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The impact of global supply chain disruptions on Egypt's inflation: An empirical analysis

تأثير إضطرابات سلاسل التوريد العالمية علي التضخم في مصر: تحليل تجريبي

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Abstract: Global supply chain disruptions due to COVID-19 and the Russian-Ukraine war have increased inflation worldwide in recent years. So, this study aims to examine the effects of these disruptions on inflation in Egypt, utilizing the structural vector autoregression (SVAR) model, with disaggregated monthly data from January 2014 to May 2024. through comparing the response of domestic inflation measures like the consumer price index (CPI) and producer price index (PPI) to supply chain disruption measures by using global prices of oil, food, and shipping costs. In addition to using the real exchange rate (RER). The results indicate that according to structural impulse response functions (IRFs), the global oil price shock and RER immediately positively impact Egypt's CPI and PPI. While shipping costs have an immediate positive impact on PPI and a negative impact on CPI. According to structural variance decomposition, oil prices and shipping costs have tended to significantly affect the PPI more significantly than the CPI. While RER and food have tended to have a more significant effect on the CPI than the PPI. The study's findings could spur policymakers to lessen the inflationary effect of high oil prices by switching to other renewable energy sources and adopting energy-efficient and fuel-efficient technologies. Diversify import sources from geographically close regions to mitigate the effects of inflation resulting from shipping costs. Moreover, it should also enhance all social protection systems for vulnerable categories, maintain currency stability, and enhance export competitiveness.

Keywords : Supply chain disruptions, Egypt, SVAR model, inflation.

الملخص: في السنوات الأخيرة، أدت اضطرابات سلاسل التوريد العالمية بسبب كوفيد-19 والحرب الروسية الأوكرانية إلى زيادة التضخم في جميع أنحاء العالم. لذا تهدف هذه الدراسة إلى دراسة آثار هذه الاضطرابات على التضخم في مصر، باستخدام نموذج الانحدار الذاتي الهيكلي مع بيانات شهرية من يناير 2014 إلى مايو 2024. وتقارن الدراسة استجابة مقاييس التضخم المحلية مثل مؤشر أسعار المستهلك ومؤشر أسعار المنتجين لمقاييس اضطراب سلاسل التوريد، والتي تم التعبير عنها بالأسعار العالمية للنفط، الغذاء، وتكاليف الشحن، بالإضافة الى سعر الصرف الحقيقي. تشير النتائج إلى أنه وفقًا لدوال استجابة الصدمات الهيكلية، فإن صدمة أسعار النفط وسعر الصرف الحقيقي لهما تأثير إيجابي فوري على كل من مؤشري أسعار المستهلك وأسعار المنتجين. بينما، تكاليف الشحن لها تأثير إيجابي على مؤشر أسعار المنتجين، وتأثير سلبي على مؤشر أسعار المستهلك. ووفقًا لتحليل التباين الهيكلي، فإن أسعار النفط وتكاليف الشحن تميل إلى التأثير بشكل أكبر على مؤشر أسعار المنتجين، من مؤشر أسعار المستهلك. في حين أن سعر الصرف الحقيقي، وأسعار الغذاء تميل إلى التأثير بشكل أكبر على مؤشر أسعار المستهلك، من مؤشر أسعار المنتجين. يمكن أن تحفز نتائج الدراسة صانعي السياسات على تقليل التأثير التضخمي لارتفاع أسعار النفط، من خلال التحول إلى مصادر أخرى للطاقة المتجددة وتبني تقنيات موفرة للطاقة. والسعي الى تنويع مصادر الواردات من مناطق قريبة جغرافيا وذلك للتخفيف من اثار التضخم الناتجة عن تكاليف الشحن، كما ينبغي أيضًا تعزيز جميع أنظمة الحماية الاجتماعية للفئات الضعيفة، والحفاظ على استقرار العملة، وتعزيز القدرة التنافسية للصادرات. ووضع عروض جذابة للمستثمرين من أجل جذب المزيد من الاستثمار الأجنبي المباشر إلى قطاعي الصناعة والزراعة لتعزيز الانتاج المحلي.

الكلمات الدالة: اضطرابات سلاسل التوريد، مصر، نموذج الانحدار الذاتي الهيكلي، التضخم.

1.Introduction:

In recent decades, global economies have achieved more coherence through increased trade and the integration of global value chains. In this situation, the economic consequences of disruptions to the global supply chains can be substantial (Meier and Pinto, 2024). In recent years, these kinds of disruptions have become more frequent. Even before the repercussions of the COVID-19 pandemic had subsided, the Russian war on Ukraine ignited in February 2022, causing disruptions in energy markets and food supply chains and increased production input costs (Hamidu et al., 2023). Furthermore, before the effects of the Russian-Ukrainian war were beginning to fade, the Israel. war on Gaza ignited in October 2023, leading to disruptions in shipping lines when Houthi's attacks on commercial ships traversing the Red Sea began in November 2023, causing the ships to reroute towards the Cape of Good Hope and increasing shipping costs (Notteboom et al., 2024). Rises in shipping costs may produce widespread impacts on consumer pricing. Initially, they may directly influence import prices, as the local cost of imported goods escalates by shipping costs. Secondly, a rise in shipping costs for intermediate goods imposes further financial burdens on producers, compelling them to increase prices for domestic consumers (Carrière-Swallow et al., 2023). All of these events pose threats to supply chains, increasing global uncertainty. This, in turn, affects trade flows and impacts inflation (Nana et al., 2024).

For several reasons, these crises harm societies, particularly developing countries, specifically Egypt. First, the extensive implementation of redirecting ships through the Cape of Good Hope directly influences Egypt, leading to lower toll revenues for the Suez Canal Authority (SCA). Second, Egypt, one of the leading wheat importers in the world, is more likely to be affected by the simultaneous occurrence of COVID-19 and the Russia-Ukraine war. Third, the effect of the supply chain disruptions, including the increase in the price of shipping goods–as Egypt is a net importer–and the declines of commodity supplies and the increase of global oil and food prices are anticipated to permeate through the external sector to Egypt. So the research hypothesis represents that global supply chain disruptions increase Egypt's inflation.

However, recent studies have aimed to understand how global supply chain disruptions affect inflation. Some studies focused on the global economy (OECD, 2021; UNCTAD, 2021; Abbai et al., 2022; OECD, 2022; Liu & Nguyen, 2023; Bai et al., 2024). Other studies focused on comparing between advanced and emerging economies (Alvarez et al., 2021; Szafranek, 2021; Ye et al., 2023; Carrière-Swallow et al., 2023; Yilmazkuday, 2024).

While other studies focused on the impact on the Middle East, Sub-Saharan Africa, and Asia (Zhao et al., 2016; Nguyen et al., 2017; IMF, 2022; Andriantomanga et al., 2023; Platitas & Ocampo, 2025). Other studies focused on the USA (Santacreu & LaBelle, 2022; Isaacson & Rubinton, 2022; Meier & Pinto, 2024; Pinchetti, 2024; Anderl & Caporale, 2024). Furthermore, other studies focused on the Euro area (Michail et al., 2022; Finck & Tillmann, 2023; De Santis, 2024). However, only a few studies have explored the impact on Egypt (Soliman, 2023; Alazzawi & Hlasny, 2023; Zaki et al., 2023; Abay et al., 2023). Furthermore, to our knowledge, no study examines the impact of global food, oil, and shipping costs on Egypt's consumer price index (CPI) and producer price index (PPI).

Against this background, this paper ties into the literature on the effect of shipping costs and global oil and food price shocks on global and domestic inflation. Moreover, it enhances this literature by analyzing the inflationary impact of these shocks on Egypt. by investigating the impact of disruptions in global supply chains on inflation in Egypt from January 2014– to May 2024 based on a structural vector autoregression (SVAR) model. To achieve this, the paper examined how various domestic inflation measures, including the CPI and PPI, react to supply chain disruptions, measured by global oil prices, food prices, and shipping costs.

The paper's main findings show that, according to structural impulse response functions (IRFs), the global oil price shock and RER immediately positively impact Egypt's CPI and PPI. While shipping costs have an immediate positive impact on PPI and a negative impact on CPI. And the shock in the global food prices have an immediate negative impact on both CPI and PPI. According to Structural variance decomposition (VD), oil prices and shipping costs have tended to have a more significant effect on the PPI than the CPI. While RER and food have tended to have a more significant effect on the CPI than the PPI.

The rest of the paper is organized as follows: Section 2 reviews the literature. Section 3 presents the global impact of global supply chain disruptions. Section 4 presents some stylized facts about Egypt's economy. Section 5 explains the methodology and empirical results. Section 6 provides the conclusions and recommendations.

2.Literature review

The recent supply chain disruptions caused by the COVID-19 pandemic, the Russian-Ukrainian war, and the Red Sea crisis have resulted in shipment delays, significant shipping costs, and higher prices for food and oil. This raises the question of the extent to which the rest of the price chain experiences these disruptions. Within the empirical literature, numerous papers endeavor to quantify the extent to which supply chain interruptions impact prices. However, the impact of these disruptions on inflation in developing nations, particularly Egypt, is quite limited.

In light of this context, this section examines multiple studies that have endeavored to evaluate the potential economic impacts of different disruptions in the supply chain on inflation. Several studies have examined the effects of supply chain disruptions on the global economy, such as the (OECD, 2021), which has examined the impact of rising shipping expenses on inflation. The study indicates that a steady increase of approximately 50 percent in shipping costs would lead to a corresponding rise of about 0.2 percentage points in CPI inflation within a year. According to the (UNCTAD, 2021) estimation, a relationship exists between shipping freight rates and the CPI. By examining yearly data from many advanced and emerging economies, the report concluded that if container freight costs remain elevated, as seen in 2021, global consumer prices will increase by 1.5 percent relative to a scenario without a rapid surge in freight rates. (Abbai et al., 2022) found an association between the Global Supply Chain Pressure Index (GSCPI) and several international CPI and PPI. The (OECD, 2022) used a quantitative methodology, Employing the NiGEM global macroeconomic model to evaluate the repercussions of the Russia-Ukraine conflict. The simulation demonstrates that worldwide economic growth would decrease by 1% while worldwide inflation would rise by 2.5%. According to (Garicano et al., 2022), the extent of the war's probable effects would depend on various factors, including the degree of reliance on imported commodities (especially energy and food, such as wheat), the economic relations between the two nations engaged in the battle, the exportation of agricultural and energy commodities, and the status of an economy as a net exporter or importer of food and energy. Indeed, developing countries that are net importers of agricultural products and energy are particularly vulnerable, whereas those net exporters of food and energy stand to gain. (Liu and Nguyen, 2023) determine that a GSCPI shock of one standard deviation above the mean leads to a maximum rise of 0.9% in import price inflation, up to 0.1% in inflation expectations, and up to 10% in PPI. However, they observe fluctuations in the latter as costs progress along the production chain.

