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Εξωτερικοί κλυδωνισμοί και ο πληθωρισμός στην Κύπρο

Νεκτάριος Α. Μιχαήλ και Χρήστος Σ. Σάββα

ΠΕΡΙΛΗΨΗ

Οι πρόσφατες γεωπολιτικές εντάσεις, κυρίως λόγω του πολέμου Ρωσίας-Ουκρανίας, ώθησαν τις τιμές του πετρελαίου και των τροφίμων υψηλότερα, δεδομένης της σημασίας των χωρών αυτών στο διεθνές εμπόριο των εν λόγω εμπορευμάτων. Καθώς ο κόσμος βασίζεται σε μεγάλο βαθμό σε μια συνεχή ροή ενέργειας για να υποστηρίξει τις συνεχώς αυξανόμενες ενεργειακές ανάγκες του, από τον φωτισμό σπιτιών μέχρι την υγειονομική περίθαλψη, η σημασία της ενεργειακής ασφάλειας δεν μπορεί να υποτιμηθεί. Ωστόσο, οι εξωτερικοί κλυδωνισμοί που προκαλούν αυξήσεις των τιμών δεν περιορίζονται στο πετρέλαιο: καθώς τα τρόφιμα είναι ζωτικής σημασίας για την επιβίωση της ανθρωπότητας, μια αύξηση στις τιμές τους έχει ακόμη μεγαλύτερο κοινωνικοοικονομικό αντίκτυπο. Για το σκοπό αυτό, οι κεντρικές τράπεζες ανά τον κόσμο δίνουν ιδιαίτερη προσοχή στις εξελίξεις των τιμών του πετρελαίου και των τροφίμων, ιδιαίτερα καθώς αυτοί οι εξωτερικοί κλυδωνισμοί τείνουν να μεταδίδονται γοργά στην υπόλοιπη οικονομία.

Η μελέτη αυτή διερευνά πώς οι αλλαγές στις τιμές των τροφίμων και του πετρελαίου επηρεάζουν τον πληθωρισμό. Για να εξετάσουμε τη μετάδοση αυτών των κλυδωνισμών, χρησιμοποιούμε δεδομένα για τον πληθωρισμό βάσει του Εναρμονισμένου Δείκτη Τιμών Καταναλωτή (ΕνΔΤΚ) στην Κύπρο, καθώς και τις κύριες υπό-κατηγορίες του μεταξύ Ιανουαρίου 2008 και Δεκεμβρίου 2021 για να προσδιορίσουμε εάν ένα μοντέλο θα μπορούσε να προβλέψει τη μεταβολή του πληθωρισμού στη βάση των αλλαγών στις τιμές του πετρελαίου και των τροφίμων. Για το σκοπό αυτό, χρησιμοποιούμε ένα μοντέλο διανυσματικής αυτοπαλινδρόμησης με προσέγγιση συνολοκλήρωσης (Vector Error Correction Model), καθώς έχουν ανιχνευτεί σχέσεις συνολοκλήρωσης μεταξύ των μεταβλητών.

Τα ευρήματά μας δείχνουν ότι οι εξωτερικοί κλυδωνισμοί έχουν σημαντική επίδραση στην πλειονότητα των υπό-κατηγοριών του ΕνΔΤΚ. Ειδικότερα, μια αύξηση στις τιμές του πετρελαίου κατά 1%, αυξάνει, ως αναμενόταν, τον ενεργειακό πληθωρισμό κατά 3,5%, ενώ μια παρόμοια αύξηση στην τιμή των τροφίμων επηρεάζει κυρίως τον πληθωρισμό μη επεξεργασμένων τροφίμων (1%). Για να λάβουμε υπόψιν το μακροοικονομικό περιβάλλον αλλά και την αντίδραση οικονομικής πολιτικής,

συμπεριλαμβάνουμε επίσης το επιτόκιο Euribor 3 μηνών, του οποίου η αύξηση, όπως αναμένεται και θεωρητικά, έχει αρνητικό αντίκτυπο σε κάθε επιμέρους συνιστώσα του ΕνΔΤΚ.

