Emerging Agricultural and Horticultural, 3023-3356
Volume 2023, Article ID 18
doi: 10.23958/eah/vol2023/18

Review Article

Covid-19 Pandemic and the Sudan's Economy: Issues, Policy Recommendations with Focusing on Agricultural Exports "Evidences from Simultaneous Equation Model"

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Abstract

The objective of this study is to analyze the impact of Covid-19 Pandemic on various significant economic variables in Sudan with focusing on agricultural exports to address some policy recommendations; using evidences from Simultaneous Equation Model (SEM) together with co-integration test, covering the period from 1974-2019. The results show that an increasing of exports will lead to the increasing in economic growth and in both food production index and household consumption expenditure. However, an increasing of the food production index will lead to the increasing in both investments in agricultural lands and the household consumption expenditure, meaning that investment food production based on the comparative advantages of Sudan will increase food exports in light of COVID-19 pandemic, which leads to improving the economic conditions of the population and reducing poverty. The study recommended that policy makers should take on consideration the investment in the agricultural sector side by side with the oil and mining sectors, where by drawing up strategic plans, drawing effective policies, and establishing the necessary infrastructure development of the Sudan's economy, so as it has huge and diverse potentials and resources that must be used optimally in the shadow of the COVID-19 pandemic in particular, thus, establishing the economic and political stability, construction valuable infrastructure and improvement production and promoting exports via bringing modern agricultural technology to contribute of increasing production and productivity, reducing costs and increasing competitiveness.

Keywords: Covid-19 Pandemic, Sudan Economy, Agriculture exports, Simultaneous Equation Model.

Introduction

Sudan is rich country in terms of natural resources, agricultural (fertile lands), animal, fisheries, forests, mineral, gum Arabic, oil, gold plant and water. In addition to the great benefit of Sudan from the establishment of the Ethiopian Renaissance Dam as one of the largest dams in Africa, where Sudan benefits more in the field of agriculture, the most important of which is that is to cultivate two seasons per year instead of once before the dam. So, the main approval of Sudan is agriculture; Nearly half of the national workforce is engaged in agriculture (i.e. crop, livestock, fisheries and forestry production) and agro processing industries, 90-120 million heads of animals; 175 million feddans of unused cultivable land; agriculture accounted for nearly one-third of the total national GDP. In 2009, 34 percent of the total labour force was engaged in agriculture. The total population of Sudan is 36.2 million; of which two-thirds live in rural areas Sudan is classified as a "low human development (FAO, 2015). As well as Sudan is one of the three largest countries in the African continent in terms of area and one of the most important countries in the world where there is water and agricultural land suitable for agriculture, approximately one third of its total area of 1,886,068 square kilometers (728,215 square miles), which makes it a confirmed global "food basket". The area of arable land in 2019 estimated by World Bank at (1024573905 hectares) parted to rained and irrigated land, especially on the banks of the Nile and other rivers in the north of the country (Claire, 2014 & Maria and Abdalla, 2017).

However, during the last three decades of Bashir's regime Sudan economy suffer from many constrains states as follows; secession of South Sudan, (including the loss of human and land resources, and three-quarters of the oil wealth), debt burden is a significant development constraint , Darfur and other conflicts (i.e. Darfur and Eastern Regions, Blue Nile, South Kordofan and Western Kordofan States and Abyei protocol area), high corruption, the economic obstruction of Sudan, absence of policies and weak economic planning which impacted production and exports, where Sudan missed great opportunities to be the world's food basket.

In 2020 Sudan witnessed the national December Revolution-2019 leads to changing of Sudan conditions locally, regionally, nationally and international at political and economic dimensions, subsequently an isolation as long as closely 30 years of Bashir's regime, where the Sudanese government changed and lead to transformer the government system from a military government to civil democratic government, where the Sudanese Revolution was a major shift of political power in Sudan that started with street protests throughout Sudan on 19 December to civil disobedience; which culminated in June 30 with a great change in the government system. Accordingly, in June 2020 Sudan witnessed an international conference to support Sudan in the political and economic fields where it was clearly referred to the international partnership with a

large number of great countries to foreign investment. As well as Sudan has substantial abounds huge natural resources, especially the arable land resources for food production that the world will requirement within and after the COVID-19 pandemic, and further massive mineral resources. As we noted in May 2020 that Sudan may already be increasing food exports during the COVID-19 to many countries to supply it with foodstuffs to meet the economic consequences of precautionary measures in the world to limit the spread of Covid-19. It notes the continuing export operations and the smooth flow of meat and beef exports via air freight to Saudi Arabia, Egypt, Bahrain, Kuwait and the Sultanate of Oman in bright of the food shortage due to the Covid-19 epidemic.

The question then appears: Does the COVID-19 pandemic benefit Sudan from some opportunities for agricultural exports? assuming that it is a rich country in agricultural resources and food production can be exported to Arab and other world where the demand of food is increasing severely in the accommodation of COVID-19. The study attempts to apply the Simultaneous Equations Model (SEM) together with co-integration test between several variables with focusing on agricultural exports (XTS), such as agricultural land (AAL), food production index (FPI), population growth (PPG), oil production (OXD), mining production (GXD), external balance (TTB), inflation rate (INF), household consumption expenditure (HHX), economic growth (GDP), government total expenditure (GTX), foreign direct investment (FDI) and consumer price index (CPI) during the period of 1974-2019.

Literature Review

Fabrizio and Alberto, (2007, 23, 210) argued that an increase in farm income has the potential to stimulate economic growth, where the linkages between agriculture and the rest of the economy increase. So, with public policies that strengthen the linkages between poverty and agriculture and down- stream activities, including agro-industrial processors, packagers, and other industries with process raw materials produced by agriculture. Kym, (2009, 51, 515, 522) highlighted that the shares of agriculture and food in global GDP and global merchandise trade are only 3 and 6 percent, respectively, where the contribution of farm and food policy reform to prospective welfare gain for just developing countries is even greater, at 72 percent. So, the impacts on agricultural and food output and trade for various countries and regions suggest farm trade would have been two- thirds larger in real value terms had the past two decades of reform not occurred; for developing countries as a group, their terms of trade have worsened because of these reforms for two sets of reasons: for nonagricultural goods, export prices have been lowered by 0.4 percent, while import prices have hardly been affected; and for farm products, reduced export prices 0.6 percent.

Jagdish, (2000, 48) emphasized that agricultural exports play a key role in the process of economic growth of developing countries. Since agriculture, is the sector in which natural endowments have the greatest weight, in the initial stages of economic growth of most of developing countries, agriculture has been a major source of exports, and the resulting command over the resources of more developed nations has played strategic role in facilitating modern economic growth. SQren, (2007, 313) identified that even substantial exportable- surplus of industrial crops, produced by the large-scale sector of agriculture, can usually be effectively mobilized for general economic development only by political means. So, the agriculture surplus scan be the prime generation force for developing and integrating the national economy. Carl and John, (1998, 226) believed that the economic development is a process by which an economy is transformed from one that is dominantly rural and agricultural to one that is dominantly urban, industrial, serve-oriented in composition.

Seventh, (1985, 5) has shown that the agriculture constitutes the most of important part of the primary sector. So, traditionally, agriculture has been given a fivefold role in the process of economic development. As well as enough food has to be provided to meet the rise in demand as the population grows and real incomes increase when the non- agriculture sectors of the economy develop. Also, agriculture has to provide the economy with foreign exchange, in particular at the early stages of development. Moreover, the role of agriculture must contribute both to the formation of overhead capital in the economy and to investment in the other sectors of the economy if these are to be able to grow. Where, it is the responsibility of agriculture to increase the cash incomes of the rural population, thereby stimulating the demand for non- agricultural goods and services.

