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Exchange Rate Pass-Through to Headline Consumer Prices in Egypt: Exploring Asymmetric Effects

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Abstract

While the exchange rate pass-through to Inflation has been thoroughly investigated in the theoretical and empirical literature, few studies have attempted to investigate the pass-through in Egypt with mixed results. This paper attempts at investigating the exchange rate passthrough to headline consumer prices in Egypt, including potential presence of asymmetric effects of a currency appreciation/depreciation on consumer prices. Non-linear Autoregressive Distributed Lags methodology is used on quarterly data from 2001 to 2022. The paper's contribution to the literature is threefold: First, this paper utilizes an updated time series from 2001 to 2022. Second, a newly developed quantitative index that captures the magnitude and timing of changes in subsidized fuel prices domestically, to account for the high share of subsidized items in the consumer basket, is included in the list of control variables. In addition, the study also includes a control variable that tests the effect of low/high volatility in inflation, as a proxy for the effect of the monetary policy on the exchange rate pass-through to consumer prices. Finally, this paper utilizes stationarity and causality tests that account for structural breaks into the series, which have not been previously tested for Egypt, despite the country witnessing several break points in that period that could affect stationarity and the final conclusions as a result.

JEL Classification: E3, E4, E5

Keywords: Exchange Rate, Pass-through, Consumer Prices

[1] *Acknowledgments: I would like to thank my family for their continuous support.*

I. Introduction

Choosing the appropriate exchange rate arrangement, be it a free float, a pegged exchange rate or some intermediate arrangement, for any country is not merely a technical matter but rather needs to be consistent with the country's overall policy framework (Casiraghi et al, 2022). However, there is always a tradeoff underlying the benefits and costs of any adopted exchange rate arrangement. From one side, a depreciation in the currency can lead to higher domestic consumer prices particularly via imported goods channel (which has its origins from the law of one price-LOOP[2]). From the other side, the depreciation in the currency can stimulate net exports (which has its origins from the Marshall-Lerner condition-MLC[3]). Over the past several decades, the economic literature has added new concepts that help policy makers understand in more detail why either concept (LOOP and MLC) does or does not hold both theoretically and empirically (more details on these in the literature review section).

Egypt's economy is not an exception to the above tradeoff. Anecdotal evidence of the data show Egypt's currency witnessing repetitive cycles of sudden monthly depreciation rates above 20% and sometimes above 50% in a single month[4]. These sudden shocks were usually followed by very low volatility in the currency afterwards and then the cycle is completed with another sudden depreciation in the currency and so on (see figures I.1 and I.2). This cycle has repeated itself since 1962 till present at least 5 times (complete cycle roughly every decade). This pattern can be evidence of historical aversion among policy makers to the potential costs associated with a floating exchange rate regime, relative to the benefits. While the purpose of this paper is not to investigate which regime is a better fit for Egypt from an overall policy framework perspective[5], the paper's contribution to the literature should be viewed as a way to enhance the empirical estimation of the pass through of the exchange rate depreciation to consumer prices in Egypt. If combined with other empirical studies on the effects of the depreciation on trade

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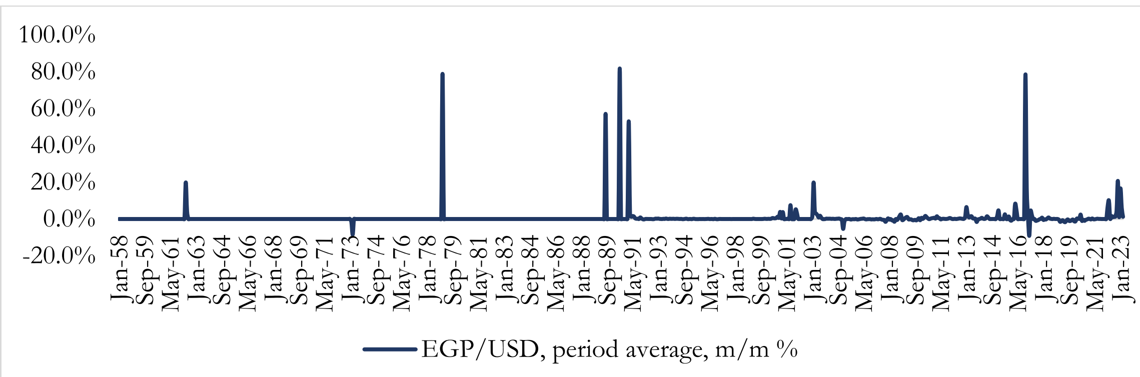
[2] The law of one price states that in the absence of trade frictions, and under free competition and price flexibility, identical goods sold in different countries must sell for the same price when prices are expressed in a common currency.
[3] The Marshall Lerner condition is a well-known concept in economics, taking its name from renowned economists; Alfred Marshall and Abba Lerner. The concept stipulates that a country's trade balance will respond to developments in the exchange rate if the sum of price elasticities of demand for both exports and imports is more than 1.
[4] These periods of severe month on month depreciation in the Egyptian Pound in front of the US Dollar are chronologically listed as follows: May 1962 (19.9%), January 1979 (78.9%), August 1989 (57.1%), July 1990 (81.8%), February 1991 (53.1%), February 2003 (19.9%), November 2016 (78.5%), November 2022 (20.7%) and January 2023 (16.6%). Calculation was based on the indirect quote of Egyptian pounds per one US Dollar.
[5] See Casiraghi et al, 2022; "The Choice of Exchange Rate Arrangement", which is a chapter in a technical assistance handbook by the International Monetary Fund's Monetary and Capital Markets Department.

for Egypt, policy makers will be able to better quantify the above tradeoff with important implications for monetary policy regime choice.

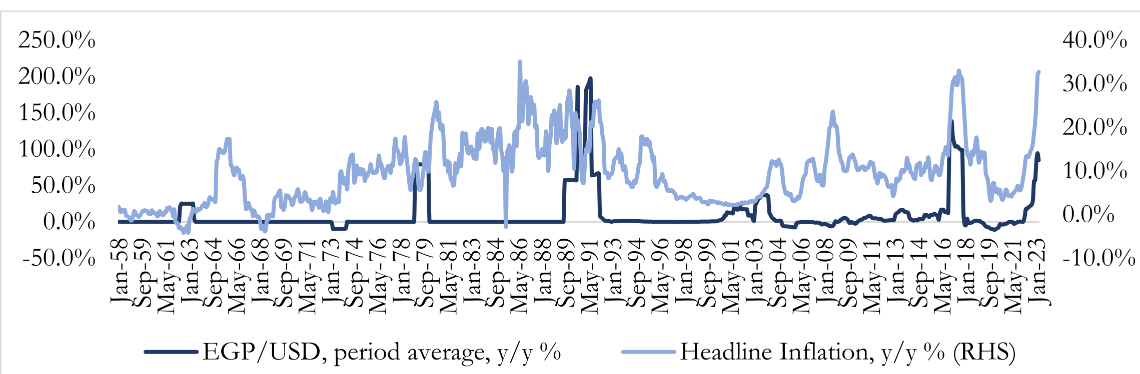
Tunc (2017) defined/classified exchange rate passthrough to prices (henceforth ERPT) in the literature into two stages/definitions. In the first stage, ERPT is defined as the percentage change in import prices in the domestic currency in response to a one percent change in the exchange rate. In the second stage, ERPT is defined as the percentage change in producer and consumer prices to a one percent change in the exchange rate. As the exchange rate passes through to consumer prices from producer prices from import prices, the passthrough tends to decline (McCarthy (2000), It and Sato (2008), Peona and Brindisb (2014) and Justel and Sansone (2015)).