Στη βάση των πιο πάνω, η πρόβλεψη του μοντέλου, χρησιμοποιώντας το πραγματικό μέγεθος του κλυδωνισμού για το πρώτο μισό του 2022, είναι παρόμοια με την πραγματική εξέλιξη του ενεργειακού πληθωρισμού κατά την ίδια περίοδο. Αυτό εξηγείται από το γεγονός ότι το πετρέλαιο, με το οποίο παράγεται η συντριπτική πλειοψηφία της ενέργειας στην Κύπρο, είναι ο κύριος μοχλός του ενεργειακού πληθωρισμού στον ΕνΔΤΚ, και ως αποτέλεσμα η επίδραση πιθανόν να είναι υψηλότερη από ό,τι σε άλλα έθνη. Ωστόσο, αυτός ο αντίκτυπος πιθανότατα θα μειωθεί στο μέλλον δεδομένης της μετάβασης σε πιο φιλικές προς το περιβάλλον πηγές ενέργειας.

CONTENTS

External Shocks and Inflation in Cyprus

Nektarios A. Michail*, **and Christos S. Savva**

Abstract

We investigate how the price of crude oil, the cost of food, and the Euribor rate affect inflation in Cyprus. To do so, we use a Vector Error Correction (VEC) methodology for the 2008–2021 period for both the headline and the main components of the Harmonized Index of Consumer Prices (HICP). As expected, the magnitude of the shocks' effects on inflation varies depending on the component. Energy inflation, expectedly, has the largest response to an oil price shock, given Cyprus' dependence on oil as an energy source. The estimates are consistent with the developments in energy inflation in the first half of 2022, but the other components do not react in accordance with the data, pointing to the possible existence of non-linearities. Finally, positive shocks to the Euribor cause all inflation categories to decline, albeit to a small extent.

Keywords: Vector Error Correction, Cyprus, Inflation, HICP, Brent oil, food prices.

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1. Introduction

The recent geopolitical tensions due to the Russia-Ukraine war, pushed oil and food prices higher, given the countries' importance in the international trade of these commodities. This was not a first-time thing: starting from the Suez crisis almost 60 years ago, there have been many occasions when oil prices rose significantly and unexpectedly (Hamilton, 2003). As the world relies extensively on a continuous flow of energy to support everything from lighting houses to health care, the importance of energy security cannot be understated. However, external price shocks are not just limited to oil: as food is vital to the survival of humankind, it has an even greater socioeconomic impact. To this end, central banks pay special attention to oil and food price developments, particularly as these external shocks are passed along to the rest of the economy.

Even though published before the recent increases in oil and food prices, the academic literature suggested that the inflationary impact of oil prices may be waning. For example, Choi et al. (2017) demonstrate that a nation's energy-subsidizing activities significantly reduce the pass-through of oil to inflation. Similar to this, according to Jongwanich and Park (2011), and with support from Brown and Tousey (2019), government regulations decrease the effect from oil and food price shocks.

Recent evidence, however, suggests that the oil pass through may still be as powerful as before. This study aims to investigate how changes in food and oil prices affect HICP inflation in Cyprus. We use data on the headline HICP inflation and its main sub-components between January 2008 and December 2021 to determine whether a model could have predicted the change in inflation as a result of higher oil and food prices. A Vector Error Correction (VEC) model is used, as cointegrating relationships are detected among the variables employed. Our findings suggest that the shocks have a significant effect on the majority of the HICP components. In particular, an oil shock is, expectedly, found to affect mostly energy inflation (3.5%), while a food price shock affects both energy inflation (1.4%) and unprocessed food (1%). To control for the macroeconomic developments and the policy reaction, we also include the Euribor 3-month rate, which appears to have a contractionary impact on each HICP sub-component.