However, livestock and husbandry in Sudan according to Mahgoob, (2014) are the main sources of livelihood in Sudan for more than 61% of the working population, according to the 1990's census were engaged in agricultural activities. Where, Sudan enjoys huge water resources, arable lands of an approximately one third of its total area of 1,886,068 square kilometers, (728,215 square miles) making it true to say that Sudan is the future food basket of the globe. The area of arable land in 1998 was estimated at 16,900,000 hectares (41.8 million acres) of which about 1.9 million hectares (4.7 million acres) of irrigated land, especially on the banks of the Nile and other rivers in the northern regions of the country. Cotton is a major export crop. Sudan is the largest sesame producing country and the first undisputed producer of Gum Arabic.

On the other side, Paul, Abura and Jaston, (2002) have shown that Sudan knew gold in ancient times and called the northern part of Nubia, Nubia means the land of gold Silver: Silver metal is produced in Sudan in some mines in the Red Sea Stat; the potential reserve is estimated at (1500) tons of silver; chrome: Excavation in Sudan started commercially since the 1970s, and the reserve is estimated at about two million tons, with a concentration rate of 48-60% in the case of high-quality vines; the chromium stock in Sudan is currently estimated at about 50,000 tons, of which about one million tons are in the mountains of Angassana in the Blue Nile State. Where, the most important vine production areas are the Kurmuk - Qaissan region, where there are economic quantities of chromium within the oviolite rocks; Copper: There are areas in western Sudan, the mountains of the Red Sea, where copper sulfate has been found in Abu Samar area and the reserve percentage is increasing in depth; iron: The area of the iron mineral in Sudan lies between latitudes 22 ° 22` - 4'21 north and longitudes 45'31 ° 15-31 'east. Iron is found Abu Hamad in the southeast and Al-Bajrawyah and Shendi in the south of the state of the Nile River and in western Sudan in Darfur, Karnawi area north of Kutum as well Burberry Mountains, West Darfur.

Josef (2020) study conjectured that the COVID-19 pandemic affects the entire food system through exerts a symmetric, and shock on global and national food systems; affect both supply and demand channels with felt at different points in time; they will affect all elements of the food system, from primary supply, to processing, to trade as well as national and international logistics systems, to intermediate and final demand. It also affects factor markets, namely labour and capital, and intermediate inputs of production, also, the channels of transmission into food and agricultural demand include

numerous macroeconomic factors. So, given the fact that, agriculture in high-income countries is a capital-intensive industry, exposed to possible disruptions of supplies of intermediate inputs in the short term and fixed capital items in the longer term. Where, the same holds for some agricultural systems in low-income countries, but their exposure to a pandemic shock can differ markedly. For the low-income countries employ higher shares of labour for primary production, which makes them more exposed to direct disruptions in labour supply, including the farmer's own labour force, where the same holds for labour-intensive production more generally.

However, according to Josef (2020) arguments where illustrated that fruit and vegetable as well as meat or dairy production have already been adversely affected by COVID-induced labour shortages; such deficits can be caused by domestic labour supply disruptions, as well as by shortages of seasonal and migrant workers. Also, macroeconomic channels of transmission affect agricultural supply, trade and final demand makes food supplies internationally more competitive, at least in the short term, and supports exports of food. Josef (2020) suggest that low-income countries may find themselves not in a price-induced food security crisis, but an income-induced one; and arguably most importantly, COVID-19 will exert a shock on final food demand by lowering overall purchasing power, especially for an increasing number of unemployed people. where, the extent of the impacts on food demand will depend on numerous factors, including the depth and length of the macroeconomic shock, the availability of savings and access to credit and safety net mechanisms, so, these factors determine the responsiveness of demand, which is used to gauge the differences in reactions across countries and food commodity groups.

FAO (2020) considers the policy makers are grappling with uncertainties surrounding the impacts of COVID-19 on food supply, demand and trade, and identifying the most appropriate measures to ensure that this pandemic does not translate into a food crisis. Where, contemplates the disease outbreaks can affect supply and demand through various channels which can lead to a reduction in the labour force (including seasonal and migrant workers), affecting land preparation, planting, crop maintenance and harvesting according to (Gunjal & Senahoun, 2016); and also affect employment in labour intensive industries and contribute to shifting production from cash to food crops conferring by (FAO and UNAIDS, 2003) and impact household incomes and food security according to (United Nations, 2004). Also, FAO (2020) recommends the policy responses to deal with such disruptions can aggravate the situations and exacerbate their market impacts, as was the case in the 2007−2008 global food price crisis; while the scale of the COVID-19 pandemic is unlike any other crisis in recent history, the policy responses available to governments against actual or perceived disruptions in the agri-food markets are similar to those taken during previous crises; which include the 2007−08 food price crisis and the epidemics of Ebola (West Africa, 2014), Severe acute respiratory syndrome (SARS) (East Asia, 2003), HIV/AIDS (Africa, 1990s, 2000s), plague (South Asia, 1994) and cholera (Latin America, 1991).

Alvaro and Michele (2020) analyzes the impact of Covid-19 and uncooperative trade policies on world food markets; quantifies the initial shock due to the pandemic under the assumption that products that are more labor intensive in production are more affected through workers' morbidity and containment policies and estimated how escalating export restrictions to shield domestic food markets could magnify the initial shock. The analysis of this study shows that, in the quarter following the outbreak of the pandemic, the global export supply of food could decrease between 6 and 20 percent and global prices increase between 2 and 6 percent on average. Where, escalating export restrictions would multiply the initial shock by a factor of 3, with world food prices rising by up to 18 percent on average; and they have confidence the import food dependent countries, which are in large majority developing and least developed countries, would be most affected.

UN (2020) considers the impact of the COVID-19 pandemic will be global; Maldives will suffer particular and unique impacts due to the high exposure of its economy to external shocks. So, both the World Bank and Asian Development Bank assess Maldives as being one of the worst hit in the world from the pandemic and will face challenges competing with countries experiencing high numbers of COVID-19 related fatalities in accessing international financial support. As well as and according the goal is to build back better, in order to continue the trajectory towards the 2030 Agenda and make tangible progress in achieving the Sustainable Development Goals (SDGs) although the scale of the crisis is yet to be fully understood, but it will be challenging for any country to respond and recover without having to make difficult choices between how public resources are spent.

Marco (2020) investigates the COVID-19 pandemic and its swept through Arab region and its importance of variations in state capacity; suggests the securitization of the pandemic response and the potential for increased repression; where the profound challenge to war-torn areas, conflict zones, and refugee concentrations; and the prominence in international relations of soft power, battles over narrative, and non-military interdependencies. So, the pandemic response has revealed, perhaps more than any other event in recent history, the variation in state capacity across the region, which involves more than wealth or coercive capacity, though both help; where, state capacity can be observed in the ability to identify virus cases across the population, to impose and enforce lockdowns in a sustainable way, to acquire testing and medical supplies, and to keep people fed and healthy during an economic freeze. Also, as Justin Schon notes in this collection, in the state's ability and willingness to credibly communicate its policies to its citizens and prevent the spread of destabilizing rumors and false information. According to Lucia Ardovini (2020) in Jordan, as Elizabeth Parker-Magyar shows, regular and clear governmental communication has made a positive difference, in stark contrast to the disastrous efforts to control information in Iran (Sally Sharif) and Egypt.

