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## Revealed Comparative Advantage in the Global Citrus Market and Implications for South Africa

TEBOGO B. SELEKA AND AJURUCHUKWU OBI

BOTSWANA INSTITUTE FOR DEVELOPMENT POLICY ANALYSIS



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## ABSTRACT

This paper adopts the Normalized Revealed Comparative Advantage (NRCA) index and data for the period 1961-2013 to examine comparative advantage among the leading citrus exporters in the global market and draws implications for South Africa's citrus industry. Results reveal that Spain was the most competitive citrus exporter throughout the review period. South Africa (SA) improved steadily over time from position four to position two, surpassing Italy and Morocco in the process. Morocco, which ranked between positions two and four, was also surpassed by Turkey, which improved from position ten during the period 1961-1965 to position three during 2006-2010. Trend analyses of the annual NRCA scores indicate that Turkey is on the verge of surpassing SA in terms of competitiveness. Broadly, the results indicate that SA experienced weakening comparative advantage during the apartheid era, owing partly to trade sanctions by several European countries. With the end of apartheid and the subsequent removal of the sanctions, the situation has vastly improved, further yielding a rise in SA citrus competitiveness in the global market.

**Key words:** Citrus exports, Competitiveness, Revealed Comparative Advantage, South Africa

JEL Classification: F14, Q17

# 1. INTRODUCTION

Having been export-oriented from inception, South Africa's citrus industry has enjoyed a global character for a very long time (Citrus Academy, 2008). For instance, of the roughly 2 million tons produced annually, the industry exports 69%, processes 7%, and sells 24% locally (Citrus Growers Association, 2014). The industry continues to enjoy comfortable market shares in many high income markets in Europe, the Middle East and South East Asia. In 2014/2015, SA's citrus exports were destined to 87 countries. SA is the second largest exporter of citrus in the world, surpassed only by Spain (Navarro, 2015). Also, SA was the world's leading exporter of oranges and grapefruit in 2013 (USDA, 2016). The billion-dollar export-oriented industry also employs about 100,100 casual and permanent workers in orchards and pack houses nationwide (DAFF, 2015b).

SA's citrus export volume rose from a mere 40 million cartons (or 600,000 tons based on the conversion of one export carton weighing 15kg) in 1994 (Byrnes, 1996; Ndou, 2012) to 1.73 and 1.77 million tons in 2014 and 2015, respectively (DAFF, 2015a). Much of this positive export performance has been attributed to improved product quality, supply chain and transportation systems and post-harvest handling (NAMC, 2015). Moreover, SA's geographical location in the Southern Hemisphere allows it to produce for a much longer period during the year and to supply Northern Hemisphere markets during their harsher winter months (Citrus Academy, 2014). Also, the country's sheer size and its unique East-West orientation that spans a wide range of agro-ecological zones provide a diverse production environment, which minimizes the industry's vulnerability to climatic conditions. However, the growing importance of a number of Southern Hemisphere competitors such as Argentina, Australia, Uruguay, Chile and Peru, may pose a serious threat to SA's dominance and climatic advantages (Sinngu and Antwi, 2014).

SA emerged from economic and trade sanctions after the end of the apartheid regime in 1994. During such regime, particularly in the 1970s and 1980s, the citrus industry attracted sustained negative campaigns in Europe. These, together with broader political and economic sanctions imposed by the international community on South Africa in 1985, adversely affected the country's citrus exports (Mather and Rowcroft, 2004; Edwards and Lawrence, 2006 ).<sup>1</sup> Given this scenario, the post-apartheid government (that came into power in 1994) saw international trade as an important pathway to wealth creation (Department of Trade and Industry, 2010). For example, it has been suggested that export growth is inevitable for achieving the government's target annual growth rate of 6%, adjudged to be necessary to deal with the high unemployment rate and current account deficits (Edwards, Rankin and Schoer, 2008). Therefore, in order for SA to achieve this and other development targets, it is imperative that its exports are

<sup>1</sup> These sanctions entailed limitations on both foreign direct and portfolio investments and various degrees of embargoes on importation of South African minerals, industrial products and agricultural commodities (Commonwealth Secretariat, 1986; Hefti and Staehelin-Witt, 2013).

competitive in the global markets, including citrus exports which currently contribute significantly to the country's foreign exchange.

The purpose of this paper is to examine the international competitiveness of the leading exporters in the global citrus market, namely, Argentina, Australia, Brazil, Chile, China, Egypt, India, Iran, Italy, Japan, Mexico, Morocco, Peru, SA, Spain, Turkey, the United States of America (USA) and Uruguay. A key objective is to draw implications for the South African citrus industry. The paper fills an existing research gap because only a limited number of studies have assessed the competitiveness of SA's citrus exports (Ndou and Obi, 2013; Sinngu and Antwi, 2014). Using the constant market share approach, Ndou and Obi (2013) found that SA's market share for oranges and lemons rose in various export markets. They also found that SA's export market share for lime and lemons in the Middle East and grapefruits and pemelos in Central Europe also increased. The increase in market share, which signaled increasing competitiveness, was attributed to "market availability, market size and strong support from the" Citrus Growers Association in SA (Adou and Obi, 2013; p. 160).

Sinnu and Antwi (2014) employed three measures of Revealed Comparative Advantage (RCA) to examine the export competitiveness of the South African citrus industry relative to the country's Southern Hemisphere competitors. Study results were inconsistent across the three RCA measures employed. A modified version of the Balassa RCA index, designed to avoid double counting in the reference country's exports (see also James and Movshuk, 2003), placed SA at second place in the case of oranges (after Uruguay). However, the Net Export index placed SA, Uruguay and Argentina almost at par, while the Relative Revealed Trade Advantage (RTA) index placed SA first (before Uruguay) with respect to oranges. Similarly, inconsistencies were observed for orange juice and grapefruit. This is consistent with the literature, which has demonstrated that the various indices of RCA commonly produce inconsistent results (Ballance, Forstner and Murray, 1987) and that such indices are neither cardinal nor ordinal measures of comparative advantage (Yeats, 1985; Hinloopen and van Marrewijk, 2001).

This paper overcomes the above stated deficiencies by adopting the Normalized Revealed Comparative Advantage (NRCA) index (Yu, Cai and Leung, 2009), which has recently been employed to measure export competitiveness in developing countries (Fourie, 2010; Seleka and Kebakile, 2017). Unlike its predecessors, the index can be used as both cardinal and ordinal measure of comparative advantage, and can therefore allow for the comparison of comparative advantage across countries and time (Yu, Cai and Leung, 2009). A recent study has confirmed that the NRCA index is superior to other leading RCA indices and that it "could be used as an ordinal measure for ranking sectors with respect to a country or ranking countries with respect to a sector" (Deb and Sengupta, 2016; p. 26).<sup>2</sup> The "index could also be

<sup>2</sup> Other RCA indices considered included Balassa index, Revealed Symmetric Comparative Advantage index,

used as a cardinal measure for comparing countries with respect to a sector or for comparing sectors with respect to a country” (Deb and Sengupta, 2016; p. 26).

The rest of the paper is organized as follows. First, we present the methodology for measuring comparative advantage, together with approaches used to compare comparative advantage across time and countries. We then discuss data and computation of variables. Next, we present the empirical results, where we assess comparative advantage across space and time and the relative performance of the individual countries against SA. We then discuss the implications of the finding on SA. Lastly, we provide final remarks.

## 2. METHODOLOGY

### 2.1 MEASURING COMPARATIVE ADVANTAGE

Most of the indices for measuring RCA are derived from the Balassa index, which may be expressed as:

$$B_j^i = (X_j^i/X_j^w)/(X^i/X^w) \quad (1)$$

where  $X$  represents exports, subscript  $j$  refers to commodity, and superscripts  $i$  and  $w$  denote a specific country and the world, respectively (Balassa 1965; Ballance, Forstner and Murray 1987; Bowen 1983; Vollrath 1991). If country  $i$ 's export share in commodity  $j$ 's export market (the numerator) exceeds the ratio of its total exports to world trade (the denominator), country  $i$  has comparative advantage in commodity  $j$ , and the reverse would imply comparative disadvantage (Ballance 1988; Hoen and Oosterhavan 2006; Yu, Cai and Leung 2009). Equality of the numerator and the denominator would imply comparative-advantage-neutral position.

The Balassa index has been criticized for, among others, its inability to allow for the comparison of comparative advantage across space and time and for its asymmetric distribution around its mean (which is greater than the index's comparative-advantage-neutral point of 1) (Hinloopen and Van Marrewijk, 2001; Hoen and Oosterhavan, 2006; Yeats, 1985; Yu, Cai, Leung, 2009). Similarly, alternative RCA indices developed to address some of the shortcomings of the Balassa index have not been successful, particularly at addressing the measurement of comparative advantage across space and time (Bowen, 1983; Vollrath, 1991; Hoen and Oosterhavan, 2006; Yu, Cai and Leung, 2009). This paper therefore adopts the Normalized Revealed Comparative Advantage (NRCA) index (Yu, Cai, Leung, 2009), which addresses these shortcomings.

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Additive Revealed Comparative Advantage index, log of Balassa index, Revealed Trade Advantage index and Revealed Competitiveness index.