The model's predicted response based on the magnitude of the shock is strikingly similar to the results of the actual data for 2022. This is explained by the fact that oil, which accounts for about 92 percent of Cyprus' energy production, is the primary driver of the energy component of the HICP, and that as a result, the pass-through may be higher than in other nations. However, we can anticipate that this impact will probably decrease in the future given the switch to more environmentally friendly energy sources.

The remainder of the paper is organized as follows: in the next section, we overview the literature on inflation pass-through, while section 3 introduces our model and the data used. Section 4 presents the empirical results and their economic interpretation, and the final section concludes.

2. Literature Review

Despite the lengthy history of the literature on inflation decomposition (Nordhaus and Shoven, 1977) and the relationship between the price of oil and inflation (Burbidge Harrison, 1984; Gisser and Goodwin, 1986), we present below the most recent advancements in the area. Additionally, as previously stated, the most significant finding of the recent literature is that the amount of inflation caused by the oil price pass-through is decreasing (Choi et al., 2017; Çatik and Karacuka, 2012; Brown and Tousey, 2019).

The literature has also concentrated on dissecting inflation and measuring the impact of such shocks on its sub-components because not all inflation components respond to external shocks in the same way. Hahn (2003) was likely the first to examine the pass-through of external shocks to the euro area, discovering that shocks to non-oil import prices have the largest and fastest pass-through, followed by shocks to exchange rates and shocks to oil prices. In a similar manner, Castro et al. (2017) use data for France, Germany, Italy, and Spain to examine the impact of the oil price pass-through on various inflationary components.

Furthermore, Conflitti and Luciani (2019), study US and euro area oil price pass-through to inflation on disaggregate prices reveals that the oil-price inflation pass-through occurred through the impact of oil prices on the economy rather than the cost channel. Similarly, Guidi (2009) finds that the UK services sector responds more strongly to negative oil price shocks than to positive ones. Most importantly, it appears that the services sector affects how long inflation persists at the overall price level.

Other studies place stronger emphasis on the wider economic connections from oil prices. For instance, He et al., (2010) demonstrate the existence of a cointegration relationship between oil prices, the Kilian economic activity, and US dollar indices. Other studies lend support to this conclusion, as they demonstrate a close relationship between oil prices and economic activity (e.g. Ibrahim and Said, 2012; Irz et al., 2013). Lòpez-Villavicencio and Pourroy (2019) expand on this and suggest that inflation-targeting countries have a higher oil pass-through to inflation, indicating that country-specific factors also play a significant role. However, it does seem that inflation targeting facilitates the symmetrisation of said pass-through.

The literature has also looked into food prices, particularly because of how significant they are in the broader socioeconomic context. In particular, emphasis is placed on the distinction between developed and developing economies. Mitchell (2008) notes a negative effect on developing nations, while Jalil and Esteban (2011), who look at the impact of food price shocks on the inflation rates of five Latin America nations, suggest that a country's inflation may not be affected for one to six quarters. In contrast to developed economies where inflation expectations are more firmly rooted, food is more prevalent in consumer baskets in emerging economies leading to a higher impact in overall inflation as Furceri et al., (2016) demonstrate.

Durevall et al. (2013) support the above arguments, as they demonstrate that during severe food crises in emerging nations, short-term shocks were so large that the long-term price deviated from its initial trend. However, as Jongwanich and Park (2011) demonstrate, government regulations such as price controls and subsidies appear to have lessened the impact of both oil and food price shocks (see also Brown and Tousey, 2019). Other studies support the existence of a link between oil and food prices: Esmaeili and Shokoohi (2011) show how changes in the price of oil have an indirect impact on food costs, and Irz et al., (2013) argue that macroeconomic variables in Finland have a long-term (cointegrating) relationship with the country's food and energy prices.

