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CO-VARIABILITY OF EXPORTS, IMPORTS AND GDP-A RELATIONAL MOVEMENT ANALYSIS

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Abstract: *Purpose*-The aim of the study is to find out the mutual co-movement of exports, imports, components of exports and imports, and the GDP of Saudi Arabia.
Research Methodology- Exports, imports, and components of exports and imports extracted from the SAMA website for the period 2002 to 2021. Mean, standard deviation, and coefficient of variation are applied to get the data variability. Index numbers, ANOVA, and post hoc analysis were applied to get the growth trend, and significant difference among the groups of variables, and identify the significantly different groups, respectively.

Findings- The analysis of the study revealed that there is a co-movement relationship between the exports, imports, and GDP of Saudi Arabia in long run. In exports components, non-mineral products growth rate is significantly different while articles of base metals, machinery and mechanical appliances electrical equipment & parts thereof growth rate is different from the other components of imports.

Research Limitations- The study considers only the quantitative data for the period 2002 to 2021. Population growth, technological advancements, and other abnormal and external factors should be considered to measure the movements of the variables.

Practical Implications- Based on the findings, the exports of non-mineral products can be enhanced and imports of base metals and, articles of base metals, machinery mechanical appliances electrical equipment & parts thereof can be reduced to accelerate the growth of the Saudi economy. The results of the study are expected to be advantageous for researchers, policymakers, and academicians.

Originality/value- For a long time, researchers involved to get insights into the components and sub-components of foreign trade and their trend of movement to get the governing key factors. However, the international trade status of every nation is different from others. The present study tries to explore the exports, imports, components of exports and imports, and their significant co-movement with the GDP of Saudi Arabia.

Keywords: Exports, Imports, GDP, Saudi Arabia, Post hoc analysis.
JEL Classification: P45, F1, F14

1. Introduction

Now a day, foreign trade plays a vital role in the development of the economy and accelerates its growth of the economy. Foreign trade is concerned with the exchange of goods and goods and services between or among nations at the international level. Foreign trade can be divided into three categories i.e. Imports, Exports, and Re-exports. Imports refer to the purchasing the goods and services from other nations while exports meant the selling of goods and services to other nations. Re-exporting refers to the importing of goods from other nations to export it another nation. The exports and imports of the nation are beneficial for the economy and economic in many ways. International trade enhances the revenue, and disposal of a surplus of goods and services, and facilitates the opportunity to specialize in specific field production and rendering the services. Additionally, exports decrease domestic competition and earn profits from the currency exchange rates. It also facilitates a vast market for goods and services and enhance the reputation and strengthens international relationship. There are negative aspects of foreign trade that intellectual property theft, increased transportation costs, and language and cultural barriers. Saudi Arabia is well known in the world for its mineral resources and holy places Makkah and Medina. Saudi Arabia is one of the largest exporters of mineral products and nurtures its economy. It is evident that since last year's exports and imports of Saudi Arabia is fluctuating.

Table 1: Exports, Imports and GDP of Saudi Arabia

Years	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Exports	763313	688424	831882	1103900	981012	651952	1035672
+/-(%)from Pre. Year	-40.6	-9.8	20.8	32.7	-11.1	-33.5	58.9
Imports	655033	525637	504440	513993	574361	517492	573186
+/-(%)from Pre. Year	0.5	-19.8	-4	1.9	11.7	-9.9	10.8
GDP	2453512	2418508	2582198	3062170	3013561	2637629	3125780
+/-(%)from Pre. Year	-13.5	-1.4	6.8	18.6	-1.6	-12.5	18.5

Source: Exports, Imports & GDP values available on https://www.sama.gov.sa/en-us/economicreports/pages/database.aspx

The fluctuations in the exports and imports affect the economy of Saudi Arabia. Saudi Arabia exports mineral products, foodstuffs, chemical products, plastic products, articles of base metals, electrical machines, equipment & tools, other exports, and re-exports. While imports includes animals; vegetables; oils, readymade beverages spirits vinegar & tobacco; mineral and chemical products; artificial resins, plastic and rubber materials; bags, fur skins articles, wooden and paper materials; textiles, footwear headgear umbrellas sunshade whips artificial flowers; ceramic products glass & glassware; precious stones jewelry; base metals and heavy machinery, mechanical appliances electrical equipment & parts thereof; transport equipment; medical and surgical equipment; watches, musical instruments and parts thereof; arms and ammunition; antiques and other manufactured items. The list of import items is more vast than

the import items list in Saudi Arabia. There is a significant negative trend seen in the exports while negligible corresponding negativity in the imports of Saudi Arabia in past few years. There is a need to know the relationship intensity of exports, imports, and GDP and the components of exports and imports that significantly influence the economy of Saudi Arabia.

1. Literature Review

Bakari and Krit (2017) found that exports govern the economy positively while imports affect it negatively. Mehta (2015) observed that GDP governs the exports in the long run while there is no relationship between the GDP and imports. Also, he found that the export governs the imports but has no impact of the import on the exports in India. Turan and Karamanaj (2014) revealed an equilibrium relationship between exports, imports, and GDP in the long run. Miyan and Biplob (2019) found an equilibrium relationship between exports, imports, and economic growth. In the short run, exports affect economic growth and economic growth enhances imports. Ali et al. (2021) found no causality between the exports, imports, and capital with the economic growth of the nation. Okyere and Jilu (2020) studied the impact of imports on the GDP of Ghana. They found that there is a causal relationship between the imports and GDP while the positive impact of the exports on the GDP in Ghana. Ahmad et al. (2017) found that exports positively affect economic growth. Consumer price index, terms, and conditions of trade negatively govern the growth of the economy. Ahmed et al. (2013) found a moderate relationship between imports, exports, and GDP. Exports govern positively while imports negatively to the Bangladeshi economy.

