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RESEARCH ARTICLE

INDO-BRITAIN TRADE DURING GOLD STANDARD: AN ECONOMETRIC VIEW

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ABSTRACT

In this paper author tried to show the trends and patterns of India's export to Britain and import from Britain during the gold standard period from 1870 to 1913.The paper also seeks to cointegrate among India's export to Britain and India's import from Britain with India's GDP, UK's GDP, India's nominal effective exchange rate and Britain inflation rate respectively. Author used semi-log linear models to find trends. Bai-Perron (2003) model is used for structural breaks. Decomposition of trends and cycles were obtained from H.P.Filter model(1997) and Hamilton filter model(2018).Johansen(1988) model was applied to find cointegration and vector error correction processes. Cointegrating equation was used to verify long run causality and Wald test (1943) was applied to scrutinise the short run causality. The paper concludes that both export and import are upward rising with structural breaks showing peaks and troughs. Both have one cointegrating equations with their determinants. India's export to Britain and import from Britain had long run causalities from India's and UK's GDP, India's nominal effective exchange rate and UK's inflation respectively. Their VECMs are stable and nonstationary although cointegrating equations move towards equilibrium with low speed of adjustments.

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INTRODUCTION

During the regime of Emperor Akbar in 1600, trade was established between India and England when Elizabeth I sent a precious gift on the eve of newly formed East India Company. English East India Company chartered in 1599 and started spice trade from India. This company landed at the port of Surat in August 24, 1608 but was secured trade agreement with Emperor Akbar at Surat in 1618 although since1613, it started trading with pepper, spices, silk and tea from Surat.East India Company got Diwani of Bengal after military victories of battle of Plassey (1757) and Buxar(1764). Dasgupta (2001) verified that the Sultanate of Gujarat, Kingdom of Bengal (1368-1576) and Emperor of Vijayanagara had developed in maritime trade in India prior to arrival of the Portuguese and British in Indian ocean. Gujarati muslim dominated Indian ocean trade and traded with Malabar, Malacca, Hormuz and Aden from Surat. The decline of Mughal port of Surat, disappearance of fleets and loss of commerce during 1701-1750 facilitated the expansion of English private trade. Roy (2008) stated that British East India company got Madras in 1639, Bombay in 1661 and Sutanuti, Dihi Kolkata and Gobindapur in 1698.

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(Although Bombay was sacked by Portuguese twice in 1661 and 1662 and Diu in 1668 and 1676 while Bassein was plundered in 1674 which was described by Dasgupta in 2001).In 1664, British East India Company imported 7.5 lakh pieces of cloths from India which was equivalent of 73% of Company's trade and within 20 years it stood doubled. In 1764, the company captured Bengal, Bihar and Orissa after defeating Siraj ud-Daulah. In the end of the 17th century India exported spices, cotton, muslin, indigo, salt, raw silk to England from the ports of Calcutta and Patna. Even, European companies imported from India and re-exported to other European nations with higher prices. English trade from India started to catapult since 1670 and it was recorded that in 1740, England exported cloth and raw cotton from India from the ports of Kolkata, Calicut, Cochin, Goa, Surat and Bombay.

Mukhopadhyaya (2004) explicitly described that till 1700, India was the dominant country against England, Dutch and France in the Indian Ocean trade where Gujarati muslims played significant role because of low cost of trading. Then, India exported rice, dal, wheat, oil, sugar, raw silk, raw cotton, spices, chilli and indigo and India imported gold, silver, tin, medicine, horse, foreign currencies etc. Ray (1993) emphasized that British consolidated overseas trade in India to have strategic ports under their control. In 1611, they set up factory at Masulipatam in east coast from where pepper, spices, cotton fabrics were exported and cotton piece, yarn,

metal, oil, were imported. In 1639, they set up Madras base and Bombay in 1668. British traded 28% of total from Bombay port during 1903-04. In 1687 British shifted headquarter from Surat to Bombay. In 1633, British established port at Balassore in Orissa. On July 14, 1669, they were permitted by the East India Company to ship up the Hooghly river. In 1904-05, about 84% of India's trade was carried by British flage from Calcutta port. British founded Vizagapatnam in 1682 and set up a factory. Maddison (1971) also added that in 1850, first textile mill was started by Indian capitalist with the help of British trading company to produce cotton textile. But jute factory expanded rapidly by three times than textiles for export during 1879-1913.In the exchange system, author reiterated that in 1898, India adopted gold exchange standard from silver standard due to fall in prices of silver and rupee depreciation against sterling since 1870.It affected India's competitiveness against China and Japan and terms of trade went in favour of England. It was also evident that there was no trading relation between England and India in ancient times and even during 1-1500.Thus the paper is unable to hint any description about Indo-UK trade during those regimes. In this paper author analyses econometric Indo-UK trade patterns of export and import as well as finds cointegration and vector error correction between Indo-British export and import with British and Indian GDP, Indian nominal effective exchange rate and Britain's consumer price index during the period from 1870 to 1913 i.e. during the heyday of gold standard regime.

Some studies on Indo-British trade: During long years between 1870 to 1913, British government practiced free trade imperialism and India was forced to accept free trade as her colony and used their naval power to cajole smaller or weaker countries outside Europe to sign free trade treaties. Gradually, free trade imperialism remained an important element of British imperial expansion in 1880s and 1890s.It affects British terms of trade inversely and its growth of national income reduced. In 1900, UK by stimulating capital exports into railways and industries, reducing agricultural price, shifted to terms of trade in its favour and began to rise national income.(Cain, 1999). Ray et al. (1992) also explained that Indian business expanded due to dominance of foreign capital in Indian trade during 1800-1947.This notion was vividly studied by Roy (2014) and the study revealed that during 1800-1940, in Bombay and Calcutta, trade was composed of Malwa opium and Khandesh cotton in Bombay and Bihar opium and Bengal indigo in Calcutta. Later, wheat or cotton were procured from greater distance. Calcutta was famous for Maritime trade. Parsi and Gujarati merchants were the dominant traders. Premchand and Roychand was successful in financial markets. Liverpool was connected for cotton business. From 1870 to 1914, India's exports of primary commodities were wheat, rice, cotton, jute, wool, oilseeds, semi-processed hides and skins and cotton textiles was the largest import where European firms dominated. British exported sewing machines, processed foods and bicycle etc. Hindu, Muslims, Parsis, Eurasians, Chinese dominated hides export to Britain and the European nations. Madras tannery started export from 1903.Before that Delhi and Kanpur started factories and exported therein. During 1860-1914, a steady inflow of British capital promoted European trading firms in collaboration with East India Company in Calcutta and concentrated on indigo trade. Finlay company started buying cotton from India and export tea to Europe. Binny & Company expanded caravan trade but during 1900 their main business turned into textile mills and banking.

After 1870, A.V. Best Dunlop became the largest exporter of hides and skins from Madras. On Malabar coast, Peirce Leslie and Harrisons Crossfield were prominent in trade and manufacturer of rubber, coffee, tea, cashew, coir and tiles. Around 1880, E.Hill and Tellery invested money in loomsheds hiring designs and artisans from Kashmir and Punjab started to produce woollen knotted carpets for exports. Indian fiscal and monetary system were fully extracted by British empire during 1870-1914 and Indian surplus trade earnings was drained to U.K. This phenomenon was clarified by Roy(2019).India's debt/GDP was 14.9% in 1870 which catapulted to 22.4% in 1910 where debt of UK rose from 34.8% in 1870 to 65.9% in 1810.In 1870, Indian revenue per head as a ratio of British revenue per head(%) was 12.9% which reduced to 7.5% in 1910.The revenue % of GDP of UK was 7.2% in 1870 which increased to 9.1% in 1910.Revenue % of GDP in India was 7.0% in 1870 which decreased to 6.7% in 1910.Revenue per head at 1873 prices in India was 0.27 in 1870 which marginally increased to 0.28 in 1910.It implies that India's fiscal system was colonial and exploited by British interest. Irrespective of that, during colonial India, there were revolutionary changes in cultivated land, long distance trade, cotton textile mills and ocean trade.