The NRCA index is also derived from the Balassa index and is based on the extent to which observed exports deviate from comparative-advantage-neutral exports. At a comparative-advantage-neutral position, the Balassa index is equal to 1 and the numerator of equation 1 is equal to the denominator. Therefore, we can express this position as:  $\hat{X}_j^i / X_j^w = X^i / X^w$ , where  $\hat{X}_j^i$  denotes comparative-advantage-neutral exports of commodity  $j$  (Yu, Cai and Leung 2009). Rearranging terms yields:  $\hat{X}_j^i = X^i X_j^w / X^w$ . Deviation of actual from comparative-advantage-neutral exports of commodity  $j$  may then be measured as:

$$\Delta X_j^i = X_j^i - \hat{X}_j^i = X_j^i - X^i X_j^w / X^w \quad (2)$$

The NRCA index  $N_j^i$  may then be derived by dividing equation 2 through by world exports of all commodities (or a group of commodities)  $X^w$  to obtain:

$$N_j^i = X_j^i / X^w - X^i X_j^w / X^w X^w \quad (3)$$

Unlike its predecessors, the NRCA index is distributed symmetrically around its mean (of 0), and its scores fall in the range of -1/4 to +1/4 (Yu, Cai and Leung, 2009). The index is also unique in that it can be used to compare comparative advantage across space and time. Thus, if the NRCA score for country A is double the NRCA score for country B, it can be concluded that country A's comparative advantage is twice (or 100%) stronger than the comparative advantage for country B (Yu, Cai and Leung, 2009). Similar conclusions could be derived with respect to temporal comparison of comparative advantage. Another important property of the NRCA index is that the sum of its scores across countries or commodities is equal to 0. Thus, if one country gains comparative advantage, other countries must lose comparative advantage for the balance to be restored. The index also has other properties that are essential for the measurement of comparative advantage, which are not restated in this paper (see Yu, Cai and Laing, 2009).

## 2.2 COMPARATIVE ADVANTAGE ACROSS SPACE

As noted earlier, one of the properties of the NRCA index is that it can be used to compare comparative advantage across countries. To allow for such comparisons, we normalized the NRCA scores for country  $i$  and Rest of World (ROW) by the NRCA score for SA as follows:<sup>3</sup>

$$\bar{N}_{ck}^r = 100(N_{ck}^r - N_{ck}^{SA}) / |N_{ck}^{SA}|, \quad r = i, ROW \quad (4)$$

where  $\bar{N}_{ck}^r$  is the percentage deviation of the NRCA score for country  $i$  (or ROW) from the NRCA score for SA in period  $k$  ( $k=1961-1965, 1966-1970, \dots, 2006-2010$ ),  $|N_{ck}^{SA}|$  is the absolute value of the NRCA score for SA in period  $k$ , and  $c$  denotes citrus. For each period  $k$ , the percentage deviation for SA is equal to 0, since  $N_{ck}^r = N_{ck}^{SA}$  (see also Seleka

<sup>3</sup> This approach was also adopted by Seleka and Dlamini (2017). See also Seleka and Kebakile (2017), for related analysis.

and Dlamini 2017). For other countries,  $\bar{N}_{ck}^r = 0$  would imply that the comparative advantage for country  $i$  (or ROW) in period  $k$  is equal to the comparative advantage for SA, and  $\bar{N}_{ck}^r > 0$  ( $\bar{N}_{ck}^r < 0$ ) would imply that the comparative advantage for country  $i$  (or ROW) is  $\bar{N}_{ck}^r$  % stronger (weaker) than the comparative advantage for SA.

### 2.3 COMPARATIVE ADVANTAGE ACROSS TIME

To assess comparative advantage across time, we used the ordinary least squares (OLS) method to estimate multi-period piecewise linear regression equations of the form:

$$N_{ct}^r = \beta_0 + \beta_1 Y_t + \sum_{j=2}^n \beta_j (Y_t - \bar{Y}_j) D_{jt} + u_t, \quad r = i, ROW \tag{5}$$

where  $Y$  denotes year (1961, 1962, ..., 2013),  $\bar{Y}_j$  is the year that begins period  $j$ ,  $D_j$  is the dummy variable for period  $j$  ( $D_2=0$  for the first period and  $D_2=1$  otherwise;  $D_3=0$  for first and second periods and  $D_3=1$  otherwise; ... ;  $D_n=0$  for the first, second, third, ..., and  $n-1$  periods and  $D_n=1$  otherwise),  $\beta_0$ ,  $\beta_1$  and  $\beta_j$  are parameters to be estimated,  $u$  is the error term and  $t$  denotes year (Seleka 1999; Seleka and Kebakile 2016). From equation 5,  $\beta_1$  measures the annual change in the NRCA score for the first period, and  $\beta_j$  is the incremental (differential) annual change in the NRCA score for period  $j$ . Therefore, the annual changes in the NRCA scores for first, second, third, ..., and  $n$ th periods may be derived as  $\beta_1$ ,  $\beta_1+\beta_2$ ,  $\beta_1+\beta_2+\beta_3$ , ..., and  $\beta_1+\beta_2+\dots+\beta_n$  respectively.

The number of periods considered for country  $i$  were based on visual observations of the patterns of the respective country's NRCA scores. Single-period equations were estimated for Argentina, Australia, Italy, Japan, Mexico, Peru, Morocco and ROW. Two-period linear piecewise regression equations were estimated for China and India, with  $\bar{Y}_2 = 2009$ . Another set of two-period piecewise linear regressions was estimated for Chile, SA and Uruguay, with  $\bar{Y}_2 = 2014$ . Three-period linear piecewise equations were estimated for Brazil, Egypt and Spain, with  $\bar{Y}_2 = 1973$  and  $\bar{Y}_3 = 1993$ . Similarly, a three-period linear regression was estimated for Turkey, with  $\bar{Y}_2 = 1981$  and  $\bar{Y}_3 = 1997$ . Lastly, four-period linear piecewise regressions were estimated for Iran and the USA, with  $\bar{Y}_2 = 1972$ ,  $\bar{Y}_3 = 1980$  and  $\bar{Y}_4 = 1987$ . Single-period regressions were also estimated for countries that exhibited multi-period patterns in the NRCA scores, to compute annual changes in the comparative advantages for the entire period from 1961 to 2013.

To further assess changes in comparative advantage across time, we standardized the NRCA scores for each country across time as follows:

$$\dot{N}_{ck}^r = 100(N_{ck}^r - N_{c\bar{k}}^r) / |N_{c\bar{k}}^r|, \quad r = i, ROW \tag{6}$$

where  $\dot{N}_{ck}^r$  is the percentage deviation of the NRCA score for country  $i$  (or ROW) in period  $k$  from its NRCA score in period  $\bar{k}$  ( $\bar{k}=1961-1965$ ) and  $N_{c\bar{k}}^r$  is the NRCA score for country  $i$  (or ROW) in the  $\bar{k}$ th period (see also Seleka and Dlamini 2017).  $\dot{N}_{ck}^r =$

0 would suggest that the comparative advantage of country  $i$  (or ROW) in period  $k$  is equal to the country's comparative advantage in period  $\bar{k}$ . However,  $\dot{N}_{ck}^r > 0$  ( $\dot{N}_{ck}^r < 0$ ) would suggest that the comparative advantage of country  $i$  in period  $k$  is  $\dot{N}_{ck}^r$  % stronger (weaker) than the respective country's comparative advantage in period  $\bar{k}$ .

### 3. DATA AND CONSTRUCTION OF VARIABLES

We utilized export statistics for 18 leading world citrus exporters, namely Argentina, Australia, Brazil, Chile, China, Egypt, India, Iran, Italy, Japan, Mexico, Morocco, Peru, SA, Spain, Turkey, the United States of America (USA) and Uruguay. Seven of these countries, Argentina, Australia, Brazil, Chile, Peru, SA and Uruguay, are the leading Southern Hemisphere citrus exporters. We used annual data obtained from the Food and Agricultural Organization of the United Nations (FAO), covering the period from 1961 to 2013 (FAO 2016). The data include citrus exports for each country  $X_c^i$ , world citrus exports  $X_c^w$ , citrus exports for Rest of World (ROW)  $X_c^{ROW}$ , agricultural exports for each country  $X_A^i$ , world agricultural exports  $X_A^w$ , and ROW agricultural exports  $X_A^{ROW}$ .

Citrus exports for each country  $X_c^i$  were derived by aggregating exports of the four categories of (1) grapefruit, including pomelos, (2) lemons and limes, (3) oranges, and (4) tangerines, mandarins, clementines and satsumas. In line with Seleka and Kebakile (2017), citrus and agricultural exports for ROW were derived as:

$$X_{Bt}^{ROW} = X_{Bt}^w - \sum_i X_{Bt}^i, \quad B = c, A \tag{7}$$

where  $t$  denotes year and other variables are as previously defined. In line with equation 3, citrus NRCA scores for country  $i$  and ROW were then expressed as:

$$N_{ct}^r = X_{ct}^r / X_{At}^w - X_{At}^r X_j^w / X_{At}^w X_{At}^w, \quad r = i, ROW \tag{8}$$

## 4. EMPIRICAL RESULTS

### 4.1 STATE OF COMPARATIVE ADVANTAGE

Table 1 reports five-year mean NRCA scores for the period from 1961 to 2010. The last column provides mean NRCA scores for the entire period from 1961 to 2013. We can identify five groups of countries based on the state of comparative advantage. The first group is comprised of countries that had comparative advantage for all the ten considered periods. Only three countries, Morocco, SA and Spain fit this profile. A noteworthy feature is that all the annual NRCA scores (not shown) for these countries were positive during the period 1961-2013, signifying consistency in comparative advantage. Thus, on the basis of the state of comparative advantage, these countries appear to be the three leading citrus exporters, and were the most consistently competitive in the global citrus market during the considered period.