Alkhateeb et al. (2016) found that export enhancements in Saudi Arabia are necessary to nurture the economy and economic growth. Guntukula (2018) found a bidirectional relationship between exports and economic growth and suggested export growth for the sustainable growth of the economy. Kumari and Malhotra (2014) found no correlation between exports and per capita GDP in India. Akhter (2015) found the positive impact of export on economic growth while import negatively governs the economy. Islam et al. (2012) studied the relationship between the import and economic growth of 62 countries and found that economic growth drives the imports of the nation. They found a bidirectional causal relationship in lower-income countries while a unidirectional relationship in higher-income countries in the long run. Rentala and Nandru (2019) studied the imports, exports, and GDP of India from 1991 to 2016 and found a causal co-relationship between exports to GDP. In addition, they found the cause-and-effect relationship between the imports and exports of India. Olubiyi (2014) recommended focusing on the export base economy to enhance the economy and economic growth rate. Bakari and Mabrouki (2017) studied the imports, exports, and GDP of Panama from 1980 to 2015 and found that there is no correlation between the imports exports and GDP. Also, they found that exports and imports are the sources of economic growth in Panama. Ummalla, M., & Raghutla, C. (2015) found the relationship between imports, exports, and GDP in long run. Saaed and Hussain (2015) studied the imports, exports, and GDP of Tunisia from 1977 to 2012 and found unidirectional causality between the exports and imports and exports and the economic growth of the nation. Shkolnyk and Koilo (2018) found the effective role of strategy implementation of public debt management in the economic growth in emerging economies. Mohsen (2015) studied the contribution of oil and non-oil exports to the Syrian economy from 1975 to 2010. He found that the Syrian GDP is positively and significantly related to oil and

non-oil exports. In the short run, there is a relationship between oil and non-oil exports and GDP. While there is a unidirectional relationship between oil exports and GDP and a bidirectional relationship between the GDP and non-oil exports. He suggested enhancing the non-oil exports to govern the economy to a more significant extent. Ajmi et al. (2015) found a bidirectional causality relationship between exports and economic growth. Alhowaish (2014) explored that export growth affects production growth in the Saudi Arabia economy thus the import demand increases clearly. Islam et al. (2022) revealed that the effect of financial growth remains strong its positive impacts neutral, while negative impacts on economic growth, in the long run, make a positive impact. Likewise, the positive components of oil fare remain neutral, and the negative oil fare negatively affects financial growth. They suggested developing non-oil production and increase exports of the nation. Reddy (2020) studied the relationship between exports, imports, and economic growth in India from 1980 to 2019 and found a significant relationship between exports, imports, and economic growth in the long run. There is a unidirectional relationship between all exports, imports, and economic growth. Finally, he extracted that the imports and exports foster economic growth in India. Shadab (2021) found a significant relationship between imports, export diversification, and economic growth in UAE. Also, he confirmed that there is a unidirectional relationship between export diversification and economic growth. He found that in the UAE, there is economic diversification and the shifting of the economy from an oil economy to a non-oil economy. Habanabakize (2020) observed that long-term financial or economic growth affects more on imports more than exports as the rates are high at the time of a growing economy. Therefore, consumers prefer to import the goods than export.Sultan and Haque (2018) observed that imports are only fulfilling the needs of a consumer and not supporting the economy of Saudi Arabia as oil is the main source of financial growth of the country. Exports are more needed than imports as being an oil-based country. Exports have a positive relationship with the economic growth of Saudi Arabia. Waheed et al. (2020) indicated enhancing tourism and renewable energy for the growth of the economy of Saudi Arabia to not be dependent on oil exports. Aljebrin (2020) revealed that the non-oil sectors are supporting a balanced economy in Saudi Arabia. Government should be more focused on facilitating the non-oil sectors as well as the oil sectors to maintain good economic growth. Faisal and Reşatoğlu (2017) stated that the growth of exports governs the economy. While import has highly insignificant in the long run and it does not play an important role in economic growth. They suggested that the government should focus and invest more in the non-oil sectors as oil is the main source of income for Saudi Arabia in terms of exporting oil to other countries. Abu-lila et al. (2021) found a positive and statistically important impact of real exports on the real gross domestic products. They suggested firming export-oriented actions to get balanced economic growth. Isaiah Zayone et al. (2020) found that the non-oil sector in Angola had a positive impact on economic growth. But, the non-oil sector has a weaker impact on economic growth than the oil exports. This may be due to that Angola has made good progress in infrastructure and has adopted the needed policies. Shihab and Abdul-Khaliq (2014) found a connection between export and economic growth in Jordan and the way of connection runs strictly from economic growth to exports. They studied a kind of support for growth-led export in the case of Jordan. They suggested making some efforts toward the substitute of imports to impact more on exports. Okorie and Nwachukwu (2022) studied that the market of fruits and vegetables harms

the country's economic growth due to low facilities for the farmers. Government should promote farmers by offering them low-interest loans for agricultural activities more importantly vegetables and fruits. Bakari (2017) found that long-run domestic investment and exports negatively affect the economic growth of Egypt but in the short term, imports have a positive effect on economic growth. Nguyen et al. (2021) found the exchange rate as a tool to improve the capacity of export and reduce imports. They mainly found that the exchange rate does not play an important role in exports and imports while a trade war plays an important role in increasing exports and the volume of imports between two countries. El Alaoui (2015) studied the relationship between the export, import, and economic growth of Morocco from 1980 to 2013 and found that bidirectional causality between the import and economic growth and import, unidirectional causality relationship between the export and import and directional causality between the export and the economic growth. From the above studies, it is obvious that there is a causal relationship between the exports, imports, and GDP of the nation. However, no study is available to explain the co-movement of the components of the exports and imports with the GDP of Saudi Arabia. The study applies the following research framework as given in figure 1.

