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Are Non-Primary Exports the Source for Further Economic Growth in the UAE?

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Abstract: This paper investigates whether non-primary exports directly or indirectly cause economic growth in the United Arab Emirates (UAE). This study performs the Johansen test to examine the presence of co-integration between the variables in an augmented production function. The Granger causality test is performed to investigate the short-run causality between non-primary exports and economic growth, while the long-run causality is investigated by employing the Toda and Yamamoto procedure. The empirical analysis indicates that the variables are co-integrated, and that short-run causality runs from non-primary exports to economic growth; results exhibit no evidence of direct causality from non-primary exports to economic growth in the long-run.

Keywords: economic growth, non-primary exports, Granger causality, UAE

1 Introduction

Export expansion promotes economic growth, through increased investment, technological improvement and expansion of imports. In particular, it improves productivity through economies of scale and increased investment in the export sector, fostering technological innovation and the rate of economic growth. Moreover, export growth boosts foreign exchange earnings, expanding the country's capacity to finance imports, which are key to capital formation and economic growth (Gylfason 1999; Helpman and Krugman 1985; Herzer 2007; Ramos 2001; Riezman, Whiteman,

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and Summers 1996; Rodrik 1997). The export-led growth (ELG)[1] is a policy widely used by governments to accelerate growth, and, in certain cases, has shown great success. However, not all export types contribute equally to economic growth and, for some countries, export expansion does not offer the desired positive outcomes.

In particular, resource-based exports have been identified to be harmful to growth, with resource-abundant countries more often than not exhibiting lower levels of economic growth compared to their counterpart non-resource abundant states. This harmful effect of primary exports could be partly attributed to excessive price fluctuations and inelastic demand facing those markets, creating uncertainty in the economy. As noted by Sachs and Warner (1995) “countries with a high value of resource-based exports to GDP tend to have a lower growth rate” (Sachs and Warner 1995, p. 2). A bright example, contradicting the trend shaping most resource abundant countries described above, UAE, rich in resources and heavy reliant on primary exports, has achieved and sustained high levels of growth over the last four decades.

Between 1981 and 2017, the UAE has achieved significant export diversification coupled with high rates of economic growth. Non-primary exports’ share of total exports of goods has increased from 15.1% in 1981 to 72.4% in 2017, indicating a significant diversification process. Export diversification is further reflected in the GDP share of non-primary exports, which boomed from 6.9% in 1981 to 59% in 2017. During the same period, the UAE has grown faster than the world economy, with an average rate of 3.4%, compared to 2.9% world average, while its growth rate exceeds that of high-income countries by 1% (World Development Indicators, World Bank). Given the facts laid out above regarding the success story of the UAE since the early 1980s, in conjunction with the counterexamples of its’ resource abundant counterparts, we aim to investigate whether further diversification of exports in the UAE could foster economic growth.

Evidence to date has shown primary and the sub-categories of fuel and mining exports, to not contribute to growth neither in the short nor in the long-run for the UAE (Chamberlain and Kalaitzi 2020; Kalaitzi and Cleeve 2018). Based on the facts that UAE’s primary exports do not contribute to economic growth and that oil prices bear negative impact on income (Katircioglu, Katircioglu, and Altun 2018), non-primary[2] exports should be emphasized to assess their influence on the economic growth of the UAE.

1 See Giles and Williams (2000a, 2000b) for the ELG hypothesis.

2 Non-primary exports include chemical and related products, manufactured goods (excluding non-ferrous metals and arms and ammunition), machinery and transport equipment, miscellaneous manufactured articles and commodities and transactions (including non-monetary gold; excluding gold ores and concentrates).

This study differentiates from the precedent studies, such as Kalaitzi and Cleeve (2018), by incorporating non-monetary gold into non-primary exports and using a longer period to investigate whether non-primary exports cause economic growth in the UAE. As UAE moves away from oil and plans to become a global gold hub, the export-growth nexus in UAE should be explored further, helping the process of designing policies for sustaining economic growth.

This study uses a production function augmented with non-primary exports and total imports, and annual data over the period 1981–2017. To inspect the integration order of the variables, three unit root tests are performed, namely the Phillips–Perron test, the augmented Dickey–Fuller test and a unit root test with a breakpoint. To establish the presence of co-integration between the variables in the production function, the Johansen co-integration test is applied, while the short-run causality is investigated through the Granger causality test in a restricted vector autoregressive framework. Last, but not least, the long-run causality between the variables is assessed using the Toda and Yamamoto Granger causality test. Robustness checks are undertaken (a) with the inclusion of fuel and mining exports in the model taken from the WTO; (b) the inclusion of an exogenous variable to account for the financial year crisis 2009; (c) with the application of dynamic ordinary least squares (DOLS) model to confirm the Johansen co-integration results.

The empirical findings support the validity of the ELG in the short-run; however, we do not reach similar evidence for the long-run causality.

The paper proceeds as follows: The literature on the exports-growth nexus is presented in Section 2, while the research methodology and empirical results are described in Sections 3 and 4. The summary, conclusion and policy implications are presented in Section 5.

2 Literature Review

The received literature provides evidence of the positive impact of export expansion on economic growth, through increased investment, technological improvement, expansion of capital goods imports and improved productivity. In particular, export growth increases investment in the export sector, fostering technological advancement and increasing national production. In parallel, increased foreign exchange earnings through export expansion improve a country's capacity to import capital goods and essential material for domestic production, accelerating further economic growth (Gylfason 1999; Herzer 2007; Ramos 2001; Riezman, Whiteman, and Summers 1996; Rodrik 1997).

Although the aforementioned research has noted the positive effect of exports on economic growth, certain conclusive remarks have reinforced the view that aggregate measures of exports veil the different causal impacts of export categories. It is not uncommon for total exports to contribute positively to the economic growth of a country, while disaggregated exports to have an inverse impact on economic growth, or vice-versa. For example, evidence that exports lower economic growth could be due to the large primary exports' share of total exports of goods (Gylfason, Herbertsson, and Zoega 1999; Sachs and Warner 1995). Exports of primary goods do not offer knowledge spillovers, while primary export earnings are subject to wide fluctuations, turning the effect of aggregate exports negative.

