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How effective are VAT reforms in improving healthy dietary choices by EU consumers?

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ABSTRACT: Governments are increasingly considering fiscal instruments to improve dietary health. This paper quantifies the medium-term impacts on European food markets of a differentiated VAT policy that promotes healthy food consumption while discouraging intake of less nutritious products. Scenarios involve reduced VAT on grains, pulses, and poultry, and increased rates on beef, pork, sugar, and high-fat dairy. Our results show a significant decline in domestic consumption of targeted foods. However, part of this reduction is exported to other markets – a phenomenon described as "health leakage," raising questions about the broader effectiveness of such fiscal interventions.

¿Cuál es el potencial de la imposición directa para fomentar el cambio hacia dietas más saludables y sostenibles?

RESUMEN: Los gobiernos consideran cada vez más el uso de instrumentos fiscales para mejorar la salud alimentaria. Este artículo cuantifica los impactos a medio plazo en los mercados alimentarios europeos de una política diferenciada del IVA que promueve el consumo de alimentos saludables y desincentiva la ingesta de productos menos nutritivos. Los escenarios analizados incluyen una reducción del IVA sobre cereales, legumbres y carne de ave, y un aumento sobre carne de vacuno, cerdo, azúcar y productos lácteos con alto contenido graso. Los resultados muestran una disminución significativa del consumo interno, aunque parte de esta reducción se exporta a otros mercados, un fenómeno que denominamos "health leakage", lo que plantea dudas sobre la efectividad global de este tipo de políticas fiscales.

KEYWORDS / PALABRAS CLAVE: Diets, health leakage, agricultural commodity markets, modelling, VAT reform / dietas, health leakage (fuga de salud) mercados de productos básicos agrícolas, modelización, perdida de salud, reforma del IVA.

JEL classification / Clasificación JEL: Q10, Q11, D62, H23

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1. Introduction

Low income consumer groups in developed countries are facing simultaneously both food insecurity and diet-induced health problems, given the prevalence of cheap processed food that has more calories and fewer nutrients compared to healthy food. The Western diet is characterized by high intakes of red and processed meat, refined grains, dairy and ultra-processed foods. Given the prevalence of this diet among advanced economies, the average per capita caloric intake escalated from 2900 kcal in the 1960's to 3400 kcal per person in 2015 according to Batini (2021). According to FAO *et al*. (2022), more than 600 million people were considered obese and 2 billion overweight, simply because they eat too much unhealthy food.

Fiscal policies and taxes may be a powerful instrument to correct consumer behaviour, beside their traditional role of generating government revenue. The corrective role of taxes is present when consumption generates negative externalities, for instance, to curb consumers' demand for unhealthy food. This is the case of Pigouvian taxes. In the case of food, taxes levied on unhealthy food items could inhibit their over-consumption according to the "polluter pays" principle. In other words, those who produce the negative externality (diet related diseases) should bear the cost to prevent harm to human health and to the environment.

Unsurprisingly, the concept of modern food taxes appeared as a solution to the growing obesity epidemic worldwide. The underlying idea lies in the role of price influencing food choices. Increasing tax rates for food products of poor nutritional quality would deter consumers away from fatty, salty, and sugary foods. This way, consumers have incentives to choose healthier food, since unhealthier choices become more expensive through higher taxes. Introducing taxes to inhibit the consumption of less healthy food products has become an important point on the agenda of public health policy. The spread of obesity rates, especially childhood obesity adds up to the urgency of implementing such fiscal measures. Based on World Health Organization (WHO) data, the worldwide number of obese children five years and younger increased by 28 %, from 32 million in 1990 to 41 million in 2016.

This was precisely the reasoning behind the introduction of the tax on sugary drinks in Mexico in 2014 as a response to the rampant obesity and diabetes rates[1]. The tax amounted to a 10 % increase in the price of soda drinks. The tax was a success story of public health policies, since sales of these drinks immediately fell by 6 % and then the decline sped up to 12 % by the end of the same year as pointed out by Colchero *et al*. (2017). However, sin taxes are not a magic bullet for all diet-induced health problems. First, they must increase the price substantially in order to reduce consumption of the taxed products and second, they work better in countries with severe public health issues, where soft policies have failed. A similar Pigouvian tax on

[1] Mexico had the highest rates of obesity and diabetes among all OECD countries with 70 % of the adult population considered obese.

saturated fat was introduced in Denmark in 2011. This tax was successful in reducing the consumption of products containing saturated fat, however its design was weakly prepared and it lacked public support due to poor documentation from public health organizations, therefore it was abolished in 2013. In parallel, tax exemptions on healthy food products were thought to generate not only better nutrition and diets, but also an important financial relief to consumers during times of need. Recent policy proposals across EU Member States recommend Value Added Tax (VAT) cuts on essential food products to help consumers cope with higher food prices following the COVID pandemic and the start of the aggression of Russia on Ukraine.

Although these recent policy proposals recommend healthier food choices, for now, the reality is that current EU diets do not align yet either with the Farm to Fork strategy or with EU climate and sustainability goals. The Farm to Fork strategy includes a possible reform of VAT for food with the goal of completely eliminating the taxes for fruits and vegetables. Economic policies can be deployed to move food demand toward healthier and more sustainable options. Fiscal measures are often efficient in changing the type, combination and quantity of food that consumers buy.

Prior to the COVID-19 pandemic EU fiscal policy attempted harmonizing the VAT rates across the EU by eliminating reduced VAT rates. This view has changed after the pandemic. In light of recent inflation in 2022, fuelled by high-energy prices due to the war in Ukraine several European countries reduced VAT on essential food products to help consumers cope with inflation prices. Some essential foodstuffs cover basic needs, for which EU Member States could use zero VAT rates. Most recently, Spain scrapped the VAT for basic food products from 4 % to 0 % to help consumers maintain their purchasing power during times of rising food inflation. The list of basic food items includes bread, milk, eggs, cheese, fruit and vegetables, and cereals. In 2022, Germany also eliminated VAT for basic food products including vegetables, fruits and pulses.

