UNIVERSITY OF LJUBLJANA
SCHOOL OF ECONOMICS AND BUSINESS

UNDERGRADUATE THESIS

THE IMPACT OF STAPLE FOOD PRICE CONTROL MEASURES ON INFLATION IN POST-PANDEMIC HUNGARY

Ljubljana, July 2023 MARCELL MÉRI

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LIST OF ABBREVIATIONS

sl. – Slovene

AFPM – (sl. Ameriški proizvajalci goriv in petrokemičnih izdelkov); American Fuel & Petrochemical Manufacturers

COICOP – (sl. klasifikacijai individualne potrošnje po namenu); Classification of Individual Consumption According to Purpose

COVID-19 – (sl. koronavirusna bolezen 2019); Coronavirus disease 2019

CPI – (sl. indeks cen življenjskih potrebščin); Consumer Price Index

EIB – (sl. Evropska investicijska banka); European Investment Bank

EU – (sl. Evropska unija); European Union

GDP – (sl. bruto domači proizvod); Gross Domestic Product

HDI – (sl. indeks človekovega razvoja); Human Development Index

HICP – (sl. harmonizirani indeks cen življenjskih potrebščin); Harmonised Index of Consumer Prices

IMF – (sl. Mednarodni denarni sklad); International Monetary Fund

KSH – (sl. Statistični urad Madžarske); Hungarian Central Statistical Office

LNV – (sl. Ministrstvo za kmetijstvo, naravo in kakovost hrane); Ministry of Agriculture, Nature and Food Quality

MNB – (sl. Madžarska narodna banka); Hungarian National Bank

MNKSZ – (sl. Madžarsko nacionalno trgovinsko združenje); Hungarian National Trade Association

MSPE – (sl. srednja kvadratna napaka napovedi); Mean Squared Prediction Error

OEC – (sl. Observatorij gospodarske kompleksnosti); Observatory of Economic Complexity

OECD – (sl. Organizacija za gospodarsko sodelovanje in razvoj); Organisation for Economic Co-operation and Development

OKSZ – (sl. Madžarsko trgovinsko združenje); Hungarian Trade Association

PM – (sl. predsednik vlade); Prime Minister

PPS – (sl. standard kupne moči); Purchasing Power Standard

RMSE – (sl. korenska srednja kvadratna napaka); Root Mean Square Error

SCM – (sl. metoda sintetične kontrole); Synthetic Control Method

VAT – (sl. davek na dodano vrednost); Value-Added Tax

WHO – (sl. Svetovna zdravstvena organizacija); World Health Organization

INTRODUCTION

In recent times, the world has become tremendously turbulent due to a series of disrupting global events happening in quick succession. One such event, which could be considered as a turning point, was the global COVID-19 pandemic, which has upturned many previously held paradigms and it has disrupted supply chains globally. The world has hardly started to recover from the pandemic, a similarly distressing and impactful event followed in the form of the tragic Russo-Ukrainian war which broke out in February 2022. These events have uprooted the geopolitical status quo and also disrupted long-standing economic trends, including the seemingly ubiquitous move towards globalization, perpetual economic growth, and low and stable inflation rates. In one way or another, they have not only influenced global developments but virtually every aspect of our daily life.

Although the economic impacts of our turbulent and rapidly changing world are manifested in different ways and to varying degrees across regions, they affect practically every nation. Due to the proximity of the conflict in Ukraine, the European Union (EU), and perhaps even more so, Hungary is relatively more vulnerable to the economic and other repercussions of this seemingly regional, but in fact global conflict. Both warring nations have crucial roles in global trade, Russia being one of the greatest exporters of energy in the form of petroleum, natural gas, and coal, while Ukraine as a significant agricultural producer and exporter of corn, wheat, rapeseed, and other seed oils (see Appendix 2). As the conflict and the sanctions against Russia have significantly impacted global trade, it is unsurprising that the EU and Hungary view the rise in energy and agricultural commodity prices as one of the most pressing economic issues, which have a deeply penetrating inflationary effect in practically all economic areas, ultimately threatening economic growth and prosperity. History has demonstrated time after time that high inflation increases the risk of social and political crises by destabilizing an economy (Cohen & Linton, 2010). This can also cause regional geopolitical instability, especially in emerging markets or developing nations, which are economically weaker and thus more vulnerable. Importantly, inflation not only affects countries differently but also the various strata of society. Poorer and less economically stable societal groups are disproportionately impacted by rising prices, for this reason inflation has rightly been dubbed the "cruellest tax of all" (Easterly & Fischer, 2001, p. 160).

In hindsight, it is clear that one of the hardest hit areas besides the energy sector was agriculture. It was hindered not only by the energy price shock but also by the skyrocketing price of other inputs, such as fertilizers. These two areas are intertwined, largely because natural gas is one of the main ingredients of nitrogen-based fertilizers (Wanat & Fota, 2022). Additionally, the EU has experienced one of the worst summer droughts in decades, which hit Hungarian agriculture especially hard, resulting in an almost 40 percent decline in agricultural production (IMF, 2023; Mandiner, 2023). The rising production costs, combined with crop failures due to the drought and other extreme weather events have led to an increase in the prices of even the most fundamental food commodities. This, again, puts the

most vulnerable segments of society in a disproportionately challenging position. To put it into perspective, high inflation has a bigger impact in the Central and Eastern European region, because people spend a greater proportion of their income on food and have a smaller per capita income than in Western European countries (see Appendix 3). To counteract the price shock in the food segment the Hungarian government has introduced price caps in grocery stores—a rarely used policy in EU countries—on 6 staple food products in February 2022, and later expanded the measures to include 2 additional products in November 2022.

The thesis adopts a multifaceted approach to analyse and understand the impact of these price control measures in Hungary. Thus, the thesis not only sets out to elucidate the impact of these price control measures on the inflation rate in the food segment, but also to explore their effectiveness from various socio-economic and political perspectives. The primary quantitative analytical model used in the thesis is the Synthetic Control Method (SCM) popularized by Abadie, Diamond, and Hainmueller (2007; 2015). The SCM will be utilized to create a comparison unit, a "synthetic-Hungary," where hypothetically the price measures did not take place. This advanced method of comparative research gives depth to the analysis which would not be possible with simpler country-to-country comparisons or regression analysis. Other analytical approaches include the assessment of the upward price effect on the substitute goods of the price capped products and the effectiveness of the price control measures in terms of the choice or selection of the food items. The effects of the price regulations will be analysed from both the supply and demand side perspectives. Accordingly, the thesis purports the following two research hypotheses:

A. During the period between February and December 2022, the Synthetic Control Method fails to show a significant reduction in the inflation rate in the food segment.

B. Overall, the implemented price caps appear to be ineffective in easing the inflationary burden on low-income households, in part due to inadequate product and consumer group targeting. Additionally, the price caps lead to intermittent shortages and disproportionately hurt small and medium-sized businesses within the grocery retail sector by distorting the free market economy.

The structure of the thesis generally follows the order of the hypotheses presented above. Firstly, a brief historical context will be given for the implementation of the price control measures. This will be useful for spelling out the details of the regulations and placing them within the overall fiscal policy and economic ideology of the ruling right-wing government in Hungary headed by Fidesz. Secondly, this will be followed by the theoretical overview of the SCM methodology and its implementation to answer the first research hypothesis. This chapter will provide a more analytical approach for the undergraduate thesis, heavily relying on statistical techniques and concepts. In the last chapter, other perspectives will be considered for the analysis, including socio-cultural and political evaluations, relevant to answer the second research hypothesis. More specifically, the effectiveness of the measures

in terms of the choice or selection of staple food items will be questioned, and the manifestations of the measures' impact on suppliers and consumers will be scrutinised in more detail. Furthermore, this chapter includes the assessment of the inflation rate on the prices of substitute goods, in order to make assumptions on how the structure of inflation within the food segment was altered. Lastly, a brief overview will be given on alternative disinflationary policy measures. As opposed to the second chapter, the third chapter will present a more subjective appraisal of the measures. The last chapter of the thesis provides a summary of the key findings. Moreover, the key limitations of the analysis will be illuminated with some additional suggestions for further research into the topic. This chapter is followed by the bibliography and the appendices with calculations, data and other figures which did not make it into the main body of the thesis.

1 HISTORICAL AND POLITICAL CONTEXT OF PRICE CONTROL MEASURES IN HUNGARY

In order to understand the historical and political context of the price regulations in Hungary, the relevant external and internal factors that led to the rampant inflation rate in the food segment have to be understood. There is a myriad of interconnected external factors that drive inflation globally, many of which were already mentioned in the introduction. These will not be described in greater detail now, as their complexity would necessitate an analysis of their own. Instead, this chapter provides a short overview of these factors and the political motivation underpinning the price regulations.

When it comes to external factors, the COVID-19 pandemic and Russia's invasion of Ukraine are the two globally disruptive events that need to be considered. Both events broke the long-standing global deflationary trend and had similar economic repercussions. They significantly impeded global trade, disrupted supply chains, increased market uncertainty and shipping costs, and caused various economic unbalances worldwide. This led to shortages, a situation where many consumer goods were not available in the required quantity, which consequently drove prices up. Additionally, after the war broke out, many consumers started to stockpile and hoard several basic consumer items again just like at the start of the COVID-19 pandemic, which worsened the supply-demand disequilibrium (Southey, 2022). However, the prices of consumer goods not only rose significantly because of these circumstances, but also due to the fact that many commodities and raw materials used as important inputs in the production of these final goods have seen remarkable price increases in their own right. Some of the most important of these include energy sources like natural gas, crude oil, and petroleum, all of which represent virtually "ubiquitous input cost in most supply chains" (AFPM, 2022). For example, natural gas besides being widely used for heating and generating electricity, is also an important input of ammonia production, which in turn is necessary for fertilizer production (AFPM, 2022). This, combined with the loss of fertilizer production and decreased exports of soil nutrients from Ukraine and Russia, led to record high fertilizer prices, which is one of the most significant input costs for

agriculture (AFPM, 2022; Reuters, 2022). Due to the closeness of the conflict and the country's reliance on Russian energy exports, including about 95% of its gas and 45% of its oil and petroleum, Hungary is especially exposed to these external factors (Gerlaki & Bókay, 2022; OECD, 2022).

The agricultural sector was directly impacted by the Russo-Ukrainian war in other ways too, as the repercussions of the war limited Ukraine's agricultural production and hampered trade in the Black Sea region, while Western countries, banks, and traders avoided buying from the aggressor, Russia, and its ally, Belarus (Reuters, 2022). Russia and Ukraine together accounted for "nearly a third of global wheat and barley, and two-thirds of the world's export of sunflower oil used for cooking," while Ukraine was considered the "breadbasket" of Europe with more than 70 percent of its land dedicated to agriculture (Reuters, 2022; Southey, 2022). Other external shocks that drove food prices up include extreme weather events, such as the historic draught in Europe, and large-scale infectious diseases among livestock populations, like swine fever or avian influenza which drove up egg and poultry prices (Polansek & Hamaide, 2022). The emerging picture shows a "perfect storm" situation in an interconnected global market, whereby a number of closely connected events and crises brought on a cascading inflationary effect throughout the economy, with the food segment being one of the most severely affected areas.

Moving on to the internal factors, one of the first observations that must be made is that the unbalances and structural weaknesses in the Hungarian economy that generate inflationary pressures—not only in the food segment, but in the whole economy—predated both the war in Ukraine and the global pandemic. This is evident if we look at the core inflation—the measure of inflation that excludes volatile components from the basket of goods and services used to calculate inflation—which shows that it has been above the EU average rate since 2010 (see Appendix 4). The Hungarian agriculture and food industry, the sector most relevant to the analysis, faces the challenge of not being self-sufficient as a result of the disparity between domestic production and demand (Gerlaki & Bókay, 2022). Furthermore, it operates with significantly lower efficiency compared to other EU countries (see Appendix 5). A direct consequence of this is that the country has to rely on imports to meet its demand, especially for processed food, and import costs have dramatically increased due to the depreciation of the Forint, which contributed significantly to the food inflation rate (Gerlaki & Bókay, 2022). At this juncture, it is important to discuss the impact of Forint's depreciation against other currencies, as this is still one of the major factors that contributed to the high inflation rate. The exchange rate of the Forint against the Euro decreased by 8.99 percent in 2022 alone, but the currency has been on a downward trend since 2010 when the ruling Fidesz party headed by Viktor Orbán came to power (see Appendix 6). This significantly increased the costs of imported goods, hurting many domestic economic actors and leading to so-called "imported inflation" while putting exporters into a relatively better position. The recent volatility in the exchange rate of the Forint can be largely explained by the economic uncertainty caused by the war, which puts Hungary, a country that is "highly

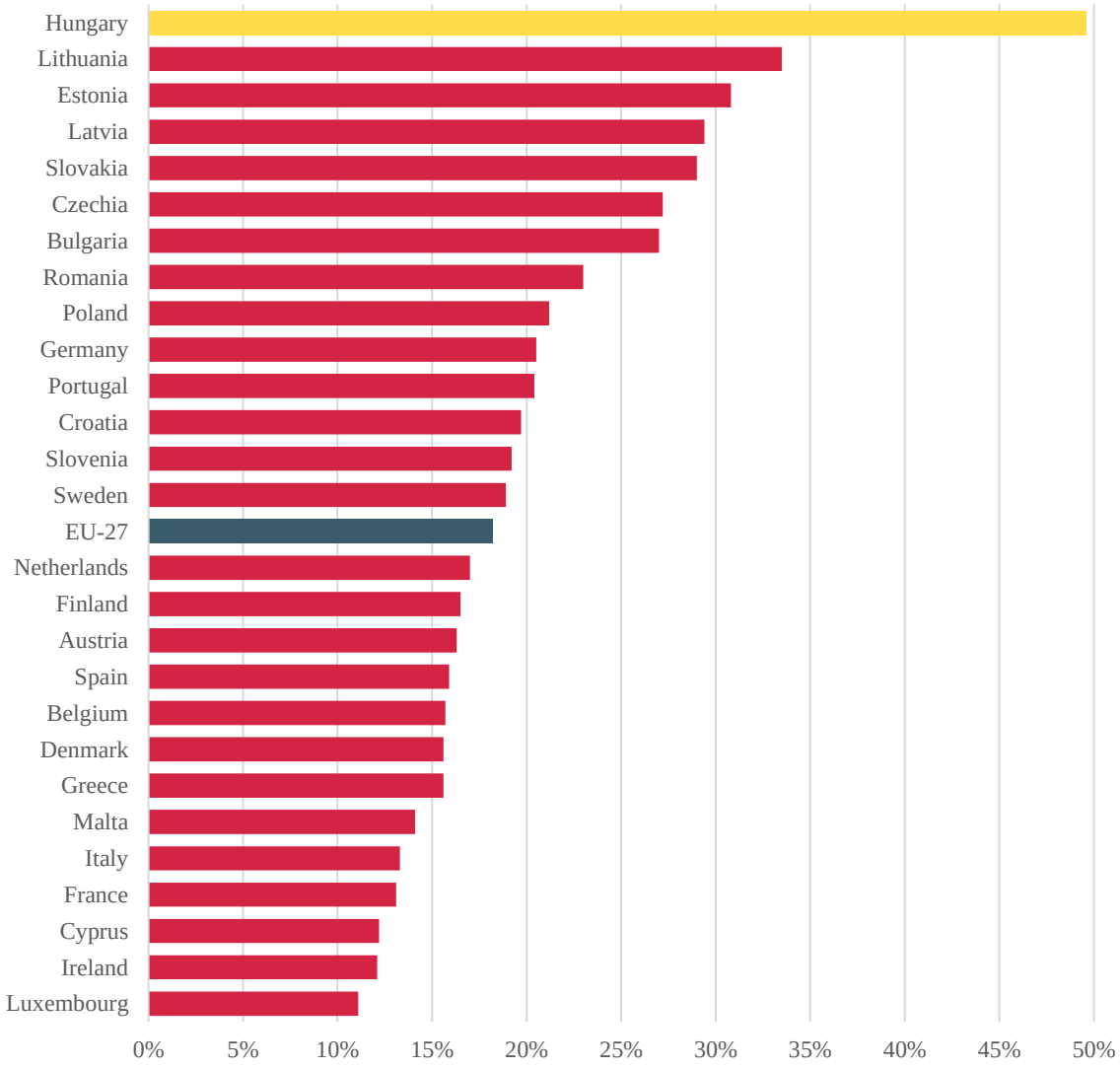
dependent on oil and gas imports from Russia," into an especially vulnerable position, and by the markets' reactions to the often questionable political, fiscal, and monetary decisions of the Hungarian government and central bank which led to pronounced fiscal and current account deficits (Kalasopatan, 2022). For example, the government has implemented several subsidized loan programmes for businesses (Széchenyi Plan) and households, like the so-called CSOK (Housing Subsidy for Families) scheme and the subsidized "baby loans" for young married couples, which flooded the financial market with cheap mortgage loans. The loose monetary policy of the Hungarian Central Bank (MNB) aggravated this situation by keeping interest rates near 1 percent. The long-standing inflationary effect of this fiscal and monetary policy is evident if we look at the core inflation rate (see Appendix 4). When it comes to fiscal policy, it is clear that the ruling government is heavily motivated by political considerations, favoring populist measures such as personal income tax refunds for parents, additional month of pension benefits for the elderly ("13th month pension"), interest rate freeze for household and student loans and also for small and medium-sized enterprises (Brückner, 2023). Also, it was estimated that Fidesz spent nearly 1 trillion Forints (over €2.6 billion) on the pre-election stimulus package leading up to the general election in April 2022, when the inflation rate was already very high (Tóth, 2023). It is no coincidence either that the price caps on the initial 6 products were introduced in February, only 2 months before the elections. It is also important to highlight that the government did not face any budgetary implications as a result of the price caps, yet these measures continue to serve as an effective communication tactic, portraying Fidesz as being aligned with the interests of the general public (Szalai & Németh, 2023). As the government needed additional sources of revenue to cover its over-expenditure, a series of taxation measures were implemented in 2022, targeting predominantly consumer expenditure and large multinational enterprises. For example, the Public Health Product Tax (NETA), the excise tax on alcoholic and tobacco products, and the retail surtax were all increased, and controversial "extra-profit" or windfall taxes were levied on various economic sectors, including the energy, telecommunications, and financial sectors (PwC, 2022). As per the observations made by Bertalan Tóth (2023) opposition politician, the "continuous increase in consumption taxes" is the primary cause of the brutal inflation rate in Hungary. Despite their name, the vast majority of the newly established taxes can be categorized as consumption taxes, since companies and retailers incorporate them into their pricing strategies to sustain their profit margins (Tóth, 2023).