Industrial revolution and British investment for expansion of Indian railways contributed in every sectors of the economy. Bogart and Chaudhury (2011) studied that Indian railways increased market integration and national income. There was a trend to higher output, productivity and profits between 1850 and 1919 and not after. Also, it was admitted that the primary impact of railway in the Indian economy was to increase interregional and international trade. It increased agricultural income by 16% and Hurd (1983) estimated that social savings was 9% of national income during 1900 due to railway. In a study, it was noted that India became a classic example of a colonial country supplying raw materials and foodstuffs to her imperialist and providing markets for manufacturers. Even, Indian agriculture was commercialized between 1850 to 1947 and industrial revolution intensified by railways after 1850 when large amount of wheat from Punjab, jute from Bengal and cotton from Bombay were exported to England ("[Indian Economy during the British Empire: An Overview]", n.d.). In an another study, it was revealed that British colony like India could not pursue independent trade policies although Britain started reduction of tariff and turned towards free trade introducing fixed exchange rate system under gold standard with huge export of capital in both short and long run deploying naval power to dominate world trade in imperialistic way ("[Trade Cooperation before 1914]", n.d.). Bhattacharjya (1986) explained that India earned balance of trade surplus during 1870-1914 by which gold and silver were imported from Britain and the rest was used for meeting home charges of the empire so that India by degrees was fallen in a great debt to Britain. Although Britain reduced tariff rate of export and import so that Indo-UK trade could expand for the interest of empire for mainly three reasons, [i] British businessmen can earn more profits, [ii] England's industry could expand rapidly by increasing more raw materials from India, and [iii] England could increase money transfer from India by expanding more exports. Ambedkar (1923) showed that during 1870-1914, England was in gold standard and India was in silver standard (1851-1893) followed by gold exchange standard but India had to pay England in convertible sterling of gold. But the gold price in respect of silver was increasing so that rupee cost of gold payments grew steadily with the appreciation of gold and

India suffered huge amount of deficit in balance of payments. In due course, India turned into trade deficit country to England. Bhowmik (2017) estimated that capital flows did not favour silver standard during 1851-1893 because one per cent hike in gold inflows per year led to 0.65% fall in GDP, 0.68% decrease in GDP per capita, 9.62% rise in export and 1.75% increase in import per annum respectively. Although GDP, export, import, gold silver price ratio had been catapulting at the rates of 0.52%, 9.14%, 5.16%, and 0.77% significantly per year during silver standard. Therefore, instability of silver standard and capital inflows were correlated. Sen (1992) stated that it was difficult to make any firm conclusion about the effect of depreciation of silver on India's trade and balance of payments. The period from 1872-73 to 1892-93 was one of the causes of expansion of export trade both in absolute term and as a ratio of export to national income. The annual movement in the value of export trade do not bear any consistent relationship with annual variation of exchange rate movement. But Ray (1934) characterized 1870-1893 as one of chequered development, 1894 to 1900 as one of stagnation and from 1900 to 1913 as one of unimpeded progress showing different indices of growth of foreign trade. Sen (1992) was on the same opinion on the surplus trade balance and meeting home charges in convertible sterling balance and transfer funds from India to UK with other Economists and also stated that India's net barter terms of trade declined during the period when the exchange value of rupee was falling in response to the fall in gold price of silver. This process was the structural symptom of India which was seen from the writing of Dean and Cole (1967) which stated that during 1784-1792, the net Indian transfer reached the peak level which was approximately less than 2% of British industrial output.

Even, Maddison (2007) explained that during the period from 1820 to1913, British per capita income grew three times as compared to 1700-1820.British export of capital expanded throughout the empire countries due to imposition of free trade imperialism. In India, too, Britain imposed free trade and imported food stuffs from India which had a favourable impact on capital inflows where India's impact was the poorest among British empires. During the British empire, the historical decline in wage rate, destruction of artisan employment vis-à-vis de-industialization of Britain, India became less competitive in international trade where share of international trade declined steadily and production of cotton textile industry fell down as a result of British industrial expansion (Clingingsmith & Williamson, 2004). Tomlinson(n.d.) specified that East India Company, as a ruler of Bengal in 1765, purchased Indian cotton and China tea to sell in London and re-exported to Europe in exchange of British goods. By 1810, private traders exported indigo and saltpetre from India to Europe. But within 1813, company's monopoly on trade between Britain and India ended and started wider trade between Europe and other nations for Indian cotton during the regime of Napoleon. During the colonial rule from 1850-1930, India's exports were concentrated mainly on primary products and Britain exported manufacturing products including railway equipment and metals to India. Britain's export surplus with India partly balanced her deficit with continental Europe and to act as the lender of the last resort for international gold standard. Transfers to Britain were certainly substantial but not enough to prevent any domestic capital formation in India.

METHODOLOGY AND SOURCE OF DATA

Linear or non-linear trend line have been obtained by applying semi-log regression model. Structural breaks was found from the Bai-Perron model (2003) and minimization of cyclical trend was calculated from H.P. Filter model(1997).Also , decomposition of trend and cycle were found from applying Hamilton regression filter model(2018).Unrestricted cointegration rank test and vector error correction were done through the Johansen model(1988).ARIMA(p, d, q) model has been applied to verify the nature of autoregressive and moving average processes of the variable .Long run causality was verified by cointegrating equation and short run causalities were verified by Wald test (1943). The data on Indian export to Britain and total export of India(in million pound), Indian import from Britain and total import of India(in million pounds) , Indian Nominal Effective Exchange Rate (8 countries trade weighted where 1913=100), consumer price index of UK (2015=100)were collected from Bank of England's(2017) A millennium of macroeconomic data for the UK from 1870 to 1913.India's GDP and British GDP were taken from Maddison (2007).The missing data of India's GDP have been calculated through method of approximation. It is assumed that x_1=Indian export to Britain in million Pound, x_2=total Indian export in million Pound, m_1=Indian import from Britain in million pounds, m_2=total import of India in million pounds, inf=consumer price index of Britain with 2015=100, neer=nominal effective exchange rate of India with 1913=100, y_1=GDP of India, y_2=GDP of Britain.

Observations from the econometric models

Trends and Patterns

India's export to UK during the gold standard period from 1870 to 1913 had increased at the rate of 0.707% per annum significantly. The linear trend line is estimated below.

$\log(x_1) = 3.3217 + 0.007075t$

(58.96)* (3.24)*

R^2=0.200, F=10.526*, DW=0.522, where x_1=India's export to UK in million pound, t=year, *=significant at 5% level. In Figure 1, the upward rising linear trend line has been clearly depicted.

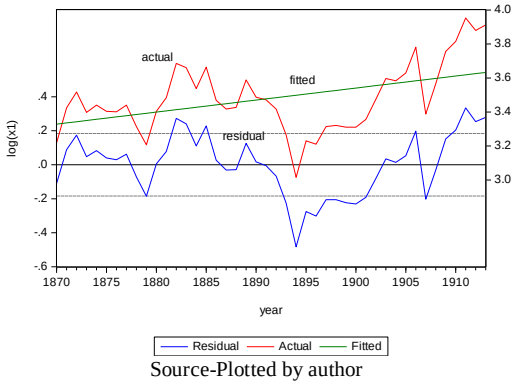

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Figure 1. Trend of India's export to UK

The fact is that the percentage share of India's export to UK as total export during 1870-1913 has been dwindling at the rate of 2.98% per year significantly which is estimated below.

$\text{Log}(x_1/x_2 X100) = 4.378 - 0.0298t$

(116.01)*(-20.45)*

R^2=0.908, F=418.35*, DW=1.26 where x_2=India's total export in million pound. The trend line is shown below.

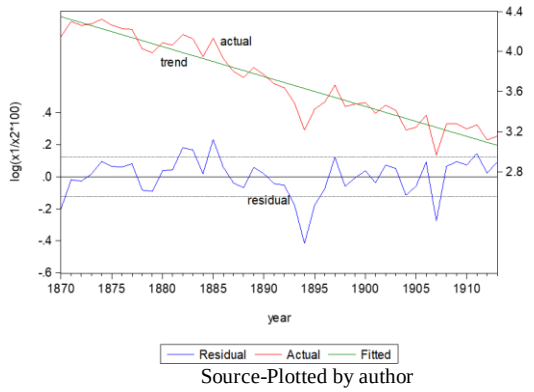

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Figure 2. Trend line of percentage share of export to UK

In fact, the export trend during 1870-1913, has been observed as cubic in nature which is estimated below.