In particular, Ghatak, Milner, and Utkulu (1997) find that the ELG is valid in Malaysia when aggregate exports are used in the estimations, however, in a disaggregation exercise; they show that non-fuel primary exports negatively affect economic growth. Ghatak and Price (1997) find no evidence of the ELG for aggregate export growth in India, but at the disaggregated level, non-traditional manufactured exports cause output growth. In addition, Hosseini and Tang (2014) show that oil and gas exports contribute negatively to economic growth in Iran, while non-oil exports positively affect economic growth. In contrast, in the case of Bahrain, oil exports are found to affect economic growth more than non-oil exports do (Khayati 2019). This is in contrast with other studies (Chamberlain and Kalaitzi 2020; Herzer, Nowak-Lehmann, and Siliverstovs 2006; Kalaitzi and Cleeve 2018), where primary exports negatively affect economic growth or, with a decreased effect compared to that of non-primary exports. Therefore, policy decisions based on aggregate measures may slow down economic growth, by overlooking the importance of some categories of exports on the growth process.

In addition to the investigation of the exports' impact on economic growth, the received literature has also examined the causality between exports and economic growth. For the most part, this strand of literature concludes to causality running from exports to economic growth (Ahmad, Draz, and Yang 2018; Ali and Li 2018; Gbaiye et al. 2013; Ramos 2001), or that the growth-led exports hypothesis exists (GLE)[3] (Abbas 2012; Alam et al. 2019; Love and Chandra 2005). Moreover, certain research concludes to a bidirectional causality (ELG-LGE) between exports and economic growth, creating circular cumulative causation (Elbeydi, Hamuda, and Vladimir 2010; Guntukula 2018; Hatemi-J 2002). However, evidence also exists of

3 Based on the GLE hypothesis, economic growth increases demand, that cannot be met by domestic production, increasing the economy's imports. Specifically, increased imports of capital and intermediate goods improve the existing technology, leading to increasing productivity and expansion of exports (See studies by Kindleberger 1962; Kaldor 1970; Boggio and Barbieri 2017).

non-causality between exports and economic growth (Kalaitzi 2018; Kwan and Cotsomitis 1991; Tang 2006).

A few studies have examined the impact of aggregate exports on economic growth in the Gulf Cooperation Countries (GCC) region, but they find contradictory results. For instance, Al-Yousif (1997) examines the ELG in Saudi Arabia, Kuwait, UAE and Oman, using an augmented production function, cointegration and ordinary least squares regression analysis. Al Yousif finds that there is no long-run relationship between exports and economic growth in these countries, while the short-run impact of exports on economic growth is statistically significant and positive. El-Sakka and Al-Mutairi (2000), by applying Granger causality tests in a bivariate framework, find no causality between exports and economic growth in Kuwait and Qatar, bi-directional causality in Oman and Bahrain, while a unidirectional causality runs from growth to exports in the UAE and from exports to growth in Saudi Arabia.

Kalaitzi and Chamberlain (2021) examine the causality between total exports of goods and economic growth in Bahrain, Kuwait, Oman, Saudi Arabia and the United Arab Emirates. Using an augmented production function and time series analysis, they find that in the short-run, a bi-directional causality exists between exports and growth in Kuwait, a unidirectional causality runs from exports to growth in the UAE, while the converse is valid for Bahrain. In the long-run, exports cause economic growth in Bahrain, while growth causes exports in Saudi Arabia and Kuwait.

Within the UAE context, Kalaitzi and Chamberlain (2020), examines the causality between merchandise exports and economic growth, by including physical capital, population and total imports, and using multivariate causality techniques. The results of this study are in line with Al-Yousif (1997) and Kalaitzi and Chamberlain (2021) regarding the existence of the ELG in the short-run and in contrast with El-Sakka and Al-Mutairi (2000) who support the GLE for UAE. Kalaitzi and Chamberlain (2020), using the Toda and Yamamoto Granger causality test, find no evidence of the ELG hypothesis for the long run which is in line with earlier research.

As far as the relationship between disaggregated exports and economic growth is concerned, Kalaitzi and Cleeve (2018) provide evidence that no causality exists between primary exports and economic growth, while the ELG-GLE exists between manufactured exports and growth in the short-run. Moreover, they show that none of these export categories cause long-run economic growth. The study by Chamberlain and Kalaitzi (2020) follows the same methodology and extends the study by Kalaitzi and Cleeve (2018), focusing on the main sub-category of primary exports, fuel and mining exports. The analysis confirms that the variables in the model are co-integrated, however, no causality runs from fuel and mining exports to economic growth in the UAE, neither in the short-run, or the long-run.

3 Research Methodology

As noted in the literature review, export expansion increases productivity through economies of scale, increased investment and technological innovation. Productivity is also enhanced by imports, which are key to capital formation and economic growth (Ramos 2001; Herzer 2007; Riezman, Whiteman, and Summers 1996; Rodrik 1997; Gylfason 1999). In this context, the direct and indirect causality between non-primary exports and economic growth is investigated using an augmented neoclassical production function. In particular, the empirical model is founded on the traditional production function:

$$Y_t = A_t K_t^{\alpha} L_t^{\beta} \tag{1}$$

here, Y_t represents the aggregate production in period t, K_t and L_t denote the traditional inputs of production, physical capital and labor respectively, while α and β measure their share on aggregate production. A_t, the total factor productivity, is assumed to be a function of non-primary exports, NPX_t, total imports, IMP_t, and other exogenous factors C_t, following precedent studies[4] on export-economic growth nexus (Herzer 2007; Kalaitzi and Cleeve 2018; Kalaitzi and Chamberlain 2021; Riezman, Whiteman, and Summers 1996).

$$A_t = f\left(NPX_t, IMP_t, C_t\right) = NPX_t^{\gamma}\, IMP_t^{\delta}\, C_t \tag{2}$$

The combination of Eqs. (1) and (2) gives the following equation:

$$Y_t = C_t K_t^{\alpha} L_t^{\beta} NPX_t^{\gamma} IMP_t^{\delta} \tag{3}$$

α and β are the production elasticities with respect to the inputs K_t and L_t, respectively, while γ and δ are the total factor productivity coefficients. Finally, Eq. (4) is obtained by taking the logarithms of both sides of Eq. (3)[5]:

4 According to Riezman, Whiteman, and Summers (1996), imports are essential for the production of export sector and their omission from the estimations can lead to biased results. In addition, as Coe and Helpman (1995) and Keller (2000) note, imports foster technology transfer and knowledge diffusion in the economy.

5 Robustness checks are undertaken with (a) the inclusion of primary exports in the model and (b) the inclusion of an exogenous variable to account for the financial year crisis 2009.

$$LY_t = c + \alpha LK_t + \beta LL_t + \gamma LNPX_t + \delta LIMP_t + \varepsilon_t \tag{4}$$

c is the intercept, α, β, γ and δ are the regression coefficients and ε_t is the regression residual.