An additional factor that has contributed to the unprecedented inflation rates in Hungary is the overhaul of the government's utility price reduction programme, which resulted in many businesses and consumers no longer paying the "protected" but the actual market-price for their utility bills. According to analysts, the abolishment of the price caps on fuels, which will be described in more detail later, has increased headline inflation—the overall rate of inflation in an economy that takes into account both essential and non-essential items—by around 3 percentage points, while the changes in the utility or overhead cost reduction programme led to a 2-3 percentage points increase (Pálos, 2022). Other geopolitical developments could be mentioned that led to uncertainty regarding the Hungarian economy,

such as the EU disputes over Hungary's rule of law, which provoked the suspension of EU Recovery funds to Hungary (Kalasopatan, 2022).

In the official communication of the government there is an attempt to put the majority of the blame for the high inflation figures on the Russo-Ukrainian war, and lately specifically on the EU sanctions against Russia (Szalai & Németh, 2023). However, Hungarian economists such as Viktor Zsiday, György Surányi or Péter Ákos Bod have repeatedly warned that this is not the case, as the internal factors listed above played a considerably part in Hungary's chart leading inflation figures, with some economists putting the equal weights on internal factors and external factors (Balatoni, 2022). As a summary, although it is undeniable that the inflationary pressures coming from external sources are in large part responsible for the current high inflation figures, the internal structural problems of the Hungarian economy considerably exacerbate the situation, ultimately leading to very high inflation figures, especially in the food segment (see Figure 1).

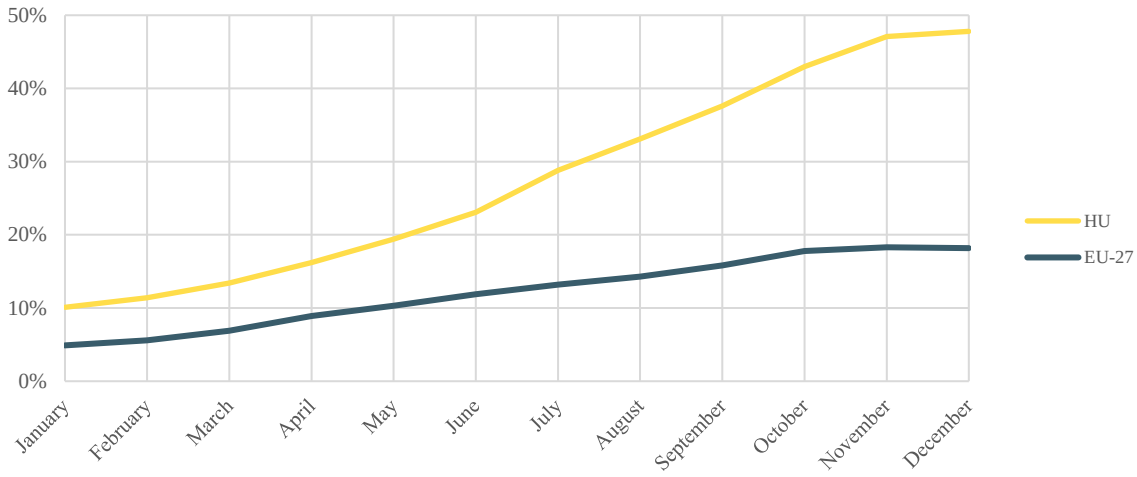
Figure 1: Year-on-year food inflation in the EU in December 2022



Source: Eurostat (2022).

In fact, the inflation rate in the food segment in Hungary is among the highest in the EU and it is paired with one of the worst levels of productivity in the food industry (see Appendix 5). The gap between the monthly food inflation rate in Hungary and in the EU has been steadily widening since January 2022 (see Figure 2), indicating a clear need for a policy solution to get the high levels of inflation under control.

Figure 2: Monthly rate of food inflation year-on-year in Hungary and the EU in 2022



Source: KSH (2023c); Eurostat (2022).

As a response to the high inflation rate the Hungarian government has implemented price caps on a wide range of foodstuffs in February 2022 in grocery stores and supermarkets. The 6/2022. (I. 14.) Government Decree stipulates that prices must be capped according to the gross price paid by the consumer in the respective shop, in other words, the prices are not set centrally but each retailer has to cap its prices according to its own digital price records. If the price records are missing or not available for the specified days, or if the capped goods were sold at a discounted price at that time, the price on the day before has to be used, otherwise the retail shop must refer to the price records kept by the Hungarian Central Statistical Office (KSH). The price control measures were initially supposed to remain in force until May 1, but the end date was later extended several times. The government also decided to expand the range of regulated products in November by including two additional items. In December the government announced that they wish to prolong the price caps again, until April 30, 2023 on the grounds that the prolonged war in Ukraine and the flawed sanctions regime of the EU exacerbate inflationary pressures (Dunai, 2023; Savage, 2022; Tamásné Szabó, 2023). Finally, the regulations ended on July 31, 2023 after another extension. The government's purported aim with these measures was to limit "the socio-economic scars" and support vulnerable households against the high energy and food prices whose consumption basket is made up of staple food items to a greater degree (IMF, 2023). Furthermore, in the government's view the price caps "have allowed more space for domestic actors to adjust to the new economic environment" (IMF, 2023, p. 3). As per the 6/2022. (I. 14.) Government Decree, the list of regulated products was the following.

Products whose gross retail prices are capped at October 15, 2021 rates since February 2022:

- granulated white sugar
- wheat flour (BL55)
- sunflower edible oil
- pork leg
- chicken breast, backs, and wing tips
- ultra-high temperature processed (UHT) cow's milk with 2.8% fat content

Products whose gross retail prices are capped at September 30, 2022 rates since November 2022:

- chicken egg (*Gallus domesticus* species)
- table potato (excluding early varieties)

At this point, it has to be noted that the government implemented other price caps as well, namely on fuel prices and residential mortgage rates. The full list of these price regulations with explanations is presented in Appendix 7. The fuel price caps have been introduced in November 2021, but were ended abruptly in December 2022 due to escalating supply constraints and logistical issues (Haász & Cseke, 2022). The freeze of mortgage rates started in January 2022 "to shield borrowers from rising loan repayments" and it is still ongoing, as they are set to end in June 2023 (Komuves & Than, 2022). By 2023, there is broad agreement amongst economists and relevant institutions on the need to phase out these regulatory measures, but the government is in favour of a more gradual approach (IMF, 2023).

2 EVAULATION OF PRICE CONTROL MEASURES USING THE SYNTHETIC CONTROL METHOD

2.1 Description of the Synthetic Control Method (SCM)

The SCM is an increasingly popular statistical technique that is used to estimate the effects of events or policy interventions that take place on an aggregate level, for instance at city, regional, or country level. The SCM was first proposed by Abadie, Diamond, and Hainmueller (2007, 2015) and Abadie and Gardeazabal (2003), and it builds on the so-called difference-in-differences statistical approach and other statistical matching techniques commonly used in economic and social science research. It is especially useful when no "single untreated unit provides a good comparison for the unit affected by the treatment or event of interest" which is often the case when the treatment in question affects large aggregates (Abadie, Diamond, & Hainmueller, 2015, p. 500). In general, the selection of a suitable control group that is not arbitrary and similar to the treated unit is one of the most challenging aspects of comparative studies (Mills, van de Bunt, & de Bruijn, 2006).

Therefore, one of the major strengths of the SCM is that it provides an advanced data-driven algorithm to construct a synthetic control group based on a precisely weighted combination of comparison units that closely resembles the characteristics of the treated unit before the intervention took place. This way the method also allows for a more robust analysis of the impact of policy interventions compared to a simple before-and-after analysis or comparing to a single comparison unit. To that end, Athey and Imbens (2017, p. 9) even claim that the SCM "is arguably the most important innovation in the policy evaluation literature in the last 15 years".

For using the SCM, firstly we need to define the outcome variable of interest as Y_{it} for unit $i \in \{1, 2, \dots, J+1\}$ at time $t \in \{1, 2, \dots, U\}$. In essence, we want to create an estimate of the unobserved counterfactual outcome ($\hat{Y}_{it}^{N}$) for the treated unit ($i = 1$) as a linear combination of the observed outcomes of the control units ($i = 2, 3, \dots, J+1$), also called the donor pool (Courthoud, 2022). If we denote the treatment period during which the intervention occurred by T, then we can denote the pre-treatment periods by $t = 1, 2, \dots, T$ and the post-treatment periods by $t = T+1, T+2, \dots, U$. We know that in the pre-treatment period the outcomes will yield the same values either in the absence (Y_{it}^{N}) or presence (Y_{it}^{T}) of the treatment as such:

$$Y_{it}^{T} = Y_{it}^{N} \text{ for } t \in \{1,2, \dots, T\} \text{ and } i \in \{1,2, \dots, J+1\},$$

And the same is true for the non-treated units in the post-treatment period:

$$Y_{it}^{T} = Y_{it}^{N} \text{ for } t \in \{T+1, T+2, \dots, U\} \text{ and } i \in \{2,3, \dots, J+1\}.$$

As we are interested in the treatment effect

$$\alpha_{it} = Y_{it}^{T} - Y_{it}^{N}$$

for the treated unit $i = 1$ in the post-treatment periods $t = T+1, T+2, \dots, U$, we can estimate it as the difference between the treated unit value and the estimated synthetic control value:

$$\hat{\alpha}_{it} = Y_{it}^{T} - \hat{Y}_{it}^{N}. \quad (1)$$

In order to create the synthetic control unit, we also need to define a weight vector w that will assign non-negative weights to each control unit in the donor pool ($w_j \geq 0$ for $j = 2,3, \dots, J+1$) so that their sum equals one ($\sum_{j=2}^{J+1} w_j = 1$). We need a vector X_1 containing the pre-treatment predictor variable for the treated unit and a matrix X_0 containing the pre-treatment predictor variables for the control units ($j = 2, 3, .., J+1$). The optimization algorithm will then attempt to find a weight vector that minimises the difference or more precisely the distance between the pre-treatment characteristics of the treated unit and the synthetic control, which is essentially a weighted average of the units in the donor pool:

$$\min \| X_1 - X_0 w \|^2$$

If a unit receives a weight that equals 0, this unit is not a good match according to the algorithm and therefore will not be considered for the analysis. The optimized weights are then used to construct the synthetic control unit in the end:

$$\hat{Y}_{1t}^N = \sum_{j=2}^{J+1} w_j Y_{jt} \text{ for } t = 1,2, \dots, U$$

Substituting this formula into equation (1) we can now calculate an estimate for the treatment effect as such:

$$\hat{\alpha}_{1t} = Y_{1t}^T - \sum_{j=2}^{J+1} w_j Y_{jt} \text{ for } t = T+1, T+2, \dots, U$$

As we have seen, the resulting synthetic control group is created using a weighted combination of similar countries to the treated state, whereby the SCM assigns weights to each country and to each predictor variable such that the synthetic control group in the end resembles the treated unit in terms of the outcome variable and other key economic, socio-political, and relevant factors. From this, it is also clear that a key idea of the method is that instead of relying on the cross-sectional variation of the data—as in traditional split testing or randomized experiments—it is based on the temporal variation, so the differences across time (Courthoud, 2022). All this makes the SCM a good quasi-experimental approach for the thesis. It allows the comparison of the impact of the price control measures on the food inflation rate in Hungary without having to find a similar control state for our counterfactual scenario—a practically unachievable endeavour—where the measures were not implemented. By comparing the actual inflation rate in Hungary with the estimated inflation rate in the synthetic control group, dubbed the "synthetic-Hungary," the study can assess the impact of the price control measures on the inflation of food products in a more robust way.

As with any statistical methodology, the SCM too holds certain key assumptions which are necessary for its correct application. One such assumption is that the treated and control units are similar. This can be ascertained by looking at relevant statistical data and doing background research on the units to be included in the donor pool. Another key assumption is that there are no spill-over effects of the intervention into any of the control units, and that a similar intervention does not take place in any of the donor pool units, which must be carefully assessed by the researcher. Lastly, external shocks must not be present in the control units of the donor pool, which again must be assessed by the researcher by reviewing prevailing trends in the outcome variable. However, an external shock that affects all units simultaneously (e.g. a global pandemic) does not violate the assumptions.

Although the SCM has a number of advantages, it also has some limitations that should be considered. One of the limitations of the technique is that it relies on the assumption of parallel trends, which assumes that the trend in the outcome variable, which in our case is the inflation rate of food items, would have been the same in the treatment group, Hungary, and in the synthetic control group in the absence of the treatment, in this case the price control measures. If this assumption is not met, the results of the SCM may be biased (Bouttell, Craig, Lewsey, Robinson, & Popham, 2018). Additionally, the SCM requires a large amount of data, both in terms of the number of time periods and the number of predictor variables used to construct the synthetic control group. If the data is not sufficient or of high quality, the results may be less reliable. Finally, the choice of the set of countries used to construct the synthetic control group can affect the final results of the SCM (Kuosmanen, Zhou, Eskelinen, & Malo, 2021). The researcher must first choose a set of countries that are similar to Hungary in terms of relevant economic and political factors, and if this choice is not done carefully, the results of the SCM may be biased. Overall, by understanding the strengths and weaknesses of the methodology, the application of the SCM in the case of the price control measures in Hungary enhances the robustness and validity of the findings and allows for a more comprehensive analysis of the impact of the measures.

2.2 Description of the *tidysynth* R package

The thesis utilizes the open-source R software environment. R is a very modular and extensible programming language, making it easy to download packages that expand its functionality. Accordingly, the SCM was applied via the publicly accessible *tidysynth* R package (Dunford, 2023). The *tidysynth* package was developed by Eric T. Dunford and Etienne Bacher and is built upon the *Synth* package created by Jens Hainmueller and Alexis Diamond. This package provides functions for the construction of a synthetic control unit based on optimization algorithms that identify a set of weights that are assigned to potential control units, and also for the summarization and illustration of the results. As its name suggests, the *tidysynth* package, offers a tidy implementation for the SCM so "that the entire preparation process for building the synthetic control can be accomplished in a single pipe", making the whole process more transparent (Dunford, 2023). Additionally, it offers several functions to visualize, inspect, and fine-tune the synthetic control more easily, making it a more user-friendly than the *Synth* package.

2.3 Application of the *tidysynth* package for the analysis

As described earlier, the *tidysynth* package has a pipe-able implementation, meaning that it uses a single pipeline of functions to generate the synthetic control. Essentially, the package is based around the functions described in Table 1. The code of the implementation of the *tidysynth* package is attached in Appendix 8.

The first step in the preparation process was the collection of the required data for the outcome and predictor variables. The chosen predictor variables must have some association with the outcome variable of food inflation rate or describe the economic conditions of the countries in the donor pool, without being too volatile or having too much noise. Based on the World Bank's guidance (2018), some of the most widely used measures of macroeconomic performance and stability were selected, including gross domestic product (GDP) per capita and growth rate, central government budget data (deficit, long-term interest rates), international trade, and indicators related to the money supply (central bank interest rates). Composite indices, such as the Gini index and the Human Development Index (HDI) were used as well, as they provide a comprehensive assessment of a country's level of economic inequality and overall societal development. Population density is another measure that condenses complex information into a single value. The measure of final consumption expenditure on food and non-alcoholic beverages was chosen as it not only signals economic well-being and poverty levels but also inflationary pressures and changes in food price levels. These predictors are used in the form of long-term averages or aggregate series as "synthetic controls were designed for settings with aggregate series" since "aggregation attenuates the magnitude of noise" in the model (Abadie & Vives-i-Bastida, 2022, p. 7). Lagged outcome variables were also used as predictors, specifically food inflation data from previous periods. The final list of predictor variables is presented in detail in Appendix 9.

Table 1: The four essential functions used in the tidysynth package's pipeline

Function	Description
synthetic_control()	Initializes the synth pipeline by specifying the panel series, outcome, and intervention period. This pipeline operates as a nested "tibble".
generate_predictor()	Creates one or more scalar variables summarizing predictor variables data across the specified time window. These predictor variables are used to fit the synthetic control.
generate_weights()	Fits the unit and predictor weights that are used to generate the synthetic control.
generate_control()	Generates the synthetic control using the optimized weights.

Adapted from Dunford (2023).

What followed is a lengthy process of experimentation with not only the selection of variables, but also with the inclusion of controls states in the donor pool and the selection of the timescale for the analysis. As suggested by Adhikari (2022, p. 56), we want to select potential donor units which are "similar to the treated unit" and limit the potential donor pool

to “the countries from the same geographic region, or same income group, or similar demographic”, and other factors depending on the research question. Accordingly, the initial donor pool consisted of all EU Member States, but the final composition of the pool had to meet several additional criteria. One, is that the control countries are not influenced by the price caps in Hungary to any degree but have similar trends considering the chosen variables. Another condition that had to be fulfilled, is that no regulation should exist there influencing food prices, like the price caps in Croatia or the reduced value-added tax (VAT) rate on food products in Poland, as this could pose as a potential confounding variable (Radosavljevic, 2022; Warsaw Economic Institute, 2022). In the end, the donor pool was constrained to the following 16 EU countries based on their geographic, demographic and economic similarities to Hungary: Bulgaria, Czechia, Germany, Estonia, Ireland, Greece, Spain, France, Italy, Latvia, Lithuania, Austria, Portugal, Romania, Slovenia, and Slovakia.

