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The Effect of a Value-Added Tax Reform on Plant-Based Milk Alternatives

AN ANALYSIS OF THE EFFECTS ON CLIMATE, INDUSTRY AND TAX REVENUES

22.08.2023

Executive Summary

Consumption of cow's milk has declined over the past 25 years, while plant-based milk alternatives (PBMA) have become increasingly popular. Despite many calls from politicians and society to reduce the value-added tax (VAT) on PBMA in Germany, the effects of such a reform have not been sufficiently quantified so far. The aim of this study is to quantify the effect of reducing the VAT on PBMA from 19 percent to 7 percent on consumption, and subsequently on tax revenues and climate policy indicators such as greenhouse gas (GHG) emissions, water and land use, and to contrast the costs of the reform with its benefits.

An economic tax model is used to measure shifts in milk consumption induced by the price reduction as well as by the socially observed trend. The indicators are calculated for two scenarios: In addition to the tax scenario in which the reform is implemented, the effects are also calculated for a business-as-usual (BAU) scenario without tax changes. The comparison of the two scenarios provides the impact of the tax reform.

The result of the calculations shows that a VAT reform on PBMA would lead to a decrease in tax revenues, but also to a reduction in future climate impact costs. The loss of tax revenues would amount to approximately € 40.0 million in one year. At the same time, future costs of climate change would decrease by € 62.4 million. These costs arise from the damage caused by CO_2 emissions, such as extreme weather conditions. Therefore, the reform makes sense from an economic point of view. Water and land use would also be significantly reduced, by 72 billion l and 1.1 billion m^2, respectively.

1 Introduction

As the production of cow's milk and plant-based milk alternatives differs in terms of both resource use and CO_2 emissions, there is a debate about the taxation of the two products

In recent years, a growing number of people have replaced cow's milk in their diets with alternative products made from oats, soy, or other plants. This phenomenon can be attributed to several factors. Firstly, the societal perception of cow's milk is changing, as the narrative about its health benefits is increasingly being questioned. Secondly, growing environmental awareness among the population is leading consumers to prefer these plant-based milk alternatives (PBMA) due to their lower impact on climate and the environment.[1] For instance, the production of one liter of cow's milk results in emissions of approximately 3.2 kg of CO_2 equivalents ($kgCO_2e$), which is about four times higher than the emissions from an equivalent amount of PBMA.[2]

The main driver of climate change is greenhouse gas (GHG) emissions.[3] The consequences of climate change in Germany include not only heat waves and droughts but also river floods and flash floods.[4] The flooding in the Ahr Valley and the Erft in July 2021 were the costliest extreme weather events in German history, with damages of € 40.5 billion.[5] The estimated costs of climate change until 2050 range from € 280 billion to € 900 billion, depending on how far climate change progresses.[6] In order to minimize both direct and indirect costs (such as political instability or health impairments), measures to reduce GHG emissions are necessary.

Against this backdrop, the German federal government has committed to reducing GHG emissions in the agricultural sector by 5.1 million tCO_2e, or around 8 percent, between 2021 and 2030.[7] The Federal Ministry of Food and Agriculture considers livestock farming as a key lever to do so.[8] In parallel, the German Federal Environment Agency (Umweltbundesamt, UBA) has presented a proposal to reform the value-added tax (VAT) to encourage the consumption of food that is less harmful to health and the climate. As part of this proposal, a reduction of the VAT rate on PBMA from the current 19 percent to 7 percent is suggested, so that PBMA would be taxed in the same way as milk from animal origin.[9] In a second step, the UBA

[1] Umweltbundsamt (2020) Umweltbewusstsein in Deutschland
[2] Poore & Nemecek (2018) Values for PBMA are based on calculations using the current consumption mix from Smart Protein Project (2021), which combines the dairy alternatives rice, coconut, soy, almond, oat, and "other" (macadamia, millet, hemp, lupin, spelt, cashew, and others)
[3] IPCC (2014)
[4] Bundesministerium für Wirtschaft und Klimaschutz (2023)
[5] The German government (2023) published an article on climate-related costs (as mentioned above) and cites the flood in the Ahr Valley as an example.
[6] Bundesministerium für Wirtschaft und Klimaschutz (2023)
[7] Umweltbundesamt (2022a) The emissions equaled 61.1m. tCO_2e in 2020. The Climate Protection Act by the Government commits to 56m. tCO_2e in 2030.
[8] BMEL (2021)
[9] Umweltbundesamt (2022b)

proposed to increse the VAT on animal-based products from 7 percent to 19 percent after a certain period of time.