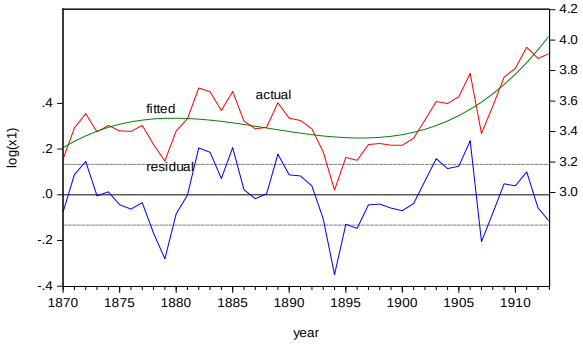

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Figure 3. Cubic trend line

$$Log(x_1)=3.245+0.0515t - 0.0033t^2+5.82E\text{-}05t^3+u_i$$

(37.14)* (3.09)* (-3.89)* (4.66)*

R^2=0.60, F=20.18*, DW=1.01, *=significant at 5% level, u_i=error

This nonlinear trend line is plotted in Figure 3 in which the trend line is found as inverse s. The nearly same type of observation was found by applying Hodrick-Prescott Filter model assuming Lamda (λ)=100 where the nonlinear trend line is inverse s and the cyclical patterns contain many peaks and troughs which are shown below in Figure 4.

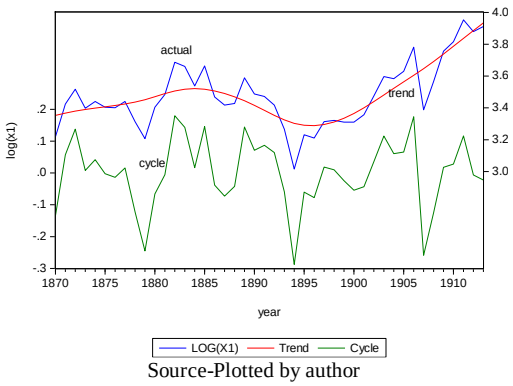

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Figure 4. H.P. Filter model of India's export to UK

Figure 4: H.P. Filter model of India's export to UK. India's export to UK during 1870-1913 has shown one upward structural break in 1903 as measured by Bai-Perron (2003) model using L+1 vs L sequentially determined breaks selecting trimming =0.15 with 5% significant level with maximum five breaks and it is shown in Figure 5 below.

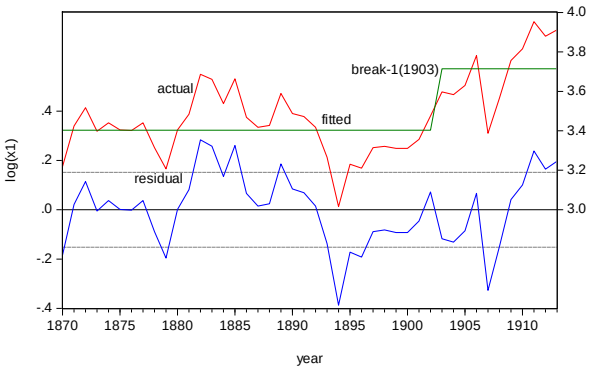

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Figure 5.Structural breaks of India's export to UK.

The estimated ARIMA(1, 0, 0) model of India's export to UK has been selected from the 25 best models of the ARIMA automatic forecasting test where AIC is found minimum which means that AR process is convergent and significant where volatility is minimum and significant.

$$\log(x_1)_t=3.494+0.812\log(x_1)_{t-1}+\varepsilon_t+0.016\sigma^2_t$$

(37.58)* (8.97)* (4.33)*

R^2=0.60, F=30.83*, DW=2.06, AIC=-1.13, SC=-1.008, AR root=0.81

This ARIMA (1, 0, 0) model is stable and stationary where AR process is convergent and its root is less than one and volatility is least and significant where AC and PAC values are all significant at 5% level converging to zero which are shown below in Figure 6.

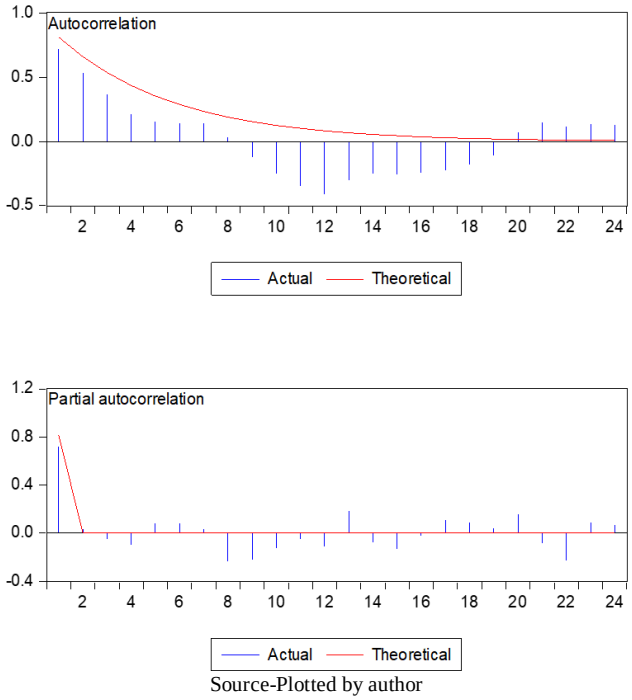

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Figure 6: AC and PAC move to equilibrium

The patterns of ACF and PACF state that the export to UK contains cyclical and seasonal variations too. The decomposition of cyclical trend, cycles, seasonal variation and

seasonally adjusted cycle can be had from the Hamilton regression filter(2018)model. The estimated regression filter is given below.

$Log(x_1)_t$=-0.0475+0.00034log$(x_1)_{t-4}$+0.00029log$(x_1)_{t-5}$-

(-27.15)* (0.27) (0.18)

0.000139log$(x_1)_{t-6}$+1.005log$(x_1)_{t-7}$+v_t

(-0.107) (1459.47)*

R^2=0.99, F=5117909, DW=0.16, n=39 (adjusted during 1876-1914), x_1=India's export to UK, *=significant at 5%.v_t=residual

Here v_t is analysed through STL method from where the cycles, cyclical trend, seasonal variation, remainder and seasonally adjusted cycle of Indo-export trade in the gold standard were found and are plotted in Figure 7.In panel 1, the cycle of Indo-UK export trade contains 7 peaks and 7 troughs in which downswings consist of many small cycles that cover from 1882 to 1896 but upswing consists of small cycles that cover from 1895 to 1902 and then fell down and stepped up. In panel 2, the cyclical trend is plotted where only one peak is available with a long downswing and upswing. In panel 3, the v shaped seasonal variation was found. In panel 4, the remainder is plotted in which there are many small cycles of downward and upward trends similar with residual cycle. In panel5, the seasonally adjusted cyclical patterns are plotted which are similar with residual cycles in panel1.

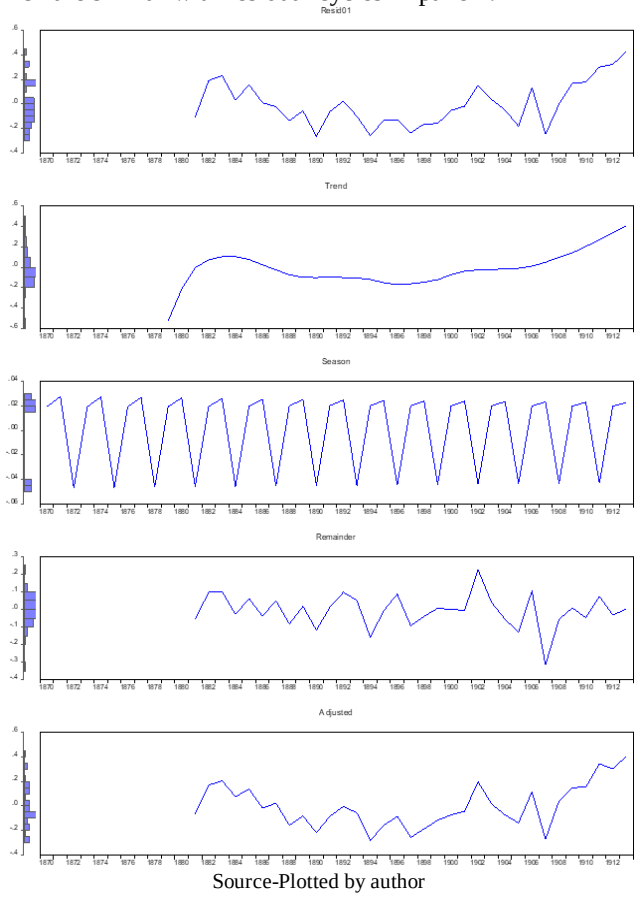

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Figure 7. Hamilton filter of Indo-UK export

India's import from UK during the gold standard period had increased by 2.0% per annuum significantly which is estimated below.

