Exchange rate uncertainty and Egyptian exports of horticultural commodities into the EU

A. Abu Hatab[1,2] and A. Nsabimana[1,3]

[1]Swedish University of Agricultural Sciences, Uppsala, Sweden; [2]Arish University, Al-Arish, Egypt; [3]Department of Economics, University of Rwanda, Huye, Rwanda.

Abstract
        This paper investigates the impact of exchange rate volatility on Egyptian exports of fresh fruit and vegetables (FFVs) to their major importing markets in the EU. Using quarterly data covering the period 1994-2016, we examine the determinants of Egypt's exports of FFVs to the EU, and then derive the long-term effects of exchange rate volatility on the FFV exports. The empirical results show that exchange rate volatility has a long-run significant effect on Egypt's FFV exports to the EU. Overall, the findings highlight the importance of exchange rate volatility in understanding the behavior of Egyptian exports of FFVs to the EU. Thus, the design and implementation of exchange rate policies and export promotion programs in Egypt should take into consideration the stability and level of the real exchange rate.

Keywords: exchange rate volatility, fresh fruit and vegetables, FMOLS model

INTRODUCTION

Following the collapse of the Bretton Woods system in the 1970s, exchange rate movements in developing countries have become more volatile (Héricourt and Poncet, 2013). A central question in the literature examining exchange rates and international trade has been the effect of exchange rate uncertainty on the performance of a country's foreign trade. Theoretically, the relationship between exchange rate volatility (ERV) and international trade is explained by the argument that increased ERV reduces a country's exports, since it raises costs for risk-averse exporters and makes them highly unpredictable. This in turn creates uncertainty regarding export profits and therefore depresses the gains from export. However, the theory also suggests that the level of risk tolerance remains the main determinant of the influence of ERV on an exporter's performance. More risk-tolerant exporters would export less since higher levels of ERV decrease their expected marginal utility of export revenue, while less risk-averse exporters would increase their expected marginal utility of export revenue, since they will produce more to avoid decreases in their export revenues. Thus, from a theoretical perspective, there is inconclusive evidence with regard to the impact of ERV on exports (Arize et al., 2000).

Likewise, the empirical evidence on the effect of ERV on exports has been quite mixed. On the one hand, several empirical studies have found that ERV has export-reducing effects (Bahmani-Oskooee and Satawatananon, 2012). On the other, some authors found a positive relationship between ERV and exports (Erdal et al., 2012). A third strand in the literature finds no effect of ERV on trade (Aristotelous, 2001; Tenreyro, 2007). On top of the ambiguous conclusions of previous empirical studies, there are two apparent drawbacks in the literature on ERV and exports. First, despite that developing countries' real exchange rates are more volatile than those of developed countries on account of high exposure to shocks, both real and nominal (Hausmann et al., 2006), the empirical literature on ERV and developing countries' exports has surprisingly been limited (Demir, 2010). Second, compared to other sectors, the impact of ERV on the performance of developing countries' agricultural exports has received comparatively less attention in the literature, in spite of the significant role that agricultural exports play in economic growth and sustainable development in developing countries. In addition, ERV studies have generally relied on aggregate data, ignoring that the impact of ERV may differ across countries and sectors depending on their degrees of openness

to international trade (Cho et al., 2002).