Figure I.1: Month on month changes in the Egyptian Pound per One United States Dollar*:



Source: *International Financial Statistic Database and the author's calculations. *Depreciation = positive change in percent.*

Figure I.2: Developments in the Egyptian Pound versus the US Dollar versus annual headline inflation in percent, year on year):



Source: *International Financial Statistic Database and the author's calculations. *Depreciation = positive change in percent.*

While the literature is abundant on the empirical estimation of ERPT among other countries, especially developed ones, studies that attempted to estimate ERPT for Egypt across different time periods had mixed results. This paper attempts at estimating ERPT for Egypt with three key contributions to the empirical literature. First this study utilizes an updated time series dataset, from 2001 Q3 to 2022 Q4. Second, it uses improved stationarity tests that account for structural breaks (given the monetary policy regime shifts), with implications on the econometric methodology that is used as well as the empirical results. Third, this study adds a new control variable, namely the subsidized fuel price index, as a way to better assess ERPT given that headline consumer prices in Egypt include a not so small weight for regulated prices that include subsidized fuel. Section II presents a summary of the literature. Section III includes the dataset and its sources, section IV explains the methodology that is used and the empirical results. The final section concludes.

II. Literature Review

Review of the Evolution of the ERPT and its determinants over history

ERPT is not a new topic, as it dates to the law of one price and purchasing power parity theory, which is said to have originally emerged in the Salamanca School in Spain in the 16th century (Rogoff, 1996). Following the collapse of the gold standard in the aftermath of World War I, Gustav Cassel (1921,1922) proposed calculating exchange rates via the cumulative consumer price inflation differentials between countries since 1914[6]. But still, the purchasing power parity puzzle, especially on the short to medium term remained, with many studies attempting to explain reasons behind the shortfall (Rogoff, 1996).

By the late 1980s early 2000s, dynamic models of imperfect competition began to emerge as a more suitable theoretical and empirical framework in assessing ERPT or what was back then termed as "Pricing to Market[7]" (Krugman (1986); Dornbusch (1987); Frankel and Froot (1987); Obstfeld and Rogoff (1995); Lafleche (1996,1997); Cunnigham and Haldane (2000); GoldFajn and Werlang (2000), Burstein, Eichenbaum and Rebelo (2007) among others). The motivation of these models was to explain reasons on why the law of one price did not hold as expected. Notable factors that emerged from these studies were; 1) Demand effects, such as firms investing in their reputation, leads their pricing to market to differ from that implied by the law of one price; 2) Supply side effects, such as the costs of distribution and marketing inside the importer country, can add to the price of the good and prevent its price from declining as expected, following an appreciation of the importer

[6] Gustav's logic was that if during the gold standard, fixed exchange rates in front of gold meant that bilateral exchange rates reflected the difference in gold values in any two countries, then the consumer price level difference (after the collapse of the gold standard) can be used to set the new levels of exchange rates (Rogoff, 1996)

[7] Pricing to market refers to the case when import prices in country A does not decline with the appreciation of the currency of country A in front of the currency of the exporter country, but rather in some cases import prices may increase.

country's currency in front of the exporter's currency;[8] 3) Expectations of the exchange rate that can be different from the developments witnessed in the spot exchange rate, leading the appreciation/depreciation in the spot rate of the importer's currency to be deemed as transitory by economic agents; and 4) other factors such as higher degree of trade openness which can lower the degree of ERPT.

McCarthy (2000), Taylor (2000), Gagnon and Ihrig (2004) among others postulated that the presence of a strong nominal anchor of monetary policy, such as successfully anchoring inflation expectations, can lower the magnitude of ERPT. Delatte and Lopez Villavicencio (2012) included the output gap as a control variable to better estimate ERPT, in a reduced form Phillips curve.

Devereux and Engel (2002); Bacchetta and Van Wincoop (2005); Campa and Goldberg (2005); Gopinath, Itskhoki, and Rigobon (2010) among others showed that the type of price invoicing of the goods and services (Local currency pricing vs. Producer Currency pricing) can materially impact the magnitude of ERPT[9]. As a result, an incomplete ERPT can be the case for a country where pricing of goods and services is rather a mix of both rather than either of these two types. Boz et al (2020) showed that the dominant currency pricing (Country C's currency is used in the invoicing of import and export prices between countries A and B) can increase ERPT to import prices, especially in developing economies. They also presented a new panel database of currency invoicing for several countries including Egypt, which showed on average 89.2% and 83.8% of Egypt's export and import invoicing being denominated in US dollars, respectively. While the remaining invoicing was mostly denominated in the Euro currency.[10]

Other determinants of ERPT also include the size of the current account balance, the degree of dollarization in the economy and size and direction of the exchange rate. The latter can be due to several factors including the rigidity of downward adjustments to prices relative to upward adjustments, the monetary policy regime and the volatility level of the exchange rate in the transmission to domestic prices (Tunc, 2017).

Review of the methodologies used

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[8] These factors lead to a differentiation between import prices at the docks and retail or consumer prices with the latter being impacted by these factors as opposed to the former.

[9] Producer currency pricing represents the case of a complete ERPT, as the prices in the importer currency becomes sticky to the prices as set by the producer (exporter currency). On the other hand, Local currency pricing represents the case of zero ERPT (Tunc, 2017).

[10] Using annual data from 2010 to 2019, which was sourced from national agencies in Egypt. The data shows that the share of other currencies invoicing excluding the US Dollar and the Euro to be only 1.6% and 2.9% on average during this period for exports and imports, respectively. It is noteworthy to highlight that the European Union is the largest trading partner for Egypt.

Bache (2006) listed the majority of methodologies that are used in assessing ERPT, notably: vector auto regressions (either structural or not), autoregressive distributed lags (either linear-ARDL or non-linear-NARDL), and Dynamic Stochastic General Equilibrium Models among others. He showed that estimates from various methodologies are: a) Not comparable and b) Sensitive to the treatment of the non-stationarity in the data. Tunc (2017) summarized the pros and cons of single equation (ARDL or NARDL) versus VAR models in that the former models can estimate the asymmetry in the passthrough while the latter cannot. On the other hand, the latter (VARs) can easily remove the potential endogeneity problem between prices and the exchange rate, unlike single equation models. However, their drawback is that the ordering of the variables, ideally from the most exogenous to the most endogenous, can materially impact the results if done in a different way.

