ECONOMIC RESEARCH FORUM
منتدى البحوث الاقتصادية
2018

working paper series

DEVALUATION: IS IT CONTRACTIONARY OR EXPANSIONARY TO ECONOMIC SECTORS? THE CASE OF EGYPT

Nada Shokry and Mohammed Bouaddi

Working Paper No. 1252

DEVALUATION: IS IT CONTRACTIONARY OR EXPANSIONARY TO ECONOMIC SECTORS? THE CASE OF EGYPT

Nada Shokry[1] and Mohammed Bouaddi[2]

Working Paper No. 1252

November 2018

Send correspondence to:
Nada Shokry
The American University in Cairo
nadashokry@aucegypt.edu

[1] Nada Shokry is a master's degree holder in Economics from the American University in Cairo.

[2] Mohammed Bouaddi is currently an associate professor of Economics, specifically Econometrics at the American University in Cairo.

First published in 2018 by
The Economic Research Forum (ERF)
21 Al-Sad Al-Aaly Street
Dokki, Giza
Egypt
www.erf.org.eg

Abstract

This paper investigates the effect of changes in exchange rate on sectoral GDP in Egypt in the period between 1982 and 2014. For this purpose, the study uses a MIDAS regression to compare between the sign and magnitude of the effect of two exchange rate measures on 22 subsectors and 4 aggregate sectors' production. One measure is the monthly deflated official bilateral exchange rate of EGP against the US dollar and the other one is the annual real effective exchange rate of the EGP. Interestingly, the results show consistent positive inelastic effect of changes in real EX rate on sectoral production, while showing consistent positive yet highly elastic effects of changes in REER. Analyzing the results of the REER estimation, most of the low elasticity sectors are public, non-tradable subsectors and contribute by only little to GDP, while most tradable large sectors are highly elastic.

Keywords: Real effective exchange rate changes, Currency devaluation, Sectoral output, growth, MIDAS regression, effect elasticities, Egypt

JEL Classifications: C22, E23, E31, F04, F31, F37, O24

ملخص

تبحث هذه الورقة في تأثير التغيرات في سعر الصرف على إجمالي الناتج المحلي القطاعي في مصر في الفترة بين عامي 1982و 2014. ولهذا الغرض ، تستخدم الدراسة انحدار ميداس MIDAS للمقارنة بين مؤشر وحجم تأثير اثنين من تدابير سعر الصرف على 22 قطاع فرعى وعلى إنتاج 4 قطاعات. أحد المقاييس هو سعر الصرف الثنائي الرسمي الشهري المنخفض مقابل الدولار الأمريكي ، والآخر هو سعر الصرف الفعلي الحقيقي السنوي للجنيه. ومن المثير للاهتمام ، أن النتائج تظهر تأثير متسق إيجابي وغير مرن للتغيرات في معدل الصرف الحقيقي على الإنتاج القطاعي ، بينما تظهر تأثيرات متناسقة إيجابية ولكن مرنة للغاية للتغيرات في سعر الصرف الحقيقي الفعلى وبتحليل نتائج تقدير سعر الصرف الحقيقي الفعلى، فإن معظم قطاعات المرونة المنخفضة مي القطاعات الفرعية العامة والقطاعات غير القابلة للتجارة وتساهم بنسبة قليلة فقط في إجمالى الناتج المحلي ، في حين أن معظم القطاعات الكبيرة القابلة للتجارة مرنة للغاية.

1. Introduction

The impact of exchange rate on economic activity remains a controversial topic in empirical literature. While traditional theory - embodied in the Mundell Fleming model – suggests that a depreciation (or a devaluation) of a local currency may stimulate economic activity through the expenditure switching effect from foreign to domestic goods as their relative prices increase (Karadam, 2014), empirical studies show discrepancies in results and no consistent positive impact on all economies following a devaluation of their domestic currencies. The huge economic contraction in Latin American economies in the 1990s after devaluation has led to gained attention to the negative effect of devaluation in developing countries. Nonetheless, the IMF stabilization programs in developing countries still require the devaluation of the currency since the 1950s (Hutchison, 2003). Hence, there is no consensus in theoretical and empirical literature on the sign of the impact of devaluation on economic activity. In this regard, this paper will first demonstrate the mechanism and different channels discussed in literature through which the impact of devaluation on economic activity can differ.

Despite the relative abundance of studies examining the impact of exchange rate changes on the aggregate economic activity, most studies ignored the disaggregated sector and industry-specific dynamics. The response of sectors and industries should be highly heterogeneous as they differ in main economic characteristics, such as the degree of trade openness, price elasticity of demand, financial structure and capital intensity (Hahn, 2007; Karadam, 2014). In this regard, the main aim of the research paper was to examine the impact of exchange rate on sectoral economic activity in a developing country, namely Egypt from 1982 till 2014. Egypt is an interesting economy to study regarding the impact of exchange rate, especially after the recent drop in the value of its currency — the Egyptian pound (EGP) — following the 2011 revolution and because of its changing exchange rate regimes during the past 30 years. However, one of the main results of this paper is the consistent sign of the impact of exchange rate on all economic sectors, except for a few and small sectors. Moreover, empirical work in literature do not agree on the same exchange rate measure when examining the impact of devaluation on economic activity. Some studies use the effective exchange rate and others use the bilateral exchange rate of the domestic currency to the US dollar. In this study, both measures of exchange rate were used to compare results, namely the real effective exchange rate and real bilateral exchange rate. Results show that using the REER the impact of devaluation on economic sectors is consistently negative and highly elastic, while using real ER the results are consistently positive and inelastic. Details on these results are demonstrated throughout the paper.

The remainder of the paper is organized as follows. Section 2 is devoted to reviewing empirical and theoretical literature. Section 3 displays a brief overview of the structure of the Egyptian economy. Section 4 and 5 present the data and methodology. Section 6 and 7 present and discuss the results. Section 8 concludes.

2. Literature Review

2.1 Theoretical Background of Exchange Rate's Effect

Changes in a country's exchange rate affect its aggregate demand, aggregate supply and its balance sheet (Karadam, 2014). As far as this study is concerned, the impact on AD and AS is of higher importance.

Starting with consumption, the larger the share of traded goods in consumption the more devaluation reduces real income as the price of traded goods increase followed by an immediate fall in real household income which reduces expenditure. Hence, a devaluation contracts consumption and in turn AD if the share of traded goods in consumption is greater than that of the non-traded goods (Krugman and Taylor, 1963).

Investments in developing countries require imported capital goods. Branson (1986) argues that a devaluation increases the price of capital and consequently investment decreases, while Landon and Smith (2009) add that the net effect of depreciation on investment depends on the degree of substitutability of capital versus labor to produce more exports. If there is a high degree of substitutability between capital and labor, industries will be more labor intensive rather than capital intensive which might decrease the cost of production and hence the cost of investment. Another approach to determine the effect of investment is through the redistribution of income that can take place as the owners of export firms benefit from devaluation and workers are harmed through the reduction in their real income. Since the marginal propensity to save from profits is assumed to be higher than that of workers, income distribution might increase investment while reducing consumption (Krugman and Taylor, 1978). Nonetheless, devaluation results in perceived vulnerability which in turn increases speculation of future devaluation and causes weakened confidence in the economy (El-Ramly and Abdel-Haleim, 2008). Hence, the impact of exchange rate on AD through the investment component is multi-faceted and is relative to the economy's sectoral structure.