The highest capacity states in the region, by pre-crisis metrics, have, for the most part, responded more quickly, more efficiently, and at larger scale according to Elham Fakhro, Kristin Diwan, Diana Galeeva and Matthew Hedges demonstrate in their essays for the small Gulf states could draw on their vast resources, omnipresent surveillance systems, and relatively competent autocratic technocratic rule to acquire medical and food necessities, identify outbreaks quickly, and deploy the repressive capacity as needed to enforce dramatic societal closures. Also, Marco (2020) presents a preliminary assessment of the impact of the coronavirus (COVID-19) pandemic on commodities exports to China with a focus on exports from Commodity Dependent Developing Countries (CDDCs), which shows that in comparison to short term tendencies observed in the past three years, total commodities exports to China are currently moving downward compared to a situation without the COVID-19 crisis, total commodities exports to China may fall by 15.5 to 33.1 billion US Dollars during 2020, resulting in reduction of the projected annual growth of up to 46 percent (i.e. 8 percentage points). Although CDDCs commodities exports to China are also

expected to decrease, the estimated impact is weaker; where on aggregate they may fall by 2.9 to 7.8 billion US Dollars during 2020, resulting in a loss in terms of annual growth rate of up to 9 percent (i.e. 1.7 percentage points).

Total effects according to Marco are driven by strong negative import demand shocks in China faced by energy products (e.g. crude petroleum oils), ores (e.g. iron ores) and grains (e.g. wheat). While CDDCs exports of those products are also expected to fall, estimated annual growth rates of exports of fruits and nuts, soya beans, rice and copper outpace those that would prevail in a situation without the COVID-19 crisis with differences in import demand shocks at the product level lead to differences in effects at the country level. So, even though most countries are expected to be negatively affected, some may see a surge in their exports to China and this effects of the current sanitary crisis could have on commodities trade, information about the reaction of trade flows in other major economies is still missing making any definitive conclusion, at this stage, hazardous.

Data, model and methods

Data were collected the annual for study variables from world bank of open data website from the period of 1974-2019.

Methodology

A Simultaneous Equation Model (SEM) is a model in the form of a set of linear simultaneous equations. Where introductory regression analysis introduces models with a single equation (e.g. simple linear regression), SEM models have two or more equations. In a single-equation model, changes in the response variable (Y) happen because of changes in the explanatory variable (X); in an SEM model, other Y variables are among the explanatory variables in each SEM equation. The system is jointly determined by the equations in the system; In other words, the system exhibits some type of simultaneity or "back and forth" causation between the X and Y variables (Arne, 2015).

Like this form:

$$GDP=c(1)+c(2)*XTS+c(3)*FDI+c(4)*OXD+c(5)*GXD+c(6)*TTB+c(7)*GTX+U_1$$

$$TTB=c(8)+c(9)*OXD+c(10)*GXD+c(11)*FDI+c(12)*GDP+c(13)*GTX+U_2$$

$$XTS=c(14)+c(15)*INF+c(16)*GDP+c(17)*GTX+c(18)*TTB+c(19)*FPI+U_3$$

$$AAL=c(20)+c(21)*FDI+c(22)*GTX+c(23)*FPI+c(24)*XTS+c(25)*PPG+U_4$$

$$FDI=c(26)+c(27)*INF+c(28)*AAL+c(29)*OXD+c(30)*GXD+c(31)*TTB+U_5$$

$$FPI=c(32)+c(33)*GDP+c(34)*PPG+c(35)*INF+c(36)*GTX+c(37)*XTS+U_6$$

$$HHX=c(38)+c(39)*FPI+c(40)*INF+c(41)*CPI+c(42)*GDP+c(43)*FDI+U_7$$

Symbols indicate

GDP: GDP growth (annual %)
AAL: Agricultural land (sq. km)
FPI: Food production index (2004-2006 = 100)
TTB: Current account balance (BoP, current US$)
XTS: Exports of goods and services (BoP, current US$)
GXT: General government final consumption expenditure (current US$)
INF: Inflation, consumer prices (annual %)
FDI: Foreign direct investment, net inflows (BoP, current US$)
HHX: Households and NPISHs Final consumption expenditure (current US$)
PPG: Population growth (annual %)
OPD: Oil production (dummy)
GPD: Mining production (dummy)
CPI: Consumer price index (2010 = 100)
$C_1, C_2, C_3, \dots C_{43}$: Parameters
$U_1, U_2, U_3, \dots U_7$: Random variables.

Results and Discussion

Unit Root and Co-Integration Tests:

Table (1): Results of Unit-Root Test (ADF)

Variables	Level ADF test	1sd Difference ADF test
GDP	-1.705003	-7.985427**
XTS	-1.891644	-7.212611**
AAL	0.829037	-4.299944**
FPI	-0.053636	-7.646750**
TTB	-0.468359	-8.883362**
GTX	-0.985219	-9.384163**
INF	-2.383476	-8.938559**
FDI	-2.622629	-8.582840**
HHX	0.475273	-3.929441**
PPG	-1.605317	-2.998534**
CPI	0.495966	-1.994407**
OPD	-1.533347	-6.480741**
GPD	-0.460810	-6.633252**

*, ** Denotes rejection at 5% and 1% levels, respectively.

Relying on the results of the conducted unit root tests, we conclude that the studied time series are of Same order of integration. According to the results of the ADF test, we have variables (GDP, XTS, AAL, FPI, TTB, GTX, INF, FDI, HHX, PPG, CPI, OPD and GPD) stationary in the first difference I (0).

Results of ADF unit root tests shown in Table 1, indicate that the hypothesis that the time series al variables, are non-stationary in the level. Relying on the results of the conducted unit root tests, we conclude that the studied time series are of same order of integration and has the order of integration I (1) based on the results of the ADF tests.

Table (2): Results of Unrestricted Co-Integration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**	Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.977774	430.5757	125.6154	0.0001	None *	0.977774	159.8721	46.23142	0.0000
At most 1 *	0.942240	270.7036	95.75366	0.0000	At most 1 *	0.942240	119.7612	40.07757	0.0000
At most 2 *	0.762447	150.9424	69.81889	0.0000	At most 2 *	0.762447	60.36937	33.87687	0.0000
At most 3 *	0.676845	90.57307	47.85613	0.0000	At most 3 *	0.676845	47.44416	27.58434	0.0000
At most 4 *	0.526526	43.12891	29.79707	0.0008	At most 4 *	0.526526	31.40167	21.13162	0.0013

At most 5	0.215627	11.72724	15.49471	0.1705	At most 5	0.215627	10.20057	14.26460	0.1991
At most 6	0.035596	1.526666	3.841466	0.2166	At most 6	0.035696	1.526666	3.841466	0.2166

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level.
* denotes rejection of the hypothesis at the 0.05 level.
**MacKinnon-Haug-Michelis (1999) p-values.
Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

Table 2 shows the results of the Johansen's cointegration test. The results show that there is 4 cointegrating equation at 5% level of significance. Since there is two cointegrating equation as depicted in table 2, we have to determine this co-integrating relationship by computing the long run coefficients.