Empirical Evidence of in ERPT in developing economies

While there is abundant empirical evidence of ERPT across developing countries, fewer studies have been done on the asymmetric ERPT in these countries (Tunc, 2017). In his summary of the empirical literature in developing countries, results for testing ERPT without looking into asymmetry varied considerably, not just across countries, but also depending on the methodology used for each country[11]. Most studies cited by Tunc (2017)[12] tested ERPT in developing countries between the late 1990s/early 2000s to the late 2010/2015. For the studies that used VAR models, ERPT was found to exist on the long term (passthrough extends beyond one year) but is incomplete, with the coefficient estimate recording an average of 0.21, and a range between less than 0.1 for Mexico, the Phillippines, Malaysia and South Korea to as high as 0.45-0.6 for Russia, China and the Czech Republic). On the other hand, the studies that used single equation had a lesser estimate of ERPT on average (0.14) for these countries, and a range of less than 0.05 for the Philippines, South Korea, Mexico, Chile, Columbia, India and China to a high of 0.45-0.5 for Brazil, Hungary and South Africa.

Tunc (2017) cited fewer studies[13] that tested the asymmetry of ERPT for India, Brazil, Poland, Columbia, Romania, Peru and Hungary. In these studies, the asymmetry can be

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[11] For detailed review of the literature on ERPT in developing economies, see Tunc (2017).
[12] See Kolhscheen (2010), Nogueira and León-Ledesmab (2009), Ghosh (2013), Ito and Sato (2008), Prasertnukul et. al. (2010), Edwards (2006), Peóna and Brindisb (2014), Espada (2013), Arintoko (2011), Aron et. al. (2014b), Jitpokkasame (2007), Chai-anant et al. (2008), Wattanakoon (2013), Kucharčuková et. al. (2013), Hajeka and Horvath (2016), Ahmad (2009), Morande and Tapia (2002), Justel and Sansone (2015), Arratibel and Michaelis (2014), Hajnal et. al. (2015), Winkelried (2014), Khundrakpam (2007), Kapur and Behera (2012), Bhattacharya (2008), Jin (2012), Shu and Su (2009), Jiang and Kim (2013), Wang and Li (2010), Stoian and Murarașu (2015), Ponomarev et. al. (2016), Arslaner et al. (2015), Kara and Öğünç (2008), Kara and Öğünç (2012), Kilinc and Tunc (2017), Maria-Dolores (2010). and three studies by the central banks of Russia, The Philippines, and Malaysia. Countries that were covered in these studies were Brazil, South Korea, Mexico, Indonesia, South Africa, Thailand, The Czech Republic, The Philippines, Chile, Columbia, Poland, Hungary, India, China, Romania, Turkey, Malaysia, Russia and Peru.
[13] These studies were Khundrakpam (2007), Correa and Minella (2010), Przystupaa and Wrobel (2011), Rincón and Rodríguez (2016), Stoian and Murarașu (2015), Forero and Vega (2015) and Hajnal et. al. (2015).

defined as a different ERPT under an exchange rate depreciation compared to an appreciation, a different ERPT under a low or high inflation environment, among other classifications. In the majority of these studies, ERPT under an exchange rate depreciation/high inflation environment/strong growth had a higher magnitude compared to an appreciation in the exchange rate/low inflation environment/weak growth rates, with the exception of India and Peru where the opposite result was found. Methodologies used ranged between non-linear/threshold VARs and single equation methods and the periods of study were between the early 1990s to 2015. In the cases where a depreciation had a higher ERPT, estimates ranged between 0.11 for Brazil to 0.25-0.3 for Poland, Romania and Columbia and 0.6 for Hungary.

Karamelikli et al (2016) tested the asymmetric ERPT using NARDL on monthly data between January 2003 to November 2015 for Turkey. Their estimates showed ERPT to hold on the short run only, with both depreciations and appreciations in the exchange rate leading to higher consumer prices. Adekunle et al (2018) tested asymmetric ERPT using NARDL on monthly data from 2001 to 2015 for Nigeria. Their estimates showed no long run cointegration with the short run ERPT being significant to consumer prices only in the case of an appreciation in the exchange rate. They also found the industrial production index (a proxy for output) to be insignificant.

Kassi et al (2018) tested asymmetric ERPT on consumer prices using NARDL on quarterly data from 1995 Q1 to 2016 Q4 for emerging and developing Asian countries[14]. They found significant ERPT both on the short and long term for the emerging Asian countries, and significant for the short term only for the developing Asian countries. Overall, estimates for ERPT in the case of an appreciation in the exchange rate were found to be complete (on average 0.9%) compared to an incomplete (0.5%) ERPT in the case of a depreciation in the local currency. The results also found higher ERPT in emerging countries with low inflation, compared to the developing countries estimates.

Kassi et al (2019) tested asymmetric ERPT using NARDL on 40 Sub Saharan African countries using quarterly data from 1990 Q1 to 2017 Q4. ERPT was found to be significant, but incomplete on the short run, while the results on the long run were mixed, but overall lower than ERPT magnitudes for Asian countries as shown earlier. They also found ERPT to be higher in the case of depreciation compared to appreciation, and higher in the countries with fixed exchange rate regimes such as the CFA Franc Zone compared to countries with floating exchange rate regimes that had higher inflation levels. Farajollahi et al (2019) tested asymmetric ERPT on consumer prices using a Markov Switching Model in addition to Johansen and Juselius Cointegration in Iran between 1980 to 2014. They

[14] *The 7 emerging countries were China, India, Indonesia, Malaysia, the Philippines, Thailand and Vietnam. The 6 developing Asian countries were Bangladesh, Cambodia, Fiji, Laos, Nepal and Sri Lanka.*

found incomplete but significant ERPT at 0.5%, with the domestic currency depreciation episodes having a larger ERPT than an appreciation.

The Vo et al (2020) tested asymmetric ERPT for both the nominal effective exchange rate and the bilateral exchange rate in front of the US Dollar on consumer prices using SVAR on monthly data from January 2009 to November 2017 for Vietnam. They controlled for the oil price, the output gap, broad money and the interest rate. They found the ERPT for the bilateral exchange rate to be significant but incomplete, increasing from 0.21% in the first month to 0.55% after 12 months, compared to 0.12% and 0.41% for the nominal exchange rate during the same periods, respectively. They also found the ERPT effect on disaggregated CPI items to vary considerably.

Aisen et al (2021) tested the asymmetric ERPT using NARDL on monthly data from January 2001 to December 2019 for Mozambique. They tested ERPT for the nominal effective exchange rate, and the bilateral exchange rates in front of the US Dollar and the South African Rand (South Africa is Mozambique's largest trading partner) on consumer prices while controlling for the rainfall index (a proxy for supply side dynamics), money supply (a proxy for demand side output) and the import price index. They found long run ERPT to be significant but incomplete, with estimates varying between 0.53% for the bilateral exchange rate in front of the US Dollar, 0.42% for the nominal effective exchange rate and 0.3% for the bilateral exchange rate in front of the South African Rand. They also showed the ERPT magnitude to be higher in the case of depreciation and/or high inflation environment compared to an appreciation and/or low inflation environment.