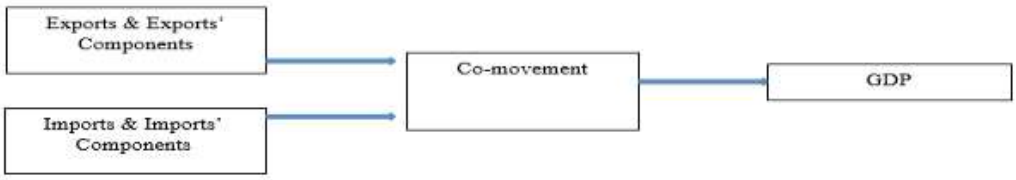


Figure 1: Research framework to study co-movement of exports, imports and their components with GDP

As per the above research framework, the following hypothesis can be framed to study the co-movement of exports, imports, and their components with the GDP of Saudi Arabia.
$H_0$1: There are no co-movement exports with the GDP of Saudi Arabia.
$H_0$2: There are no co-movement imports with the GDP of Saudi Arabia.
$H_0$3: There are no co-movement components of exports with the GDP of Saudi Arabia.
H04: There are no linear co-movement components of imports with the GDP of Saudi Arabia.

3. Research Methodology

The study is purely based on the secondary data obtained from the website of the SAMA (Saudi Arabian Monetary Agency). To fulfill the objectives of the study exports, imports, and GDP (Gross Domestic Product data) from 2002 to 2021 were analyzed by applying statistical tools. The mean of the absolute variables (Exports and Imports and their components) is calculated to get the weightage in the context of the GDP in form of percentages to explore their proportional relationship. Fixed Base Index Numbers calculate to get the movement over a period of time (Ali, 2021).

FBI (Fixed Base Index Numbers) = $\frac{v_{cy}}{v_{By}} * 100$

Standard Deviation and Coefficient of Variation (CV) calculated to get the normality in the variability of the variables.

CV (Coefficient of Variation) = $\frac{\sigma}{\bar{x}}$

Stacked column charts and line charts reveal absolute differences and co-variability or growth trends in a period.

ANOVA calculated to get the significant mean differences among the variables of Exports and Imports and their components, and GDP (Ali and Ali, 2022).

ANOVA (Analysis of Variance) = F =$\frac{Bss/df1}{Wss/df2}$; While, F≥ F∝ , Reject H0;

Where F is Variance or Fisher's ratio, Bss/df1, and Wss/df2 are the sum of squares between samples divided by degrees of freedom, and the sum of squares within samples divided by degrees of freedom, respectively.

A post hoc test is applied to identify the group or groups (variable or variables) of which mean performances are significantly different from others. Post Hoc test is applicable while p-value < α. There is a comparison between all the groups to know the mutual significant difference. To know the number of a couple of groups, the following formula is applied (Rahman et al., 2021).

K (k-1)/2,

Where K is the number of groups under consideration for significant mean differences study. T-test (p-value) is calculated between the various combinations of groups and compared with the Bonferroni corrected α (α/k). If calculated p-vale < post hoc α (Bonferroni corrected α), there is a significant mean difference between the two groups.

The exports of Saudi Arabia are divided into two categories for analysis point of view i.e. Mineral products export and non-mineral products exports. Non-mineral product exports include foodstuffs, chemical products, Plastic Products, Base Metals and Articles of Base Metals, Electrical Machines, Equipment & Tools, other exports, and re-exports. Also, the imports of Saudi Arabia are divided among three categories for analysis and study point of view i.e. Base metal articles, Machinery mechanical appliances and parts thereof; Transport Equipment; and other imports. Base metal articles, Machinery mechanical appliances, and parts thereof include Base Metals & Articles of Base Metals; and Machinery Mechanical Appliances Electrical Equipment & Parts Thereof. While, other imports include live animals, animal & vegetable fats oils and their product; prepared foodstuffs beverages spirits vinegar & tobacco; mineral products; chemical & allied industries products; resin, plastic, rubber products; cork, wooden, and charcoal products; paper and board making products; footwear, umbrellas, artificial flower, and human hair; stone and ceramic products, glass and glassware; pearls, stones, and metals; optical photographic measuring checking precision medical & surgical instruments & apparatus clocks & watches musical instruments sound records & reproducers & parts thereof; arms ammunition and parts thereof; miscellaneous manufactured articles; work of art collection pieces and antiques.

4. Analysis & Interpretations

The analysis and interpretations of the co-variability of the exports and imports and GDP can be divided into three categories.