Log(m_1)=3.0363+0.020098t

(66.529)* (11.37)*

R^2=0.755, F=129.43, DW=0.528, m_1= India's import from UK in million pound, t= year, *=significant at 5% level. The estimated linear trend line is depicted in Figure 8 below.

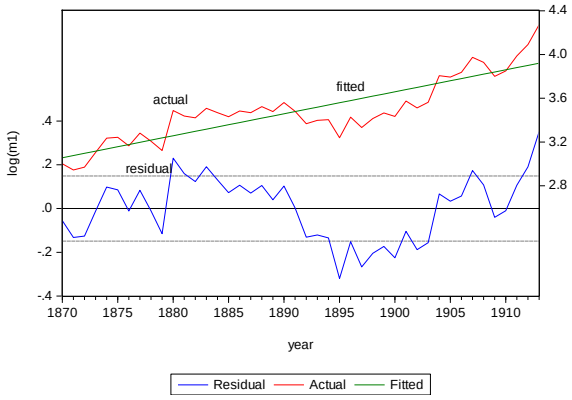

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Figure 8. Trend line of import from UK

It is noted that the percentage share of India's import from UK as total import during 1870-1913 has been declining slowly and steadily at the rate of 3.16% per annum significantly which is estimated below.

Log(m_1/m_2X100)=4.6817-0.031609t

(97.67)* (-17.03)*

R^2=0.87, F=290.308*, DW=0.65 where m_2=India's total import in million pound,*=significant at 5% level.

In Figure 9, it is observed that the percentage share of India's import from UK has been falling significantly.

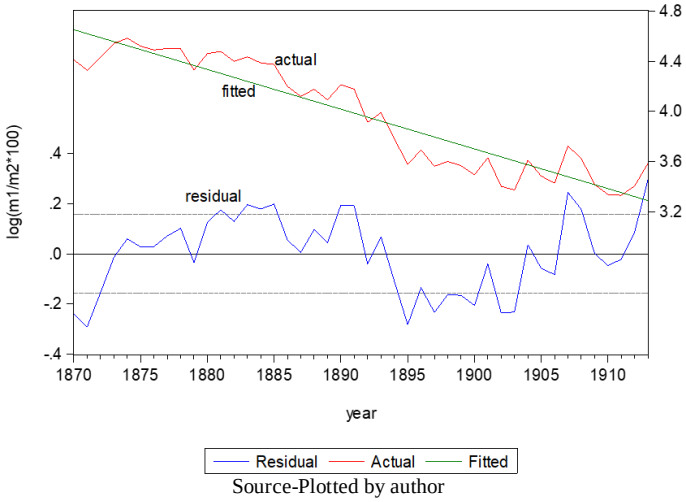

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Figure 9: India's share of import from UK

The estimated trend line is shown below which is cubic and non-linear where all the coefficients are significant at 5% level.

Log(m_1)=2.8267+0.0855t-0.004028t^2+6.41E-05t^3+u_i
(43.73)* (6.95)* (-6.38)* (6.94)*

R^2=0.89, F=117.93*, DW=1.195, AIC=-1.71, SC=-1.55, *=significant at 5% level.

The actual trend line of India's import is nonlinear and cubic in nature which is inverse s shaped and is shown below in Figure 10.

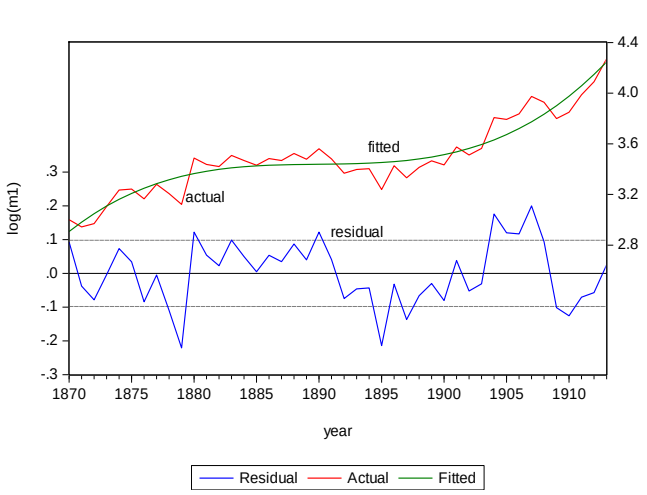

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Figure 10: Nonlinear trend of India's import with UK

More or less similar pattern of trend line of India's import from UK has been observed when it is estimated by Hodrick - Prescott Filter model with Lamda (λ)=100 where trend line is inverse s shaped and cycles have many peaks and troughs which are shown in Figure 11.

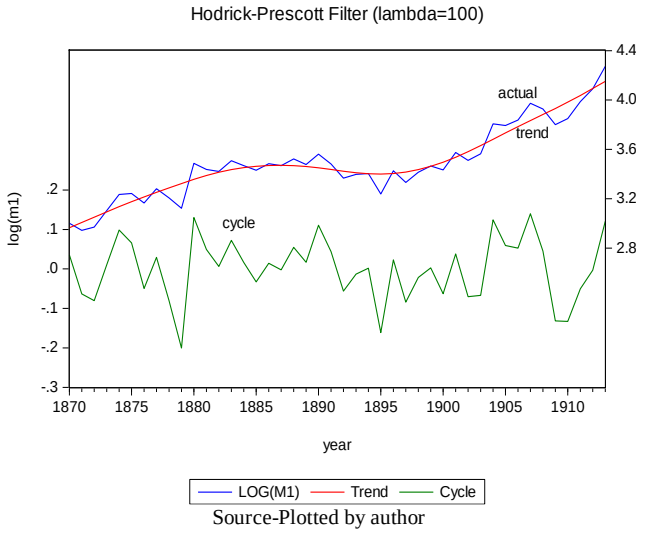

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Figure 11. H.P.Filter model of India's import with UK

It has two upward structural breaks in 1880 and 1904 which were measured by Bai-Perron model using L+1 vs L sequentially determined breaks selecting trimming 1.5 with 5% significant level with maximum five breaks taking HAC standard errors and covariances with Newey-West fixed bandwidth=4.0. It is shown in Figure 12.

The estimated ARIMA(4, 1, 2) model of first difference series of India's import from UK is selected from 25 best model of ARIMA forecasting test where AIC is found minimum(AIC=-1.61918).Here both AR and MA processes are convergent but insignificant and it is stable since all the roots are less than one and lie inside the unit circle, so that it is stable and stationary.

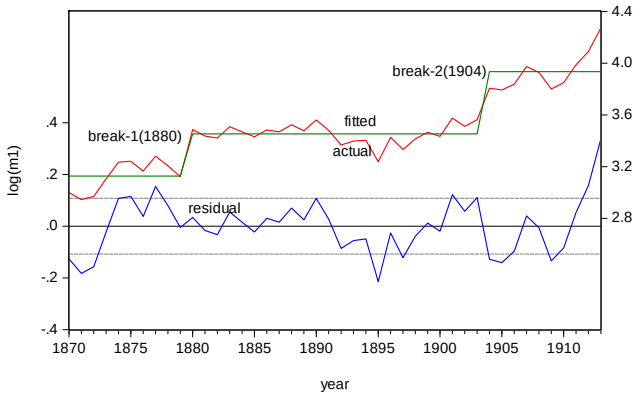

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Figure 11:H.P.Filter model of India's import with UK

The AR roots are 0.52±0.52i, - 0.52±0.52i, and MA roots are ±0.38.The model has minimum volatility since coefficient of σ^2 is significant at 5% level.

