# Phillips in a Revolution: Unemployment and Prices in Early 21st Century Egypt

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November, 2019

## Abstract

The relative price Phillips curve hypothesis gives a better account of the dynamics of the Egyptian economy than the price Phillips curve. Using standard aggregate macroeconomic quarterly data for the Egyptian economy from 2003q1 to 2019q1 to obtain Ordinary Least Squares and Generalized Method of Moments estimates for four versions of the Phillips curve, this article provides evidence that the exchange rate regime affects the relation between prices and unemployment in emerging economies: while an economic boom leads to lower unemployment and higher inflation in a fixed exchange rate regime, the nominal appreciation of the currency negatively affects imported goods prices and flattens the price Phillips curve in a flexible exchange rate regime. The results also suggest a broken link between inflation and unemployment during the Egyptian Revolution and the subsequent period, raising questions on macroeconomic management in times of political turmoil.

**Keywords:** Phillips Curve, Egyptian Economy, Labour Market, Monetary Policy, Small Open Economy.

**JEL Classification:** E24, E31, E52, E58.

# 1 Introduction

The Phillips curve has been a highly debated relation since it was first proposed in 1958. In high income economies, the Stagflation of the 1970s, the Missing deflation during the 2007 - 2008 financial crisis and the Missing inflation during the subsequent recovery led many economists to question the specification, the pertinence, or even the existence of this relation. Less attention has been paid however to the evolution of this relation in developing and emerging countries. Egypt's dual labour market is characterized by a high informality level and low female and educated youth employment rate, which makes it quite similar to that of other Arab countries. Because inflation has been relatively high and volatile since the early 2000s, studying the Phillips curve in the context of the Egyptian economy is of high interest, in itself, and more broadly to intend to draw policy lessons in the MENA region.

In this article, I examine the relation between unemployment and inflation in Egypt through the lense of a small open economy conceptual framework. Using aggregate quarterly macroeconomic data for the period 2003q1 - 2019q1, I ask whether considering that the Phillips curve is a relation between the real exchange rate, i.e. relative prices instead of prices, and unemployment allows to better assess the dynamics of the Egyptian economy in the early 21st century. In a fixed exchange rate regime, an economic boom, created for example by an expansionnary policy that positively affects aggregate demand, leads to a decline in the unemployment rate as well as inflationnary pressures. Because the price of traded goods is exogenously determined in the global markets, this price does not respond to the increase in domestic demand, while the price of non-traded goods do. However, in a flexible exchange rate regime, such a policy will lead to a nominal appreciation of the currency, therefore decreasing the price of imported goods. In this case, the effect of an expansionnary policy on inflation is ambiguous and the negative correlation between inflation and unemployment is not necessarily observed, while the negative correlation between real exchange rate appreciation and unemployment stands. I hypothesize that this mechanism can explain the relation between the general price level, relative prices and unemployment in Egypt.

The concept of the Phillips curve has evolved greatly since it was first introduced in Phillips (1958), and it is now a core equation of New Keynesian macroeconomic models. From a simple linear relation between wages growth rate and unemployment, it is now often specified as a relation between a monetary variable, the price or nominal wage inflation rate, its expected future value, and a real variable, the unemployment rate or the output gap, such as in Woodford (2003). Geerolf (2018) defends the concept of a real exchange rate Phillips curve and provides theoretical arguments and empirical evidence for high-income countries suggesting that it can be generalized.

The contribution of this article is threefold. First, it shows using simple correlations that the relative price Phillips curve can be more useful than the price Phillips curve to analyse the macroeconomic fluctuations of the Egyptian economy during the period spanning from 2003q1 to 2019q1. Second, it provides evidence that the relation between prices and unemployment vanished during the Egyptian Revolution and the subsequent period, until the devaluation of the Egyptian Pound. Third, it is, to the best of my knowledge, the first empirical study that supports the view that the relative price Phillips curve, or the real exchange rate Phillips curve, can be generalized to small open emerging economies.

This article reviews four different Phillips curve specifications for the Egyptian economy, namely the Original, the Augmented, the Accelerationnist and the New Keynesian Phillips curves. Ordinary Least Squares (OLS) estimates are complemented with the Generalized Method of Moments (GMM) for the New Keynesian specification in order to obtain more robust correlations and for comparability purposes. The Phillips curve correlations indicate that the slope is flat over the period. However, by looking at subperiods, there is evidence of a negative slope before the Egyptian Revolution that started in 2011q1, a period characterized by a fixed exchange rate regime, while a positive slope is observed after the 2016q4 devaluation and announced liberalization of the exchange rate regime, although the *de facto* liberalization was temporary, according to the IMF[1]. This positive correlation between inflation and unemployment from the devaluation to 2019q1 is not a structural relation, but characterizes a period of transition after a strong exogenous shock. When looking at the correlation between the Real effective exchange rate (REER) and unemployment, a negative slope can be observed both before the start of the Revolution and after the devaluation. These results correspond to the predictions of the relative price Phillips curve hypothesis. During the Revolution and in the subsequent period until the devaluation, no correlation is observed between inflation and unemployment, nor between the REER and unemployment. Political turmoil is likely to have altered this relation through various channels. This absence of correlation does not indicate however that unemployment could have been combatted at a lower cost in terms of inflation than during the previous period, but it rather evidences the economic impact of high uncertainty and of the growing imbalances documented in Helmy and Zaki (2017) and Zaki (2017).

The remainder of the article is organized as follows. Section 2 reviews the literature. Section 3 describes the data and presents stylized facts on the Egyptian economy, focusing on unemployment, inflation and the real effective exchange rate. Section 4 details the empirical strategy and discusses the results. Finally, section 5 concludes.

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[1]See the CBE Press Realease on Nov. 3, 2016 and the IMF 2018 Annual Report on Exchange Arrangements and Exchange Restrictions.

## 2 Related literature

The Phillips curve, despite being highly criticized since it has been introduced by Phillips (1958) using British data[2], has become a core concept of modern macroeconomic analysis. Le Bihan (2009) provides an extensive review of the evolution of the concept and Schmitt-Grohé and Uribe (2008) present a theoretical discussion on the relevance of its New Keynesian version for the conduct of monetary policy. After the Global Financial Crisis, Simon et al. (2013) note that with high unemployment in most high-income countries, inflation should have decreased but remained very stable. Furthermore, as activity and employment recovered, inflation remained very low when it should have increased. These facts have led economists to question the relevance, or even the existence, of the Phillips curve[3]. Using U.S. data, Farmer and Nicolò (2019) propose to eliminate the Phillips curve from macroeconomic models. Abdih et al. (2016) compare a bottom-up model that they introduce with a Phillips curve and prefer the former rather than the latter to assess the effects of economic shocks on inflation. They show that while national factors determine the inflation rate of services, foreign factors, namely import prices, drive the core inflation of goods in the U.S. The author argue that low inflation in the US is explained mostly by international pressure.

In contrast, Medel (2015) for the Chilean economy, Laseen and Sanjani (2016) and Gordon (2013) for the U.S. economy, and Berson et al. (2018) and Moretti et al. (2019) for the Eurozone, among others, argue in favour of the Phillips curve and find significant and stable coefficients. Mojon and Ragot (2018) explain the low wage inflation in a context of low unemployment by a large positive supply-side shock on OECD countries' labour markets and find significant coefficients of unemployment in the Phillips curves they estimate. Chatelais et al. (2015) use a Phillips curve augmented with import prices and find that between 1997 and 2014, inflation in the Eurozone is equally driven by import prices and economic activity. Lodge and Mikolajun (2016) obtain a similar result for commodity prices. Diev et al. (2019) decompose the inflation rate in the Eurozone and find that in 2017-2018, the real exchange rate appreciation is an explanation of why the observed wage Phillips curve doesn't transmit to a price Phillips curve. Based on a discussion of historical events, Hooper et al. (2019) argue that the Phillips curve is not dead and provide further evidence of its current relevance using states and Metropolitan Statistical Areas data. Coibion and Gorodnichenko (2015) also defend the relevance of the Phillips curve and argue that missing deflation disseapears once household's in-

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[2]Previous work, such as Fisher (1926), had already observed a negative relationship between inflation and unemployment.

[3]Press articles have also contributed to the debate. For recent examples, see "Finding Phillips: Economists' models of inflation are letting them down" (The Economist, October 10, 2019) and "Wages are a poor guide for monetary policy" (Financial Times, July 21, 2019).

flation expectations are included in the Phillips curve in replacement of other measures of inflation expectations. Blanchard (2016) shows that the unemployment coefficient in the Phillips curve of advanced economies has not declined after the crisis, but instead has remained low and stable since the 1980s.