Scholle (2022) shows that zero VAT rates adopted in 2022 for essential food products are an appropriate tool to fight inflation and provide a permanent relief to consumers. The advantage of the zero VAT rates in an inflationary setting lies in the permanent reduction of the price trend that would permanently limit the price increase of food. Additionally, the VAT cut would reduce anticipated inflation. Fuest *et al*. (2021) analyses the fiscal stimulus package designed as temporary VAT cuts in Germany in 2020 in the wake of the pandemic. They argue that this move would work and stimulate demand only if the VAT cuts translate into lower consumer prices. However, their findings show that about 70 % of the VAT reduction is not passed on to consumers.

Some critics however, strongly oppose this practice of lowering VAT. The IMF report by Amaglobeli *et al*. (2022) advises against tax cuts be as they are regressive and translate into a loss of significant tax revenue. Moreover, these tax cuts might work temporarily in food insecure countries.

The central question we are interested in this paper is how effective are VAT changes in improving health outcomes and diets of EU consumers. We analyse how different VAT on food items affect consumer choices, health outcomes and EU agricultural market balances. We also analyse the extent to which European consumers become relatively healthier at the expense of foreign consumers. In other words, we analyse whether exports of unhealthy food products rise as an effect of higher domestic taxes. Thus, we look at potential spillovers coming from the trade effects of VAT changes.

Previous literature assessed the demand effects of changes in taxation of individual food products. However, our paper addresses the impact of revised set of food taxes on total food demand and diets. The contribution of this paper lies in the analysis of economic and health effects of a revised food taxation policy; specifically, we show that VAT reductions on healthy food coupled with VAT increases for unhealthy food bring out stronger positive changes in consumer' diets and food choices compared to scenarios where VAT changes are levied individually.

We analyse four scenarios using the Aglink-Cosimo model of the global agricultural markets. The first scenario is a food affordability scenario in which taxes for all food products considered in this study are eliminated. The second scenario is a mixed taxation policy in which VAT for unhealthy food doubles while the VAT for healthy food is cut in half. This scenario is a revenue neutral taxation scenario that would internalize the public health expenditure associated with obesity. The third and fourth scenario represent sensitivity analyses in which either only the VAT's of unhealthy food products double or only the VAT's of healthy food products are halved.

Our study is relevant for the Spanish food system where consumers' diet is a hot-button topic. One in four calories consumed by the average Spanish consumer is estimated to be from ultra-processed food according to Sassi (2023). Children whose diets consists of more than 30 % of ultra-processed food have biomarkers for obesity. Therefore, in the last few years, Spain has witnessed repeated policy proposals for health taxes on food and soft drinks coupled with regulation of food marketing targeting children and nutrition labelling of food products. Yusta-Boyo *et al*. (2023) show that the Spanish population's dietary intake of fat, sugar and salt is higher than the current recommendation in Spain and in most European countries. There was a 4-year initiative (2016–2020) calling for Spanish food reformulation that aimed at reducing added sugars by 0.6 % to 60 % and total fat by 24.9 % to 36 %. Moreover taxes on sugar sweetened beverages (SSB) have been introduced in Catalonia in 2017. Fichera *et al*. (2021) show that the introduction of SSB taxes in Catalonia was followed by a 2.2 % reduction in sugar purchases. They argue that a combination of different policies would be required to reduce successfully obesity rates even more.

The Aglink-Cosimo model used in our study is an aggregated model of regional blocks of EU countries. However, since EU markets are integrated, prices will affect Spanish consumers and producers following the same pattern as our results show.

Moreover our research question is very relevant for the Spanish public policy debate, given the current policy interest in Spain in tackling diet related diseases with taxes.

2. Literature review

Consistent with Engels'curve, food taxes are usually regressive, in the sense that low-income consumers pay a larger share of their income on food and thus, on these taxes, than high-income consumers. Bach & Isaac (2017) show that almost 40 % of the VAT revenue comes from the population in the lower income bracket. This implies that the burden of the tax is, in relative terms, significantly higher for low-income households. Likewise, a tax cut would be completely transferred to consumers and would benefit mostly low and middle-income groups.

The question that is still debatable in the literature is whether food taxes are progressive in terms of health effects. Several empirical studies look at the impact of food taxes on consumer behaviour and health. Tiffin & Arnould (2011) quantify the effects of fiscal policies on diets by focusing on the change in the consumption of unhealthy food. They propose a scenario where they measure the impact of a revenue neutral policy mix consisting of a fat tax coupled with a subsidy on fruits and vegetables. Their conclusion is that this policy mix is effective on tackling the risks associated with diet-related diseases. Results show that the subsidy in itself is efficient in bringing up the intake of fruits and vegetables near dietary recommendations, but the proposed tax on saturated fat is not enough to lower the fat intake down to recommended values. Grossman *et al*. (2014) indicate that a 10 % increase in the price of unhealthy food consumed at home decreases body fat by 9 %.

There are several other relevant studies that focus on the health effects generated by tax changes. Nordström & Thunström (2011) find that revenue-neutral VAT reforms increase the fibre intake across all income groups, but they also increase the intake of salt, sugar, and fat. Interestingly, they observe the strongest dietary effect for the lowest income group.

Similarly, Jensen & Smed (2013) analysed the effect of the Danish tax on saturated fat introduced in 2011. The fat intake level from butter, butter-blends, margarine and oils dropped by 10-15 % because of this tax. This result is based on weekly consumption panel data spanning from 2008-2012. The aim of food taxes is a potential change in consumption of the taxed product depending on the availability of substitutes, the pass-through rate on consumers, and the size of the tax. Thow *et al*. (2014) explain that fiscal policies might be more effective in the case of food products with high price elasticities of demand that can easily be substituted by consumers for healthier options (for instance, unsweetened beverages for sugar sweetened beverages). Another factor determining the success of such tax reform is the income elasticity of demand. Based on their findings soft drinks taxes and healthy food subsidies are the most effective in changing food consumption patterns, while

taxes on fat, sugar, and salt that apply to essential goods, only have a modest effect on the consumption of these nutrients.