Studies with Cyprus data involved, are few and do not directly address how food and oil prices affect inflation. According to Clerides (2010), retail fuel prices adjust somewhat faster to an increase in the international price than they do to a decrease, but the difference is neither statistically significant nor has much of an impact on the economy. Charalambous and Clerides (2020), who also present evidence of weak asymmetry, bolster these conclusions. While other studies have also explored the role of oil in the Cyprus economy (e.g. Zachariadis and Pashourtidou, 2007; Zachariadis and Taibi, 2015; Michail and Savva, 2021), no study has, to date, elaborated on the impact from oil and food price changes on inflation.

In short, the literature suggests that food and oil prices have an impact on inflation, even though this relationship seems to have eased recently. Given the recent developments in oil and food prices, following the Russia-Ukraine war, in what follows, we aim to examine whether this is still the case in Cyprus. In addition, since no study has looked at the pass-through of oil and food prices to Cyprus inflation, this is also the first time that a model on this topic is presented. Information on the model and data used is provided in the section that follows.

3. Empirical Methods and Data

Following the literature, we aim to elaborate on the pass-through of oil and food prices to the Cyprus economy. Given the noted presence of a cointegrating (long-run) relationship between oil and food prices and the overall price index, we propose the use of a Vector Error Correction (VEC) model, as per Johansen and Juselius (1990). Formally, the VEC model general form is:

$$\Delta Y_{j,t} = \alpha_j + \sum_{i=1}^{p} \beta_{1,i,j} \Delta Y_{j,t-i} + \sum_{k=1}^{K-1} \sum_{i=1}^{p} \gamma_{k,i,j} \, \Delta \boldsymbol{X}_{t-i} + \psi_j \Omega_t + \lambda_t (Y_{t-i} - \theta_{1,j} \boldsymbol{X}_{t-1} - \theta_{0,j}) + \varepsilon_{j,t}$$

where the total amount of variables is *K,* with $Y_{j,t}$ being the dependent variable in each case. X_t is a matrix containing all endogenous variables of the estimation (excluding *j*) and Ω_t is a matrix that includes the exogenous variables used in the estimation. Δ is the first difference operator, $\beta_{1,i,j}$ is the coefficient of the own lagged value(s), $\gamma_{k,i,j}$ denotes the coefficient of other variables' lags in the estimation, and the ψ_j refers to the exogenous variables' coefficients. Lastly, $\varepsilon_{j,t}$ is the error term in each of the *K* equations and λ_t is the coefficient of the error correction term contained in brackets (see also Michail and Melas, 2022 for an application).

The VEC model was selected since it enables the use of the long-term relationship between our K variables. As the literature on this topic suggests, (e.g. Hendry and Juselius, 2000), it is more appropriate for the data generating path to use a long-term relationship, when one exists, than to use first differences.[1] The setup enables us to investigate the shock persistence as well as the rate at which a long-run equilibrium is reached if a long-term (co-integrating) relationship is present (Michail and Melas, 2022).

[1] Johansen and Juselius (1990) refer to the long run as the equilibrium relationship among the variables as the outcome that would be reached in the absence of any external shocks. Likewise, short run refers to the ups and downs in said variables that may occur and could cause deviations from the expected equilibrium. Thus, both "long run" and "short run" do not relate to a fixed (or predetermined) period, or time length, but refer more to the standard way of relationship notation as derived from theoretical models.

In this case, we employ two models in order to have a more detailed view of inflation. The first model (HICP Model) includes K=4 variables, and in particular oil prices defined at the price of Brent oil in euros, food prices, headline HICP inflation, and the 3-month Euribor rate. Data definitions and sources are found in the Appendix. Concerning the included variables, oil and food prices are the main variables of interest, and the ones that exert the main exogenous inflationary pressures (see De Gregorio et al., 2007). Euribor refers to the 3-month euro interbank rate, which proxies the ECB policy rate and hence allows for a view of the monetary conditions of the economy at that point in time.