Finally, (Bai et al., 2024) examine how output and prices respond to supply chain shocks using the SVAR model. The findings illustrate the impact of supply chain disruptions on inflation in 2021. However, in 2022, both conventional demand and supply shocks contributed significantly to explaining inflation.

Other studies focus on comparison between advanced and emerging economics, such as (Alvarez et al., 2021) and (Szafranek, 2021), focus on The positive inflation effect of global oil shocks, indicating that price comovements are time-varying and still most discernible for advanced, tightly integrated economies, strengthen for emerging countries but remain weak for least developed economies. (Carrière-Swallow et al., 2023), Investigate the influence of shipping costs measured by the Baltic Dry Index (BDI) on pricing indices for 46 advanced and emerging economies by employing the SVAR model from February 1992 to December 2021. The findings indicate that higher worldwide shipping costs result in significant rises in import and consumer prices and inflation predictions. The analysis shows that, on average, a one-standard-deviation rise in worldwide transportation costs results in a 0.15 percent increase in domestic headline inflation. Nevertheless, the influence is less significant in nations where imports constitute a minor fraction of domestic consumption and employ an inflation-targeting framework or well-established inflation expectations. Shipping shocks have a more long-term impact than shocks to global oil and food prices. (Ye et al., 2023) investigates the impact of global supply chain disruption on CPI in both developed and emerging economies by using a panel nonlinear autoregressive distributed lag model (NARDL) from October 1997 to February 2022. The results suggest that pressures in the global supply chain affect inflation in both economies. (Yilmazkuday., 2024) investigates the effects of global and domestic supply chain disruptions on inflation in the United States (U.S.), Germany, France, Italy, Spain, China, and the United Kingdom (U.K.). Using the SVAR model during the monthly period from 2010- to 2023. The results indicate that, in all countries, shocks to global and domestic supply chain disruptions lead to increase inflation, except china, where the effects of global supply chain disruptions are significantly higher than those of domestic supply chain disruptions.

While other studies focus on the Middle East, Sub-Saharan Africa, and Asia where, (Zhao et al., 2016) noted that oil price shocks (external supply and demand shocks) have resulted in inflation fluctuations in China. (Nguyen et al., 2017) have emphasized how domestic demand pressures and global shocks, particularly production shocks, have a favorable impact on Sub-Saharan Africa's inflation dynamics in the recent decade.

(IMF, 2022) investigates the impact of global supply chain disruptions on CPI in Oman using an autoregressive distributed lag model (ARDL). The result suggests that the pass-through effects of international food and oil prices on domestic inflation are relatively short-lived, unlike the impact of global supply chain pressures, which appear more persistent. The food price shock and oil price shock disappeared after 13 months. At the same time, the shock in the global supply chain pressure takes up to 22 months to vanish. (Andriantomanga et al., 2023), Studies the implications of supply chain disruptions for inflation and monetary policy in 29 sub-Saharan Africa during the period 2000-2022 using IRFs. The results suggest that Increases in supply chain pressures have had a sizeable impact on headline, food, and tradable inflation. (Platitas and Ocampo, 2025) Employs VAR model to investigate the inflationary impact of GSCPI in the Philippines and select East Asian neighbors from Jan 2019 to July 2023. the results find that supply-chain disruptions are followed by sizable and statistically significant increases in headline inflation in the Philippines, Rep. of Korea, Thailand, and Singapore. Supply-chain shocks also considerably impact the tradable segment of core inflation.

While other studies focused on the U.S. economy, (Herriford et al., 2016) Investigated the influence of shipping expenses on core inflation using an SVAR model. The results showed that a 15% rise in shipping expenses results in a 0.10% growth in core inflation within one year. (Santacreu and LaBelle, 2022) Examine the impact of supply chain interruptions caused by the COVID-19 epidemic on inflation, explicitly focusing on PPI. Their findings suggest that supply chain pressure accounted for as much as 20% of the producer price inflation in November 2021. (Isaacson and Rubinton, 2022) investigate the pass-through of shipping costs to import prices using a fixed effect model. The results show that shipping charges are transmitted minimally. However, the significant increase in shipping costs can contribute to an annual inflation rate for import prices during the post-pandemic period, ranging from 3.60 to 5.87 percentage points Monthly. (Meier & Pinto, 2024) examines the impact of COVID-19 supply chain interruptions on actual economic activity and prices. The findings indicate that the sectors heavily reliant on imported intermediate goods from China faced substantial decreases in output, employment, imports, and exports. Furthermore, these industries saw an increase in relative input and output prices. (Pinchetti, 2024) investigates the effects of geopolitical risk shocks on inflation and economic activity, explicitly emphasizing the influence of energy markets. The results indicate that industries with higher energy intensity experience more significant reductions in production and higher price increases.

(Anderl and Caporale, 2024) examine the impact of global supply chain disruptions during COVID-19 and the subsequent rise in shipping costs on headline CPI, core CPI, PPI, and import price inflation using SVAR models for the U.S., the U.K., and the euro area. The findings indicate that fluctuations in shipping costs significantly impact several inflation indicators and have a more pronounced transmission effect than other local or global shocks.

Additional papers have focused on the Euro area, such as the study conducted by (Michail et al., 2022) employed a vector error correction model (VECM) and threshold regressions to analyze the relationship between inflation and shipping costs by using monthly data from January 2009 to August 2021. They found that an unexpected change in freight rates primarily impacts inflation in sectors that typically produce goods outside the euro area, specifically garments and major household appliances. When freight costs increase by more than $1,300-$1,500 per day, the impact of changes in freight on inflation becomes more pronounced. (Finck and Tillmann, 2023) using the VAR model. The findings indicate that a worldwide supply chain disruption leads to a decline in the euro area's actual economic performance and a significant rise in CPI. Within a year, the global supply chain shock accounts for around 30% of inflation dynamics, and the supply chain disruptions originating in China significantly influence unanticipated fluctuations in industrial production. On the other hand, disruptions originating outside of China play a crucial role in shaping consumer pricing dynamics. A Bayesian VAR model (De Santis, 2024) identifies energy supply and supply chain disruption shocks. The results show that the latter has a long-term impact on core inflation, while the former only has a temporary effect.

Finally, some papers have focused explicitly on Egypt. (Soliman, 2023) Investigate the impact of the COVID-19 pandemic on Egypt's inflation by employing monthly data and applying the ordinary least squares model from January 2020 to December 2021. The results indicate a positive correlation between new confirmed cases of COVID-19, food costs, imports, the PPI, and the level of inflation.

(Alazzawi and Hlasny, 2023) examine commodity price variations' effects on household spending and welfare. Egypt's urban and rural commodity prices from January to December 2022 were analyzed. The results show that the Russia-Ukraine war has affected households' consumption patterns and socio-economic categories. The results show that lower-spending and rural residents have seen considerable welfare reductions. From January to May 2022, when world prices rose quickly, the lowest rural Egyptian households had a much greater inflation rate than higher-income rural and urban households. Affluent urban families in Egypt

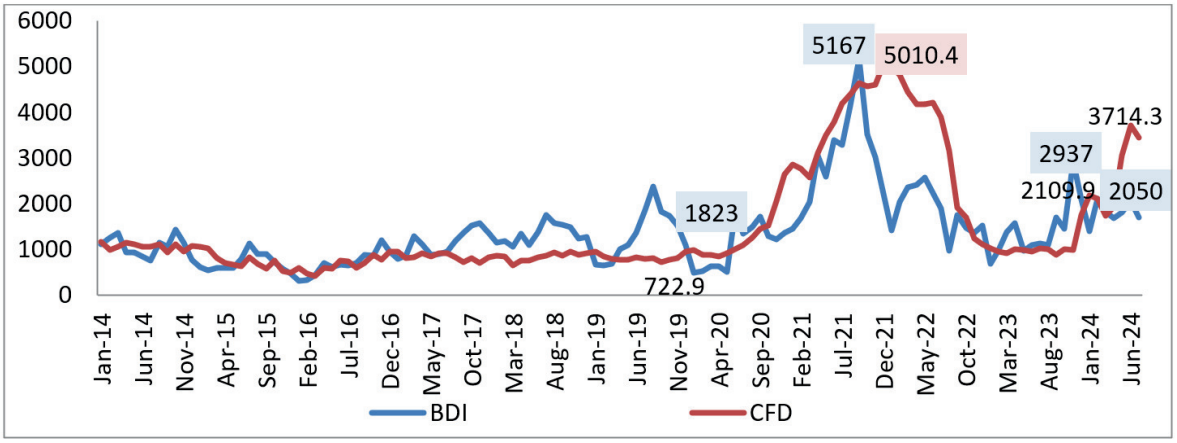
had an inflation rate of 18.1% in 2022, while impoverished rural households had 22.5%, a 4.4% difference. (Zaki et al., 2023) aim to analyze the interconnection between trade, food security, and the war in Ukraine, with a particular emphasis on Egypt and Sudan. Utilizing an error correction model from 2012 to 2022, the findings indicate that Egypt and Sudan saw a significant exchange rate pass-through, which could have long-term effects on inflation. Finally, (Abay et al., 2023) examined the repercussions of the Russia-Ukraine conflict on worldwide and regional food security. Furthermore, they presented detailed information on the impact of food systems and policies on price susceptibility in specific countries, namely Egypt, Sudan, and Yemen. These countries are especially susceptible to trade shocks due to their significant reliance on food imports. This evidence indicates that the war's impact varies between impoverished and affluent households and families in rural and urban areas. Urban poor families would experience tremendous suffering due to the absence of social protection and food subsidies. They suggest that it is crucial to diversify wheat sources in the short term, considering a cost-benefit analysis for this policy choice. It is critical to prioritize protecting impoverished and vulnerable households in the chosen countries. In Egypt, they suggest that it would be beneficial to expand agricultural land options by focusing on enhancing water management techniques and modernizing agricultural systems for long-term planning.

This paper contributes to a growing literature analyzing the effects of global shocks on domestic inflation. In comparison, previous studies that focused on Egypt have examined the impact of the COVID-19 pandemic on Egypt's inflation or focused on the impact of the Russia-Ukraine war on Egyptians' household spending and food security. To our knowledge, no study has examined the impact of global food, oil prices, and shipping costs on Egypt's inflation. So, this study builds on previous theoretical and empirical studies on the effect of global oil, food, and shipping cost shocks on global and domestic inflation. Moreover, it enhances this literature by analyzing the inflationary impact of these shocks on Egypt. Thus, the study makes a twofold contribution. Firstly, it analyzes the macroeconomic effects of supply chain disruptions on Egypt. Secondly, it investigates the impact of global supply chain disruptions on domestic inflation, using measures such as global oil prices, food prices, and shipping costs. It utilizes the SVAR model and monthly data from January 2014 to May 2024.