After a devaluation, if the government put ad valorem taxes on exports and imports, tax revenue will increase as the value of exportable as well as importable goods increase. This implies an income transfer from the private to the public sector. Since the marginal propensity to consume from the government is assumed to be lower than that from the private sector, a reduction in AD is induced through decreased aggregate consumption despite the increasing government revenue (Krugman and Taylor, 1978).

In macroeconomics, AS is mainly concerned with inputs of production: intermediate goods, capital and labor. As discussed earlier, a currency devaluation causes an increase in import prices which in turn increases the cost of production the higher the exchange pass-through in developing countries (Campa and Goldberg, 2005). Not only does the price of capital increase because of imports, it also increases because of the increasing cost of working capital. In the case of devaluation, the volume of credit in the market decreases as interest rates tend to rise due to inflation which negatively affects AS (Buffie, 1986). Finally, if nominal wages increase with the increase in price level, i.e. wage indexation, AS is again adversely affected by the increase in cost of production (Edwards, 1986). Hence, the effect of devaluation on AS is mainly negative. Differentiating developing and emerging countries from developed ones in the economic analysis is due to the low demand elasticities of exports and imports while mostly having a trade

deficit. Large external debts and high vulnerability are also causes of reduction in expenditure, bankruptcies and weakened confidence in the economy (El-Ramly and Abdel-Haleim, 2008).
Finally, the most obvious impact of devaluation is through increased international competitiveness of exports and encouraging import substitution, which increases output. However, counter-inflationary macroeconomic policies result in a reduction in AD as well as a deterioration in trade balance. Nonetheless, the magnitude of increase in AD has to be compared to the magnitude of reduction in aggregate supply in response to devaluation to decide whether the impact is contractionary or expansionary to the economy.

2.2 Empirical Research on Exchange Rate's Effect

Literature on Egypt or on the sectoral level of an economy is of interest to this study. The impact of exchange rate on economic activity in Egypt is examined only in a few studies. Egypt is expected to follow the contractionary impact on developing countries hypothesis as it is still a developing country. In this regard, El-Ramly and Abdel-Haleim (2008) studied the relationship between exchange rate changes and output in the Egyptian economy in the period from 1982 till 2004 using a nonstructural VAR model and annual real effective exchange rate as the measure of exchange rate while controlling for money supply growth and fiscal policy deficit as percentage of GDP. The findings of the paper are that devaluation is contractionary for the first four years, then it starts to be expansionary given that no multiple short-run devaluations happened in a row postponing the positive impact. Findings of the study also showed the large influence of real exchange rate changes on output through the econometric results that show real exchange rate variations explaining as much as 45-68% of the changes in the rate of growth of output. It is important to note that this study was conducted in 2008 before the 2011 revolution and the series of devaluation that happened afterwards. Results may differ now and the speed of adjustment of the impact might be longer than four years as found in this study. Finally, Kandil and Dincer conduct a comparative study between the impact of changes in exchange rate on output in Turkey vs. Egypt distinguishing unanticipated – residuals of the model– from anticipated changes in exchange rate – assuming rational expectation – in the period from 1980 till 2005. Results show that unanticipated depreciation has more pervasive impact than unanticipated appreciation in Egypt because exports appear to be more inelastic to currency changes while import prices are highly affected. Hence, due to the limited new studies on Egypt and to the debatable nature of the research question of the thesis project, there is no consensus on the empirical results for Egypt which gives room for the thesis project to add significant value in this regard. The previous aggregate output analysis does not necessarily give a full picture of the exchange rate's effect on production as it is subject to aggregation bias, where the collective result can be different from the sectoral disaggregated one. Sectors are heterogeneous as they differ in many aspects such as the export and import share in production, production differentiation, price elasticities of demand and supply and exposure to exchange rate shocks (Hahn, 2007). The magnitude and timing of the impact differs from a sector to another. Some sectors will be immediately affected, and some will experience delayed effect which will help in detecting the exchange rate effect on inflation at the earliest possible stage. Sectors with higher import share in inputs, higher degree of product differentiation and competition reducing factors, will experience a lesser response to exchange rate changes. In contrast, the higher the export

share of a sector, the higher the share of imported competitor goods and the higher the price elasticity of demand, the higher the magnitude of response of a sector (Hahn, 2007).

Bahmani-Oskooee and Mirzaie (2000) investigate the impact of exchange rate changes on the US. production in eight sectors with quarterly data from 1970 till 1994 using a modified version of the Johansen-Juselius cointegration analysis. In their model, unemployment, oil prices, government spending and imports were explanatory variables along with the nominal effective exchange rate. The main findings of this paper are that there is no evidence of a long-run relation between the value of the dollar and sectoral output in the US.

Another wide study was conducted by Hahn (2007) to determine the magnitude & speed of the impact of exchange rate shocks on activity in all Euro area sectors from 1985 till 2004. Hahn used a VAR framework as it provides the tools to trace out the dynamic responses of the system. The main findings of Hahn differ from that of Bahmani-Oskoee and Mirzaei (2000) in that its results show industry, added value in trade and transportation services to be the most sectors affected by an exchange rate shock while the adjustment in intermediate goods production to be one of the fastest. In the subsectors of industry, the effect is heterogeneous ranging from zero impact in food production to a very high response in manufacturing of machinery. Similarly, in a doctoral thesis written by (He, 2011) the impact of exchange rate on real output of 24 sectors in 20 OECD countries is examined using ARDL-ECM from 1971 till 2008. According to the findings of the study, the impact of devaluation is expansionary for two of the three tradable sectors, namely manufacturing and agriculture, while it is contractionary to half of the non-traded sectors. As evident from the studies cited above, industry is affected heavily in developed countries mostly positively by a devaluation as the export share of the production of this sector is higher than its reliance on imported intermediate inputs. Even firms in Indian industries benefited from the rupee's depreciation against the dollar from 2006 till 2011 according to a firm-level analysis conducted by (Sikarwar, 2014).

Finally, Karadam (2014) examined in his doctoral thesis the impact of real exchange rate changes on imports, exports, and production of 22 Turkish manufacturing industry's sub-sectors over the period of 1994 to 2010 taking into consideration the financial dollarization and import and export share of each sector. Results show that growth in industries is negatively affected by real depreciations whereas this negative effect is larger for high and medium-high technology sectors and smaller for export-oriented industries. Hence, the result of this study is similar to the expected results of studying Egypt as sectoral studies on Egypt and the Middle East are limited.

3. Brief Overview: Egypt's Sectors

The structure of Egypt's economy is important in the context of this study as results may differ and have more significant impact depending on several characteristics, such as the size of each sector in the economy, the export and import orientation of each sector and industry as well as employment division among the sectors. Unfortunately, detailed data on Egypt for the 22 subsectors examined in this study are not fully and publicly available. However, using the data already examined in this study and some data on the aggregated division of trade is of some help.