Against this background, this paper aims to examine short and long-term impacts of ERV on Egypt's exports of fresh fruit and vegetables (FFVs) to the EU during the period 1994:Q1 to 2016:Q4. The selection of Egypt as a case study was justified for two main reasons: first, Egypt has always been a major supplier of FFV in the Mediterranean region to the EU market. It is estimated that FFV constitute around 66 percent of the country's total agricultural exports to the EU during the period 2000-2016 (WITS, 2017). As shown in Figure 1, Egyptian FFV exports to the EU have grown steadily from about USD 50 million in 1994 to USD 655.4 million in 2016. Since 2004, Egypt's FFV exports to the EU have been rapidly increasing at the rate of about 21 percent per annum. Such growth is accredited to the establishment of the Association Agreement between the EU and Egypt in 2004, which accelerated agricultural trade liberalization between the two trading partners and expanded the quota for many Egyptian FFV exports (Abu Hatab and Surry, 2015).
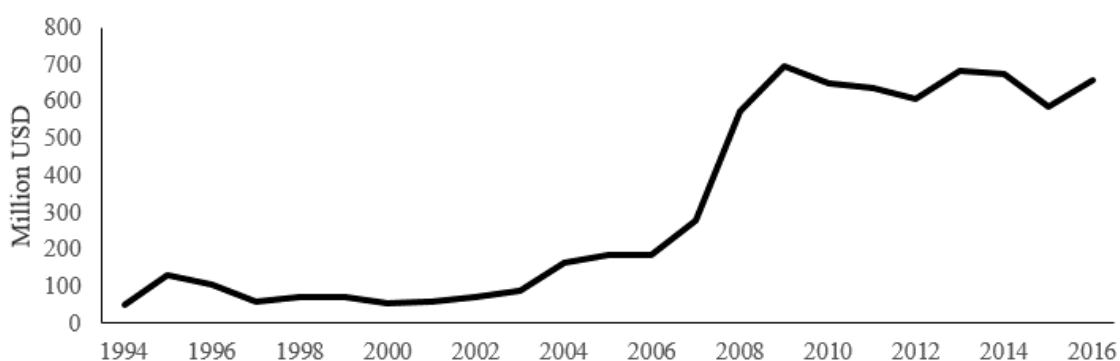

Figure 1. Evolution of Egyptian FFVs to the EU, 1994-2016. Source: World Integrated Trade Solutions (WITS, 2017).

Secondly, the Egyptian FFV sector has two important characteristics: it is dominated by smallholder farmers who grow at least 90 percent of the FFV crops in the country. The majority of FFV exports are carried out by small and medium-sized agrifood export firms, amplifying its contribution to poor household incomes and food security (Abu Hatab and Hess, 2013; El Nour, 2015). As noted by Acharya and Patterson (2005), a decline in EU import demand for FFV imports (due to ERV, for instance) would lead to an oversupply in exporting developing countries and thus lower farm prices. Therefore, while a considerable proportion of Egypt's FFV are exported to the EU, given the perishable nature of these commodities, ERV could have a significant impact on the competitiveness of Egypt's FFV exports to the EU market, and thus, adverse effects on smallholder farmers and exporters in the country.

A look at the existing literature on the determinants of Egypt's agricultural exports to the EU shows that there has been a limited focus on understanding the impact of ERV on FFV exports. Few studies have however highlighted that ERV is likely to have a determinant effect on Egypt's agrifood exports to the EU and that it is potentially one of the sources of instability in the country's agricultural exports to the EU (Achy and Sekkat, 2003; Abu Hatab et al., 2010). However, the empirical evidence in these studies is rather limited partially because assessing the impact of ERV on the performance of Egyptian agrifood or FFV exports was not a main objective. Thus, we attempt to fill this gap in the present paper.

The empirical evidence analyzed in this paper contributes to the literature in two important ways. First, we provide fresh empirical evidence on the impact of ERV on a developing country's agricultural exports by assessing how these ambivalent findings in the literature apply to the case of Egypt. Furthermore, in contrast to the bulk of previous studies which investigated aggregate effects of ERV on export performance, we assess the sectoral and sub-sectoral effects (Serenis and Tsounis, 2012). Although there are some existing studies on

12

the impact of ERV on Egypt's agricultural and food exports, most of these suffer from aggregation bias due to the heavy reliance on aggregated data. To account for this deficiency, this paper focuses on FFV which are progressively making up an important proportion of developing countries agricultural exports to the EU. This paper contributes to the efforts aimed at promoting FFV exports which fulfil important functions in economic growth, poverty reduction and development in developing countries.