The literature has also provided several explanations why identifying a Phillips curve is a difficult empirical task. First, as discussed in Blanchard (2016), the choice of the exact variables has an impact on the estimated coefficients. By noting also the vast set of point estimates obtained due to the uncertainty around the correct specification, Mavroeidis et al. (2014) underline the limits of using aggregate macroeconomic data. Muto (2009) uses Japanese data from 1975 to 2004 and stresses the importance of taking into account a robust measure of the real marginal cost to identify the New Keynesian Phillips Curve parameters. This result has implications for the estimation of such relations in developing economies, and particularly in Arab countries, as their labour markets are characterized by multiple frictions that are less binding in OECD and other high-income countries.

Second, widely adopted empirical strategies might not allow to overcome identification issues. Barnichon and Mesters (2019) explain the caveats of most common methods, which lead to underestimated slopes and overestimated coefficients of forward inflation, and present an alternative methodology based on the narrative approach. Jondeau and Le Bihan (2005) compare Maximum Likelihood and GMM estimations of New Keynesian Phillips curves. They find that the forward component is upward biased in estimations that use the GMM. They also find that the results differ greatly depending on the lag and the forward structure of the equation, and depending on the economy that is analyzed, providing further support to the idea that the true specification of the Phillips curve is unknown. The issues that arise when estimating a Phillips curve with a GMM approach and with the use of the Hodrick-Prescott filter are also discussed by Dees et al. (2009). The authors defend a global vector autoregression (GVAR) approach for a proper identification of the parameters in the setting of a multi-country analysis.

Third, McLeay and Tenreyro (2019) point out that the Phillips curve is difficult to identify due to the endogenous policy response of the central bank : a level of unemployment below the natural rate will lead to a monetary tightening that will cause a decrease in the inflation rate, creating therefore a positive correlation between unemployment and inflation. However, this issue might be less stringent in the case of Egypt, as the monetary policy was compelled to maintain a fixed exchange rate under the regime that prevailed for most of the beginning of the 21st century.

Geerolf (2018) proposes an alternative explanation to the fact that the Phillips curve

is not observed empirically in some periods or in some countries. By considering that the Phillips curve is a relation between unemployment and the real exchange rate, instead of inflation, the author predicts that a negative relation between inflation and unemployment is only observed in the context of fixed exchange rate regimes, while a negative relation between real exchange rate appreciation and unemployment is observed under all exchange rate regimes. The author provides evidence, mainly for the U.S. and other OECD countries, based on aggregate macroeconomic data, dissaggregated consumer price inflation indexes, data at the states and Metropolitan Statistical Areas level and based on moments identified using a narrative approach. In this article, I argue that this interpretation of the Phillips curve is usefull to better understand the dynamics of the Egyptian economy and that it might therefore be extended to developing countries.

Probably because of the fiscal dominance and the fixed exchange rate regimes that characterize many countries of the region, the literature that specifically discusses the Phillips curve in Arab countries is relatively scarce. Some notable exceptions exist however, such as Ben Ali (2013) who discusses the use of the GMM to identify the parameters of a New Keynesian Phillips curve and who estimates it for the Tunisian economy using quarterly data from 1991q1 to 2007q2 and taking various measures of the unemployment gap as the main dependant variable. Other articles, such as Abdelaziz Touny (2013) in the case of Egypt, study the relationship between inflation and unemployment but from a long-term perspective. Using data from 1974 and 2011, the author finds that inflation is not associated with a reduction in the unemployment gap in the long run.

Baaziz (2016) and Fekry Mabrouk and Maher Hassan (2012) center their analysis on the conduct of monetary policy in Egypt and insist on the fact that the Egyptian Revolution represents a structural break in this aspect. Abdelfattah Moursi and El Mossallamy (2010) study the dynamics of inflation in Egypt by calibrating a DSGE model of the Egyptian economy using data from 2002 to 2008. Their impulse response functions indicate that the economy responds greatly to foreign shock on both output and prices, but only modestly to domestic interest rate shocks. Arbatli and Moriyama (2011) also evidence a weak response to domestic interest rate shocks using the Global Projection Model + (GPM+) developed at the IMF and calibrated using quarterly data from 2005q3 to 2010q2. Furthermore, the results from their estimation of the Phillips curve indicate that the inflation inertia is high in Egypt over the period and that the exchange rate pass-through is relatively low. Ali (2012) specifically looks at the inflation dynamics in Egypt from 1989 to 2009 using a VAR model and evidences an increase in the persistence of inflation over the period, consistent with the findings of Moriyama

(2011) over the period 2000 - 2009. The author also documents a flattening Phillips curve, explained by the persistence of high inflation inertia, high money supply and large fiscal deficits. Over the whole period, the author finds that the exchange rate pass-through is relatively weak in Egypt, consistent with the results in Arbatli and Moriyama (2011). A more recent study by Abdelraouf et al. (2019) assesses the inflation dynamics in Egypt using monthly data from 2000m01 to 2018m10, and confirms previous results finding that, while inflation dynamics is driven by supply-side shocks and exchange rates movements in the short run, the long-run increase in inflation over the period is driven by an excess of monetary growth and relative prices distortions.

This paper also relates to a rich literature that has studied extensively the distinctive features of labour markets in Arab countries. Assaad (2014) argues that the existence of the dual labour markets observed in most Arab countries, that are characterized by a large share of public employment, a high level of youth unemployment and a low female participation, are the result of particular political dynamics in which labor markets have been used as instruments to ensure political appeasement. The Egyptian labour market is no exception within the region, and a long tradition of high quality labour surveys has allowed for a rather vast literature that analyses its characteristics, from Hansen (1969) in the case of rural Egypt to more recent studies such as Assaad and Krafft (2017) which documents the youth exclusion from the Egyptian labour market or Assaad et al. (2019b) which assess the apparent contradiction between rising female education and stagnant female participation in the labour market. El-Mallakh et al. (2018) use a Difference-in-Differences strategy and data from the Egypt Labor Market Panel Surveys (ELMPS) of 2006 and 2012 to estimate the impact of the Revolution on the Egyptian labour market. The authors find that the relative participation of women increased after the Revolution as a consequence of higher men's income volatility, thus providing further evidence of the substantial impact of this event on the Egyptian labour market (Bargain et al., 2019, provide a broader assessment of the impact of the Egyptian Revolution on social norms and women's empowerment). Assaad et al. (2019a) use the latest version of the ELMPS, as well as the survey from previous years, to evidence that the recent decline in unemployment observed since 2014 is concommitent with a decline in the employment rate and an increase in informality. The authors also evidence a structural shift in the employment towards the sectors of construction and transportation, denoting a boom in the non-tradable sectors in a context of declining competitiveness, which is of particular interest for this article.

# 3 Data and Stylized Facts

Macroeconomic data for the Egyptian economy is provided by various sources. The Consumer Price Index comes from the Central Bank of Egypt (CBE) and the International Financial Statistics (IFS) dataset issued by the International Monetary Fund (IMF). The interest rate is computed as the average of the deposit and the lending rates and is retrieved from the IFS dataset. The real effective exchange rate is taken from the updated version of the Bruegel database introduced by Darvas (2012) and includes 143 trading partners. Data for the unemployment rate comes from the IFS dataset and from the Egyptian Central Agency for Public Mobilization and Statistics (Capmas). All time series have a quarterly frequency and cover the period spanning from 2003q1 to 2019q1. The interest rate, the real effective exchange rate and the inflation rate, computed as the year-over-year growth rate of the CPI, are all available since at least 2001q1.