The time series data for these countries had to be collected for a longer period of time, going back to 2010, to test pre-intervention periods of various lengths. The 3 different pre-intervention periods tested for the model were 2010-22, 2016-22, and 2020-22. The results showed that choosing a longer pre-intervention period did not yield a better pre-intervention fit for the selected variables. This was due to the high volatility and variability of the variables over the long run, especially when it comes to the inflation rate on food and other economic indicators. The high seasonality of these indicators would not be a cause for concern itself, as this effect is cancelled out by averaging the variables. However, they also show high sensitivity to various economic and other world events in the past. Ultimately, the pre-intervention period was limited to January 2020 till January 2022, as this produced the most satisfactory matching of trendlines. The shortest pre-intervention period is still much longer than the post-intervention period, which started in March 2022 and ended in December 2022. This is important as the further away we go from the treatment date, the more likely it is that other shocks or policies are implemented, which can contaminate our treatment effect (Adhikari, 2022).

After this, the weights for the predictor variables and the countries in the donor pool were calculated using the built-in optimisation algorithms, which essentially try to minimise the error between our outcome variable in Hungary and the synthetic-Hungary in the pre-treatment periods. The *tidysynth* package by default uses the Nelder-Mead and the Broyden–Fletcher–Goldfarb–Shanno (BFGS) optimization algorithms and returns the result for the best performing method. The resulting non-negative weights for the predictor variables and control units are presented in Appendix 10 and 11 respectively. The countries Ireland, Estonia, Latvia, Austria, Italy, Bulgaria, Greece, Slovenia, France, Germany, and Portugal all received a weight under 1 percent, as they were deemed unsuitable matches for Hungary by the algorithm. Lithuania (71.71%), Czechia (11.96%), Romania (10.68%), and Slovakia (5.47%) received the majority of the weights, suggesting they were the best match for Hungary in terms of the predictor variables. This result is consistent with expectations, as these countries share numerous similar geographic and socio-economic characteristics with

Hungary. The predictor variables that received the highest weights include the general (CPI) inflation rate (50.50%), the GDP per capita (24.24%), the food harmonized price index HICP (11.52%), and the share of agriculture within the GDP (4.31%). Using the optimal weights we can construct our synthetic-Hungary, but the goodness of fit for the pre-treatment period has to be considered, and whether the behaviour of the synthetic control makes sense to intuition. This is why the donor pool's selection of countries, and the timescale was restricted in the final analysis. A balance table is presented for easy comparison in Table 2. While certain variables exhibit greater discrepancies—such as notably high interest rates due to their extreme nature in Hungary relative to the donor pool—the predictor variables that carry greater weight in the model align more closely with the actual values observed in Hungary.

Table 2: Balance table showing the average values of predictor variables across the treated and comparison units, and the donor pool

Variable name	Hungary	Synthetic-Hungary	Donor pool
Central_int_20_21	3.532	0.750	0.513
Food_expend_20_21	9.200	12.283	9.625
Food_HICP_1	97.877	97.745	98.171
GDP_agriculture_20_21	3.350	3.114	2.401
GDP_pc_avg_20_21	13.185	14.301	22.762
GDP_pc_rate_20_21	0.075	0.046	0.060
GDP_trade_20_21	159.582	141.099	116.619
Gini_index_18	29.600	33.838	32.163
Govt_deficit_20_21	-7.282	-4.868	-6.035
HDI_20_21	0.848	0.872	0.885
Inflation_CPI_20_21	0.028	0.029	0.042
Inflation_HICP_20_22	92.665	90.363	94.180
Long_term_int_20_21	2.643	0.717	0.488
Pop_density_19	107.100	63.605	101.050
Unemployment_20_21	2.700	4.763	4.766

Source: Own work.
Note: Variable names are explained in Appendix 9.

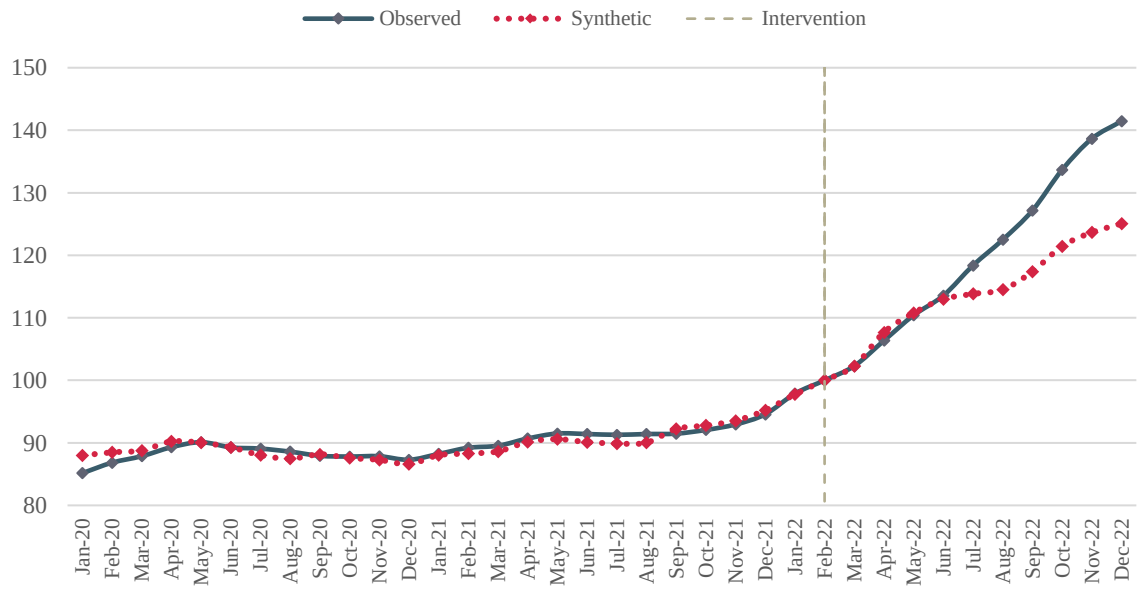
To test the robustness of the results a sensitivity analysis had to be conducted. Since the SCM uses a non-parametric approach, it is virtually unfeasible to calculate the standard

errors using traditional statistical methods. The fact that the technique relies on an optimized weighted combination of multiple control units further complicates the calculation of the standard errors. Hence, the second-best option available to evaluate the performance of the model is using placebo tests, commonly utilized in medical research. When conducting placebo tests for the SCM, the same model has to be applied iteratively for every unit in the donor pool as was for the treated unit, in other words "placebo synthetic controls" have to be generated (Dunford, 2023). Essentially, we want to observe whether the treatment effect disappears or not if we replace the data for Hungary with one of the control states in our donor pool and generate a synthetic control for that country. This process then can be repeated for all countries in the donor pool. The expected result is that the treatment effect of the price regulations is not present in any of these scenarios, meaning that there is a similar pattern for the generated synthetic control and the respective states, which proves there is no identifiable effect on the control from the treatment. The results of the placebo synthetic controls are presented in the next section along with the results of the model.

2.4 Results of the analysis

The outcome variable of food price index (COICOP 01.1) is presented in Figure 3 for both Hungary and the synthetic-Hungary. As seen in the figure, the generated synthetic-Hungary more or less matches the pre-treatment trend in Hungary but significantly diverges from it in the post-treatment period. This means that the model underestimates the inflation rate of food products based on pre-treatment values. This is expected, as official organisations, like the MNB, also underestimated this unexpectedly high inflation rate in their forecasts. Still, the focus is on the time periods that came right after the treatment period of February 2022,

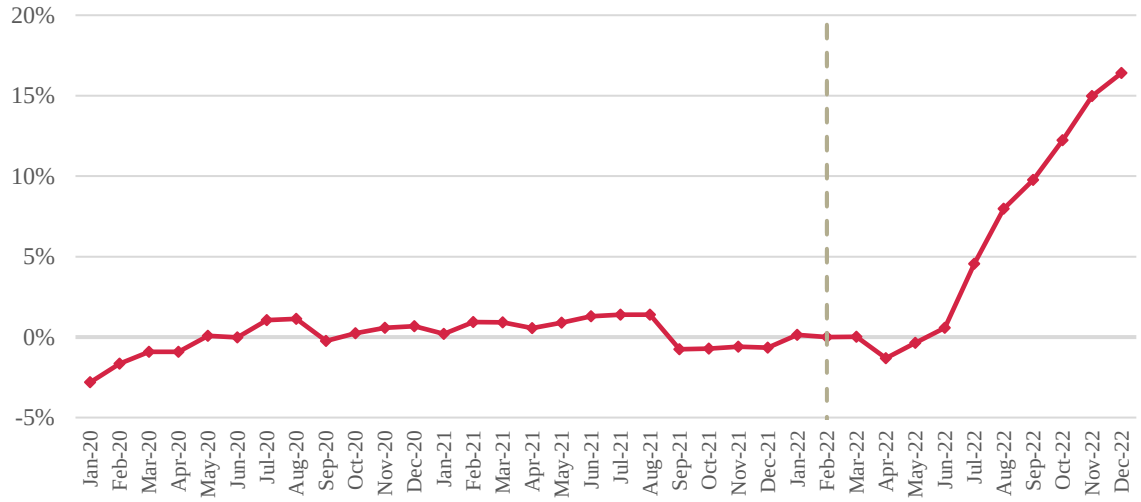
Figure 3: Synthetic and observed food price index (COICOP 01.1) in Hungary and synthetic-Hungary 2020-2022



Source: Own work.

which show an interesting result. The inflation rate of food products in the synthetic-Hungary at first is very close to the observed one in real-life Hungary, and even dips below it for April and May by 1.32 and 0.36 percentage points accordingly. This an economically significant finding as this suggests that the price caps indeed had a small disinflationary effect on food inflation. Crucially, however, this effect is only temporary and by June the synthetic outcome value is on par with the actual outcome value. After June 2022, the outcome variables start to diverge significantly, as the actual food inflation rate in Hungary skyrockets. The differences between the outcome variables are illustrated in Figure 4 below to make this trend more apparent.

Figure 4: Percentage difference in the food price index between the synthetic and observed Hungary 2020-2022



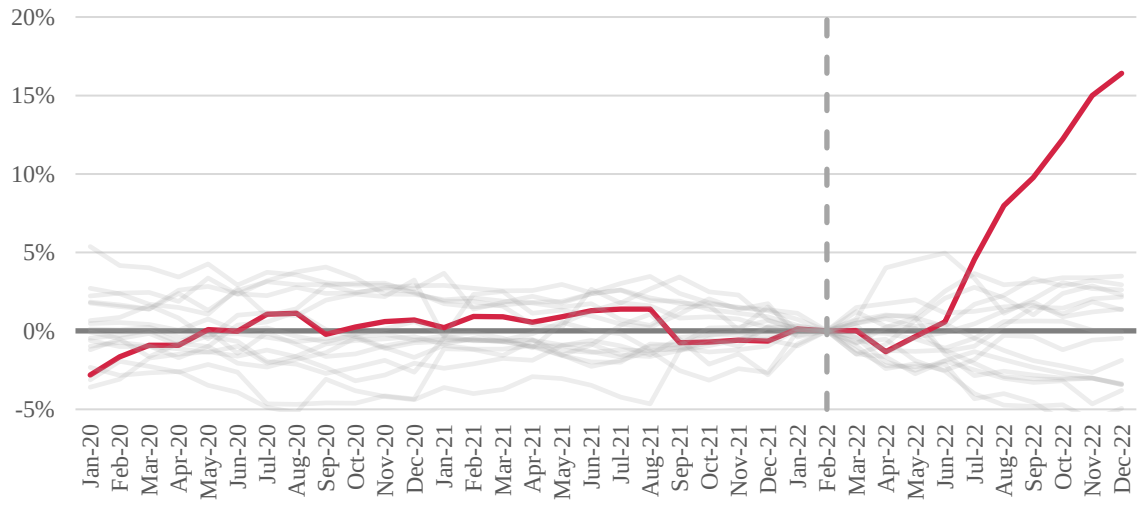
Source: Own work.
Note: Jagged line denotes the intervention period.

In summary, it can be said that the results of the SCM indicates a small and temporary disinflationary effect of -0.56 percentage points on average till May, three months after the intervention's implementation in February and largely coinciding with the general election campaign period. However, this effect is so negligible and short-lived that our hypothesis A, namely that the SCM does not demonstrate a substantial disinflationary effect on the inflation rate in the food segment in the period from February 2022 till December 2022 has to be upheld.

To check the validity of the model two approaches were taken based on the tools provided by the *tidysynth* package. The first approach was to generate placebo synthetic controls as discussed in the previous section. The *tidysynth* package has a built-in function to apply the method to each donor in the donor pool. The generated placebo tests are illustrated in Figure 5. As can be seen on the graph, most of the placebo synthetic controls do not exhibit any clear change of trend at the intervention period, but the result for the synthetic-Hungary is unique, as a shorter period of negative difference is followed by an exponentially increasing

positive difference. The distinctiveness of this trendline implies that the SCM is correctly estimating the causal effect of the treatment, providing evidence of its validity.

Figure 5: Difference of each placebo synthetic control for the units in the donor pool

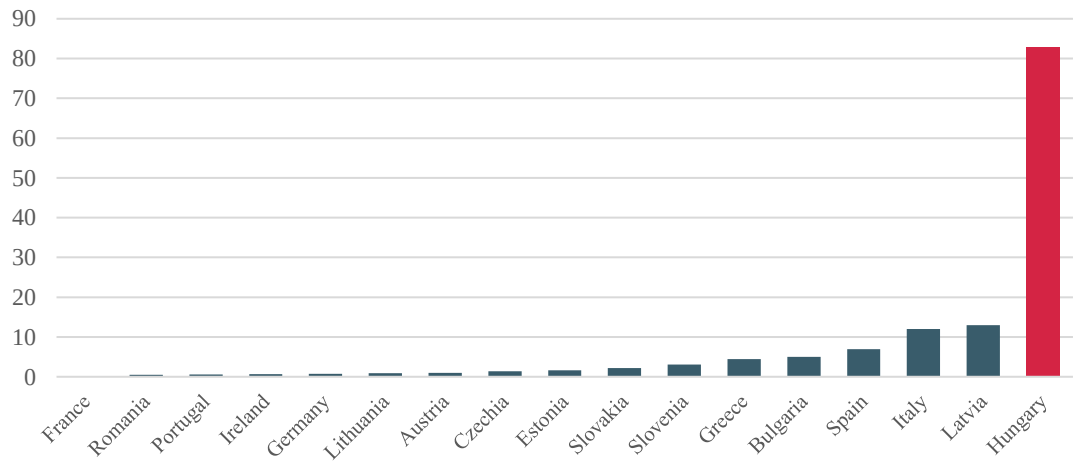


Source: Own work.

Note: Jagged vertical line denotes the intervention period; red line denotes difference if Hungary is the treated country.

The second approach following the placebo approach was to calculate the ratio of the post-intervention Mean Squared Prediction Error (MSPE) and the pre-intervention MSPE, and then to rank all the units in descending order. Again, the *tidysynth* package has a built-in function that does just that. The results of this measure suggest the extreme difference between the synthetic-Hungary and real-life Hungary, as it has the highest ratio of all (Figure 6). The reason behind the high ratio for Hungary is that the pre-treatment MSPE is actually very small due to the low variation in the outcome variable, while it is very high post-treatment as the food inflation rate reaches unexpected highs. The specific values for the MSPE are included in Appendix 12 for reference.

Figure 6: Ratio of the pre- and post-intervention period MSPE for all units



Source: Own work.

3 OTHER PERSPECTIVES CONSIDERED FOR THE ANALYSIS

3.1 Inflation rate of substitute products

One of the major flaws of the price caps in Hungary seems to be that they not only do not reduce the inflation rate in the food segment overall, but they disproportionately increase the price of substitute products. As expressed by the current governor of the Hungarian National Bank (MNB), György Matolcsy—who has been openly critical about the price control measures and their consequences—the upward price effects caused by the price caps essentially counteract this government policy. At a parliamentary hearing he likened the price caps on fuel and foodstuff to communist-era policies, and presented figures based on research by András Balatoni, head of the Economic Forecast and Analysis Directorate of the MNB, showing that they have caused excess inflation of around 3-4 percent since February (Balatoni, 2022; Economic Committee of the National Assembly, 2022). On the one hand, he presented that the direct effect of the price caps on food items lead to a 1.2 percentage point decrease in inflation, but on the other hand the upward price effect on other goods and associated spill-over effects in the food service industry caused an estimated inflation rate of 1.4-1.6 percentage points (Balatoni, 2022). This suggests that the upward price effect offsets the disinflationary effect of the price controls, moreover, exceeds it, resulting in a higher inflation rate than without the price manipulations. The upward price effects for substitute and related final goods can be traced back to the market distorting nature of price maximization, which leads to shortages, supply disruptions, and quality degradation (Nelson & Schwartz, 2008). These topics will be explored in more detail in section 3.3. What is important for now is that all actors in the grocery sector, from producers through wholesalers to retailers are squeezed by the price controls, not to mention the extra tax burdens laid out in chapter 1, with the final retailers bearing the brunt of the revenue loss. Significantly, according to the Secretary General of the Hungarian National Trade Association (MNKSZ), for many price capped goods—notable for sugar, sunflower oil, and chicken breast—this loss can amount to 200-300 Forints per litre or kilogram for the final retailer, as the purchase prices are this much higher than capped sales prices (Kaszás, 2023; LNV, 2022). Still, even wholesalers and producers are faced with a necessity to operate below market dictated prices, and they often do not have the same opportunity to distribute their losses over a range of products, which pushes prices even higher. Many suppliers, distributors, and retailers have been forced to turn to imports more often due to these market distortions. For example, although the price-capped chicken breast has sold out in shops, chicken thighs have not, and the agricultural sector simply cannot cope with such unnatural structural imbalances (Kaszás, 2023). The situation in the end is that many customers are not able to purchase price capped products in the required quantity either because of a temporary shortage or rationing measures implemented by the retailers themselves. Hence, they have to turn to alternative or substitute products which have seen some of the highest inflation rate since February, as seen in Table 3.