The data for the UAE, from 1981 to 2017, is obtained from the World Trade Organization (WTO), the World Bank (WB) and the International Monetary Fund (IMF). Specifically, non-primary exports[6] (NPX_t) are taken from the WTO, while the gross domestic product (Y_t) and the working age population (L_t) are from the WB-World Development Indicators (WDI). Gross fixed capital formation (K_t) and imports of goods and services (IMP_t) are taken from the WB-WDI and the IMF International Financial Statistics. Y_t, K_t, NPX_t and IMP_t are expressed in real terms and all variables in logarithmic form. Table 1 presents the descriptive statistics of the variables.

Before examining the causality between non-primary exports and economic growth, the integration order of the variables is investigated by applying the Phillips–Perron (PP) test, the augmented Dickey–Fuller (ADF) test and the modified ADF test with a breakpoint (ADFBP).[7] In particular, the order of integration is inspected including intercept and trend (a), intercept only (b), and no intercept or trend (c) and the appropriate model is selected following Dolado, Jenkinson and Sosvilla-Rivero (1990):

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 t + \sum_{i=1}^{p} \beta i \Delta Y_{t-i} + \varepsilon_t \tag{a}$$

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \sum_{i=1}^{p} \beta i \Delta Y_{t-i} + \varepsilon_t \tag{b}$$

Table 1: Descriptive statistics of the model variables.

	LY_t	LK_t	LL_t	$LNPX_t$	$LIMP_t$
Mean	25.96	24.45	14.73	24.55	25.14
Median	25.91	24.38	14.58	24.55	25.13
Maximum	26.68	25.27	15.90	26.25	26.40
Minimum	25.27	23.74	13.55	22.61	23.91
Std. Dev.	0.46	0.45	0.82	1.10	0.82
Jarque-Bera	3.01	2.13	3.18	2.13	2.72
(Probability)	0.22	0.34	0.20	0.34	0.26
Observations	37	37	37	37	37

Source: Authors' calculation.

6 Non-primary exports include SITC Rev.3 codes: 5, 6, 7, 8 (excl. 68, 891) and 9.

7 Developed by Perron (1989) and Vogelsang and Perron (1998).

$$\Delta Y_t = \gamma Y_{t-1} + \sum_{i=1}^{p} \beta i \Delta Y_{t-i} + \varepsilon_t \qquad \text{(c)}$$

where α_0 and α_2 represents the deterministic elements and ε_t are the random errors $\{\varepsilon_t \sim \text{ii}(0, \sigma^2)$ for $t = 1, 2, \ldots.\}$.

The PP unit root test involves the following equations:

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 (t - T/2) + \varepsilon_t \qquad \text{(a)}$$

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \varepsilon_t \qquad \text{(b)}$$

where α_0, α_1 and α_2 represent the deterministic elements, T is the number of observations and ε_t are the random errors $\{E(\varepsilon_t) = 0\}$.

The ADFBP is based on the following general equation:

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 t + \theta DU_t (T_b) + \omega D_t (T_b) + \sum_{i=1}^{p} \beta i \Delta Y_{t-i} + \varepsilon_t \qquad \text{(a)}$$

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \theta DU_t (T_b) + \omega D_t (T_b) + \sum_{i=1}^{p} \beta i \Delta Y_{t-i} + \varepsilon_t \qquad \text{(b)}$$

where α_0, α_1 and α_2 represent the deterministic elements, T is the number of observations and ε_t are the random errors. T_b denotes the break date, DU_t is an intercept break variable, which takes 0 for all dates prior to T_b, and 1 thereafter. $D_t(T_b)$ is a one-time break dummy variable, which takes the value of 1 on the break date and 0 otherwise. The null hypothesis for the ADF, PP and ADFBP tests is that $\alpha_1 = 0$; H_0: the time series is non-stationary, while the alternative hypothesis is that $\alpha_1 < 0$; H_a: the time series is stationary.

Once the stationary properties of the variables have been assessed, the presence of cointegration between the variables is investigated by applying the Johansen co-integration test.[8] This test will determine the number of cointegrating vectors based on an unrestricted vector autoregression VAR(p),[9] using the trace test statistic, adjusted for small size.[10] The lag length for the unrestricted VAR is chosen based on the Schwarz information criterion (SIC), as it is considered to be preferable for small samples (Lutkepohl 1991). In addition, the Pantula's principle (Pantula 1989) is used for the inclusion of deterministic trends.

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8 Robustness check is undertaken with the application of dynamic ordinary least squares (DOLS) model to confirm the Johansen cointegration results.

9 Trace statistics are adjusted following the suggestion by Reinsel and Ahn (1992).

10 The Breusch–Godfrey LM test, the Jarque–Bera normality test, the White heteroskedasticity test, and the AR roots stability test are performed to ensure that the model is well specified and stable.

Providing that the variables LY_t, LK_t, LL_t, $LNPX_t$ and $LIMP_t$ (Eq. (4)) are cointegrated, this study examines the short-run causality by estimating the following vector error correction model (VECM)[11]:

$$\begin{bmatrix} \Delta LY_t \\ \Delta LK_t \\ \Delta LL_t \\ \Delta LNPX_t \\ \Delta LIMP_t \end{bmatrix} = \sum_{j=1}^{p} \beta_{ij} \begin{bmatrix} \Delta LY_{t-j} \\ \Delta LK_{t-j} \\ \Delta LL_{t-j} \\ \Delta LNPX_{t-j} \\ \Delta LIMP_{t-j} \end{bmatrix} + \begin{bmatrix} \lambda_y \\ \lambda_k \\ \lambda_l \\ \lambda_{npx} \\ \lambda_{imp} \end{bmatrix} ECT_{t-1} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \end{bmatrix} \tag{5}$$

Δ is the difference operator, while LY_t, LK_t, LL_t, $LNPX_t$ and $LIMP_t$ represent the variables of Eq. (4). $\sum_{j=1}^{p}\beta_{ij}$ and λ are the coefficients of the variables and ECT_{t-1} is the error correction term derived from the cointegrating vector. This study conducts the multivariate Granger causality in the VECM framework (Granger 1969), using the chi-square (χ^2) statistic. To examine the direct and indirect causality in the short-run, the null hypothesis H_0: $\sum_{j=1}^{p}\beta_{ij} = 0$ is tested.