The aim of this study is to empirically evaluate the proposed reduction of the VAT on plant-based milk alternatives

The economic impact of the proposed reform have not yet been adequately quantified. This study therefore examines the impact of a reform of the VAT on PBMA on the consumption of milk and its alternatives, and consequently on the sector's carbon footprint and tax revenues. As a first step, the study applies price elasticities to estimate how a reduction in the VAT would affect consumption behavior. The analysis then calculates the expected effects of the change in consumption on tax revenues, GHG emissions, land use and water use. For comparison, a business-as-usual (BAU) scenario is calculated, which forecasts market development without the tax reform based on current market trends observed in recent years. Ultimately, this comparison shows the potential impact of a VAT reform.

In what follows, insights about the market will be provided, focusing on the changing consumption of dairy products and their plant-based substitutes in recent years (Chapter 2). Secondly, the model and the two scenarios are described in more detail (Chapter 3). Chapter 4 provides an overview of the results and relates them to the climate policy indicators mentioned above (CO_2 emissions, and land and water use). Finally, Chapter 5 places these results in the current overall economic and political context and provides an outlook.

2 Market development

Consumption of cow's milk has declined over the past 25 years, while plant-based milk alternatives have become increasingly popular in recent years

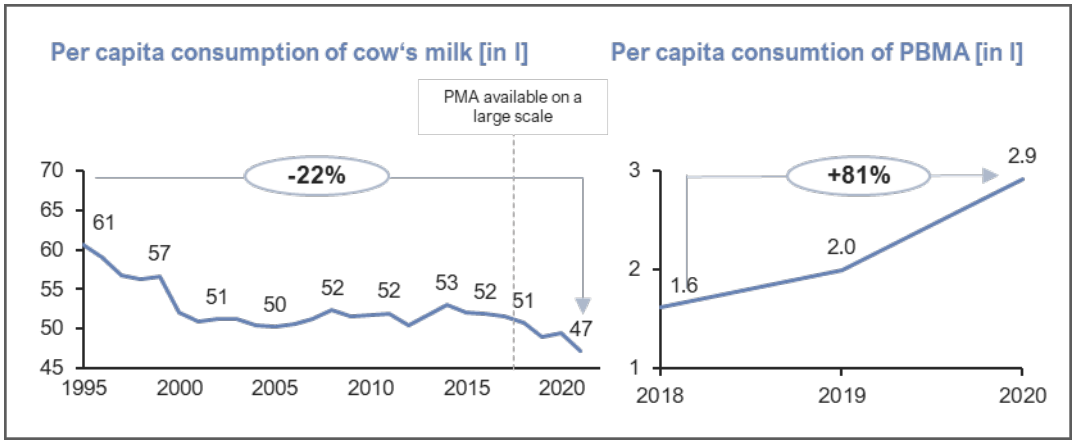
Looking at the consumption of both cow's milk and PBMA, it is noteworthy that cow's milk still accounts for the majority of milk consumption. At around 49.4 l per person, consumption in 2020 is about 17 times higher than that of PBMA at 2.9 l.[10]

Nevertheless, per capita consumption has fallen by more than 22 percent over the past 26 years (see Figure 1).[11] This decline occurred mainly between 1995 and 2005, and since around 2015, with the latter date roughly coinciding with the widespread market entry of PBMA. Since then, consumption of the two products has moved in opposite directions: while per capita consumption of cow's milk has declined, consumption of plant-based milk

[10] BLE (2022)
[11] BMEL (2023)

alternatives has increased from 1.6 l per person to 2.9 l between 2018 and 2020.[12] During this period, data on PBMA consumption was collected for the first time.

Figure 1: Per capita consumption of cow's milk and plant-based milk alternatives



Source: IPE based on BMEL (2022) and Smart Protein Project (2021).