$dlog(m_1)_t=0.0267-0.2856dlog(m_1)_{t-4}+\varepsilon_t-0.1478\varepsilon_{t-2}+0.0100\sigma^2_t$
(2.02)* (-1.31) (-0.829) (4.88)*

R^2=0.114, F=2.67 , DW=2.35, AIC=-1.56, SC=-1.40, *=significant at 5% level.

Even the values of AC and PAC are lying at 5% significant level and they are converging to zero which means that it is the best fitted ARIMA model for convergence. It is seen in Figure 13.

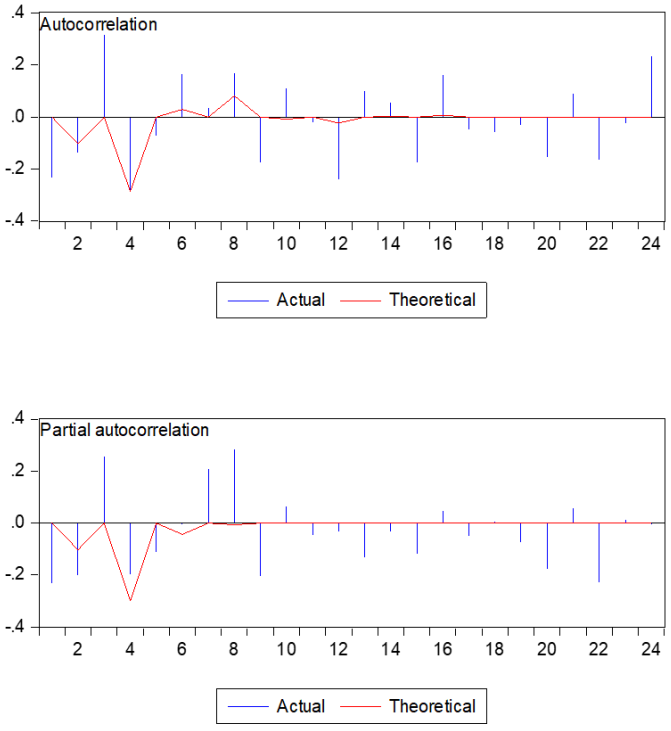

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Figure 13.AC and PAC of India's import

The patterns of ACF and PACF of Indo-UK import during gold standard confirmed that there are seasonal and cyclical fluctuations of it. Now, the Hamilton regression filter can find

the decomposed cyclical trend, cycle, seasonal fluctuation and the seasonally adjusted cycle which are given below.

$Log(m_1)_t=0.1055+0.188log(m_1)_{t-4}+0.191log(m_1)_{t-5}$

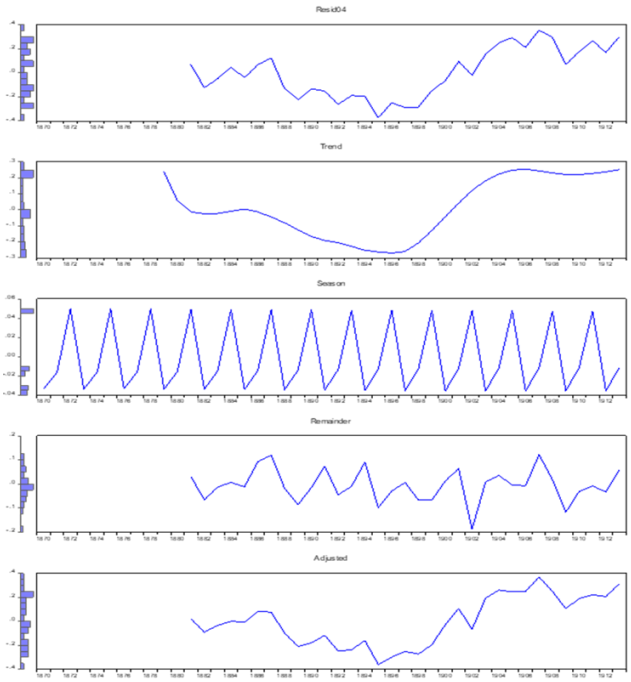
(0.53) (0.86) (0.76)

$+0.632log(m_1)_{t-6}+0.0138log(m_1)_{t-7}+v_t$

(2.54)* (0.06)

$R^2=0.97$, F=299.39, DW=1.02, n=38(adjusted for 1877-1914), *=significant, v_t=residual

Here v_t is decomposed by STL method which showed cycles, trend , cyclical variation and seasonally adjusted cycle all of which have been plotted in Figure14.The cycle consists of 9 peaks and 10 troughs respectively in panel 1.In panel 2, the cyclical trend is plotted which contains two peaks and troughs where downswings took more longer periods than the upswings. In panel 3, the v shaped seasonal variation was found and in panel 4 , the remainder consists of small cycles of many peaks and troughs but in Panel 5, the seasonally adjusted cycles are similar with the actual cycles. The nature is downward and then upward.

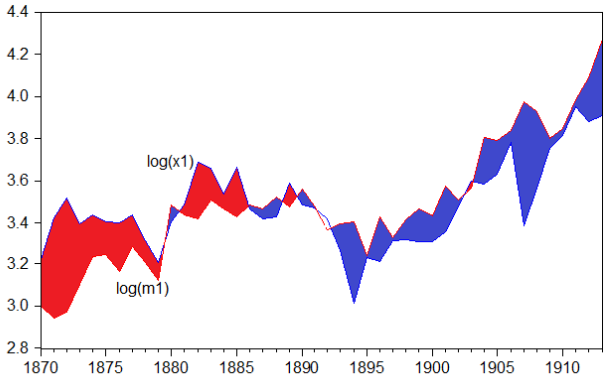


Source-Plotted by author

Figure 14. Hamilton filter for Indo-UK import

India's trade balance with UK during the gold standard period was surplus till 1890 and then it started deficit where both the trade surplus and deficit have cyclical in nature although in later period deficit had grown significantly. In Figure 15, the trade balance was plotted where red colour showed the trade surplus of India from UK and blue colour showed the trade deficit from UK during 1870-1913(vertical axes measured by log of export and import in million pounds and horizontal axes measured by year).

Cointegration and Vector Error Correction models: Johansen unrestricted rank cointegration test has been done for India's export to UK from 1870 to 1913 i.e. during the heyday of gold standard taking India's GDP(y_1), NEER, UK's GDP(y_2) and CPI(inf) as the determinants of India's export.First difference series of those log variables have been included for cointegration test which revealed that there is one cointegrating equation in both Trace and Max Eigen statistic which are significant at least 5% level and are given in the following Table 1.



Source-Plotted by author

Figure 15. India's trade balance with UK

The estimated vector error corrections of all equations are given in the Table 2. The estimated error correction model revealed that all the coefficients including error correction of the first equation are insignificant although error term approaches equilibrium. The second equation is not a good fit where change of GDP of India and UK is inverse. Here error term diverges significantly. The third equation is not also a good fit yet the change of GDP of UK is positively related with change of India's export and negatively related with India's neer significantly. The error term converges towards equilibrium significantly. In the fourth equation, the change of inflation in UK is positively related with change of export of India and change of GDP of UK significantly and negatively related with change of India's GDP and change of neer of India significantly. Here, error term tends to equilibrium insignificantly. In the fifth equation, the change of neer is negatively related with change of export of India significantly where error term is divergent and insignificant.R^2 are low in all estimated equations and F values are insignificant. This VECM is stable since all roots lie on or inside the unit circle but there are four unit-roots so that it is nonstationary. The residual test for correlogram confirmed that the VEC model contains problem autocorrelation and partial autocorrelation which are shown in the Figure 17. The residual test for response to Cholesky one standard deviation innovations showed that responses of $log(x_1)$ to $log(y_2)$ and log(neer) reached equilibrium and then diverted.The similar observations were found from responses of log (y_1) to $log(y_2)$ and log(neer), from $log(y_2)$ to log(neer), from log(inf) to $log(y_1)$ and $log(y_2)$ and from log(neer) to $log(y_1)$

From the system equations, the cointegrating equation has been estimated as given below.