**Table 1: Mean NRCA scores for the leading citrus exporters**

| Country   | 1961-1965 | 1966-1970 | 1971-1975 | 1976-1980 | 1981-1985 | 1986-1990 | 1991-1995 | 1996-2000 | 2001-2005 | 2006-2010 | 1961-2013 |
|---|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| <b>(a) Countries maintaining CA:</b>                      |           |           |           |           |           |           |           |           |           |           |           |
| Morocco   | 0.00132   | 0.00153   | 0.00107   | 0.00104   | 0.00073   | 0.00061   | 0.00046   | 0.00057   | 0.00043   | 0.00033   | 0.00078   |
| South Africa  | 0.00084   | 0.00066   | 0.00055   | 0.00054   | 0.00051   | 0.00043   | 0.00043   | 0.00042   | 0.00055   | 0.00065   | 0.00056   |
| Spain   | 0.00283   | 0.00287   | 0.00266   | 0.00296   | 0.00274   | 0.00396   | 0.00442   | 0.00381   | 0.00398   | 0.00313   | 0.00328   |
| <b>(b) Countries emerging from CD to CA:</b>              |           |           |           |           |           |           |           |           |           |           |           |
| Argentina   | -0.00045  | -0.00043  | -0.00021  | -0.00020  | -0.00019  | -0.00007  | -0.00002  | 0.00006   | 0.00008   | 0.00008   | -0.00013  |
| Egypt   | -0.00011  | 0.00001   | 0.00021   | 0.00021   | 0.00028   | 0.00022   | 0.00006   | 0.00005   | 0.00009   | 0.00025   | 0.00014   |
| Mexico  | -0.00009  | -0.00013  | -0.00005  | -0.00006  | -0.00005  | -0.00007  | -0.00002  | -0.00001  | 0.00004   | 0.00010   | -0.00003  |
| Peru  | -0.00007  | -0.00005  | -0.00004  | -0.00002  | -0.00001  | -0.00001  | -0.00001  | -0.00001  | 0.00000   | 0.00002   | -0.00002  |
| Turkey  | -0.00007  | 0.00002   | 0.00013   | 0.00021   | 0.00024   | 0.00020   | 0.00024   | 0.00028   | 0.00041   | 0.00052   | 0.00024   |
| Uruguay   | -0.00005  | -0.00004  | -0.00001  | 0.00002   | 0.00003   | 0.00007   | 0.00010   | 0.00009   | 0.00007   | 0.00004   | 0.00003   |
| <b>(c) Countries changing from CA to CD:</b>              |           |           |           |           |           |           |           |           |           |           |           |
| Italy   | 0.00154   | 0.00145   | 0.00079   | 0.00046   | 0.00014   | -0.00001  | -0.00015  | -0.00015  | -0.00020  | -0.00013  | 0.00035   |
| Japan   | 0.00015   | 0.00012   | 0.00014   | 0.00003   | 0.00003   | 0.00002   | -0.00001  | -0.00003  | -0.00003  | -0.00002  | 0.00004   |
| <b>(d) Countries moving from CA to CD and back to CA:</b> |           |           |           |           |           |           |           |           |           |           |           |
| Chile   | 0.00000   | -0.00001  | -0.00001  | -0.00001  | -0.00001  | -0.00003  | -0.00005  | -0.00004  | -0.00001  | 0.00003   | -0.00001  |
| China   | 0.00000   | -0.00010  | -0.00009  | -0.00010  | -0.00017  | -0.00032  | -0.00035  | -0.00022  | -0.00019  | 0.00011   | -0.00011  |
| <b>(e) Countries moving from CD to CA and back to CD:</b> |           |           |           |           |           |           |           |           |           |           |           |
| USA   | -0.00045  | -0.00028  | -0.00030  | -0.00030  | -0.00002  | 0.00034   | 0.00022   | 0.00001   | 0.00001   | -0.00021  | -0.00010  |
| <b>(f) Countries maintaining CA:</b>                      |           |           |           |           |           |           |           |           |           |           |           |
| Australia   | -0.00067  | -0.00059  | -0.00048  | -0.00039  | -0.00035  | -0.00035  | -0.00022  | -0.00016  | -0.00015  | -0.00010  | -0.00033  |
| Brazil  | -0.00029  | -0.00042  | -0.00043  | -0.00043  | -0.00040  | -0.00029  | -0.00025  | -0.00030  | -0.00038  | -0.00046  | -0.00037  |
| India   | -0.00025  | -0.00020  | -0.00015  | -0.00013  | -0.00011  | -0.00010  | -0.00010  | -0.00012  | -0.00012  | -0.00016  | -0.00015  |
| Iran  | -0.00003  | -0.00004  | -0.00004  | -0.00002  | -0.00001  | -0.00002  | -0.00001  | -0.00001  | -0.00001  | -0.00001  | -0.00002  |
| <b>(g) Aggregates:</b>                                    |           |           |           |           |           |           |           |           |           |           |           |
| ROW   | -0.00415  | -0.00437  | -0.00376  | -0.00382  | -0.00338  | -0.00459  | -0.00476  | -0.00425  | -0.00456  | -0.00416  | -0.00415  |
| Total   | 0.00415   | 0.00437   | 0.00376   | 0.00382   | 0.00338   | 0.00459   | 0.00476   | 0.00425   | 0.00456   | 0.00416   | 0.00415   |
| World   | 0.00000   | 0.00000   | 0.00000   | 0.00000   | 0.00000   | 0.00000   | 0.00000   | 0.00000   | 0.00000   | 0.00000   | 0.00000   |

Notes. CA: Comparative Advantage. CD: Comparative Disadvantage. NRCA: Normalized Revealed Comparative Advantage.

The second group is comprised of countries that emerged from initial states of comparative disadvantage to states of comparative advantage. In Table 1, these include Argentina, Egypt, Mexico, Peru, Turkey and Uruguay. Egypt and Turkey were the best performers in this group as they emerged from states of comparative disadvantage after the first period and maintained comparative advantage for the remaining nine periods. When considering the mean NRCA scores for the period 1961-2013, we may conclude that, on balance, Egypt and Turkey had comparative advantage. Uruguay emerged out of the state of comparative disadvantage during the period 1976-1980, and maintained comparative advantage for the rest of the considered period. For the entire period from 1961 to 2013, Uruguay recorded a positive mean NRCA score, signifying comparative advantage. Argentina, Mexico and Peru emerged from states of comparative disadvantage during the periods 1996-2000, 2001-2005 and 2001-2005, respectively. On balance, these countries had comparative disadvantages, based on the mean NRCA scores for the entire period from 1961 to 2013.

The third group consists of two countries, Italy and Japan, which declined from states of comparative advantage to states of comparative disadvantage. Italy declined into comparative disadvantage during the period 1986-1990 while Japan began experiencing comparative disadvantage during the period 1991-1995. However, on balance, the two countries had comparative advantages when considering the mean NRCA scores for the entire period from 1961 to 2013. The fourth group covers Chile and China, which recorded comparative advantages only in the first and last periods (1961-1966 and 2006-2010) and comparative disadvantages for the middle eight periods. On balance, the two countries had comparative disadvantages as evident from the mean NRCA scores for the period 1961-2013.

The fifth group is comprised of only one country, the USA. This country emerged from a state of comparative disadvantage during the period 1986-1990, but transitioned back to this state during the period 2006-2010. On balance, the USA had a comparative disadvantage, when considering its mean NRCA score for the entire period from 1961 to 2013. The last group is comprised of countries that had comparative disadvantage for all the ten considered periods; Australia, Brazil, India and Iran. When considering annual NRCA scores for the period from 1961 to 2013 (not shown), Australia, Brazil and India had comparative disadvantages for all the years, while Iran recorded comparative advantage only in 2005 and 2006. ROW also recorded comparative disadvantages for all the considered periods. This is because ROW is comprised of citrus exporting countries that are not necessarily among the global market leaders. Consistent with one of the properties of the NRCA index, the NRCA scores for all the considered countries (including ROW), or world NRCA scores, are equal to zero (see Yu, Cai, Laung 2009).