To assess the parameter stability[12] for the estimated equations, the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMQ) tests are conducted. The CUSUM test is based on the plot of the statistic:

$$W_t = \sum_{k+1}^{t} w_t / s \quad t = k+1, \ldots, T \tag{6}$$

where s is the standard deviation of the recursive residuals w_t:

$$w_t = \left(y_t - x_t' b_{t-1}\right) \Big/ \left(1 + x_t' \left(X_{t-1}' X_{t-1}\right)^{-1} x_t\right)^{1/2}$$

where $y_t - x_t' b_{t-1}$ is the forecast error, b_{t-1} is the coefficient vector up to period $t-1$, while x_t' is the row vector of observations on the regressors in period t. The $(t-1) \times k$ matrix of the regressors from period 1 to period $t-1$ is represented by X_{t-1}. Parameter stability exists when the CUSUM statistics lies inside the two 5% critical lines.

The CUSUMQ test is based on the statistic:

$$S_t = \left(\sum_{k+1}^{t} W_t^2\right) \Big/ \left(\sum_{k+1}^{T} w_t^2\right) \tag{7}$$

where w_t^2 denotes the squared recursive residuals and $t = k+1, \ldots, T$. Movements inside the 5% critical lines shows parameter stability during the period 1981–2017.

This study also investigates the long-run causality between non-primary exports and economic growth. Although the direction of the long-run causality from

11 The recursive coefficient test is also applied, and the results are presented in Appendix A.

12 As Giles and Mirza (1999) note, Toda and Yamamoto tests performs well for stationary and near-stationary systems, and mixed integrated systems.

each variable on the dependent variable can be identified in bivariate ECMs, in the case of multivariate ECMs this is not possible. For this reason, we use the Toda and Yamamoto causality test (Toda and Yamamoto 1995), which provides evidence on the separate causal effect of each explanatory variable to either growth or non-primary exports. In addition, Toda and Yamamoto causality test does not require testing for the presence of cointegration,[13] avoiding pre-test biases (Giles and Williams 2000b). The Toda and Yamamoto test utilizes the following augmented VAR model:

$$\begin{bmatrix} LY_t \\ LK_t \\ LL_t \\ LNPX_t \\ LIMP_t \end{bmatrix} = \begin{bmatrix} \alpha_{1t} \\ \alpha_{2t} \\ \alpha_{3t} \\ \alpha_{4t} \\ \alpha_{5t} \end{bmatrix} + \sum_{j=1}^{p+d\max} \beta_{ij} \begin{bmatrix} LY_{t-j} \\ LK_{t-j} \\ LL_{t-j} \\ LNPX_{t-j} \\ LIMP_{t-j} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \end{bmatrix} \tag{8}$$

p denotes the optimal lag length, while $d$max is the maximum integration order of the variables. p is augmented by $d$max and the χ^2 test is performed to the first p coefficients. To investigate the direct and indirect causality between non-primary exports and economic growth in the long-run, the null hypothesis H_0: $\sum_{j=1}^{p+dmax} \beta_{ij} = 0$ is tested.

4 Empirical Results

The PP, ADF and ADFBP test results show that all the variables at the logarithmic level are I(1). The first-differenced variables ΔLY_t, ΔLK_t and $\Delta LNPX_t$, are stationary at the 1% level, while $\Delta LIMP_t$ is stationary at the 5% level. As for ΔLL_t, the ADF test indicates that the variable is stationary at 5%, while the PP test shows that is non-stationary at any conventional significance level. When a structural break is considered, the null hypothesis of a unit root is rejected for ΔLY_t, ΔLK_t and $\Delta LNPX_t$ at the 1% level and at the 5% level for ΔLL_t and $\Delta LIMP_t$. The results are presented in Table 2.

As indicated by the unit root tests, all variables are integrated of order one and therefore, the Johansen test is conducted in order to examine the presence of cointegration between the variables. The results, presented in Table 3, show that the null hypothesis of one cointegrating vector is rejected at the 5% significance level and, therefore, the variables are cointegrated with two cointegrating vectors.[14]

13 The DOLS is used to confirm the cointegrating properties of the variables and the results are presented in Table A1, Appendix A.

14 The diagnostic tests for the estimated equations show that the residuals are normally distributed, homoscedastic and that serial correlation is not present. Equation for ΔLY_t:

Table 2: Unit root tests results.

Variables	**PP**	**ADF**	**ADFBP**	
Log Levels				
LY_t	0.54^{e} {2}	$-3.36^{a,d}$ [1]	-4.00^{d} [0]	1985
LK_t	-2.71^{d} {0}	-2.71^{d} [0]	-1.60^{e} [5]	1993
LL_t	4.77^{f} {4}	-2.23^{d} [2]	-2.56^{e} [2]	2000
$LNPX_t$	-3.24^{d} {9}	$-3.44^{a,d}$ [1]	-4.82^{d} [4]	1997
$LIMP_t$	-2.87^{d} {3}	$-3.37^{a,d}$[1]	-1.86^{e} [0]	1987
1st Difference				
ΔLY_t	$-4.66^{e,c}$ {1}	$-3.89^{e,c}$ [1]	$-6.81^{c,d}$ [0]	1986
ΔLK_t	$-5.68^{c,f}${3}	$-5.63^{c,f}$ [0]	$-6.87^{c,e}$ [0]	1987
ΔLL_t	-1.07^{f} {4}	$-3.17^{b,e}$ [1]	$-4.04^{b,e}$ [9]	2003
$\Delta LNPX_t$	$-9.06^{c,f}${9}	$-4.56^{c,e}$[1]	$-7.70^{c,e}$[0]	1986
$\Delta LIMP_t$	$-3.47^{f,b}${2}	$-3.55^{b,e}$[0]	$-4.74^{b,e}$ [9]	1997

[a, b, c] denote rejection at the 10, 5 and 1% significance level, respectively. The order of integration is inspected including intercept and trend [d,] intercept only [e,] and no intercept or trend [f] and the appropriate model is selected following Dolado, Jenkinson, and Sosvilla-Rivero (1990). Newey–West Bandwidth in { }. Optimal lags for the ADF and ADFBP tests are chosen based on the SIC and F-statistic, respectively, and are given in [ ]. The years refer to the structural breaks.

Table 3: Cointegration test.

Rank (*r*)	**Trace statistic**	**C (1%)**	**C (5%)**
$r = 0$	117.15^{c}	84.84	76.81
$r \leq 1$	59.76^{b}	60.81	53.94
$r \leq 2$	29.33	40.78	35.07
$r \leq 3$	15.35	24.69	20.16

[b] and [c] denote rejection at the 5 and 1% significance level. The SIC is used for the selection of the optimal lag. The model includes constant in the cointegrating vector, following the Pantula principle (Pantula 1989). The residual analysis confirms that the residuals are homoscedastic, normal and that serial correlation is not present. The Trace statistics are adjusted following the suggestion by Reinsel and Ahn (1992). Critical values, C(1%) and C(5%) are taken from Doornik et al. (1998).