A second contribution of this paper is our focus on the European Union (EU) that represents one of the major target export markets for many developing countries. The importance of the EU market to developing countries FFV exporters is justified by the fact that: i) it the largest agrifood importer in the world with a total agrifood import value of around USD 126.5 billion; and ii) around 70 percent of these imports originate in developing countries (EU Commission, 2017). In recognition of the enticing export opportunities that the EU presents to developing countries' FFV exports, our findings could help policymakers and agrifood exporters to develop a better understanding of the influence of ERV on their FFV exports to the EU.

METHODOLOGY

Model specification

In this study, the extent to which ERV influences Egypt's FFV exports to the EU is modeled via a standard export demand function where the FFV export volume at a point in time depends upon a number of explanatory variables as follows:

$$\ln(EXFFV_{ijt}) = \alpha_0 + \beta_1 \ln(GDPC_{it}) + \beta_2 \ln(GDPC_{jt}) + \beta_3 \ln(RXrate_{it}) + \beta_4 \ln(ERV_{it}) + \beta_5 \ln(Openness_{it}) + \beta_6 \ln(EXP_{it}) + \lambda_j + \mu_t + \varepsilon_{it} \qquad (1)$$

where *EXFFV*$_{ijt}$ is the export value of Egypt's (i) fresh fruit and vegetables to an EU importing market (j) at time period (t); *GDPC*$_{it}$ is Egypt's real per capita income; *GDPC*$_{it}$ denotes the importing county's real per capita income; *RXrate*$_{it}$; represents the real exchange rate levels of EGP against the importers' national currencies; and *ERV*$_{it}$ denotes the exchange rate volatility. Furthermore, the variable *Openness*$_{it}$ denoting openness to trade index (measured by the ratio of Egypt's trade to GDP) was included to capture the impact of trade policies and institutional reforms on Egypt's FFV export performance. The term ε_{it} represents the error term. Moreover, it is noteworthy that we accounted in all our estimations for country (λ_i) and time (μ_t) fixed effects.

A deeper look at the ERV literature indicates that there is no consensus on the appropriate method of measuring ERV. Importantly, the literature suggests that the selection of an ERV measure matters in the assessment of the impact of ERV on export performance, since the resulting econometric estimates can be sensitive to the selected operational measure of ERV (Serenis and Tsounis, 2012). This may partially explain the conflicting evidence about the impact of ERV on export performance in previous studies. In this econometric exercise, we adopted the method suggested by Cho et al. (2002) to measure the ERV. According to their argument, the key feature of ERV which leads to uncertainty among firms is determined by firms/exporters' previous experience as they can still remember the highs and lows of the past periods and adjust for the most recent period, relative to some ideas of the equilibrium exchange rate. Thus, the following formula was used to calculate ERV:

$$Vol_{i\,j,t} = \frac{\max\ Y_{ij,t-10}^t - \min\ Y_{ij,t-10}^t}{\min\ Y_{ij,t-10}^t} + \left[1 + \frac{\left| Y_{ij,t} - Y_{ij,t}^p \right|}{Y_{ij,t}^p} \right] \qquad (2)$$

with max (min) $Y_{ij,t-10}^t$ being the maximum (minimum) value of absolute value of the real exchange rate over ten years. In Equation 2, the first expression captures accumulated experience while firms may still remember the (negative) experiences of the past even if the

variations became modest in recent periods. The second part of Equation 2 accounts for the most recent information, as measured by deviations of exchange rate $Y_{ij,t}$ from the equilibrium exchange rate $Y_{ij,t}^p$. With regard to the expected signs on the coefficients of the variables in Equation 1, Egypt's real per capita income growth ($GDPC_{it}$) is an indicator of the future potential and sustainability of production level and we therefore expect a positive sign on the coefficient β_1. Likewise, real per capita income of the importing countries ($GDPC_{jt}$) represents market size i.e. the economic conditions and potential export demand in the importing country. The per capita income elasticity (β_2) is projected to have a positive sign. As per the "Law of One Price", a devaluation of Egypt's Pound (EGP) would make FFVs more competitive in the EU market and thus the expected sign on the coefficient β_3 is negative. In relation to our variable of interest ERV_{it}, the sign for β_4 is ambiguous since it could be negative or positive, as discussed in the introduction of this paper. Finally, an increase in the level of Egypt's openness to trade ($Openness_{it}$) is likely to be associated with an increase in the value of its FFV exports to the EU.