$Z_{t-1}=-0.206log(x_1)_{t-1}-4.8975log(y_1)_{t-1}+2.910log(y_2)_{t-1}$

(-0.906) (-8.66)* (6.32)*

$-2.708log(inf)_{t-1}-0.1373log(neer)_{t-1}+21.552$

(-7.67)* (-1.58)

It states that there are long run causalities to India's export to UK from India's GDP, UK's GDP and Inflation rate, and India's NEER respectively during 1870-1913.Since the coefficient of $log(x_1)_{t-1}$is negative and insignificant so that it approaches towards equilibrium insignificantly and even the coefficient of log(neer) is also insignificant. The speed of adjustment is found as 20.6% per year. The cointegrating equation is given below.

Table 1. Cointegration test

Hypothesised no of CEs	Eigen value	Trace statistic	CV 5% level	Prob
None *	0.601158	82.20902	69.81889	0.0037
At most 1	0.449812	43.60306	47.85613	0.1186
At most 2	0.230042	18.50826	29.79707	0.5287
At most 3	0.132940	7.528672	15.49471	0.5171
At most 4	0.035946	1.537517	3.841466	0.2150
		Max Eigen statistic		
None *	0.601158	38.60595	33.87687	0.0126
At most 1	0.449812	25.09481	27.58434	0.1008
At most 2	0.230042	10.97959	21.13162	0.6494
At most 3	0.132940	5.991155	14.26460	0.6143
At most 4	0.035946	1.537517	3.841466	0.2150

* denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values Source-Calculated by author

Table 2. Error Correction Model

	dlog(x_1)	dlog(y_1)	dlog(y_2)	dlog(inf)	dlog(neer)
CointEq1	-0.206180	0.189353	-0.095920	-0.016603	0.726153
	[-0.90615]	[2.86873]*	[-2.82880]*	[-0.61210]	[0.98287]
dlog(x_1(-1)))	-0.140259	-0.062660	0.068776	0.062985	0.100178
	[-0.55589]	[-0.85607]	[1.82906]*	[2.09403]*	[0.12228]
dlog(x_1(-2)))	-0.169082	-0.047648	0.003958	0.021174	-0.446128
	[-0.72551]	[-0.70477]	[0.11396]	[0.76215]	[-0.58955]
dlog(y_1(-1)))	-0.555785	0.078770	-0.150920	-0.085843	2.756992
	[-0.58475]	[0.28569]	[-1.06550]	[-0.75764]	[0.89334]
dlog(y_1(-2)))	-0.410523	-0.103083	-0.095942	-0.147236	0.560389
	[-0.63112]	[-0.54630]	[-0.98975]	[-1.89880]	[0.26533]
dlog(y_2(-1)))	1.445353	-0.463669	0.209867	0.315340	4.984723
	[1.22044]	[-1.34963]	[1.18912]	[2.23363]*	[1.29628]
dlog(y_2(-2)))	0.376148	-0.913987	0.062139	0.083841	-0.857682
	[0.30558]	[-2.55960]*	[0.33875]	[0.57137]	[-0.21459]
dlog(inf(-1)))	1.093837	0.402361	0.162808	0.259112	5.680899
	[0.73572]	[0.93291]	[0.73481]	[1.46196]	[1.17677]
dlog(inf(-2)))	-0.308772	0.205290	-0.194270	-0.102493	-3.552355
	[-0.23476]	[0.53805]	[-0.99113]	[-0.65369]	[-0.83180]
dlog(neer(-1)))	-0.037063	0.019395	-0.023638	-0.022733	-0.795556
	[-0.61798]	[1.11476]	[-2.64477]*	[-3.17973]*	[-4.08530]*
dlog(neer(-2)))	0.043268	0.019905	-0.005904	0.000393	-0.235211
	[0.65683]	[1.04162]	[-0.60137]	[0.05003]	[-1.09966]
C	-0.000218	0.040613	0.015918	-0.006396	-0.125675
	[-0.00503]	[3.22339]*	[2.45935]*	[-1.23539]	[-0.89115]
R-squared	0.151718	0.475588	0.401982	0.452902	0.438635
F-statistic	0.471523	2.390915	1.772135	2.182449	2.059977

t values are in third brackets,*=significant at 5% level,Source-Calculated by author

Table 3. Values of roots

Roots	Modulus
1.000000	1.000000
1.000000	1.000000
1.000000	1.000000
1.000000	1.000000
0.330216 - 0.640637i	0.720735
0.330216 + 0.640637i	0.720735
-0.421896 - 0.491561i	0.647787
-0.421896 + 0.491561i	0.647787
-0.007380 - 0.539200i	0.539250
-0.007380 + 0.539200i	0.539250
-0.535360	0.535360
-0.242542 - 0.427103i	0.491165
-0.242542 + 0.427103i	0.491165
0.421517	0.421517
-0.058474	0.058474

Source-Calculated by author

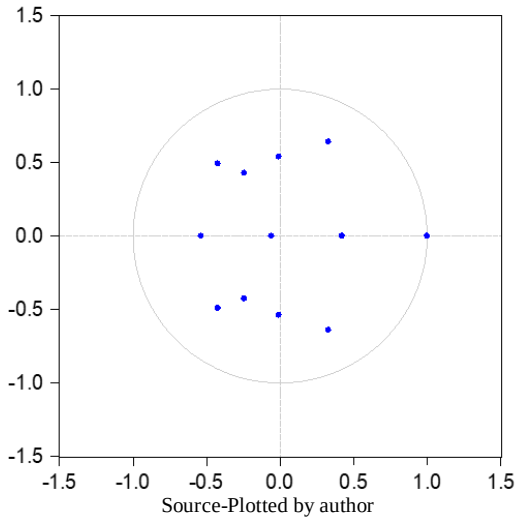


Figure 16. Unit circle

There are short term causalities from UK's GDP to India's GDP and from India's neer to UK's GDP and from India's GDP to UK's inflation rate and there is short run causality from India's neer to UK's inflation rate respectively which have been arranged in the Table 4. From the double log multiple regression analysis, it implies that if one percent increase in India's GDP, UK's inflation rate and India's neer per year then India's export will enhance by 1.57%, 2.012% and 0.098% per year respectively during the period of gold standard which are significant at 10% level.And one per cent rise in UK's GDP per annum led to 0.517% decrease in India's export during the same period which is significant at 10% level.The estimated regression equation is given below.

$Log(x_1)$=-9.9865+1.5751log(y_1)-0.517log(y_2)

(-5.75)* (4.03)* (-1.67)*

+2.0125log(inf)+0.0983log(neer)

(5.77)* (1.73)*

R^2=0.638, F=17.19, DW=1.165, *=significant at 10% level

This model is stable since the CUSUM of squares test is significant at 5% level which is shown below. There is one cointegrating equation among India's import from UK, India's GDP, UK's GDP, India's NEER and UK's inflation rate during 1870-1913 which have been found from the Johansen unrestricted cointegration rank test of the first difference series where the trace statistic and max eigen statistic are significant at 5% level. The values are given in the Table 5. Since the cointegration is established then the estimated VECM is given below. In the estimated VECM equation 1, it was found that the change of India's import from UK is negatively related with India's GDP and neer and positively related with UK's inflation significantly. It is converging to equilibrium because the coefficient of error term is negative and significant. In the equation 2, it was found that the change of GDP of both India and UK is positively related significantly. Here coefficient of error term is diverging significantly. In the third equation, it was found that change of UK's GDP is positively related with change of India's import and negatively related with UK's inflation. Here the coefficient of error correction is negative and significant which implies that it is converging to equilibrium. The estimated fourth equation revealed that change of UK's GDP is positively correlated with change of UK's inflation. The estimated fifth equation infers that the change of India's neer is positively correlated with change of India's import. The VECM contains 4 unit-roots and other roots which are less than one so that all roots lie on or inside the unit circle which implies that the model is stable and nonstationary. The VECM suffers from auto correlation and partial auto correlation problems which were verified by residual test for correlogram. In the impulse response functions, the response of log of India's GDP to log of UK's GDP , to UK's inflation and neer reached equilibrium and diverted slowly. Response of India's import to UK's GDP converges to equilibrium. Moreover, the response of UK's GDP to India's import from UK and neer reached equilibrium and then departed from it. All these responses are seen in the Figure 23.