Figure 1 – Real Effective Exchange Rate and Unemployment
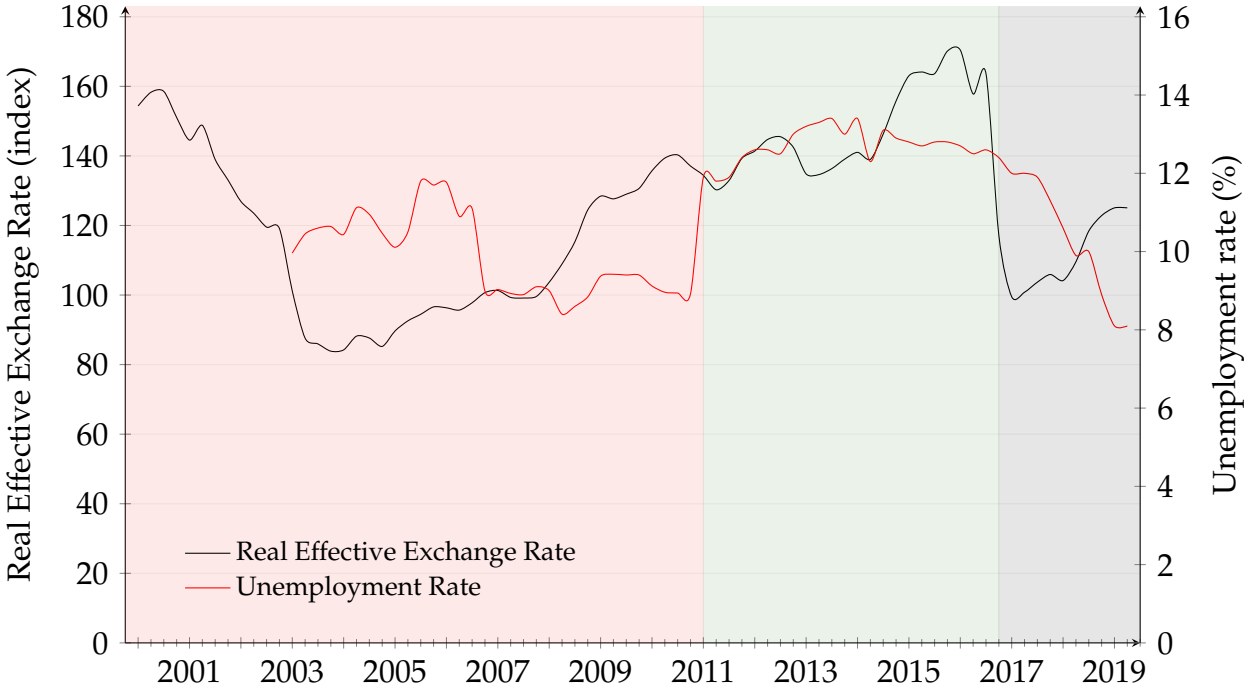


Sources: Capmas, IFS, Bruegel. An increase in the REER denotes an appreciation. The red background denotes the period prior to the Egyptian Revolution, the green background the period during the Revolution and prior to the devaluation, and the grey background denotes the period since the devaluation.

The early 21st century Egyptian economy has been characterized by relatively large imbalances, both internal and external. Herrera et al. (2010) present an overview of

the Egyptian economy before the Revolution, while Helmy and Zaki (2017) and Zaki (2017) discuss the evolution of these imbalances until 2016. By the end of that year, these imbalances led the Government to decide the free-floating of the Egyptian Pound (EGP) and a 48% devaluation of the currency, which occured on November 3, 2016. The nominal exchange rate inmediately rose from 8.8 to 13 EGP per US Dollar (US$), before reaching 17 EGP per US$ the following days, and the International Monetary Fund (IMF) approved a US$12 bn loan on November 11, 2016[4].

Figure 2 – Inflation Rate and Unemployment
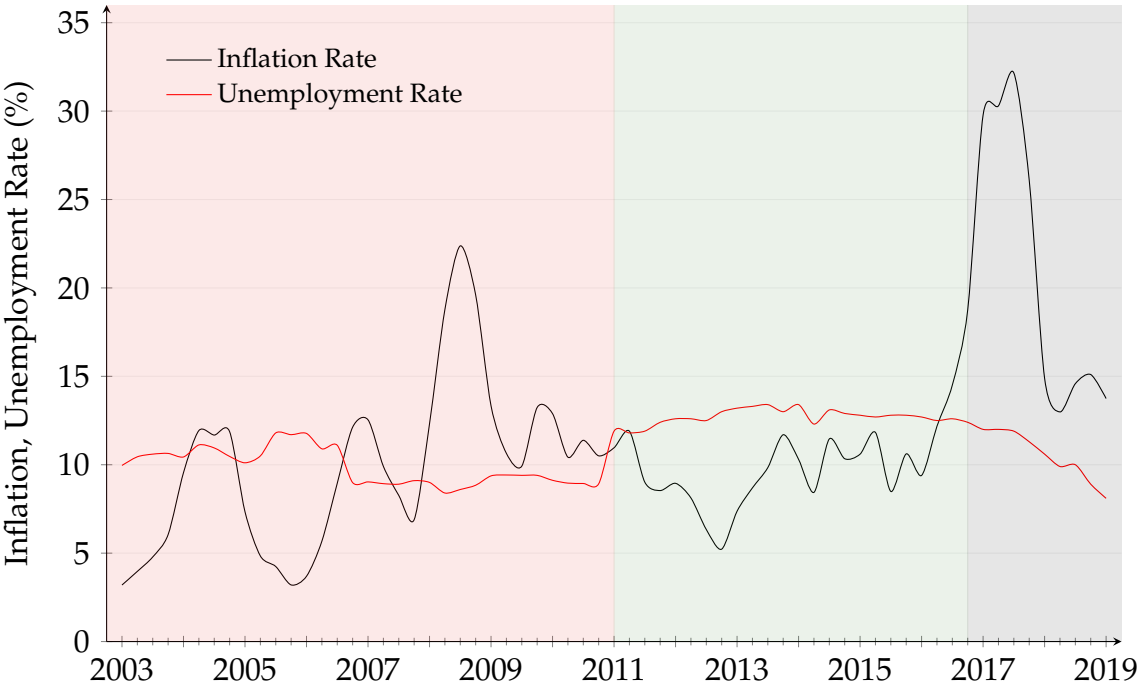


Sources: Capmas, CBE, IFS. The red background denotes the period prior to the Egyptian Revolution, the green background the period during the Revolution and prior to the devaluation, and the grey background denotes the period since the devaluation.

Figure 1 shows the evolution of the real effective exchange rate (REER) and the unemployment rate between 2000q1 and 2019q1, while figure 2 shows the evolution of the inflation rate and the unemployment rate from 2003q1. Until the end of 2003, the REER sharply depreciated and inflation remain below 5% (quarterly data on unemployment is unavailable until that year). From 2004, the REER started a 12-years steady appreciation while inflation averaged more than 10% and unemployment remained stable. In 2005 however, inflation dropped while unemployment increased, and the reverse occured from 2006, when inflation rose sharply while the unemployment rate decreased

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[4]See IMF Country Report No. 17/17 and IMF Press Release No. 16/501.

from 11% to 9%. This drop in unemployment was followed one year after, from 2008q1, by an acceleration in the appreciation of the currency, while inflation stabilized slightly above 10% from 2009.

The Egyptian Revolution that started in 2011q1 impacted these three variables in different ways. The REER appreciation decelerated slightly for several years while the inflation droped before stabilizing again at around 10%. The unemployment rate increased dramatically from around 9% in 2010q4 to 12% in 2011q1 and reached 13.4% by the beginning of 2014. From that moment until the devaluation, the unemployment rate started to decrease slightly while the REER appreciation accelerated again.

Figure 3 – Nominal and nominal effective exchange rates after the devaluation
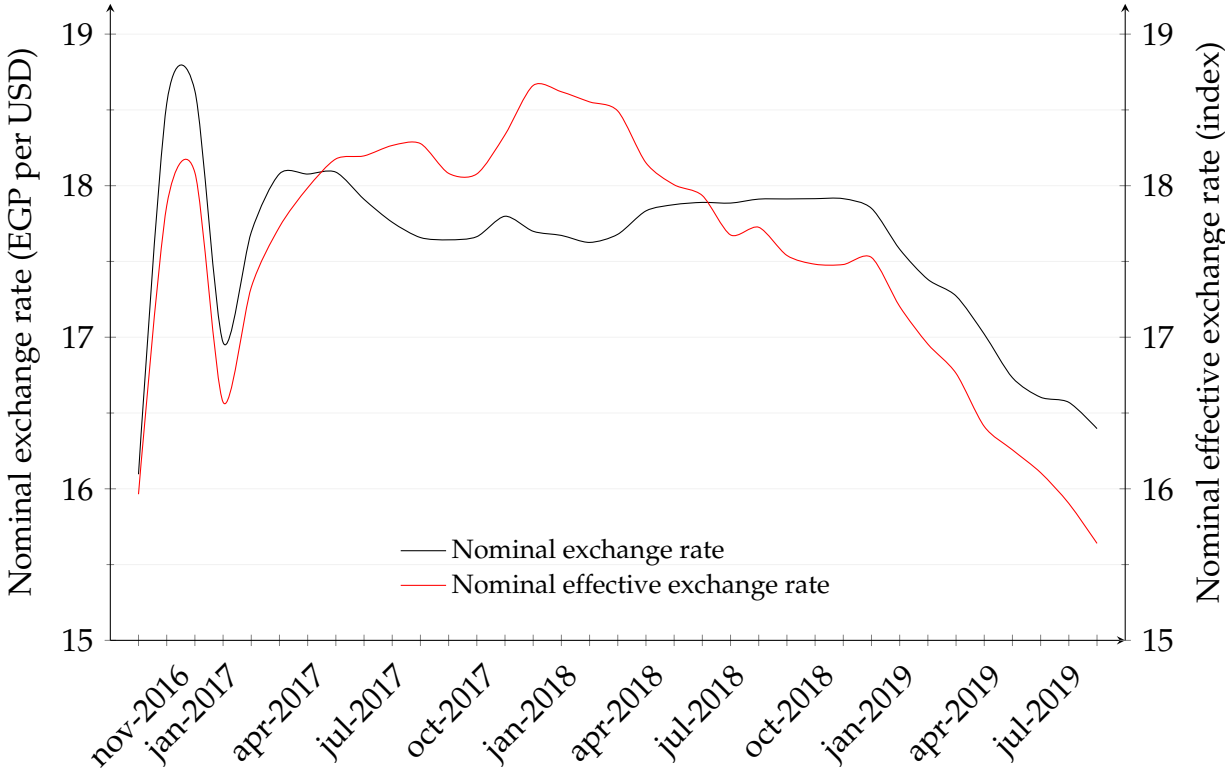