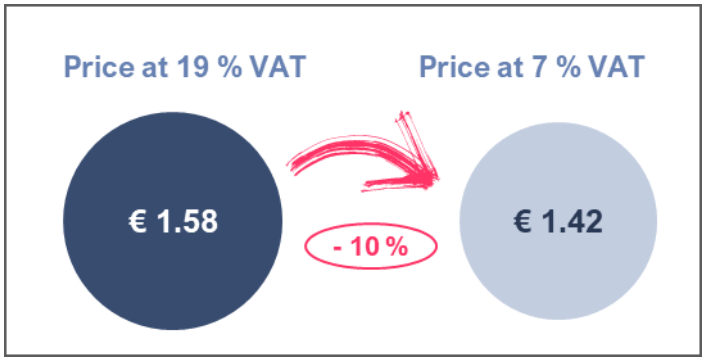
Several studies have already examined the reasons for these trends. These studies have attributed the decline in milk consumption to several factors, including generational differences and a wider range of available beverage options.[13] For example, younger people are skipping the glass of milk with a meal. Additionally, research conducted by the University of New South Wales found that factors such as lactose intolerance, health considerations, and ethical concerns related to environmental and animal welfare are also driving changes in consumption patterns.[14]

At presence, PBMA is more expensive than cow's milk – this price difference would be reduced by adjusting the VAT

With an average price of € 1.58 per pack in 2020, PBMA was almost twice as expensive as cow's milk, which had an average cost of approximately € 0.84 per pack.[15,16] In addition to subsidies for cow's milk, the difference is also due to differences in taxation, which are usually passed on to consumers through price adjustments. In Germany, cow's milk is currently categorized as a basic foodstuff, along with products such as fruits, vegetables, meat, and fish, and as such, is subject to a reduced VAT rate of 7 percent. Plant-based alternatives are taxed at the standard rate of 19 percent, as they are not classified as staple foods. Considering only the effect of a VAT reduction to 7 percent, the average price of PBMA would be reduced by around € 0.16, which would correspond to a 10 percent decrease (see Figure 2).

[12] Smart Protein Project (2021)
[13] Stewart, Dong, & Carlson (2013)
[14] Knight (2022)
[15] Values for PBMA are based on calculations using the current consumption mix by Smart Protein (2021)
[16] Landesanstalt für Landwirtschaft, Ernährung und Ländlichen Raum (2022)

Figure 2: Effect of a VAT reduction from 19 percent to 7 percent on the price of PBMA



Source: IPE based on Smart Protein Project (2021).

3 Model description

The model calculates the impact of the price changes caused by the VAT reform on the quantity of consumption and various climate policy indicators

To examine the effects of the VAT reform, a microeconomic model[17] is used that calculates changes in consumer behavior as a result of price adjustments. As 2020 is the last year with fully available data, 2020 is the benchmark year for the model and market volumes can be forecasted for 2021. The calculation is carried out in two steps: First, market volumes are calculated in a BAU scenario assuming no tax or price change. This model captures trends such as the steady decline in milk consumption described in Chapter 2 and the rise of PBMA through a switching behavior from cow's milk to PBMA. Population change is also included in the model. Subsequently, in a tax scenario, the effect of a tax and price reduction is calculated in addition to the developments depicted in the BAU scenario. Price elasticities are used to estimate the impact of price changes on market volumes. For this purpose, price elasticities from the Swedish market based on Huang (2022) are adapted to the German market. This study examines the income and price elasticity of animal-based dairy products and PMA in the Swedish market. A comparison of the results between the BAU scenario and the tax scenario then allows the effect of the tax reform to be quantified.

When calculating the effect of a tax and price change, it is assumed that a tax reduction leads to a price reduction of PBMA, i.e. that producers pass on the tax reduction in full to consumers. As a result of the price reduction, consumers of cow's milk replace part or all of their milk with PBMA. This change in consumption is represented by cross-price elasticities. The cross-price elasticity determined by Huang (2022) for the Swedish market has been adapted to the German market composition and is 0.33. This means that the demand for cow's milk decreases by 0.33 percent when the price of PBMA decreases by 1 percent. The

[17] The microeconomic model was developed by the IPE Institute for Policy Evaluation and has already been applied to various sectors and industries.

increase in PBMA consumption, on the other hand, results from the amount by which cow's is substituted by PBMA, calculated using the same cross-price elasticity. This takes into account that, in practice, only a switching behavior of consumers can be expected, but not a change in the total quantity consumed. This assumption is based on the low price elasticity of the milk market found in the literature.[18]

In addition to the price change, the model incorporates societal trend on the milk market and the population development

In addition to the effect of tax and price changes, the model includes other developments that describe market changes thar are independent of the price: First, the model accounts for the gradual decline of the milk market over time, which comprises animal and PBMA. The historical annual decline is -0.05 percent. This is due to various reasons such as differences between generations, for example, the decreasing trend of drinking a glass of milk with meals, as discussed in chapter 2.