## 4.2 COMPARATIVE ADVANTAGE ACROSS COUNTRIES

### Ranking of countries

One of the unique properties of the NRCA index is that it allows for the comparison of comparative advantage across countries (Yu, Cai and Leung 2009). In Table 2, we used the NRCA scores to rank countries for each of the considered periods. Evidently, Spain ranked first throughout the considered period, suggesting that it is the most competitive in the global citrus market. Consistent with the previous findings, SA and Morocco ranked second and third, respectively, in more recent periods. SA improved in ranking over time; it ranked fourth from the early 1960s to the mid-1970s, third from the mid-1970s to the late 1990s and second from the early to the late 2000s. In turn, SA gained two positions during the considered period. Morocco also performed well, maintaining position two for most of the period. However, the country had slid to fourth position by 2006–2010. In turn, Morocco lost one position during the review period.

Turkey ranked third during the period 2006–2010, and experienced a steady and consistent improvement from the tenth position during the period 1961–1965. In turn, Turkey had gained seven positions by the period 2006–2010. Similarly, Egypt gained eight places during the considered period; from position 13 during the period 1961–1965 to position five during 2006–2010. China, which ranked sixth during 2006–2010, gained only one place from position seven in 1961–1965. However, the country's ranking deteriorated from position seven to 18 during the period from 1961 to 1995, before improving to position 6 during the period 2006–2010. Mexico ranked seventh during the period 2006–2010, compared to position 12 during 1961–1965, an improvement of five places.

Argentina, which ranked eighth during 2006–2010, saw a tremendous improvement in ranking during the considered period, where it gained nine places. Uruguay and Peru, which respectively ranked ninth and eleventh in 2006–2010, experienced no changes in rankings between 1961–1965 and 2006–2010. To the contrary, Chile, which ranked tenth in 2006–2010, lost four places between the two periods. Similarly, India and Iran lost two and four places, respectively, during the review period. Italy and Japan experienced substantial deterioration in rankings. Italy moved from position 2 during the period 1961–1965 to position 15 during 2006–2010, recording the highest loss in ranking (13 places) as a result. Similarly, Japan moved from position 5 to 13 during the review period, in turn losing eight places.

Australia improved from position 18 to 14, gaining four places as a result. The USA ranked sixteenth and seventeenth during 1961–1965 and 2006–2010, respectively, although it had improved to position four during the period 1986–1990. Lastly, Brazil ranked between positions 15 and 18 during the considered period, suggesting that it was one of the consistent low performers among the leading citrus exporters. In recent

**Table 2: Ranking of citrus exporters in terms of the NRCA scores**

| Country      | 1961-1965 | 1966-1970 | 1971-1975 | 1976-1980 | 1981-1985 | 1986-1990 | 1991-1995 | 1996-2000 | 2001-2005 | 2006-2010 | Change |
|--------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|--------|
| Argentina    | 17        | 17        | 15        | 15        | 16        | 13        | 12        | 6         | 6         | 8         | 9      |
| Australia    | 18        | 18        | 18        | 17        | 17        | 18        | 16        | 16        | 15        | 14        | 4      |
| Brazil       | 15        | 16        | 17        | 18        | 18        | 16        | 17        | 18        | 18        | 18        | -3     |
| Chile        | 6         | 8         | 8         | 9         | 10        | 12        | 13        | 13        | 12        | 10        | -4     |
| China        | 7         | 12        | 13        | 13        | 15        | 17        | 18        | 17        | 16        | 6         | 1      |
| Egypt        | 13        | 7         | 5         | 5         | 4         | 5         | 7         | 7         | 5         | 5         | 8      |
| India        | 14        | 14        | 14        | 14        | 14        | 15        | 14        | 14        | 14        | 16        | -2     |
| Iran         | 8         | 9         | 10        | 10        | 9         | 11        | 10        | 11        | 11        | 12        | -4     |
| Italy        | 2         | 3         | 3         | 4         | 6         | 9         | 15        | 15        | 17        | 15        | -13    |
| Japan        | 5         | 5         | 6         | 7         | 7         | 8         | 8         | 12        | 13        | 13        | -8     |
| Mexico       | 12        | 13        | 12        | 12        | 13        | 14        | 11        | 9         | 8         | 7         | 5      |
| Morocco      | 3         | 2         | 2         | 2         | 2         | 2         | 2         | 2         | 3         | 4         | -1     |
| Peru         | 11        | 11        | 11        | 11        | 11        | 10        | 9         | 10        | 10        | 11        | 0      |
| South Africa | 4         | 4         | 4         | 3         | 3         | 3         | 3         | 3         | 2         | 2         | 2      |
| Spain        | 1         | 1         | 1         | 1         | 1         | 1         | 1         | 1         | 1         | 1         | 0      |
| Turkey       | 10        | 6         | 7         | 6         | 5         | 6         | 4         | 4         | 4         | 3         | 7      |
| USA          | 16        | 15        | 16        | 16        | 12        | 4         | 5         | 8         | 8         | 17        | -1     |
| Uruguay      | 9         | 10        | 9         | 8         | 8         | 7         | 6         | 5         | 7         | 9         | 0      |
| ROW          | 19        | 19        | 19        | 19        | 19        | 19        | 19        | 19        | 19        | 19        | 0      |

Note. NRCA: Normalized Revealed Comparative Advantage.

periods, Brazil surpassed only ROW, which is composed of a collection of citrus exporters that are not necessarily among the world leaders.

### **Spatial comparisons of comparative advantage with SA as a base**

To advance the analysis further, Table 3 compares comparative advantage across countries, using SA as a benchmark (equation 4). For each period, the score for SA is normalized at 0 and the scores for other countries represent percentage deviations of the respective country's NRCA score from the NRCA score for SA. Two countries, Spain and Morocco, generally had stronger comparative advantages than SA. Spain's comparative advantage was 235-918% stronger than that for SA during the considered periods. Morocco's comparative advantage was 7-132% stronger than that for SA during the periods from 1961 to 2000. However, Morocco's comparative advantage was 23 and 49% weaker than that for SA during the periods from 2001 to 2010.

Italy's comparative advantage was 44-119% stronger than that for SA during the periods from 1961 to 1975. However, for the remaining periods, Italy's comparative advantage was 14-137% weaker than that for SA. The remaining countries had comparative advantages that were weaker than those for SA for all the 10 periods. For example, Japan's comparative advantage was 75-107% weaker than that for SA. Similarly, Brazil, one of the least competitive citrus exporters, recorded comparative advantages that were 134-180% weaker than the comparative advantages for SA. The scores for the remaining countries may be interpreted along similar lines.

## **4.3 COMPARATIVE ADVANTAGE ACROSS TIME**

### **Patterns of comparative advantage**

Table 4 provides estimates of annual changes in the NRCA scores for the period 1961-2013, which were computed using equation 5. As evident, the estimated coefficients are statistically significant, implying that the NRCA scores have changed over time. Table 5 provides period-based annual changes in the NRCA scores for each country, which were computed from the coefficients in Table 4. Also, the last column of Table 5 reports annual changes in the NRCA scores estimated through a single-period regression covering the period 1961-2013. Argentina, Australia, Italy, Japan, Mexico and Peru exhibited single-period trends in comparative advantage. Of these countries, Argentina, Australia, Mexico and Peru experienced increasing comparative advantages over time (see period 1 coefficients). With the exception of Australia, one other commonality is that these countries emerged from initial states of comparative disadvantage to states of comparative advantage. To the contrary, Italy, Japan and Morocco experienced declining comparative advantages over the review period. These trends caused Japan and



**Table 3: Changing comparative advantage across countries among citrus exporting countries**

| Countries    | 1961-1965 | 1966-1970 | 1971-1975 | 1976-1980 | 1981-1985 | 1986-1990 | 1991-1995 | 1996-2000 | 2001-2005 | 2006-2010 | 1961-2013 |
|--------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Spain        | 235.0     | 334.9     | 380.4     | 451.4     | 434.3     | 814.9     | 918.0     | 802.8     | 619.6     | 383.3     | 481.7     |
| Morocco      | 56.6      | 132.4     | 93.4      | 94.8      | 42.5      | 41.8      | 6.7       | 34.3      | -23.0     | -48.8     | 38.4      |
| South Africa | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       |
| Italy        | 82.4      | 119.1     | 43.5      | -13.5     | -72.4     | -101.5    | -133.5    | -136.7    | -136.3    | -119.6    | -38.3     |
| Argentina    | -153.5    | -165.8    | -138.3    | -136.7    | -136.3    | -115.5    | -104.4    | -84.7     | -86.2     | -88.3     | -122.9    |
| Australia    | -179.4    | -190.0    | -187.0    | -173.0    | -168.7    | -179.9    | -150.5    | -137.6    | -126.3    | -115.1    | -158.9    |
| Brazil       | -134.4    | -163.6    | -178.3    | -179.5    | -177.1    | -168.0    | -157.6    | -171.7    | -168.3    | -171.6    | -166.0    |
| Chile        | -99.7     | -101.4    | -101.2    | -101.9    | -102.3    | -107.6    | -111.0    | -109.1    | -102.5    | -96.1     | -101.8    |
| China        | -100.5    | -115.7    | -116.6    | -118.6    | -133.6    | -173.6    | -181.0    | -152.9    | -133.9    | -82.9     | -120.1    |
| Egypt        | -113.1    | -97.9     | -61.3     | -60.0     | -45.4     | -50.2     | -85.7     | -88.5     | -84.0     | -60.6     | -75.0     |
| India        | -129.6    | -129.7    | -127.5    | -123.8    | -122.1    | -122.8    | -123.8    | -128.1    | -121.3    | -124.4    | -126.3    |
| Iran         | -103.4    | -105.4    | -106.4    | -103.6    | -101.6    | -103.6    | -102.8    | -101.8    | -102.0    | -101.7    | -103.1    |
| Japan        | -81.7     | -82.0     | -74.8     | -94.2     | -93.8     | -94.9     | -102.2    | -106.6    | -105.8    | -103.6    | -93.4     |
| Mexico       | -110.8    | -120.0    | -109.3    | -111.2    | -109.5    | -115.8    | -104.0    | -101.2    | -92.3     | -84.5     | -104.8    |
| Peru         | -108.8    | -108.0    | -106.5    | -104.5    | -102.6    | -102.9    | -102.2    | -101.3    | -100.2    | -97.3     | -103.2    |
| Turkey       | -108.5    | -96.7     | -76.1     | -61.7     | -53.5     | -53.2     | -45.0     | -33.3     | -25.8     | -19.1     | -57.4     |
| USA          | -153.2    | -143.1    | -154.6    | -155.7    | -103.0    | -21.5     | -48.2     | -98.7     | -98.7     | -133.1    | -118.5    |
| Uruguay      | -106.1    | -106.1    | -101.4    | -96.6     | -94.4     | -84.5     | -76.2     | -78.2     | -87.7     | -93.1     | -94.5     |
| T total      | 391.2     | 561.3     | 578.0     | 611.7     | 560.5     | 961.4     | 996.6     | 906.9     | 725.4     | 543.8     | 635.8     |
| ROW          | -591.2    | -761.3    | -778.0    | -811.7    | -760.5    | -1161.4   | -1196.6   | -1106.9   | -925.4    | -743.8    | -835.8    |