Sources: CBE, Bruegel. An increase in the NER and the NEER denotes an depreciation. The period spans from 2016m11 to 2019m09. The NER is the average of the buy and sell quotes. The NEER is computed as: $NEER = \frac{1}{NEER_{Bruegel}} * 700$.

The devaluation impacted greatly the REER and the inflation rate, but with opposite effects, as it led to a sharp depreciation of the EGP and a hike in inflation. The slight downward trend of the unemployment rate before that event further improved afterwards, suggesting that the devaluation succeeded at reducing some of Egypt's imbalances at that time. However, as discussed in Noureldin (2018) and evidenced in

figure 3, the initial devaluation was followed by a period of remarkable stability of the nominal exchange rate, casting doubts on the free floatation of the EGP[5].

As inflation rose sharply after the devaluation, the REER started to appreciate again from 2017q2. The same occured with the nominal effective exchange rate from the beginning of 2018 and with the nominal exchange rate with respect to the US$ from january 2019, leading to an acceleration in the REER appreciation while inflation started to decelerate and remained close to 15% until 2019q1.

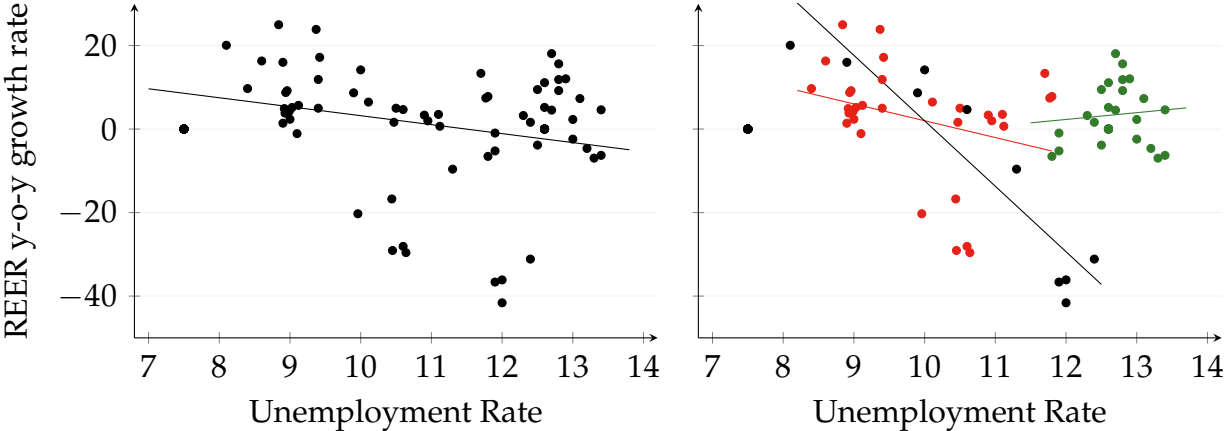Figure 4 – Price Phillips curve
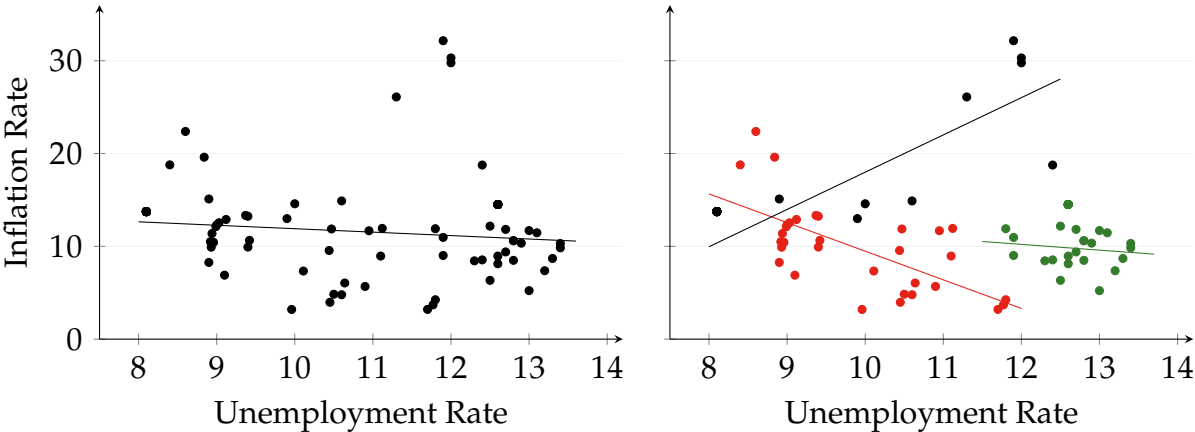


Source: CBE, IFS, Bruegel. The red colour indicates the period prior to the Egyptian Revolution, the green colour the period during the Revolution and prior to the devaluation, and the black colour the period since the devaluation.

The relations between inflation and unemployment and between the REER year-over-year growth rate and unemployment are also represented in figures 4 and 5, respectively. The left-hand side graph in figure 4 shows the correlation between inflation and unemployment over the entire period. There seems to be no evidence of a Phillips curve, in the sense of an negative correlation between these two variables, as the slope coefficient is close to zero. The right-hand side graph in figure 4 indicates however that different results appear when the period is devided into three sub-periods: before the Revolution (from 2003q1 to 2010q4), during the Revolution and before the devaluation (from 2011q1 to 2016q3), and after the devaluation (from 2016q4 to 2019q1). During the period of fixed exchange rate regime, there is evidence of a price Phillips curve, i.e. a negative relationship between inflation and unemployment, although the Phillips curve slope appears to be flat during the Revolution and before the devaluation. Since

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[5]In its 2018 Annual Report on Exchange Arrangements and Exchange Restrictions, the IMF requalified Egypt's *de facto* exchange rate arrangement from "Floating" to "Stabilized arrangement".

the declaration of the floatation of the EGP, that is, during the period of (relatively) flexible exchange rate regime, this negative correlation does not appear, and even seems to have been reverted.

Figure 5 – Relative Price Phillips curve



Source: Capmas, IFS, Bruegel, elaboration by the author. An positive REER y-o-y growth rate denotes an appreciation. The red colour indicates the period prior to the Egyptian Revolution, the green colour the period during the Revolution and prior to the devaluation, and the black colour the period since the devaluation.

The left-hand side graph in figure 5 shows the correlation between unemployment and the REER year-over-year growth rate. The negative relation between these two variables appears slightly more clearly than in the case of the price Phillips curve, but a narrative decomposition of the period, similar to the one in figure 4, provides a better insight. As evidenced in the right-hand side graph in figure 5, the negative relationship between the REER y-o-y growth rate and unemployment, i.e. the relative price Phillips curve, or the "real exchange rate Phillips curve", can be observed in both fixed and flexible exchange rate regimes, that is, before the Revolution and after the devaluation. Combining the observations from figure 4 and 5 gives support to the real exchange rate Phillips curve hypothesis that predicts a negative correlation between unemployment and inflation only in fixed exchange rate regimes, while the negative correlation between a real exchange rate appreciation and unemployment should be observed in both fixed and flexible exchange rate regimes.

The period during the Revolution and before the devaluation, however, seems to be characterized by a broken link between unemployment and both inflation and the REER. As these simple correlations do not take into account the effect of expectations or inflation persistence, evidenced by more than sixty years of research, empirical es-

timations of the price Phillips curve during these periods is needed in order to form more conclusive interpretations.