Other studies focus on the potential of food taxes to shift consumer behaviour toward healthier diets. A Pigovian tax corrects for market failure for goods causing negative externalities by raising these goods'costs, therefore, by reducing the demand for them. Such a tax represents a win-win situation, since it produces a socially desirable outcome while generating public revenues. Säll & Gren (2015) analyses the impact of a Pigovian tax on the consumption of meat and dairy in Sweden. The tax incorporates the environmental costs of producing meat and dairy, that is the value of measured GHG, nitrogen, and ammonia. They show that such a tax is more successful in the case of domestically produced meat products than for dairy such that consumption would drop by 1.8-13 %. Their findings show that Pigovian taxes could bring both environmental and health benefits across all income groups of the population.

Chouinard *et al*. (2007) analyse both the health and welfare effects of fat taxes on dairy products in the US. They show that fat taxes have minimal positive health effects, such that a 10 % VAT on the percentage of fat reduces the fat intake by less than 1 %. They point out that these fat dairy taxes are regressive and the tax incidence falls mainly on the poor and elderly. Wang *et al*. (2021) use an annual US state-level dataset of grocery taxes from 2009 to 2016 that is regressed on rates of diabetes and obesity. They estimate the effects of grocery taxes on these two health outcomes. The results show that 1 % increase in food taxes translates into 0.58 % and 0.21 % increase in obesity and diabetes rates. WHO published a 2015 technical report on fiscal policy on diet that recommended raising taxes on sugary drinks by 20 % or more to generate the desired consumption effects (WHO, 2015). Their recommendation was to couple such taxes with subsidies on fresh fruits and vegetables that would reduce their prices by 10-30 % to improve consumers' diets. The report highlights that the success of such fiscal policies depend heavily on the price elasticity of demand of the food products that may be taxed. In most cases, the demand for food is inelastic. Yet, this fact is not viewed by policymakers as an obstacle in designing such fiscal policies. It simply means that the VAT should be high enough to generate the desired response from consumers. This way, the tax could successfully bring the desired health effects.

Tax instruments are thought to be an effective tool for achieving sustainability goals proposed by the Green Deal. Batini (2021) focuses on policies aimed at greening food demand in advanced economies. A variety of fiscal policies and structural reforms are considered. On the demand side, taxes and subsidies could shift the type and amount of food people consume, just like on the supply side. The proposed measures refer to taxes on unhealthy food, tax credits or subsidies on healthy food, health tax bonuses, and healthcare system reform combined with product market reform. Tiffin & Arnoult (2011) argue that a fat tax is just one of the many instruments that could help fight poor diets. Moreover, more complex polices, are likely more effective in improving the overall health status of the population. Beach *et al*. (2019) analyse the effect of climate change on agricultural productivity, more exactly on global nutrient

availability. According to this study, there are no benefits of CO2 fertilization on the availability of iron, zinc and proteins. Fuglie *et al*. (2022) report on potential productivity growth effects for different commodities and countries because of technology change in agriculture. They analyse how these changes affect economic growth, land and water use, greenhouse gas emissions and diets. Nelson *et al*. (2018) focus on nutrient availability based on the global needs of the population projected for 2050. The authors find that the biggest challenge for food security is to supply the population with nutritious diets and not necessarily with the targeted calories intake.

Other studies focus on the potential of food taxes to shift consumer behaviour toward healthier diets. Tukker *et al*. (2009) show that switching to a healthier diet decreases the environmental impact by 8 %. Other studies are also pointing out the connection between healthy diets and a cleaner environment. Himics *et al*. (2022) finds that the adoption of a plant based diet would permit the EU agricultural sector to contribute significantly to the zero pollution plan.

3. Analytical framework

3.1. Modelling framework

The analysis builds on the Aglink-Cosimo model and on the EU Agricultural Outlook for markets, income, and environment (2021-2031). Aglink-Cosimo is a recursive-dynamic, partial equilibrium model of world agriculture developed by OECD and FAO of the United Nations. The model produces yearly projections of agricultural markets for a 10 year horizon included in the EU medium-term agricultural outlook (European Commission, 2022). Commodity markets clear at domestic and world level. Macroeconomic determinants, such as GDP growth, inflation, exchange rates, oil prices enter all exogenously in the model.

Aglink-Cosimo is an economic model that analyses supply and demand of world agriculture. It is used to make projections of the developments of annual market balances (production, consumption, and trade) and prices for the main food commodities. OECD & FAO (2022) and Pieralli *et al*. (2022) document the model.

We model different VAT scenarios through the consumer price equations of the AglinkCosimo model.

Consumer prices are calculated in the model as follows:

$$CP = (PP + MAR) \times (1+VAT/100) + TAX \qquad [1]$$

where: *PP* represents producer prices, *MAR* consumer price margins, and *TAX* excise taxes.

For this analysis, consumer prices were adjusted to account for changes in VAT, retail margins, and organic market. We used 2007-2021 consumer prices from Euro Monitor data to estimate the consumer price margins.

Aglink-Cosimo model is a dynamic, partial equilibrium model that focuses on the analysis of supply and demand or world agricultural markets. The model solves for regional and world market equilibrium of supply and demand. The market clearing prices are determined when markets are in equilibrium. The Aglink-Cosimo model is elasticity driven. The elasticities are model coefficients and they are constant for all years of simulation. They are estimated in such a way that they fulfil several economic conditions. Historical data for consumer prices came from the International Labour Organization (LABORSTA database) and is available by Member State up to 2008. For the following years, consumer prices are estimated using equation [1].

Our goal is to quantify the impact of tax changes on consumer food choices and the respective quantities consumed. Per capita food demand (*F0*) is modelled as a decreasing function of own price and direct increasing function of other substitutes 'prices and per capita GDP:

$$\log(F0_{c,r,t}) = \sum_{c=1}^{c} \alpha_c \log\left(\frac{CP_{c,r,t}}{CPI_{r,t}}\right) + \beta \log\left(\frac{GDPI_{r,t}}{POP_{r,t}}\right) + \log(P0P_{r,t}) + \delta T + \log(R_{F0,c,r,t}) \quad [2]$$

where: *CPI* represents consumer price index, *GDPI* GDP index, and *POP* population.