3.The global impact of global supply chain disruptions

COVID-19 has significantly affected worldwide supply networks, resulting in unparalleled rises in shipping costs, delays, and congestion at ports. These restrictions adversely affect international trade and inflation, particularly in a globalized world. Fluctuations in shipping costs can impact both the inflation of import and producer prices, as well as the inflation of consumer prices (Carrière-Swallow et al., 2023; Anderl and Caporale, 2024). In September 2021, the Containerized Freight Index (CFD) showed that the cost of maritime freight for shipping containers had risen by more than 500% compared to the levels before the pandemic in September 2019. Similarly, the Baltic Exchange Dry Index (BDI) indicated that The cost of maritime transportation for bulk goods has increased threefold. Figure 1 illustrates this.

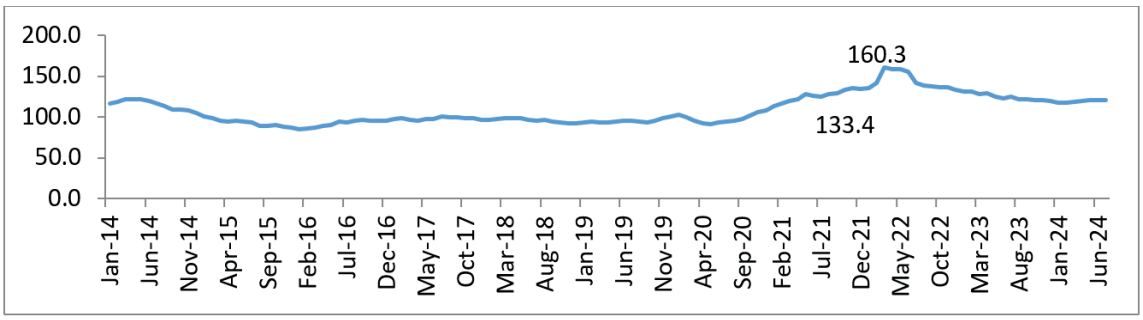
Figure 1: Shipping costs index during the period January 2014- July 2024



Source: Constructed by the author using the Trading Economics online database. (2024)

Also, the COVID-19 pandemic created substantial disturbances in the food sector regarding production and demand, leading to a rise in the global prices of important food staples. In October 2021, global food prices had risen above pre-pandemic levels, reaching 133.4 points. Figure 2 illustrates this. Consumer inflation worldwide has increased far more quickly than anticipated (Michail et al., 2022).

Figure 2: World food price index during the period January 2014- July 2024

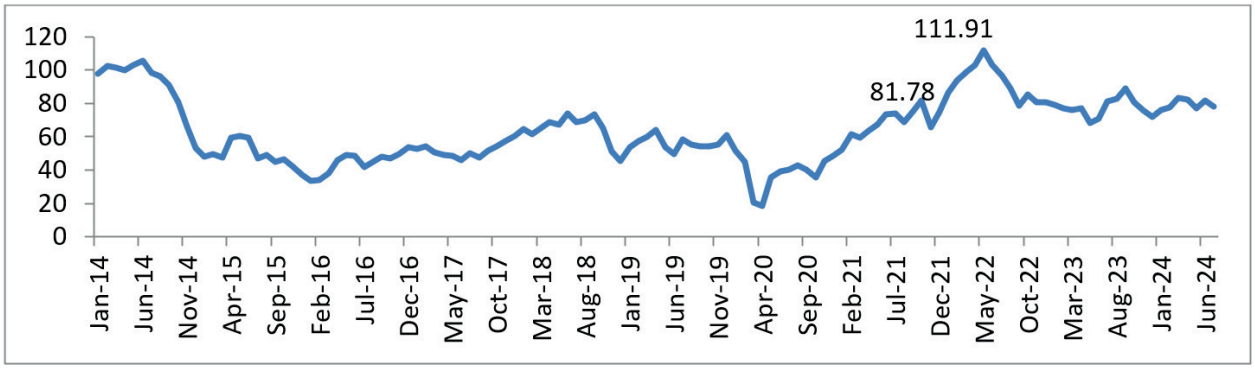


Source: Constructed by the author using the FAO online database. (2024)

The Russia-Ukraine war has triggered a new wave of disruptions concerning raw materials, food products, and energy supply, significantly affecting most manufacturing companies. These wars resulted in a rise in worldwide prices of vital food commodities. Moreover, generalized inflation worldwide (Hamidu et al., 2023). Both countries, Russia and Ukraine, are significant providers of food and agricultural commodities, including wheat, corn, and vegetable oils; also, Russia is a leading supplier of fertilizers (Zaki et al., 2023). As shown in Figure 2, in March 2022, global food price levels rose above pandemic levels and reached 160 points, compared to 133.4 points in October 2021. As depicted in Figure 3, global oil price levels had risen above pandemic levels in May 2022, reaching 111.9 points, compared to 81.7 points in October 2021. This resulted in a severe energy crisis throughout Europe (De Santis, 2024).

Additionally, several developing nations in Africa were disproportionately impacted by the war due to their vulnerable food security systems, as the costs of food imports have escalated, which were already elevated beyond typical values because of the COVID-19 pandemic (Mostafa et al., 2024). Therefore, the purchasing power of households would be impacted, as most households in Africa dedicate a significant portion of their expenditures to food (UNDP, 2022).

Figure 3: World oil price index during the period January 2014- July 2024



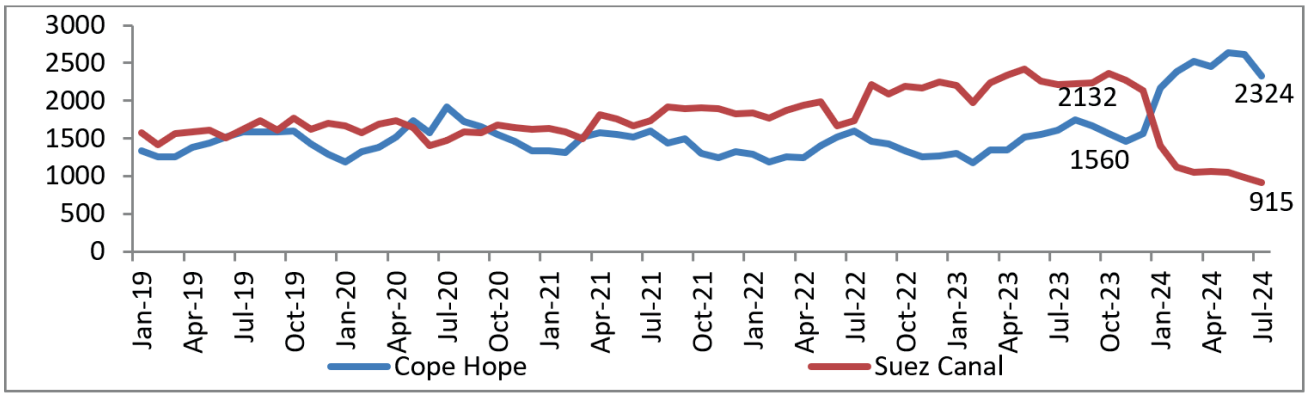
Source: Constructed by the author using the Trading Economics online database. (2024)

Additionally, the recent assaults on commercial vessels in the Red Sea, commencing on November 19, 2023, have generated uncertainty and are anticipated to affect world trade, given that 40% of Asia-Europe trade routes traverse this area. This conflict has compelled maritime companies to redirect their services through the Cape of Good Hope, causing substantial disruptions to global supply networks. This has led to shipment delays, a substantial increase in shipping costs, and significant negative impacts on the trade (Notteboom et al., 2024).

This is comparable to what transpired during the "Ever Given" incident in March 2021, when the Suez Canal was closed for six days, costing the global economy $10 billion per day in lost trade (Notteboom et al., 2024). UNCTAD emphasized that these interruptions have significant economic ramifications. While the current container rates are approximately half of what they were during the COVID-19 crisis. It will take some time for consumers to feel the full impact of the higher prices, with the full effect anticipated in a year.

Additionally, the Red Sea Crisis impacted natural gas and oil transit through the region, directly affecting energy supplies and leading to a spike in energy costs, particularly in Europe (UNCTAD, 2024). Similar conflicts affected energy trade and pricing throughout the Middle East, particularly in the Hormuz Strait, which channeled 21% of the world's petroleum liquids consumption (Nana et al., 2024). At the end of November 2023, the BDI index increased again to reach 2937 points, then decreased to 2050 at the end of June 2024. The CFD index also experienced an increase, reaching 3714 points at the end of June 2024, as shown in Figure 1. Nevertheless, compared to the record freight prices experienced during the COVID-19 years (2021–early 2022), the significant rises in freight rates remained much lower. The key reason is that since December, the 74% increase in sailings around the Cape of Good Hope has compensated for the 50% decrease in shipping traffic via the Suez Canal (Notteboom et al., 2024). Figure 4 illustrates this.

Figure 4: Number of monthly transit Ships (cargo and tanker Ships) during the period January 2014- July 2024



Source: Constructed by the author using the IMF Portwatch online database. (2024)

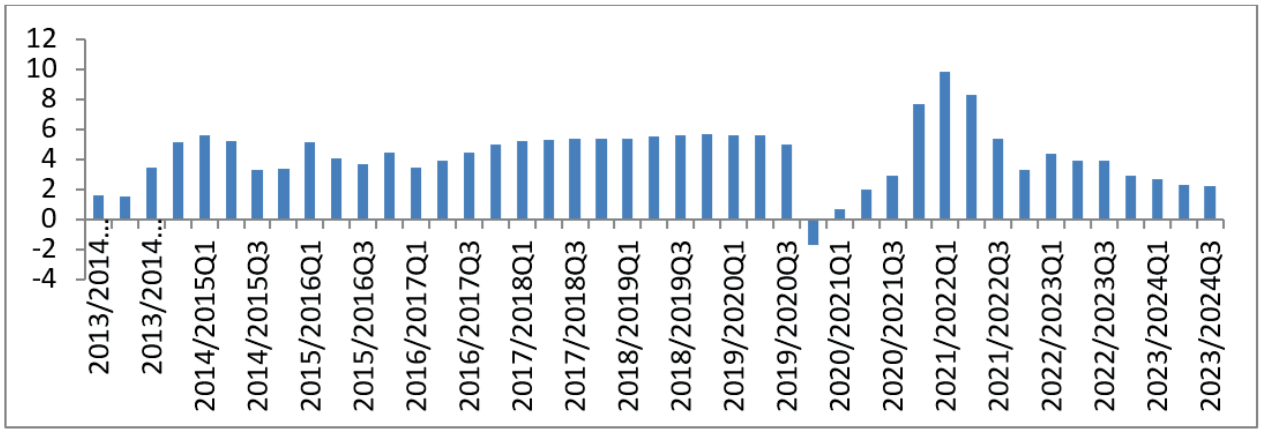
4.Some stylized facts about Egypt's economy

The country's existing imbalances have been worsened by severe global shocks, specifically the Russian invasion of Ukraine and, more recently, the Red Sea crisis. 2023 consumer inflation increased significantly, rising sharply to 33.9% from 13.9% in 2022. The World Bank predicts that economic activity will decrease from 3.8% in the fiscal year (FY) 2022/2023 to 2.8% in the FY 2023/2024(World Bank, 2024).