As is shown in Figure 1, the subsectors petroleum, industry and mining and the money market are the largest subsectors in the public sector and are larger than those in the private sector accounting for around 72% of the public sector's production. The GDP of the Suez Canal is the fourth largest, however, accounting for only 9% of the public sector's GDP. Thus, the regression results of these four subsectors are the most important results for the public sector. On the other hand, the three largest subsectors in the private sector are industry & mining, agriculture and trade accounting together for 61% of the total GDP of the private sector. Housing and construction subsectors are significantly larger in the private sector than they are in the public sector. After all, the share of the private sector as a whole, accounts for almost 75% of the total production – excluding insurance services - while the public sector accounts only for 25% (Fig. A in the appendix). Accordingly, the regression results for these five subsectors are the most import results for the private sector.

After visualizing the division of sectors and subsectors in the economy's structure, it is then important to examine the export and import composition of trade in Egypt. Unfortunately, data for subsector composition is not readily available unlike the aggregate structure or the specific products division, such as in Figure 2.

The industry and mining sector encompasses manufactures as well as fuels and mining which account together for nearly 75% of Egypt's exports, while agricultural products account for the rest of the commodity exports. Similarly, 77% of Egypt's imports are industrial products as opposed to 23% agricultural products. Despite the similar aggregate structure of Egypt's imports and exports, they differ in products and in size. In 2015, the trade deficit was $46 million, which accounts for a negative 14% of GDP. This insight gives rise to negative expectations of the effect of devaluation on sectoral activity because the size of imports is higher in all sectors of commodity trade.

4. Data

In this study, there are two estimations with 24 dependent variables, five macroeconomic control variables and two explanatory variables- one for each estimation. Some data for Egypt are challenging to find which made this study a multi-sourced one. The study is conducted over the period from 1982 till 2014.

4.1 Dependent Variables

Sectoral output represented in the dependent variables are divided into public and private for each sector, except for the Suez Canal public sector. The sectors included in the study are: agriculture, industry and mining, petroleum products, electricity, construction, transportation and storage services, telecommunication services, hotels and restaurants and finally housing and real estate property. Hotels and restaurants can be a proxy of tourism revenue as there was no indicator for tourism to cover this sample period.

4.2 Exchange Rate Variables

A comparison will be conducted between using monthly official nominal exchange rate manually deflated by the ratio of GDP deflator of Egypt and that of the USA, and annual real effective exchange rate to test if results will differ as there was no consensus in literature as to which measure is better. The advantage of the effective exchange rate is that it is a multilateral measure

of the EGP against 67 countries which considers the international trade of Egypt with other countries other than the US. It is a more accurate measure of the real value of the Egyptian currency against the trading partners which gives it a strong explanatory power. On the other hand, monthly frequency gives room for examining the difference the monthly volatility can do to results as the number of observations is 12 times greater.

4.3 Other Explanatory Variables (Control Variables)

In vast literature, macroeconomic variables are being controlled for when investigating the relationship between exchange rate and sectoral output. In this study, government spending, GDP per capita, oil prices, inflation and real interest rates are controlled for. All data sources are cited in Table B in the appendix.

5. Methodology

Two estimations were run: one uses annual real effective exchange rate as the measure of exchange rate, while the other uses monthly bilateral deflated exchange rate. After deflating all nominal variables by the GDP deflator of Egypt and the nominal exchange rate by the ratio of GDP deflator of Egypt over that of the US, the first step was to check the stationarity of the variables using unit root tests. All variables showed to be stationary, where the unit root hypothesis was rejected for all variables except for government expenditure, a control variable. However, after smoothing the government expenditure indicator, the variable became stationary. The stationarity of the variables is the reason to use the conventional OLS estimation model for this study. Consequently, all variables are I(0) and the OLS equation is constructed as follows:

$$yit = c + \beta 1 \ln REXt + \beta 2 \ln GDPCt + \beta 3 \ln GOVt + \beta 4 \ln INTt + \beta 5 \ln OILPt + \beta 6 \ln INFLt + \varepsilon t$$

- where REX: denotes the exchange rate measure at time t (once as the annual real effective
- exchange rate and once as the deflated official bilateral exchange rate)
- GDPC: deflated GDP per capita
- GOV: deflated and smoothed government spending
- INT: deflated interest rate
- OILP: international real oil prices
- INFL: inflation rate
- y: deflated sector GDP

The logarithm (ln) is used to make it possible to make an inference about the β coefficients as they represent the elasticity of the y variables to changes in the accompanied explanatory variables. Having two variables in monthly frequency – namely, the bilateral exchange rates and the real oil prices, makes it necessary to use the Mixed-data sampling MIDAS estimation method. It is a method of estimation for models where the dependent variable is recorded at a lower frequency than one or more of the independent variables. Contrary to the traditional approach where data were aggregated in the lower frequency, MIDAS uses information from every observation in the higher frequency space without aggregation (IHS eviews9) so that the volatility of the higher frequency would be taken advantage of.

5.1 Estimation Results

The regression results are summarized in three tables: a table showing the elasticities and their significance for both measures for all the subsectors of the public sector (table 1), the second showing the same for the private sector (Table 2) and the third for aggregated sectors (Table2.3). For the regressor coefficients to be reliable measures of the elasticity or the responsiveness of the y-variable to changes in the exchange rate, all variables in the estimation are presented in their logarithmic form. Hence, a real exchange rate (RER) coefficient value of 0.60 (-0.60) can be interpreted as follows: for every one percent increase in RER, the concerned y-sector production increases (decreases) by 0.6%. Similarly, for every one percent increase in REER, the concerned y-sector's production increases (decreases) by 0.6%. In general, an increase in REER implies that the price of exports become higher and that of imports become lower; therefore, an increase indicates a loss in trade competitiveness. Therefore, results for the elasticities of the REER is interpreted oppositely from that of the RER.

5.2 Results for the Public Sector

Table 1 shows the elasticity of each subsector of the public sector to changes in the real effective exchange rate (REER) as well as to changes in monthly deflated exchange rate (RER). Three stars means significant at 1%, two stars significant at 5% and one star significant at 10%. Most of the estimations using both measures showed R-squared to be between 0.80 and 0.95 (Table C in appendix) which shows the strength of the regression equation and that the model explains from 80% to 90% of the variability in sector production.

Many inferences can be drawn from this table. First, the results of the regression using REER are opposite from those of the regression using RER in all subsectors, except for agriculture, which accounts for less than 0.5% of the public-sector production, which is intuitive. Secondly, when analyzing the REER results, it is observable that elasticities are consistently much higher than those of the RER elasticties. In addition, all elasticities are significant at 1%, except for agriculture, which is significant at 5% as well as transportation and storage, and trade are insignificant.

Interestingly, the four largest subsectors in the public sector - namely industry and mining, petroleum and its products, Suez Canal and finally electricity generation – show the highest elasticities exceeding 100% to changes in REER. For instance, the petroleum and its products and Suez Canal respond with a 200% decrease for every 100% increase in the REER measure. On the other hand, housing and real estate property as well as construction are showing the lowest elasticities, while both subsectors combined do not account for more than 2.5% of the public sector's production. Hence, it can be concluded that the public sector is significantly vulnerable to increases in REER.