Table 3: Year-on-year price increases for product categories, price capped products, and their substitute products (except for eggs and potatoes) in December 2022

Product and product category names	Dec. 2021 = 100%
SUGAR	**110.3%**
White sugar*	93.7%
Sugar cubes	183.2%
Powdered sugar	192.5%
Brown cane sugar	129.5%
FLOUR	**106.7%**
Plain flour*	95.2%
Pastry flour	171.9%
Whole-wheat flour	149.5%
EDIBLE OIL	**101.5%**
Cooking oil (sunflower seed)*	98.0%
Olive oil (extra virgin)	134.5%
PORK	**129.9%**
Pork leg*	111.0%
Pork ribs	143.3%
Pork tenderloin	148.6%
Pork short-cut loin	145.9%
POULTRY MEAT	**151.5%**
Filleted chicken breast*	104.7%
Filleted turkey breast	160.6%
Chicken wings	162.9%
Chicken leg	165.8%
Chicken ready to cook	162.4%
MILK	**152.1%**
Long-life UHT 2.8% milk*	96.3%
Pasteurised ESL 2.8% milk	175.0%
Pasteurised ESL 1.5% milk	182.2%
Lactose-free 2.8% milk	122.3%
Rice/oat milk	126.4%

Source: KSH (2023a).

Note: Capped products are marked with asterisk. Average food inflation in the period was 144.8%.

3.2 Evaluation of the selection of the targeted products and related consumer groups

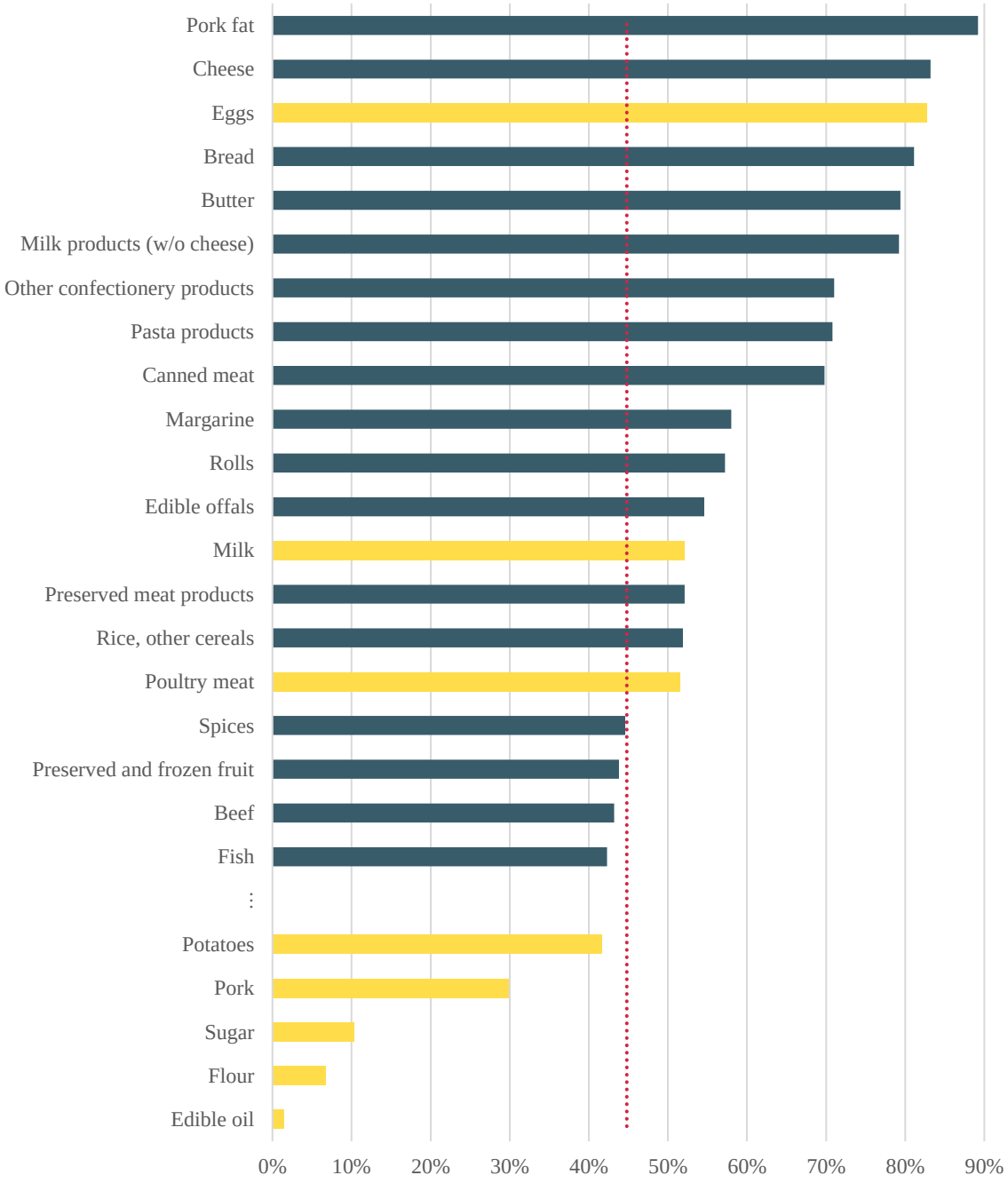
As officially stated, the government has selected the mentioned basic food items because they would significantly ease the additional financial burden put on families by high inflation, which is especially beneficial for low-income households. This aim could have been achieved in the following two ways. One approach could be that the government specifically targets those food items where the biggest price rises were observed, as theoretically these items would put the greatest additional financial burden on lower income households' budgets. The other option could be that the government caps those items specifically on which low-income deciles spend a greater proportion of their budget than high-income deciles. The findings in this chapter seem to suggest that the government only partially followed the latter path, and the selection of the capped products was motivated by political considerations as well. Linked to this particular point, it is crucial to mention again that the price caps were implemented in February 2022, only 2 months prior the general elections in Hungary. Because of this, Bertalan Tóth (2023) opposition politician even expressed his opinion that the price cap measures were "obviously a pre-election move to boost support for the ruling party, without the need for budgetary resources."

To appraise whether the government followed the first approach mentioned, the top 20 product categories which have seen the highest inflation rate year-on-year in December 2022 were plotted in Figure 7. We can see that only 3 out of the 8 price-capped products belong to that group. However, it has to be noted that these product categories only contain up to 1 price capped product, and that the KSH collects price data from marketplaces as well, where the price caps are not enforced. Incidentally, if we look at some of the items which are consumed at a higher rate by low-income families, like bread, canned or frozen meat, and animal fats and oils (see Appendix 15), it is conspicuous that these have seen some of the highest inflation in 2022. With that said, it is clear that these more affordable items by low-income families are also less healthy food items, an important consideration for the last part of this section. Conclusively, it can be argued with hindsight that many staple food items have seen inflation rates far above the average inflation rate, but their prices were not capped even later on, meaning that the government must have selected the products to be capped according to a different set of criteria.

To see whether the second option was taken by the government, namely that items which take up a bigger share in the budgets of lower income households were selected, a budget share analysis was conducted. This provides crucial insight into the spending capacity and habits of the population arranged into income deciles, even though the last available data comes from 2020. In the case of most product categories, it seems that the government has indeed considered the spending habits of poorer households when drawing up the legislation, as several capped products take up the largest part of the budget share within the relevant food categories (see Appendix 16). The only exceptions that could be mentioned are flour and eggs, but if we consider that these goods are consumer staples and can be purchased at

a relatively lower price than other products in their respective categories, we can explain why they take up only a smaller percentage (see Appendix 16). What is more striking however, is that in the food category of cereals only white flour was capped, while pasta, bread and other pastries (rolls) took up a much more significant portion of the budget in the case of each income decile in 2020 (see Figure 8).

Figure 7: Year-on-year price increase for food product categories in December 2022

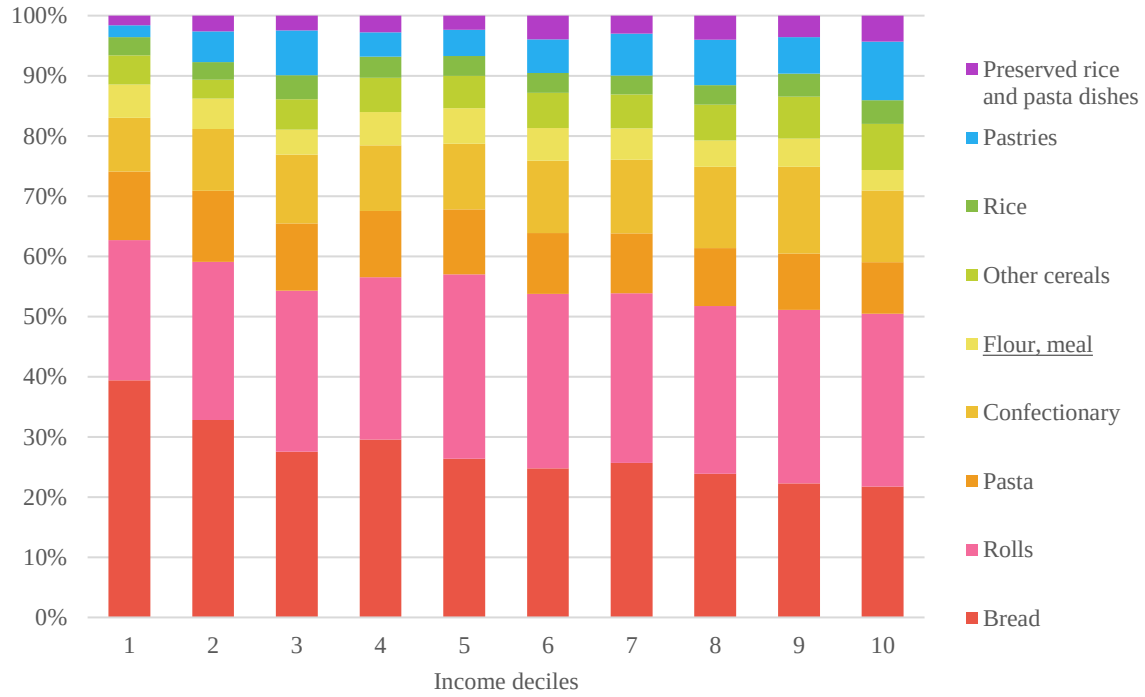


Source: KSH (2023a).

Note: Product groups that contain at least 1 price capped product are in yellow, red line denotes average increase for food items. The top 20 products are shown, followed by those price capped products which were not included, hence the gap in the chart.

As argued previously and in the subsequent section, the price of these products increased at an even higher pace as the price of flour was capped only for consumers but not for bakeries and other businesses in the sector. This way, flour producers and distributors—who are already squeezed by unfavourable economic and environmental conditions—rationally increased their price to their partners to make up for their losses due to the lower price paid by consumers via grocery stores. The estimation of this upward price effect would be challenging, but this effect is reflected by the fact that the prices of bread, pasta and pastries (rolls) increased by 70.8%, 81.1%, and 44.8% respectively in 2022, putting them at the forefront of the products that have seen the biggest price rise (see Figure 7).

Figure 8: Per capita budget share within the cereals and cereal food category segmented by income deciles in 2020



Source: KSH (2020).
Note: Category for price capped product is underlined.

It is also clear from the budget share analysis, that in most cases the price capped products do not only represent a higher share in the budget of lower-income deciles, but generally of all income deciles (see Appendix 16). In the end, these findings question the extent to which the price cap policy truly incorporates a social dimension, and rather focuses on offering assistance to the general populace, with limited consideration to social status. Furthermore, the effectiveness of the measures in helping poorer households is diminished by the fact that they unnecessarily exacerbate inflationary pressures by blocking price signals that would otherwise motivate consumers to decrease their spending, and by causing a disproportionately high price increase for substitute and end products, many of which are also basic consumer goods and often the only option on the shelves due to intermittent shortages, which will be discussed in the following section.

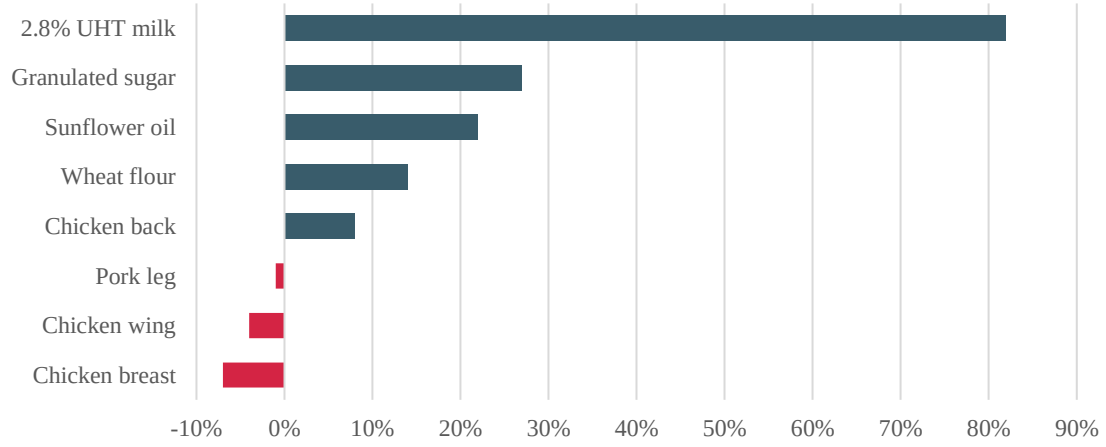
Another viewpoint that is crucial to consider, is the dietary and nutritional aspect of the selected items, as these measures could sway lower income families to drastically shift their food purchasing decisions towards the price capped foodstuff. This is an especially vital question, since chronic diseases connected to poor dietary habits—such as obesity, diabetes and heart disease—are prevalent in the Hungarian population and are among the leading causes of death (OECD, 2021). Among the regulated food products, only chicken breast, egg, and milk can be considered as healthy food choices as they are rich in nutrients and protein. The rest of the items—such as pork leg, chicken tail, potatoes—can be only considered good dietary choices when prepared in a healthy way and consumed in moderation, while granulated white sugar, regular wheat flour, and sunflower oil are the least nutrient-rich foodstuff on the list of regulated items. It is clear that these are staple food products for Hungarian families as they are basic ingredients for countless traditional meals, but the government might have also taken the opportunity to promote healthier alternatives and substitutes to these (e.g. honey, olive oil, whole-wheat flour) to provide a more balanced set of products. It is also interesting to consider why chicken breast and tail have been included, but not chicken thighs or internal organs, which are comparatively much more nutrient-dense. Furthermore, the government did not include any whole grains, fruits or vegetables besides potatoes in the regulations, even though these are amongst the healthiest food categories and have seen staggering price increases in 2022 as illustrated in Figure 7 (WHO, 2003). Reasonably, it can be concluded that the Hungarian government seems not to have incorporated dietary considerations into the price cap regulations. This could be considered a missed opportunity, as even in the short-term, selecting more healthier, nutrient-rich food products could have promoted healthier eating habits, even if this is not the primary focus of the regulations. While challenging, this issue remains crucial for the government's pursuit of enhancing public health outcomes and curbing healthcare costs linked to diet-related diseases in the long-run.

3.3 Other negative consequences of the price controls

In this section, the consequences of the market distorting nature of the price caps will be explored in greater detail. In an unregulated free market, it would be expected that the sales volume of most goods would stagnate or even decrease in this period, as consumers adjust their demand to the increased prices, however the price caps alter and distort price signals (Rockoff, 2008). If we would illustrate a price control, namely a price ceiling on a supply-demand diagram, we could clearly see that if the fixed price is below the market equilibrium price, the increased demand is not met by the lower supply, resulting in a shortage (see Appendix 17). The increasing consumption pattern for the price capped goods is clear in Hungary. According to a NielsenIQ report, the price-controlled food products were consumed 25-40 percent more in 2022 than in the previous year (Tamásné Szabó, 2023). Markedly, the amount of sugar bought in the first half of 2022 was almost equal to the entire amount bought in 2021, while the sales volume of milk nearly doubled in the February-

December period compared to 2021 (Tamásné Szabó, 2023). As seen in Figure 9, the volume of sales increased virtually for all of the initially capped goods in the February-December

Figure 9: Change in the volume of sales (%) of the initial 6 price capped products in the period February-December 2022 compared to the same period in 2021



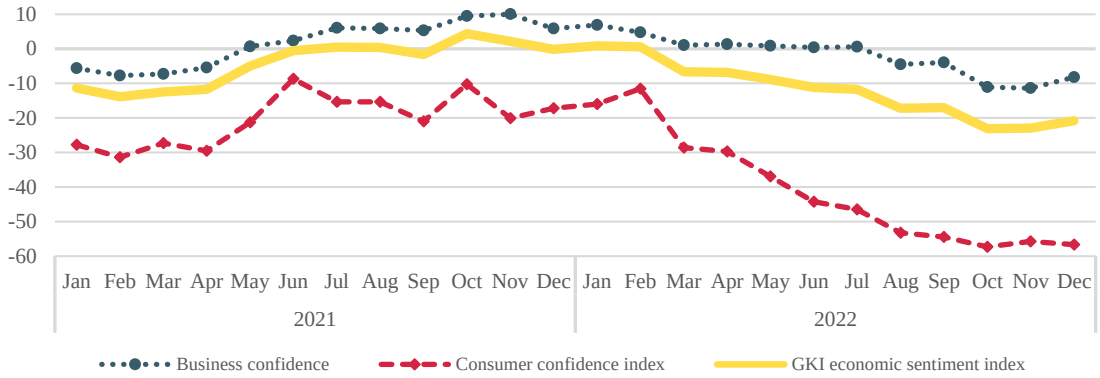
Source: NielsenIQ (Tamásné Szabó, 2023).

period, with the exception of most meat products, which could be explained by several reasons. Firstly, the data available in the report on fresh meat came from a narrow segment of the sector, which could lead to some distortion, as many consumers are increasingly willing to switch stores for cheaper and discounted products (Tamásné Szabó, 2023). Secondly, fresh meat has a shorter expiry date than long-lasting foods like sugar, or even UHT milk, and requires deep freezer capacity for storage (Tamásné Szabó, 2023). Thirdly, it can be assumed that consumers are also trying to economise by eating less meat in general, especially of the relatively more expensive kinds (Tamásné Szabó, 2023).