Since the variables are I(1) and cointegrated, a VECM is specified and the Granger causality test is applied. The results, presented in Table 4, indicate that the null hypothesis of non-causality from non-primary exports, $\Delta LNPX_t$, to economic growth, ΔLY_t, is rejected at the 5% level, confirming the validity of the ELG in the short-run. In contrast, the null hypothesis of non-causality from ΔLY_t to $\Delta LNPX_t$

$BG\chi^2(1) = 0.80$, $W\text{-}het\chi^2\{28\} = 0.27$, $ARCH(1) = 0.19$. Equation for $\Delta LNPX_t$: $BG\chi^2(1) = 0.14$, $W\text{-}het\chi^2\{28\} = 0.41$, $ARCH(1) = 0.77$. The existence of multicollinearity between the model variables is examined using correlation analysis and the results are reported in Appendix A, Table A2.

Table 4: Granger causality test in VECM.

	ΔLY_t	ΔLK_t	ΔLL_t	$\Delta LNPX_t$	$\Delta LIMP_t$
$\Delta LY_t \not\Rightarrow$	–	1.36	0.7	2.33	0.01
$\Delta LK_t \not\Rightarrow$	1.95	–	2.13	0.50	0.03
$\Delta LL_t \not\Rightarrow$	0.08	0.04	–	2.29	2.53
$\Delta LNPX_t \not\Rightarrow$	3.84[b]	1.5	1.54	–	0.15
$\Delta LIMP_t \not\Rightarrow$	1.40	3.23[a]	0.00	0.73	–
$ALL \not\Rightarrow$	4.84	3.91	7.27	5.33	3.97

[a] and [b] denote rejection at the 10 and 5% significance level (χ^2df(1) and χ^2df(4) for the joint causality). The residual analysis reveals no evidence of serial correlation and heteroscedasticity, while the residuals are normal (LM(25) = 0.32, W-hetχ^2(210) = 0.26, JB(10) = 0.95). The VECM is found to be stable based on the AR roots polynomial analysis.

cannot be rejected at any conventional level. In addition, the results provide evidence of a direct causality from imports to physical capital at 10% significance level. However, imports do not directly or indirectly cause economic growth or non-primary exports in the short-run at any conventional significance level.

Based on these results, export expansion fosters technological advancement through increased investment and productivity (Kalaitzi and Chamberlain 2020). In addition, physical capital can be enhanced by import expansion, as imports foster technology transfer and advancement (Coe and Helpman 1995; Keller 2000).

To ensure that the parameters of the estimated ECM equations[15] for ΔLY_t and $\Delta LNPX_t$ are stable, the CUSUM and CUSUMQ tests are performed. Figure 1 shows that the estimated ECMs are stable even during oil crises occurred in the period 1981–2017, as the CUSUM and CUSUMQ statistics lies inside the two 5% critical lines.

As for the long-run causality, the Toda and Yamamoto test is performed, and the results are presented in Table 5.

Toda and Yamamoto test results indicate that the null hypothesis of non-causality from $LNPX_t$ to LY_t cannot be rejected at the 5% level. Moreover, the null hypothesis of non-causality from LY_t to $LNPX_t$ cannot be rejected at any significance level. These results show that there is no direct long-run causality between non-primary exports and economic growth.

The analysis also finds that imports cause economic growth in the long-run at 5% significance level, indicating that import expansion contributes to long-run economic growth. Moreover, the null hypothesis that LK_t does not cause

15 The recursive coefficient test also confirms stability and the results are presented in Appendix A, Figures A1 and A2.

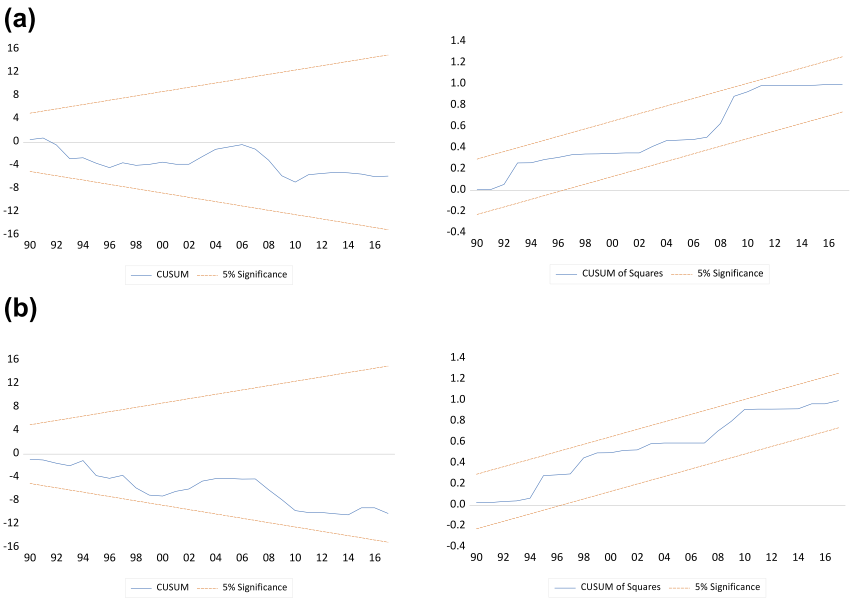

Figure 1: CUSUM and CUSUMQ tests of the ECM equations: (a) ΔLY_t and (b) $\Delta LNPX_t$.

Table 5: Toda and Yamamoto causality test.

	LY_t	LK_t	LL_t	$LNPX_t$	$LIMP_t$
$LY_t \nRightarrow$	–	1.70	10.30[c]	0.35	0.14
$LK_t \nRightarrow$	3.91	–	1.85	0.46	4.90[a]
$LL_t \nRightarrow$	1.94	0.74	–	0.12	1.94
$LNPX_t \nRightarrow$	3.56	2.51	0.79	–	3.86
$LIMP_t \nRightarrow$	6.15[b]	1.00	3.09	5.46[a]	–
$ALL \nRightarrow$	12.69	5.48	19.52[b]	7.41	20.18[c]

[a], [b] and [c] denote rejection at the 10, 5 and 1% significance level respectively (χ^2df(2) and χ^2df(8) for the joint causality). Lag selection based on SIC. The residual analysis for VAR(p) reveals no evidence of serial correlation and heteroscedasticity, while the residuals are normal.