5.3 Results for the Private Sector

Table 2 shows again the intuitively opposite coefficients. All coefficients are significant at 1%, except for hotels and restaurants which is significant at 5%. Again, Table C in the appendix shows R-squared for all estimations to be in the range from 0.85 to 0.97 which shows a model with high explanatory power.

Compared to the public sector's results, the private sector shows higher elasticities for all subsectors to the extent that all of them are higher than 1, especially the telecommunications

services with an elasticity of 3.79 despite being the smallest subsector in the private sector. In contrast, the largest subsectors – agriculture, industry and mining and trade - do not show the highest elasticities as it did in the public sector yet are still high. The only subsector with an elasticity lower than 1 is hotels and restaurants which accounts for only 3% of the private sector's production.

5.4 Results for Aggregated Sectors

Table E in the appendix shows the elasticities of the aggregated sectors' value added using both REER and RER. All elasticities for the REER and RER are positive are all significant at 1%. Corresponding elasticities of the sectors using REER are all high while all elasticities using the RER are all low. As discussed in the data characteristics using Fig.1, the services sector is the greatest sector accounting for 50% of Egypt's value added, while agriculture is the smallest accounting for 11% of the total value added. Hence, these results suggest that the total value added is highly elastic and responsive to changes in the real effective exchange rate.

Conclusion: Egypt's sectors' GDP and value added are all highly elastic to and positively affected by an increase in REER and a depreciation of RER, except for public agriculture. Moreover, the subsectors' elasticity to RER are relatively lower than those of the REER with most of the elasticities being less than 1.00. Finally, Table D in the appendix shows the significance of each control variable to changes in the subsectors' and sectors' GDP for both estimations. GDP per capita shows the highest significance for subsectors for both estimations followed by the government expenditure. Generally, control variables are more significant in the REER estimations than they are in the RER estimations despite being similar.

6. Brief Qualitative Analysis of the Results

6.1 Using RER vs. REER

Most literature use only one measure to examine the effect of exchange rate on economic activity, either the effective exchange rate or the bilateral exchange rate. Real effective exchange rate is often more interesting for economists to study as it is considered as the average of all the bilateral exchange rates of the trading partners of the economy under study, weighted by the trade shares of each partner after adjusting for inflation differentials. Therefore, the results of the regression using REER should have more explanatory power when it comes to the sectoral activity and accordingly the elasticities estimated using REER are the ones to be studied further.

6.2 Possible Causes of Magnitude Response Differences of Subsectors

As discussed in literature, there are several factors that could affect the sign and magnitude of the sector's production response to changes in exchange rate such as the export and import share in production, production differentiation, price elasticities of demand and supply and exposure to exchange rate shocks. Sectors with higher import share in inputs, higher degree of product differentiation and competition reducing factors will experience a lesser response to exchange rate changes. In contrast, the higher the export share of a sector, the higher the share of imported competitor goods and the higher the price elasticity of demand, the higher the magnitude of response of a sector (Hahn, 2007). Unfortunately, data on Egypt's sectors is too scarce to be able to compare literature with estimation results for Egypt. However, with the data available and the examination of other factors a brief explanation attempt for the results will be developed in this section.

Table 3 categorizes the subsectors according to their magnitude of response or elasticity to changes in REER and the subsectors' share in GDP to give an insight to how much the economy can be affected by the subsector's response to devaluation. All the subsectors in the <0.5 elasticity category, do not exceed 1% of their share in GDP while almost all subsectors contributing by more than 5% to the economy's GDP are in the >1.0 elasticity category. On the other hand, those subsectors that have more than 2.0 elasticity such as the Suez Canal, private telecommunication services, and the private money market contribute each with less than 2%. Hence, those subsectors contributing most to the aggregate GDP are highly elastic to REER changes with an elasticity higher than 1.00.

6.3 Public vs. Private Subsectors

It is worth noting that all the subsectors in the low elasticity category in Table 1.3 are public subsectors and all the private sectors are listed under the high elasticity category. Moreover, the highest public subsector contributors to GDP are listed in the highly elastic category such as the public subsector of petroleum and its products and public mining and industry. Therefore, it can be concluded that public subsectors are more likely to be less responsive to changes in REER than are private subsectors, except for mining and industry, and petroleum products. A possible explanation could be that public sectors produce what the market fails to sufficiently provide. So, the amount of production is not to be affected by market prices as produced amounts should meet certain needs and hence are inflexible to price changes. However, the public as well as private subsector petroleum and its products including natural gas being highly elastic and negatively signed is against the common belief in literature and economic concepts as Egypt's exports mainly depend on them and on mining which should suggest a devaluation to positively affect the production and not vice versa.

6.4 Export Orientation vs. Import Penetration

Literature suggests that the higher the share of imports in production the lower the elasticity and the higher the share of exports in production the higher the elasticity of production to REER (Hahn, 2007). However, such data for sectors and subsectors is not readily available for Egypt's over 20 subsectors. In this section, trade deficit or trade surplus per relatively large sectors can be observed to test if it can explain results. Intuitively and according to literature, a trade deficit should result in an import substitution or expenditure switching behavior as producing domestically would be less expensive than importing in the case of devaluation. A devaluation in the case of a trade surplus, on the other hand, should foster more exports and more trade surplus. However, in the case of a developing country like Egypt where import and export elasticities are low, debts are increasing and the economy becoming more vulnerable, the general contractionary effect on sectors is expected.

As is evident in Figure 3, agricultural products show a trade deficit of more than 50%. Most of the agricultural imported products are raw food such as fruits, cheese and potatoes (WTO) which are relatively necessary for many households. Results for Egypt show private agriculture production which accounts for more than 11% of GDP (see Table 3) is positively and highly affected by devaluation.

Non-Agricultural products include petroleum oil crude and other than crude, medicaments and other metal products. Again, a trade deficit of more than 50% is to be observed even though

Egypt's largest exports are petroleum and natural gas. Public and private production combined of petroleum products alone contribute by nearly 10% of GDP (see Table 3) and are positively affected and highly elastic to currency depreciation.

Commercial Services include transport, travel and other commercial services. Here, a trade surplus of nearly 10% can be observed which theoretically suggests that a devaluation should encourage the services sector, which is the case as it is shown in Table2.3, the aggregate services sector which accounts for 50% of GDP is positively affected and is elastic by 109% to devaluation. Again, these results are intuitive with economic theory.

Transport methods include transport by sea, air and other methods. A trade surplus of 20% can be observed. The trade surplus here can be due to the Suez Canal which its GDP share declined significantly with an elasticity greater than 200% to REER. Private trade together with private transportation and storage which accounts for more than 15% of GDP are positively and highly affected by devaluation. Again, this is economically intuitive.

These were the sectors for which data is available for comparison. The conclusion in this section is that REER has an expansionary effect on most of the sectors' production taking into consideration the import penetration or export orientation of the sector.