On the supply side, the issues are made even worst by the productivity and efficiency problems faced by the Hungarian food industry, which makes domestic production even more costly. As stated previously, imports are increasing at the expense of domestic producers, even in segments where Hungarian producers, like dairy and meat products, have gained a strong market position in recent years (NAK, 2023a). This is mainly driven by the fact that many retailers have turned to cheaper imports to compensate for the losses caused by the price caps, and many domestic producers started to export to more profitable foreign markets (NAK, 2023a). However, we have to note that smaller retailers are in a disadvantage in this regard as well, as large supermarket chains hold stronger position in the import market as they import in greater quantities (Kaszás, 2023). Hence, many small businesses are not able to take advantage of cheaper imports as they have been forced out of the market. According to KSH statistics, "the volume of export of food, beverages and tobacco lessened by 7.9%, while the volume of their imports was 5.5% higher" in 2022, driven by the commodity group of grains and cereal preparations and meat and derived products (KSH, 2023d). Another consideration when it comes to the government's interference in the market

economy, is that the price control measures could decrease investor confidence, conveying that the country is not sufficiently committed to the principles of the market economy (Prinz, 2022). Although it cannot be explained solely on the basis of this (the price caps represent only a small portion of the government's policy mix) and other macroeconomic indicators have to be factored in, the business and consumer confidence have sharply decreased in 2022 (Figure 10), a trend that is also reflected on the value of the Forint against foreign currencies.

Figure 10: Economic sentiment index and its elements 2021-2022



Source: GKI Economic Research (2023).

As mentioned in the previous chapters, one of the major consequences of the price caps are the sporadic and localised shortages of the price-capped, low-priced products due to the demand-supply disequilibrium, as reported by numerous media outlets (Agrárszektor, 2023; Velti, 2023; Vorák, 2022; Zalavári, 2022). Although the price caps did not lead to a general shortage of these goods, the periodical shortages led to many situations when customers were not able to benefit from the purchase of the price capped goods and had to buy more expensive alternatives, counteracting the intended outcome of the measures. What makes this worse is the fact that the price control measures pushed the prices of these substitute products even higher, as explained in section 3.1. Many supermarkets and shops, including supermarket giants like Lidl, Aldi, or Spar, even had to repeatedly resort to the introduction of rationing or quantity quotas in order to prevent empty shelves (Kasnyik, 2022). We see this also further up the supply chain, as wholesalers have limited supply to their partners in an effort to stockpile all stores, but smaller retailers are in a disadvantage in this respect (Ferkó, 2022). The government's solution was to introduce another legislation in January 2023, which forces retailers to keep a higher stock of the price capped items, as enforced by the General Inspectorate for Consumer Protection (Molnár S., 2022). This way, the government pushes the responsibility to the retailers whose logistical and supply chains are already overwhelmed by the turbulent global economic conditions and rising costs. Moreover, the government does not provide any financial compensation even to smaller retailers. On the contrary, the government has "increased tax rates for big retailers from 2.7 percent to 4.1 percent", a clear move against international food retailers, but hardly beneficial to domestic retailers in any regards (Savage, 2022). Since groceries are not always

able to acquire as much of certain regulated products as the governmental decree stipulates they must hold, they constantly risk fines for not meeting the minimum product availability quota, which is the daily average of the stock in 2021 (Pálos, 2022). Significantly, store owners who do not comply may be fined for an amount between 50,000 and 3,000,000 Forints which is roughly equal to €126 and €7,500 at July 2022 exchange rate (LNV, 2022). Small retailers, mainly Hungarian-owned, independent small shops and chains do not just suffer a disadvantage with respect to the amount of supply they receive from wholesalers and their weaker positions on the import market, but also because they do not have the same capacity or ability to spread out their losses on various products as bigger retail chains have. This is simply a consequence of the scale and size of their operations, which also means they operate with higher retail prices from the outset. To put it plainly, large supermarket chains operate with a much wider product portfolio then smaller businesses do. On these grounds, György Raskó agricultural economist called the measures unfair in terms of both economic policy and competition law (Sipos, 2023). To put a figure on this loss, György Vámos, secretary general of the Hungarian Trade Association (OKSZ), pointed out in January 2023 that hitherto the loss in sales revenue that retailers have incurred as a result of the price caps could be as high as 250 billion Forints (Molnár G., 2023). Clearly, the additional costs and the losses cannot be passed on to consumers without limit, as households are buying lower quantities of groceries overall as a result of price increases. In numbers, this is shown by an 8.3 percent decrease in sales volume of the food and beverages retail sector in December 2022 compared to the same period last year (see Appendix 18).

Significantly, The Hungarian Chamber of Agriculture (NAK), the Hungarian National Trade Association (MNKSZ), the Hungarian Trade Association (OKSZ) and other key representative organisations have expressed their view that the range of price capped products should not be extended, rather the existing ones should be phased out, as they are ruining small businesses and threaten the competitiveness of the domestic agriculture and food industry (Kaszás, 2022; NAK, 2023b). If we also factor in, that in addition to the burden of price caps, smaller businesses and producers are faced with a significant increase in overhead costs due to the energy crisis, rising material prices and wages, we can expect that many small retailers are going to find themselves in a though situation in the near future (Kaszás, 2022). The changing structure of the groceries sector is already reflected in a 4.1 percent decrease in the number of food shops since December 2021 (see Appendix 18).

The price cap policy only regulates consumer prices and retail stores have to get their goods from wholesale suppliers at market prices, the price caps exert an artificial downward pressure on prices across the entire supply chain (LNV, 2022). Therefore, producers also price their non-capped products higher to make up for the losses they make on the capped goods. However, Hungarian producers and farmers have a limited capacity to reduce their prices. Externally, it is a consequence of the increasing production, transportation, and energy costs and the weakened Forint, internally, it is due to the low efficiency and productivity of the sector which puts producers in a disadvantaged position. Additionally,

like in the case of retailers, various producers with different capacities have varying degrees of feasibility to spread out their losses and to compensate for the revenue losses. For instance, in the case of chicken eggs or potatoes, the price control measures apply indiscriminately to all sizes, handling methods, and varieties, with the exception of early potatoes and ecological or bio produce. Consequently, these producers are not able to distribute their losses on other products unlike diary producers, who are able to increase the price of cheese or yoghurt, to compensate for the losses on 2.8% UHT milk (Agrárszektor, 2022). Crucially, the escalating tensions arising from price and quantity disputes among suppliers, wholesalers, and retailers have damaged the long-standing relationships founded on mutual trust within the supply chains, which ultimately jeopardises the "sustainable and predictable functioning of domestic supply chains" (NAK, 2023b).

Another important negative consequence of price caps cited by numerous economists is the degradation in the quality of the involved product categories. This is in part caused by the cost-minimization efforts of producers in order to sell their goods under the market price to retailers, which can lead to worse quality end products. Another reason is that, as mentioned previously, many retailers have turned to exporting suppliers from other countries that sell their goods at a cheaper, but often at a lesser quality than domestic producers (NAK, 2023a). Notable examples include the import of eggs from big Polish farms and dairy products from Western European countries (Szlavkovits, 2022; VG, 2023). Another important perspective is that not only the quality is lower, but the imported goods also have to travel longer distances, which raises environmental and sustainability concerns. Not to mention that the increased volume of imports worsens the current account balance of the country, which is another factor that is reflected in the Forint's exchange rate. On the other side of the coin, many domestic producers started to export to more profitable foreign markets, as the price caps crush their profitability in the domestic market (Köpöncei, 2022). One of the most illustrative examples, is how several Hungarian chicken farmers went out of business or simply started to export to more profitable foreign markets since the introduction of the price regulations (Köpöncei, 2022). This is a major distorting effect in the import-export market that can be traced back to the price caps.

3.4 Alternative disinflationary policy measures

In the following alternative policy solutions will be explored for decreasing the inflation rate. Anti-inflationary measures are a highly debated topic amongst economists and there is no universal solution for controlling high inflation. However, economic theory and analysis of historical precedents also suggest that broad price controls are "costly and of limited effectiveness", and other fiscal and monetary policies are preferred instead (Neely, 2022).

One potential alternative policy solution would be tightening the monetary policy, which the MNB has already started in June 2021 with an interest rate hiking cycle, leading to mixed results (IMF, 2023). Controlling the exchange rate would be another advisable monetary

policy, especially considering the extreme volatility of the Forint against other currencies in 2022. From a fiscal policy standpoint, the government could reduce its spending to decrease the amount of money in circulation or increase certain taxes to reduce domestic demand. The Hungarian government has used both approaches to some degree as it employed revenue mobilization measures by increasing corporate taxes and implementing windfall taxes on the energy, banking, and telecoms sectors, while streamlining its expenditures by cutting expenditures in ministry budgets and postponing a significant proportion of public investments and infrastructure projects (IMF, 2023). Notably, the government even "decided to narrow the access to the long-standing system of subsidized utility prices available to households" according to the average level of consumption, which has been one of the cornerstones of Fidesz' populist political programme (IMF, 2023, p. 2).

However, these policy changes are largely offset by other measures which, although on the surface mitigate the negative effects of inflation, in reality increase the purchasing power of consumers and businesses, which in turn contributes to the prolongation of high inflation levels. Examples for these measures besides the price caps include the minimum wage raise, the additional month of pension benefits, the interest rate freeze for household and student loans, and also for small and medium-sized enterprises (Brückner, 2023). As put by the recent IMF Country Report (2023, p. 1), these "regulatory measures undermine the tighter fiscal and monetary policy mix". More effective measures that would mitigate the impact of high inflation while also maintaining the price signals which allow demand to properly adjust would be the reduction of taxes for customers by decreasing the VAT rate on staple products or providing direct targeted support to vulnerable households and societal groups (IMF, 2023; OECD, 2022). Another, albeit long-term approach could be to introduce supply-side policies and investments which increase the productivity of the Hungarian food industry, which would be especially beneficial considering its low effectiveness and productivity.

CONCLUSION

The aim of the thesis was to answer the two hypotheses related to price control measures on food products in Hungary introduced in the introduction. According to the findings in chapter 2., hypothesis A must be upheld, as the model created using the SCM only shows a temporary and negligible disinflationary effect on the inflation rate in the food segment after the months of the intervention. Therefore, there is no evidence according to the SCM that the price control measures had a substantial disinflationary effect on the inflation rate in the food segment within the period from February 2022 till December 2022. This small window of decreased inflation rate can be due to the fact that retailers and producers adjusted their prices for other products to make up for the losses incurred by the price regulatory measures with a slight delay. However, once the price adjustments were made, the upward price effect on substitute products generated by the price caps become visible, and the disinflationary effect of the price caps disappeared.

Similarly, hypothesis B can be retained, as suggested by the findings in chapter 3. The selection of the products does not seem to be well targeted for poorer households, and rather appear to be focused on "common" food items, which are consumed essentially equally by all segments of the society. The chosen products do not include all the products which have seen the highest inflation in the study period, and most of them are unfavourable from a public health perspective. The intended benefits of the price caps to ease the financial burden on Hungarian families are not only diminished, but essentially cancelled out by the negative consequences of the measures in the retail and food segment. Amongst these repercussions, the aforementioned shortages and rationing in supermarkets are one of the most debilitating effects of the price controls, as they force many customers to buy more expensive substitute products. This defeats the aim of the price freezes to ensure that even lower-income earners have access to these goods in the current inflationary environment. In other words, there is no real disinflationary effect, only a redistribution of the inflation between consumers with different consumption habits. Still, retailers incur significant losses by maintaining the price caps as they only have a limited ability to spread out their losses. As discussed, this spills over to the whole food sector and the supply chains, putting producers in a difficult position.

Based on the findings, it can be argued that the price regulations are only beneficial for the consumers in the short-run, but in the long-run they lead to market distortions, intermittent shortages, and ultimately jeopardise the "sustainable and predictable functioning of domestic supply chains" (NAK, 2023b). As the regulations capped the prices at the October 2021 price levels, the conventional forces of supply and demand were artificially altered for over 15 months. Nevertheless, the thesis does not intend to claim that the price caps are a key driver of food inflation, rather that they do not effectively help to reduce or slow down food inflation and their long-term consequences are far more detrimental to the health of the Hungarian food and retail sectors than their short-term benefits the general population.

Lastly, some of the limitations of the thesis will be outlined. One of the limitations of the thesis is that the analysis of price control measures is limited to the price caps on food items, excluding the evaluation of the price caps on fuel, loan rates and other areas (see Appendix 7). These other measures could have spill-over effects in the food industry. Furthermore, as the analysis is limited to Hungary, it has to be noted that the results may not be generalizable to other countries with different economic and political systems, and they should be understood within the current socio-economic context. The research design is also heavily reliant on secondary data sources, and further research could expand on the findings by incorporating more comprehensive qualitative methods, especially when it comes to the analysis of the upward price effects on substitute products. Additionally, future research could explore the effectiveness of alternative price control measures in Hungary, like evaluating the impact of price control measures on fuel or those in the banking sector. The thesis is also innately constrained by the limited timeframe of the analysis.

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APPENDICES

Appendix 1: Povzetek (Summary in Slovene language)

V diplomskem delu z naslovom "Učinki regulacije cen osnovnih prehranskih izdelkov na inflacijo na Madžarskem po pandemiji" preučujemo učinkovitost ukrepov za nadzor cen osnovnih prehranskih izdelkov, ki jih je zaradi naraščajoče inflacije madžarska vlada vpeljala v februarju 2022. V diplomskem delu uporabimo večstranski pristop, s katerim iz različnih družbenih in ekonomskih vidikov ovrednotimo učinkovitost omejevanja cen prehranskih izdelkov. Po pregledu gospodarskih in političnih okoliščin na Madžarskem pred uvedbo regulacije cen v delu postavimo dve hipotezi:

A. V obdobju od začetka regulacije cen v februarju 2022 do konca leta 2022 ni mogoče potrditi ugodnih učinkov regulacije cen osnovnih prehranskih izdelkov na rast cen hrane na Madžarskem.

B. Izvedena regulacija cen je neučinkovita metoda za blaženje inflacijskega bremena za gospodinjstva z nižjimi prihodki, saj izbira prehranskih izdelkov ni ustrezna.

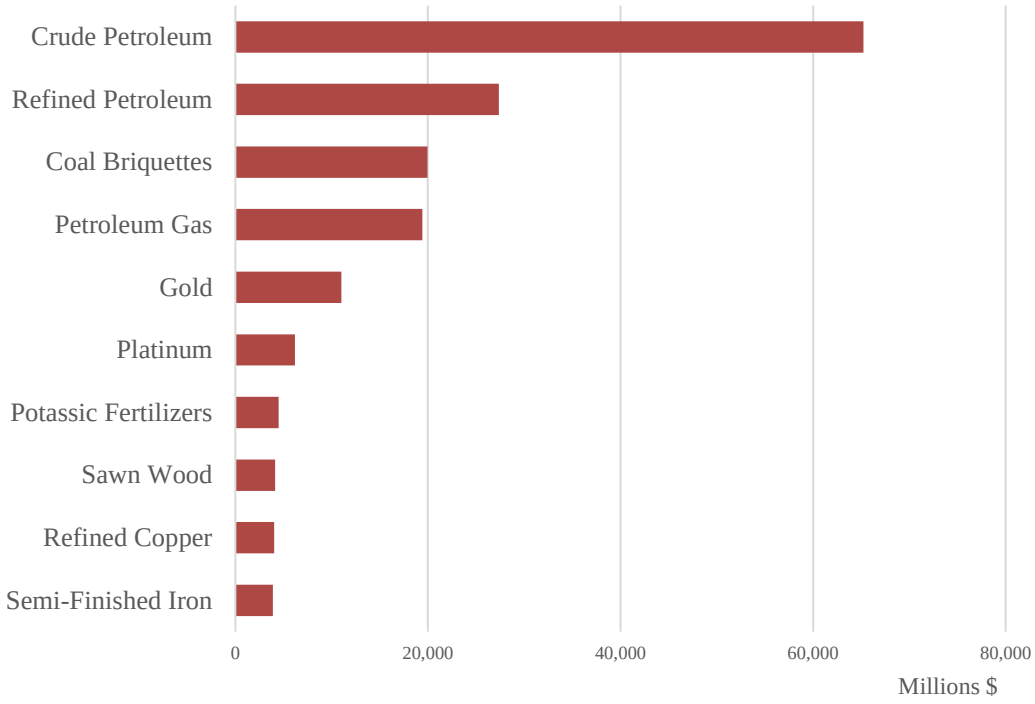
Hipotezo A preverimo z metodo sintetične kontrole. Ta nam omogoča, da z uporabo podatkov več evropskih držav, v katerih regulacije cen prehranskih izdelkov niso uporabljene, ustvarimo "sintetično Madžarsko". To je hipotetična Madžarska, v kateri cenovne regulacije ni, v vseh ostalih vidikih pa je podobna resnični Madžarski. S primerjavo indeksa cen hrane v sintetični in resnični Madžarski v obdobju po regulaciji potrdimo, da ugodnih učinkov na inflacijo ni bilo.

Hipotezo B preverimo v dveh korakih. Najprej preučimo dinamiko cen reguliranih prehranskih izdelkov in njihovih substitutov. Ker je količina izdelkov z reguliranimi cenami naravno omejena in so zato potrošniki prisiljeni kupovati substitute, je močna rast cen substitutov povsem izničila učinek regulacije cen. Nadalje preučimo še kupne navade gospodinjstev. Tu ugotovimo, da nekatere izmed izdelkov z reguliranimi cenami pogosteje kupujejo potrošniki v gospodinjstvih v srednjem ali celo višjem dohodkovnem razredu. Vpliv regulacije na gospodinjstva z nižjimi prihodki je zato zelo omejen.