Before switching to a more disaggregated approach, we use the overall HICP in the initial iteration to examine the aggregate effect. This is made in order to get a general understanding of how the model variables fluctuate after a shock. While this exercise is helpful, it only provides a broad overview of how the price of food and oil affects the economy. Additionally, according to the literature, items such as services HICP show signs of elevated inflation persistence (Lunnemann and Mathä, 2005), while items with a heavy import share, such as NEIG, tend to have an important effect on overall inflation (Lim and Sek. 2015; Michail et al., 2022).[2] As such, we employ the main sub-categories of inflation, notably Energy, Non-Energy Industrial Goods (NEIG), Processed Food, Unprocessed Food, and Services.

Further to the above, we have also included exogenous variables, namely a dummy variable which takes the value of one in March, April and May of 2020, in order to capture the effects of Covid-19 on the economy. All endogenous variables are seasonally adjusted, except Euribor 3m in which no seasonality was present. The data used for this analysis ranges from January 2008 to December 2021.

[2]We note that in alternative specifications (not presented but available upon request) we have also included variables such as the unemployment rate, however with no significant effect on the responses of HICP and its subcategories.

TABLE 1
Unit Root Tests

Variable	Levels	1st Differences	Levels	1^{st} Differences
oil_prices_t	-2.574	-9.894***	-2.601*	-10.203***
$food\_prices_t$	-0.636	-6.442***	-0.737	-6.496***
$hicp\_energy_t$	-2.027	-6.761***	-1.817	-6.847***
$hicp\_neig_t$	-1.288	-15.242***	-1.011	-16.685***
$hicp\_pfood_t$	-3.057**	-13.334***	-3.270**	-13.405***
$hicp\ ufood_t$	-3.363**	-8.686***	-3.262**	-31.150***
$hicp\_total_t$	-2.642*	-15.145***	-2.499	-15.165***
$hicp\_serv_t$	-1.932	-13.882***	-1.913	-13.881***
$euribor\_3m_t$	-2.948	-4.814***	-3.001**	-4.878***

*,**,*** denotes significance at the 10%, 5%, and 1% level of H_0 rejection respectively. Critical values, one sided: 1% level: -3.47, 5% level: -2.87, 10% level: -2.57. The null hypothesis is that the variable has a unit root.