6.5 Tradable vs. Non-Tradable Subsectors

Another theoretical explanation for observed differences in magnitude of the subsectors to changes in REER could be the distinction between tradable and non-tradable sectors. Intuitively, tradable sectors should be more affected in magnitude by REER than are non-tradable sectors as production decision is not affected directly by changes in REER and prices. Tradable sectors are industries that produce goods and provide services that are or can be traded
internationally, such as the manufacturing sector, while non-tradable sectors are those that provide services that can only be used domestically and using only domestic workforce, such as construction, education, health, housing services…etc.

In the case of Egypt according to Table2.3, Most of the low elasticity sectors are public, non-tradable and contribute by only little to GDP, such as public housing and real estate, public construction and public hotels and restaurants. On the other hand, however, there are other many private non-tradable subsectors in the highly elastic category as well, such as private housing and real estate, private construction and private and public telecommunication. Hence, the distinction in tradable and non-tradable sectors as a possible differentiation point between highly elastic and relatively more inelastic subsectors' production to changes in REER.

7. Limitations

There are several limitations to this study. First, this study does not cover the period after 2014 which has witnessed a sudden great devaluation after the floatation. Even though this study is focused on historical time series which gives insight to the consequences that can happen with the current devaluation, including the time of great devaluation might influence results. Moreover, as the exchange rate system was pegged for more than 20 years at the beginning of the studied sample period, black market rates could have been more indicative of the changes in the value of the currency. However, black market rates for this whole sample period was lacking for Egypt.

Another limitation which is not high in importance, the bilateral exchange rate was deflated by the GDP deflator over the GDP deflator of the US and sectors' production were deflated by the GDP deflator, while it could have been more accurate to use the CPI deflator instead of the GDP deflator and CPI deflator per sector instead of an aggregate one. However, such data is not readily available for Egypt for this sample period.
Finally, the import and export share of production as in raw materials is not readily available for Egypt which could have given more insight and explanation to estimation results.

7.1 Recommendations

This study is a gateway to further deeper analysis of each subsector and to other influencing factors other than those mentioned in this study. A deeper analysis of each sector's characteristics and economic background can be further analyzed. Moreover, comparing Egypt's results with results of another developing country and another developed one could give more insight to Egypt's situation. Finally, the effect of this study's results on inflation or pass-through can also be further studied.

8. Conclusion

This study has provided insightful findings and a basis for further and more focused research. The first finding is that the choice of exchange rate measure changes the magnitude of the effect on economic sectors; using the monthly bilateral deflated exchange rate of the Egyptian pound vs. the US dollar provided lower elasticities of sectors' GDP than those of the REER. As REER should have more explanatory power as it is by nature calculated in a way to be more comprehensive and to be more representative of the value of the Egyptian currency and all of the currencies of Egypt's trade partners. REER results showed positive elasticities for all subsectors, except for public agriculture, while RER results showed positive elasticities for all subsectors. At the same time, most results are highly significant for both measures. Hence, devaluation measured by REER and RER is expansionary to almost all subsectors of Egypt's economy with differences in magnitude.
Secondly, private sectors are generally more responsive to REER changes than are public sectors. However, public sectors which contribute largely to GDP are also highly responsive, such as public industry and mining and public petroleum and its products. This can be attributed to the fact that the public sector in general should be producing what the market fails to or inadequately produces to fill a needed gap in the market which are generally necessary goods. Necessities are more inelastic to external changes. However, industry and petroleum products are more traded in international market and will be more flexible to REER changes. Such a finding implies that the private sector should be taken care of in the case of devaluation by cutting taxes or increasing subsidies.
Thirdly, Egypt's subsectors follow economic theory regarding the factors affecting production, such as import penetration vs. export orientation, expenditure switching effects…etc., as sectors where exports exceed imports the effect of devaluation is positive. In a nutshell, almost all sectors are affected positively and are highly vulnerable to exchange rate changes, private and tradable sectors are generally more elastic to exchange rate changes.

References

Aghion, Philippe et al. "Exchange Rate Volatility and Productivity Growth: The Role of Financial Development." *Journal of Monetary Economics* 56.4 (2009): 494–513. Web.

Bahmani-Oskooee, Mohsen, Ida A Mirzaie, and Ilir Miteza. "Sectoral Employment, Wages and The Exchange Rate: Evidence From The U.S." *Eastern Economic Journal* 33.1 (2007): 125–136. Web.

Bahmani-Oskooee, Mohsen, and Magda Kandil. "Exchange Rate Fluctuations and Output in Oil-Producing Countries: The Case of Iran." *Emerging Markets Finance and Trade* 46.3 (2010): 23–45. Web.

Bahmani-Oskooee, Mohsen, and Aghdas Mirzaie. "The Long-Run Effects of Depreciation of The Dollar on Sectoral Output." *International Economic Journal* 14.3 (2000): 51–61. Web.

Bebczuk, Ricardo, Arturo Galindo, and Ugo Panizza. "An Evaluation of the Contractionary Devaluation Hypothesis." *Inter-American Development Bank Working Paper* 582 (2006): n. pag. Print.

Blecker, Robert A., and Arslan Razmi. "The Fallacy of Composition and Contractionary Devaluations: Output Effects of Real Exchange Rate Shocks in Semi-Industrialised Countries." *Cambridge Journal of Economics* 32.1 (2008): 83–109. Web.

Branson, William H. *Stabilization, Stagfaltion and Investment Incentives : The Case of Kenya , 1979-1980*. Ed. Sebastian and Ahamed Liaquat Edwards. University of Chicago Press, 1986. Print.

Buffie, Edward F. "Devaluation, Investment and Growth in LDCs." *Journal of Development Economics* 20.2 (1986): 361–379. Web.

Calvo, Guillermo A., Alejandro Izquierdo, and Ernesto Talvi. "Sudden Stops, the Real Exchange Rate, and Fiscal Sustainability: Argentina's Lessons." *Monetary Unions and Hard Pegs: Effects on Trade, Financial Development, and Stability*. N.p., 2004. Web.

Campa, José Manuel, and Linda S. Goldberg. "Exchange Rate Pass-Through into Import Prices." *Review of Economics and Statistics* 87.4 (2005): 679–690. Web.

CBE Monthly Statistical Bulletin April 2013 - Document Library - Economena Analytics. N.p., 2013. Web.

Central Bank of Egypt. "2009/2010 Report." n. pag. Web.

Cooper, Richard N. "Currency Devaluation in Developing Countries." *Essays in International Finance* 86.86 (1971): n. pag. Print.

Coudert, Virginie, and Cécile Couharde. "Currency Misalignments and Exchange Rate Regimes in Emerging and Developing Countries." *Review of International Economics* 17.1 (2009): 121–136. Web.

Darvas, Zsolt. "Real Effective Exchange Rates for 178 Countries: A New Database." *Bruegel Working Paper* 6 (2012): 1–35. Web.

Edwards, Sebastian. "Are Devaluations Contractionary?" *The Review of Economics and Statistics* 68.3 (1986): 501–508. Web.