Within this declining trend, there is also a shift from animal milk to PBMA, leading to growth in the PBMA market. This is independent of the price and is driven by factors such as increased climate awareness, as explained in Chapter 2. To capture this development, a forecast of PBMA market volume growth over the coming years is used, specifically at an annual rate of 7.5 percent.[19] It is assumed that the growth in the PBMA market will mainly come from the substitution of animal milk, resulting in a corresponding reduction in the market volume of animal milk.

Finally, the model considers the effect of the demographic change in Germany on the market volume for both animal-based milk and PBMA. For this purpose, the actual population development in Germany between 2020 and 2021 is used. [20]

Based on these new consumption volumes, the next step is to quantify the tax revenues and the environmental indicators, including CO_2 emissions, water use, and land use. This involves calculating these indicators in both the BAU and tax scenario and then comparing them. This approach allows to determine the impact of the VAT adjustment on these indicators.

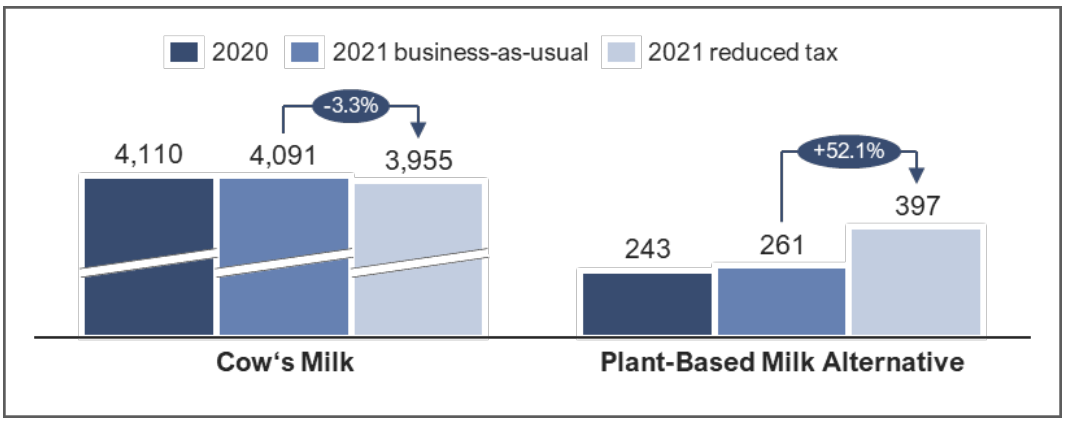
[18] Schröck (2010) – The paper finds a low own-price elasticity for conventional milk and organic milk. Since these two products were the only relevant dairy products on the market at the time the paper was written, it can be concluded that the dairy market is inelastic.
[19] Schreijen, S., Smit, Harry, & Hilgeman, M. (2021)
[20] Worldbank (2023)

4 Results

A tax reduction on PBMA from 19 percent to 7 percent would considerably reduce CO_2 emissions, land use and water use – but also tax revenues

The results of the model calculations indicate that in both the BAU and the tax scenario the sales volume of PBMA would increase in line with the current trend. At the same time, the consumption of cow's milk continues to decline in both scenarios. However, a reduction of the VAT on PBMA would lead to a significant decline in cow's milk consumption of about 4 percent (see Figure 3), while the decrease in the BAU scenario amounts to approximately 0.5 percent. Concurrently, the findings of this study indicate that the market volume of PBMA could increase to 397 million liters because of the VAT reform. This is an increase of more than 64 percent compared to 2020. In contrast to the BAU scenario, this would be an additional increase in sales volumes of around 136 million liters.

Figure 3: Actual sales volume of cow's milk and plant-based milk alternatives in 2020 and estimated sales volume in two scenarios in 2021 (in million liters)