Obeng et al (2022) tested asymmetric ERPT using NARDL on monthly data from January 1990 to January 2020 for Ghana. Their results showed almost complete ERPT for both depreciation and appreciation in the short run (0.81% and 0.74% respectively), while the long run ERPT was incomplete and significant only in the case of a depreciation. Fandamu et al (2023) tested asymmetric ERPT using SVAR on quarterly data from 1985 Q1 to 2017 Q4 for Zambia. They found an incomplete but significant ERPT with the Zambian currency depreciation having a higher ERPT on consumer prices compared to an appreciation.

Empirical Evidence of in ERPT in Egypt

Savastano et al (2005) tested ERPT of Egypt's nominal effective exchange rate on consumer and producer prices using SVAR on monthly data from 1995 to 2004, and controlling for the oil price and GDP but found the ERPT to be statistically insignificant.

Abou-Zaid (2011) tested ERPT on Egypt and Israel on quarterly data from 1996 Q1 to 2006 Q1 using a recursive VAR, with the following order of variables; oil prices, real GDP at 2000 prices, the bilateral exchange rate in front of the US Dollar, wholesale prices, consumer prices and short-term interest rates. He found ERPT to be complete for Egypt while incomplete for Israel, concluding that this can be due to a higher inflation environment for the former. In addition, ERPT tended to decrease as the exchange rate shock moves from wholesale prices to consumer prices for Egypt and vice versa for Israel.

Helmy et al (2018) estimated ERPT using SVAR for the bilateral and the nominal effective exchange rate on consumer and producer prices in Egypt, using monthly data from August 2003 to October 2015. They controlled for import prices which was obtained on an annual frequency and transformed into monthly frequency using E-views in addition to the international food price index and the industrial production index. Their order of the variables were the international food price index, the industrial production index, the exchange rate, the import prices, producer price index (PPI) and finally the consumer price index (CPI). Their estimate for ERPT was found to be incomplete and slow for the bilateral exchange rate, higher for CPI compared to PPI, which was not surprising given that the PPI excludes imported goods in its calculation. Meanwhile, their ERPT results for the Nominal effective exchange rate were immediate and fairly significant, but only last for 10 months.

Awad (2019) estimated ERPT for Egypt using SVAR on quarterly data from 2006 Q1 to 2016 Q3. On top of the variables used by Abou Ziad (2011), Awad (2019) also added an estimated control variable for import prices[15], demand for money as proxied by growth in M1 and M2. He also used a similar order of the variables like Abou-Zaid (2011) both of which following McCarthy (2000, 2007) where import prices gets to be impacted by the exchange rate and then the passthrough moves to producer prices and consumer prices afterwards. He further ran the model on two sub-samples between2006 Q1 to 2010 Q4 and between 2011 Q1 to 2016 Q3. ERPT estimates to consumer prices and producer prices for the whole period were insignificant. However, estimates for ERPT on consumer prices were significant when run on the two sub samples separately, complete for the first sub-sample but incomplete in the second sub-sample. He cited the existence of structural breaks in the data as well as the potential shift in monetary policy regime as possible reasons behind these results. He also used a Markov regime switching model on the same dataset and variables in the SVAR model estimated the ERPT to CPI to be between 0.15 and 0.55 for the slow growth inflation and fast growth inflation regimes respectively. Finally, he ran another Markov switching model on a fewer set of variables notably the domestic and foreign CPI and the bilateral exchange rate and found ERPT to hover between 0.23 and 0.2 for the two regimes, respectively. He concluded that the weak ERPT across the whole sample period could be due to the existence of structural breaks.

[15] *Calculated as the product of the US consumer price index and the bilateral exchange rate for Egypt and the US.*

Elnagger and Richter (2022) tested ERPT using VAR on monthly data from December 2005 to February 2018 for Egypt using nine endogenous variables in the following order; the industrial production index, imports from the USA, Europe and China as proxy variables for demand, broad money supply (M2), the real exchange rate, the bilateral exchange rate in front of the US Dollar, the bilateral exchange rate in front of the Euro currency and finally the consumer price index. The results showed statistically insignificant passthrough for the real exchange rate, and the two bilateral exchange rates on consumer prices.

To the best of our knowledge, Abouelhassan (2022) was the only study that tested for an asymmetric ERPT of Egypt's nominal effective exchange rate on consumer and producer prices using NARDL on quarterly data from 2006 Q1 to 2020 Q4 for Egypt. Control variables included the output gap for GDP, which was estimated using the Hodrick Prescott Filter and the international fuel price index from the International Financial Statistics Database. The results for the NEER were statistically insignificant at the aggregate and the asymmetric levels (depreciation and appreciation).

III. Dataset

Table 1 describes the variables used in the model. Our variable of interest is the bilateral exchange rate in front of the US Dollar which is the average of daily rates as sourced from the International Financial Statistics Database. It was used instead of the nominal effective exchange rate that was used in previous studies because the majority of exports and imports of Egypt are invoiced in US Dollars (on average 89.2% and 83.8%, respectively) using the newly developed database of invoicing by Boz et al (2020). The Consumer price index is the Urban headline index for consumer prices in Egypt and was sourced from the International Financial Statistics Database as well.
Regarding supply side control variables, the international wheat price from the US Department of Agriculture was used to capture the supply side shock to inflation with wheat in particular being the commodity of choice given that Egypt is the largest importer in terms of volume of wheat in the world. Egypt's CPI contains the price of subsidized bread, which has been stable for more than 30 years, as well as market priced bread products as well, with the subsidized bread having a larger weight compared to the market priced one.

In addition, one of the contributions of this study to the literature is the use of a newly calculated index for domestic subsidized fuel prices in Egypt, which to the best of our knowledge has not been used in any previous study on Egypt. Helmy et al (2018) suggested that the low ERPT to CPI in Egypt could be because of regulated prices having a large share of the consumer price index in Egypt, thereby mitigating the passthrough of international oil prices in general to inflation. The fuel price index was calculated as dummy variable with a base price of 1 that grows by the weighted average growth of domestic regulated prices in Egyptian pounds per unit of consumption for the following energy items: Gasoline, Diesel and butane gas. The weights were calculated as the share of volume consumption in tons for each item to their total sum of consumption. Prices were gathered on a monthly frequency from www.FuelpriceEgypt.com website and reflect the decisions of the Ministry of Finance's Automatic Fuel Price Indexation Committee. Meanwhile, the volume consumption per ton for the three items was sourced from the Joint Oil Database Initiative website, also on a monthly frequency from January 2002. The Indexation Committee was created in 2019 Q2 and currently decides on regulated prices for select fuel items such as gasoline and diesel every quarter subject to a cost recovery equation that includes the exchange rate and international oil prices into account.

Regarding demand side control variables, we use Egypt's real GDP levels at market prices using a fixed base year from Egypt's Ministry of Planning and Economic Development, seasonally adjust it and use the Hodrick Prescott filter to de-trend it while accounting for the end of period bias of the filter. The output gap which is calculated as the difference between actual and trend GDP as a share of trend GDP is used in the model results.