4.1 Co-variability of Exports, Imports and GDP

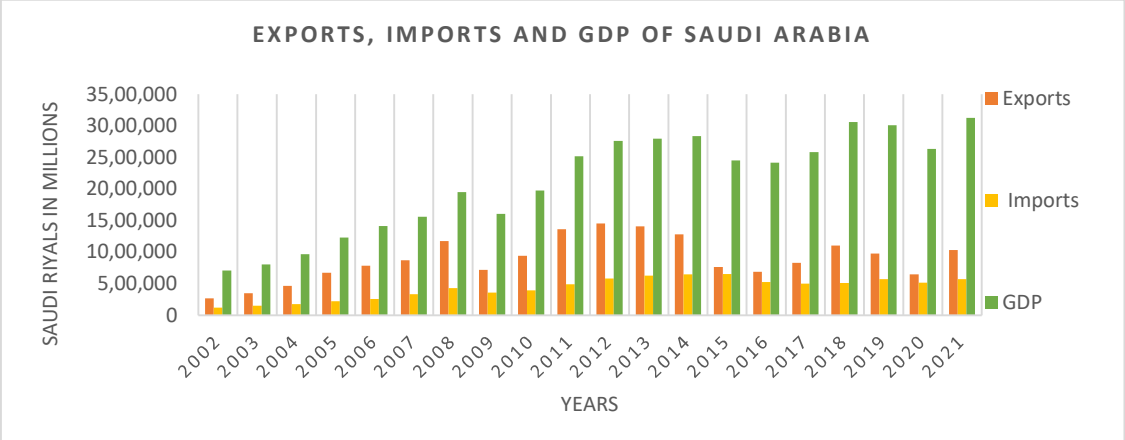
Co-variability of exports, imports, and GDP refers to the co-integration or co-movement of the variables, mutually. Fixed base Index Numbers (FBI) measure the relational variations of the exports, imports, and GDP. Symmetry in the FBI refers to the significant co-movement while asymmetry indicates the no or weak relationship among the variables.

Table 2: Co-variability of exports, imports and GDP of Saudi Arabia

Years	Exports	FBI	Imports	FBI	GDP	FBI
2002	271741	100	121088	100	711022	100
2003	349664	129	156391	129	809279	114
2004	472491	174	177659	147	970283	136
2005	677144	249	222985	184	1230771	173
2006	791339	291	261402	216	1411491	199
2007	874403	322	338088	279	1558827	219
2008	1175482	433	431753	357	1949238	274
2009	721109	265	358290	296	1609117	226
2010	941785	347	400736	331	1980777	279
2011	1367620	503	493449	408	2517146	354
2012	1456502	536	583473	482	2759906	388
2013	1409524	519	630582	521	2799927	394
2014	1284122	473	651876	538	2836314	399
2015	763313	281	655033	541	2453512	345
2016	688424	253	525637	434	2418508	340
2017	831882	306	504440	417	2582198	363
2018	1103900	406	513993	424	3062170	431
2019	981012	361	574361	474	3013561	424
2020	651952	240	517492	427	2637629	371
2021	1035672	381	573186	473	3125780	440
Mean (% of GDP)	892454(42%)	328	434596 (20.48%)	359	2121873(100%)	298
S.D.		125		141		111
CV		0.38		0.39		0.37

Source: Exports, Imports & GDP values available on https://www.sama.gov.sa/en-us/economicreports/pages/database.aspx

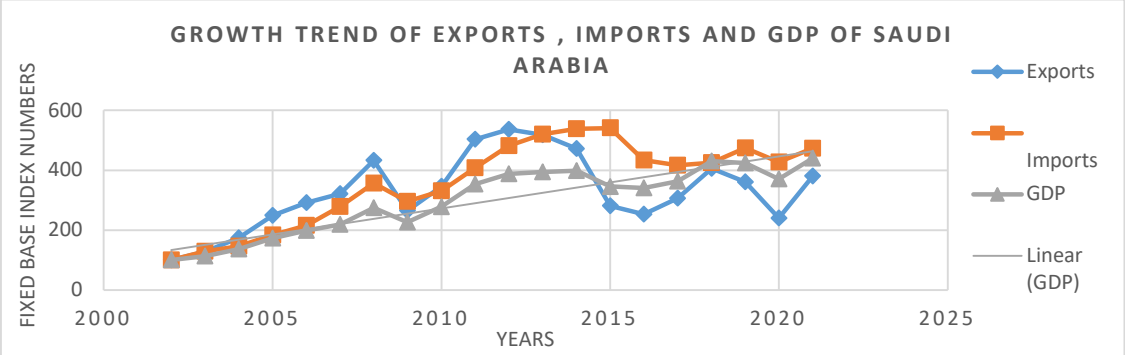
From the table 2 , it is clear that the exported products contribute two times more (42%) than the imports of products (20.48%). There is variability in the exports, imports, and GDP of Saudi Arabia as the CV of the exports (0.38), imports (0.39), and GDP (0.37) is more than 0.30. But, the variability of all variables is positive given that the mean of the FBI is more than the 3 times that of the base year's FBI.



Source: Exports, Imports & GDP values available on https://www.sama.gov.sa/en-us/economicreports/pages/database.aspx

Figure 2: Exports, Imports and GDP of Saudi Arabia

Figure 2 explains that there is a snake-moving pattern in the absolute values of exports and the GDP of Saudi Arabia. The exports directly contribute proportionately to the GDP of Saudi Arabia. The amount of imports varies but not in the equal amount of the exports in the context of GDP. Hence there is a strong co-movement between the exports and GDP than the imports in Saudi Arabia.



Source: Fixed base numbers values given in the table 2.

Figure 3: Growth trend of exports, imports and GDP of Saudi Arabia

Figure 3 explains the growing trend of the exports, imports, and GDP of Saudi Arabia. The growth rate of the imports is better than the GDP and exports of Saudi Arabia from 2002 to 2021. Symmetry exists in the co-movement of the exports and GDP of Saudi Arabia. The fluctuations in the exports affect the GDP positively but not proportionately. There is more variability in the exports compared to the imports and GDP. But, the trend shows the growth of exports, imports, and GDP of Saudi Arabia.