Econometric estimation technique

Prior to the econometric estimations, panel unit root tests, using the Levin, Lin and Chu (LLC) test (2002) and Hadri Lagrange Multiplier (HLM) test (2000), were performed for all data series to determine the stationarity of the data series under study. The results of these tests indicated that the variables included in our model are stationary, implying the redundancy of further time series analyses.

For the econometric estimation of Equation 1), we used the Fully Modified Ordinary Least Squares (FMOLS) method, developed by Phillips and Hansen (1990). The FMOLS method provides consistent and efficient estimates even in the absence of co-integration, and it is robust to both stationary and non-stationary series in a single co-integration (Phillips, 1995). Furthermore, given that each sub-sample in our analysis consist of panel data, which has a greater time-period than the number of groups (that is, n<T), the use of FMOLS within a panel setting helps to circumvent problems of serial correlation and non-stationarity.

Following the estimation of the FMOLS model, we derived the long-run effects of ERV on the performance of Egypt's FFV exports to the EU. To derive the long run effects of the ERV on Egyptian foreign trade with EU, we estimate the fixed effect linear model with AR. The process has simultaneously allowed to account for country fixed effects, autocorrelation and heterogeneity all together.

Data sources

Quarterly panel data covering the period 1994:Q1 to 2016:Q4 were used to estimate the model. An advantage of using quarterly data are to account for unobservable cross-sectional specific effects that may influence the flow of Egyptian FFV either through random or fixed effects. Data on the values (in Euro) of Egypt's FFV exports to their major destinations in the EU were obtained from the EUROSTAT database. The selection of the EU importing markets under study was based on their respective import share in total Egyptian FFV exports to the EU during the study period 1994-2016. These importers consist of the following countries: the UK (26.2%), Italy (19.4%), the Netherlands (15.3%), Germany (10.4%), Greece (7%), Belgium (5.4%) and France (3.7%). Collectively, these seven importers absorbed around 88% of Egyptian FFV exports between 1994 and 2016 (WITS, 2017).

Quarterly data on the exchange rates of the EGP against former currencies of Italy, Netherlands, Germany, France and Belgium during the period 1994:Q1 to 1999:Q1 were collected from the EUROSTAT database. Using the same data source, quarterly data on the exchange rates of EGP against the former Greek Drachma for the period 2001:Q1 to 2016:Q4 were obtained. As from 1999:Q1 (and 2001:Q1 for the case of Greece), exchange rates of EGP against the Euro were compiled directly from the quarterly exchange rate database of EUROSTAT.

Real per capita GDP data covering the period 1994:Q1 to 2016:Q4 for Egypt were

collected from the Quarterly Economic Reviews of the Central Bank of Egypt (CBE). The corresponding data for each EU importer were collected from the EUROSTAT database. Per capita GDP data and values of FFV imports by each EU importing market were expressed in Euros. Egypt's trade openness index was calculated by dividing the quarterly values of total trade by the quarterly values of GDP based on data from CBE and the World Development Indicators (WDI).

RESULTS AND DISCUSSION

Table 1 summarizes the econometric estimations of the determinants of Egypt's FFVs exports to the EU using the FMOLS method.

Table 1. FMOLS for the determinants of Egyptian exports of FFVs to the EU.