VATs are exogenous variables in the model computed based on historical data for the last three years. Cuts in VAT will impact consumers through a reduction in prices: as consumers pay relatively lower prices for essential or healthy food items, they have an increased ability to raise their food consumption of healthy products and substitute unhealthy food products for healthy ones. In practice however, categorizing one food product as healthy or unhealthy is a task that could easily become highly debatable. Yet, the question of what constitutes unhealthy or healthy food is essential for our study. In other words, what criteria should we use to label food products as healthy or unhealthy?

In order to define accurately our understanding of healthy food choices, we use a universal healthy reference diet based on Willet *et al*. (2019). The EAT-Lancet Commission Report on Food, Planet and Health constitutes the most comprehensive report to date of what represents a healthy and sustainable diet. It provides the basis for estimating the health and environmental effects of switching from the existing diet to an alternative, healthier diet. Based on prior empirical findings on nutrition, the EAT-Lancet diet prescribes an appropriate caloric intake of 2500 kcal/day per person largely adapted to plant-based foods with very low quantities of animal sourced foods. This is essentially a flexitarian diet that is heavily plant-based with minimal amounts of fish, meat and dairy products.

Reaching such a diet on a global scale by 2050 would require doubling the consumption of healthy plant-based food (grains, pulses, fruits and vegetables) and halving the consumption of less healthy foods (meat, dairy products and added sugars). Moving from the existing Western diet to the EAT-Lancet diet would provide global social and economic benefits.

Another important point to take into account when assessing the efficiency of both sin taxes and health taxes is the elasticity of demand. Price elasticity of demand is the main determinant of the extent to which a price change will affect the consumption of a good. Inelastic goods are more resilient to changes in price while elastic goods are more responsive to price changes. It is also true that in the short run, demand is on average more inelastic, while in the long run, consumers have enough time to adapt and/or find substitutes for goods that became pricier and therefore their demand becomes more elastic over time. However, this idea is not captured by our model since price elasticities of demand are exogenous parameters in line with the values used in the literature. Table 1 presents the main elasticities for the healthy and less healthy food products that we considered in our study that builds on the EAT-Lancet diet.

TABLE 1

Price elasticities of demand for healthy and less healthy food products.

Food item	E14[2]	NMS
Less healthy		
Pork	-0.37	-0.49
Beef	-0.47	-0.50
Butter	-0.18	-0.20
Cheese	-0.20	-0.30
Sugar	-0.22	-0.24
Healthy		
Maize	-0.20	-0.29
Rice	-0.10	-0.21
Wheat	-0.12	-0.21
Poultry	-0.39	-0.41
Pulses	-0.20	-0.19

Source: Own elaboration.

[2] E14 covers the first 14 Member States1 (E14; excluding the UK) while NMS covers the 13 newer Member States (NMS). The E14 aggregate is composed of: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, and Sweden. The NMS aggregate is composed of: Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, and Slovenia.

The cross-price elasticity between beef and poultry is 0.10 suggesting that a 10 % decrease in the price of chicken will lead to a 1 % decrease in the quantity demanded for beef, since consumers will substitute beef for the relatively cheaper and healthier chicken meat. Similarly, the cross-price elasticity between pork and poultry is 0.08.

3.2. Scenarios

Taking into account the EAT-Lancet healthy reference diet described by Willet *et al*. (2019), we consider beef pork, high-fat dairy products, and sugar as unhealthy food products, while grains, pulses and poultry as healthy food. We use EU Member States VAT data between 2020 and 2022. VAT rates vary widely not only across countries within EU, but also among food items inside each country. Empirical data shows that VAT rates are consistently higher in the 13 actual Member States entering the EU after 2004 (NMS) than in the other 14 Member States (E14).

TABLE 2

VAT rates for healthy and less healthy food products

VAT rates (%) Food item	E14	NMS
Less healthy		
Pork	7	11
Beef	9	12
Butter	8	11
Cheese	7	12
Sugar	11	17
Healthy		
Maize	7	12
Rice	6	12
Wheat	6	12
Poultry	9	12
Pulses	7	14

Source: Own elaboration.

We are performing four scenario analyses by comparing the results of each VAT scenario against a business-as-usual situation (baseline) for year 2031. This baseline corresponds to the medium-term agricultural market outlook (European Commission, 2021).

In *Scenario 1* we assume a complete elimination of VAT for all food products. This represents a scenario in which food affordability could become a general problem due to exogenous events such as recessions, inflation high-energy prices.

Scenario 2 represents a scenario that is closer to a budget neutral VAT redistribution. Here we consider the option of parallel tax credits on healthy food to offset the cost of higher taxes on unhealthy food. In this scenario, consumers maintain their purchasing power but they have higher incentives and increased ability to switch to a healthier and sustainable diet. The EAT-Lancet diet would become more affordable in this scenario, especially for low-income consumers. Specifically we consider the option of halving VAT for healthy foodstuffs and doubling VAT for unhealthy food. Thus we do a -50 % exogenous shock on VAT for maize, rice, wheat, soybeans and poultry and a +100 % exogenous shock on butter, cheese, beef, pork and sweeteners. Intuitively, this scenario would translate into doubling the VAT for unhealthy food and halving the VAT for healthy food products. This scenario is a revenue neutral taxation scenario that would, at least partly, internalize the public health expenditure associated with obesity.

Scenario 3 and *Scenario 4* represent sensitivity analyses based on Scenario 2. The purpose of these simulations is to decompose the individual effects of different fiscal measures and to understand the main factors driving the results of scenario 2. In Scenario 3 we consider a +100 % shock on VAT for the poor nutritional food products. In Scenario 4 we consider a 50 % reduction of essential/ healthy food VAT, similar to the recent policy measures implemented by several European governments as a response to the food inflation that started in 2022.

In all scenarios, the changes considered are equal exogenous shocks from 2022 to 2031 relative to the medium-term baseline.