# 4   Empirical Methodology and Results

To assess the relationship between prices and unemployment in Egypt, this article follows the evolution of the Phillips curve since its origin and estimates the different specifications it has taken in order to obtain more robust correlations between inflation and unemployment.

Equation (1) corresponds to the original Phillips curve, which consists in a simple correlation between inflation and unemployment:

$$\pi_t = \alpha + \lambda U_t + \varepsilon_t \tag{1}$$

where $\pi_t$ denotes the inflation rate in quarter $t$, $U_t$ the unemployment rate, $\alpha$ the intercept parameter and $\varepsilon_t$ the error term. The coefficient $\lambda$ indicates the slope of the Phillips curve.

Table 1 reports the results obtained from an OLS estimation of equation (1). The coefficients correspond to figure 4. Over the full period (i.e. from 2003q1 to 2019q1), there seems to be no evidence of a negative correlation between inflation and unemployment in Egypt. However, when decomposing the full period into three subperiods, a different pattern emerges.

Table 1 – Original Phillips Curve

| Period | PC Slope | t-stat | $R^2$ | Obs. |
|---|---|---|---|---|
| Full period | -0.37 | -1.06 | 0.01 | 65 |
| Before the Revolution | -3.09*** | -4.88 | 0.44 | 32 |
| Before the Devaluation | -0.62 | -0.86 | 0.01 | 23 |
| Since the Devaluation | 4.02*** | 3.26 | 0.56 | 10 |

All regressions include robust standard errors. * Significant at the 10 percent level, ** Significant at the 5 percent level, *** Significant at the 1 percent level.

Before the Egyptian Revolution that started in 2011q1, the coefficient of the Phillips curve slope is negative and highly significant. This period is characterized by a fixed

exchange rate regime. After the devaluation, which was initially announced as the setting-up of a floating exchange rate regime, the coefficient of the Phillips curve slope appears to be non-negative, and even significantly positive. This result is also obtained in Geerolf (2018) in floating exchange-rate regimes and must not be interpreted as causal: in the case of Egypt, it is a mere correlation during a period in which the economy adjusted to an exogenous shock that seeked to correct some of its profound imbalances, which are discussed extensively in Helmy and Zaki (2017) and Zaki (2017). The devaluation of the Egyptian Pound led to a sharp increase in inflation which was followed by a rapid decline (although inflation remained high during the period). Simultaneously, by correcting external imbalances, the devaluation allowed the economy to recover and unemployment to decline, creating therefore a positive correlation between inflation and unemployment. This relation, therefore, is transitory and must not be considered as structural.

Although the period that spanned from the beginning of the Revolution to the devaluation of the EGP was also characterized by a fixed exchange rate regime, the coefficient of the Phillips curve slope is not significantly different from zero. This result is not consistent with the price Phillips curve and is not predicted by the relative price Phillips curve hypothesis: it might be caused by the economic impact of the political turmoil that charactarised a large part of this period.

Equation (2) corresponds to the augmented Phillips curve, which allows to take into account the inflation dynamics:

$$\pi_t = \alpha + \lambda U_t + \gamma \pi_{past} + \varepsilon_t \tag{2}$$

where $\pi_{past} = \frac{1}{s} \sum_{i=1}^{s} \pi_{t-i}$ corresponds to the average of the inflation rate over the past $s$ quarters and $\gamma$ captures the effect of past inflation on current inflation. Following Blanchard et al. (2015), $\pi_{past}$ includes the inflation rate of the four previous quarters, i.e. $s = 4$. As explained in Le Bihan (2009), this specification relies on the hypothesis of adaptative anticipations, according to which the expected inflation is determined by past values of inflation.

Table 2 – Augmented Phillips Curve

| Period | PC Slope | t-stat | $R^2$ | Obs. |
|---|---|---|---|---|
| Full period | 0.05 | 0.14 | 0.38 | 65 |
| Before the Revolution | -2.60*** | -3.54 | 0.47 | 32 |
| Before the Devaluation | 1.01 | 0.93 | 0.15 | 23 |
| Since the Devaluation | 4.01*** | 3.08 | 0.57 | 10 |

All regressions include robust standard errors. * Significant at the 10 percent level, ** Significant at the 5 percent level, *** Significant at the 1 percent level.

The results obtained from an OLS estimation of equation (2) are presented in table 2 and confirm those obtained from the original Phillips curve: when considering the full period, i.e. between 2003q1 and 2019q1, the Phillips curve is flat in Egypt. However, these results also reinforce the evidence that this relation was significantly negative before the Revolution and became positive after the devaluation.

The accelerationist version of the Phillips curve, formulated by Friedman (1968), corresponds to equation (3). As $\Delta \pi_t \equiv \pi_t - \pi_{t-1}$ is the first difference of inflation, equation (3) is a special case of equation (2) in which $s = 1$ and $\gamma = 1$:

$$\Delta \pi_t = \alpha + \lambda U_t + \varepsilon_t \tag{3}$$

Such a specification imply that the monetary policy trade-off is not between inflation and unemployment, but instead between unemployment and the growth rate of inflation. Table 3 presents the results of the OLS estimation of equation (3).

Table 3 – Accelerationist Phillips Curve

| Period | PC Slope | t-stat | $R^2$ | Obs. |
|---|---|---|---|---|
| Full period | 0.17 | 0.77 | 0.00 | 65 |
| Before the Revolution | -0.01 | -0.02 | 0.00 | 32 |
| Before the Devaluation | 0.99 | 1.21 | 0.06 | 23 |
| Since the Devaluation | 1.30 | 1.43 | 0.10 | 10 |

All regressions include robust standard errors. * Significant at the 10 percent level, ** Significant at the 5 percent level, *** Significant at the 1 percent level.

Contrary to what is obtained from the original and the augmented versions of the Phillips curve, none of the estimated coefficients of the slope is significantly different from 0 when the accelerationist version is estimated. This result, however, does not represent a threat for the argument of this article: based on empirical evidence for various, mostly high-income, countries and for different periods, Chatelais et al. (2015) and Geerolf (2018) reject the accelerationnist version of the Phillips curve and adopt instead the original or the New Keynesian versions. Blanchard (2018) also rejects the accelerationist Phillips curve and notes that a failure of this specification increases the ability of stabilization policies to affect unemployment at a limited cost in terms of inflation.

Equation (4) corresponds to the New Keynesian version of the Phillips curve which relates current inflation to unemployment and expected inflation:

$$\pi_t = \beta E[\pi_{t+4}] + \lambda(u_t - u_t^*) + \varepsilon_t \tag{4}$$

where $E[\pi_{t+4}]$ is the expected one-year-ahead inflation at quarter $t$ and $u_t - u_t^*$ is the deviation of the unemployment rate $u_t$ from its natural rate $u_t^*$.

Equation (5) corresponds to the hybrid version of the New Keynesian Phillips curve which is widely used, including in Galí and Gertler (1999), and which relates current inflation to unemployment and to both expected and past inflation.

$$\pi_t = \beta E[\pi_{t+4}] + \lambda(u_t - u_t^*) + \gamma \pi_{past} + \varepsilon_t \tag{5}$$

The New Keynesian Phillips curve is considered to be a structural relation in New Keynesian macroeconomic models, and its empirical estimation relies on the hypothe-

sis of rational expectations. The literature, however, is inconclusive on the horizon that must be choosen for the expected inflation term: leading textbooks, such as Blanchard (2017) and Galí (2015), include the expected one-period-ahead inflation rate, while Blanchard et al. (2015) use the long-term inflation expectation. For this reason, and because data availability does not allow to use longer-term expectations, this article considers both the medium-term inflation expectation (i.e. the one-year-ahead inflation expectation) corresponding to equations (4) and (5), and the one-quarter-ahead, i.e. the short-term, inflation expectation corresponding to equations (6) and (7).

$$\pi_t = \beta E[\pi_{t+1}] + \lambda(u_t - u_t^*) + \varepsilon_t \tag{6}$$

$$\pi_t = \beta E[\pi_{t+1}] + \lambda(u_t - u_t^*) + \gamma \pi_{past} + \varepsilon_t \tag{7}$$

Table 4 – New Keynesian Phillips Curve, medium-term expectations

| Period | NKPC | | | Hybrid NKPC | | | |
|---|---|---|---|---|---|---|---|
| | PC Slope | t-stat | $R^2$ | PC Slope | t-stat | $R^2$ | Obs. |
| Full period | -0.91 | -0.96 | 0.05 | -0.34 | -0.43 | 0.42 | 61 |
| Before the Revolution | -2.91*** | -4.31 | 0.30 | -2.19*** | -2.86 | 0.41 | 32 |
| Before the Devaluation | -0.40 | -0.35 | 0.19 | 0.01 | 0.01 | 0.27 | 23 |
| Since the Devaluation | 22.50*** | 4.21 | 0.85 | 19.34*** | 4.35 | 0.92 | 6 |

The forward component is the one-year-ahead inflation rate ($\pi_{t+4}$) and past inflation in the hybrid version corresponds to the average inflation rate of the four previous quarters ($\pi_{past} = \frac{1}{4}\sum_{i=1}^{4}\pi_{t-i}$). All regressions include robust standard errors. * Significant at the 10 percent level, ** Significant at the 5 percent level, *** Significant at the 1 percent level.