$LIMP_t$ is rejected at the 10% level, as is the hypothesis that $LIMP_t$ does not cause $LNPX_t$ (at 10% level). This indicates that an indirect causality runs from physical capital to non-primary exports, through imports of goods and services. At the same time, the null hypothesis that LY_t, LK_t, LL_t and $LNPX_t$ do not jointly cause $LIMP_t$ is rejected at 1%. Combining the above results, in the long-run, a direct causality runs jointly from all the variables to imports, while an indirect joint causality runs from all the variables to non-primary exports and economic growth, through imports. Also, the null hypothesis that LY_t does not cause LL_t is rejected at 1% significance level, as is the hypothesis that LY_t, LK_t, $LNPX_t$ and $LIMP_t$ do not jointly cause LL_t.

The non-existence of direct causality between non-primary exports and growth is probably due to the fact that aggregate export measures veil the different causal impacts of non-primary export components on economic growth (Herzer, Nowak-Lehmann, and Siliverstovs 2006; Kalaitzi and Cleeve 2018). Based on the above results, domestic productivity is enhanced by import expansion, as imports, especially of capital goods, are essential for technology advancement in the export-oriented sectors (Coe and Helpman 1995; Keller 2000). In addition, the above results provide evidence that import expansion provides the raw and intermediate materials for increasing the export-oriented non-primary production (Gylfason 1999; Riezman, Whiteman, and Summers 1996), facilitating export diversification away from oil. Robustness checks performed to verify that the above results remain unchanged. In particular, after the inclusion of fuel and mining exports in the empirical model, the short-run causality from non-primary exports to economic growth and the non-existence of significant long-run causality between non-primary exports and economic growth are verified. The initial estimates are also confirmed with the inclusion of the exogenous variable for the financial year crisis 2009. The results are presented in Appendix B and C.

5 Conclusion

This study examines the direct and indirect causality between non-primary exports and economic growth in the UAE over the period 1981–2017. The Johansen test confirms the presence of cointegration between the variables included in the model. The Granger causality test in VECM shows that the causality runs from non-primary exports to economic growth, indicating that the ELG is valid in the short-run. The above results suggest that non-primary exports may offer knowledge spillover effects, achieving further growth (Herzer, Nowak-Lehmann, and Siliverstovs 2006; Kalaitzi and Cleeve 2018). In particular, expansion of non-primary exports may improve productivity through financing imports, increased investment and technological innovation (Helpman and Krugman 1985; Herzer 2007; Gylfason 1999; Ramos 2001; Riezman, Whiteman, and Summers 1996; Rodrik 1997). The findings are in line with those of Al-Yousif

(1997), Kalaitzi and Chamberlain (2020) and Kalaitzi and Chamberlain (2021), who found that exports cause short-run economic growth in the UAE, while partially agree with those of Kalaitzi and Cleeve (2018), who support the ELG-GLE in the short-run. In addition, causality runs from imports to physical capital, showing that imports foster technology transfer and advancement (Coe and Helpman 1995; Keller 2000).

As for the long-run causality, the results do not support the validity of the ELG or GLE hypothesis. This is in line with Kalaitzi and Chamberlain (2020) and Kalaitzi and Chamberlain (2021), but in contrast with Kalaitzi and Cleeve (2018), who found that the GLE is valid in the long-run. However, the empirical results provide evidence to support a direct causality from imports to non-primary exports and economic growth, noting that imports play an important role in export diversification and long-run economic growth in the UAE. These results are in line with the study by Kalaitzi and Chamberlain (2021), which shows that imports directly cause economic growth in UAE, Bahrain and Kuwait and with Kalaitzi and Cleeve (2018) who found that imports directly cause manufactured exports in the long-run. Moreover, this study provides evidence that an indirect joint causality exists from all the variables to non-primary exports and economic growth, through imports. Robustness checks verify that the above results remain unchanged.

The empirical results suggest that focus must be placed not only on non-primary exports expansion which contributes to economic growth in the short-run, but also on increasing domestic investment in physical and human capital and expanding imports, facilitating long-run export diversification. At the same time, the absence of long-run causality among non-primary exports and economic growth shows that export diversification itself does not result in long-run economic growth. Parallel import and export promotion policies must be implemented, targeting on categories that foster technological innovation, promoting long-run export diversification and sustainable economic growth. Therefore, future research may want to focus on a deeper disaggregation of non-primary exports and imports, in an effort to find the subcategories that are most likely to accelerate further economic growth in the UAE.

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Conflict of Interest: The authors declare that they have no conflict of interest.

Appendix A

Table A1: DOLS results (Eq. (4)).

	α	β	γ	δ
LY_t	0.25^b	0.30^c	−0.02	0.18
	(0.048)	(0.005)	(0.934)	(0.433)

[b] and [c] denote rejection at the 5 and 1% significance level respectively (*p*-values in parentheses); Also, the null hypothesis of no cointegration, H_0: $\alpha = \beta = \gamma = \delta = 0$, is rejected at 1% level [χ^2df(4) = 0.00].

Table A2: Correlation analysis between the model variables.

	ΔLY_t	ΔLK_t	ΔLL_t	ΔLPX_t	$\Delta LNPX_t$	$\Delta LIMP_t$
ΔLY_t	1					
ΔLK_t	0.11	1				
ΔLL_t	0.09	0.22	1			
ΔLPX_t	0.09	0.37	0.25	1		
$\Delta LNPX_t$	0.47	0.04	0.09	0.11	1	
$\Delta LIMP_t$	0.32	0.54	0.30	0.33	0.22	1

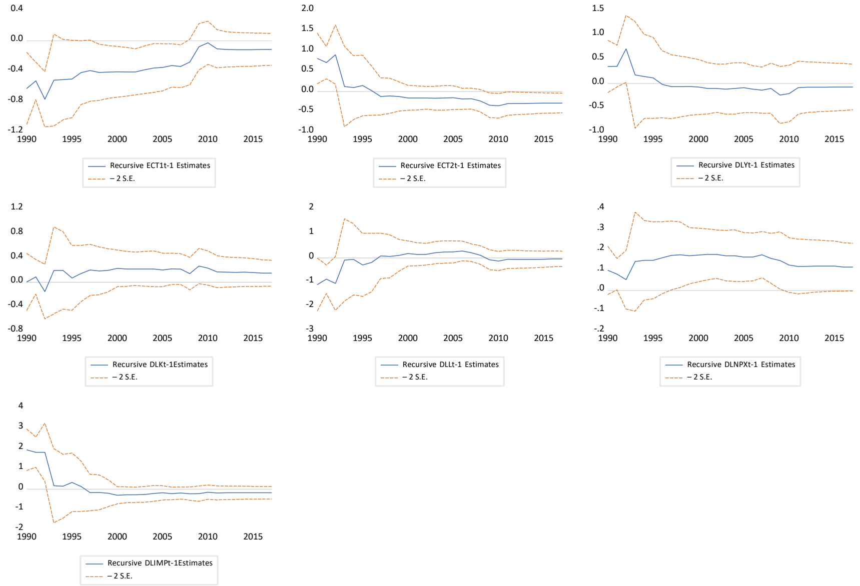

Figure A1: Recursive coefficients test of the ECM equation: ΔLY_t.