4. Results

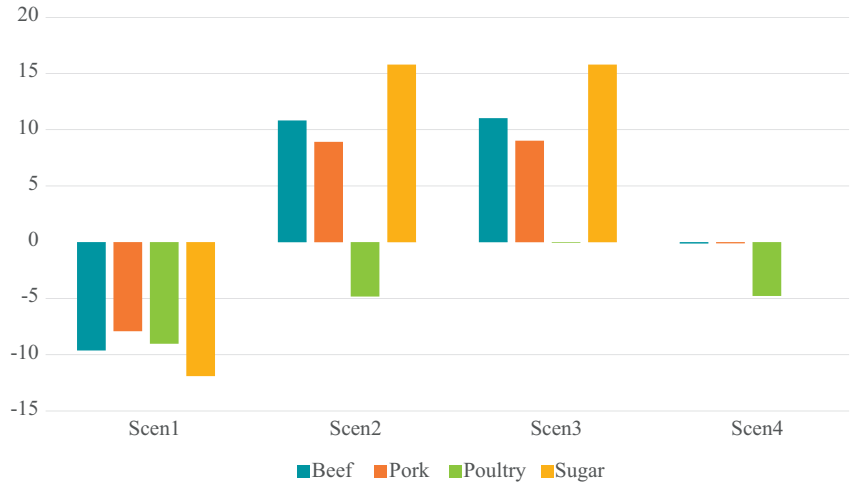
The main objective of the scenario analysis is to quantify the medium-term effects of a policy that promotes healthy, nutritional rich food products, and penalizes the consumption of nutritionally poor food. In order to analyse the effects of VAT changes across the EU, we look at results for the year 2031 and compare to the medium-term baseline projections. We focus on four categories of food products in the EU region: meats, dairy, grains and sweeteners. The impact of tax changes on consumer behaviour and market outcomes is quantified by the changes in consumer prices, caloric intake, food consumption and trade. We measure the caloric intake by annual total energy consumed (kcal).

First, we look at the pass-through rate of VAT onto consumer prices. The highest pass-through rate is for sugar and meats. Figure 1 indicates that both in Scenario 2 and Scenario 3 consumers end up paying 15 % higher prices when VAT for

sugar doubles. In the case of beef and pork, Figure 1 indicates a 9-11 % increase in consumer prices in both Scenario 2 and Scenario 3 when VAT doubles. At the same time a 50 % VAT cut in poultry would decrease consumer prices by almost 5 %.

FIGURE 1

Impact of VAT changes on EU consumer prices for sugar and meat (%)



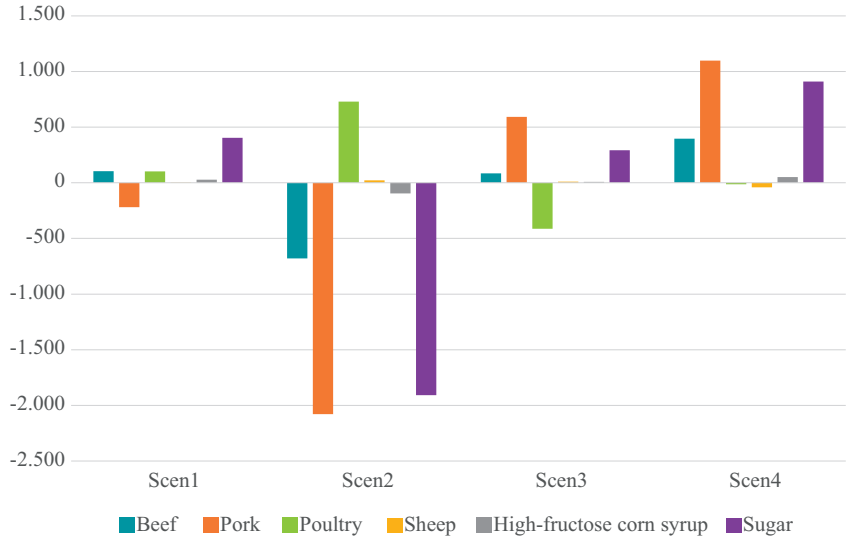
Source: Own elaboration

4.1. Impacts on diets

We analyse the effectiveness of a policy that punishes financially consumers for unhealthy eating and rewards them for making better food choices. Scenario 2, the budget neutral scenario, is the scenario that indicates how successful are fiscal measures in shaping consumers' dietary choices when their purchasing power remains unaffected. We want to see whether a combination of fiscal measures could move European consumer preferences and their health status towards the EAT-Lancet diet. Figure 2 indicates that doubling the taxes for pork decreases the world annual caloric intake from pork by nearly 2000 kcal per year, which represents 3 % of EU total caloric intake per capita from pork per year. The results from Scenario 2 show that higher taxes on beef and pork coupled with lower taxes on poultry creates a stronger substitution effect compared to higher meat taxes alone.

FIGURE 2

Impact of VAT changes on EU total caloric intake from meats and sugars (TCA/year)



Source: Own elaboration.

The results shown in Figure 2 suggest that a 100 % increase on sugar tax would lead to drop in the yearly caloric intake by 1400 kcal per capita per ann, that is, approximately 2 % of per capita caloric intake from sugar. Diet wise, VAT reductions for healthy foods are more successful when they are combined with higher VAT on pork, beef and sugar.

4.2. Impacts on food choices by consumers

Consistent with previous results from the literature, our analysis suggests that higher VAT for less nutritional food combined with lower VAT for healthy food could be a successful mix of policies, since it decreases both beef and pork consumption by 4 %. The results concerning food consumption are in line with and follow closely the ones concerning the effects of tax changes on caloric intake. The results shown in Figure 3 suggest that taxes on less healthy foods like beef, pork and sugar would generate positive dietary changes following the reduction in purchases and consumption of taxed products.

FIGURE 3

Impact of VAT changes on EU meats and sugar consumption (%)

Source: Own elaboration.