D(GDPt)=-0.0005D(TTBt)-0.0005D(XTSt)+1.79D(AALt)+0.002 D(FDIt)+8.61D(FPIt)-0.82D(HHXt)
D(GDPt)=0.0001D(TTBt)-0.0009D(XTSt)-8.19D(AALt)+0.008 D(FDIt)+2.56D(FPIt)+0.32D(HHXt)
D(GDPt)=0.0001D(TTBt)-0.0009D(XTSt)-8.31(AALt)+0.008 D(FDIt)+2.58D(FPIt)+0.31D(HHXt)
D(GDPt)=0.0003D(TTBt)-0.0008D(XTSt)-1.35D(AALt)+0.004 D(FDIt)+2.52D(FPIt)-1.16D(HHXt)

1. Estimation of simultaneous equations model system:

The system of simultaneous equations represents the existence of the causal relationship in two directions from the independent variable to the dependent variable as well as from the dependent variable to the independent variable and this mutual effect makes the assumption that relates to the independence of the random variable from the independent variable is incorrect and thus the capabilities of the usual small squares are biased and inconsistent and therefore the presence of an effect Two-way in the function means in itself the necessity of having two equations or a set of equations to describe the relationship between two variables as the dependent variable in the first equation may exist within the group of independent variables in the second equation and on that it performs a dual role as it is the effect in the first equation and the influence in the second equation and from Here the importance of the research highlights the estimation and clarification of the causal relationship between the economic variables of the Sudanese economy and the knowledge of the relationship between them through building and estimating a system of simultaneous equations for the exchange rate where the two-stage least squares method and the three-stage least squares method were used in the estimate and the Econometrics Program (E-Views9) to get results.

Weighted Least Squares (WLS):

Linear Regression is a supervised machine learning algorithm where the predicted output is continuous and has a constant slope. It's used to predict values within a continuous range, (e.g. sales, price) rather than trying to classify them into categories (e.g. cat, dog). There are two main types:

Simple regression

Simple linear regression uses traditional slope-intercept form, where mm and bb are the variables our algorithm will try to "learn" to produce the most accurate predictions. xx represents our input data and yy represents our prediction.

Multivariable regression

A more complex, multi-variable linear equation might look like this, where ww represents the coefficients, or weights, our model will try to learn.

For the WLS approach, β is estimated by (for example, Tasker, 1980) The components of the LWLS matrix are a function of the type and source of the dependent variable. As with the OLS approach, the WLS approach is suitable when the errors in equations are independent. However, for the WLS approach, weights in the weighting matrix are assigned so that gages that have more "reliable" estimates of stream flow characteristics have larger weights. The variables x,y,zx,y,z represent the attributes, or distinct pieces of information, we have about each observation.

Table (3): Estimation of simultaneous equamodel system for study variables through Weighted L.S. (Equation Weights)

Model	
GDP Growth	GDP= 492+40.31*XTS-15.49*FDI-180*OXD+5.42*GXD-44.29*TTB+46.42*INF Std.Error (3.32) (12.58) (7.52) (4.91) (6.92) (17.05) (5.12) T-Test = (1.48) (3.46)** (-2.06)* (-0.36) (7.83)** (-2.64)** (0.89) R^2 = 0.89 R^{-2} = 0.87 D.W = 1.37
Current Account Balance	TTB=- 24.26+24.29*OXD+48.83*GXD-0.02*FDI-0.0002*GDP+0.163*GTX Std.Error = (2.27) (3.78) (8.70) (0.005) (0.000) (0.167) T-Test = (-1.09) (0.647) (0.554) (-4.169)** (-2.15)** (0.976) R^2 = 0.82 R^{-2} = 0.80 D.W = 2.30
Exports of Goods and Services	XTS= 17.2-0.15*AAL-29.43*FPI+1.22*GTX-58.12*PPG+0.013*FDI Std.Error = (2.60) (1.55) (2.60) (0.20) (3.00) (0.01) T-Test = (-2.14)** (-0.09) (-1.47) (6.05)** (-2.08)** (1.61) R2 = 0.89 R-2 = 0.87 D.W = 1.89
Agricultural Land	AAL= -11.94-0.001*FDI-0.003*GTX+71.52*FPI-0.001*XTS+51.87*PPG Std.Error = (8.01) (0.00) (0.02) (2.08) (0.01) (3.00) T-Test = (-1.32) (-1.35) (-0.12) (4.33)** (-0.09) (1.94)* R^2 = 0.531 R^{-2} = 0.45 D.W = 1.33
Foreign Direct Investment	FDI= -12.48-12.66*INF+1.23*AAL+45.8*OXD+56.8*GXD-22.62*TTB Std.Error = (2.81) (1.52) (4.22) (1.30) (1.90) (3.58) T-Test = (-0.04) (-0.83) (0.03) (3.49)** (2.99)** (-6.32)** R^2 = 0.85 R^{-2} = 0.83 D.W = 1.70
Food Production Index	FPI= 37.45+4.38*GDP-12.86*PPG+4.11*INF+4.23*GTX+8.20*XTS Std.Error = (4.59) (6.80) (2.17) (4.10) (1.90) (1.10) T-Test = (9.02)** (6.45)** (-7.84) ** (1.00) (2.23)** (0.75) R2 = 0.92 R^{-2} = 0.91 D.W = 0.89
Household Consumption Expenditure	HHX= -3.85+23.09*FPI+20.84*INF-12.3*CPI+8.36*GDP+15.74*FDI Std.Error = (3.78) (6.77) (2.29) (7.29) (0.88) (3.03) T-Test = (-1.02) (3.45)** (0.08) (-1.71)* (9.49)** (5.61)** R^2 = 0.98 R^{-2} = 0.98 D.W = 1.62

*,** *Denotes rejection at 5% and 1% levels, respectively.*

A. Evaluating the signs of single equations of the system model:

1. Evaluation of the parameters of economic growth (GDP):

The indication of the exports (XTS) and government expenditure (GXT) are positive and significance effect (GDP), meaning that an increasing of exports and government expenditure can increase economic growth, and this result is expected. While, the indication of the external balance (TTB) and foreign direct investment (FDI) are negative and significance effect (GDP).

2. **Evaluating the parameters of the Current Account Balance (TTB)**

The foreign direct investment (FDI) and the economic growth (GDP) coefficients in the external balance are negative and significant effect (TTB), but at the lower extend.

3. **Evaluating the parameters of the Exports of Goods and Services (XTS):**

The indication of the government expenditure (GTX) is positive and significant effect (XTS), while, the indication of the population growth (PPG) is negative and significant effect (XTS).

4. **Evaluating the parameters of the Agricultural Land (AAL):**

The indication of the foreign direct investment (FDI) and population growth (PPG) are positive and significant effect (AAL), this meaning that policy makers should express effective policies to attract FDI for agriculture sector.

5. **Evaluating the parameters of the Foreign Direct Investment (FDI):**

The indication of oil production (OXD) and mining production (GXD) are positive and significant effect (FDI). While, the external balance (TTB) is negative and significant effect the foreign direct investment (FDI), and this results my take policy makers to articulate effective policies regarding foreign direct investment in oil and gold mining sectors.

6. **Evaluating the parameters of the Food Production Index (FPI):**

The indication of the economic growth (GDP) and government expenditure (GTX) are positive and significant effect (FPI). While, population growth (PPG) is negative and significant effect the inflation (FPI).

7. **Evaluating the parameters of the Household Consumption Expenditure (HHX):**

The indication of the food price index (FPI), GDP growth (GDP) and the foreign direct investment (FDI) are positive and significant effect (HHX), while the consumer price index (CPI) is effects household consumption expenditure (HHX) negatively.

B. Evaluating the signs of the system equation (model):

An increasing of exports will lead to an increase in economic growth, and increase in both the food production index and household consumption expenditure, this meaning that the improvement of the economic situation of the population and poverty reduction, also an increase in economic growth will reduce the external balance deficit to lower extent. Hence, policy-makers must be thoughtfulness to agricultural and food exports, since Sudan has a comparative advantage in this field where by developing the infrastructure and creating effective policies to increase production and productivity to promote food exports, especially since the global demand is increasing, especially in light of the COVID-19 pandemic taking into consideration the development of the industrial sector on the side with the agricultural sector and the integration between them in order to export food in factories instead of exporting raw materials to obtain the value added.