Note. Computed using equation 4.

**Table 4: Piece-wise estimation of annual changes in NRCA scores, 1961-2013**

| Country   | Parameter Estimates     |                          |                          |                         |                         | Adj. R <sup>2</sup> |
|---|-------------------------|--------------------------|--------------------------|-------------------------|-------------------------|---------------------|
|   | Intercept               | Y                        | $(Y-\bar{Y}_2)D_2$       | $(Y-\bar{Y}_3)D_3$      | $(Y-\bar{Y}_4)D_4$      |                     |
| (a) Countries with one period:  |                         |                          |                          |                         |                         |                     |
| Argentina   | -0.022145<br>(0.000)*** | 0.000011<br>(0.000)***   |                          |                         |                         | 0.813               |
| Australia   | -0.02418<br>0.000**     | 0.000012<br>(0.000)***   |                          |                         |                         | 0.926               |
| Mexico  | -0.007994<br>(0.000)*** | 0.000004<br>(0.000)***   |                          |                         |                         | 0.674               |
| Peru  | -0.00346<br>(0.000)***  | 0.000002<br>(0.000)***   |                          |                         |                         | 0.869               |
| Italy   | 0.073178<br>(0.000)***  | -0.000037<br>(0.000)***  |                          |                         |                         | 0.755               |
| Japan   | 0.008046<br>(0.000)***  | -0.000004<br>(0.000)***  |                          |                         |                         | 0.794               |
| Morocco   | 0.049653<br>(0.000)***  | -0.000025<br>(0.000)***  |                          |                         |                         | 0.810               |
| ROW   | 0.00573<br>(0.538)      | -0.000005<br>(0.290)     |                          |                         |                         | 0.082               |
| (b) Country with two periods ( $\bar{Y}_2=1990$ ):  |                         |                          |                          |                         |                         |                     |
| India   | -0.011654<br>(0.000)*** | 0.000006<br>(0.000)***   | -0.000011<br>(0.000)***  |                         |                         | 0.783               |
| China   | 0.029792<br>(0.000)***  | -0.000015<br>(0.000)***  | 0.000042<br>(0.000)***   |                         |                         | 0.705               |
| (c) Country with two periods ( $\bar{Y}_2=1994$ ):  |                         |                          |                          |                         |                         |                     |
| Chile   | 0.003476<br>(0.000)***  | -0.000002<br>(0.000)***  | 0.000007<br>(0.000)***   |                         |                         | 0.820               |
| South Africa  | 0.025670<br>(0.000)***  | -0.0000127<br>(0.000)*** | 0.0000315<br>(0.000)***  |                         |                         | 0.650               |
| Uruguay   | -0.01049<br>(0.000)***  | 0.000005<br>(0.000)***   | -0.000010<br>(0.000)***  |                         |                         | 0.868               |
| (d) Countries with three periods ( $\bar{Y}_2=1973$ ; $\bar{Y}_3=1993$ ):                   |                         |                          |                          |                         |                         |                     |
| Brazil  | 0.034020<br>(0.000)***  | -0.000018<br>(0.000)***  | 0.000030<br>(0.000)***   | -0.000026<br>(0.000)*** |                         | 0.718               |
| Egypt   | -0.083186<br>(0.000)*** | 0.000042<br>(0.000)***   | -0.000053<br>(0.000)***  | 0.000022<br>(0.000)***  |                         | 0.530               |
| Spain   | 0.110924<br>(0.041)**   | -0.000055<br>(0.046)**   | 0.000153<br>(0.000)***   | -0.000181<br>(0.000)*** |                         | 0.574               |
| (e) Countries with three periods ( $\bar{Y}_2=1981$ ; $\bar{Y}_3=1997$ ):                   |                         |                          |                          |                         |                         |                     |
| Turkey  | -0.032473<br>(0.000)*** | 0.0000165<br>(0.000)***  | -0.0000169<br>(0.000)*** | 0.0000270<br>(0.000)*** |                         | 0.862               |
| (f) Countries with four periods ( $\bar{Y}_2=1972$ ; $\bar{Y}_3=1980$ ; $\bar{Y}_4=1987$ ): |                         |                          |                          |                         |                         |                     |
| Iran  | 0.002842<br>(0.004)***  | -0.000001<br>(0.003)***  | 0.000006<br>(0.000)***   | -0.000005<br>(0.000)*** | 0.000001<br>(0.137)     | 0.733               |
| USA   | -0.049916<br>(0.014)**  | 0.000025<br>(0.015)**    | -0.000046<br>(0.025)**   | 0.000130<br>(0.000)***  | -0.000136<br>(0.000)*** | 0.756               |

Notes. \*\*\* and \*\* denote statistical significance at 1% and 5%, respectively.

Estimated using equation 5. NRCA: Normalized Revealed Comparative Advantage

Italy to transit into states of comparative disadvantage, from initial states of comparative advantage. While Morocco maintained a state of comparative advantage, the continued decline in its NRCA scores would ultimately lead the country to also transit into a state of comparative disadvantage.

**Table 5: Annual changes in NRCA scores by period, 1961-2013**

| Country   | Period 1   | Period 2   | Period 3   | Period 4   | 1961-2013             |
|---|------------|------------|------------|------------|-----------------------|
| Countries with one period:  |            |            |            |            |                       |
| Argentina   | 0.0000111  |            |            |            | 0.0000111 (0.000)***  |
| Australia   | 0.0000120  |            |            |            | 0.0000120 (0.000)***  |
| Mexico  | 0.0000040  |            |            |            | 0.0000040 (0.000)***  |
| Peru  | 0.0000017  |            |            |            | 0.0000017 (0.000)***  |
| ROW   | -0.0000050 |            |            |            | -0.0000050 (0.290)    |
| Italy   | -0.0000367 |            |            |            | -0.0000367 (0.000)*** |
| Japan   | -0.0000040 |            |            |            | -0.0000040 (0.000)*** |
| Morocco   | -0.0000246 |            |            |            | -0.0000246 (0.000)*** |
| Country with two periods ( $\bar{Y}_2=1990$ ):  |            |            |            |            |                       |
| India   | 0.0000058  | -0.0000055 |            |            | 0.0000011 (0.015)**   |
| China   | -0.0000152 | 0.0000267  |            |            | 0.0000023 (1.195)     |
| Country with two periods ( $\bar{Y}_2=1994$ ):  |            |            |            |            |                       |
| Chile   | -0.0000018 | 0.0000050  |            |            | 0.0000003 (0.184)     |
| South Africa  | -0.0000127 | 0.0000188  |            |            | -0.0000031 (0.019)**  |
| Uruguay   | 0.0000053  | -0.0000044 |            |            | 0.0000023 (0.000)***  |
| Countries with three periods ( $\bar{Y}_2=1973$ ; $\bar{Y}_3=1993$ ):                   |            |            |            |            |                       |
| Brazil  | -0.0000175 | 0.0000121  | -0.0000142 |            | -0.0000008 (0.350)    |
| Egypt   | 0.0000423  | -0.0000107 | 0.0000111  |            | 0.0000040 (0.003)***  |
| Spain   | -0.0000550 | 0.0000980  | -0.0000830 |            | 0.0000162 (0.012)**   |
| Countries with three periods ( $\bar{Y}_2=1981$ ; $\bar{Y}_3=1997$ ):                   |            |            |            |            |                       |
| Turkey  | 0.0000165  | -0.0000004 | 0.0000266  |            | 0.0000115 (0.000)***  |
| Countries with four periods ( $\bar{Y}_2=1972$ ; $\bar{Y}_3=1980$ ; $\bar{Y}_4=1987$ ): |            |            |            |            |                       |
| Iran  | -0.0000015 | 0.0000042  | -0.0000008 | 0.0000003  | 0.0000006 (0.000)***  |
| USA   | 0.0000252  | -0.0000211 | 0.0001089  | -0.0000271 | 0.0000070 (0.004)***  |

Notes. \*\*\* and \*\* denote statistical significance at 1% and 5%, respectively.