4.3. Impacts on trade

Health leakages could be a potential side effect of VAT changes for food products. We want to know if the improvement in diets and health status of European consumers through fiscal measures might be followed by higher exports of food of poor nutritional qualities to other countries. That seems to be a realistic hypothesis in the case of pork exports. As Figure 4 shows, the production of pork is marginally affected by higher VAT and over time it remains at similar levels compared to the baseline values. Consumption drops as an effect of higher taxes passed through to consumers, but pigmeat exports rise sharply in Scenario 2. As a result of higher VAT pigmeat exports would increase by 541 kt by 2031 and this represents a 14 % increase compared to the baseline. Also beef exports increase by 9 % as well. This suggests that consumers will substitute pork for healthier alternatives but indeed the quantity produced will be sold somewhere else. This result brings fort the idea that taxes on unhealthy food products are often regressive. Also, obesity and diet related diseases are regressive, affecting especially the low-income group of consumers in developing countries.

Similar results are found in the case of butter, where production remains at levels comparable to the baseline, but exports jump by 26 kt in 2031; this represents an 8 % increase following the drop in consumption due to higher taxes. As shown in Figure 4, part of this reduced consumption will be exported to non-EU markets.

FIGURE 4

Effect of VAT changes (Scenario 2) on EU market balances for pigmeat, butter and sugar (Kt)

Source: Own elaboration

The same pattern could be observed for sugar. In this case, as domestic consumption drops due to higher taxes, exports increase by 229 kt, which is equivalent to a 14 % increase in Scenario 2. Therefore, we could see this health leakage in the form of increased exports for most food products for which VAT was increased.

Diet related fiscal policies promote not only VAT increases for less healthy food, but also VAT cuts for healthy food. The other side of the coin for these fiscal policies is to make sure they do not discriminate against imported products. In the presence of VAT cuts, imports drop slightly only in the case of pulses by less than 1 %. The imports effect is negligible in the case of wheat, maize, and poultry.

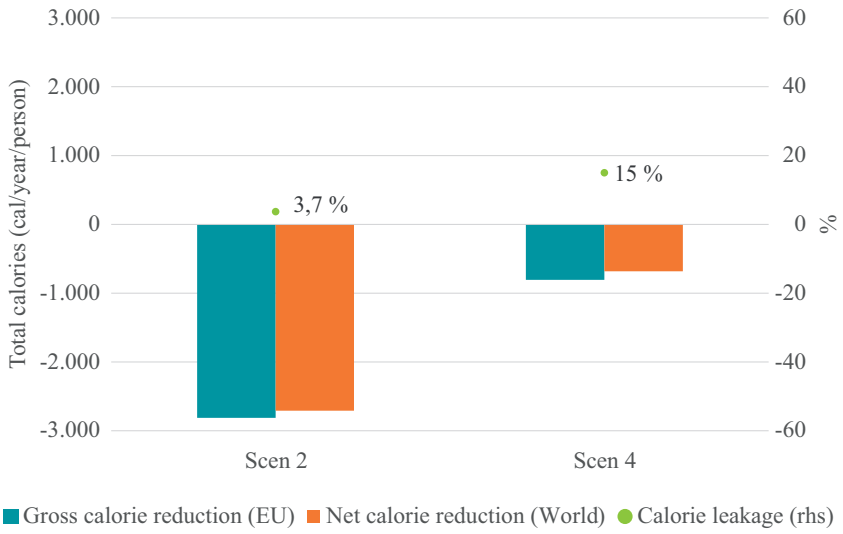
4.4. Health leakage

In this analysis we also try to identify a potential policy-driven "health leakage": are we exporting "bad calories" when improving our diets? Results indicate that policy proposals designed for helping consumers cope with food inflation by cutting VAT for healthy food products are successful in improving EU consumers' diets as well. Tax cuts translate into lower consumer prices that push up quantity demanded for healthy food. Consumers substitute unhealthy food for healthier (and now relatively cheaper) food. The combination of tax cuts for health food and tax increases

for less healthy food leads to a 0.5 % drop in the annual caloric intake compared to the baseline, that is, 2813 Tcal/year. Out of these calories dropped in EU, 3.7 % of them are leaked to other countries through exports. The health leakage happens since producers face a lower domestic demand and therefore they sell their production abroad at a price relatively higher than the domestic price. The results of Scenario 4 show even stronger results. The overall effect shows that the annual caloric intake in the EU decreases by 807 Tcal/year (0.14 %) compared to the baseline according to Scenario 4. However, it becomes apparent that this caloric improvement in EU diets causes in turn, a deterioration of the diets in the rest of the world. Figure 5 indicates that 15 % of the calories dropped by EU consumers are exported to the rest of the world causing a health leakage.

FIGURE 5

Health leakage effect of tax cuts: improved EU diets (caloric drop) vs. deteriorated rest of the world diet (caloric increase)



Source: Own elaboration.

5. Policy implications

Research has shown that Pigouvian taxes (or taxes on products with high externalities) might not be very efficient in the short run. In the long run, however, they might prove to be successful in shifting consumers' preferences away from unhealthy goods. The degree of success of such fiscal measure depends on the demand elasticity of the food item being taxed. Since the purpose of VAT changes is to correct behaviour and improve the health status and diets of consumers, a more elastic demand curve is better because a relatively small tax can cause a relatively large reduction in consumption. Consider for instance the example of a higher VAT on sugar. If the demand for sugar is inelastic, then the tax will not significantly reduce sugar consumption; but if the demand is elastic, then it will. In other words, the more sensitive demand is to price changes, the more effective the VAT tool will be to correct dietary choices. If demand is inelastic, then the government may use alternative methods to correct behaviour, such advertising campaigns. The introduction of VAT cuts on healthy food products coupled with the introduction of higher taxes on less healthy food items would allow consumers not only to afford a healthier and more sustainable diet but also to perceive and be made aware of the externality cost of their food choices.