The continued series of global shocks is anticipated to intensify the present burdens on external accounts and undermine the strength of the exchange rate. The debt-to-GDP ratio rose to 95.2% by the end of FY2023, reflecting the negative impact of the exchange rate's depreciation. These recent changes pose significant hurdles to government initiatives that mitigate the effects of increasing inflation (World Bank, 2024).

Per GDP, since 2016/2017, Egypt's economy has experienced consistent growth, except for the last quarter of 2019/2020, when the growth rate turned negative due to the impact of COVID-19. The economy reached its highest point in the first quarter of the fiscal year 2021/2022, with a growth rate of 9.8%. In the first quarter of 2022/2023, the economy grew by 4.4%. However, from the last quarter of 2022/2023 to the third quarter of 2023/2024, the economy's growth rates declined due to ongoing tensions in the Red Sea, resulting in decreased revenues from the Suez Canal. The revenue generated from the Suez Canal is one important source of income for Egypt. (See Figure 5).

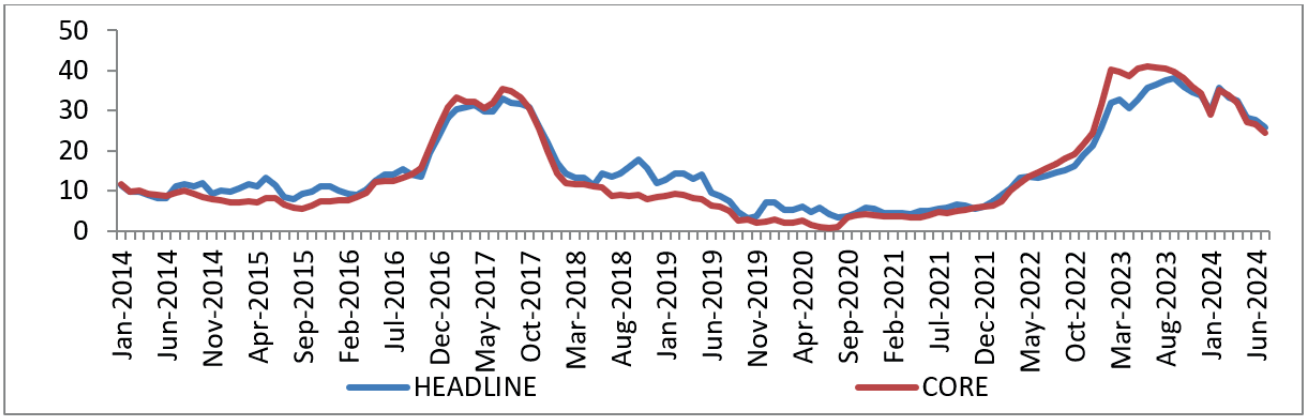
Figure 5: Real GDP Growth in Egypt during the period January 2014- July 2024



Source: Ministry of Planning and Economic Development online dataset. (2024)

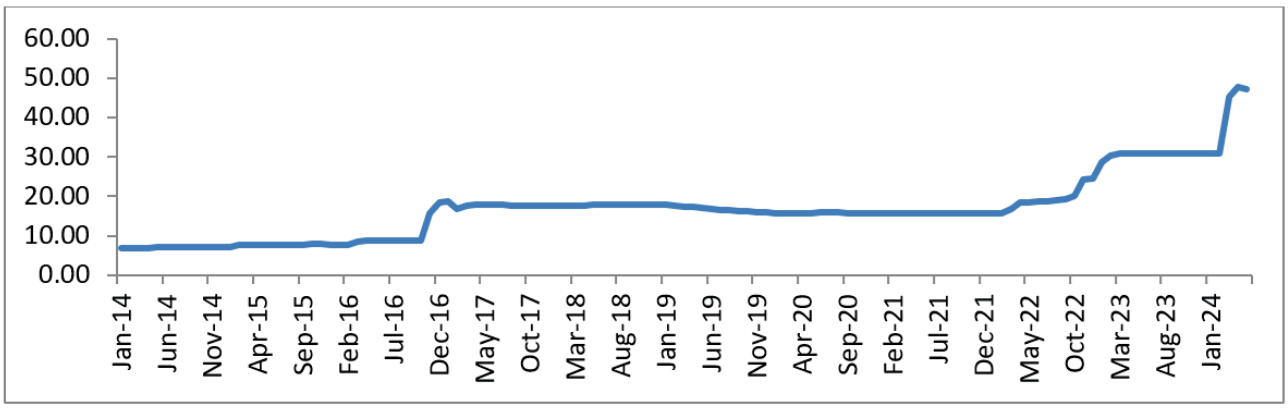
Regarding inflation, Egypt had significant surges of inflation starting from Jan 2022, As shown in Figure 6, due to several factors. First, the primary factor contributing to the increase in inflation was the devaluation of the exchange rate despite implementing a floating exchange rate system in 2016 as part of the IMF program. However, the Central Bank of Egypt (CBE) adopted a managed exchange rate regime. In response to the rise in external debt and the restricted supply of foreign currencies within the economy, the CBE initiated a series of currency devaluations beginning in early 2022 (Zaki et al., 2023). By May 2024, the official exchange rate for the dollar had risen to 47.13 EGP/USD, compared to 15.6 EGP/USD in March 2022. As shown in Figure 7. Second, the Russian–Ukrainian war assisted in inflation surges; according to Figure 6, core and headline inflation had a substantial surge, reaching around 40% and 32% in February 2023.

Figure 6: Core and headline inflation in Egypt during the period January 2014- July 2024



Source: Constructed by the author using the Central Bank of Egypt online database. (2024)

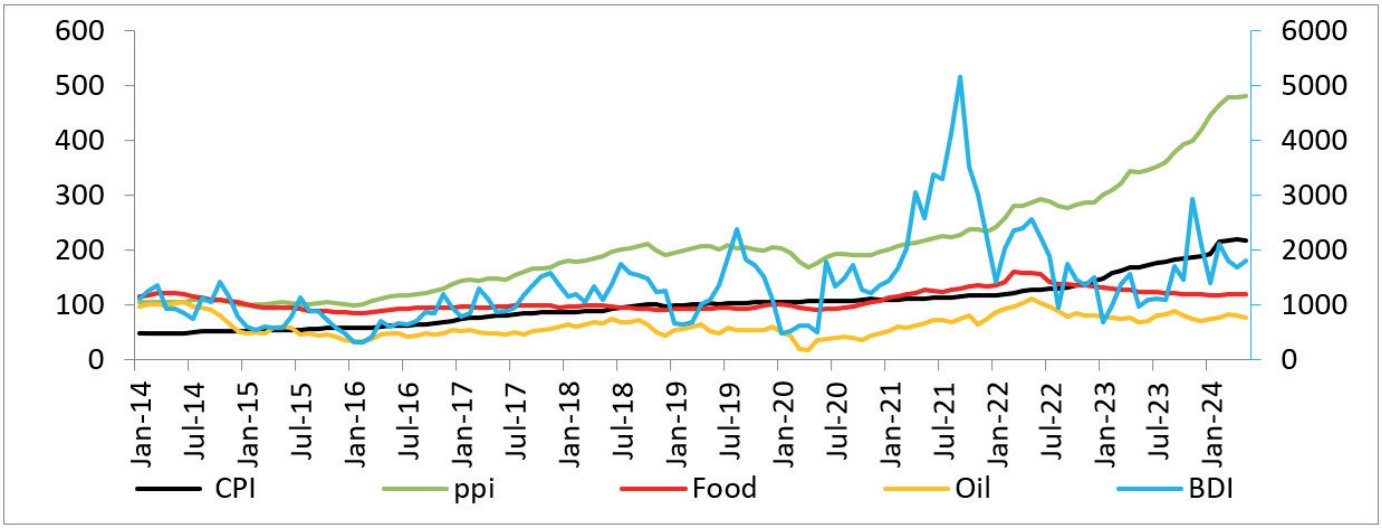
Figure 7: Evolution of the exchange rate in Egypt during the period January 2014- July 2024



Source: Constructed by the author using the IMF online database. (2024).

Through the comparison between Egypt's inflation and global prices of food, oil, and shipping prices, figure (8), we observe that Egypt's CPI and PPI have been moving in tandem in the same direction with both food and oil prices until April 2022 as food prices starting to decrease, while oil prices starting to decrease from June 2022. at the same time, Egypt's CPI and PPI continue to rise. Regarding shipping prices, we note that the trend is fluctuating, as it took an increasing trend until January 2022, and began to decline from January 2022 to October 2023, then rose again. Inflation in Egypt has an increasing trend throughout the study period. This confirms that, in addition to global trends in food, oil, and shipping prices, the devaluation of the currency plays a significant role in increasing inflation in Egypt, which is consistent with the study of (Forster & Tillmann, 2014), Which emphasizes that the importance of country-specific factors on inflation.

Figure 8: Egypt's inflation and global prices during the period January 2014- July 2024

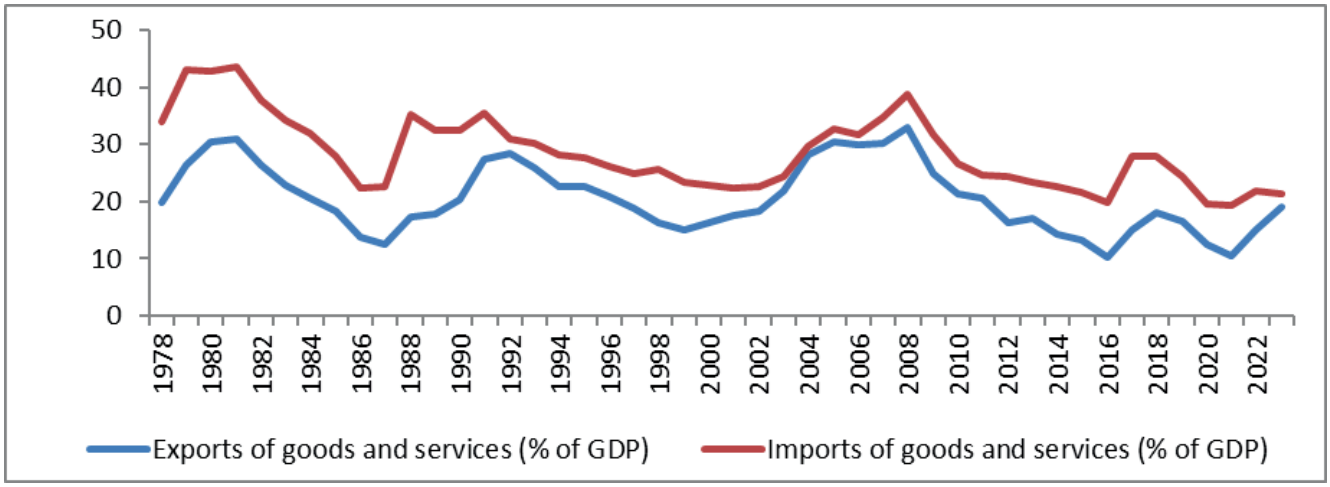


Source: CPI and PPI from Source: Constructed by the author using the Central Bank of Egypt online database (2024).