	1994-02	2003-11	2012-16	1994-16
Real GDP per capita importers	1.526***	1.521***	1.963***	1.598***
	(0.381)	(0.380)	(0.382)	(0.354)
Real GDP per capita Egypt	0.538	0.540	-0.002	0.469
	(0.372)	(0.371)	(0.396)	(0.348)
Real exchange rate	-2.288***	-2.291***	-2.298***	-2.506***
	(0.503)	(0.501)	(0.312)	(0.303)
Trade openness	0.002	0.002	0.008*	0.003
	(0.004)	(0.004)	(0.004)	(0.004)
Exchange rate volatility	-0.397***	-0.397***	-0.429***	-0.403***
	(0.038)	(0.038)	(0.038)	(0.037)
Constant	-3.355	-3.416	-2.864	-3.397
	(3.661)	(3.651)	(3.643)	(3.668)
Time FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Observations	643	643	643	643
R-squared	0.483	0.528	0.525	0.533
Adjusted R-squared	0.384	0.437	0.434	0.444
Long Run SE	0.482	0.480	0.478	0.483
Bandwidth(neweywest)	92.05	92.51	92.36	92.27

Standard errors in parentheses, *Significant at the 10% level; **Significant at the 5% level; ***Stands for significant at 1% level.

Most of the estimated elasticities from the three sub-period models and the full-period model had the expected signs and are statistically significant. The main exceptions are the estimates of Egypt's real GDP per capita and trade openness that turned out to be statistically insignificant.

In the four estimated models, growth in real GDP per capita in the importing countries had a significant positive effect on Egypt's FFV exports at the 1% level. The elasticity of importers' real GDP per capita increased in absolute terms from 1.526 in the first sub-period (1994-2002) to 1.963 in the third sub-period (2012-2016), registering around 29 percent growth rate. Such an increase in the size of the EU real per capita income elasticity between the first and the third sub-periods may reflect the impact of the EU expansion and economic growth since the 1990s. Thus, it could be inferred that EU's income growth over the past one and one half decades has stimulated demand for Egyptian FFVs. Furthermore, as expected, a depreciation in the value of the EGP would boost the competitiveness of Egyptian FFV exports and increase the EU import demand for them. This outcome is consistent with the findings of Zaki et al. (2017), showing that exchange rate depreciation is likely to improve the competitiveness and increase the volume of Egyptian FFV exports.

Trade policy reforms and institutional changes, proxied by openness-to-trade, seem to have had a positive but statistically insignificant influence on the value of Egypt's FFV exports to the EU. This finding substantiates previous findings in the literature (Abu Hatab et al.,

2010), suggesting that Egypt's trade openness does not show significant effects on the country' agricultural exports to the world. Concerning our variable of interest (ERV), the estimates in Table 1 show that increased exchange rate volatility is negatively correlated with the value of Egyptian exports of FFV to the EU.

In relation to the long-run effect of ERV on the performance of Egyptian exports of FFVs to the EU, Table 2 indicates that exchange rate volatility has a long-run negative impact on the country's FFV exports to the EU.

Table 2. Long-run effects of ERV on Egyptian exports of FFVs to the EU.

Variables	Model 1 94-02	Model 2 03-16	Model 3 12-16	Model 4 All
Real GDP per capita importers	1.681*	2.085**	2.385***	0.137*
	(0.901)	(0.901)	(0.852)	(0.0755)
Real GDP per capita Egypt	0.0914	0.231	0.412	1.863***
	(1.053)	(1.040)	(1.016)	(0.704)
Real exchange rate	-0.469**	-0.665***	-0.618***	-0.336***
	(0.232)	(0.182)	(0.214)	(0.128)
Trade openness	0.00723	0.0101	0.0144	0.0170**
	(0.00852)	(0.00920)	(0.00892)	(0.00796)
Exchange rate volatility	-0.389***	-0.417***	-0.435***	-0.425***
	(0.0888)	(0.0879)	(0.0855)	(0.0858)
Constant	-1.277	-2.610	-3.751	-16.81**
	(7.878)	(7.845)	(7.816)	(6.902)
R-squared	0.301	0.286	0.275	0.666

Standard errors in parentheses. *Significant at the 10% level; **Significant at the 5% level; ***Significant at 1% level.