Table 3 : ANOVA of growth exports, Imports and GDP of Saudi Arabia

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F critical value*
Between Groups	36583.105 56	2	18291.552 78	1.14495 35	0.3254 48	3.158843
Within Groups	910620.79 25	57	15975.803 38			
Total	947203.89 81	59				

Source: Fixed base numbers values given in the table 2.

Table 3 reveals that there is no significant difference among the growth of the exports, imports; and GDP as the F (1.1449535) <F *critical value (*3.158843) or *P-value (*1.1449535)> Fα (0.05). Hence, $H_0$1 and $H_0$2 are rejected.

4.2 Co-variability of components of Exports and GDP

Co-variability of components of exports and GDP refers to the co-integration or co-movement of the variables, mutually. Fixed base Index Numbers (FBI) measure the relational variations of the components of exports and GDP. Symmetry in the FBI refers to the significant co-movement while asymmetry indicates the no or weak relationship among the variables.

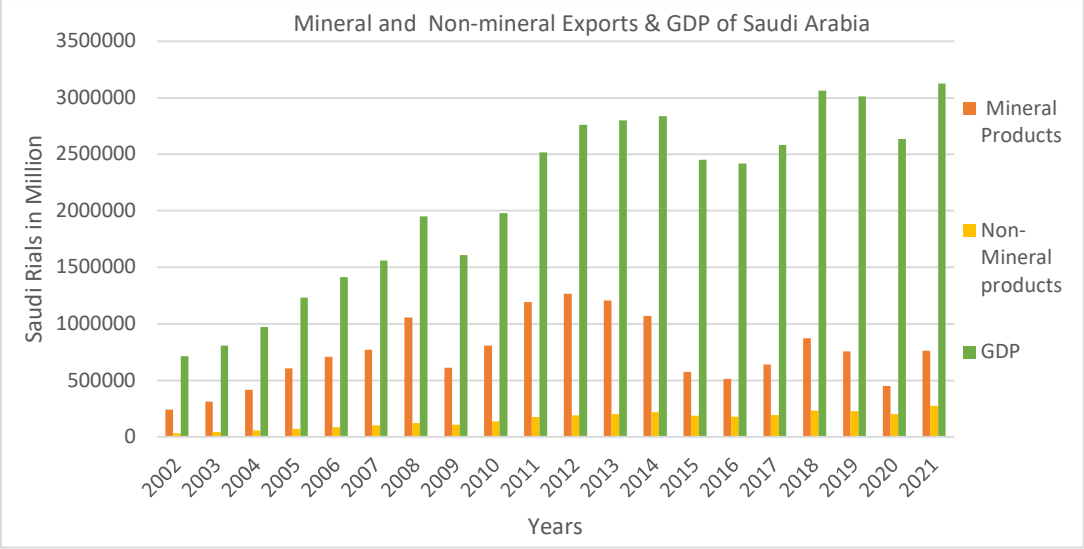
Table 4: Co-variability of components of exports and GDP of Saudi Arabia

	Mineral Products	FBI	Non-Mineral products	FBI	GDP	FBI
2002	239973	100	31768	100	711022.2	100
2003	308993	129	40671	128	809278.7	114
2004	415696	173	56795	179	970283.5	136
2005	606371	253	70773	223	1230771	173
2006	706486	294	84853	267	1411491	199
2007	771107	321	103296	325	1558827	219
2008	1055300	440	120182	378	1949238	274
2009	612344	255	108765	342	1609117	226
2010	808220	337	133565	420	1980777	279
2011	1192116	497	175504	552	2517146	354
2012	1266354	528	190148	599	2759906	388
2013	1208154	503	201370	634	2799927	394
2014	1068088	445	216034	680	2836314	399
2015	574677.2	239	188635.8	594	2453512	345
2016	512216	213	176208	555	2418508	340
2017	640010	267	191872.2	604	2582198	363
2018	871775.8	363	232124.7	731	3062170	431
2019	754833	315	226179	712	3013561	424
2020	450951	188	201001	633	2637629	371
2021	762416	318	273256	860	3125780	440

Mean (% of GDP)	741304.1 (35%)	309	151150 (7%)	476	2121873 (100%)	298
S.D.		124		221	100	111
CV		0.4		0.46		0.37

Source: Exports, Imports & GDP values available on https://www.sama.gov.sa/en-us/economicreports/pages/database.aspx

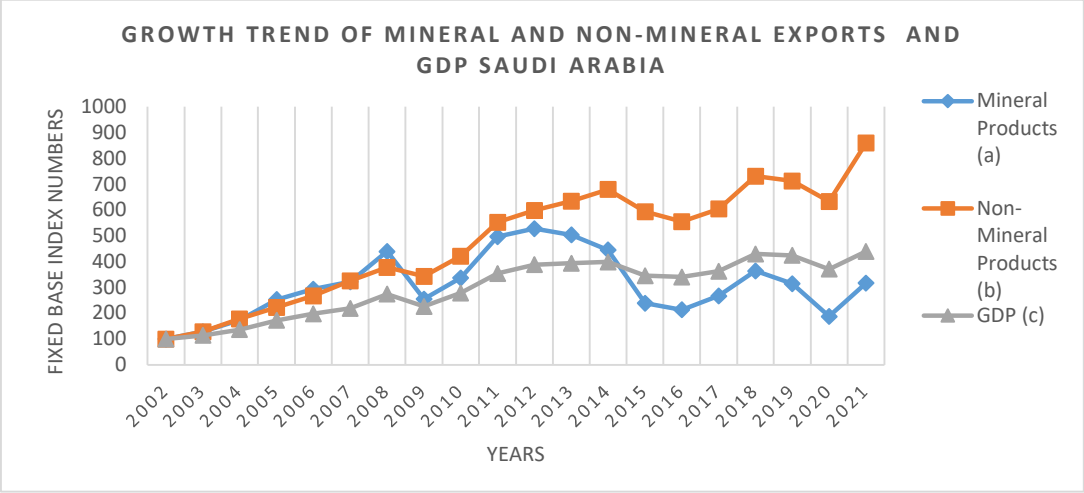
From table 4, it is clear that the mineral exports products contribute 5 times more (35%) than the exports of non-mineral products (7%). There is variability in the mineral and non-mineral exports and GDP of Saudi Arabia as the CV of the mineral exports (0.4), non-mineral exports (0.46) and GDP (0.37) is more than 0.30. But, the average growth of 3 times seen in the mineral exports and GDP while 5 times in non-mineral exports of Saudi Arabia from 2002 to 2021.