One aspect not captured in the Aglink-Cosimo model is the variation of VAT rates across countries. VAT rates vary between 0 % and 25 % for food products across EU Member States. It is only natural to infer that the impact of VAT cuts on food consumption of healthy food (therefore the success of such fiscal policy) would vary considerably from one country to another. On one end of the spectrum we have countries like Ireland or Luxembourg, with very low VAT (< 3 %), while Austria and Sweden have on average 10-12 % VAT for food. At the other end, there are countries like Denmark, Germany, Italy and Finland that all have very high VAT for food items; therefore a significant reduction in VAT taxes would generate significant responses from demand side, especially in the long run. Previous studies show that sin tax experiments in Denmark and Hungary, did not have the immediate desired effects in the short run, but they could be beneficial in the longer run by changing consumer preferences.

Beside fiscal policies, there are other economic options that could structurally shift food demand toward a more sustainable and healthy diet. Among these options, which could allow greening food demand, are subsidies for low-income groups, food and health information, labelling , education, guidelines, and regulation on food marketing.

Last but not least, when discussing 'health leakage' we should pay attention to the destiny of the 'unhealthy' products. From a food security perspective, cheaper exports from the EU could improve access to nutrient-rich food to poor households in developing economies. Therefore, it would be good to further investigate the composition of this trade of calories and identify how certain micronutrients such as sugars and saturated fats are traded away from the EU into other economies.

References

Amaglobeli, D., Hanedar, E., Hee Hong, G. & Thévenot, C. (2022). *Fiscal policy for mitigating the social impact of high energy and food prices*. *IMF Note 2022/001*. Washington, DC: International Monetary Fund. https://doi.org/10.5089/9798400211614.068

Bach, S. & Isaak, N. (2017). "Value-Added Tax cuts bring greatest relief to lower and middle income households". *DIW Economic Bulletin*, 7(31-32), 315-321. http://hdl.handle.net/10419/167694

Batini, N. (2021). *The economics of sustainable food, smart policies for health and the planet*. Washington, D.C.: Island Press and International Monetary Fund.

Beach, R.H., Sulser, T.B., Crimmins, A., Cenacchi, N., Cole, J., Fukagawa, N., Mason-D'Croz, D., Myers, S., Sarofim, M.C., Smith, M. & Ziska, L.H. (2019). "Combining the effects of increased atmospheric carbon dioxide on protein, iron, and zinc availability and projected climate change on global diets: a modelling study". *The Lancet Planetary Health*, 3(7), e307-e317. https://doi.org/10.1016/S2542-5196(19)30094-4

Capéau, C., Decoster, A. & Güner, D. (2022). "*Extension of the EUROMOD-ITT Tool", Final Report JRC Project no. JRC/SVQ/2020/OP/1373*. Retrieved from: Andredecoster.be. http://www.andredecoster.be/publication/capeau-decoster-and-guner-2022-extension-of-the-euromod-itt-tool/

Chouinard, H.H., Davis, D.E., LaFrance, J.T. & Perloff, J.M. (2007). "Fat taxes: Big money for small change". *Forum for Health Economics & Policy*, 10(2), 1-30. https://doi.org/10.2202/1558-9544.1071

Colchero, M.A., Molina, M. & Guerrero-López, C.M. (2017). "After Mexico implemented a tax, purchases of sugar-sweetened beverages decreased and water increased: Difference by place of residence, household composition, and income level". *The Journal of Nutrition*, 147(8), 1552-1557. https://doi.org/10.3945/jn.117.251892

Dogbe, W. & Gil. J.M. (2020). "Internalizing the public cost of obesity in Spain: Distributional effects on nutrient intake". *Journal of Policy Modelling*, 42(6), 1352-1371. https://doi.org/10.1016/j.jpolmod.2020.01.011

European Commission. (2022). "*EU agricultural outlook for markets, income and environment, 2022-2032"*. Luxembourg: Publications Office of the European Union. https://doi.org/10.2762/29222

European Commission. (2021). "*VAT rates applied in the Member States of the European Union"*. Retrieved from: Taxation and Customs Union. https://taxation-customs.ec.europa.eu/system/files/2021-06/vat_rates_en.pdf

FAO, IFAD, UNICEF, WFP & WHO. (2022). *The state of food security and nutrition in the World 2022. Repurposing food and agricultural policies to make healthy diets more affordable*. Rome: Food and Agriculture Organization of the United Nations. https://doi.org/10.4060/cc0639en

Fichera, E., Mora, T., Lopez-Valcarcel, B.G. & Roche, D. (2021). "How do consumers respond to "sin taxes"? New evidence from a tax on sugary drinks". *Social Science & Medicine*, 274, 1137992021. https://doi.org/10.1016/j.socscimed.2021.113799

Fuest, C., Neumeier, F. & Stöhlker, D. (2021) *The pass-through of temporary VAT rate cuts: Evidence from German supermarket retail. CESifo Working Paper No. 9149*. Retrieved from: Cesifo. https://www.cesifo.org/en/publications/2021/working-paper/pass-through-temporary-vat-rate-cuts-evidence-german-supermarket

Fuglie, K., Wiebe, K., Sulser, T.B., Cenacchi, N. & Willenbockel, D. (2022). "Multidimensional impacts from international agricultural research: Implications for research priorities". *Frontiers in Sustainable Food Systems*, 6, 1031562. https://doi.org/10.3389/fsufs.2022.1031562

Grossman, M., Tekin E. & Wada, R. (2014). "Food prices and body fatness among youths". *Economics & Human Biology*, 12, 4-19. https://doi.org/10.1016/j.ehb.2013.10.003

Hernandez-Aguado, R. & Lumbreras, B. (2018). "The impact of the tax on sweetened beverages: A systematic review". *The American Journal of Clinical Nutrition*, 108(3), 548-563. https://doi.org/10.1093/ajcn/nqy135

Himics, M., Giannakis, E., Kushta, J., Hristov, J., Sahoo, A. & Pérez-Domínguez I. (2022). "Co-benefits of a flexitarian diet for air quality and human health in Europe". *Ecological Economics*, 191, 107232. https://doi.org/10.1016/j.ecolecon.2021.107232