In reaction to the escalating inflation, the governments implemented policy measures to alleviate the issue. The decision was made to reduce governmental expenditures and postpone expensive projects. In 2022, the Central Bank implemented four interest rate hikes. Furthermore, regarding social policy, vulnerable categories are covered through the conditional cash transfer programs Takaful and Karama. Furthermore, the government has introduced novel initiatives aimed at offering financial assistance to those in informal employment. The National Authority for Social Insurance has been allotted 190.5 billion pounds to distribute pension rises of 13%, with a minimum of 120 pounds. The tax exemption ceiling has also been raised from 24 to 30 thousand pounds (Zaki et al., 2023).

Egypt's most important imports during the period 2004-2023 were oil, with an average of 14%; nuclear reactors, boilers, machinery, and mechanical appliances, 9.1%; cereals, 7.2%; and Electrical machinery and equipment, 6.6% (International Trade Center, 2024).

Figure 9: Egypt's exports and imports of goods and services (% of GDP) over 1978-2023



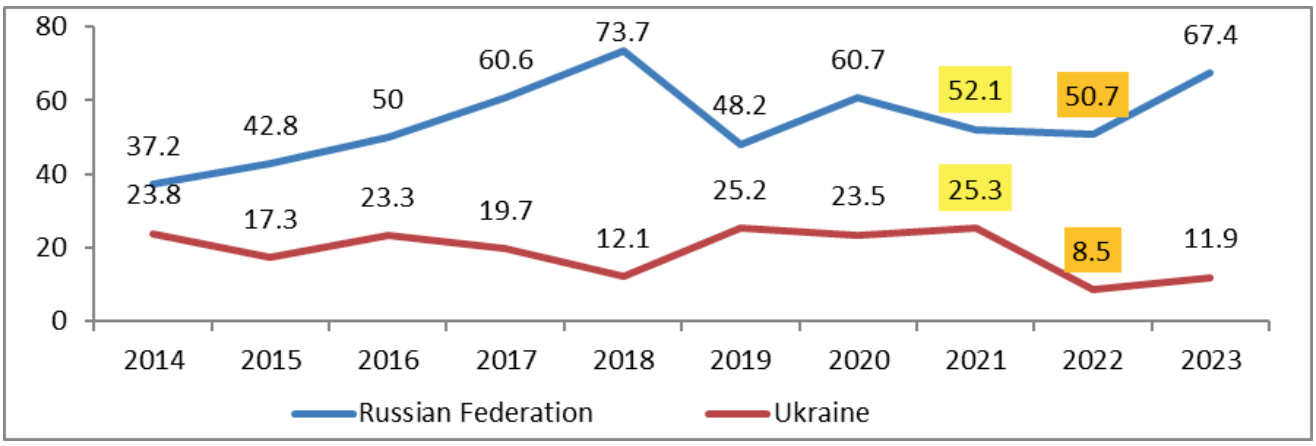
Source: Constructed by the author using the International Trade Center online database. (2024).

Based on historical data in figure (9), Egypt's export performance has shown a lack of steady development despite the volatility and devaluation of its currency. This may be attributed to high trade expenses before and at the country's borders. Exporting enterprises face significant fixed expenses due to various limitations. Therefore, although the devaluation of currency is expected to boost exports by making domestic product prices more competitive, achieving rapid and consistent export growth undoubtedly requires more than just a change in pricing (Youssef & Zaki, 2019).

4.1. The impact of Russian-Ukrainian war on Egypt's economy

Egypt's reliance on imports to fulfill its food requirements has grown significantly. Consequently, it is among the nations that experienced both the pandemic and the Russian-Ukrainian war (Mostafa et al., 2024). Approximately 62% of the country's total wheat consumption is typically met through imports (Abay et al., 2023). Egypt has become one of the world's top wheat importers, with approximately 77 percent of its wheat imports in 2021 originating from Russia and Ukraine, as depicted in Figure 10. In addition to wheat, Ukraine and Russia are significant exporters of other essential agricultural commodities. 2021 Ukraine accounted for around 21.7% of Egypt's corn imports. Russia and Ukraine are key sunflower oil suppliers to Egypt, accounting for around 85% of the total supply (Abay et al., 2023; International Trade Center, 2024).

Figure 10: Egypt's wheat imports from Russia and Ukraine (% of Egypt's wheat import)



Source: Constructed by the author using the International Trade Center online database. (2024).

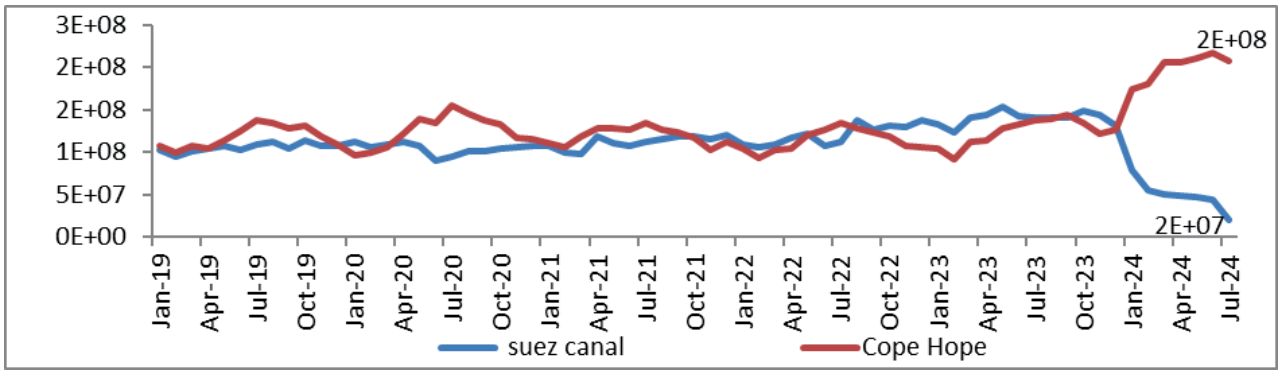
Following the onset of the war, there was a sharp rise in food costs in Egypt, and consumers felt these impacts. In March 2022, the Consumer Price Index (CPI) reached 122.7 points, and in the following month, it further grew to 126.7 points, compared to 118.1 points in January 2022, primarily driven by a surge in food prices as food price inflation reached 19.7% in March and 26% in April 2022. The rise in food prices in April can be attributed to multiple factors. Firstly, the impact of war has played a role in driving up prices. Additionally, The heightened demand for food in April, driven by altered eating patterns during Ramadan, has exacerbated inflationary pressures. Furthermore, a second devaluation in March 2022 has led explicitly to higher inflation in the food sector (Abay et al., 2023).

4.2. The impact of attacks on vessels in the Red Sea on Egypt's economy.

Attacks on ships in the Red Sea region have decreased trade through the Suez Canal. This canal is the most direct sea route connecting Asia and Europe, passing approximately 15% of the world's maritime trade volume (UNCTAD, 2024). Alternatively, numerous maritime corporations rerouted their vessels around the Cape of Good Hope. On average, this led to a significant increase in delivery times, extending them by at least 10 days. This negatively impacted enterprises that had limited inventory (Notteboom et al., 2024).

Between December 2023 and July 2024, the number of vessels passing through the Suez Canal decreased by 57%, dropping from 2132 to 915. In contrast, the number of vessels transiting through the Cape of Good Hope increased by 49%, rising from 1560 to 2324 vessels (Fig. 4). Additionally, the container tonnage (trade volume) crossing the canal experienced an 85% decline, while the container tonnage crossing the Cape of Good Hope increased by 63% (Fig. 11).

Figure 11: Transit trade volume (ton) during the period January 2014- July 2024



Source: Constructed by the author using the IMF Portwatch online database. (2024)

The widespread use of redirecting ships over the Cape of Good Hope directly impacts Egypt, reducing toll revenues for the SCA. The SCA has reported a decrease in transits via the Suez Canal, leading to Egypt's significant decline in toll revenues. Specifically, there has been a 23.4% decrease in toll revenues, from $9.4 billion in the Fiscal Year (FY) 2022/2023 to $7.2 billion in the FY 2023/2024 (Notteboom et al., 2024; Ahram Online, 2024).

Consequently, significant inflation, many instances of currency devaluation, a substantial increase in external debt, global disturbances such as the Russian invasion of Ukraine, worldwide monetary tightening, and the more recent Red Sea crisis have further worsened preexisting imbalances. The following section examines how global shocks are transmitted to domestic inflation.

5.Methodology and results

The supply chain interruptions caused by various crises, such as COVID-19, the Russia-Ukraine war, and the Red Sea crisis, are anticipated to affect increasing global inflation, contributing to local inflation immediately. The primary and immediate impact of supply chain disruptions is anticipated to be transmitted to the economy through imported goods. As Egypt is a net importer, expect these interruptions to impact inflation. In order to investigate the correlation between supply chain disruptions and inflation in Egypt, the study utilizes a structural vector autoregression model (SVAR). Furthermore, in addition to the SVAR model, the study uses Structural impulse response functions (IRFs) and Structural variance decomposition (VD). Using disaggregated monthly data from January 2014 to May 2024 and employing various measures to represent inflation and supply chain disruptions.

(Sims, 1980), criticized the econometric models used in the 1970s, and provided a vector autoregressive (VAR) model for situations with more than one time series variable of interest. A critical drawback of those models is their inability to describe contemporaneous relationships between the analyzed variables. This becomes a central issue in the impulse response analysis for such models, where knowing the contemporaneous effects of a shock to the economy is important. An alternative to this approach is the so-called SVAR model, where the relationship between contemporaneous variables is modeled more directly. The SVAR models allow special restrictions on the parameters of shocks following economic theory (Blanchard & Watson, 1986).

The SVAR model is defined as $z_t = (Food_t,\ BDI_t,\ Oil_t,\ RER_t)$, Where depending on the model specification, $Food_t$ represents the global food prices index, BDI_t represents the shipping costs, Oil_t represents the global oil prices index, and RER_t represents Real exchange rate. The Consumer Price Index (CPI_t) is used as the dependent variable in model 1, and the Producer Price Index (PPI_t) is used as the dependent variable in model 2 to provide comparative estimates for the reactions of the two price series to various shocks. Table (1) presents a succinct summary of the variables employed in this study and their corresponding definitions and sources. The formal investigation is based on the following expression (Bernanke, 1986; Blanchard & Watson, 1986)

$$A_0 z_t = C_0 + \sum_{t=1}^{p} \beta_i\, z_{t-i} + \varepsilon_t \quad (1)$$

z_t is the vector of endogenous variables lags, p is the number of lags, β_i is the model parameter matrix, and ε_t is the structural error coefficient matrix. According to economic theory and literature, many restrictions have been placed on the coefficients of matrix A to determine the effect of structural shocks in the model, which is known as structural limitation. The study assumed that shocks to other variables would not impact the real exchange rate, meaning that it would only be affected by shocks to the variable itself. Furthermore, as oil is a significant economic input, the changes in global oil prices can affect shipping costs and food (Yilmazkuday, 2024).