V diplomskem delu opišemo še druge negativne učinke regulacije cen, zlasti z vidika malih in srednjevelikih podjetij v živilskem in trgovskem sektorju. Regulacija cen izkrivlja trg in zavira cenovne signale, ki bi sicer uravnavali ponudbo in povpraševanje. Nastalo neravnotežje in posledično pomanjkanje nekaterih izdelkov na trgovskih policah pa negativno vplivata na razpoloženje potrošnikov.

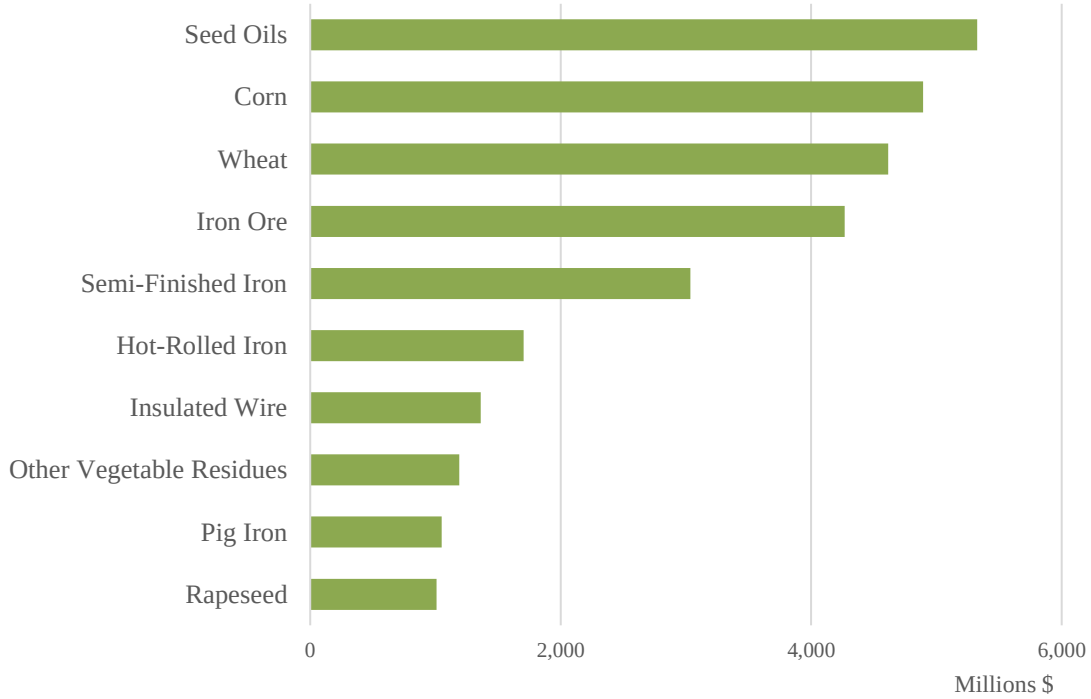
Appendix 2: Top exports of Russia and Ukraine in 2020

Figure 11: Top 10 Russian export products in 2020



Adapted from OEC (2020a).

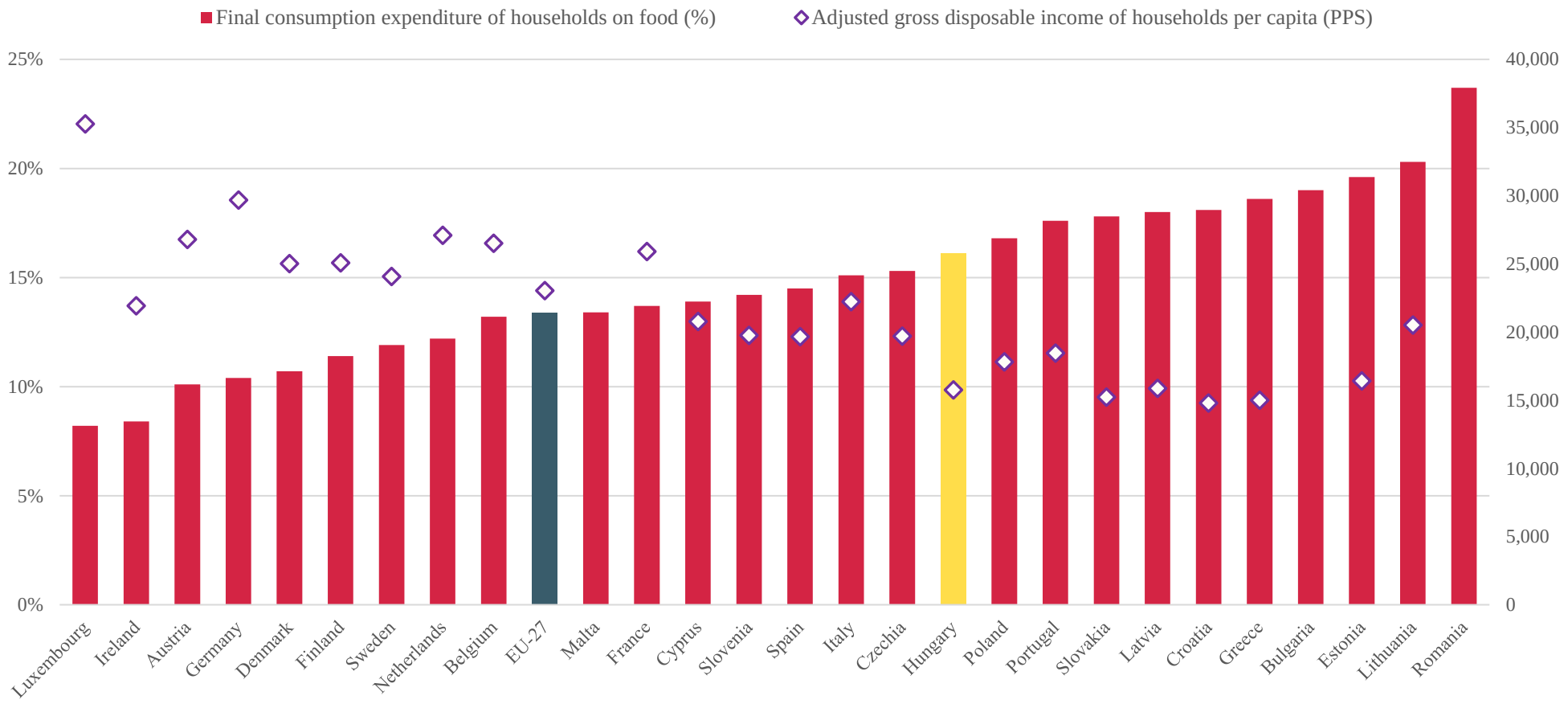
Figure 12: Top 10 Ukrainian export products in 2020



Adapted from OEC (2020b).

Appendix 3: Household income and expenditure on food in the EU, 2020

Figure 13: Gross disposable income of households per capita (PPS) and final consumption expenditure on food by households as a percentage of total in 2020

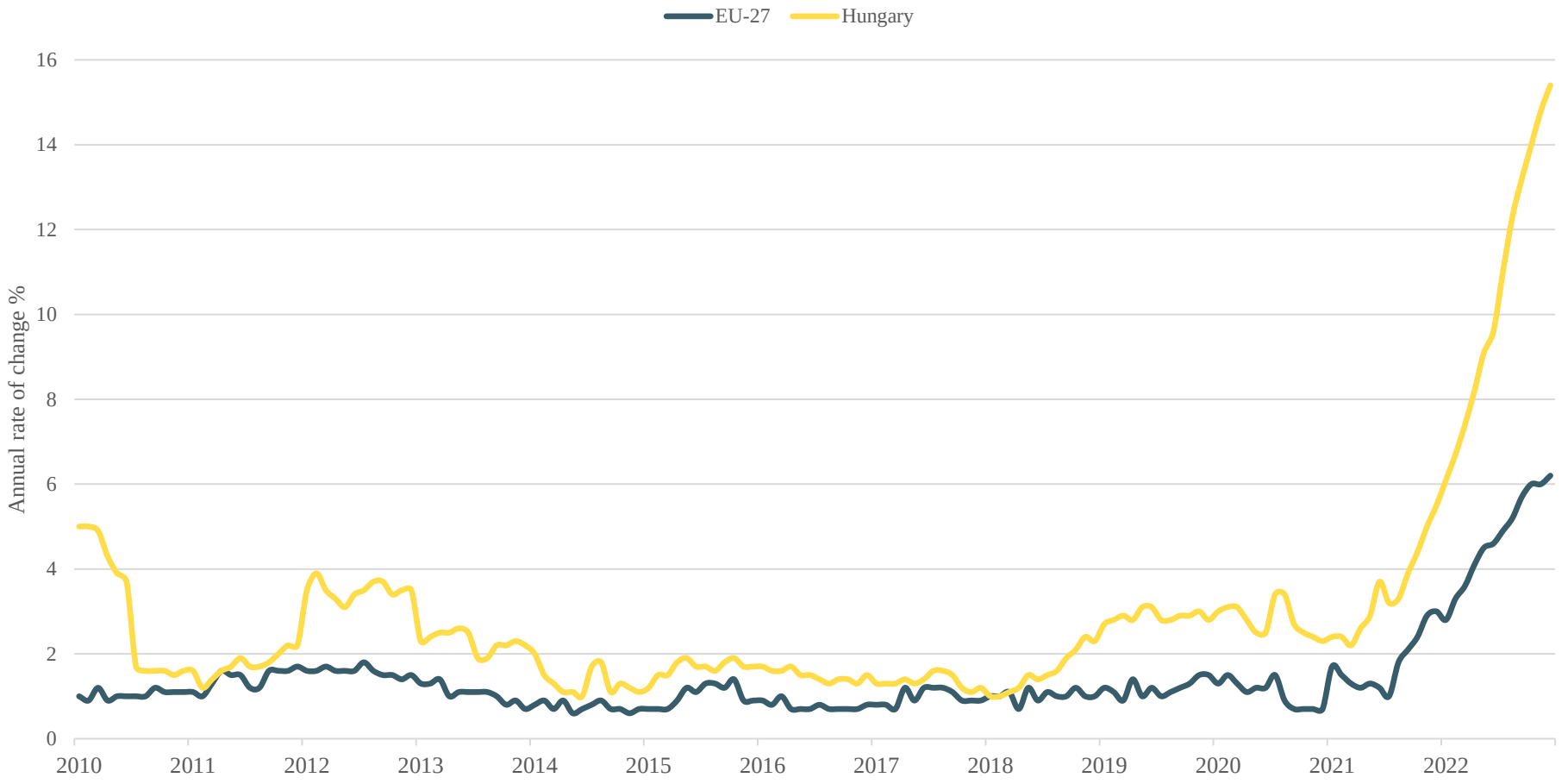


Source: Eurostat (2023a; 2023b).

Note: Data on disposable income for Romania, Bulgaria, and Malta are missing and therefore omitted from the chart.

Appendix 4: Core inflation in Hungary and the EU, 2010-2022

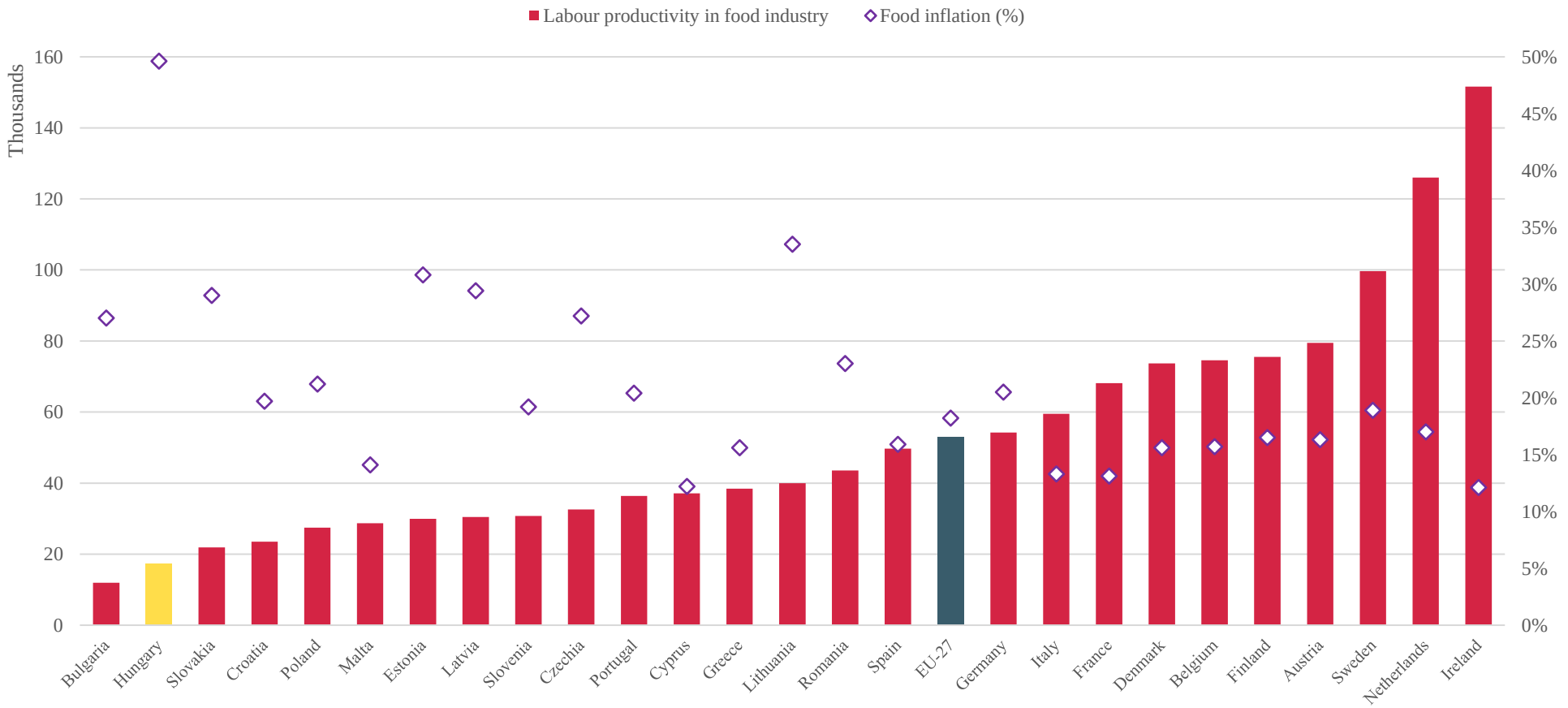
Figure 14: Monthly HICP annual rate of change excluding energy, food, alcohol and tobacco (core inflation) between 2010-2022



Source: Eurostat (2023c).

Appendix 5: Labour productivity in the food industry and food inflation in the EU in December 2022

Figure 15: Food industry labour productivity expressed as Gross Value Added (GVA) per person employed (2019) and year-on-year food inflation in December 2022



Source: Agri-food Data Portal (2022); Eurostat (2022).
Note: Luxembourg is not included in the figure due to lack of data.

Appendix 6: Euro to Hungarian Forint exchange rate since 2010

Figure 16: Chart showing the HUF/EUR exchange rate since 2010

Source: ECB (2023).

Appendix 7: Price and interest rate caps in Hungary

Table 4: Price and interest rate caps in Hungary as of April 2023

Measure	Date	Coverage	Description	Cost borne by
Household utility price	2014 -	All households	The prices of household gas and electricity were fixed at around 24 and 75 EUR per MWh, respectively, for all levels of consumption. In August 2022, the cap was increased for consumption levels above the national average to price levels closer to market rates, this is to be adjusted quarterly.	Utility companies and government
Motor fuels price	Nov 2021 - Dec 2022	Resident privately-owned vehicles, taxis, and agricultural machinery	Price of petrol and diesel fuel is capped at HUF 480 per liter. Coverage was initially universal, then narrowed to Hungarian residents only in July. The cap had been extended twice, but eventually ended earlier than planned as it led to supply pressure and closures of petrol stations nationwide.	Wholesalers
Food price	Feb 2022 -	Universal	Prices of granulated sugar, wheat flour, sunflower oil, pork leg, chicken breast, and 2.8% cow milk capped at their October 15th, 2021 levels. The cap has been extended several times, and the list was expanded in November to include potatoes and eggs capped at the end-September retail price.	Retailers
Mortgage interest rate	Jan 2022 -	Variable rate mortgages, and those with fixation dates through June 2023	Mortgage rates capped until June 30, 2023 at October 27, 2021 levels for mortgages with short to medium-term interest periods. Analysts estimate that capped mortgages amount to about 2.3 percent of GDP or 22.7 percent of own funds.	Banks
Loans to SME interest rate	Nov 2022 -	All SMEs with variable interest-rate loans	Interest rates on HUF-denominated business loans to SMEs capped at the reference rate as of June 28, 2022. The MNB estimates the cost to banks at about 0.1 percent of GDP.	Banks
Large deposits interest rate	Nov 2022 -	Large depositors with at least HUF 20 million in deposits	Interest rates on some large deposits are capped at the average 3-month T-bill yield. The government's objective is to divert those funds toward the government securities.	Large depositors (foregone interest)
Student loan interest rate	Jan 2023 -	Student loans	The interest rate on student loans that are subject to interest will stay at 4.99 percent as of January 2023, when it would otherwise have increased to 10 percent for over 100,000 borrowers. Other student loans are interest free.	State-owned student loan provider

Adapted from IMF (2023).