Table 4 reports the results of the OLS estimation of equation (4) (left-hand side) and equation (5) (right-hand side), and table 5 does the same for equation (6) (left-hand side) and equation (7) (right-hand side). Although the statistical significance is slightly lower and the Phillips-curve slope is somewhat flatter before the Revolution when the short-term inflation expectations are used, the estimation of New Keynesian versions of the Phillips curve, including the hybrid form, confirm the results obtained with the original and the augmented versions of the Phillips curve.

Table 5 – New Keynesian Phillips Curve, short-term expectations

| Period | NKPC | | | Hybrid NKPC | | | |
|---|---|---|---|---|---|---|---|
| | PC Slope | t-stat | $R^2$ | PC Slope | t-stat | $R^2$ | Obs. |
| Full period | -0.40 | -0.89 | 0.75 | -0.12 | -0.30 | 0.82 | 64 |
| Before the Revolution | -1.06*** | -2.97 | 0.70 | -0.60** | -1.97 | 0.76 | 32 |
| Before the Devaluation | -0.21 | -0.18 | 0.49 | 0.09 | 0.08 | 0.53 | 23 |
| Since the Devaluation | 8.39* | 1.81 | 0.66 | 4.16 | 0.52 | 0.70 | 9 |

The forward component is the one-quarter-ahead inflation rate ($\pi_{t+1}$) and past inflation in the hybrid version corresponds to the average inflation rate of the four previous quarters ($\pi_{past} = \frac{1}{4}\sum_{i=1}^{4}\pi_{t-i}$). All regressions include robust standard errors. * Significant at the 10 percent level, ** Significant at the 5 percent level, *** Significant at the 1 percent level.

The results presented in tables 1 to 5 correspond to various specifications of simple correlations between inflation and unemployment. As discussed in section 2, numerous articles use a GMM approach in order to identify the parameters of New Keynesian Phillips curves, but the results differ greatly depending on the exact specification (including the structure of lag inflation), the choice of instruments and the economy considered. Tables 6 and 7 report the results from the GMM estimation of the Egyptian New Keynesian Phillips curve and its hybrid form, respectively. Except for the fact that Ben Ali (2013) uses the output instead of unemployment as forcing variable, the instruments correspond to those used by this author for the Tunisian economy: the past deviation of unemployment from its natural rate ($u - u^*$) and the past inflation rates ($\pi$) in the left-hand side columns, and the past monetary policy rates ($i$) in addition to the two previous variables in the right-hand side columns. The first two lags are included as instruments in the regressions of the standard New Keynesian version, reported in table 6, while the regressions of the hybrid New Keynesian version reported in table 7 include the first three lags of unemployment and the monetary policy rate, as well as the fifth, sixth and seventh lags of the inflation rate (the four first lags being included in the dependent variable of past inflation, $\pi_{past}$).

Table 6 – New Keynesian Phillips Curve (GMM)

| Instruments (2 lags)[a]: | $(u - u^*), \pi$ | | | | $(u - u^*), \pi, i$ | | | |
|---|---|---|---|---|---|---|---|---|
| Period | PC | S.E. | J-stat | Obs. | PC | S.E. | J-stat | Obs. |
| *Forward component: 1 period* | | | | | | | | |
| Full period | -0.73 | 0.71 | 4.44 (0.11) | 62 | -0.62 | 0.67 | 11.03 (0.03) | 62 |
| Before the Revolution | -1.07 | 0.66 | 6.67 (0.04) | 30 | -1.05* | 0.54 | 9.00 (0.06) | 30 |
| Before Devaluation | -1.61 | 2.05 | 0.52 (0.77) | 23 | -1.94 | 2.02 | 2.20 (0.70) | 23 |
| Since the Devaluation | 8.50*** | 3.18 | 5.38 (0.07) | 8 | 7.86*** | 2.69 | 5.92 (0.20) | 8 |
| *Forward component: 2 periods* | | | | | | | | |
| Full period | -0.91 | 1.70 | 2.19 (0.34) | 61 | -2.07* | 1.16 | 5.88 (0.21) | 61 |
| Before the Revolution | -3.82*** | 1.44 | 5.52 (0.06) | 30 | -2.95*** | 0.97 | 7.86 (0.10) | 30 |
| Before Devaluation | -3.36 | 2.20 | 1.34 (0.51) | 23 | -2.66 | 1.87 | 2.38 (0.67) | 23 |
| Since the Devaluation | 19.2*** | 2.25 | 5.99 (0.05) | 7 | 18.23*** | 1.84 | 6.35 (0.17) | 7 |
| *Forward component: 4 periods* | | | | | | | | |
| Full period | -0.24 | 4.42 | 1.08 (0.58) | 59 | -2.24 | 1.57 | 7.39 (0.12) | 59 |
| Before the Revolution | -5.57*** | 1.63 | 1.13 (0.57) | 30 | -5.57*** | 1.35 | 3.71 (0.45) | 30 |
| Before Devaluation | -2.65 | 3.74 | 0.82 (0.66) | 23 | -2.59 | 2.05 | 1.99 (0.74) | 23 |
| Since the Devaluation | 24.15*** | 1.62 | 2.79 (0.25) | 5 | - | - | - | - |

[a] The complete set of instruments comprises the variables $(u - u^*)_{t-1}$, $(u - u^*)_{t-2}$, $\pi_{t-1}$ and $\pi_{t-2}$ in the left hand side colums, and the variables $(u - u^*)_{t-1}$, $(u - u^*)_{t-2}$, $\pi_{t-1}$, $\pi_{t-2}$, $i_{t-1}$ and $i_{t-2}$ in the right hand side columns. All regressions include robust standard errors. * Significant at the 10 percent level, ** Significant at the 5 percent level, *** Significant at the 1 percent level.

Tables 6 and 7 are both divided into three panels: the top panels corresponds to equations (6) and (7), in which the expected inflation term is the one-quarter-ahead inflation rate ($t + 1$), and the bottom panels correspond to equations (4) and (5), in which the expected inflation term is the one-year-ahead inflation rate ($t + 4$). To ensure additionnal robustness, the panels in the middle correspond to an alternative specification that includes the two-quarters-ahead inflation rate[6].

Because of the uncertainty surrounding the choice of the instruments and the correct specification, the results from the GMM estimations presented in tables 6 and 7 should not be interpreted as structural parameters, but provide instead further evidence of the correlation between inflation and unemployment in Egypt since the beginning of the 21st century, as they confirm the results obtained with alternative specification and estimation methods of the Phillips curve.

Considered together, the results of the estimation of different specifications of the Phillips curve, using OLS and GMM aproaches, indicate that the dynamics of the Egyptian economy in the early 21st century is consistent with the relative price Phillips curve hypothesis. The results evidence a significant and stable Phillips curve before the Egyptian Revolution, during a fixed exchange rate regime, while the price Phillips curve is not observed after the devaluation, a period during which the exchange rate regime was mores flexible. The period spanning from the beginning of the Egyptian Revolution to the devaluation of the EGP, during which the exchange rate regime remained fixed, is charactarised by an absence of negative correlation between unemployment and both inflation and REER appreciation.

Instead of indicating a failure of the relative price Phillips curve hypothesis, the results for the period 2011q1 - 2016q3 evidence the effects of political turmoil on the economy. As uncertainty rises and confidence drops, some of the complex relations within the productive sector are cut and the production is negatively affected, leading to an increase in unemployment and a relatively high inflation which, under a fixed exchange rate regime, leads to a real appreciation of the currency and a lost of competitiveness, hindering further the prospects of economic recovery and breaking the relation between unemployment and both inflation and the REER.

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[6]The specifications that include the three-quarters-ahead inflation rate are not presented in the tables but give similar results and are available from the author upon request.