El-Ramly, H., and S. Abdel-Haleim. "The Effect of Devaluation on Output in the Egyptian Economy: A Vector Autoregression Analysis." *International Research Journal of Finance and Economics* 14.14 (2008): 82–99. Web.

Frankel, Jeffrey. "Contractionary Currency Crashes In Developing Countries." *Fifth Annual Research Conference of the International Monetary Fund* (2004): 1–54. Web.

Hahn, Elke. *The Impact of Exchange Rate Shocks on Sectoral Activity and Prices in the Euro Area*. N.p., 2007. Print.

He, Wei. "Effects of the Exchange Rate on Sectoral Profits, Value Added, Wages and Employment." University of Alberta, 2011. Web.

Hutchison, Michael. "A Cure Worse Than the Disease? Currency Crises and the Output Costs of IMF-Supported Stabilization Programs." *Nber*, University of Chicago Press, Jan. 2003.

IHS eviews9. "EViews 9.5 MIDAS Forecasting Demonstration." N.p., n.d. Web.

Kamin, Steven B, and Marc Klau. "Working Papers no. 48 "Some multi-country evidence on the effects by" (1997): n. pag. Web.

Kandil, Magda, and Nazire Nergiz Dincer. "A Comparative Analysis of Exchange Rate Fluctuations and Economic Activity The Cases of Egypt and Turkey." *International Journal of Development Issues* 7.2 (2008): 136–159. Web.

Karadam, D. Y. "The Real Exchange Rate and Economic Growth." The Graduate School of Social Sciences of Middle East Technical University, 2014. Web.

Kim, Yoonbai, and Yung Hsiang Ying. "An Empirical Assessment of Currency Devaluation in East Asian Countries." *Journal of International Money and Finance* 26.2 (2007): 265–283. Web.

Krugman, Paul, and Lance Taylor. "Contractionary Effects of Devaluation." *Journal of International Economics* 8.3 (1978): 445–456. Web.

Landon, Stuart, and Constance E. Smith. "Investment and the Exchange Rate: Short Run and Long Run Aggregate and Sector-Level Estimates." *Journal of International Money and Finance* 28.5 (2009): 813–835. Web.

Ministry of Planning (MoP). "Time Series Data: Annual and Quarter Aggregate Economic Indicators." N.p., 2015. Web.

Pesaran, M. H., Shin, Y. "An Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis." *Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium.* March 3-5, 1995 (1999): 1–31. Web.

Reinhardt, Carmen M. "Exchange Rates (Official and Parallel)." N.p., n.d. Web.

Reinhart, C, and G Calvo. "When Capital Inflows Come to a Sudden Stop: Consequences and Policy Options." *Reforming the International Monetary and Financial System* 6982 (2000): 175–201. Web.

Sikarwar, E. "A Re-Examination of Exchange Rate Exposure: Industry-Level Analysis of Indian Firms." *Global Business Review* 15.4 (2014): 867–882. Web.

The guardian. "Egypt Devalues Currency by 48% to Meet IMF Demands for $12bn Loan." 3 Nov. 2016. Web.

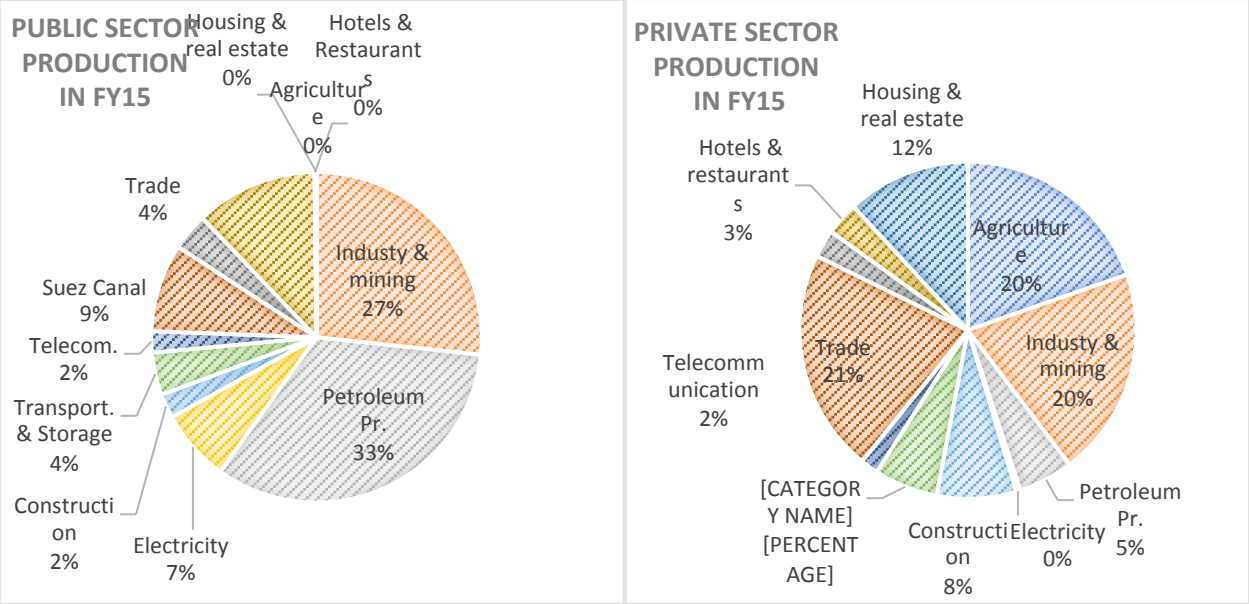
"U.S. Energy Information Administration (EIA)." N.p., n.d. Web. 15 Dec. 2016. Upadhyaya, Kamal P. "Currency Devaluation, Aggregate Output, and the Long Run: An Empirical Study." 64 (1999): 197–202. Web.

Wong, Hock Tsen. "Real Exchange Rate Misalignment and Economic Growth in Malaysia." *Journal of Economic Studies* 40.2 (2013): 298–313. Web.

World Bank. "The World Bank DataBank." *Data Bank*. N.p., 2016. Web.

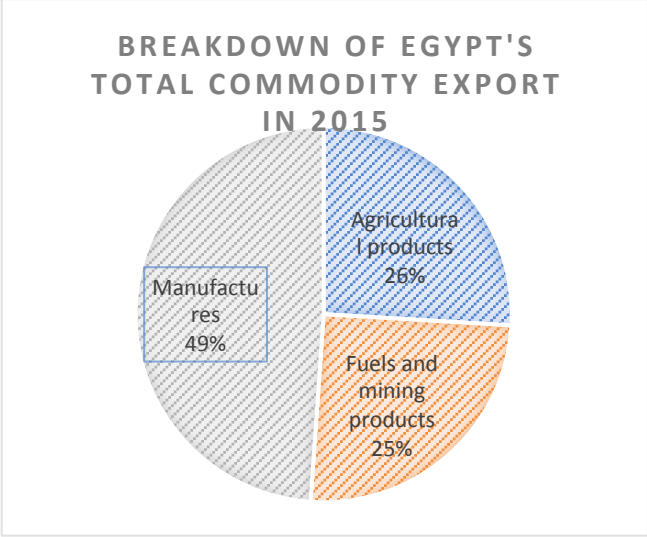
World Integrated Trade Solution. N.p., 2014. Web. 14 Dec. 2016.