Source: Exports, Imports & GDP values available on https://www.sama.gov.sa/en-us/economicreports/pages/database.aspx

Figure 4: Mineral and Non-Mineral Exports & GDP of Saudi Arabia

Figure 4 explains that there is a snake-moving pattern in the absolute values of exports of mineral products and the GDP of Saudi Arabia, together. The mineral exports directly contribute proportionately to the GDP in Saudi Arabia. The amount of non-mineral products varies but not in the equal amount of the exports in the context of GDP. Hence there is a strong co-movement between the mineral exports and GDP than the non-mineral exports products in Saudi Arabia.



Source: Fixed base numbers values given in the table 3.

Figure 5: Growth Trend of Mineral and Non-mineral exports and GDP Saudi Arabia

Figure 5 explains the growing trend of the mineral exports, non-mineral exports, and GDP of Saudi Arabia. The growth rate of the non-mineral exports is better than the GDP and mineral exports of Saudi Arabia from 2002 to 2021. There is symmetry seen in the co-movement of the mineral exports and the GDP of Saudi Arabia. There is more variability in the mineral exports compared to the non-mineral exports and GDP. But, the trend shows the growth of non-mineral exports more than mineral exports and the GDP of Saudi Arabia.

Table 5: ANOVA of mineral and non-mineral exports and GDP of Saudi Arabia

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	396125.5	2	198062.8	7.760081	0.001046	3.158843
Within Groups	1454827	57	25523.29			
Total	1850953	59				

Source: Fixed base numbers values given in the table 4.

Table 5 reveals that there is a significant difference between the growth of mineral and non-mineral exports and the GDP of Saudi Arabia as the F (7.760081) >F *critical value (*3.158843) or *P-value (*0.001046) < Fα (0.05).

Table 6: Post Hoc test of mineral and non-mineral exports and GDP of Saudi Arabia

		Post Hoc	
Groups	p value (T test)	α (α/k)=0.05/3	Significant ?
a-b	0.005485	0.016666667	Yes
b-c	0.002728	0.016666667	Yes
a-c	0.779694	0.016666667	No

Source: Fixed base numbers values given in the table 4.

In table 6, the Post hoc test explains that there is no significant difference between the mineral exports and the GDP of Saudi Arabia. While the mean differences between mineral exports and non-mineral exports are significantly different. There is a relationship between mineral exports and the GDP of Saudi Arabia. Hence, H03 is rejected, partially.

4.3 Co-variability of components of Imports and GDP

Co-variability of components of imports and GDP refers to the co-integration or co-movement of the variables, mutually. Fixed base Index Numbers (FBI) measure the relational variations of the components of imports and GDP. Symmetry in the FBI refers to the significant co-movement while asymmetry indicates the no or weak relationship among the variables.

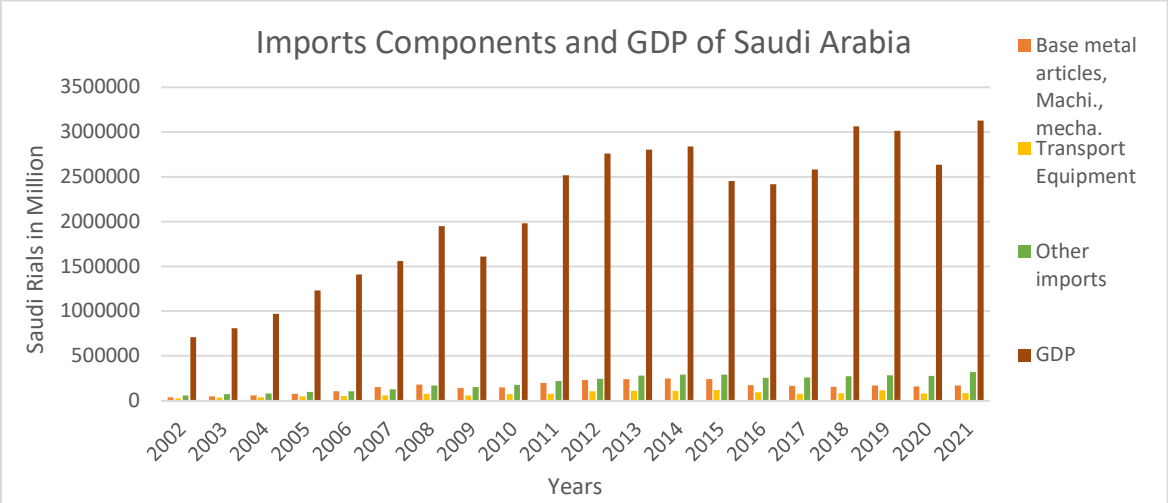
Table 7: Co-variability of components of imports and GDP of Saudi Arabia