Figure A2: Recursive coefficients test of the ECM equation: $\Delta LNPX_t$.

Appendix B

Table B1: Unit root tests results for the additional variable primary exports LPX_t.

Variable	PP	ADF	ADFBP	
Log Levels				
LPX_t	-2.60^{d} {4}	-2.73^{d} [0]	-3.68^{d} [5]	2014
1st Difference				
ΔLPX_t	$-5.98^{c,e}$ {3}	$-6.06^{c,f}$ [0]	$-6.55^{c,e}$ [0]	1987

^{c} denotes rejection at the 1% significance level. The order of integration is inspected including intercept and trend ^{d}, intercept only ^{e}, and no intercept or trend ^{f} and the appropriate model is selected following Dolado, Jenkinson, and Sosvilla-Rivero (1990). Newey–West Bandwidth in { }. Optimal lags for the ADF and ADFBP tests are chosen based on the SIC and F-statistic, respectively, and are given in [ ]. The years refer to the structural breaks.

Table B2: Co-integration test (LY_t, LK_t, LL_t, LPX_t, $LNPX_t$, $LIMP_t$).

Rank (*r*)	Trace Statistic	C (1%)	C (5%)
$r = 0$	144.60^{c}	111.01	102.14
$r \leq 1$	85.85^{c}	84.45	76.07
$r \leq 2$	47.07	60.16	53.12
$r \leq 3$	30.37	41.07	34.91

^{c} denotes rejection at the 1% significance level. The SIC is used for the selection of the optimal lag. The model includes constant in the cointegrating vector, following the Pantula principle (Pantula 1989). The residual analysis confirms that the residuals are homoscedastic, normal and that serial correlation is not present. The Trace statistics are adjusted following the suggestion by Reinsel and Ahn (1992). Critical values, C(1%) and C(5%) are taken from Osterwald-Lenum (1992).

Table B3: DOLS results (LY_t, LK_t, LL_t, LPX_t, $LNPX_t$, $LIMP_t$).

	α	β	γ	δ	ζ
LY_t	0.49[b]	0.19[c]	0.02	0.03	0.08[c]
	(0.01)	(0.005)	(0.65)	(0.78)	(0.00)

[b] and [c] denote rejection at the 5 and 1% significance level, respectively (*p*-values in parentheses), also, the null hypothesis of no cointegration, H_0: $\alpha = \beta = \gamma = \delta = \zeta = 0$, is rejected at 1% level [χ^2df(5) = 0.00].

Table B4: Granger causality test in VECM (LY_t, LK_t, LL_t, LPX_t, $LNPX_t$, $LIMP_t$).

	ΔLY_t	ΔLK_t	ΔLL_t	ΔLPX_t	$\Delta LNPX_t$	$\Delta LIMP_t$
$\Delta LY_t \nRightarrow$	–	1.91	6.61[b]	10.84[c]	1.77	1.23
$\Delta LK_t \nRightarrow$	3.31[a]	–	9.88[c]	4.50[b]	0.37	1.34
$\Delta LL_t \nRightarrow$	0.00	0.05	–	0.01	1.98	3.24[a]
$\Delta LPX_t \nRightarrow$	2.24	1.00	2.78[a]	–	0.07	2.14
$\Delta LNPX_t \nRightarrow$	4.23[b]	3.27[a]	0.33	2.34	–	0.98
$\Delta LIMP_t \nRightarrow$	1.94	4.41[b]	0.34	0.00	0.44	–
$ALL \nRightarrow$	6.15	5.69	18.75[c]	13.97[b]	5.59	7.20

[a, b] and [c] denote rejection at the 10, 5 and 1% significance level, respectively (χ^2df(1) and χ^2df(5) for the joint causality). The residual analysis reveals no evidence of serial correlation and heteroscedasticity, while the residuals are normal (LM(36) = 0.62, W-hetχ^2(336) = 0.42, JB(10) = 0.97). The VECM is found to be stable based on the AR roots polynomial analysis.

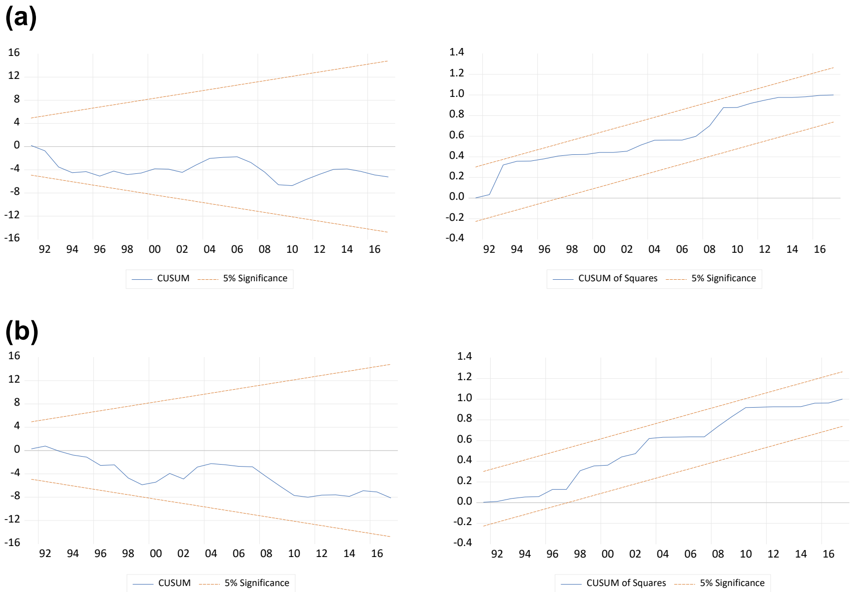

Figure B1: CUSUM and CUSUMQ tests of the ECM equations: (a) ΔLY_t and (b) $\Delta LNPX_t$.