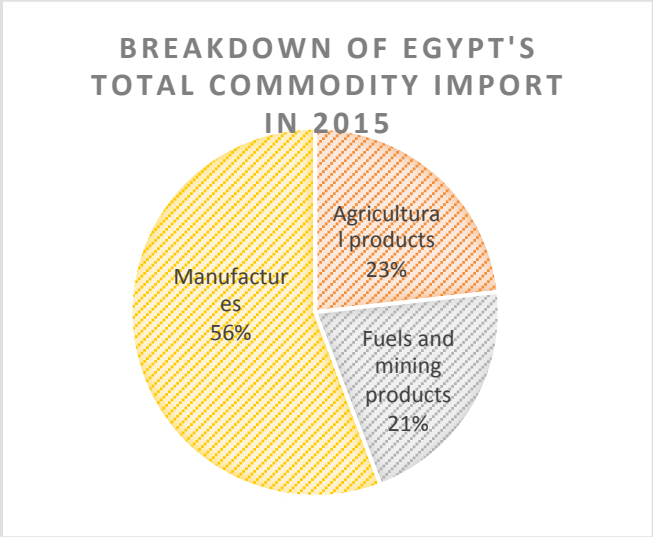
Figure 1. Division of Production by Sector and Subsectors



Source: Ministry of Planning of Egypt (data used for estimation)

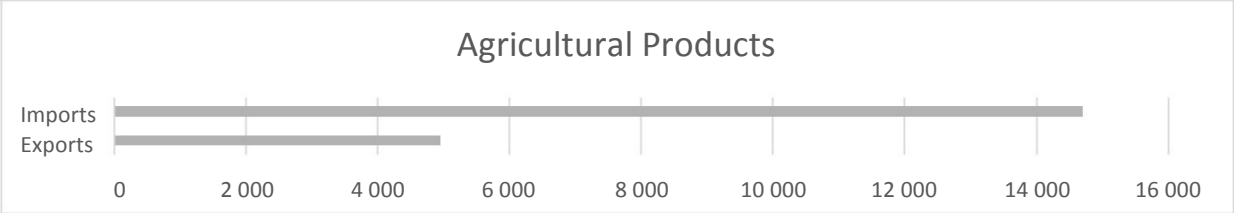
Figure 2. Egypt's Commodity Export and Import Composition in 2015





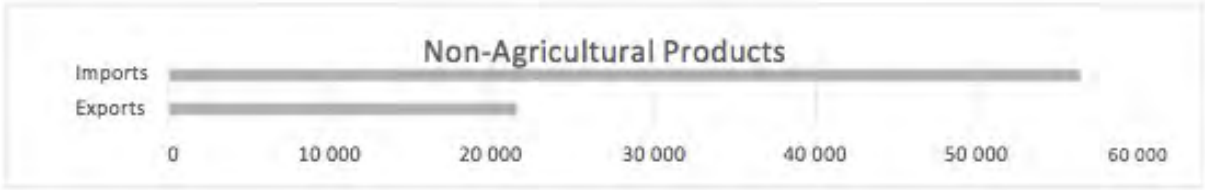
Data Source: World Trade Organization

Figure 3. Import and Export division of Agricultural Products in Egypt (in mio. $)



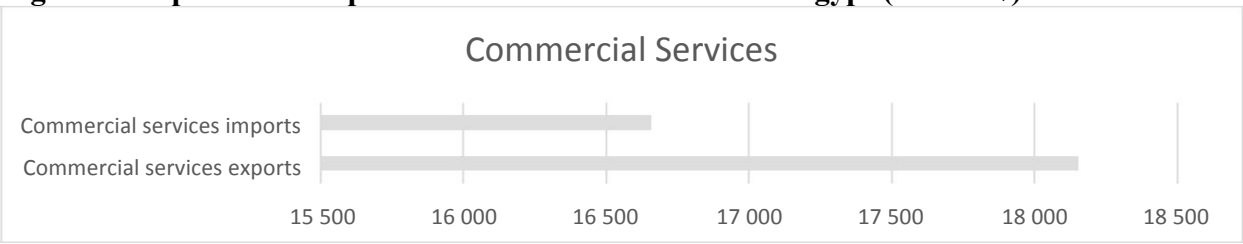
Source: World Trade Organization (WTO)

Figure 4. Import and Export Share of Non-Agricultural Products in Egypt (in mio. $)



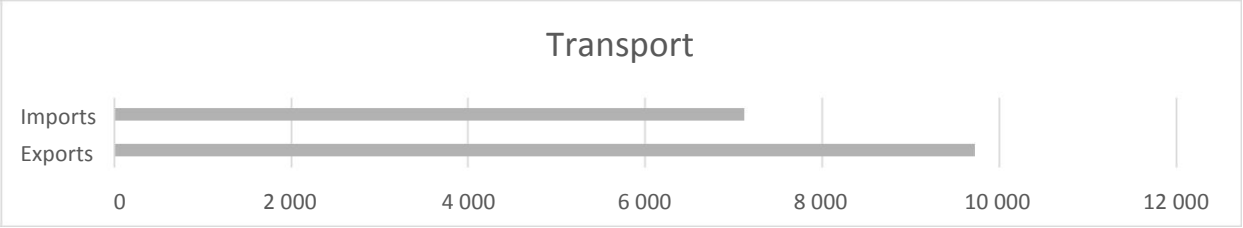
Source: World Trade Organization (WTO)

Figure 5. Imports and Exports of Commercial Services in Egypt (in mio. $)



Source: World Trade Organization (WTO)

Figure 6. Transport Imports and Exports of Egypt (in mio. $)



Source: World Trade Organization

Table 1. Estimation Elasticities for the Public Sector

#	Public Sectors	REER	RER
1	Agriculture	1.13**	-0.49***
2	Industry & mining	-0.67***	0.28***
3	Petroleum products	-2.08***	0.67***
4	Electricity	-1.5***	0.62***
5	Construction	-0.47***	0.23***
6	Transportation & storage services	-0.09	0.31***
7	Telecommunication services	-1.26***	0.47***
8	Suez Canal	-2.19***	0.74***
11	Hotels & Restaurants (Tourism)	-0.86***	0.27***
12	Housing & Real Estate property	-0.49***	0.44***

Source: Author's Estimations

Table 2. Estimation Elasticities for the Private Subsectors

#	Private Sector	REER	RER
13	Agriculture	-1.10***	0.44***
14	Industry & mining	-1.53***	0.65***
15	Petroleum products	-1.71***	0.61***
16	Construction	-1.28***	0.51***
17	Transportation & storage services	-1.34***	0.54***
18	Telecommunication services	-3.79***	1.50***
21	Hotels & Restaurants (Tourism)	-0.68**	0.78***
22	Housing & Real Estate property	-1.10***	0.27***

Source: Author's estimations

Table 3. Elasticities of GDP per Subsector to REER and the subsectors' share in GDP