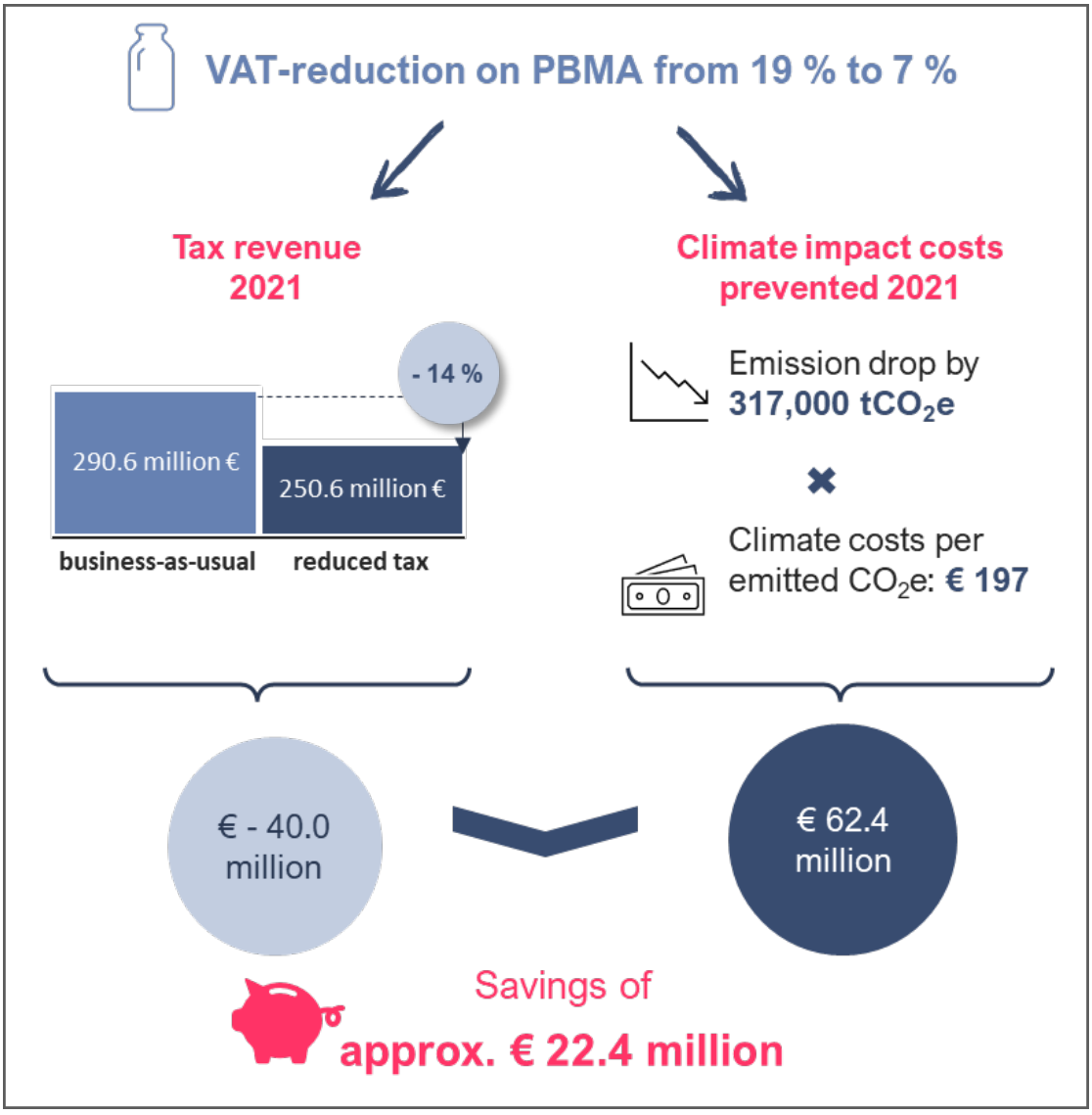


Source: IPE based on own Calculations.

Looking at the market development from the perspective of the resulting tax revenues, tax revenues would increase by around € 3.6 million in the BAU scenario compared to the previous year. This increase is due to the growing demand for PBMA, which has a higher tax rate and net price than animal milk, resulting in higher tax revenues. In comparison, a lower VAT rate in the tax scenario would lead to a decrease of € 36.4 million in tax revenues compared to the BAU scenario. This is mainly because the tax revenues of the PBMA which was already consumed without the tax reform are falling. They do so because PBMA is now taxed at 7 percent instead of 9 percent. Looking at this decline in relation to the overall federal budget, the short-term impact of the tax reform would be small. The decline would only

amount to about 0.008 percent of the federal budget in Germany in 2021. [21] The comparison of scenarios is illustrated in Figure 4, which compares the hypothetical decline in tax revenues with the costs saved in order to show the real short-term gain or loss of the tax adjustment.

Figure 4: Tax revenue loss vs. climate impact costs prevented



Source: IPE based on Umweltbundesamt (2022) and on Smart Protein Project (2021).