Appendix 8: The code for the SCM implementation via the *tidysynth* package

```
# load packages

library(tidyverse)
library(tidysynth)

inflation <- read.csv(file = 'long_ver3_2020_final.csv', header = TRUE)

inflation_out <-

  inflation %>%

# initiate the synthetic control object

  synthetic_control(outcome = food_HICP, # outcome variable
                    unit = country, # unit index in the panel data
                    time = time_index, # time index in the panel data
                    i_unit = "Hungary", # unit where the intervention occurred
                    i_time = 26, # time period when the intervention occurred
                    generate_placebos=T) %>% # generate placebos

# generate the aggregate predictor variables used to fit the weights

  generate_predictor(time_window = 1, # values aggregated outside of R
                     GDP_pc_avg_20_21 = GDP_pc_avg,
                     GDP_pc_rate_20_21 = GDP_pc_rate,
                     Food_expend_20_21 = food_expend,
                     GDP_agriculture_20_21 = GDP_agriculture,
                     GDP_trade_20_21 = GDP_trade,
                     Govt_deficit_20_21 = GDP_govt_deficit,
                     Central_int_20_21 = base_int_rate,
                     Long_term_int_20_21 = long_int_rate,
                     Unemployment_20_21 = unemp_rate,
                     Pop_density_19 = pop_density,
                     Gini_index_18 = gini,
                     HDI_20_21 = hdi,
                     Inflation_CPI_20_21 = inflation_CPI) %>%

  generate_predictor(time_window = 1:25, # monthly values aggregated in R
                     Inflation_HICP_20_22 = mean(inflation_HICP, na.rm = T))%>%

# last pre-treatment value as a lagged outcome predictor

  generate_predictor(time_window = 25, Food_HICP_1 = food_HICP)%>%

# generate the fitted weights for the synthetic control

  generate_weights(optimization_window = 1:26,
                   optimization_method = c("Nelder-Mead", "BFGS"),
                   include_fit = TRUE) %>%

  # generate the synthetic control

  generate_control()
```

Appendix 9: Predictor variables used in the analysis

Table 5: Definitions and explanations of the predictor variables used in the analysis

Variable name	Definition	Source
Central_int_20_21	Time series data on central bank policy rates.	Bank for International Settlements (BIS) policy rate statistics.
Food_expend_20_21	Final consumption expenditure of households on food and non-alcoholic beverages.	Eurostat [NAMA_10_CO3_P3].
Food_HICP_1	Harmonised index of consumer prices for food (COICOP 01.1).	Eurostat [PRC_FSC_IDX].
GDP_agriculture_20_21	Agriculture, forestry, and fishing, value added (% of GDP).	World Bank national accounts data, and OECD National Accounts data files.
GDP_pc_avg_20_21	Average real GDP per capita in euro.	Eurostat [SDG_08_10].
GDP_pc_rate_20_21	Real GDP per capita rate of increase.	Eurostat [SDG_08_10].
GDP_trade_20_21	The sum of exports and imports of goods and services measured as a share of gross domestic product.	World Bank national accounts data, and OECD National Accounts data files.
Gini_index_18	Gini index that measures the distribution of income among households within an economy.	World Bank, Poverty and Inequality Platform (PIP).
Govt_deficit_20_21	Government deficit and debt (% of GDP).	Eurostat [GOV_10DD_EDPT1].
HDI_20_21	Human Development Index measuring average achievement in three basic dimensions of human development.	Human Development Report Office (HDRO).
Inflation_CPI_20_21	Growth rate of inflation as measured by the consumer price index.	International Monetary Fund (IMF).
Inflation_HICP_20_22	Harmonised index of consumer prices (All-items).	Eurostat [PRC_HICP_MMOR].
Long_term_int_20_21	Long-term interest rate statistics.	European Central Bank's (ECB) Statistical Data Warehouse, and OECD database.
Pop_density_19	Population density (persons per square kilometre).	Eurostat [DEMO_R_D3DENS].
Unemployment_20_21	Unemployment rate as a percentage of total population (from 15 to 74 years).	Eurostat [UNE_RT_A].

Source: Own work.

Appendix 10: Predictors weights for the synthetic-Hungary

Table 6: Predictor variable weights for the generated synthetic-Hungary

Variable name	Variable weights
Inflation_CPI_20_21	50.504%
GDP_pc_avg_20_21	24.242%
Food_HICP_1	11.524%
GDP_agriculture_20_21	4.306%
GDP_trade_20_21	4.278%
HDI_20_21	1.758%
GDP_pc_rate_20_21	0.769%
Unemployment_20_21	0.724%
Gini_index_18	0.700%
Central_int_20_21	0.694%
Long_term_int_20_21	0.350%
Pop_density_19	0.093%
Food_expend_20_21	0.047%
Inflation_HICP_20_22	0.006%
Govt_deficit_20_21	0.003%

Source: Own work.
Note: Variable names are explained in Appendix 9.

Appendix 11: Control unit weights for the synthetic-Hungary

Table 7: Country weights (%) for the generated synthetic-Hungary

Country	Control unit weights
Lithuania	71.7064%
Czechia	11.9577%
Romania	10.6847%
Slovakia	5.4695%
Ireland	0.0949%
Estonia	0.0325%
Latvia	0.0103%
Austria	0.0093%
Italy	0.0090%
Bulgaria	0.0075%
Greece	0.0050%
Slovenia	0.0045%
France	0.0033%
Germany	0.0029%
Portugal	0.0021%
Spain	0.0004%

Source: Own work.

Appendix 12: Inferential statistics based on the observed difference between the treated unit and its synthetic control to each placebo unit

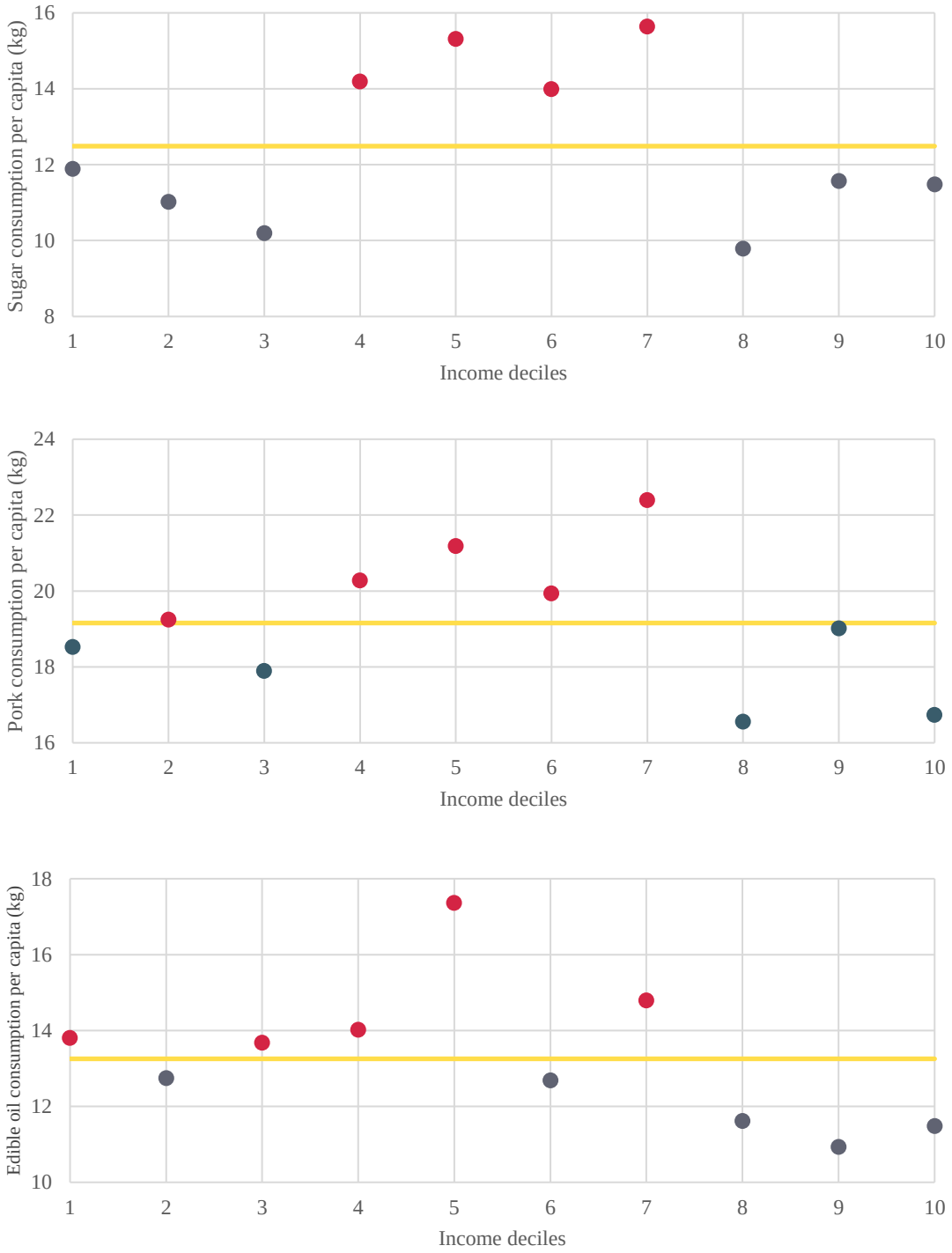
Table 8: Generated inferential statistics based on the observed difference between the actual treated unit and its synthetic control to each placebo unit

Rank	Unit name	Type	Pre MSPE	Post MSPE	MSPE ratio
1	Hungary	Treated	0.996	82.549	82.871
2	Latvia	Donor	0.578	7.491	12.950
3	Italy	Donor	0.480	5.746	11.981
4	Spain	Donor	1.268	8.832	6.966
5	Bulgaria	Donor	1.124	5.652	5.028
6	Greece	Donor	4.343	19.353	4.456
7	Slovenia	Donor	4.937	15.178	3.075
8	Slovakia	Donor	0.522	1.163	2.229
9	Estonia	Donor	1.409	2.299	1.631
10	Czechia	Donor	2.928	3.998	1.365
11	Austria	Donor	2.261	2.212	0.978
12	Lithuania	Donor	10.822	10.183	0.941
13	Germany	Donor	6.771	4.772	0.705
14	Ireland	Donor	8.307	5.267	0.634
15	Portugal	Donor	4.094	2.349	0.574
16	Romania	Donor	3.330	1.755	0.527
17	France	Donor	5.628	0.284	0.050

Source: Own work.

Appendix 13: Food categories included in the price regulations and consumed at a higher rate by middle-income deciles

Figure 17: Sugar consumption (kg), pork consumption (kg), and edible oil consumption (kg) per capita, categorized by income deciles in 2020

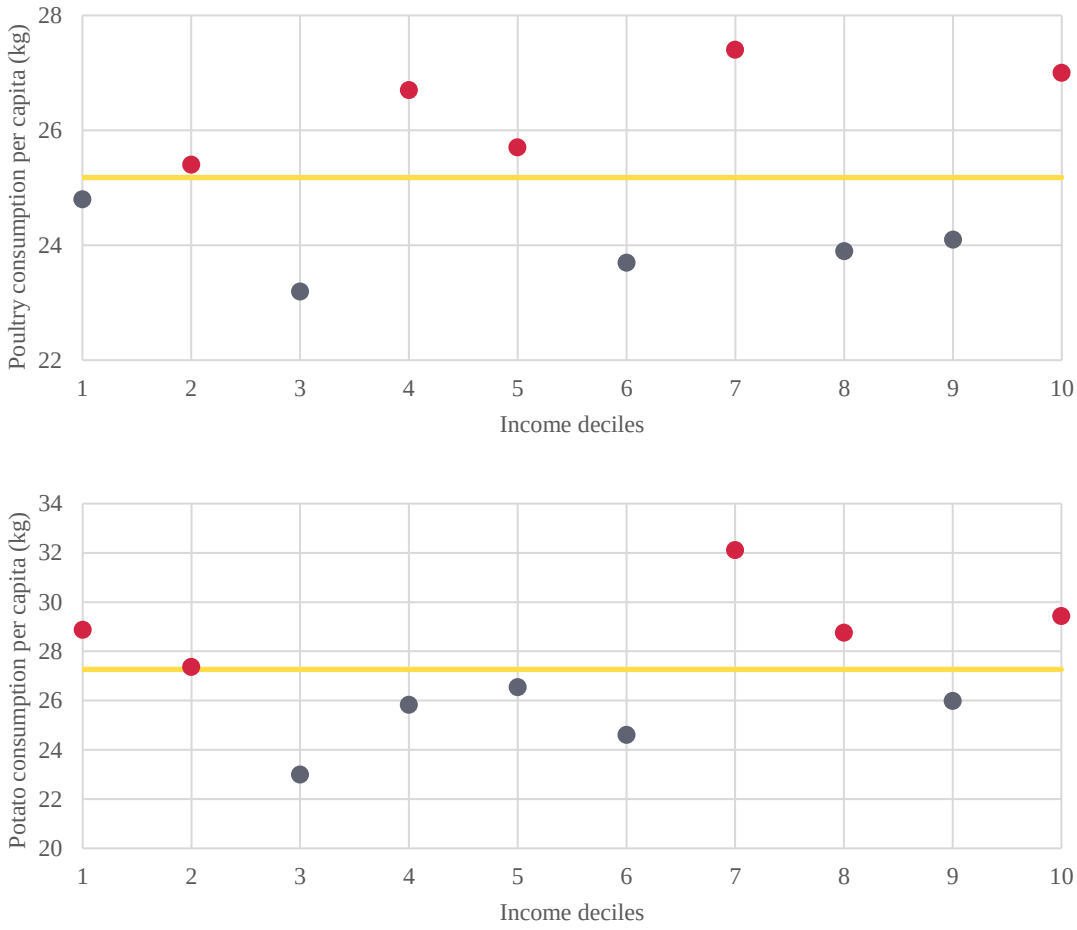


Source: KSH (2023e).

Note: Blue dots represent below, red dots above average per capita consumption. Yellow line denotes average consumption rate across the entire population.

Appendix 14: Food categories included in the price regulations but not having a clear consumption pattern

Figure 18: Poultry and potato consumption (kg) per capita by income deciles in 2020

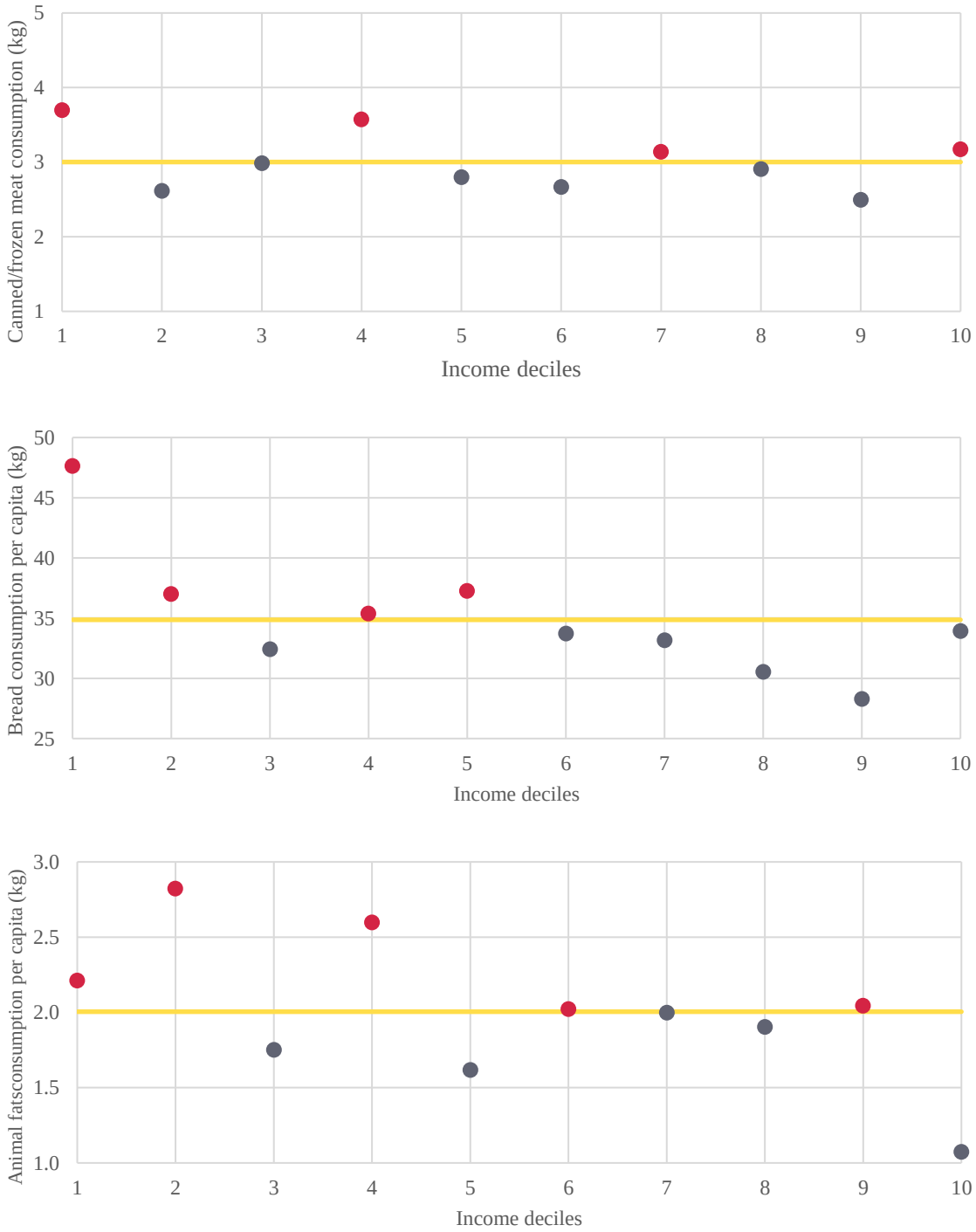


Source: KSH (2023e).

Note: Blue dots represent below, red dots above average per capita consumption. Yellow line denotes average consumption rate across the entire population.