The coefficients of the ERV were statistically significant at the 1% level across the four models. This finding implies that Egyptian exporters of FFVs are generally risk-averse and that increased volatility in exchange rates of the EGP will increase the uncertainty about the future behavior of the exchange rate. That is, Egyptian FFV exporters respond to future exchange rate uncertainty by selling in domestic markets rather than foreign markets, and thereby exports are adversely affected. In this context, Abu Hatab and Hess (2013) point out that FFV export firms in Egypt with a larger domestic market base can perform "market shifts" by reallocating commodities between the domestic and foreign market to avoid trade restrictions and exchange rate movements. Notably, most of the estimated coefficients for other variables in Table 2 are analogous to the FMOLS estimates in terms of both the signs and the significance levels. Overall, the econometric estimates for ERV across the estimated models – with no exception - indicate that increased exchange rate volatility has an export-reducing effect on Egyptian FFV exports to the EU.

SUMMARY AND CONCLUSIONS

Theoretically, the relationship between exchange rate volatility and foreign trade is inconclusive and the empirical evidence in existing studies is analytically indeterminate. To a large extent, these drawbacks in the literature explain the dramatic increase in the studies examining this relationship on specific country pairs or products in recent years. Despite the existence of past studies that examined the relationship between ERV on agricultural exports, most of these suffer from aggregation bias due to the heavy reliance on aggregated data. To account for this deficiency, we took up the case of Egypt's exports of fresh fruit and vegetables to the EU. In recent years, Egypt has experienced a great deal of political and economic uncertainty that has impacted on its exchange rate regime and the value of the national currency. Furthermore, the FFV sub-sector has important socioeconomic roles through its significant contributions to the country's agricultural exports to the EU, the incomes and livelihoods of the poor in rural communities, and the inclusion of smallholder farmers in high

value chains.

In this context, the paper examined the impact of ERV on Egyptian exports of FFV to the EU during the period 1994-2016. Specifically, quarterly data on the country's exports of FFVs to their major importing markets in the EU were used to estimate four FMOLS models to quantify the export determinants of Egyptian FFVs and then derive the long-term effects of exchange rate volatility on fresh fruit and vegetable exports. Estimates from all the estimated models showed that ERV has a statistically significant negative effect on Egyptian FFV exports to the EU in both the short run and long run. The estimated elasticities for other explanatory variables (that is, real GDP per capita, exchange rate and openness) had the expected signs. With the exception of the variable "openness to trade", these explanatory variables were statistically significant.

Overall, our findings suggest that ERV is an important variable for modeling the export behavior of Egyptian FFV exports to the EU. Therefore, the design and implementation of exchange rate policies and export promotion programs in Egypt should take into consideration the stability and level of the real exchange rate. In the context of ongoing economic transition and reforms in Egypt, which put promoting and stabilizing agricultural exports in their traditional markets (such as the EU) high on the economic policy agenda, an appropriate management of the country's exchange rate system would be desirable to promote higher volumes of FFV exports to the EU.

Literature cited

Abu Hatab, A., and Hess, S. (2013). Opportunities and constraints for small agricultural exporters in Egypt. Int. Food Agribus. Manag. Rev. 16.

Abu Hatab, A., and Surry, Y. (2016). Determinants of import demand for Egyptian potatoes in Germany and the United Kingdom. Acta Hortic. *1132*, 39–48 https://doi.org/10.17660/ActaHortic.2016.1132.6.

Abu Hatab, A., Romstad, E., and Huo, X. (2010). Determinants of Egyptian agricultural exports: a gravity model approach. Modern Economy *1* (*03*), 134–143 https://doi.org/10.4236/me.2010.13015.

Acharya, R.N., and Patterson, P.M. (2005). Impact of depreciating exchange rate on US produce trade. American Agricultural Economics Association annual meeting (Providence, RI).

Achy, L., and Sekkat, K. (2003). The European single currency and MENA's exports to Europe. Rev. Dev. Econ. *7* (*4*), 563–582 https://doi.org/10.1111/1467-9361.00209.

