampered as the demand for packaging sizes differs between the public sector and households. More, our study suggests that GPP in this market setting with an indeed rigid supply in a period of two years may temporarily crowd out private sales when demand increases more than expected.

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Appendix

Table A1: Price premiums for organic for individual food items.

Food product	*Price premium*	*Food product*	*Price premium*
Meat balls	28.1 %	Oats	56.1 %
Chicken	158.4 %	Sugar	52.0 %
Pork chops	87.2 %	Crisp bread	47.1 %
Bacon	64.2 %	Spaghetti	26.3 %
Minced beef	20.2 %	Olive oil	56.6 %
Carrots	82.0 %	Balsamic vinegar	76.1 %
Potatoes	72.3 %	Orange juice	18.4 %
Onions	187.9 %	Ketchup	20.9 %
Cabbage	99.4 %	Baby food, canned	5.4 %
Tomatoes	93.2 %	Ground coffee	13.1 %
Canned tomatoes	11.2 %	Eggs	49.2 %
Pickled beetroot	24.2 %	Bregott (table margarine)	18.6 %
Pickled cucumber	11.9 %	Consumption milk, 3 % fat content	21.9 %
Apples	26.3 %	Double cream	16.4 %
Bananas	13.1 %	Cheese, Prästost Mellan	22.2 %
Chickpeas, canned	26.6 %	Butter	24.4 %
White flour	22.9 %	Sour milk	28.8 %
Rice	56.0 %		

Table A2: Regression results – absolute values 2009-2019

Variables	(I) All organic farmland	(II) All organic farmland	(III) Organic farmland major crops
Consumption_t-2			
All	11.3***		
Coupled		20.6***	
Strongly coupled			34.3***
Coupled horticultural crops			
Share GPP	596,945*	569,210*	394,707
Constant	293,612***	223,880***	268,319***
No. observations	11	11	11
R^2	0.93	0.93	0.94

Notes: *** for p<0.01,** for p<0.05 and * for p<0.10. Robust standard errors.

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