Jensen, J.D. & Smed, S. (2013). "The Danish tax on saturated fat – Short run effects on consumption, substitution patterns and consumer prices of fats". *Food Policy*, 42, 18-31. https://doi.org/10.1016/j.foodpol.2013.06.004

Nelson, G., Bogard, J., Lividini, K., Arsenault, J., Riley, M., Sulser, T.B., Mason-D'Croz, D., Power, B., Gustafson, D., Herrero, M., Wiebe, K., Cooper, K., Remans, R. & Rosegrant, M. (2018). "Income growth and climate change effects on global nutrition security to mid-century". *Nature Sustainabilty*, 1, 773-781. https://doi.org/10.1038/s41893-018-0192-z

Nordström, J. & Thunström, L. (2011) "Can targeted food taxes and subsidies improve the diet? Distributional effects among income groups". *Food Policy*, 36(2), 259-271. https://doi.org/10.1016/j.foodpol.2010.11.023

OECD & FAO. (2022). *The Aglink-Cosimo model. A partial equilibrium model of world agricultural markets*. Retrieved from: OECD-FAO Agricultural Outlook. https://www.agri-outlook.org/documents/2022_Aglink%20Cosimo%20Brochure.pdf

Pieralli, S., Chatzopoulos, T., Elleby, C. & Pérez-Domínguez, I. (2022). *Documentation of the European Commission's EU module of the Aglink-Cosimo model: 2021 version*. Luxembourg: Publications Office of the European Union. https://doi.org/10.2760/222318

Royo-Bordonada, M.Á., Fernández-Escobar, C., Gil-Bellosta, C.J. & Ordaz E. (2022). "Effect of excise tax on sugar-sweetened beverages in Catalonia, Spain, three and a half years after its introduction". *International Journal of Behavioral Nutrition and Physical Activity*, 19, 24. https://doi.org/10.1186/s12966-022-01262-8

Säll, S. & Gren, I-M. (2015). "Effects of an environmental tax on meat and dairy consumption in Sweden". *Food Policy*, 55, 41-53. https://doi.org/10.1016/j.foodpol.2015.05.008

Sassi, F. (2023). *A new economic model for better health*. Retrieved from: Agencia Española de Seguridad Alimentaria y Nutrición - Ministerio de Consumo. https://www.aesan.gob.es/AECOSAN/docs/documentos/noticias/2023/D._Franco_Sassi.pdf

Scholle, L. (2022). "Mehrwertsteuer für Lebensmittel auf null senken". *Wirtschaftsdienst*, 102(6), 492-494. https://doi.org/10.1007/s10273-022-3221-5

Simon, D.R. (2013). *Meatonomics: "How the rigged economics of meat and dairy make you consume too much and how to eat better, live longer, and spend smarter"*. San Francisco: Conari Press.

Springmann, M., Clark, M., Mason-D'Croz, D., Wiebe, K., Bodirsky, B.L., Lassaletta, L., de Vries, W., Vermeulen, S.J., Herrero, M., Carlson, K.M., Jonell, M., Troell, M., DeClerck, F., Gordon, L.J., Zurayk, R., Scarborough, P., Rayner, M., Loken, B., Fanzo, J., Godfray, H.C.J., Tilman, D., Rockström, J. & Willett, W. (2018). "Options for keeping the food system within environmental limits". *Nature*, 562, 519-525. https://doi.org/10.1038/s41586-018-0594-0

Thow, A.M., Downs, S. & Jan, S. (2014). "A systematic review of the effectiveness of food taxes and subsidies to improve diets: Understanding the recent evidence". *Nutrition Reviews*, 72(9), 551-565. https://doi.org/10.1111/nure.12123

Tiffin, R. & Arnoult, M. (2011). "The public health impacts of a fat tax". *European Journal of Clinical Nutrition*, 65, 427-433. https://doi.org/10.1038/ejcn.2010.281

Tilman, D. & Clark, M. (2014). "Global diets link environmental sustainability and human health". *Nature*, 515, 518-522. https://doi.org/10.1038/nature13959

Tukker, A., Bausch-Goldbohm, S., Verheijden, M., De Koning, A., Kleijn, R., Wolf, O. & Pérez-Domínguez, I. (2009). *Environmental impacts of diet changes in the EU*. Luxembourg: Office for Official Publications of the European Communities. https://doi.org/10.2791/88996

Wang, L., Zheng, Y., Buck, S., Dong, D. & Kaiser, H.M. (2021). "Grocery food taxes and U.S. County obesity and diabetes rates". *Health Economics Review*, 11, 5. https://doi.org/10.1186/s13561-021-00306-2

Weintraub, A. (2018). "*Should we tax junk food to curb obesity?"*. Retrieved from: Forbes. https://www.forbes.com/sites/arleneweintraub/2018/01/10/should-we-tax-junk-foods-to-curb-obesity/

Willet, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T., Tilman, D., DeClerck, F., Wood, A., Jonell, M., Clark, M., Gordon, L.J., Fanzo, J., Hawkes, C., Zurayk, R., Rivera, J.A., De Vries, W., Sibanda, L.M., Afshin, A., Chaudhary, A., Herrero, M., Agustina, R., Branca, F, Lartey, A., Fan, S., Crona, B., Fox, E., Bignet, V., Troell, M, Lindahl, T., Singh, S., Cornell, S.E., Reddy, K.S., Narain, S., Nishtar, S. & Murray, C.J.L. (2019). "Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems". *The Lancet*, 393(10170), 447-492. https://doi.org/10.1016/S0140-6736(18)31788-4

WHO. (2015). *Fiscal policies for diet and the prevention of noncommunicable diseases*. Retrieved from: World Health Organization. https://www.who.int/publications/i/item/9789241511247

Yusta-Boyo, M.J., Gutiérrez González, E., García-Solano, M., Rollán Gordo, A., Peña-Rey, I. & Rodríguez-Artalejo, F. (2023) "Reduction of sugar, salt and fat content in foods over the period 2016–2021 in Spain: the National Food Reformulation Plan". *European Journal of Clinical Nutrition*, 78, 149-154. https://doi.org/10.1038/s41430-023-01357-w