Table 1: Variables, Definitions and Sources

Variables	source	Definitions
Consumer Price Index(CPI)	https://www.cbe.org.eg/ar/economic-research/time-series/	The Central Agency for Public Mobilization and Statistics (CAPMAS) publishes a monthly price index that tracks weighted price changes of consumer items and services that comprise a household "consumption basket.
Producer Price Index (PPI)		It is a collection of indices that tracks domestic producers' average selling price changes over time.
Baltic Dry Index(BDI)	https://tradingeconomics.com/commodity/baltic	The Baltic Exchange in London publishes the Baltic Dry Index daily, a proxy for global shipping prices. The index sets marine freight prices for primary raw materials and comprises three dry bulk carrier size sub-indices. This index considers 23 shipping routes for coal, iron ore, grains, and other commodities.
World oil price(OIL)	https://tradingeconomics.com/commodity/crude-oil	West Texas Intermediate Crude Oil Prices: Crude oil futures are the U.S. and global benchmark for oil prices.
world food price index (Food)	https://www.fao.org/worldfoodsituation/foodpricesindex/en/	The FAO Food Price Index (FFPI) tracks monthly international food commodity prices. Their 2014–2016 export shares weight the average of five commodity group price indices.
Real exchange rate(RER)	Calculated by the author depending on the World Development Indicator (WDI), 2024	Egypt's real exchange rate refers to the actual bilateral exchange rate between the Egyptian pound and the U.S. dollar. Which is calculated as (NER* PUSA/PEG); NER refers to the nominal bilateral exchange rate, PUSA represents the price level in the USA, and PEG represents the price level in Egypt. Simultaneously, the CPI data serves as a substitute for P

5.1. Empirical Results:

Table (2) presents the descriptive statistics for whole variables. Associated with the inflation ratios, the average CPI is 102, and the mean value for PPI is 203. Concerning the exogenous factors, the average oil price index is 64, the average price index for food is 109, and the average price index for shipping costs is 1374. concerning the endogenous variable, the average exchange rate of the Egyptian pound against the dollar is 42 pounds. We note that shipping costs are the most volatile among global indicators, as they have the highest variation rate, followed by oil and food.

In table (3), the correlation matrix is presented. This reflects the interaction between inflation indicators and food prices, oil, shipping costs, and exchange rates. There is a significant and highly positive correlation between the inflation indicators and exchange rates up to 65% in both CPI and PPI. The increase in the inflation rate is closely linked to the currency devaluation. The currency depreciation increases import prices, contributing to higher domestic inflation. Egypt is a net importer; the most significant percentage of imports is represented in production inputs -Oil, Nuclear reactors, boilers, machinery- and cereals. Hence, the currency devaluation increases prices (Soliman, 2024). Also, changes in global prices will affect domestic inflation in Egypt as the correlation between inflation indicators and global food prices is up to 51% in CPI and 58% in PPI.

where substantially exogenous events (such as global weather anomalies or outbreaks of disease) may amplify price comovements, particularly in developing nations where food inflation is a significant component of the consumer basket (Blagrave, 2020). The correlation between inflation indicators and shipping costs is up to 53% in CPI and 57% in PPI. where a surge in shipping costs leads to a rapid and significant increase in import prices, which is promptly transmitted to producer prices and subsequently to consumer prices (Carrière-Swallow et al., 2023). Moreover, the correlation between CPI and oil prices is up to 24% in CPI and up to 39% in PPI. where Crude oil is a significant economic input, so oil prices have tended to have a more significant effect on the PPI than the CPI, which explains the relatively weak correlation between Oil and CPI and the strong one between crude and PPI (Szafranek, 2021; Xiang Deng and Fang Xu, 2024).

Table 2: Descriptive Statistics

	PPI	CPI	RER	OIL	FOOD	BDI
Mean	203.8320	102.0432	42.44695	64.04112	108.6624	1374.408
Maximum	481.0000	219.3000	68.39050	111.9100	160.3000	5167.000
Minimum	99.60000	48.30000	31.42949	18.54000	84.90000	317.0000
Std. Dev.	93.56259	41.91736	8.922382	19.67846	17.85881	781.8636
Variance	0.459	0.411	0.210	0.307	0.164	0.569
Observations	125	125	125	125	125	125

Source: computation by the author based on e-views-12.

Table 3: Correlation matrix

Correlation Probability	LCPI	LPPI	LFOOD	LBDI	LOL	LRER
LCPI	1.000000					

LPPI	0.986271	1.000000				
	0.0000	-----				
LFOOD	0.509209	0.585071	1.000000			
	0.0000	0.0000	-----			
LBDI	0.529714	0.575441	0.592814	1.000000		
	0.0000	0.0000	0.0000	-----		
LOIL	0.247879	0.387636	0.759506	0.500063	1.000000	
	0.0053	0.0000	0.0000	0.0000	-----	
LRER	0.647877	0.658497	0.187447	0.243485	0.211479	1.000000
	0.0000	0.0000	0.0363	0.0062	0.0179	-----

Source: computation by the author based on e-views-12.

In order to apply the SVAR model, First, verifying the stationarity of variables is necessary. Estimating dynamic economic models requires that the time series of economic variables be stationary—that is, the mean and variance of the variable under study do not change significantly over time. However, most time series of economic variables are non-stationary. If the time series of variables are non-stationary, this leads to spurious regression, meaning that the results of the estimated model are misleading. Table (4) displays the outcomes of unit root tests conducted at both the levels and the first differences, using the Augmented Dickey-Fuller (ADF) test and the Philips and Perron (PP) test (values reported are in the log). The results indicate that all variables are not stationary at level, but all have stationary at the first difference; in other words, all have an integrated order of I (1).

Table 4: Unit Root test

variables	PP		ADF	
	level	first difference	level	first difference
LCPI	1.1516	-5.9232***	0.9355	-3.9682***
LPPI	1.3990	-7.0327***	3.4098	-6.358***
lRER	-1.2684	-10.1852***	-1.1999	-10.2196***
LBDI	0.1246	-14.1848***	-0.0713	-12.434***
LOil	-0.3549	-9.2997***	-0.351	-8.7680***
LFood	0.055	-7.2729***	-0.351	-8.7680***

Source: computation by the author based on e-views-12, *, **, and * significant at the 1%, 5%, and 10% levels, respectively.**

Second, after ensuring that all variables are stationary in the first differences, the VAR models are estimated using the variables in the log and the first differences to determine the lag length. The importance of this test is that increasing the number of lags more than necessary leads to data loss and specifying the number of lags less than necessary causes the problem of autocorrelation. Two VAR models were prepared, one using the CPI as the dependent variable and the other using the PPI as the dependent variable. According to the CPI model, using a lag length criteria Akaike information criterion (AIC), Final prediction error (FPE), and sequential modified (LR) test statistic, the optimal lag length is one, as shown in Table (5). According to the PPI model, using a lag length criteria Akaike information criterion (AIC), Hannan-Quinn information criterion (HQ), and Final prediction error (FPE), the optimal lag length is one, as shown in Table (6).

Table 5: Lag order selection according to CPI Model

Lag	LogL	LR	FPE	AIC	SC	HQ
0	784.1650	NA	1.01e-12	-13.43388	-13.31519*	-13.38570*
1	820.1008	68.15395*	8.35e-13*	-13.62243*	-12.91029	-13.33334
2	834.0435	25.24120	1.01e-12	-13.43178	-12.12620	-12.90179
3	845.9562	20.53907	1.28e-12	-13.20614	-11.30711	-12.43524
4	866.0288	32.87758	1.41e-12	-13.12119	-10.62871	-12.10938
5	881.1570	23.47475	1.70e-12	-12.95098	-9.865062	-11.69828
6	901.8594	30.33972	1.88e-12	-12.87689	-9.197519	-11.38327
7	921.6917	27.35495	2.14e-12	-12.78779	-8.514976	-11.05327
8	938.6020	21.86680	2.59e-12	-12.64831	-7.782052	-10.67289

Source: computation by the author based on e-views-12

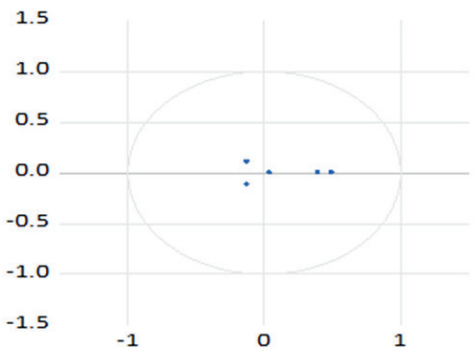
Table 6: Lag order selection according to PPI Model

Lag	LogL	LR	FPE	AIC	SC	HQ
0	743.3518	NA	2.04e-12	-12.73020	-12.61151*	-12.68202
1	787.4053	83.54969	1.47e-12*	-13.05871*	-12.34658	-12.76963*
2	801.1514	24.88526	1.79e-12	-12.86468	-11.55910	-12.33469
3	812.4350	19.45453	2.28e-12	-12.62819	-10.72916	-11.85729
4	837.2132	40.58486*	2.31e-12	-12.62436	-10.13189	-11.61256
5	849.4041	18.91698	2.94e-12	-12.40352	-9.317599	-11.15081
6	867.2469	26.14890	3.41e-12	-12.28012	-8.600752	-10.78651
7	883.3139	22.16139	4.14e-12	-12.12610	-7.853289	-10.39158
8	902.9048	25.33305	4.80e-12	-12.03284	-7.166582	-10.05742

Source: computation by the author based on e-views-12

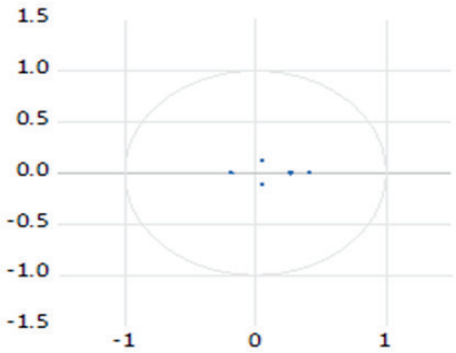
Third, After re-estimating the model using the correct lag length and before estimating the Structural impulse response functions (IRFs), we should verify the stability of the model results by using AR Roots, according to the CPI model Figure (12) and PPI model Figure (13). No roots lie outside the unit circle. This means that the models are stable; in other words, the models do not suffer from the problem of autocorrelation or non-stationarity of variance.