Elasticity < 0.5	*Share in GDP (%)*	*> 0.5 & < 1.0*	*Share in GDP (%)*	*> 1.0*	*Share in GDP (%)*
Public Construction	0.47	Public Industry & Mining	5.19	Public Agriculture	0.01
Public Transport. & Storage *(insignificant)*	0.81	Public Hotels & Restaurants	0.02	Public Petroleum & its Prods.	6.46
Public Trade*(insignificant)*	0.71	Private Hotels & Restaurants	1.81	Public Electricity	1.37
Public Housing & R.E.	0.01			Public Telecom. Services	0.41
				Suez Canal (> 2.0)	1.68
				Private Agriculture	11.17
				Private Industry & mining	11.4
				Private Petroleum & its Prod.	3
				Private Construction	4.33
				Private Transportation & Storage	3.48
				Private Telecom. (> 3.0)	0.96
				Private Trade	12.2
				Private Housing & R.E.	6.75

Source: Author's Estimations

Appendix

Table A: Sectors and Subsectors used in this study

Categorization of Sectors and Subsectors
1. Industry
Industry & mining
Manufacturing
Petroleum Products
2. Agriculture
3. Services
Construction
Telecommunication
Suez Canal Money Market
Transportation and Storage
Hotels and Restaurants
Housing and Real Estate Property
Electricity

Table B. Data Sources

Data	Source
GDP per sector in EGP are current, annual for public and private sector. Using the GDP deflator, these data were converted to real.	Website of the Ministry of Planning of Egypt (MoP)
Aggregated Value Added data for agriculture, industry, manufacturing and services.	the World Bank country indicators (World Bank)
monthly official exchange rate from 1982 to 1998	the official website of Carmen Reinhardt, where she collected and measured official and parallel market exchange rates for more than 100 countries from 1946 till 1998 (Reinhardt). This is the only online source for monthly official exchange rate for the specified period.
monthly official exchange rate from 1999 to 2014	Citadel Capital at the American University in Cairo.
Annual real effective exchange rate of the EGP against the currencies of 67 countries is retrieved from	Bruegel Database for calculating the nominal and real effective exchange rates for 178 countries.
All annual control variables	the World Development indicators of the World Bank (World Bank)
Oil prices (monthly frequency), All variables are deflated by the annual GDP deflator of Egypt.	the US. Energy Information Agency (EIA).

Table C: R-squared estimation results for both EX measures

Subsectors	R-squared (REER)	R-squared (REX)
Public Sector		
Agriculture	0.62	0.66
Industry & mining	0.96	0.97
Petroleum & products	0.94	0.89
Electricity	0.97	0.97
Construction	0.94	0.95
Transportation & Storage	0.98	0.97
Telecommunication	0.96	0.95
Suez Canal	0.98	0.93
Trade	0.96	0.95
Money Market	0.97	0.97
Hotels & Restaurants	0.85	0.80
Housing & Real Estate Prop.	0.95	0.93
Private Sector		
Agriculture	0.97	0.97
Industry & mining	0.96	0.96
Petroleum & products	0.90	0.97
Construction	0.97	0.97
Transportation & Storage	0.97	0.98
Telecommunication	0.92	0.92
Trade	0.97	0.98
Money Market	0.97	0.97
Hotels & Restaurants	0.93	0.92
Housing & Real Estate Prop.	0.95	0.95
Aggregates		
Services	0.97	0.95
Manufacturing	0.96	0.94
Industry	0.97	0.95
Agriculture	0.97	0.96

Source: Regression Estimation

Table D: Significance of the five Control Variable in both Estimations (REER & RER)

Subsector	GDPD		GOVDS		RINT		INFL		ROIL	
	REER	*RER*	*REER*	*RER*	*REER*	*RER*	*REER*	*RER*	*REER*	*RER*
Public Sector										
Agriculture	no	*	no	*	no	no	no	no	***	NA
mining & Industy	***	***	***	***	no	**	no	no	no	no
.Pr Petroleum	***	***	***	no	**	no	no	no	no	no
Electricity	***	***	***	**	**	*	***	*	**	no
Construction	***	***	*	no	no	no	no	no	***	***
Storage & .Transport	***	***	***	**	no	*	no	no	no	no
.Telecom	***	***	no	no	**	no	no	no	no	no
Suez Canal	***	***	***	no	*	**	**	no	no	no
Trade	***	***	***	***	no	no	no	no	no	no
Restaurants & Hotels	***	***	***	**	no	**	no	no	**	no
Real estate & Housing	***	***	*	**	no	no	no	no	**	no
Private Sector										
Agriculture	***	***	***	no	**	no	*	no	no	no
Mining & Industry	***	***	***	no	***	no	**	no	no	no
.Pr Petroleum	***	***	***	no	*	**	**	no	***	***
Construction	***	***	no	**	**	no	no	no	***	no
Storage & Transportation	***	***	***	no	**	no	**	no	no	***
Telecommunication	***	***	*	no	**	no	no	no	**	***
Trade	***	***	***	**	**	no	**	no	no	no
restaurants & Hotels	***	***	***	no	***	no	no	no	no	no
real estate & Housing	***	***	***	***	no	no	**	**	***	***
Aggregates										
Services	***	***	***	**	***	no	***	no	no	no
Manufacturing	***	***	***	**	***	no	***	no	no	no
Industry	***	***	***	**	***	no	***	no	no	no
Agriculture	***	***	***	**	***	no	***	no	*	no

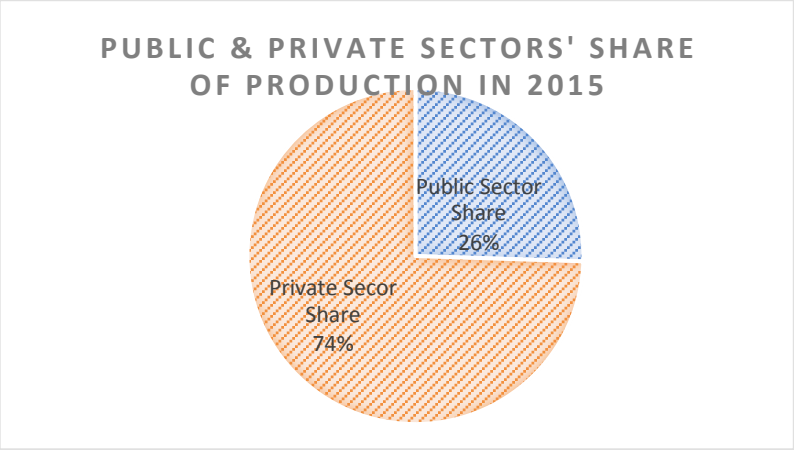
Source: Regression Estimations

Table E: Estimation Elasticities for the Aggregate Sectors' Value Added:

#	Aggregate Value Added	REER	REX
23	Agriculture	-1.22***	0.25***
24	Industry	-1.35***	0.27***
25	Manufacturing	-1.50***	0.27***
26	Services	-1.09***	0.23***

Source: Author's Estimations

Figure A: Public and Private Sectors' Share in Production



Data Source: Ministry of Planning (data used in estimation)