Period-based estimates derived from Table 4 coefficients. NRCA: Normalized Revealed Comparative Advantage.

India, China, Chile, SA and Uruguay exhibited two-period trends in comparative advantage (Table 5). India and Uruguay experienced increasing and decreasing comparative advantages during periods 1 and 2, respectively. Despite experiencing increasing comparative advantage in period 1, India was never able to emerge out of

the state of comparative disadvantage. However, India's annual change in the NRCA score for the entire period from 1961 to 2013 is positive, suggesting that, on balance, the country witnessed increasing comparative advantage (Table 5; last column). Uruguay, which transitioned from a state of comparative disadvantage to that of comparative advantage, also experienced increasing comparative advantage during the entire review period.

China, Chile and SA experienced declining comparative advantages in period 1, followed by increasing comparative advantages in period 2. China had comparative disadvantage for most of the considered period, and emerged from such a state in 2008. On balance, China's comparative advantage remained stagnant during the period 1961-2013, given that its estimated annual change in the NRCA scores is statistically insignificant. Despite experiencing declining NRCA scores during period 1, SA managed to maintain comparative advantage throughout the entire review period. However, on balance, the country experienced negative annual changes in its NRCA scores during the period from 1961 to 2013. Chile, which generally recorded negative NRCA scores during the period 1961-2013, recorded stagnant NRCA scores during the same period.

Brazil, Egypt, Spain and Turkey exhibited three-period trends in the NRCA scores. Brazil and Spain witnessed declining, increasing and declining comparative advantages during periods 1, 2 and 3, respectively. However, Brazil maintained comparative disadvantage while Spain maintained comparative advantage during the entire period from 1961 to 2013. On balance, Spain experienced positive while Brazil recorded stagnant annual changes in the NRCA scores during the same period. In contrast, Egypt and Turkey experienced increasing, declining and increasing comparative advantages in periods 1, 2 and 3, respectively. These countries emerged from states of comparative disadvantage in the late 1960s and maintained comparative advantage for the remaining period. On balance, Egypt and Turkey recorded positive annual changes in the NRCA scores during the entire review period.

Iran and the USA exhibited four-period trends in the NRCA scores. However, Iran's differential change in the NRCA score for period 4 is statistically insignificant (Table 4). Therefore, we can conclude that Iran witnessed decreasing, increasing and decreasing comparative advantage during period 1, period 2 and period 3, respectively, while the period 4 estimate is not statistically different from that for period 3. Iran had comparative disadvantage for most of the considered period, except for years 2005 and 2006. However, on balance, Iran saw positive changes in its NRCA scores during the period 1961-2013, suggesting an improvement in comparative advantage over time.

The USA saw rising comparative advantage during periods 1 and 3 and declining comparative advantage during periods 2 and 4. While it emerged out of a state of comparative disadvantage to that of comparative advantage during period 3, the USA

transited back into a state of comparative disadvantage during period 4. On balance, the USA witnessed positive annual changes in its NRCA scores during the period 1961-2013, implying increasing comparative advantage.

### Temporal strength of comparative advantage

Table 6 provides comparisons of comparative advantage across time, with the NCRA scores for the period 1961-1965 normalized at 0 (equation 6). Countries are arranged according to whether they experienced strengthening or weakening comparative advantage between the periods 1961-1965 and 2006-2010. Countries that witnessed stronger comparative advantages in 1961-1965 than in 2006-2010 are Argentina, Australia, Chile, China, Egypt, India, Iran, Mexico, Peru, Spain, Turkey, the USA and Uruguay.<sup>4</sup> Evidently, Turkey experienced the strongest increases in comparative advantage, with its NRCA scores rising by 131-832% against the estimate for the period 1961-1965. Egypt and Uruguay also exhibited impressive trends, with comparative advantages for the periods from 1966 to 2010 being respectively 112-353% and 23-299% stronger than the countries' comparative advantages for 1961-1965.

Comparative advantages for Argentina, Peru and the USA for the periods between 1966 and 2010 were 4-117%, 29-123%, and 33-176% stronger than the countries' comparative advantages for the period 1961-1965. Similarly, comparative advantages for Australia, India and Spain were respectively 11-85%, 21-61% and 2-56% stronger than the countries' comparative advantages for the period 1961-1965 (except that Spain's comparative advantages for 1971-1975 and 1981-1985 were 6% and 3% weaker than the country's estimate for 1961-1965). While Mexico's comparative advantage during the period 1966-1970 was 45% weaker than the country's comparative advantage for 1961-1965, its comparative advantages for the remaining periods were 34-210% stronger than the country's comparative advantage for 1961-1965.

Similarly, despite recording weaker comparative advantages for the two periods between 1966 and 1975, Iran recorded comparative advantages that were 34-72% stronger than its comparative advantage for the period 1961-1965 for the periods between 1976 and 2010. Chile and China exhibited unique patterns of comparative advantage, with their NRCA scores for the periods from 1966 to 2005 being respectively 419-2308% and 1908-7568% weaker than the countries' comparative advantages for the period 1961-1965. However, Chile's and China's comparative advantages for the period 2006-2010 were respectively 1072% and 2518% stronger than the corresponding estimates for 1961-1965.

Despite being among the leaders in terms of the strength of comparative advantage, SA and Morocco had weaker comparative advantages during the periods from 1966 to 2010 than for 1961-1965. Brazil, Italy and Japan also had weaker comparative advantages for the

<sup>4</sup> Chile and China were included among these countries although they attained positive entries only during 2006-2010. The rest of the periods exhibited lower comparative advantage compared with the estimates for 1961-1965.

**Table 6: Changing comparative advantage across time among citrus exporting countries**

| Country                              | 1961-1965 | 1966-1970 | 1971-1975 | 1976-1980 | 1981-1985 | 1986-1990 | 1991-1995 | 1996-2000 | 2001-2005 | 2006-2010 |
|--------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| <b>Countries with increasing CA:</b> |           |           |           |           |           |           |           |           |           |           |
| Argentina                            | 0.0       | 3.9       | 53.0      | 56.4      | 58.9      | 85.2      | 95.7      | 114.2     | 116.9     | 116.8     |
| Australia                            | 0.0       | 11.4      | 28.2      | 41.6      | 47.5      | 48.4      | 67.3      | 76.4      | 78.3      | 85.5      |
| Chile                                | 0.0       | -531.6    | -419.2    | -570.1    | -654.7    | -1622.6   | -2307.5   | -1873.6   | -733.8    | 1071.7    |
| China                                | 0.0       | -2158.9   | -1908.4   | -2075.9   | -3660.2   | -6851.3   | -7568.0   | -4767.3   | -3987.8   | 2517.6    |
| Egypt                                | 0.0       | 112.3     | 293.4     | 293.5     | 352.7     | 294.4     | 155.9     | 143.7     | 179.7     | 330.0     |
| India                                | 0.0       | 21.4      | 38.9      | 48.8      | 54.7      | 60.5      | 58.7      | 52.5      | 52.9      | 36.8      |
| Iran                                 | 0.0       | -22.4     | -22.8     | 34.1      | 72.3      | 46.8      | 58.5      | 74.3      | 62.3      | 62.7      |
| Mexico                               | 0.0       | -45.0     | 43.4      | 34.0      | 46.5      | 24.9      | 80.8      | 94.5      | 146.9     | 210.3     |
| Peru                                 | 0.0       | 29.1      | 51.3      | 67.5      | 82.0      | 83.2      | 87.2      | 92.7      | 98.5      | 123.9     |
| Spain                                | 0.0       | 1.6       | -5.9      | 4.5       | -3.2      | 40.0      | 56.1      | 34.6      | 40.6      | 10.5      |
| Turkey                               | 0.0       | 130.5     | 285.1     | 387.2     | 433.4     | 383.3     | 433.6     | 493.4     | 673.6     | 831.5     |
| Uruguay                              | 0.0       | 22.7      | 84.8      | 135.2     | 155.5     | 229.5     | 299.2     | 278.0     | 231.8     | 186.8     |
| USA                                  | 0.0       | 36.7      | 32.7      | 33.5      | 96.6      | 175.6     | 150.1     | 101.2     | 101.6     | 52.4      |
| <b>Countries with declining CA:</b>  |           |           |           |           |           |           |           |           |           |           |
| Brazil                               | 0.0       | -44.3     | -49.1     | -46.5     | -35.9     | -1.1      | 14.1      | -4.0      | -29.8     | -59.3     |
| Morocco                              | 0.0       | 16.1      | -19.0     | -21.0     | -44.8     | -53.6     | -65.0     | -57.2     | -67.8     | -75.0     |
| South Africa                         | 0.0       | -21.8     | -34.4     | -36.5     | -39.3     | -48.7     | -48.6     | -50.0     | -34.5     | -23.4     |
| Italy                                | 0.0       | -6.1      | -48.4     | -69.9     | -90.8     | -100.4    | -109.4    | -110.1    | -113.0    | -108.2    |
| Japan                                | 0.0       | -22.8     | -9.4      | -79.9     | -79.3     | -85.7     | -106.2    | -118.1    | -120.7    | -115.1    |
| <b>Aggregates:</b>                   |           |           |           |           |           |           |           |           |           |           |
| Total†                               | 0.0       | 5.3       | -9.4      | -8.0      | -18.4     | 10.8      | 14.7      | 2.4       | 10.0      | 0.4       |
| ROW                                  | 0.0       | -5.3      | 9.4       | 8.0       | 18.4      | -10.8     | -14.7     | -2.4      | -10.0     | -0.4      |