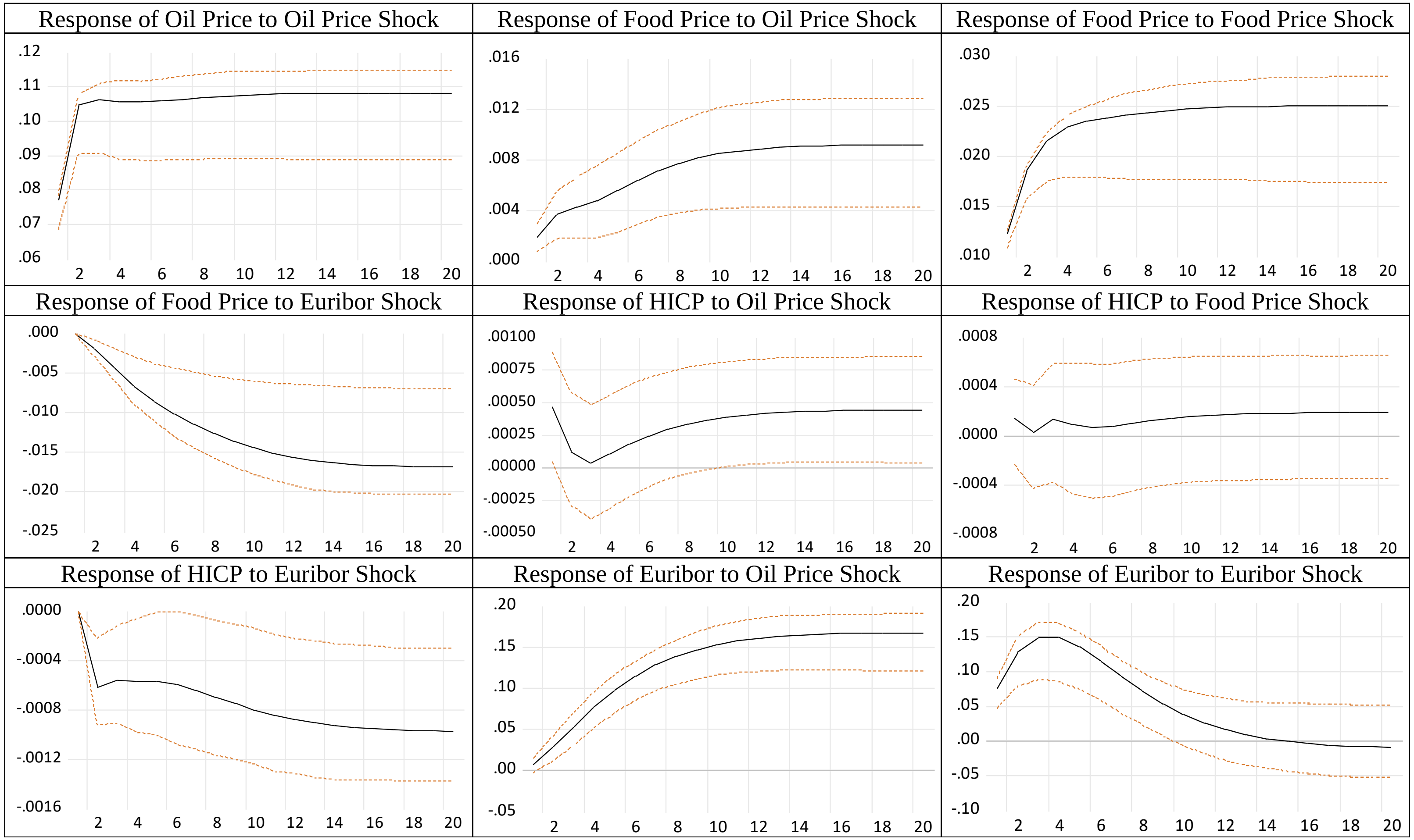
All variables were tested for unit root presence using the Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests. Table 1 presents the unit root test results, showing that all variables are I(1). Further to this, a Johansen cointegration test was conducted, which confirmed the presence of one cointegrating relationship. The optimal lag length was found to be two, and one for each of the two models, on the basis of the Schwarz Information Criterion. The Johansen test and the information criteria results are available upon request. The following section provides the estimates from the VEC estimation.

4. Empirical Results

Throughout the section, a shock magnitude of one standard deviation of the relevant residuals is used. Naturally, depending on the variable, a one standard deviation shock typically has a different magnitude, and hence its precise size can be determined by looking at the shocked variable’s initial response. An exogenous shock in our models could be intuitively interpreted as a rise in global oil prices because of tighter oil supply, or higher food prices due to supply constraints. For completeness, we also include the effects from a change in the ECB interest rate. The 95% confidence interval is represented by dashed lines.