However, increasing the food production index leads to both an increase in investment of agricultural lands and the household consumption expenditure, meaning that investment in food production based on the comparative advantages of Sudan and thus increasing food exports in light of the pandemic, will lead to improving the economic conditions of the population. In addition, the increasing of population growth lead to an increase in investment of agricultural lands, but at the same time my reduces the volume of exports, which are mostly agricultural, so, the researcher realizes that there are structural deficiency in the Sudanese economy and suffers from great rigidities in production, the absence of effective policies, weakness in the infrastructure and some obstacles, and thus block the outflows of exports and export operations, health and financial requirements, etc., all of this must taking policymakers to address these dilemmas in the short and long run through conscious strategic planning, effective policies, clear goals and an insightful vision.

Moreover, government expenditure leads to an increase in both exports and food production index, so this is considered one of the constructive results that must be strengthened, and in this context the researcher believes that the change of Bashir's regime in Sudan into a democratic civil government instead of the 30-year military regime that led Sudan to a great economic and political openness which providing a great opportunities for economic and political stability and upgrading production and promoting exports by integrating new markets and removing the obstacles imposed previously, so policymakers, in light of this global openness, must bring modern agricultural technology to contribute to increasing production and productivity, reducing costs and increasing competitiveness.

In the same context, we note that foreign direct investment has a significant positive impact in increasing the level of household consumption expenditure where by creating new job opportunities, reducing unemployment, reducing poverty and immigration rates, reducing activities in the unreal sector that absorbs the majority of the population, since the problems that the agricultural sector suffers from. Also, foreign direct investment contributes significantly to increasing agricultural production and food exports, where in the light of the world's growing need for food as a result of the COVID-19 pandemic, Sudan must benefit from these opportunities through increasing food exports. Also, foreign direct investment has not great effect in reducing the trade balance deficit, and it also has a significant negative impact in economic growth, this result attributed to the weak economic stability in Sudan and the isolation from the international community that Sudan witnessed during the 30 years of Bashir's Regime, in addition to the absence of effective investment policies, widespread corruption, the absence of the rules and laws, wars and conflicts in most parts of Sudan. Policy makers should draw a clear investment map, enact the necessary laws and legislations, fight corruption and encourage attracting foreign capital inflows to invest in Sudan where bringing a great benefit.

Nevertheless, the investment in the oil and mining sectors has a positive and moral effect on attracting foreign direct investment and also leads to a significant increase in economic growth. Here, the researcher perceives that investment in the fields of oil and mining is no less important than the agricultural investment in which Sudan has a comparative advantage, as it also supports and enhances exports and returns of foreign currencies, which is necessary and is reflected in most of macroeconomic indicators such as stability of the exchange rate, reducing the trade balance deficit, reducing inflation rates and raising the value of the national currency and the economic stability that is necessary for investment in agricultural and food and their exports. Here, the study recommends policy-makers to take on consideration the investment in the agricultural

sector side by side with the oil and mining sectors, by drawing up strategic plans, effective policies, and establishing the necessary infrastructure development to take the significant role in the world, so as it has huge and diverse potentials and resources that must be used optimally in the shadow of the COVID-19 pandemic particularly.

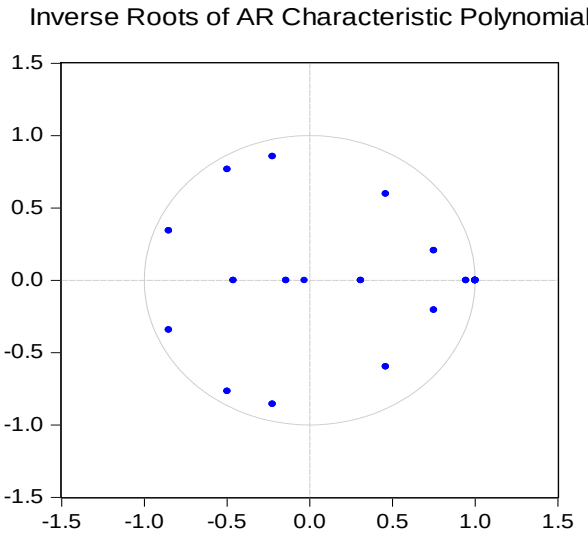
VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares):

In the table 4, We notice that the level of significance of the test chi square for each of the 7 behavioral equations in the model is greater than (5%) and this indicates, according to Heteroskedasticity test, that the complete model system does not suffer from the problem of difference in variance.

Table (4): VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

Chi-sq	df	Prob.
871.7141	840	0.2176

Figure .1



Concoction and policy recommendations

The study attempts to apply the Simultaneous Equations Model (SEM) together with co-integration test between several variables with focusing on agricultural exports (XTS), to analyzing does the COVID-19 pandemic benefit Sudan from some opportunities for agricultural exports?, such variables are: agricultural land (AAL), food production index (FPI), population growth (PPG), oil production (OXD), mining production (GXD), external balance (TTB), inflation rate (INF), household consumption expenditure (HHX), economic growth (GDP), government total expenditure (GTX), foreign direct investment (FDI) and consumer price index (CPI) during the period of 1974-2019. The results find out that an increasing of exports leads to an increase in economic growth and in both food production index and household consumption expenditure which meaning improvement in the economic situation of the population and poverty reduction, and an increase in economic growth reduces the external balance deficit to a lower extent.

However, increasing the food production index leads to increase in both investments in agricultural lands and the level of household consumption expenditure, meaning that investment in food production based on the comparative advantages of Sudan and thus increased food exports in light of COVID-19 pandemic, which leads to improving the economic conditions of the population.

In addition, the increasing population growth lead to an increase in investment in agricultural lands, but at the same time it reduces the volume of exports, which are mostly agricultural. In the same context, we note that foreign direct investment has a great positive impact in increasing the level of household consumption expenditure by creating new job opportunities, reducing unemployment, reducing poverty and immigration rates, and reducing activities in the unreal sector that absorbs the majority of the population since the problems that the agricultural sector suffers from. Also, foreign direct investment contributes significantly to increasing agricultural production and food exports in light of the world's growing need for food as a result of the COVID-19 pandemic. Also, foreign direct investment has not great effect in reducing the trade balance deficit, and it also has a significant negative impact on foremost to decrease in economic growth, due to the weak economic stability in Sudan and the isolation from the international community that Sudan witnessed during the 30 years of Bashir's Regime, in addition to the absence of effective investment policies, widespread corruption, the absence of the rule of law, wars and conflicts in most parts of Sudan. Policy makers should draw a clear investment map, enact the necessary laws and legislations, fight corruption and encourage attracting foreign capital to invest in Sudan to bring great benefits to Sudan.

Nevertheless, the investment in the fields of oil and mining has a positive and moral effect on attracting foreign direct investment and also leads to a significant increase in economic growth. Here, the researcher perceives that investment in the fields of oil and mining is no less important than the agricultural investment in which Sudan has a comparative advantage, as it also supports and enhances Sudanese exports and returns of foreign currencies, which is necessary and is reflected in most of macroeconomic indicators such as stability of the exchange rate, reducing the trade balance deficit, reducing inflation rates and raising the value of the national currency and the economic stability that is necessary for investment in agricultural and food and their exports.

The study recommends policy-makers to take on consideration the investment in the agricultural sector side by side with the oil, mining sectors, by drawing up strategic plans, drawing effective policies, and establishing the necessary infrastructure development of the Sudanese economy to foremost their position in the world, so as it has huge and diverse potentials and resources that must be used optimally in the shadow of the COVID-19 pandemic in particular. So, benefiting from that changing of Bashir's regime in Sudan into a democratic civil government instead of the 30-year military regime that commanded Sudan to a great economic and political openness provided a great opportunities for stability and upgrading production and promoting exports where by global opening and new markets and removing the obstacles imposed previously, so policymakers, in light of this global openness, must bring modern agricultural technology to increasing production and productivity, reducing costs and increasing competitiveness.