Figure (12): AR Roots according to CPI model



Source: computation by the author based on e-views-12

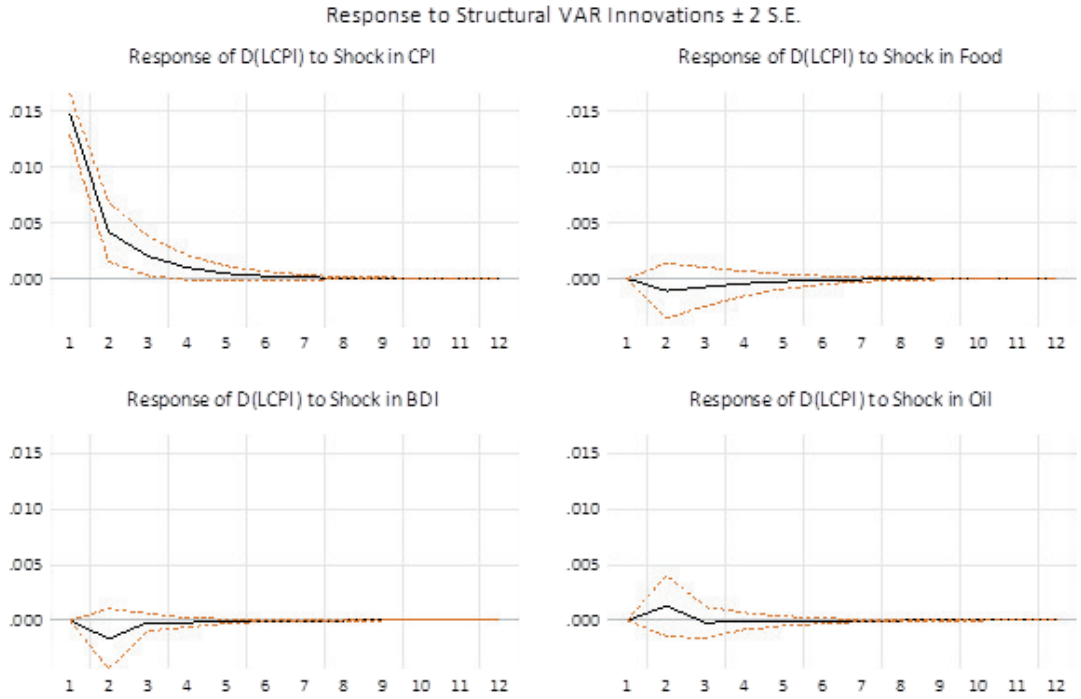
Figure (13): AR Roots according to the PPI model

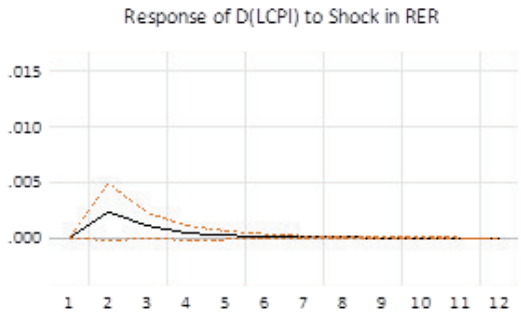


Source: computation by the author based on e-views-12.

Fourth, After ensuring the stability of the model, Structural impulse response functions (IRFs) are used. These describe the response of variables to a shock in the error term. They also describe the response to the shock as a reaction to one of the innovations, duration, and direction of this effect, whether negative or positive. This study assumed that changes in other variables do not affect the real exchange rate. Furthermore, as oil is a significant economic input, global oil price changes can affect Food and shipping costs (Yilmazkuday, 2024). Therefore, the response to structural shocks according to the CPI model is arranged as shown in Figure (14) and according to the PPI model as shown in Figure (15).

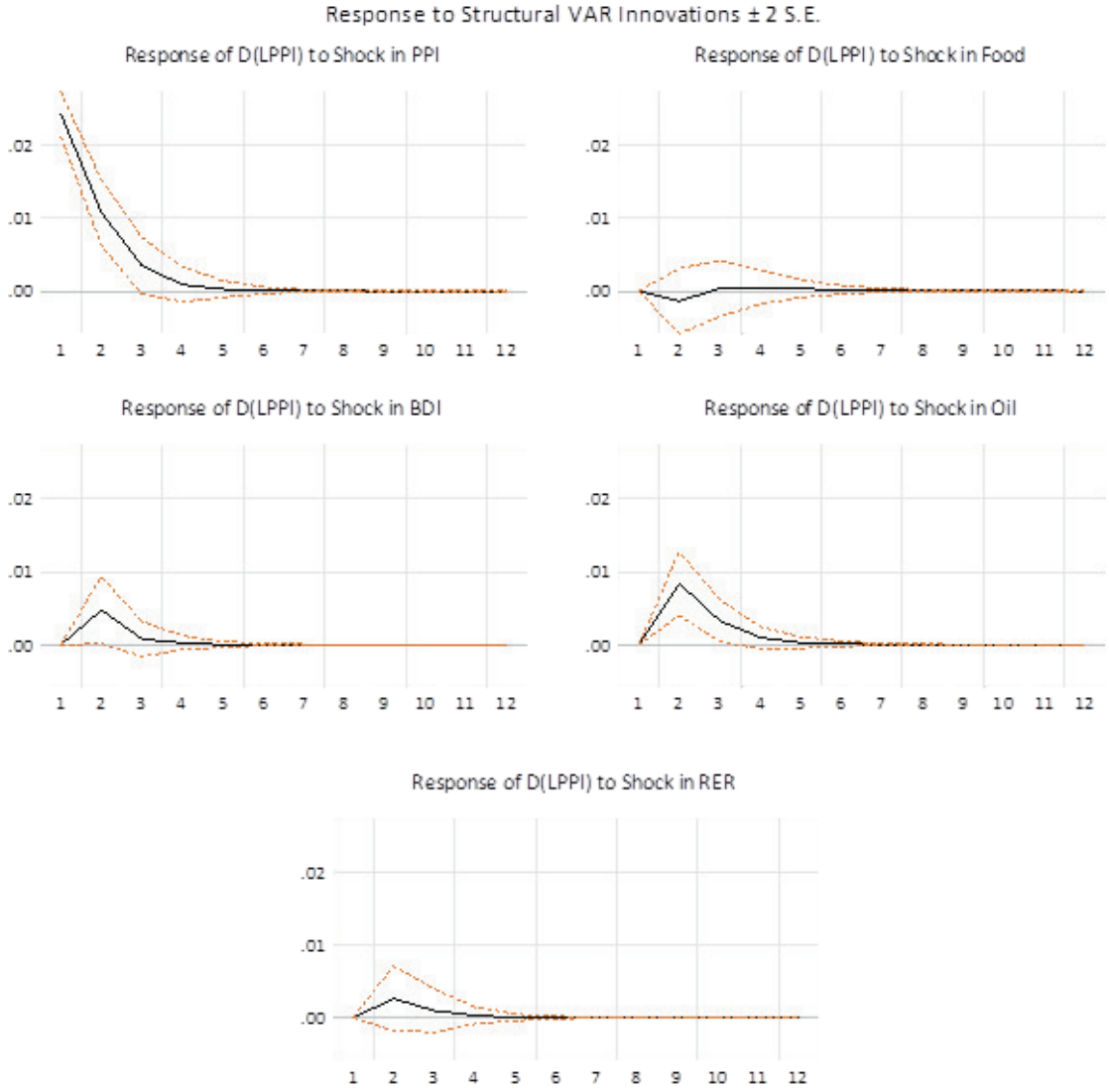
Figure (14): CPI model response to domestic and global structural shocks





Source: computation by the author based on e-views-12.

Figure (15): PPI model response to domestic and global structural shocks



Source: computation by the author based on e-views-12.

The results of the response functions show a positive immediate response to inflation in Egypt according to CPI and PPI models after a global oil price shock until the second month; after that, the effect dies out over time. According to (Choi et al., 2018), Oil shocks influence all economies that import this commodity and swiftly spread to consumer prices, as inflation is significantly influenced by fluctuating energy costs (Szafranek, 2021). Also, the results of the study are consistent with (Alvarez et al., 2021) (Szafranek, 2021) as they indicated that price oil comovements are time-varying and still most discernible for advanced, tightly integrated economies, strengthen for emerging countries but remain weak for the least developed economies.

It also becomes clear that the inflation response, according to both CPI and PPI models, to a shock to the real exchange rate is immediate and positive for two months. Then, it declines, and the effect dies out over time. Currency depreciation leads to rising import prices, contributing to higher domestic inflation. The study's results are consistent (Zaki et al., 2023).

According to both CPI and PPI models, the shock to global food prices have an immediate negative impact on inflation in Egypt until the second month, after which the impact turns positive, but this impact is close to zero, which contradicts the study (Blagrave, 2020). Where global food prices play a crucial role in inflation. Where food inflation is a significant component of the consumer basket in developing countries

Finally, there is an immediate positive impact of the shipping cost shock until the second month, according to the PPI model; after that, it begins to decline, and the effect dies out over time. According to the CPI model, there is an immediate negative impact of the shipping cost shock until the second month, and after that, it begins to increase, and the effect dies out over time. The study results are consistent with those (Michail et al., 2022; Isaacson & Rubinton, 2022; Carrière-Swallow et al., 2023; and Anderl and Caporale, 2024). These results enhance comprehension of the dynamic impact of shipping costs on inflation. Due to a surge in shipping costs, import prices experience a rapid and significant increase, which is promptly transmitted to producer and then consumer prices. One possible reason is that transportation costs, unlike food and oil, are not directly marketed to customers. Instead, they are paid by intermediaries who incorporate these expenses into the prices of all traded goods. In macroeconomic models, including pricing frictions, exemplified by the staggered price setting assumption introduced by Calvo (1983), the price adjustment process, known as pass-through, requires an extended duration to complete when many goods are readjusted compared to fewer goods. (Carrière-Swallow et al., 2023).

Fifth, In addition to using Structural IRFs, Structural VD is used to identify the percentage of unexpected change that may occur in each variable due to shocks to other variables. In other words, this analysis can present the relative impact of one variable on another. Variance decomposition also allows for assessing the economic significance of this impact by expressing it as a percentage of the forecast error for one of the variables. This, of course, will be the result of the presence of external shocks. Tables (7 and 8) show the structural VD for CPI and PPI over a 12-month.

Table (7): Structural variance decomposition of CPI model

Period	S.E.	Shock in CPI	Shock in Food	Shock in BDI	Shock in Oil	Shock in RER
1	0.014749	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.015682	95.52989	0.494098	1.095369	0.677339	2.203302
3	0.015867	94.91377	0.703335	1.082229	0.680052	2.620614
4	0.015911	94.76801	0.781326	1.091536	0.678396	2.680732
5	0.015921	94.72254	0.807542	1.093116	0.680077	2.696727
6	0.015924	94.71010	0.815397	1.093472	0.680988	2.700040
7	0.015924	94.70670	0.817634	1.093565	0.681316	2.700784
8	0.015924	94.70579	0.818246	1.093587	0.681423	2.700953
9	0.015924	94.70555	0.818408	1.093592	0.681455	2.700992
10	0.015924	94.70549	0.818451	1.093593	0.681463	2.701001
11	0.015924	94.70548	0.818462	1.093594	0.681466	2.701003
12	0.015924	94.70547	0.818464	1.093594	0.681467	2.701003

Source: computation by the author based on e-views-12.