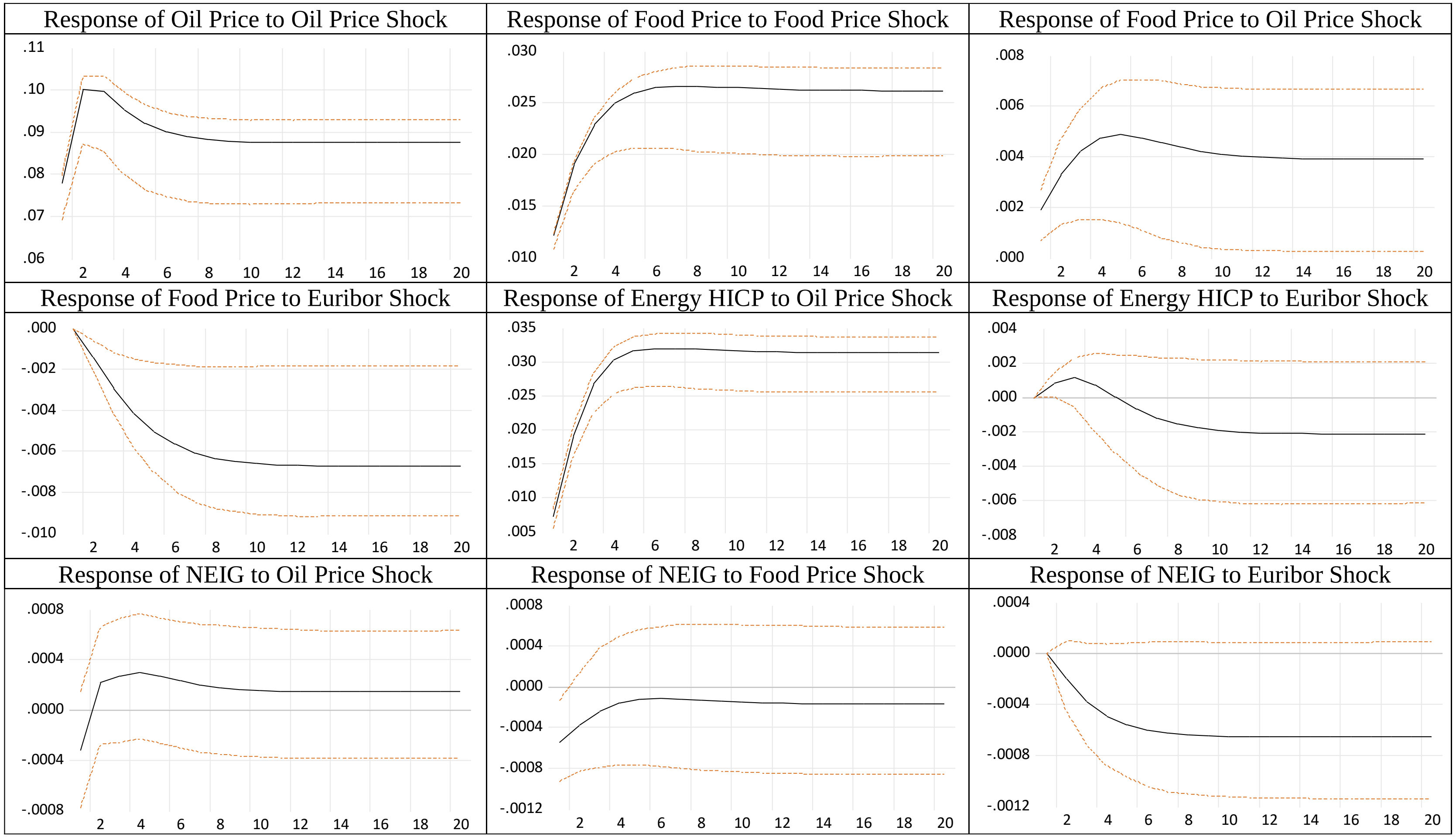
FIGURE 1

Overall HICP model Impulse Response



` **FIGURE 2**

HICP Breakdown Impulse Responses (selected)



In Figure 1, we observe that an oil price shock, with a long-term permanent impact of around 11% causes the aggregate HICP to rise by approximately 0.05%, with the effect becoming significant only after several months have elapsed. Given that some categories may be less responsive to the change in oil prices, the estimates may be understated (see Figure 2 for more details). Additionally, it appears that after this shock, the price of food across the globe increases by roughly 0.8%, stabilizing at this level around 10 periods following the shock. Given the heavy use of oil by-products in the food industry (Henry, 1998), this response is to be expected. A spike in food prices has little effect on overall inflation, but an increase in the Euribor rate causes the HICP to decline, as expected.