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Appendices

System: UNTITLED				
Estimation Method: Weighted Least Squares				
Date: 08/17/20 Time: 13:44				
Sample: 1974 2019				
Included observations: 46				
Total system (balanced) observations 322				
Linear estimation after one-step weighting matrix				

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	4.93E+11	3.32E+11	1.484066	0.1389
C(2)	400.3123	115.5791	3.463536	0.0006
C(3)	-15.49722	7.517960	-2.061360	0.0402
C(4)	-1.81E+11	4.91E+11	-0.368373	0.7129
C(5)	5.42E+12	6.92E+11	7.833955	0.0000
C(6)	-444.2992	168.0529	-2.643805	0.0087
C(7)	4.61E+09	5.12E+09	0.899597	0.3691
C(8)	-2.48E+08	2.27E+08	-1.090508	0.2764
C(9)	2.45E+08	3.78E+08	0.647708	0.5177
C(10)	4.83E+08	8.70E+08	0.554789	0.5795
C(11)	-0.022734	0.005453	-4.168913	0.0000
C(12)	-0.000258	0.000120	-2.145256	0.0328
C(13)	0.163467	0.167474	0.976076	0.3299
C(14)	1.76E+10	8.21E+09	2.145491	0.0328
C(15)	-0.154058	1.555470	-0.099043	0.9212
C(16)	-299777.4	203300.6	-1.474553	0.1415
C(17)	1.221779	0.201837	6.053283	0.0000
C(18)	-58061856	27871218	-2.083219	0.0381
C(19)	0.013078	0.008085	1.617638	0.1069
C(20)	-1.06E+09	8.01E+08	-1.324006	0.1866
C(21)	-0.001041	0.000773	-1.347216	0.1790
C(22)	-0.003181	0.025637	-0.124073	0.9013
C(23)	71949.53	16622.08	4.328551	0.0000
C(24)	-0.001384	0.013973	-0.099043	0.9212
C(25)	5158533.	2656683.	1.941719	0.0532
C(26)	-1.24E+09	2.81E+10	-0.044134	0.9648
C(27)	-1.27E+08	1.52E+08	-0.832284	0.4060
C(28)	1.237510	36.22741	0.034160	0.9728
C(29)	4.56E+10	1.30E+10	3.498945	0.0005
C(30)	5.69E+10	1.90E+10	2.993038	0.0030
C(31)	-22.62954	3.581260	-6.318876	0.0000
C(32)	37987.46	4212.594	9.017593	0.0000
C(33)	4.39E-10	6.80E-11	6.448088	0.0000
C(34)	-118.8700	15.16730	-7.837256	0.0000
C(35)	4.114171	4.100623	1.003304	0.3166
C(36)	4.24E-07	1.90E-07	2.228791	0.0266
C(37)	8.20E-08	1.10E-07	0.748505	0.4548
C(38)	-3.85E+12	3.78E+12	-1.020003	0.3086
C(39)	2.34E+09	6.77E+08	3.453609	0.0006
C(40)	2.05E+09	2.29E+10	0.089341	0.9289
C(41)	-1.24E+10	7.29E+09	-1.708050	0.0887
C(42)	8.368674	0.882197	9.486169	0.0000
C(43)	151.7489	27.03145	5.613788	0.0000
Determinant residual covariance		2.4E+127		
Equation: GDP=C(1)+C(2)*XTS+C(3)*FDI+C(4)*OXD+C(5)*GXD+C(6)				
*TTB+C(7)*INF				
Observations: 46				
R-squared	0.887262	Mean dependent var		2.70E+12
Adjusted R-squared	0.869918	S.D. dependent var		2.93E+12
S.E. of regression	1.06E+12	Sum squared resid		4.36E+25
Durbin-Watson stat	1.371145			
Equation: TTB=C(8)+C(9)*OXD+C(10)*GXD+C(11)*FDI+C(12)*GDP				
+C(13)*GTX				
Observations: 46				
R-squared	0.824837	Mean dependent var		-1.68E+09

Adjusted R-squared	0.802941	S.D. dependent var		2.02E+09
S.E. of regression	8.97E+08	Sum squared resid		3.22E+19
Durbin-Watson stat	2.302740			
Equation: XTS=C(14)+C(15)*AAL+C(16)*FPI+C(17)*GTX+C(18)*PPG				
+C(19)*FDI				
Observations: 46				
R-squared	0.888133	Mean dependent var		2.97E+09
Adjusted R-squared	0.874149	S.D. dependent var		3.32E+09
S.E. of regression	1.18E+09	Sum squared resid		5.55E+19
Durbin-Watson stat	1.895926			
Equation: AAL=C(20)+C(21)*FDI+C(22)*GTX+C(23)*FPI+C(24)*XTS				
+C(25)*PPG				
Observations: 46				
R-squared	0.514626	Mean dependent var		8.49E+08
Adjusted R-squared	0.453954	S.D. dependent var		1.51E+08
S.E. of regression	1.12E+08	Sum squared resid		4.98E+17
Durbin-Watson stat	1.330426			
Equation: FDI=C(26)+C(27)*INF+C(28)*AAL+C(29)*OXD+C(30)*GXD				
+C(31)*TTB				
Observations: 46				
R-squared	0.853383	Mean dependent var		5.81E+10
Adjusted R-squared	0.835056	S.D. dependent var		7.59E+10
S.E. of regression	3.08E+10	Sum squared resid		3.80E+22
Durbin-Watson stat	1.702472			
Equation: FPI=C(32)+C(33)*GDP+C(34)*PPG+C(35)*INF+C(36)*GTX				
+C(37)*XTS				
Observations: 46				
R-squared	0.921690	Mean dependent var		7680.758
Adjusted R-squared	0.911902	S.D. dependent var		2904.441
S.E. of regression	862.0780	Sum squared resid		29727140
Durbin-Watson stat	0.896203			
Equation: HHX=C(38)+C(39)*FPI+C(40)*INF+C(41)*CPI+C(42)*GDP				
+C(43)*FDI				
Observations: 46				
R-squared	0.985627	Mean dependent var		4.42E+13
Adjusted R-squared	0.983831	S.D. dependent var		3.83E+13
S.E. of regression	4.87E+12	Sum squared resid		9.49E+26
Durbin-Watson stat	1.625355			

Date: 08/17/20 Time: 13:46							
Sample (adjusted): 1978 2019							
Included observations: 42 after adjustments							
Trend assumption: Linear deterministic trend							
Series: GDP TTB XTS AAL FDI FPI HHX							
Lags interval (in first differences): 1 to 3							
Unrestricted Cointegration Rank Test (Trace)							
Hypothesized		Trace	0.05				
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**			
None *	0.977774	430.5757	125.6154	0.0001			
At most 1 *	0.942240	270.7036	95.75366	0.0000			
At most 2 *	0.762447	150.9424	69.81889	0.0000			
At most 3 *	0.676845	90.57307	47.85613	0.0000			
At most 4 *	0.526526	43.12891	29.79707	0.0008			
At most 5	0.215627	11.72724	15.49471	0.1705			
At most 6	0.035696	1.526666	3.841466	0.2166			