Notes. †: Refers to an aggregate of the 18 countries. CA: Comparative Advantage. Estimates were computed using equation 6.

periods from 1966 to 2010 than for the period 1961-1965. SA's comparative advantages during the periods from 1966 to 2010 were 22-50% weaker than its comparative advantage for the period 1961-1965. Similarly, Morocco's comparative advantages for the periods from 1971 to 2010 were 19-75% weaker than its comparative advantage for 1961-1965. However, Morocco's comparative advantage for the period 1966-1970 was 16% stronger than the country's estimate for 1961-1965. Brazil's comparative advantage for the period 1991-1995 was 14% stronger than its comparative advantage for 1961-1965. However, for the remaining periods, Brazil's comparative advantages were 1-59% weaker than its comparative advantage for the period 1961-1965. The comparative advantages for Italy and Japan for the periods from 1966 to 2010 were respectively 6-113% and 9-121% weaker than the countries' comparative advantages for 1961-1965.

## 5. IMPLICATIONS FOR SOUTH AFRICA

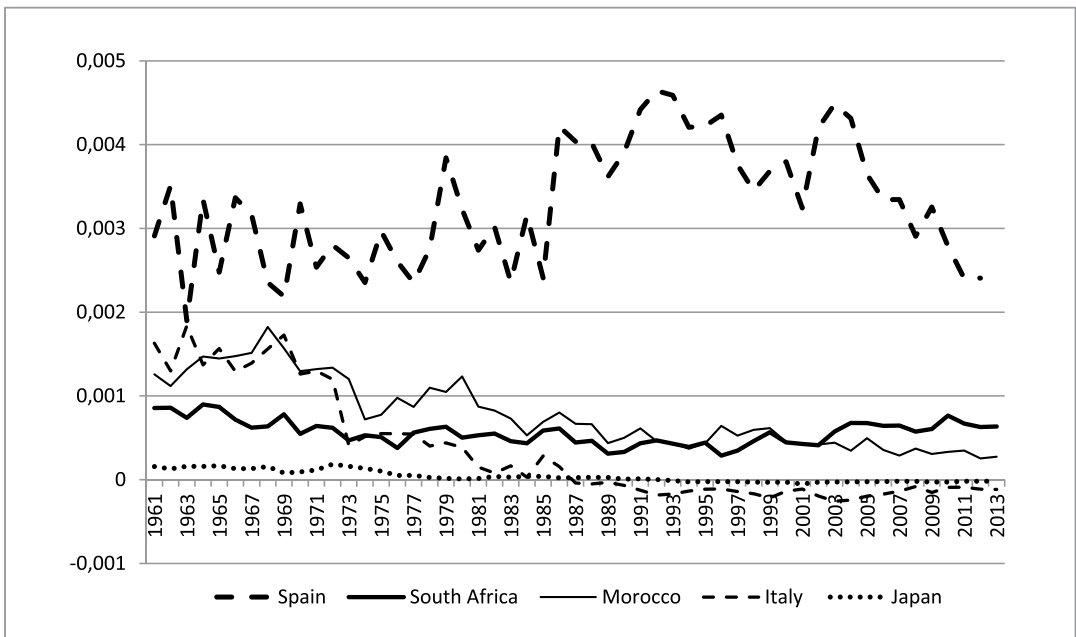
As noted previously, SA is one of the most competitive exporters in the global citrus market. To explore this issue further, Figure 1 compares the annual NRCA scores for SA with those for other countries that were among the top five citrus exporters, in terms of the strengths of comparative advantage, in the period 1961-1965. As evident, SA ranked fourth during the period from 1961 to the early 1970s, surpassed by Spain, Morocco and Italy. But SA's comparative advantage was stronger than that for Japan, which ranked fifth during the period 1961-1970. SA then bypassed Italy during the mid-1970s and remained at third position until the late 1990s to early 2000s. By around 2003, SA had bypassed Morocco to reach second place, which it maintained for most of the remaining period (until 2013). From Figure 1 it is also evident that SA's comparative advantage was weaker than that for Spain during the entire period from 1961 to 2013. Also, SA's comparative advantage was stronger than that for Japan throughout the considered period.

Improvements in SA's relative performance against its competitors were due to a number of trends, including the following. First, Italy's and Morocco's comparative advantages fell faster than SA's during the period from the early 1960s to the early 1990s, a situation which led to SA bypassing the two countries in the early 1970s and early 2000s, respectively. Second, while SA's comparative advantage declined during the period from 1961 to the mid-1990s, the country experienced increasing comparative advantage for the remaining period up to 2013, leading to improved relative performance against other key players in the global citrus market in more recent periods. This trend suggests that SA's comparative advantage weakened during the apartheid era (1961-1994), perhaps due to trade sanctions, and strengthened during the post-apartheid period (1994-2013) after the removal of trade sanctions (see Tables 4 and 5).

The implications of the most recent trends being maintained in future are as follows. First, if the comparative advantages for Italy and Morocco continue to weaken while that for SA strengthens, there would be continued divergence in the comparative advantages of the two countries from that for SA. Therefore, the relative performance of SA against

the two countries would continue to improve. Second, the continued weakening of Spain's and strengthening of SA's comparative advantages would lead to further convergence in the comparative advantages of the two countries. This situation would work in favor of SA and strengthen its relative competitiveness against Spain. This is illustrated in Figure 2, which plots both actual and predicted NRCA scores for the two countries. As seen, if the most immediate trends in the NRCA scores for the two countries are continued into the future, the relative performance of SA against Spain would continue to improve, and equality in the comparative advantages of the two countries would be reached around 2033. After 2033, SA would surpass Spain in terms of comparative advantage in citrus exports. However, it appears improbable that the current trends would be maintained in the next two decades, implying that the prospects of SA bypassing Spain in the near future are remote.

**Figure 1: Trends in the NRCA scores for the five leading citrus exporters in the early 1960s**

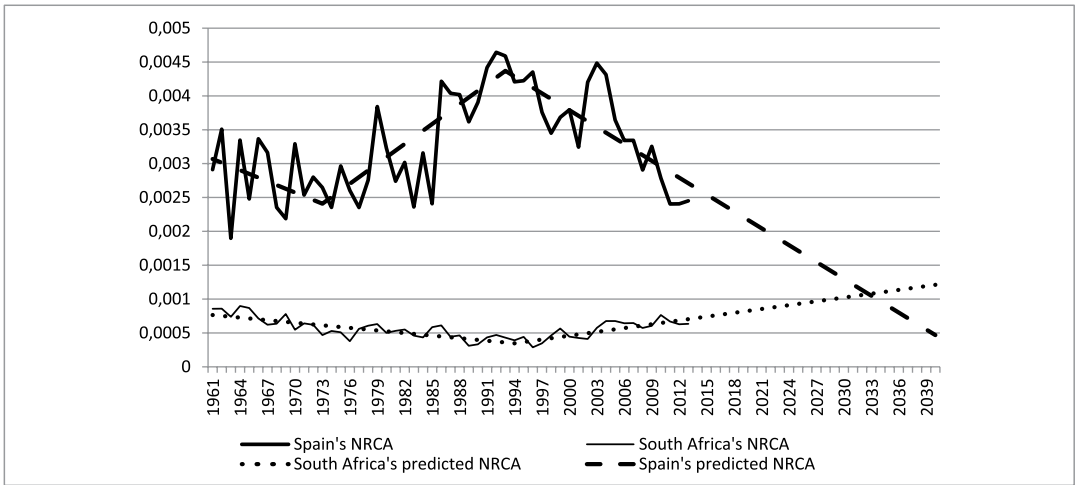


Note. NRCA: Normalized Revealed Comparative Advantage.

Despite its relative improvement against Spain, Morocco, Italy and Japan, which were the leading exporters in the early 1960s, SA may face a threat from countries that were not that competitive in the early 1960's. To demonstrate this point, Figure 3 provides comparisons of the NRCA scores for SA with those for Turkey and Egypt. As seen, there appears to have been convergence of the two countries' NRCA scores with those for SA, implying that the changes in the two countries' comparative advantages generally outstripped those for SA.