We display the estimates using the inflation sub-components in Figure 2. Energy HICP responds to a 9% shock in oil prices by rising by 3%, with the effect stabilizing after the third period. Food prices also increase at the same time, reaching a peak of about 0.5% four months after the shock. The services HICP registers a short-lived 0.08% response to oil prices, while unprocessed food is negatively affected from the same shock. On the other hand, processed food and NEIG inflation record insignificant responses.

A food price shock appears to have negligible effects on the components of the HICP model, with two exceptions. First, energy HICP that records on increase of 1.2%, and second, unprocessed food price HICP, which rises by 0.3% on impact and stabilizes at 0.8% after the fourth period. Energy (-0.20%), processed food (-0.12%), NEIG (-0.05%), and services HICP (-0.07%) appear to all record significantly negative responses in relation to the Euribor shock.

We compare our model results to the actual values of the Brent oil price in the first half of 2022 (which have almost doubled), in order to cross-check our model results. As a result of this 100% oil price shock energy HICP would increase by about 31%, which is consistent with the actual data pointing to a 35% increase. This demonstrates the reliability of our model and indicates that, in the case where oil is the only source of shock, calculating the effects through an economic model is a relatively straightforward task. This is also because oil accounts for approximately 92% of all energy used in Cyprus (Michail and Savva, 2021).

On the other hand, the model predicts that the same increase in oil prices (i.e. a 100% rise in the price level) would result in a rise of 0.7% in NEIG, a decrease of 0.9% in processed food, and an increase of 0.5% in total services. According to the data for the time period, NEIG increased by 5%, processed food increased by 7%, unprocessed food increased by 26.4%, and services increased by 5.2%. The model does not seem to capture second round effects that cause additional volatility to our parameters, a result can be justified by acknowledging the model's flaws. Yet, while the estimates are not quantitatively close to the observed ones, the model's predictions have the proper economic sign. Hence, this leaves the door open for future research to elaborate on the possible existence of any threshold effects, or any other non-linearities in the relationship between oil, food prices, and inflation.

5. Conclusions

In this study, we investigate the impact of global Brent crude oil prices, food prices, and the Euribor, on Cyprus's overall inflation rate and its subcomponents. According to the findings, the energy HICP increases by about 3% in response to an oil price shock of about 10%. A significant impact on inflation is also observed from a shock in food prices, particularly in the energy and unprocessed food categories. The effects from a tightening of monetary policy on inflation are expected to be negative, even though not large, as evidenced by the analysis of how the inflation's constituents responded to a Euribor shock.

The inflation responses to oil price shocks appear to hold in practice, particularly for the Energy HICP response to the oil price shock of early 2022, given that the predicted values are close to the actual data. This is intuitively appealing, given that Cyprus's energy production comes mainly from oil, making it easier to gauge the energy HICP response to oil price shocks. For the remaining variables, the deviations from actual data are larger, given that the combination of shocks (e.g. both food and oil prices), as well as the potential existence of second round effects that are not captured by the model could pose significant non-linearities, a topic we leave open for future research.

Finally, the model results can become outdated as oil dependence is expected to decline given the adoption of renewable energy sources. Hence, to assess the impact from rising oil prices on inflation, future studies should take the shift toward alternative energy sources into account.

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Appendix

Table 1

Variable	**Description**	**Source**
oil_prices_t	Oil Price per barrels (in euros)	Eurostat
$food\_prices_t$	European Food Prices	Eurostat
$hicp_t$	Harmonized Index of Consumer Prices (overall)	Eurostat
$euribor\_3m_t$	Euro Interbank Offered Rate.	European Central Bank, Statistical Data Warehouse
$hicp\_serv_t$	Services Price Index	Eurostat
$hicp\_energy_t$	Energy Price Index	Eurostat
$hicp\_neig_t$	Non-Energy Industrial Goods Index	Eurostat
$hicp\_pfood_t$	Processed Food Price Index	Eurostat
$hicp\ ufood_t$	Unprocessed Food Price Index.	Eurostat