Table 1: Description of the Dataset and Variables used in the Model:

Log of consumer price index	LNCPI	International Financial Statistics Database	Headline Urban Consumer Price Inde.x
Log of Exchange rate	LNEGP	International Financial Statistics Database	Egyptian pound per 1 US Dollar.
Log of average international Wheat price	LNFOOD	US Department of Agriculture	Weighted average of all seasoned US wheat prices, weighted by monthly marketing.
Log of Index for subsidized fuel prices	LNFUEL	www.FuelpriceEgypt.com and www.jodi.org	Weighted average of the diesel, gasoline and butane gas. Weights are calculated as the consumption share of each to their total consumption.
Log of Output gap	LNYGAP	Ministry of Planning	HP filter of the real GDP at market prices using the 2001/02 as a base year.

Source: Author's calculations using Eviews 10.

IV. Methodology and Empirical Results

Table 2 shows the unit root test results. We use the traditional Augmented Dickey Fuller following Dickey and Fuller (1979) and cross check the results using Zivot-Andrews unit root test following Zivot and Andrews (1992). Our second contribution to the literature on Egypt is using a unit root test that accounts for structural breaks. Perron (1989) showed that augmented Dickey-Fuller tests may fall into type II error if a present structural break was not accounted for.[16] Amer (2014), Awad (2014), Elshamy (2016) among others refer

[16] *Perron (1989) modified the Dickey Fuller test by accounting for an exogenously determined structural break using a dummy variable that can replicate a crash (or a change in intercept) in a series, or a changed slope (change in trend) or a mix of both (trend and intercept). Christiano (1992) criticized Perron (1989) for his imposition of an exogenous structural break, showing that this invalidates the distribution theory underlying conventional testing. Since then, numerous tests such as Zivot*

to macroeconomic structural breaks that could be present in the dataset due to a significant shift in macroeconomic policy. Egypt's economy has indeed witnessed many macroeconomic shocks during the period of study, a significant devaluation in 2003 Q1, 2016 Q4 and 2022 (Q1 and Q4), political unrest in 2011 Q1 and 2013 (Q3 and Q4), in addition to the global financial crisis in 2008 and the Covid-19 pandemic in 2020 Q1. All these shocks can materially impact the variables under study and impact their stationarity. The results in Table 2 show that the bilateral exchange rate and the output gap are stationary if we control for structural breaks in 2016 Q4 and 2011 Q1, respectively, where as the results showing stationarity for the other variables were deemed to be non-robust. These results show that we cannot test for long run cointegration using Johansen's test as the variables are of different orders of integration.

Table 2: Absolute Values of T-Statistic Results for the Augmented Dickey Fuller and Zivot Andrews Unit Root tests at the levels (*,**,*** denote rejection of Null Hypothesis-H0 of non-stationarity at the 10%, 5% and 1% significance level):

Variable	Augmented Dickey Fuller Test		Zivot Andrews (ZA) Test			Conclusion
	Intercept	Trend and Intercept	Intercept	Trend	Trend and Intercept	
LNCPI	0.58	-2.7	-4.78* (2016 Q2)	N/A	-5.16** (2016 Q4)	Non-stationary of order 1-I(1) given non robust results from the ZA test
LNEGP	-0.46	-1.81	-6.66*** (2016 Q4)	-2.98 (2010 Q1)	-7.35*** (2016 Q4)	Stationary if we control for the November 2016 Devaluation-I(0)
LNFOOD	-2.48	-2.71	-4.17 (2014 Q3)	-3.24 (2008 Q1)	-3.88 (2014 Q3)	Non-stationary of order 1-I(1)
LNFUEL	1.34	-1.69	-5.24** (2016 Q4)	-2.55 (2009 Q3)	-3.20 (2016 Q4)	Non-stationary of order 1-I(1) given non robust results from the ZA test
LNYGAP	-4.15***	-4.12***	-4.99** (2011 Q1)	-4.20 (2009 Q3)	-5.19** (2011 Q1)	Stationary if we control for the January 2011 Revolution-I(0)

Source: Author's calculations using Eviews 10.

Toda and Yamamoto (1995) highlighted that the Granger Causality test, following Granger (1969), may have a non-standard distribution when some of the variables are not stationary. They developed a procedure that mimics the Granger Causality test while overcoming this issue. Table 3 lists the results of the Toda Yamamoto procedure in comparison to the conventional Granger causality results. Toda Yamamoto Causality tests show a one directional causality between the exchange rate and inflation on the short and long runs. It also shows potential long run relationship between Headline CPI

Andrews (1992) among others have devised tests that estimate structural breaks endogenously, thereby accounting for this criticism. For more details on the literature review of unit root tests, see Glynn et al (2007).

from one side and the International Wheat price, the subsidized fuel price index and the bilateral exchange rate.

Table 3: P-values for the granger causality and Toda Yamamoto Procedure: *,**,*** denote the rejection of the null hypothesis-H0 at the 10%,5% and 1% significance levels

	Null Hypothesis	LNEGP (Level)	LNFOOD (Level)	LNFUEL (Level)	LNYGAP (Level)
Granger Causality Procedure	This variable does NOT cause LNCPI	0.05*	0.54	0.19	0.83
	LNCPI does NOT cause this variable	0.04**	0.07*	0.06*	0.27
Toda Yamamoto Causality Procedure	This variable does NOT cause LNCPI	0.00***	0.08*	0.04**	0.4
	LNCPI does NOT cause this variable	0.16	0.14	0.85	0.99
	Null Hypothesis	DLNEGP (1st Difference)	DLNFOOD (1st Difference)	DLNFUEL (1st Difference)	LNYGAP (Level)
Granger Causality Procedure	This variable does NOT cause D(LNCPI)	0.01***	0.41	0.26	0.86
	D(LNCPI) does NOT cause this variable	0.10	0.11	0.18	0.27
Toda Yamamoto Causality Procedure	This variable does NOT cause D(LNCPI)	0.01***	0.12	0.27	0.25
	D(LNCPI) does NOT cause this variable	0.15	0.01***	0.83	0.93

Source: Author's calculations using Eviews 10.

Following Pesaran et al (2001) and Shin et al (2014), we use the Nonlinear Autoregressive distributed lag-NARDL methodology specification. ARDL is superior to traditional VARs, Vector Error Correction Model (VECM) and Johansen Cointegration in that it can account for long run cointegration between variables of different stationarity orders (I(0) and I(1)) conditional upon that no variables are stationary at the second difference (I(2)). Given the results above for both stationarity and causality tests, ARDL is the optimal methodology to use to study ERPT as opposed to VARs. In addition, ARDL also provides consistent estimates asymptotically. Finally, NARDL can also be used to directly test for asymmetry in the exchange rate depreciation/appreciation.