The tax reform of PBMA would reduce CO_2 emissions, land and water use

In the context of climate policy indicators, such as CO_2 emissions and resource use, the tax reform would also lead to a reduction compared to the BAU scenario. As a result of lower CO_2 emissions from the production of plant-based alternatives, the VAT adjustment would lead to a

[21] German Bundestag (2020) The 2021 federal budget amounts to € 498.62 billion.

reduction of approximately 317,000 tCO_2e or 2.8 percent reduction in CO_2 emissions compared to the BAU scenario. This is roughly equivalent to the total emissions of 29,000 average consumers in 2021, or 0.05 percent of Germany's total CO_2 emissions in 2021. Considering only agricultural emissions in Germany, the reduction is even 0.6 percent. A difference is also visible in terms of water and land use compared to the BAU scenario.[22] They are reduced by 3.1 percent and 3.5 percent, respectively, compared to their use in this sector in 2020, while the BAU scenario only indicates a decrease of 0.4 percent. Reducing water use by 72 billion liters is equivalent to the freshwater consumption of Germany for almost one week.[23] The reduction in land use by more than 1.1 billion m^2 is larger than the combined area of Hamburg and Bremen.[24]

The emissions saved as a result of a tax adjustment could lead to significant cost savings and thus offset the tax losses

The UBA estimates the costs caused by one tCO_2e in 2021 at € 197.[25] In contrast, the opportunity cost of lost tax revenue per avoided tCO_2e is € 126. From an economic perspective, such a reform would therefore be efficient, as the loss of tax revenues is lower than the benefit of avoided climate impact costs. The cost per tCO_2 saved is remarkably low compared to alternative government policies to reduce CO_2 emissions. For example, the cost of subsidizing electric vehicles is estimated to be between € 800 and € 1,200 per tCO_2e avoided.[26] Overall, avoiding CO_2 emissions would reduce future costs by € 62.4 million (see Figure 4).

5 Outlook

The proposed tax reform would reduce greenhouse gas emissions, land use and water use. It would also be economically beneficial, despite the loss of tax revenues, because of the avoided costs of climate change

Due to the societal trend towards PBMA and the potential cost savings of reducing CO_2 emissions, a reduction in VAT on these products has been discussed for some time. However, there is a lack of scientific analysis of the effects of such a VAT reform. This study examines the potential impact of a VAT reduction for PBMA to 7 percent on tax revenues and environmental indicators, providing important information for policy makers.

[22] The reduction would arise at the place of production and not necessarily in Germany.
[23] Calculations based on data from Umweltbundesamt (2022c) and population data from the World Bank (2023).
[24] Statistikamt Nord (2023); Landesportal Bremen (2023)
[25] Umweltbundesamt (2022c)
[26] Heymann (2021); Weimann (2020)

The VAT reduction would lead to a decrease in cow's milk consumption and an increase in PBMA consumption, resulting in lower GHG emissions and lower land and water use. Although the VAT reform would reduce tax revenues by around € 40 million, the lower GHG emissions would also lead to a reduction in the costs of climate change of approximately € 62.4 million.[27] This implies that the costs of the reform in terms of lost tax revenues would be lower than the costs of dealing with the climate-related damages that would occur without the tax reform. From an economic perspective, the VAT reform would be beneficial.

Further research on the economic consequences of taxing consumer goods is needed to improve the data on plant-based alternatives. Among other factors, the results depend largely on the elasticity used. As research on price elasticities for PBMA is still incomplete, a careful estimation of price elasticities for the German market could substantiate the results. Furthermore, the UBA proposal applies not only to PBMA but also to plant-based alternatives for cheese, sausages, and meat. An assessment of the effects of the VAT reform on these consumer goods would therefore provide an important basis for further discussions. Immediate action is essential to combat climate change. It is increasingly important to assess reform proposals quickly and to provide a scientific basis for policy decisions to tackle the climate crisis.

[27] Capacities that would become available through a tax reform and the associated reduction in cow's milk consumption, such as cultivation areas, are not included in the calculation.

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IPE Institut für Politikevaluation GmbH
Walther-von-Cronberg-Platz 6
660594 Frankfurt am Main

+49 69 67808053
info@ipe-evaluation.de
www.ipe-evaluation.de

Authors

Sandra Möglich
Susanne Wellmann
Nina König
Janis Beginen

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