## Table 7 – Hybrid New Keynesian Phillips Curve (GMM)

| Instruments (3 lags)[a]: | $(u - u^*), \pi$ | | | | $(u - u^*), \pi, i$ | | | |
|---|---|---|---|---|---|---|---|---|
| Period | PC | S.E. | J-stat | Obs. | PC | S.E. | J-stat | Obs. |
| *Forward component: 1 period* | | | | | | | | |
| Full period | -0.53 | 0.76 | 1.14 | 61 | -0.54 | 0.58 | 3.29 | 61 |
| | | | (0.77) | | | | (0.77) | |
| Before the Revolution | -2.23*** | 0.86 | 0.13 | 29 | -1.56** | 0.70 | 7.34 | 29 |
| | | | (0.99) | | | | (0.29) | |
| Before Devaluation | -4.22 | 4.08 | 0.15 | 23 | -0.77 | 1.69 | 5.41 | 23 |
| | | | (0.99) | | | | (0.49) | |
| Since the Devaluation | 15.93*** | 2.69 | 5.04 | 8 | - | - | - | - |
| | | | (0.17) | | | | | |
| *Forward component: 2 periods* | | | | | | | | |
| Full period | -1.35 | 1.06 | 0.99 | 60 | -1.47 | 1.11 | 4.21 | 60 |
| | | | (0.80) | | | | (0.65) | |
| Before the Revolution | -3.61*** | 0.95 | 0.66 | 29 | -2.55*** | 0.78 | 5.05 | 29 |
| | | | (0.88) | | | | (0.54) | |
| Before Devaluation | -4.06 | 3.17 | 0.09 | 23 | -0.70 | 1.64 | 7.79 | 23 |
| | | | (0.99) | | | | (0.25) | |
| Since the Devaluation | 18.17*** | 2.01 | 6.28 | 7 | - | - | - | - |
| | | | (0.10) | | | | | |
| *Forward component: 4 periods* | | | | | | | | |
| Full period | -1.11 | 1.20 | 1.32 | 58 | -0.38 | 1.02 | 8.40 | 58 |
| | | | (0.73) | | | | (0.21) | |
| Before the Revolution | -3.26** | 1.47 | 0.74 | 29 | -2.89*** | 0.86 | 5.65 | 29 |
| | | | (0.86) | | | | (0.46) | |
| Before Devaluation | -3.69 | 2.48 | 0.18 | 23 | -0.83 | 1.84 | 10.22 | 23 |
| | | | (0.98) | | | | (0.12) | |
| Since the Devaluation | - | - | - | - | - | - | - | - |

[a] The complete set of instruments comprises the variables $(u - u^*)_{t-1}$, $(u - u^*)_{t-2}$, $(u - u^*)_{t-3}$, $\pi_{t-5}$, $\pi_{t-6}$ and $\pi_{t-7}$ in the left hand side colums, and the variables $(u - u^*)_{t-1}$, $(u - u^*)_{t-2}$, $(u - u^*)_{t-3}$, $\pi_{t-5}$, $\pi_{t-6}$, $\pi_{t-7}$, $i_{t-1}$, $i_{t-2}$ and $i_{t-3}$ in the right hand side columns. All regressions include robust standard errors. * Significant at the 10 percent level, ** Significant at the 5 percent level, *** Significant at the 1 percent level.

After the devaluation of the EGP, a restrictive monetary policy (see figures 8 and 9 in Appendix), along with the use of the exchange rate as a stable nominal anchor, helped to bring down inflation after the initial shock, therefore leading to a positive correlation between inflation and unemployment. Increasing real GDP growth rate and declining unemployment ensued, but the employment rate did not increase, and Assaad et al. (2019a) present evidences that it even shrinked. Furthermore, the REER and the nominal exchange rates both sharply appreciated. As discussed in Végh (2013), this relation between a booming economy and a deteriorating competitiveness raises concerns for future growth and advocates for further measures aiming at adressing this issue, even more so as Youssef and Zaki (2019) provide evidences that firms' exports did not fully benefited from the devaluation of the EGP in 2016q4.

# 5  Conclusion

This article studies the correlation between inflation and unemployment in the early 21st century Egypt using different specifications of the Phillips curve and using OLS and GMM estimation techniques in order to test the relative price Phillips curve hypothesis. It contributes to the literature by providing evidence that this hypothesis might be extended to emerging countries.

The results of this article indicate that the price Phillips curve is only observed before the Revolution, during a fixed exchange rate regime, and not after the devaluation, a *de jure* and temporary *de facto* more flexible exchange rate regime. This finding is robust to various specifications of the Phillips curve and to various estimation methods. The results also suggest that there is a negative relation between a real exchange rate appreciation and unemployment under both fixed and flexible exchange rate regimes. The relative price Phillips curve hypothesis appears to be effective in providing insight on the fluctuations of the Egyptian economy, and this suggests that this concept also applies to emerging economies.

Two results of this article are not predicted by the relative price Phillips curve hypothesis and can be explained by large exogenous shocks. First, similarly to what has been observed in different periods in high-income economies, the slope of the price Phillips curve appears to be positive after the devaluation of the EGP in 2016q4. The absorption of this large exogenous shock can explain the positive relation that is observed between inflation and unemployment, but as inflation has remained relatively high while the REER has appreciated during the period, attention must be oriented towards the competitiveness of the Egyptian economy in order to ensure future growth and human development. During the Revolution and before the devaluation, flat price

and relative price Phillips curve slopes are observed in Egypt, evidencing a dissociation between the dynamics of prices and the labour market during. This period is characterized by relatively high unemployment and inflation rates, as well as an appreciating currency in real terms, denoting a loss of competitiveness of the economy. This environment is contrary to the traditional view that a flat Phillips curve indicates that unemployment can be lowered at a relatively small cost in terms of inflation. Instead, stabilization policy might prove heavily constrained in such an environment. This raises the question of temporary, more direct interventions in the labour market in order to limit uncertainty, improve expectations and ensure enough political support for necessary structural reforms.

While this article assesses the relation between relative prices and unemployment, future empirical research could take into account the informal labour and the specific dynamics of female and youth unemployment, as these specificities of the Egyptian labour market, and more broadly of other Arab and emerging countries labour markets, have important implications in terms of welfare. Using the growth rates of the different components of the Consumer Price Index could represent an interesting future extension. Further research aiming at reinforcing the theoretical foundations of the relative price Phillips curve hypothesis and multi-country empirical analyses would also prove useful to reinforce the conclusions on whether this hypothesis can be generalized to other emerging and developing countries.

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# A   Appendix

Figure 6 – Price Phillips curve (1989 - 2017), yearly data

a. Full period                                      b. Subperiods
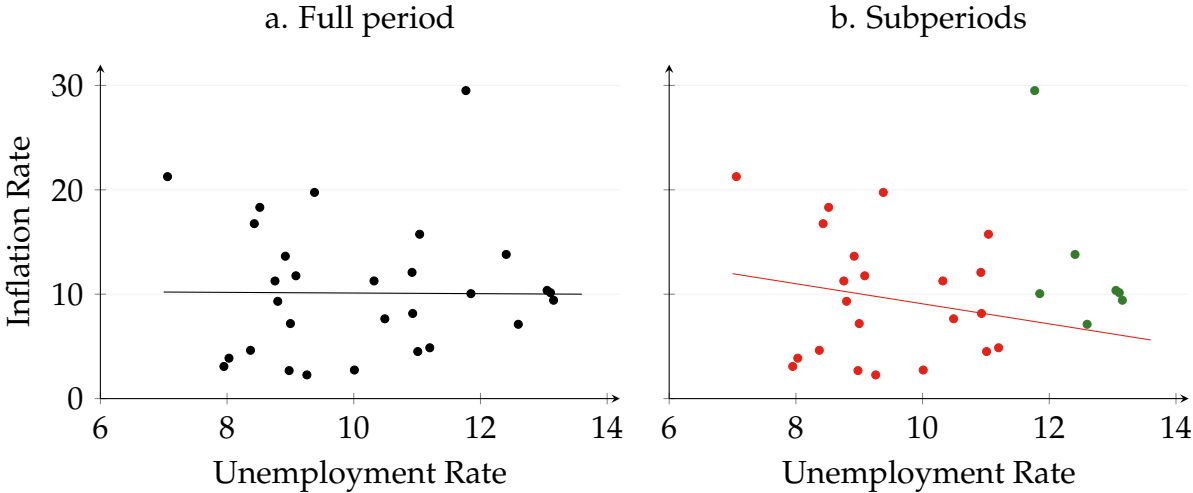


Source: World Development Indicators Database (The World Bank). The black colour is used for the full period, from 1989 to 2017, the red colour indicates the period prior to the Egyptian Revolution and the green colour the period during, and since, the Revolution.