In order to derive the ARDL equation, we first assume a conventional error correction model equation, following Campa and Goldberg (2005), Delatte and Lopez Villavicencio (2012) among others:

$$DLNCPI_t = \beta_1 + \sum_{i=1}^{p} \beta_{2i} * DLNCPI_{t-i} + \sum_{i=0}^{q_1} \beta_{3i} * DLNEGP_{t-i} + \sum_{i=0}^{q_2} \beta_{4i} * DLNFOOD_{t-i} + \sum_{i=0}^{q_3} \beta_{5i} * DLNFUEL_{t-i} + \sum_{i=0}^{q_4} \beta_{6i} * LNYGAP_{t-i} + \beta_7 * JANREV + \beta_8 * NOVDEVAL + \delta * Z_t + \varepsilon_t \quad (1)$$

In Equation (1), '*DLN*' that precedes any variable denotes the first difference in logs. 'Janrev' is a dummy for the January 2011 (2011 Q1) revolution that is included as a structural break to ensure stationarity of the output gap variable. 'Novdeval' is another dummy variable that captures the devaluation of the exchange rate in November 2016 (2016 Q4), again to ensure the stationarity of the exchange rate variable at the level. 'ε_t' is an iid error term. All other variables, with the exception of 'Z_t' , are described in Table 1 above. 'Z_t' is the cointegration term and can be thought of the as the OLS residuals series from the long run co-integration (equation 2 below) and 'δ' can be thought of as the speed of adjustment parameter from the short run to the long run steady state.

$$LNCPI_t = \alpha_1 + \sum_{i=1}^{p} \alpha_{2i} * LNCPI_{t-i} + \sum_{i=0}^{q_1} \alpha_{3i} * LNEGP_{t-i} + \sum_{i=0}^{q_2} \alpha_{4i} * LNFOOD_{t-i} + \sum_{i=0}^{q_3} \alpha_{5i} * LNFUEL_{t-i} + \alpha_7 * JANREV + \alpha_8 * NOVDEVAL + \rho * T + \Xi_t \quad (2)$$

Where 'ρ' is the parameter of the trend variable 'T' which was included following Taylor (2004)[17] and Aisen et al (2021). If a long term cointegration equation exists, that is after testing for the long run bounds test, we can derive from the above a conditional error correction equation. After accounting for the asymmetries in the exchange rate following Kassi et al (2019), Aisen et al (2021) and Abouelhassan (2022) among others, our baseline NARDL equation, a conditional error correction model, is listed below:

$$\begin{aligned} \Delta LNCPI_t = \mu_1 &+ \sum_{i=1}^{p} \mu_{2i} * LNCPI_{t-i} + \sum_{i=0}^{q_1} \mu_{3i} * LNEGP\_POS_{t-i} + \sum_{i=0}^{q_2} \mu_{4i} * LNEGP\_NEG_{t-i} \\ &+ \sum_{i=0}^{q_3} \mu_{5i} * LNFOOD_{t-i} + \sum_{i=0}^{q_4} \mu_{6i} * LNFUEL_{t-i} + \sum_{i=0}^{q_5} \psi_i * LNYGAP_{t-i} + \mu_7 * JANREV \\ &+ \mu_8 * NOVDEVAL + \rho * T + \sum_{i=1}^{q_6} \theta_{1i} * DLNCPI_{t-i} + \sum_{i=0}^{q_7} \theta_{2i} * DLNEGP\_POS_{t-i} \\ &+ \sum_{i=0}^{q_8} \theta_{3i} * DLNEGP\_NEG_{t-i} + \sum_{i=0}^{q_7} \theta_{4i} * DLNFOOD_{t-i} + \sum_{i=0}^{q_8} \theta_{5i} * DLNFUEL_{t-i} + \eta_t \end{aligned}$$

Where $\mu_{2i}, \mu_{3i}, \mu_{4i}, \mu_{5i}$ are the long run parameters and $\theta_{1i}, \theta_{2i}, \theta_{3i}, \theta_{4i}$ *and* θ_{5i} are the short run parameters. the asymmetric depreciation in the Egyptian Pound vis a vis the US Dollar is captured by $LNEGP\_POS_{t-i} = \sum_{i=0}^{q_1} Max(\Delta LNEGP_{t-i}, 0)$ with the depreciation being a positive increase in the variable. Meanwhile, the appreciation in the bilateral exchange rate

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[17] Taylor (2004) argued that the Harrod Balassa Samuelson Effect that showed optimally higher inflation rates for countries with higher productivity differentials suggests that time should be included as a control variable for CPI.

is defined as $LNEGP\_NEG_{t-i} = \sum_{i=0}^{q_1} Min(\Delta LNEGP_{t-i}, 0)$ which represents a negative change.

The bounds test is used to test the Null Hypothesis that $\mu_{2i} = \mu_{3i} = \mu_{4i} = \mu_{5i} = 0$. If the F-statistic is larger than the upper bound critical value I(1), we reject the null hypothesis and conclude that there is a long run cointegration between the variables irrespective of their integration. On the other hand, the F-statistic is lower than the lower critical value I(0), we fail to reject the null hypothesis. If the statistic ends up between the lower and upper critical values the results are inconclusive. Table 4 shows the results of the ARDL equation above. Lags for the variables in the model were selected automatically using Schwartz Bayesian Information Criterion.

Table 4: NARDL Results: Dependent Variable: The log of the Consumer Price Index
Variables in bold have Statistically Significant Coefficients

Sample (adjusted): 2002Q1 2022Q4

Included observations: 84 after adjustments

Dynamic regressors (4 lags, automatic): LNEGP_POS LNEGP_NEG LNFOOD LNFUEL

Fixed regressors: NOVDEVAL JANREV LNYGAP C @TREND

Selected Model: ARDL(2, 1, 0, 0, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNCPI(-1)	**1.13**	**0.10**	**11.62**	**0.00**
LNCPI(-2)	**-0.26**	**0.09**	**-2.79**	**0.01**
LNEGP_POS	**0.15**	**0.04**	**4.26**	**0.00**
LNEGP_POS(-1)	**-0.11**	**0.04**	**-2.91**	**0.00**
LNEGP_NEG	0.03	0.06	0.54	0.59
LNFOOD	0.01	0.01	1.33	0.19
LNFUEL	**0.07**	**0.03**	**2.78**	**0.01**
LNFUEL(-1)	**-0.08**	**0.02**	**-3.33**	**0.00**
NOVDEVAL	-0.04	0.02	-1.80	0.08
JANREV	-0.02	0.02	-1.32	0.19
LNYGAP	**0.00**	**0.00**	**2.06**	**0.04**
CONSTANT	**0.53**	**0.19**	**2.82**	**0.01**
TREND	**0.00**	**0.00**	**3.09**	**0.00**
R-squared	1.0	Mean dependent var		5.6
Adjusted R-squared	1.0	S.D. dependent var		0.7
Sum squared resid	0.0	Schwarz criterion		-5.3

*Note: p-values and any subsequent tests do not account for model election.

Source: Author's calculations using Eviews 10.

The above results show a clear asymmetry between the depreciation and the appreciation of the exchange rate, with the former having a larger and statistically significant magnitude compared to the later. The subsidized fuel index is also statistically significant at the 1% level.

A key assumption of the NARDL estimates is that the error term does not exhibit serial correlation. Table 5 below shows that the series exhibits a serial correlation particularly at the 3rd quarterly lag.