Years	Base metal articles, Machi.,mecha. (A)	FBI (a)	Transport Equipment (B)	FBI (b)	Other imports (C)	FBI (c)	GDP (D)	FBI (d)
2002	36555	100	26723	100	57810	100	711022	100
2003	48074	132	34144	128	74173	128	809279	114
2004	56533	155	38290	143	82836	143	970283	136
2005	77941	213	46704	175	98340	170	1230771	173
2006	105928	290	50453	189	105021	182	1411491	199
2007	150569	412	59440	222	128079	222	1558827	219
2008	183330	502	77620	290	170803	295	1949238	274
2009	142631	390	62287	233	153371	265	1609117	226
2010	148551	406	73628	276	178557	309	1980777	279
2011	198213	542	77141	289	218095	377	2517146	354
2012	234438	641	103544	387	245491	425	2759906	388
2013	243332	666	107552	402	279698	484	2799927	394
2014	250771	686	108610	406	292495	506	2836314	399
2015	242794	664	120516	451	291723	505	2453512	345
2016	176745	484	93925	351	254966	441	2418508	340
2017	163971	449	79397	297	261079	452	2582198	363
2018	155155	424	84652	317	274186	474	3062170	431
2019	169187	463	118264	443	286910	496	3013561	424
2020	158694	434	83009	311	275788	477	2637629	371
2021	168235	460	86201	323	318749	551	3125780	440
Mean (% of GDP)	155582 (7.33%)	426	76605 (3.61%)	287	202408 (9.54%)	350	2121873 (100%)	298
S.D.		176		104		150	100.00	111
CV		0.41		0.36		0.43		0.37

Source: Exports, Imports & GDP values available on https://www.sama.gov.sa/en-us/economicreports/pages/database.aspx

From table 7, it is clear that average import products constitute 20.48% of the GDP of Saudi Arabia for the period 2002 to 2021. Articles of base metals, machinery mechanical appliances

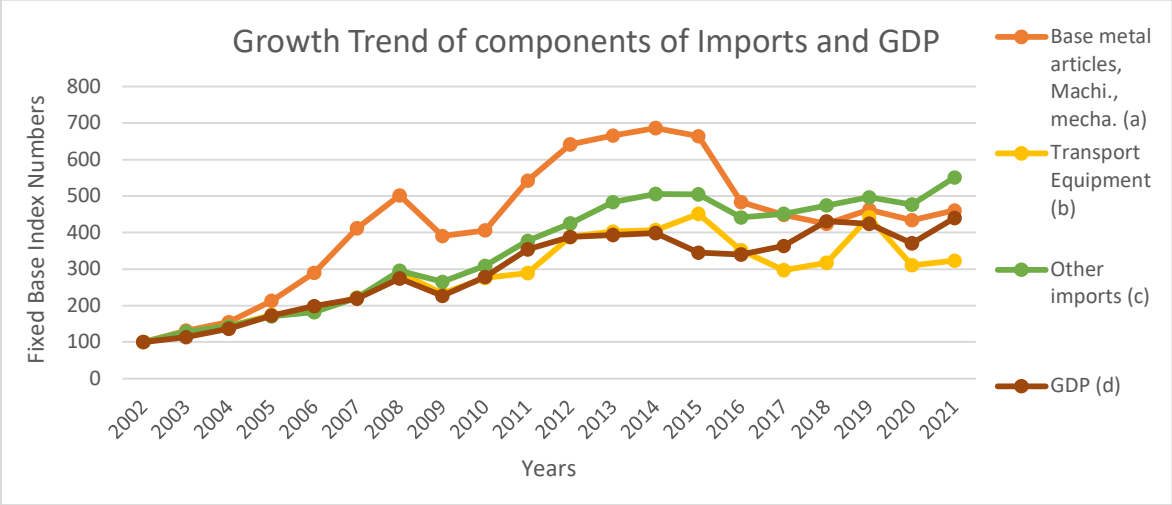
electrical equipment , transport equipment; and other imports constitute 7.33%, 3.61%, and 9.54% of the Saudi GDP, respectively. There is variability in the components of imports i.e. Base Metals & Articles of Base Metals, Machinery Mechanical Appliances Electrical Equipment & Parts Thereof (CV= 0.41); transport equipment (CV= 0.36); and other imports (CV=0.43) and GDP (CV=0.37) of Saudi Arabia. But, the average growth in all components reveals 3 times the average growth in the period from 20002 to 2021 exceptionally more than 4-times the average growth in the articles of base metals, machinery mechanical appliances electrical equipment & parts thereof. So, there is positive variability in all components and the GDP of Saudi Arabia.



Source: Exports, Imports & GDP values available on https://www.sama.gov.sa/en-us/economicreports/pages/database.aspx

Figure 6: Imports Components and GDP of Saudi Arabia

Figure 6 explains that there is a snake-moving pattern in the absolute values of components of imports and the GDP of Saudi Arabia, together. All components of the imports are smaller in the context of the GDP of Saudi Arabia. But, the fluctuations in the GDP affect the components of imports in Saudi Arabia. Hence there is a co-movement between the components of imports and GDP in Saudi Arabia from 2002 to 2021.



Source: Fixed base numbers values given in the table 6.

Figure 7: Growth Trend of components of Imports and GDP

Figure 7 explains the growing trend of the components of imports and GDP of Saudi Arabia. The growth rate of the articles of base metals, machinery mechanical appliances electrical equipment & parts thereof is better than the GDP and other components of imports of Saudi Arabia from 2002 to 2021. There is symmetry seen in the GDP and other imports. While there is a symmetry of co-movement of Base Metals, Machinery Mechanical Appliances Electrical Equipment & Parts Thereof; and transports equipment observed. But, the trend shows the growth of all components of imports and GDP of Saudi Arabia from 2002 to 2021.