Appendix 15: Food categories consumed at a higher rate by low-income deciles but excluded from the price regulations

Figure 19: Canned or frozen meat, bread, and animal fats and oils consumption (kg) per capita by income deciles in 2020

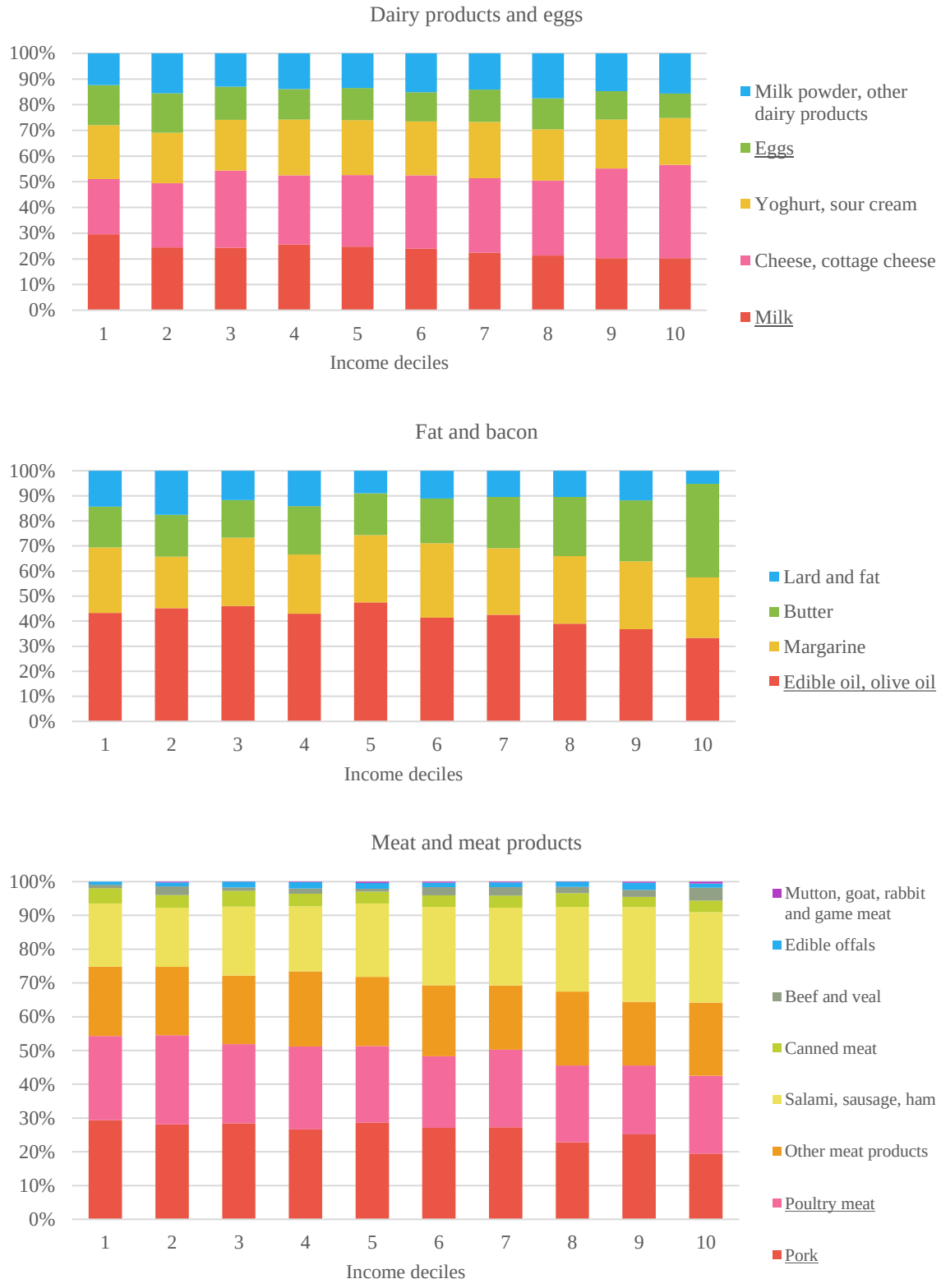


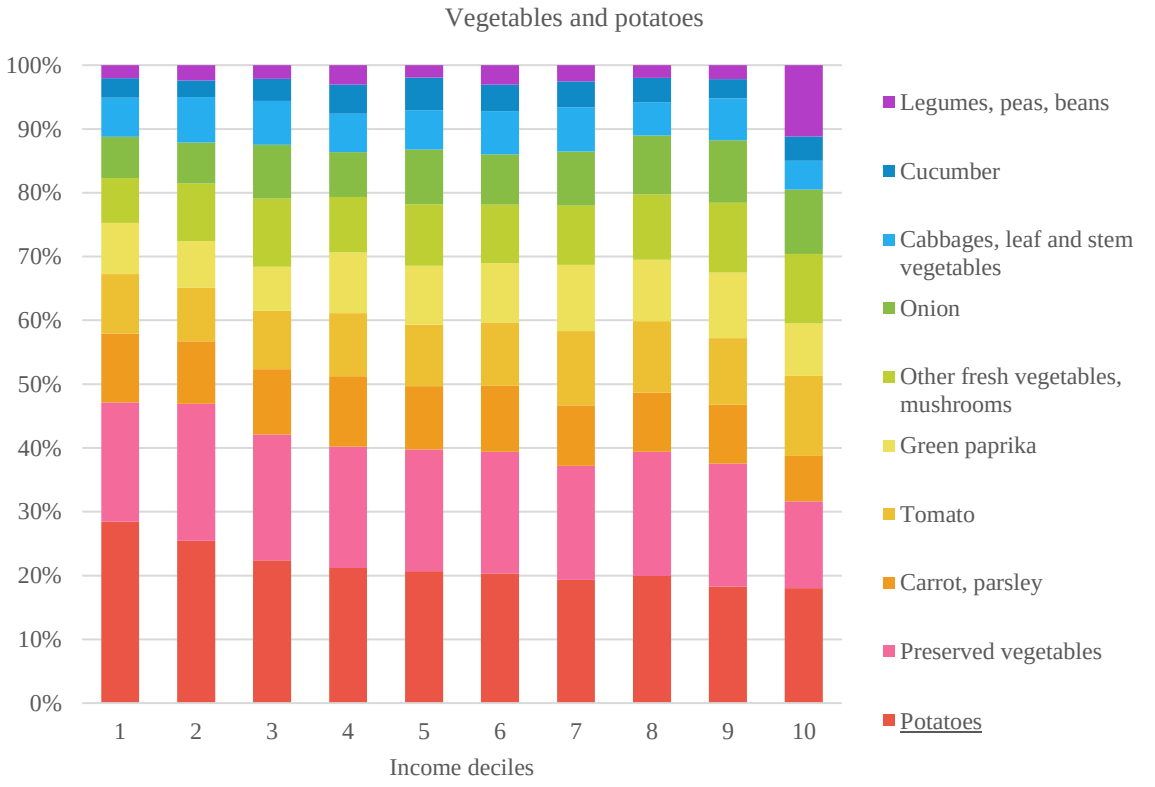
Source: KSH (2023e).

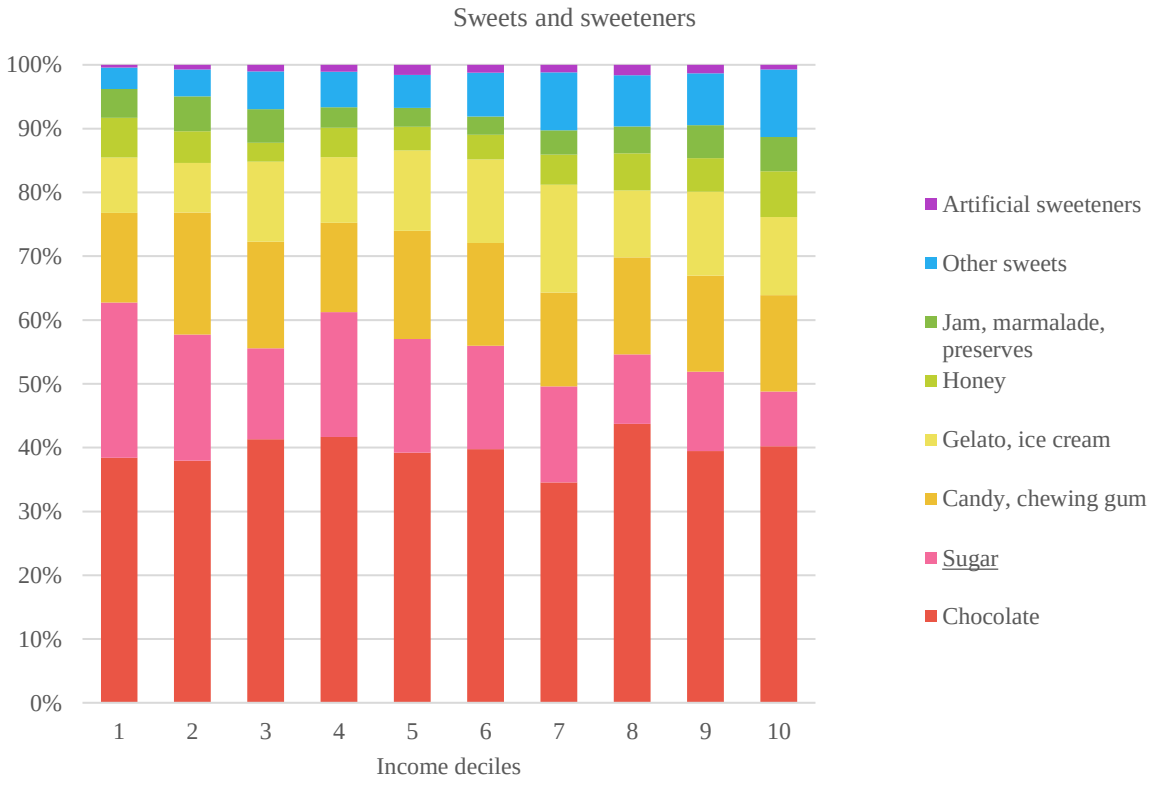
Note: Blue dots represent below, red dots above average per capita consumption. Yellow line denotes average consumption rate across the entire population.

Appendix 16: Per capita budget share for some food categories segmented by income deciles in 2020

Figure 20: Per capita budget share within the dairy products and eggs; fat and bacon; meat and meat products; vegetables; and sweets and sweeteners food categories segmented by income deciles in 2020



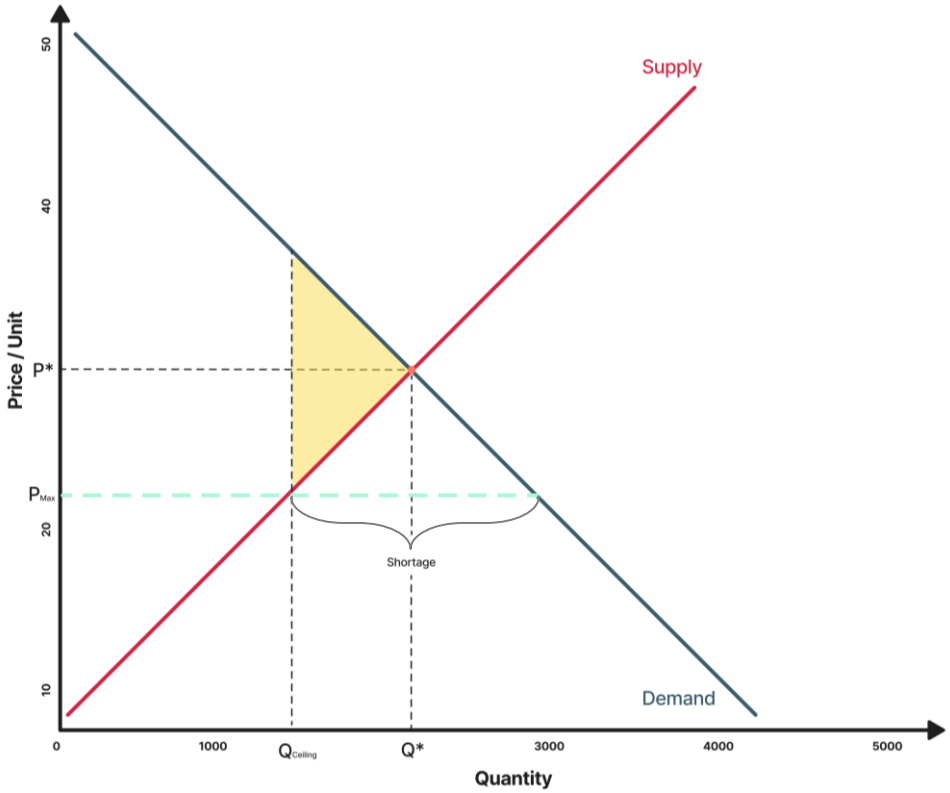




Source: KSH (2020).
Note: Price capped products are underlined.

Appendix 17: Supply-demand curves diagram

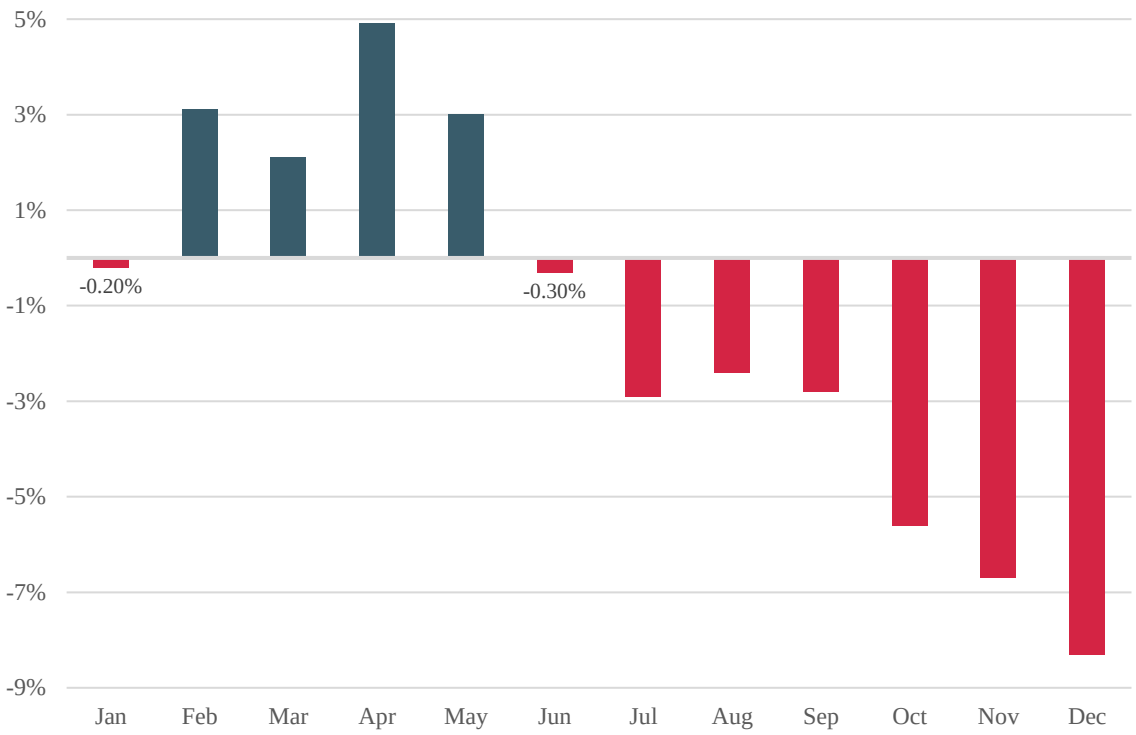
Figure 21: Supply-demand curves diagram illustrating a price ceiling and the resulting shortage for an imaginary, unnamed product



Source: Own work, created with Figma.

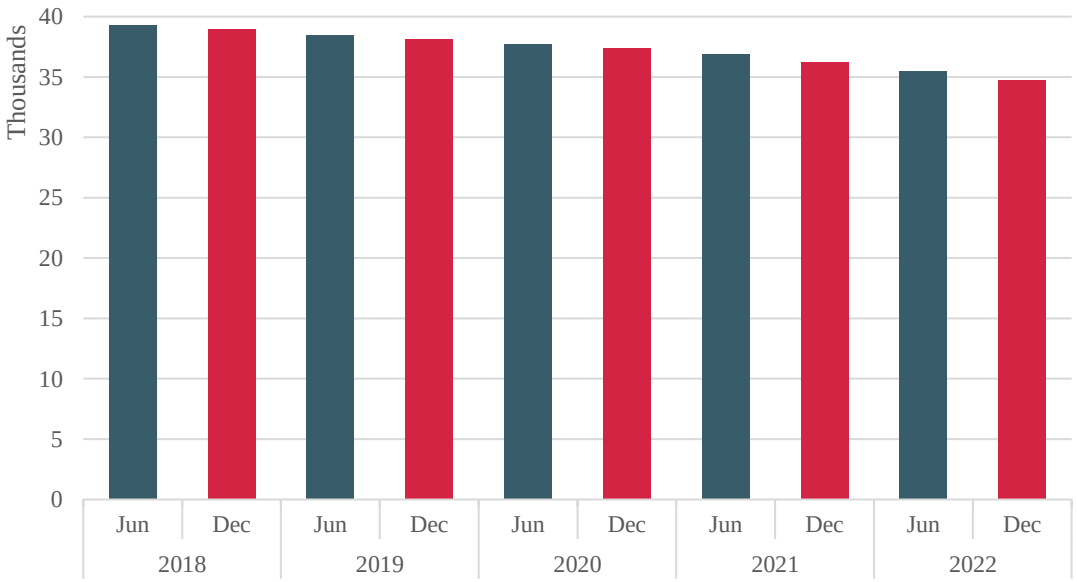
Appendix 18: Post-intervention effects on the demand and supply side in food and beverage sector

Figure 22: Monthly calendar effect adjusted volume changes on retail sales in specialized and non-specialized food shops 2022



Source: KSH (2023b).

Figure 23: Number of specialised and non-specialised food shops in Hungary biannually between 2018-2022



Source: KSH (2022).