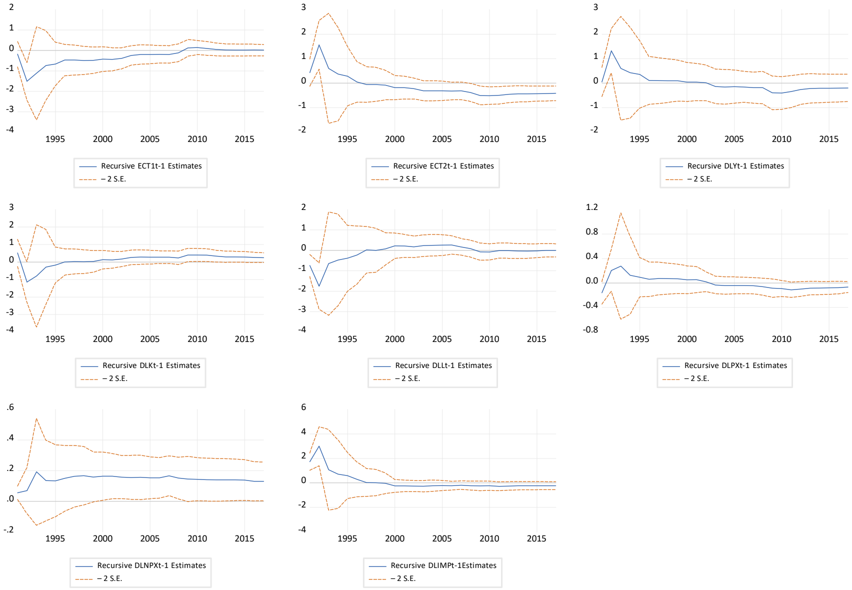

Figure B2: Recursive coefficients test of the ECM equation: ΔLY_t.

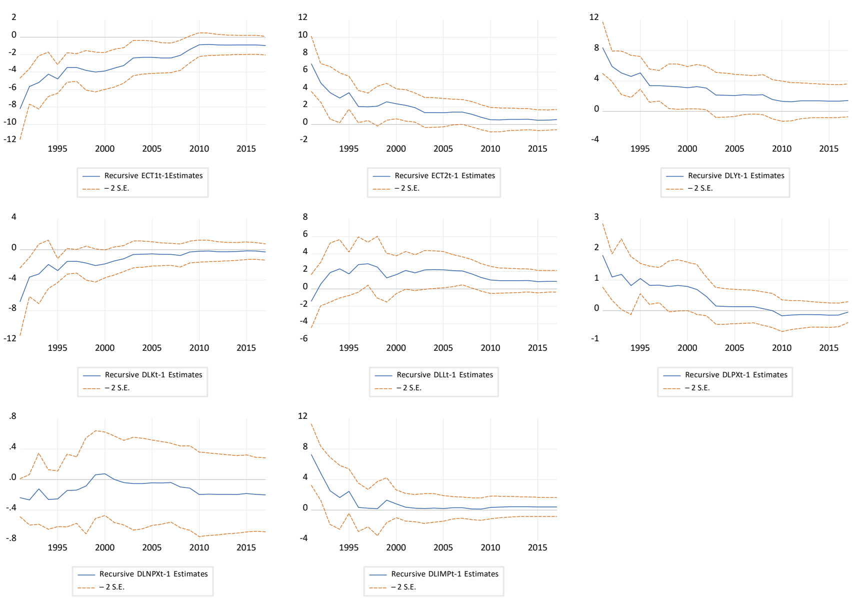

Figure B3: Recursive coefficients test of the ECM equation: $\Delta LNPX_t$.

Table B5: Toda and Yamamoto causality test (LY_t, LK_t, LL_t, LPX_t, $LNPX_t$, $LIMP_t$).

	LY_t	LK_t	LL_t	ΔLPX_t	$LNPX_t$	$LIMP_t$
LY_t⇏	–	4.49	7.58[b]	15.98[c]	0.13	1.53
LK_t⇏	3.54	–	7.26[b]	5.37[a]	0.78	10.18[c]
LL_t⇏	1.04	0.01	–	7.09[b]	0.00	3.84
ΔLPX_t⇏	2.31	3.56	7.47[b]	–	0.39	2.87
$LNPX_t$⇏	3.22	4.35	0.45	3.01	–	4.96[a]
$LIMP_t$⇏	3.09	4.16	4.68[a]	0.50	2.04	–
ALL⇏	14.45	20.62[b]	30.91[b]	41.77[c]	7.25	26.52[c]

[a], [b] and [c] denote rejection at the 10, 5 and 1% significance level respectively (χ^2df(2) and χ^2df(10) for the joint causality). Lag selection based on SIC. The residual analysis for VAR(p) reveals no evidence of serial correlation and heteroscedasticity, while the residuals are normal.

Appendix C

Table C1: Granger causality test in VECM (LY_t, LK_t, LL_t, $LNPX_t$, $LIMP_t$; $DUM09$).

	ΔLY_t	ΔLK_t	ΔLL_t	$\Delta LNPX_t$	$\Delta LIMP_t$
ΔLY_t⇏	–	2.21	0.77	2.01	0.04
ΔLK_t⇏	0.96	–	1.03	0.45	0.33
ΔLL_t⇏	0.45	0.46	–	3.78[a]	2.89[a]
$\Delta LNPX_t$⇏	3.82[b]	2.01	0.78	–	0.27
$\Delta LIMP_t$⇏	1.17	4.80[b]	0.08	0.71	–
ALL⇏	5.80	6.59	5.12	6.62	4.92

[a] and [b] denote rejection at the 10 and 5% significance level (χ^2df(1) and χ^2df(4) for the joint causality). The residual analysis reveals no evidence of serial correlation and heteroscedasticity, while the residuals are normal (LM(25) = 0.56, W-hetχ^2(225) = 0.46, JB(10) = 0.94). The VECM is found to be stable based on the AR roots polynomial analysis.

Table C2: Toda and Yamamoto causality test (LY_t, LK_t, LL_t, $LNPX_t$, $LIMP_t$; $DUM09$).

	LY_t	LK_t	LL_t	$LNPX_t$	$LIMP_t$
LY_t⇏	–	1.39	10.58[c]	0.34	0.12
LK_t⇏	4.02	–	1.02	1.27	4.62[a]
LL_t⇏	0.49	1.12	–	0.02	1.83
$LNPX_t$⇏	5.19[a]	3.55	1.11	–	3.40
$LIMP_t$⇏	10.81[b]	0.39	3.58	7.32[b]	–
ALL⇏	17.03	6.02	20.02[c]	9.68	18.96[c]

[a], [b] and [c] denote rejection at the 10, 5 and 1% significance level, respectively, (χ^2df(2) and χ^2df(8) for the joint causality). Lag selection based on SIC. The residual analysis for VAR(p) reveals no evidence of serial correlation and heteroscedasticity, while the residuals are normal.

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