Trace test indicates 5 cointegrating eqn(s) at the 0.05 level							
* denotes rejection of the hypothesis at the 0.05 level							
**MacKinnon-Haug-Michelis (1999) p-values							
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)							
Hypothesized		Max-Eigen	0.05				
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**			
None *	0.977774	159.8721	46.23142	0.0000			
At most 1 *	0.942240	119.7612	40.07757	0.0000			
At most 2 *	0.762447	60.36937	33.87687	0.0000			
At most 3 *	0.676845	47.44416	27.58434	0.0000			
At most 4 *	0.526526	31.40167	21.13162	0.0013			
At most 5	0.215627	10.20057	14.26460	0.1991			
At most 6	0.035696	1.526666	3.841466	0.2166			
Max-eigenvalue test indicates 5 cointegrating eqn(s) at the 0.05 level							
* denotes rejection of the hypothesis at the 0.05 level							
**MacKinnon-Haug-Michelis (1999) p-values							
Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):							
GDP	TTB	XTS	AAL	FDI	FPI	HHX	
-1.77E-12	-3.32E-09	-2.51E-09	-1.04E-07	1.95E-10	0.003879	-3.36E-13	
2.67E-12	9.20E-10	2.62E-09	1.03E-07	3.67E-11	-0.002238	-4.09E-13	
5.52E-14	-4.22E-09	-1.24E-09	-2.22E-08	-4.19E-11	0.001553	-2.08E-13	
-1.67E-12	3.01E-09	-5.02E-10	-1.95E-07	-5.39E-13	0.007538	1.13E-13	
3.18E-12	3.55E-09	3.41E-10	9.27E-08	1.68E-10	-0.001181	-4.79E-13	
-4.59E-12	4.53E-11	2.75E-12	-1.72E-08	-5.00E-11	0.001217	3.37E-13	
-4.25E-12	5.74E-09	-8.79E-10	-4.12E-08	6.66E-11	-0.000806	6.01E-13	
Unrestricted Adjustment Coefficients (alpha):							
D(GDP)	2.06E+10	-6.70E+10	-1.59E+11	-5.24E+10	1.51E+10	3.36E+10	-1.26E+10
D(TTB)	3.11E+08	2.72E+08	92421680	-99400651	-1.14E+08	32587780	-25172569
D(XTS)	3.05E+08	-1.65E+08	1.37E+08	-96408932	1.72E+08	83726287	4376431.
D(AAL)	-1010785.	-3736486.	-2196211.	3098115.	-3678991.	390057.1	-594551.8
D(FDI)	-1.54E+09	1.84E+09	2.60E+09	2.20E+09	3.46E+09	3.81E+09	6.79E+08
D(FPI)	-48.69401	63.57980	46.04117	4.014091	23.04891	-7.638938	-10.74252
D(HHX)	4.66E+11	4.28E+11	-1.05E+11	8.85E+11	2.19E+11	1.83E+11	1.34E+10
1 Cointegrating Equation(s):		Log likelihood	-6099.170				
Normalized cointegrating coefficients (standard error in parentheses)							
GDP	TTB	XTS	AAL	FDI	FPI	HHX	
1.000000	1880.058	1420.540	58612.61	-110.3736	-2.19E+09	0.189943	
	(177.945)	(65.4137)	(4016.15)	(5.37904)	(1.6E+08)	(0.01235)	
Adjustment coefficients (standard error in parentheses)							
D(GDP)	-0.036434						
	(0.09264)						
D(TTB)	-0.000549						
	(0.00016)						
D(XTS)	-0.000538						
	(0.00016)						
D(AAL)	1.79E-06						
	(3.4E-06)						
D(FDI)	0.002718						
	(0.00449)						
D(FPI)	8.61E-11						
	(4.4E-11)						
D(HHX)	-0.824039						
	(0.51640)						
2 Cointegrating Equation(s):		Log likelihood	-6039.290				
Normalized cointegrating coefficients (standard error in parentheses)							
GDP	TTB	XTS	AAL	FDI	FPI	HHX	
1.000000	0.000000	881.4190	34142.44	41.60102	-5.34E+08	-0.230256	
		(79.2987)	(5373.25)	(7.06856)	(2.1E+08)	(0.01474)	

0.000000	1.000000	0.286757	13.01564	-0.080835	-883109.2	0.000224	
		(0.05650)	(3.82832)	(0.00504)	(152005.)	(1.0E-05)	
Adjustment coefficients (standard error in parentheses)							
D(GDP)	-0.215170	-130.0806					
	(0.16039)	(172.778)					
D(TTB)	0.000177	-0.782660					
	(0.00021)	(0.22352)					
D(XTS)	-0.000979	-1.163709					
	(0.00027)	(0.28707)					
D(AAL)	-8.19E-06	-7.65E-05					
	(5.6E-06)	(0.00601)					
D(FDI)	0.007636	6.804095					
	(0.00802)	(8.64352)					
D(FPI)	2.56E-10	2.20E-07					
	(6.4E-11)	(6.9E-08)					
D(HHX)	0.317200	-1156.035					
	(0.88082)	(948.831)					
3 Cointegrating Equation(s):		Log likelihood	-6009.105				
Normalized cointegrating coefficients (standard error in parentheses)							
GDP	TTB	XTS	AAL	FDI	FPI	HHX	
1.000000	0.000000	0.000000	405089.7	-4595.439	-2.63E+10	8.768309	
			(313879.)	(378.207)	(1.3E+10)	(0.94812)	
0.000000	1.000000	0.000000	133.6982	-1.589431	-9281381.	0.003151	
			(104.556)	(0.12598)	(4394642)	(0.00032)	
0.000000	0.000000	1.000000	-420.8524	5.260880	29287028	-0.010209	
			(358.416)	(0.43187)	(1.5E+07)	(0.00108)	
Adjustment coefficients (standard error in parentheses)							
D(GDP)	-0.223959	542.2321	-30.24496				
	(0.10977)	(186.894)	(131.347)				
D(TTB)	0.000182	-1.172822	-0.182758				
	(0.00020)	(0.33388)	(0.23465)				
D(XTS)	-0.000971	-1.743222	-1.365738				
	(0.00025)	(0.42007)	(0.29522)				
D(AAL)	-8.31E-06	0.009195	-0.004524				
	(5.3E-06)	(0.00909)	(0.00639)				
D(FDI)	0.007780	-4.180790	5.467759				
	(0.00779)	(13.2700)	(9.32595)				
D(FPI)	2.58E-10	2.59E-08	2.32E-07				
	(5.4E-11)	(9.3E-08)	(6.5E-08)				
D(HHX)	0.311379	-710.7003	78.38508				
	(0.87754)	(1494.04)	(1049.99)				
4 Cointegrating Equation(s):		Log likelihood	-5985.383				
Normalized cointegrating coefficients (standard error in parentheses)							
GDP	TTB	XTS	AAL	FDI	FPI	HHX	
1.000000	0.000000	0.000000	0.000000	-5323.548	-7.43E+09	9.154613	
				(481.229)	(6.9E+09)	(1.24379)	
0.000000	1.000000	0.000000	0.000000	-1.829741	-3038876.	0.003279	
				(0.15943)	(2270497)	(0.00041)	
0.000000	0.000000	1.000000	0.000000	6.017321	9636998.	-0.010611	
				(0.53621)	(7636214)	(0.00139)	
0.000000	0.000000	0.000000	1.000000	0.001797	-46691.03	-9.54E-07	
				(0.00037)	(5274.02)	(9.6E-07)	
Adjustment coefficients (standard error in parentheses)							
D(GDP)	-0.136549	384.4628	-3.941000	4739.063			
	(0.11593)	(199.961)	(124.062)	(7868.01)			
D(TTB)	0.000348	-1.472121	-0.132858	13.21818			
	(0.00021)	(0.35402)	(0.21964)	(13.9297)			
D(XTS)	-0.000810	-2.033513	-1.317340	-32.76803			
	(0.00027)	(0.45970)	(0.28521)	(18.0883)			
D(AAL)	-1.35E-05	0.018523	-0.006079	-0.837016			