Table (8): Structural variance decomposition of the PPI model

Period	S.E.	Shock in PPI	Shock in Food	Shock in BDI	Shock in Oil	Shock in RER
1	0.024224	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.028362	87.35042	0.229302	2.803736	8.757600	0.858939
3	0.028783	86.24300	0.236999	2.791321	9.790360	0.938317
4	0.028819	86.11280	0.270084	2.793035	9.877575	0.946510
5	0.028824	86.09441	0.282456	2.792331	9.884456	0.946350
6	0.028824	86.09093	0.285495	2.792202	9.885066	0.946308
7	0.028824	86.09026	0.286140	2.792179	9.885115	0.946307
8	0.028824	86.09013	0.286268	2.792175	9.885118	0.946308
9	0.028824	86.09011	0.286292	2.792174	9.885118	0.946309
10	0.028824	86.09010	0.286296	2.792174	9.885118	0.946309
11	0.028824	86.09010	0.286297	2.792174	9.885118	0.946309
12	0.028824	86.09010	0.286297	2.792174	9.885118	0.946309

Source: computation by the author based on e-views-12.

According to the CPI model (Table 7), in the second month, 95.5% of the change in CPI is due to the shock to the variable itself. Meanwhile, food, BDI, Oil, and RER shocks affected CPI by 0.49%, 1.09%, 0.68%, and 2.20%, respectively. It is clear that, in the short run, CPI is the most influential variable on itself, followed by RER.

In the long run, the degree of impact of CPI on itself decreases to 94.7%, while the percentage of global food prices increases to 0.82%, and the impact of RER increases to 2.70%. While, the percentage impact of BDI remains constant at 1.09%, and oil prices are still at 0.68%. CPI is the most influential variable, followed by RER in the short and long run. At the same time, the effect of global prices on Egypt's CPI represents a small percentage of CPI variance decomposition. This is consistent with the study (Forster & Tillmann, 2014), Which emphasizes the importance of country-specific factors on inflation.

According to the PPI model (Table 8), in the second month, 87.3% of the change in PPI is due to the shock to the variable itself. Meanwhile, food, BDI, Oil, and RER shocks affected PPI by 0.23%, 2.80%, 8.76%, and 0.86%, respectively. It is clear that, in the short run, PPI is the most influential variable on itself, followed by oil.

In the long run, the degree of impact of PPI on itself decreases to 86.1%, while the percentage of the impact of global food prices increases to 0.29%, the impact of oil increases to 9.9%, and the impact of RER increases to 0.95%. In comparison, the percentage impact of BDI is still constant at 2.8%. It is clear that, in the short and long run, PPI is the most influential variable, followed by oil and shipping costs. Since oil is a key input in manufacturing and a significant cost factor in shipping, oil prices have tended to have a more significant effect on the PPI than the CPI. Increasing oil prices will raise production and transportation costs, leading to a direct increase in the PPI. while having an indirect impact on the CPI through downstream goods like gasoline. (He., et al., 2024) This is consistent with the study of (Xiang Deng & Fang Xu, 2024). In the case of oil-importing countries, when oil prices rise, inflation also increases: a higher oil price will lead to higher production costs. Rising production costs will affect consumer prices.

Finally, accurate forecasting of CPI and PPI is vital because these indices are widely used to measure inflation and help firms, investors, and governments make informed financial strategies and economic policies. As shown in Table 9, Predictive performance is evaluated for CPI and PPI based on supply chain disruptions using Root Mean Square Error (RMSE) and the Theil inequality coefficient (Theil).

According to the RMSE in the CPI model, which is equal to 0.12, and in the PPI model, which is equal to 0.22, the values in both models are small, which means that the gap between actual and forecasting CPI is small (Figure 16), and likewise in the PPI model (Figure 17). However, when compared between the CPI and PPI models, the CPI model yields the smallest RMSE, indicating the best prediction.

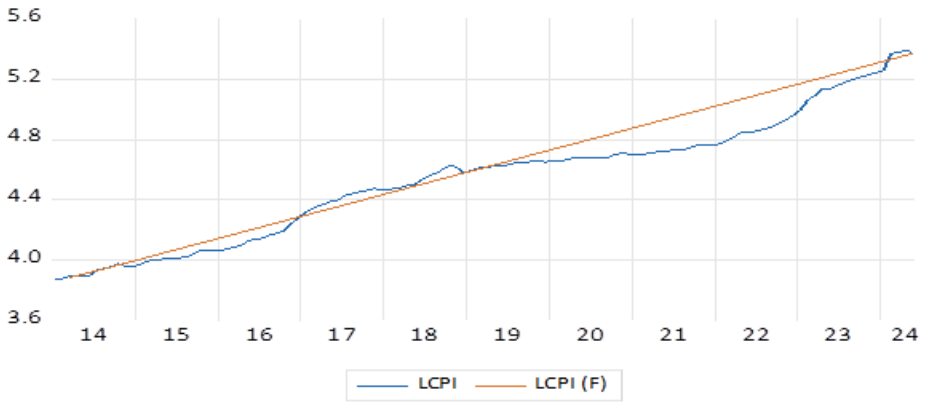
According to Theil, in the CPI model =0.01, it is close to zero, meaning that the predictive power of this model is strong (actual and forecasting CPI will move together). In the PPI model, Theil= 0.02 is close to zero, which means that the predictive power of this model is strong (actual and forecasting PPI will move together)

Table 9: CPI and PPI forecasting results

Variable	Inc. obs.	RMSE	MAE	MAPE	Theil
LCPI	124	0.116090	0.087740	1.824568	0.012592
LPPI	124	0.221791	0.188513	3.458239	0.020755

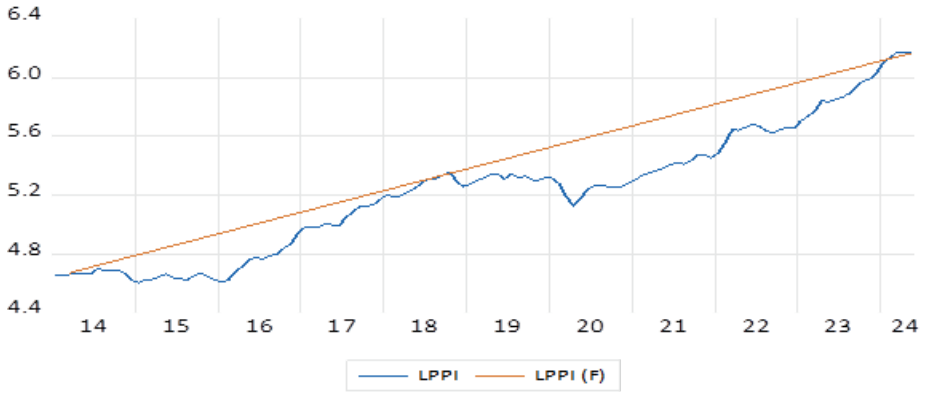
Source: computation by the author based on e-views-12.

Figure 16: CPI Actual and Forecasted



Source: computation by the author based on e-views-12.

Figure 17: PPI Actual and Forecasted



Source: computation by the author based on e-views-12.

6. Conclusion and recommendations

The recent disruptions in supply chains caused by the Covid-19 outbreak, the Russian-Ukrainian war, and the Red Sea crisis have resulted in delays in shipments, significant increases in shipping costs, and higher prices for both food and energy, contributing to global inflation and subsequently fueling local inflation. The paper makes a twofold contribution. Firstly, it analyzes the macroeconomic effects of supply chain disruptions on Egypt. Secondly, it investigates the impact of global supply chain disruptions on domestic inflation, using various measures such as global oil prices, food prices, and shipping costs. Utilizing the structural vector autoregression model (SVAR) and monthly data from January 2014 to May 2024, the findings reveal: According to structural IRFs, 1- the global oil price shock and RER have immediate positive impacts on Egypt's CPI and PPI. 2- shipping cost shock has an immediate positive impact on PPI and a negative impact on CPI. 3- According to both CPI and PPI models, the shock to global food prices has an immediate negative impact until the second month, after which the impact turns positive, but this impact is close to zero. According to structural VD, 4- oil prices and shipping costs have tended to significantly affect the PPI more significantly than the CPI. 5- RER, and food have tended to have a more significant effect on the CPI than the PPI. According to Predictive Power 6- both CPI and PPI models have strong predictive power, which means, (actual and forecasting will move together).

From a policy standpoint, 1. The study's findings could potentially spur policymakers to lessen the inflationary effect of high oil prices by switching to other renewable energy sources and adopting energy-efficient and fuel-efficient technologies, namely substituting oil with other sources of energy such as biofuels, hydrocarbons, and nuclear power, which constitute real alternatives in the long term. 2. diversify import sources from geographically close regions to mitigate the effects of inflation resulting from shipping costs. 3. maintain currency stability and enhance the competitiveness of exports. Implementing reforms that promote and diversify local industry while eliminating all bureaucratic barriers is necessary. 4. It is critical to strengthen the domestic industry by prioritizing investments in research and development and providing subsidies to small and medium enterprises. This would allow the national industry to create alternatives to imports. 5. Enhancing all social protection systems for vulnerable categories is a priority. Finally, it is crucial to establish attractive offers for investors to attract more Foreign Direct Investment into the industry and agriculture sectors, enhancing domestic production.

Despite the valuable findings of the study, it is not without several limitations, perhaps the most important of which is the immediate negative impact of the global food prices shock on both CPI and PPI, despite the positive impact of the food prices on inflation. This is confirmed by several previous studies that found a positive relationship between inflation and food prices, such as the study by (Blagrave, 2020; Garicano et al., 2022; IMF, 2022). Also, the analysis in this study was limited to the beginning of January 2014 due to the availability of all-time series data starting from this period. While this study focused on CPI and PPI, advanced research may apply to headline, core, and import prices. Moreover, it can implement these variables on different scales of countries, such as comparisons between developing and developed countries, adding value to the literature in this field. Future research may include variables such as the Global Supply Chain Pressures Index, the Economic Policy Uncertainty Index, and the Geopolitical Risk Index.

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List of abbreviations

BDI	Baltic Exchange Dry Index
CBE	Central Bank of Egypt
CFD	Containerized Freight Index
CPI	Consumer price index
FY	Fiscal year
GSCPI	Global supply chain pressure index
IRFs	impulse response functions
PPI	Producer price index
RER	Real exchange rate
SCA	Suez Canal Authority
SVAR	Structural vector autoregressive
U.K	United Kingdom
The U.S.	United States
VD	variance decomposition
VECM	Vector error correction model