Table 5: Breusch-Godfrey Serial Correlation LM Test: Null Hypothesis is no Serial Correlation

F-statistic	1.92	Prob. F(4,67)	0.12
Obs*R-squared	8.63	Prob. Chi-Square(4)	0.0711
1st Lag P-Value	2nd Lag P-Value	3rd Lag P-Value	4th Lag P-Value
0.87	0.09	0.03	0.43

Source: Author's calculations using Eviews 10.

To overcome this issue, we re-run the above estimates while adding a four-quarter moving average of the dependent variable with a three-quarter lag.

Table 6: NARDL Results After Correcting for the Serial Correlation: Dependent Variable: The log of the Consumer Price Index. Variables in bold have Statistically Significant Coefficients

Sample (adjusted): 2003Q2 2022Q4

Included observations: 84 after adjustments

Dynamic regressors (4 lags, automatic): LNEGP_POS LNEGP_NEG LNFOOD LNFUEL

Fixed regressors: NOVDEVAL JANREV LNYGAP MALNCPI(-3) CONSTANT TREND

Selected Model: ARDL(2, 1, 0, 0, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNCPI(-1)	**1.11**	**0.10**	**10.70**	**0.00**
LNCPI(-2)	**-0.27**	**0.10**	**-2.68**	**0.01**
LNEGP_POS	**0.16**	**0.04**	**3.89**	**0.00**
LNEGP_POS(-1)	**-0.11**	**0.05**	**-2.06**	**0.04**
LNEGP_NEG	0.04	0.06	0.59	0.55
LNFOOD	0.01	0.01	1.35	0.18
LNFUEL	**0.06**	**0.03**	**2.24**	**0.03**
LNFUEL(-1)	**-0.08**	**0.02**	**-3.29**	**0.00**
LNYGAP	**0.00**	**0.00**	**1.90**	**0.06**
NOVDEVAL	-0.04	0.02	-1.72	0.09
JANREV	-0.02	0.02	-1.25	0.22
MA4LNCPI(-3)	0.03	0.06	0.61	0.54
CONSTANT	**0.52**	**0.23**	**2.25**	**0.03**
TREND	**0.00**	**0.00**	**2.61**	**0.01**
R-squared	1.0	Mean dependent var		5.6

Adjusted R-squared	1.0	S.D. dependent var	0.7
Sum squared resid	0.0	Schwarz criterion	-5.3
*Note: p-values and any subsequent tests do not account for model election.			

Source: Author's calculations using Eviews 10.

Upon re-running the LM test with the results in Table 6 above, we could not reject the null hypothesis of no serial correlation (Table 7 below). Furthermore, the series does not depict heteroscedasticity (Table 8).

Table 7: Breusch-Godfrey Serial Correlation LM Test: Null Hypothesis is no Serial Correlation

F-statistic	1.16	Prob. F(4,61)	0.34
Obs*R-squared	5.57	Prob. Chi-Square(4)	0.23
1st Lag P-Value	2nd Lag P-Value	3rd Lag P-Value	4th Lag P-Value
0.86	0.2	0.1	0.96

Source: Author's calculations using Eviews 10.

Table 8: Breusch-Pagan-Godfrey Heteroskedasticity Test: Null Hypothesis is Homoscedasticity

F-statistic	0.94	Prob. F(12,71)	0.51
Obs*R-squared	12.54	Prob. Chi-Square(12)	0.48
Scaled explained SS	6.36	Prob. Chi-Square(12)	0.93

Source: Author's calculations using Eviews 10.

Results for the short run error correction model can be seen in Table 9 below. Consistent with the results in Table 6, the depreciation in the Bilateral exchange rate is statistically significant and contemporaneous, with every 10 percent depreciation in the EGP in front of the US Dollar resulting in a short term pick up in quarterly inflation by about 1.6 percentage points. In addition, because the depreciation in the exchange rate also passes through to higher subsidized fuel prices[18], the overall direct effect on quarterly inflation from the 10 percent depreciation is around 0.6 percentage points in the following quarter.

Table 9: ARDL Error Correction Regression Results. Variables in Bold have Statistical Significant Coeffients.

Selected Model: ARDL(2, 1, 0, 0, 1), Sample: 2001Q3 2022Q4

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CONSTANT	**0.52**	**0.15**	**3.58**	**0.00**
TREND	**0.00**	**0.00**	**3.34**	**0.00**
D(LNCPI(-1))	**0.27**	**0.09**	**3.21**	**0.00**
D(LNEGP_POS)	**0.16**	**0.04**	**4.06**	**0.00**

[18] The Ministry of Finance's Automatic Price Indexation Mechanism stipulates that subsidized fuel prices can adjust up or down by a maximum of +/- 10 percent, in reaction to a change in underlying costs which include the exchange rate, energy prices among other factors in the previous quarter.

D(LNFUEL)	**0.06**	**0.02**	**2.71**	**0.01**
LNYGAP	**0.00**	**0.00**	**2.21**	**0.03**
NOVDEVAL	-0.04	0.02	-1.81	0.08
JANREV	-0.02	0.02	-1.40	0.17
MA4LNCPI(-3)	0.03	0.03	1.01	0.32
CointEq(-1)*	**-0.16**	**0.05**	**-3.40**	**0.00**
Adjusted R-squared	0.55	S.D. dependent var		0.02

Source: Author's calculations using Eviews 10.

The Cointegration term is negative and statistically significant at the 1% level. However, we could not reject the null hypothesis of no long run cointegration relationship shown in Table 10 below given that the F-statistic value of 2.17 from the Bounds test falls below the lower critical bound of 3.47 at the 5% significant level. The T-statistic from the bounds test also falls between the lower and upper bounds suggesting an inconclusive result. It is noteworthy to highlight that we ran several iterations of the model with different specifications in terms of restrictions on the trend and the constant but still got a barely significant but nonsensical long run relationship.[19]

Table 10: Long Run Bounds Test Results

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Significance level	I(0)	I(1)
F-statistic	2.17	10%	3.03	4.06
k	4	5%	3.47	4.57
T-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	-3.40	10%	-3.13	-4.04
		5%	-3.41	-4.36

Source: Author's calculations using Eviews 10.

Testing for the difference in ERPT with a higher inflation magnitude and or higher inflation volatility:

We follow Aisen (2021) in testing whether ERPT changes with higher or lower inflation and inflation volatility. McCarthy (2000), Taylor (2000), Gagnon and Ihrig (2004) among others postulated that the presence of a strong nominal anchor of monetary policy, such as successfully anchoring inflation expectations, can lower the magnitude of ERPT. We calculate two new control variables and include each one instead of the main variable of

[19] Nonsensical relationship is when the F-statistic was higher than the upper bound at the 5% significance level but the T-statistic of the Bounds test and the T-statistics of all the long run coefficients were inconclusive and statistically insignificant, respectively.

interest (the bilateral exchange rate) in two alternative scenarios of the model. These variables are calculated as follows:

In the first alternative scenario, 'LNEGPMA4DLCPI' was the main variable of interest and was calculated as the product of the log of the bilateral exchange rate and the four-quarter moving average of the quarterly change in the consumer price index (quarterly inflation). In the second alternative scenario, 'LNEGPSTD' was used instead and was calculated as the product of the Log of the bilateral exchange rate and the four-quarter rolling standard deviation of the quarterly change in the consumer price index (quarterly inflation).