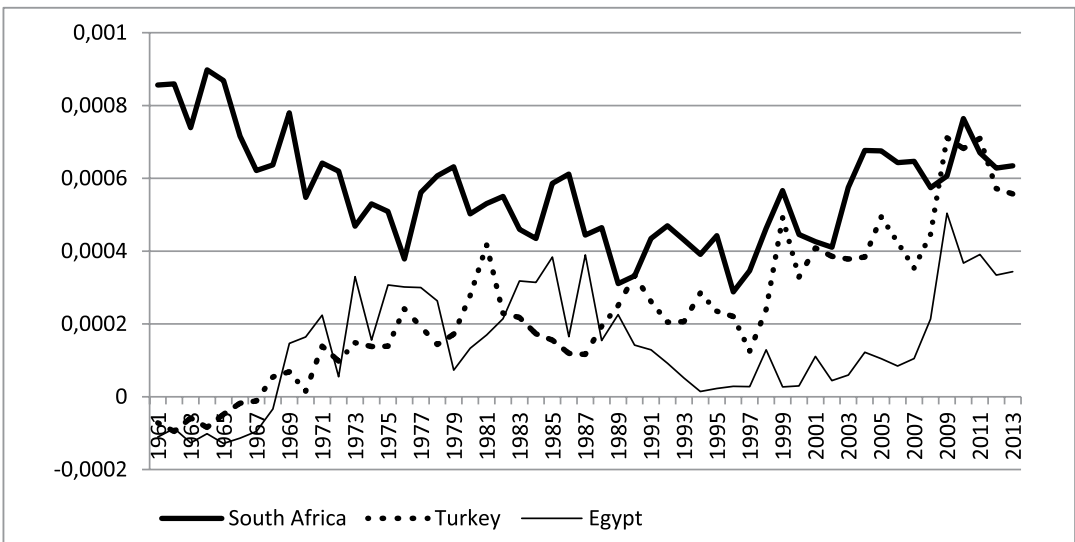


**Figure 2: Comparison of Spain’s and South Africa’s NRCA Scores**



Note. NRCA: Normalized Revealed Comparative Advantage.

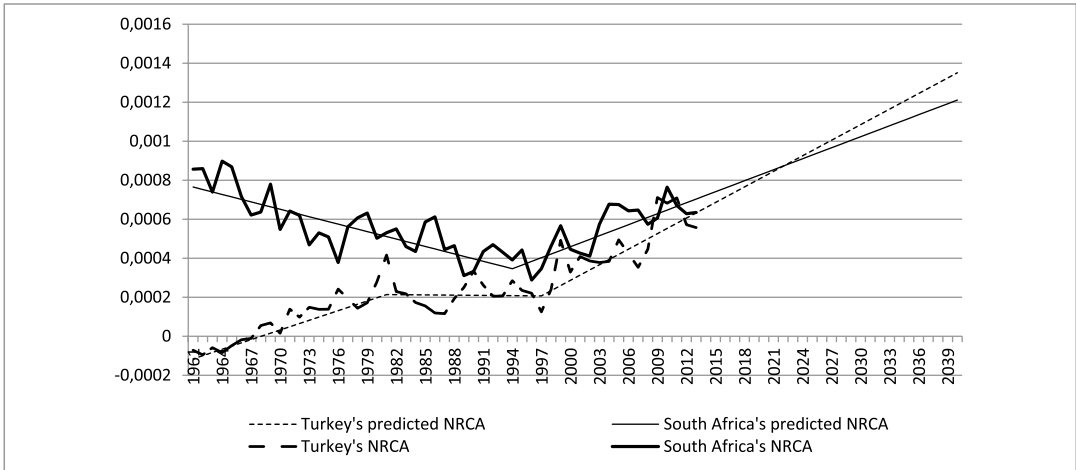
**Figure 3: Comparison of South Africa’s NRCA scores with those for Turkey and Egypt**



Note. NRCA: Normalized Revealed Comparative Advantage.

Turkey in particular poses an imminent threat and it may catch up with SA. The predicted NRCA scores indicate that Turkey would bypass SA after 2021 (Figure 4). Thus, the continuation of current trends would imply that Turkey would definitely bypass SA to rank second, after Spain, and that SA would be relegated to third place. However, the threat from Egypt does not appear to be immediate since predicted NRCA scores (not shown) showed divergence in the comparative advantages, in favor of SA, in more recent years.

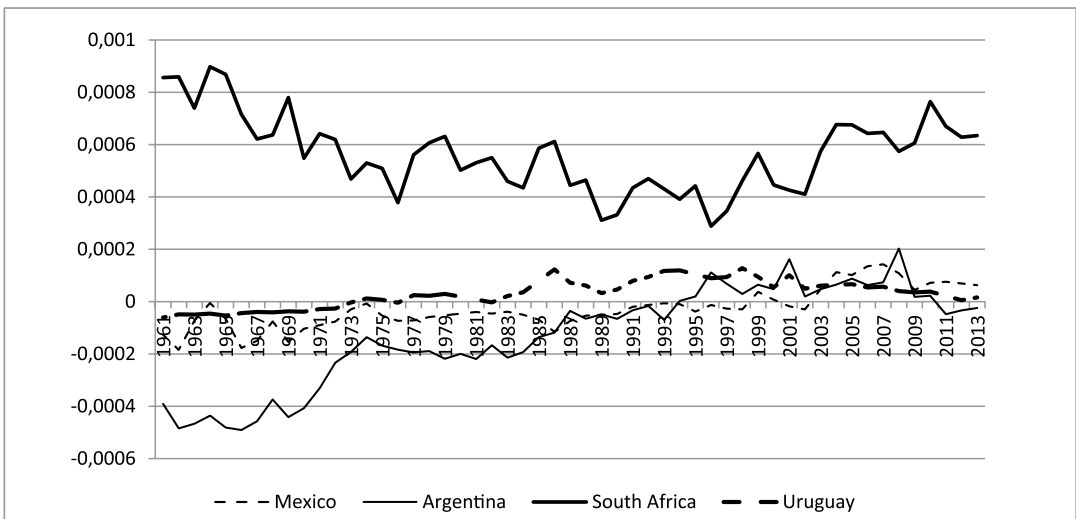
**Figure 4: Comparison of South Africa's NRCA Score with those for Turkey**



Note. NRCA: Normalized Revealed Comparative Advantage.

Figure 5 compares the NRCA scores for selected Southern Hemisphere countries with that for SA. The three countries, Argentina, Mexico and Uruguay, experienced increasing comparative advantages over time. The NRCA scores for these countries converged with that for SA up to the mid-1990s, signifying that these countries were catching up with SA. However, the NRCA scores have diverged since the mid-1990s, suggesting that SA experienced increased relative performance against these countries during the post-apartheid era. Therefore, there appears to be no immediate threat from these countries.

**Figure 5: Comparison of SA's NRCA scores with those for southern hemisphere Citrus exporters**



Note. NRCA: Normalized Revealed Comparative Advantage.

## 6. FINAL REMARKS

The purpose of this paper was to examine the export competitiveness of the world's leading citrus exporting countries in the global citrus market and to draw implications for SA. The paper adopted the NRCA index to assess RCA across countries and time. The results indicate that Morocco, SA and Spain were the leaders, as they experienced consistent comparative advantage throughout the review period from 1961 to 2013. Argentina, Egypt, Mexico, Peru, Turkey and Uruguay emerged from initial states of comparative disadvantage to states of comparative advantage during the review period, while Italy and Japan experienced opposite trends. China and Chile experienced comparative advantage during earlier and later years, and comparative disadvantage for the middle years. The USA, emerged from a state of comparative disadvantage in the late 1980s, but reentered this state in the late 2000s. Lastly, Australia, Brazil, India and Iran recorded comparative disadvantage throughout the period 1961-2013.

The ranking of countries revealed that Spain was the global leader throughout the review period. SA improved steadily from position four in the 1960s, to reach position two in the 2000s. Morocco maintained position two for most of the review period, but had slid to position four during the late 2000s. Turkey improved from position 10 in the early 1960s to position three in the late 2000s, in turn surpassing a number of countries, including Morocco.

Spatial comparisons of comparative advantage indicate that Spain's comparative advantage was 235-918% stronger than that for SA. Morocco's comparative advantage was 7-132% stronger than that for SA from the early 1960s to the late 1990s. However, a reverse scenario occurred in the 2000s, with SA's comparative advantage being 23-49% stronger than that for Morocco. The remaining countries were consistently outperformed by SA, except for Italy during the periods from 1961 to 1975.

Trend regressions over the period 1961-2013 revealed increasing comparative advantages for Argentina, Australia, Mexico, Peru, India, Uruguay, Egypt, Spain, Turkey, Iran and the USA. However, Italy, Japan, Morocco and SA exhibited decreasing comparative advantage over the same period. The remaining countries, China, Chile and Brazil, experienced no discernible trends in comparative advantage over the review period. While SA experienced a declining trend in the NRCA scores over the period 1961-2013, its situation was worth further examination. The country's comparative advantage weakened between 1961 and the mid-1990s, which coincided with the apartheid era. However, a positive trend in comparative advantage was evidence during the post-apartheid era, implying that the lifting of sanctions has played a significant part in increasing the country's competitiveness. While SA's ranking improved from fourth to second position during the review period, it faced an eminent threat from Turkey, which is likely to surpass it into position two in the early 2020s.

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