Table 8: ANOVA of components of imports and GDP of Saudi Arabia

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	240099.9	3	80033.32	4.180458	0.008552	2.724944
Within Groups	1454992	76	19144.63			
Total	1695092	79				

Source: Fixed base numbers values given in the table 7.

Table 8 reveals that there is significant difference among the growth of components of imports and GDP of Saudi Arabia as the F (4.180458) >F *critical value (*2.724944) or *P-value (*0.008552) < Fα (0.05).

Table 9: Post Hoc test of components of imports and GDP of Saudi Arabia

Groups	p value (T test)	Post Hoc α(α/k) = 0.05/4	Significant ?
a-b	0.004234	0.0125	Yes
b-c	0.128603	0.0125	No
c-d	0.223299	0.0125	No

a-d	0.009386	0.0125	Yes
a-c	0.152186	0.0125	No
b-d	0.731748	0.0125	No

Source: Fixed base numbers values given in the table 7.

In table 9, the Post hoc test explains that Articles of base metals, machinery mechanical appliances electrical equipment (a) co-moves with other imports (c). While, there is co-movement of the transport equipment (b), and other imports (c) with the GDP (d) of Saudi Arabia. Growth of Base Metals & Articles of Base Metals, Machinery Mechanical Appliances Electrical Equipment & Parts Thereof (FBI=426) is higher than the growth of transport equipment (FBI=287), and other imports (FBI=350) with the GDP (FBI=298) of Saudi Arabia. Hence, H04 is rejected, partially.

5. Discussion

From the above analysis and interpretations, it can be concluded that there is a co-movement of the exports, imports, and GDP in Saudi Arabia. In Saudi Arabia, exports and GDP strongly move together than the imports and GDP short, comparatively (Okyere and Jilu, 2020). In long run, there is growing trend symmetry among the exports, imports, and GDP of Saudi Arabia (Miyan and Biplob, 2019). In the short run, exports enhance the GDP and GDP governs the imports but not proportionately. The mineral exports are 5 times of non-mineral exports in Saudi Arabia. The mineral exports follow the growth trend of GDP while the non-mineral exports growth is higher than the mineral exports and GDP. However, the absolute amount of non-mineral exports is lower than the mineral exports to affect the GDP. In the long run, mineral exports and GDP growth pattern is similar while non-mineral export growth is higher. So, non-mineral exports contribute higher than mineral exports. But, due to lower contribution or lower absolute amount, it cannot enhance the GDP. There need to enhance the non-mineral exports of Saudi Arabia to enhance the GDP. The average growth rate of the imports of articles of base metals, machinery mechanical appliances electrical equipment & parts thereof is higher than the transport equipment and other imports in Saudi Arabia. The fluctuations in the Saudi GDP affect base metals, machinery mechanical appliances electrical equipment & parts thereof more than the imports of transport equipment and other transports. There is a strong co th-linearity between the transport equipment, other transports, and GDP than the base metals, machinery mechanical appliances electrical equipment & parts thereof. The average proportion of the absolute amount of e other imports is higher than the base metals, machinery mechanical appliances electrical equipment & parts thereof; and transport equipment. So, the government has to focus on other import category items to lower the imports to make a stronger economy. The average growth rate of articles of base metals, machinery mechanical appliances electrical equipment & parts thereof is higher than the other category exports. To make an alignment with GDP, there is a need to control the articles of base metals, machinery mechanical appliances electrical equipment & parts thereof in Saudi Arabia. In lowering the imports of Saudi Arabia, articles of base metals, machinery mechanical appliances electrical equipment & parts thereof; and other imports must be considered due to the higher rate of growth and larger absolute amount.

6. Conclusion

Based on analysis, interpretations, and discussions it can be concluded that the average exports are more than two times of average imports in Saudi Arabia. But, the average growth rate of imports is higher than the exports and GDP growth rate in Saudi Arabia. Exports contribute directly and positively to the GDP while imports are weakly governed by the GDP of Saudi Arabia. In long run, there is a growing trend in the exports, imports, and GDP of Saudi Arabia. The average mineral exports are five times higher than the non-mineral exports. But, the average growth rate of non-mineral exports is higher than the of mineral exports. So, the non-mineral exports contribute progressively more than the mineral exports to the GDP in Saudi Arabia. But, due to lower contribution or lower absolute amount, it cannot enhance the GDP. There need to enhance the non-mineral exports of Saudi Arabia to enhance the GDP. To make higher exports, there is a need to focus on non-mineral exports as the growth rate is higher than the mineral exports and GDP in Saudi Arabia. The imports constitute one-fifth of the GDP in Saudi Arabia. The average growth rate of the imports of Base Metals & Articles of Base Metals, Machinery Mechanical Appliances Electrical Equipment & Parts Thereof is higher than the transport equipment and other imports and needs to be controlled in Saudi Arabia. In imports, transport equipment, and other category imports follow the GDP movement pattern while Base Metals & Articles of Base Metals, Machinery Mechanical Appliances Electrical Equipment & Parts Thereof is higher than the transport equipment and other imports GDP in Saudi Arabia. The Saudi government has to focus on higher non-mineral products and controlling the Base Metals, Machinery Mechanical Appliances Electrical Equipment & Parts Thereof, and other exports to higher the exports and align the movement of the imports to the GDP of Saudi Arabia.

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