Aristotelous, K. (2001). Exchange-rate volatility, exchange-rate regime, and trade volume: evidence from the UK–US export function (1889–1999). Econ. Lett. *72* (*1*), 87–94 https://doi.org/10.1016/S0165-1765(01)00414-1.

Arize, A.C., Osang, T., and Slottje, D.J. (2000). Exchange-rate volatility and foreign trade: evidence from thirteen LDC's. J. Bus. Econ. Stat. *18* (*1*), 10–17.

Bahmani-Oskooee, M., and Satawatananon, K. (2012). The impact of exchange rate volatility on commodity trade between the US and Thailand. Int. Rev. Appl. Econ. *26* (*4*), 515–532 https://doi.org/10.1080/02692171.2011.619968.

Cho, G., Sheldon, I.M., and McCorriston, S. (2002). Exchange rate uncertainty and agricultural trade. Am. J. Agric. Econ. *84* (*4*), 931–942 https://doi.org/10.1111/1467-8276.00044.

EU Commission. (2017). Trade and development- some facts and figures. http://europa.eu/rapid/press-release_MEMO-04-218_en.htm (accessed June 12, 2018).

Demir, F. (2010). Exchange rate volatility and employment growth in developing countries: evidence from Turkey. World Dev. *38* (*8*), 1127–1140 https://doi.org/10.1016/j.worlddev.2009.12.019.

El Nour, S. (2015). Small farmers and the revolution in Egypt: the forgotten actors. Contemporary Arab Affairs *8* (*2*), 198–211 https://doi.org/10.1080/17550912.2015.1016764.

Erdal, G., Erdal, H., and Esengün, K. (2012). The effects of exchange rate volatility on trade: evidence from Turkish agricultural trade. Appl. Econ. Lett. *19* (*3*), 297–303 https://doi.org/10.1080/13504851.2011.576996.

Hadri, K. (2000). Testing for stationarity in heterogeneous panel data. Econom. J. *3* (*2*), 148–161 https://doi.org/10.1111/1368-423X.00043.

Hausmann, R., Panizza, U., and Rigobon, R. (2006). The long-run volatility puzzle of the real exchange rate. J. Int. Money Finance *25* (*1*), 93–124 https://doi.org/10.1016/j.jimonfin.2005.10.006.

Héricourt, J., and Poncet, S. (2013). Exchange rate volatility, financial constraints, and trade: empirical evidence from Chinese firms. World Bank Econ. Rev. *29* (*3*), 550–578 https://doi.org/10.1093/wber/lht035.

Levin, A., Lin, C.F., and Chu, C.S.J. (2002). Unit root tests in panel data: asymptotic and finite-sample properties. J. Econom. *108* (*1*), 1–24 https://doi.org/10.1016/S0304-4076(01)00098-7.

Phillips, P.C. (1995). Fully modified least squares and vector autoregression. Econometrica *63* (*5*), 1023–1023 https://doi.org/10.2307/2171721.

Phillips, P.C., and Hansen, B.E. (1990). Statistical inference in instrumental variables regression with I (1) processes. Rev. Econ. Stud. *57* (*1*), 99–125 https://doi.org/10.2307/2297545.

Serenis, D., and Tsounis, N. (2012). A new approach for measuring volatility of the exchange rate. Procedia Econ. Finance *1*, 374–382 https://doi.org/10.1016/S2212-5671(12)00043-3.

Tenreyro, S. (2007). On the trade impact of nominal exchange rate volatility. J. Dev. Econ. *82* (*2*), 485–508 https://doi.org/10.1016/j.jdeveco.2006.03.007.

World Integrated Trade Solution (WITS) Database. (2017). http://wits.worldbank.org/

Zaki, C., Ehab, M., and Abdallah, A. (2017). How Do Trade Margins Respond to the Exchange Rate? The Case of Egypt (No. 189). Working Paper No. 189 (Cairo, Egypt: The Egyptian Center for Economic Studies).