## Figure 7 – Relative Price Phillips curve (1989 - 2018), yearly data

### a. Full Period

### b. Subperiods
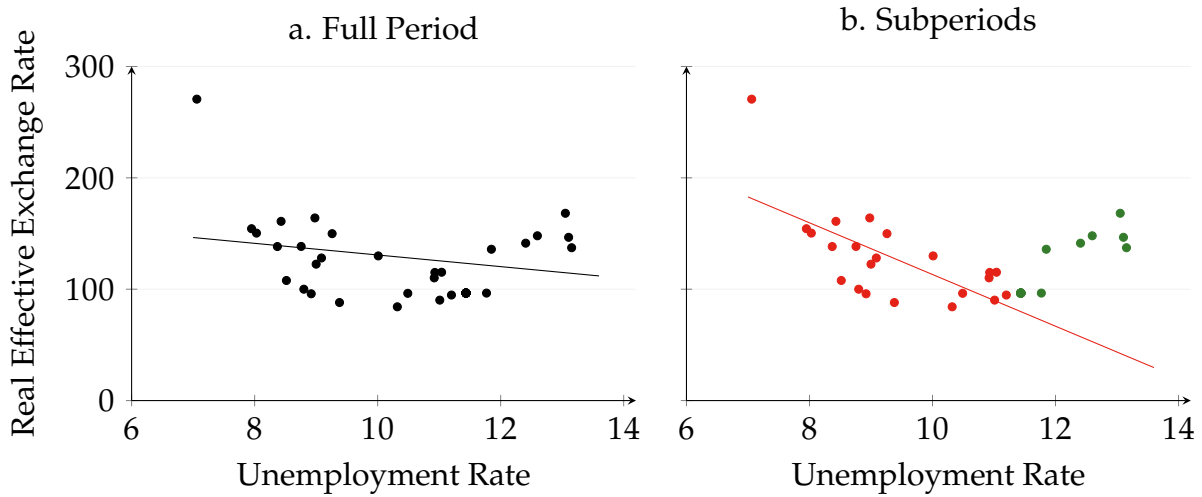


Source: World Development Indicators Database (The World Bank), Bruegel. An increase in the REER denotes an appreciation. The black colour is used for the full period, from 1989 to 2017, the red colour indicates the period prior to the Egyptian Revolution and the green colour the period during, and since, the Revolution.

## Figure 8 – Monetary base, index and growth rate
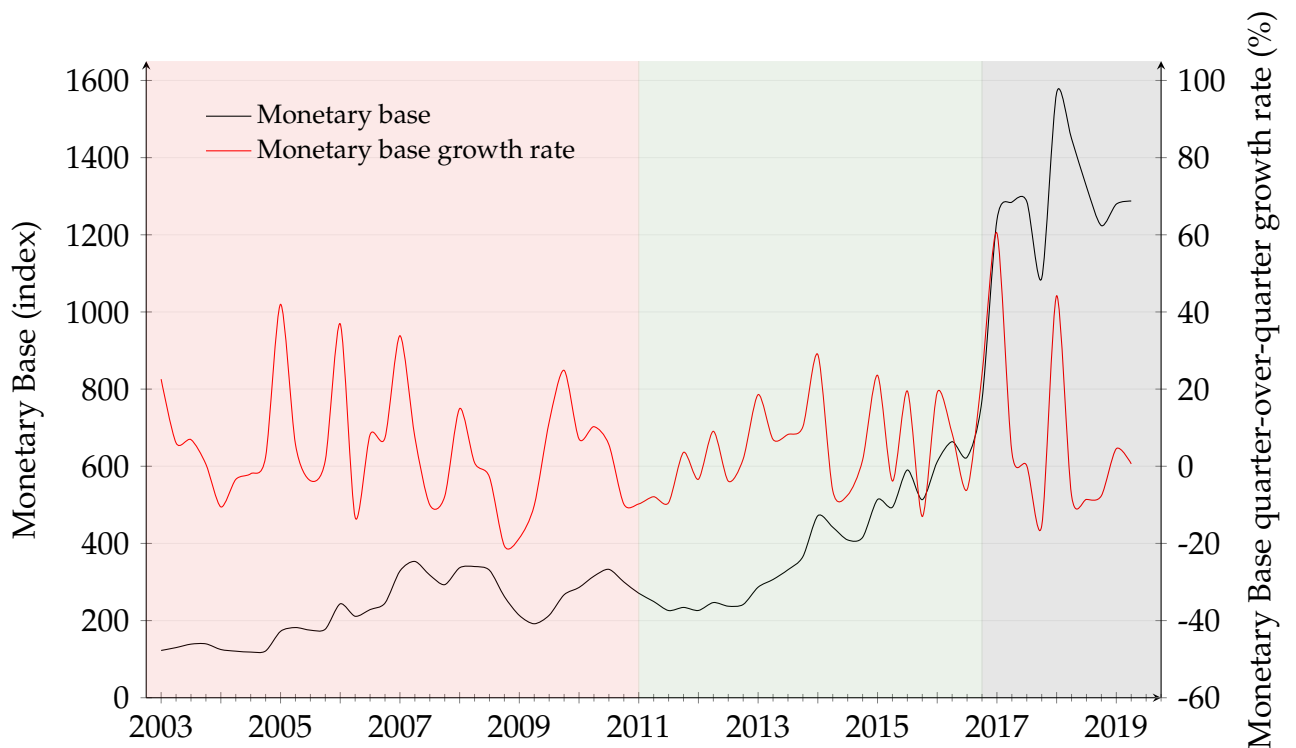


Source: IFS, computation by the author. Monetary Base index = 100 in 2002q4. The red background denotes the period prior to the Egyptian Revolution, the green background the period during the Revolution and prior to the devaluation, and the grey background denotes the period since the devaluation.

Figure 9 – Interest Rate
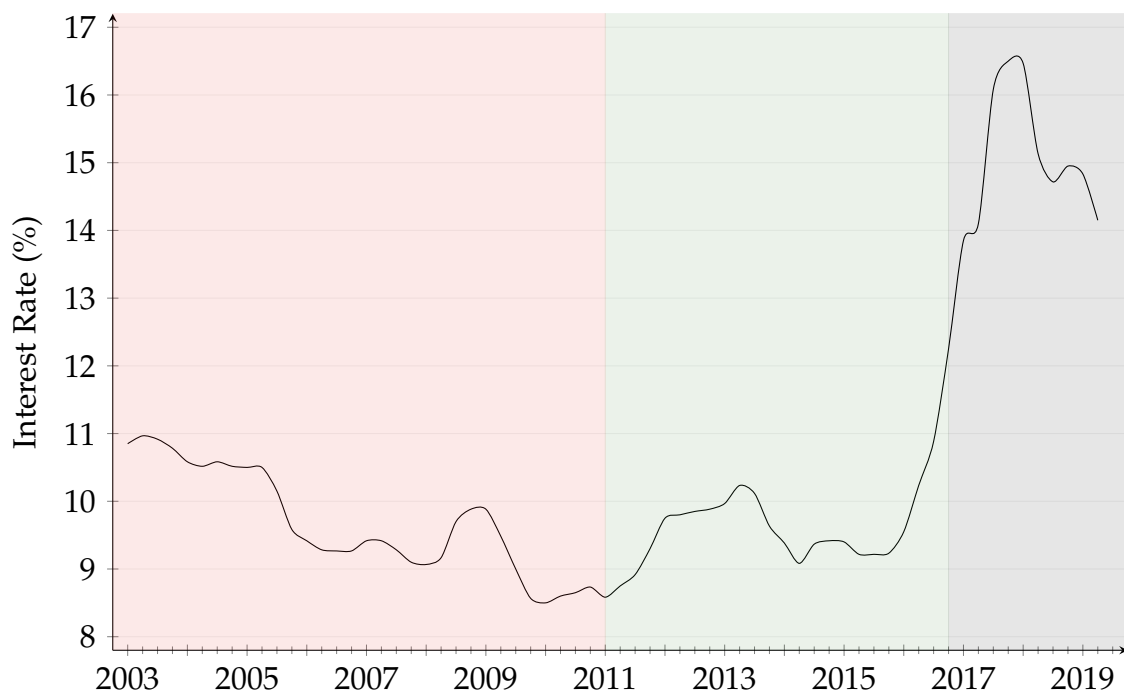
Source: IFS, computation by the author. The interest rate is computed as the average of the deposit and the lending rates. The red background denotes the period prior to the Egyptian Revolution, the green background the period during the Revolution and prior to the devaluation, and the grey background denotes the period since the devaluation.