The estimated cointegrating equation is shown below;

Z_{t-1}=-0.4359log(m_1)$_{t-1}$-4.662log(y_1)$_{t-1}$+2.095log(y_2)$_{t-1}$

(-3.90)* (-7.12)* (3.93)*

-2.644log(inf)$_{t-1}$+0.0937log(neer)$_{t-1}$+27.353

(-5.73)* (0.909)

This cointegrating equation states that India's import from UK has long run causalities from India's GDP, UK's GDP and inflation and India's neer respectively. It tends to equilibrium significantly because coefficient of log (m_1)$_{t-1}$ is negative and significant. Even all coefficients are significant at 5% level except for neer so that the cointegrating equation curve marginally departed from equilibrium. In Figure24, it is clearly depicted. There are short run causalities running from UK's GDP to India's GDP, from India's import to UK's GDP, from UK's GDP to UK's inflation rate respectively which are significant at 5% level at H0=rejected for Null hypothesis of no causality all of which are given below in the Table 8. Lastly, the estimated double log multiple regression model is given below.

Log (m_1)=-14.396+0.889 log (y_1)+0.579log (y_2)

(-7.56)* (2.07)* (1.707)*

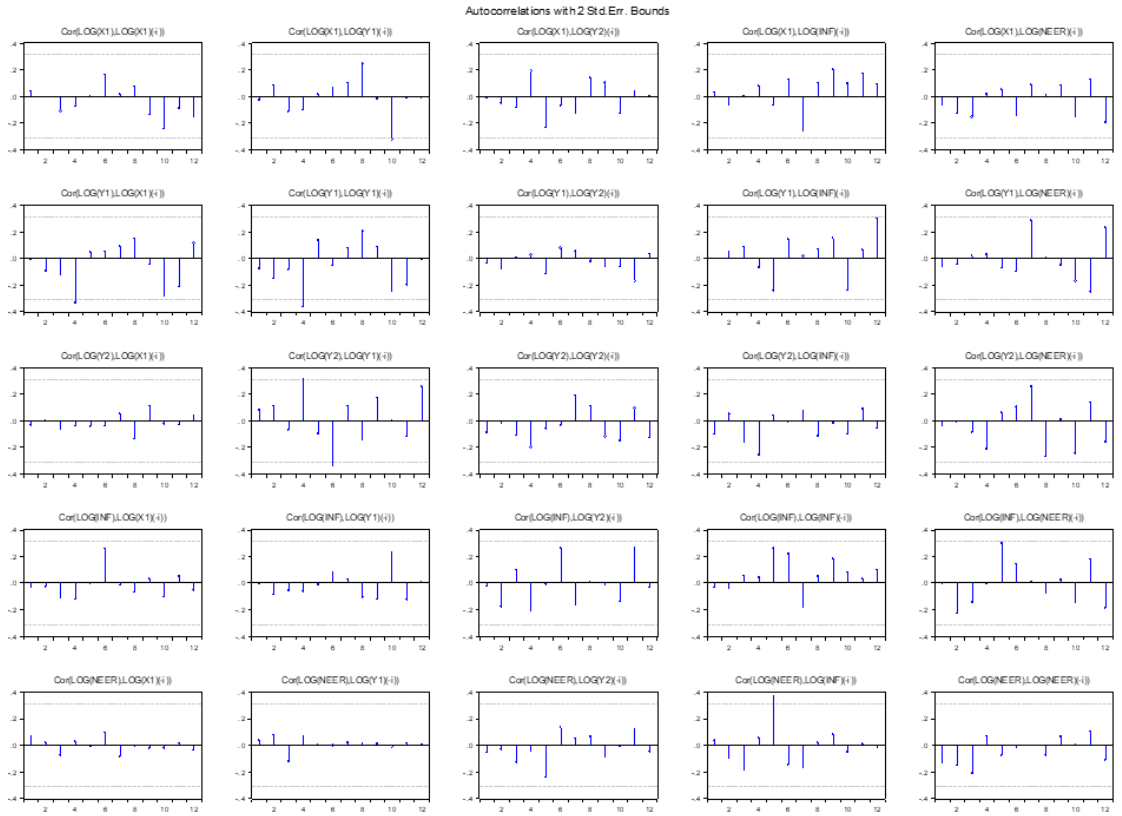
+0.9919log (inf)+0.0404 log (neer)

(2.59)* (0.649)*

R^2=0.79, F=38.21, DW=0.79, *=significant at 10% level.

This estimate states that one per cent increase in GDP of India and UK, UK's inflation and India's neer per year led to 0.889% rise, 0.579%, rise, 0.991% rise and 0.0404% rise in India's import from UK during 1870-1913 which are significant at 10% level except neer. This estimate is unstable during 1886-1894 and 1902-1904 but rest of the period, it is stable at 5% level of significant level which was tested by CUSUM of squares which is plotted below in Figure 25.

Limitations and scope of future research: During 1870-1913, India was under both silver standard and gold exchange standard and England was in the gold standard. Therefore, the demand for export and import have not changed uniformly. Even, the re-exports of British have been increasing too fast.In general, there were other factors which determined export and import of Indo-British trade which were not considered in the model such as price of gold and silver, reserves of gold and silver, rates of tariffs etc. If the paper can add banking crises as dummy variables which had occurred in England in 1870-1913, and in India during 1910-1913, then a good result might be obtained in the patterns of export and import. There is enough scope in these areas which are left for future research.



Source-Plotted by author

Figure 17. AC and PAC

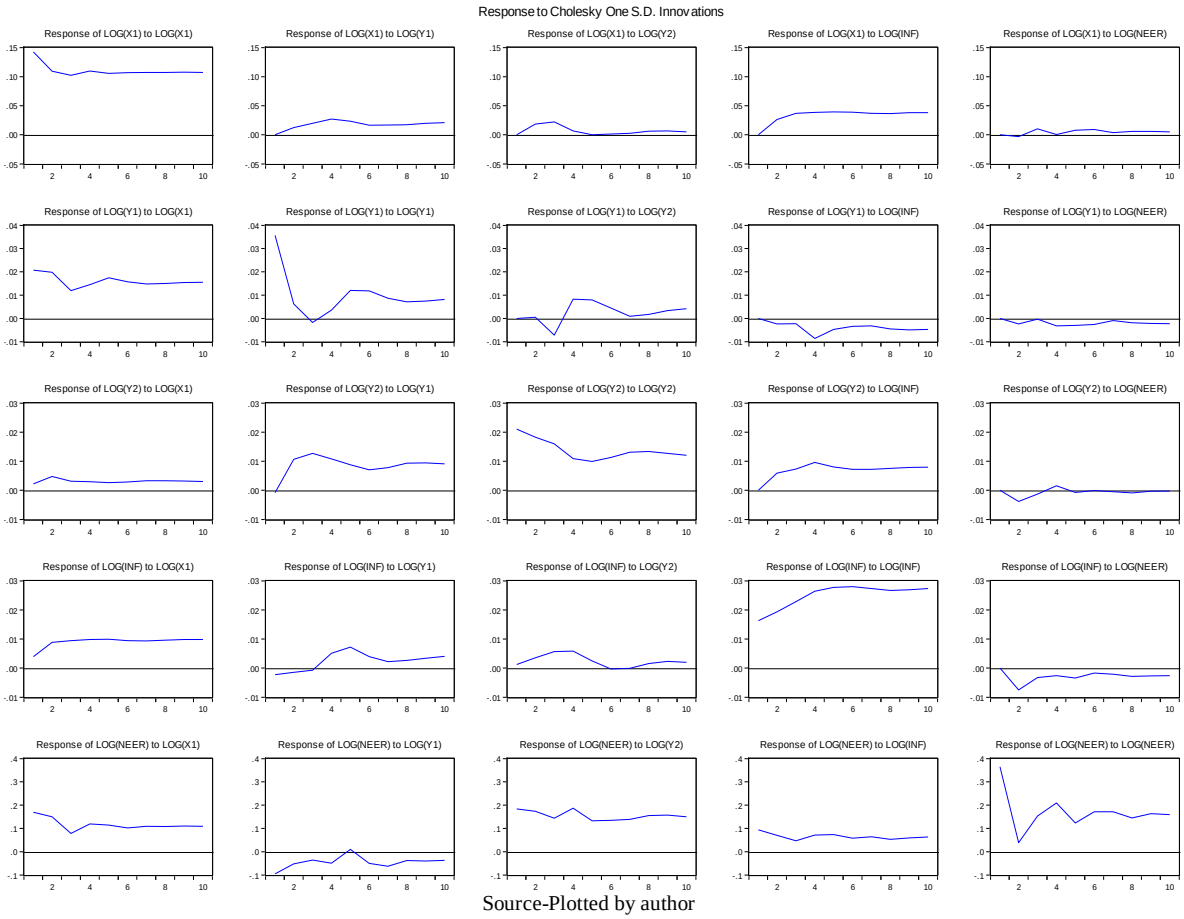


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Figure 18: Impulse Response Functions