	(5.4E-06)	(0.00940)	(0.00583)	(0.36981)			
D(FDI)	0.004109	2.445509	4.362994	-138.5790			
	(0.00860)	(14.8304)	(9.20120)	(583.542)			
D(FPI)	2.52E-10	3.80E-08	2.30E-07	9.79E-06			
	(6.1E-11)	(1.1E-07)	(6.6E-08)	(4.2E-06)			
D(HHX)	-1.164352	1952.899	-365.7017	-174726.8			
	(0.66509)	(1147.22)	(711.769)	(45140.5)			
5 Cointegrating Equation(s):		Log likelihood	-5969.682				
Normalized cointegrating coefficients (standard error in parentheses)							
GDP	TTB	XTS	AAL	FDI	FPI	HHX	
1.000000	0.000000	0.000000	0.000000	0.000000	1.10E+09	-0.190673	
					(2.2E+08)	(0.02008)	
0.000000	1.000000	0.000000	0.000000	0.000000	-104018.1	6.65E-05	
					(65030.4)	(6.0E-06)	
0.000000	0.000000	1.000000	0.000000	0.000000	-14632.82	-4.73E-05	
					(180711.)	(1.7E-05)	
0.000000	0.000000	0.000000	1.000000	0.000000	-49574.01	2.20E-06	
					(3201.18)	(2.9E-07)	
0.000000	0.000000	0.000000	0.000000	1.000000	1603975.	-0.001755	
					(1105213)	(0.00010)	
Adjustment coefficients (standard error in parentheses)							
D(GDP)	-0.088388	438.1898	1.214540	6140.734	10.80989		
	(0.15366)	(228.853)	(123.814)	(8362.59)	(8.41721)		
D(TTB)	-1.48E-05	-1.876494	-0.171660	2.668584	0.047633		
	(0.00024)	(0.36200)	(0.19585)	(13.2278)	(0.01331)		
D(XTS)	-0.000261	-1.421372	-1.258600	-16.79801	0.076684		
	(0.00030)	(0.44692)	(0.24179)	(16.3310)	(0.01644)		
D(AAL)	-2.52E-05	0.005456	-0.007333	-1.177928	-0.000864		
	(6.0E-06)	(0.00897)	(0.00485)	(0.32777)	(0.00033)		
D(FDI)	0.015133	14.74373	5.543109	182.2667	0.240518		
	(0.01081)	(16.0955)	(8.70798)	(588.151)	(0.59199)		
D(FPI)	3.25E-10	1.20E-07	2.38E-07	1.19E-05	-5.22E-09		
	(7.8E-11)	(1.2E-07)	(6.3E-08)	(4.2E-06)	(4.3E-09)		
D(HHX)	-0.468559	2729.095	-291.2194	-154476.8	147.3833		
	(0.85333)	(1270.87)	(687.566)	(46439.3)	(46.7426)		
6 Cointegrating Equation(s):		Log likelihood	-5964.582				
Normalized cointegrating coefficients (standard error in parentheses)							
GDP	TTB	XTS	AAL	FDI	FPI	HHX	
1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	-0.072390	
						(0.00683)	
0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	5.54E-05	
						(2.2E-06)	
0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	-4.89E-05	
						(5.4E-06)	
0.000000	0.000000	0.000000	1.000000	0.000000	0.000000	-3.11E-06	
						(3.7E-07)	
0.000000	0.000000	0.000000	0.000000	1.000000	0.000000	-0.001584	
						(4.0E-05)	
0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	-1.07E-10	
						(8.0E-12)	
Adjustment coefficients (standard error in parentheses)							
D(GDP)	-0.242428	439.7105	1.306773	5563.962	9.130791	-3.89E+08	
	(0.20603)	(222.098)	(120.157)	(8133.01)	(8.31426)	(2.8E+08)	
D(TTB)	-0.000164	-1.875017	-0.171571	2.108679	0.046003	165166.8	
	(0.00033)	(0.35801)	(0.19369)	(13.1101)	(0.01340)	(452655.)	
D(XTS)	-0.000646	-1.417579	-1.258370	-18.23654	0.072496	935234.1	
	(0.00039)	(0.42519)	(0.23003)	(15.5699)	(0.01592)	(537584.)	

D(AAL)	-2.70E-05	0.005474	-0.007332	-1.184630	-0.000883	29203.57	
	(8.3E-06)	(0.00895)	(0.00484)	(0.32763)	(0.00033)	(11312.2)	
D(FDI)	-0.002357	14.91640	5.553582	116.7788	0.049870	11088708	
	(0.01375)	(14.8249)	(8.02038)	(542.873)	(0.55497)	(1.9E+07)	
D(FPI)	3.60E-10	1.20E-07	2.38E-07	1.21E-05	-4.84E-09	-0.265961	
	(1.1E-10)	(1.2E-07)	(6.2E-08)	(4.2E-06)	(4.3E-09)	(0.14546)	
D(HHX)	-1.309794	2737.400	-290.7157	-157626.7	138.2136	7.32E+09	
	(1.14527)	(1234.61)	(667.935)	(45210.3)	(46.2178)	(1.6E+09)	

VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

Date: 08/17/20 Time: 13:48

Sample: 1974 2019

Included observations: 43

Joint test:

Chi-sq	df	Prob.
871.7141	840	0.2176

Individual components:

Dependent	R-squared	F(30,12)	Prob.	Chi-sq(30)	Prob.
res1*res1	0.614754	0.638298	0.8446	26.43443	0.6528
res2*res2	0.939471	6.208419	0.0009	40.39726	0.0974
res3*res3	0.972367	14.07528	0.0000	41.81177	0.0743
res4*res4	0.795432	1.555336	0.2110	34.20356	0.2728
res5*res5	0.890053	3.238109	0.0175	38.27227	0.1429
res6*res6	0.508211	0.413357	0.9754	21.85308	0.8593
res7*res7	0.802841	1.628821	0.1866	34.52217	0.2604
res2*res1	0.650989	0.746096	0.7517	27.99253	0.5708
res3*res1	0.526932	0.445544	0.9641	22.65806	0.8291
res3*res2	0.891419	3.283890	0.0165	38.33102	0.1414
res4*res1	0.734038	1.103975	0.4478	31.56364	0.3881
res4*res2	0.933494	5.614526	0.0015	40.14026	0.1022
res4*res3	0.953859	8.269052	0.0002	41.01593	0.0866
res5*res1	0.881111	2.964497	0.0250	37.88779	0.1527
res5*res2	0.881539	2.976644	0.0246	37.90618	0.1522
res5*res3	0.864741	2.557296	0.0438	37.18388	0.1718
res5*res4	0.845189	2.183803	0.0764	36.34315	0.1971
res6*res1	0.601873	0.604704	0.8709	25.88053	0.6812
res6*res2	0.659070	0.773263	0.7271	28.34003	0.5524
res6*res3	0.809690	1.701838	0.1653	34.81668	0.2494
res6*res4	0.888016	3.171950	0.0190	38.18470	0.1451
res6*res5	0.863940	2.539885	0.0449	37.14943	0.1728
res7*res1	0.795837	1.559222	0.2096	34.22101	0.2721
res7*res2	0.936064	5.856256	0.0012	40.25075	0.1001
res7*res3	0.927359	5.106529	0.0023	39.87644	0.1073
res7*res4	0.841204	2.118948	0.0845	36.17175	0.2025
res7*res5	0.852640	2.314443	0.0626	36.66353	0.1872
res7*res6	0.690233	0.891293	0.6204	29.68001	0.4821