In the first alternative scenario, we could not reject the no long run cointegration relationship. In addition, we could not reject the absence of asymmetry in the short term passthrough, with both the higher and lower magnitudes of inflation leading to higher and significant contemporaneous ERPT by roughly the same magnitude. Table 11 lists the main results of this scenario.

Table 11: Summary of results for Alternative Scenario I

Short term coefficients	D(LNEGPMA4DLCPI_POS) High Inflation Environment		D(LNEGPMA4DLCPI_NEG) Low Inflation Environment		
Lag	Contemporaneous	1st quarter lag	Contemporaneous	1st quarter lag	2nd quarter lag
Coefficient value	1.42	-0.80	1.58	-0.85	0.30
T-statistic of the Coefficient	22.63	-4.84	15.60	-4.88	2.66
Cointegration term value	0.00				
T-statistic of the Cointegration term	-4.05				
F-statistic for the Bounds test	2.50				
Lower bound critical value for the Bounds test	3.05				
Upper bound critical value for the Bounds test	3.97				

Source: Author's calculations using Eviews 10.

In the second alternative scenario, the opposite result was found, namely a significant and asymmetric long run relationship with the increase in inflation volatility leading to a higher and statistically significant ERPT and vice versa. The F-statistic from the Bounds test was also higher than the upper critical value, indicating the significance of the long run relationship. However, we could not find a statistically significant relationship on the short term for either the increase or the decrease in the inflation volatility in relation to ERPT.

Table 12: Summary of results for Alternative Scenario II

Long term coefficients	LNEGPSTD_POS	LNEGPSTD_NEG
Lag	Contemporaneous	Contemporaneous
Coefficient value	0.70	0.23

T-statistic of the Coefficient	4.65	1.65
Cointegration term value	-0.18	
T-statistic of the Cointegration term	-6.02	
F-statistic for the Bounds test	6.85	
Lower bound crtical value for the Bounds test	3.47	
Upper bound critical value for the Bounds test	4.57	

Source: Author's calculations using Eviews 10.

While we corrected for the presence of serial correlation in both alternative scenarios, in addition to ensuring the stability of coefficients using CUSUM and CUSUM of Squares tests, we still consider the results from the two alternative scenarios to be non-robust given that conditional heteroscedasticity with the two main variables of interest was detected and could not be corrected for even after using white standard errors.

V. Conclusion

The literature on ERPT in Egypt had mostly concluded an insignificant exchange rate passthrough on consumer prices with respect to Egypt's nominal effective exchange rate, and to a lesser extent the bilateral exchange rate in front of the US Dollar, with few exceptions. In most of the studies, VAR or SVAR methodologies were utilized and the main variable of interest (the bilateral or effective exchange rates) were assumed to be non-stationary of order 1. This allowed for testing Johansen Cointegration on the exchange rate and consumer price index, which is also non-stationary of the same order. This was the case despite numerous papers citing the possible presence of macroeconomic structural breaks in the series especially in the time frame that was used in most of these studies including this paper (late1990s/early 2000s till present). Such structural breaks can materially impact the conclusion regarding stationarity, following Pesaran et al (2001) among others, with implications on the methodology that is being used.

To the best of our knowledge, Abouelhassan (2022) was the only paper that tested NARDL and the Bounds Cointegration test which allows for different orders of integration to be tested. However, the results of Abouelhassan (2022) were an insignificant ERPT, likely because it used the nominal effective exchange rate as opposed to the bilateral exchange rate. This is despite the newly developed database on currency invoicing by Boz et al (2020) showing a range between 80%-90% of exports and imports of Egypt being invoiced in the US Dollar as opposed to any other currency (the dominant currency pricing).

Our contribution to the literature is threefold. First, we used an extended database from 2001 Q3 till 2022 Q4 which includes three periods of significant depreciation in the Egyptian pound vis a vis the US Dollar (namely 2003, 2016 and 2022). We also used the bilateral exchange rate in front of the US Dollar as opposed to the nominal effective exchange rate that was used in earlier studies to narrow down our study of ERPT, and focus on the role of the dominant currency that is used in invoicing of exports and imports on consumer prices. Second, we utilized the Zivot Andrews unit root test to show that if we control for a structural break in 2016 Q4 (the November 2016 devaluation in the Egyptian Pound), the bilateral exchange rate will be stationary at the level. This meant that ARDL is superior to VARs/ SVARs that were previously used to study ERPT in Egypt, as the former can be used to test for long run cointegration given the different orders of integration unlike the latter. We also used the Toda Yamamoto causality test and showed that endogeneity is not of concern when it came to the two main variables of interest (consumer prices and the bilateral exchange rate), further supporting our choice of ARDL as opposed to VAR for the methodology. Third, some of the previous studies on Egypt, such as Helmy et al (2018) cited the presence of a relatively large share of subsidized items in the consumer price index as possible reason for the low magnitude of ERPT. We build on that conclusion by directly controlling for a newly developed subsidized fuel index, which turned out to be statistically significant on the short run, with its magnitude roughly recording 50% of the magnitude for the short run ERPT. We also introduced asymmetry in our baseline model, following Abouelhassan (2022), and found that only the depreciation in the bilateral exchange rate had a positive and statistically significant effect on inflation in the short term, while the appreciation was insignificant. This is in line with anecdotal evidence for Egypt and is also consistent with the downward price rigidity for prices in general. We further tried to explore, in two alternative scenarios, whether ERPT changes with higher inflation rates and or higher inflation volatility, however we could not find a robust conclusion given the presence of conditional heteroscedasticity in both alternative scenarios.

The results of this paper have significant policy implications. First, the results confirm the asymmetry in the exchange rate passthrough, which means that any overshooting that took place historically in the bilateral exchange rate had likely caused a damage (higher inflation on the short run) that could not be compensated for later on with any appreciation that might have followed. This means that in the event of currency depreciation in the future that is not warranted by fundamentals, the Central Bank of Egypt should consider other monetary policy tools to limit such overshooting. This in itself is not an easy task given that historically the depreciations in the Egyptian Pound had occurred during times of low foreign exchange reserves, thereby denying the central bank another tool to stabilize the exchange rate. Increasing the transparency of monetary policy and enhancing the communication channel could be of good use in that case. Despite the above, the short term ERPT (1.6% higher quarterly inflation for every 10 percent depreciation in the currency) was found to be in line with the magnitudes in other developing economies, falling roughly in the middle range of the passthrough when it comes to consumer prices using single equation estimates.

Finally, additional areas that should be studied in the future include the impact of a depreciation in the currency on the trade balance especially in light of the dominant currency pricing of Egyptian exports and imports. Such research could help form a complete picture for policy makers regarding the optimal monetary policy regime, with likely implications on the 'fear of floating' debate as well.

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