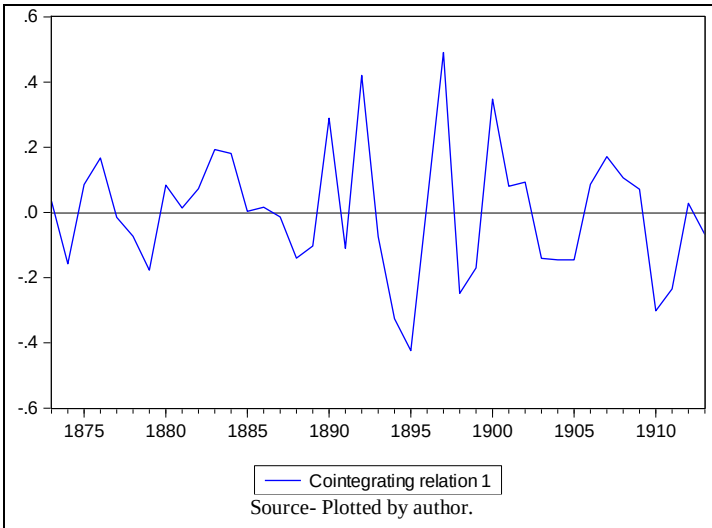

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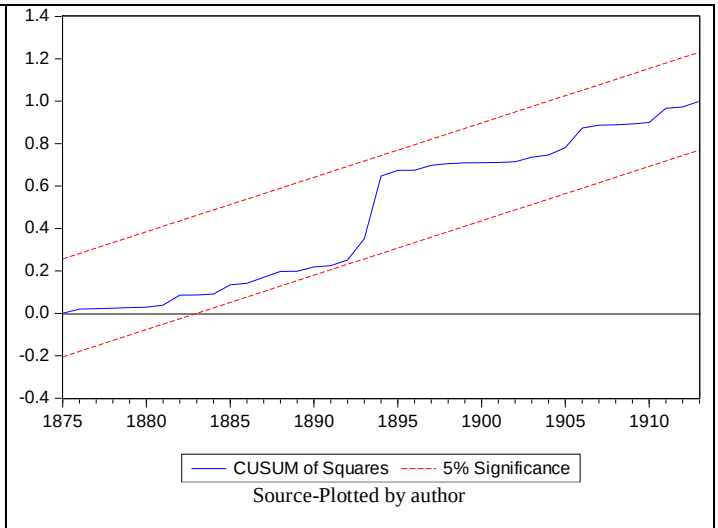
Figure 19: Cointegrating equation



Source-Plotted by author

Figure 20:Stability test

Table 5. Cointegration test

No of hypothesised CEs	Eigen value	Trace Statistic	0.05 critical value	Probability
None *	0.576353	81.12527	69.81889	0.0048
At most 1	0.429187	45.05341	47.85613	0.0895
At most 2	0.251091	21.50429	29.79707	0.3269
At most 3	0.194881	9.360518	15.49471	0.3331
At most 4	0.006086	0.256386	3.841466	0.6126
		Max Eigen statistic		
None *	0.576353	36.07186	33.87687	0.0269
At most 1	0.429187	23.54912	27.58434	0.1512
At most 2	0.251091	12.14377	21.13162	0.5335
At most 3	0.194881	9.104132	14.26460	0.2776
At most 4	0.006086	0.256386	3.841466	0.6126

* denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values Source-Calculated by author

Table 6. Estimated Vector Error Correction Model

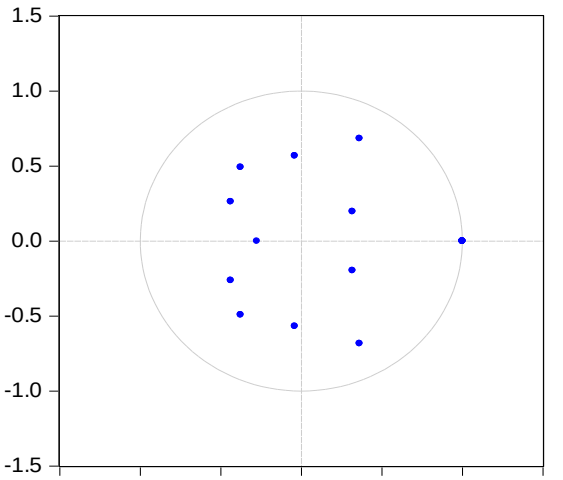
	dlog(m_1))	dlog(y_1))	dlog(y_2))	dlog(inf))	dlog(neer))
CointEq1	-0.435914	0.170577	-0.068008	-0.007745	0.299623
	[-3.90042]*	[2.85130]*	[-2.23211]*	[-0.29674]	[0.46680]
dlog(m_1(-1))	0.057014	-0.058395	0.095971	0.010251	1.607331
	[0.34719]	[-0.66431]	[2.14373]*	[0.26732]	[1.70425]
dlog(m_1(-2))	0.008895	0.003790	-0.014067	-0.013304	-0.231029
	[0.05542]	[0.04412]	[-0.32149]	[-0.35495]	[-0.25063]
dlog(y_1(-1))	-0.885457	0.095725	-0.018793	-0.001439	2.923334
	[-1.75984]	[0.35542]	[-0.13701]	[-0.01225]	[1.01165]
dlog(y_1(-2))	-0.532506	-0.037761	-0.124477	-0.131307	-0.594218
	[-1.39084]	[-0.18425]	[-1.19258]	[-1.46860]	[-0.27024]
dlog(y_2(-1))	0.610416	-0.426609	0.191733	0.375567	4.842952
	[0.92840]	[-1.21213]	[1.06967]	[2.44602]*	[1.28252]
dlog(y_2(-2))	0.958411	-0.704449	-0.002341	0.125115	0.700376
	[1.45607]	[-1.99937]*	[-0.01305]	[0.81397]	[0.18527]
dlog(inf(-1))	1.416197	0.494580	0.110612	0.322725	5.498724
	[1.83107]*	[1.19462]	[0.52460]	[1.78681]	[1.23791]
dlog(inf(-2))	-0.968261	0.334948	-0.372113	-0.128186	-6.177721
	[-1.25393]	[0.81035]	[-1.76768]	[-0.71086]	[-1.39301]
dlog(neer(-1)	-0.079766	-0.016037	-0.011398	-0.018255	-0.962674
	[-1.98424]*	[-0.74527]	[-1.04008]	[-1.94458]*	[-4.16967]*
dlog(neer(-2))	-0.018697	-0.004050	0.009044	0.004796	-0.157375
	[-0.44473]	[-0.17997]	[0.78909]	[0.48850]	[-0.65179]
C	0.024960	0.034741	0.014247	-0.008459	-0.184202
	[0.98432]	[2.55944]	[2.06091]*	[-1.42841]	[-1.26482]
R-squared	0.629188	0.458995	0.393644	0.363877	0.467875
F-statistic	4.473335	2.236721	1.711520	1.508059	2.318047
Akaike AIC	-2.015899	-3.265801	-4.615274	-4.924822	1.480138
Schwarz SC	-1.514365	-2.764268	-4.113741	-4.423289	1.981671

Source-Calculated by author

Table 7: Values of roots

Roots	Modulus
1.000000	1.000000
1.000000	1.000000
1.000000	1.000000
1.000000	1.000000
0.362345 - 0.683489i	0.773596
0.362345 + 0.683489i	0.773596
-0.375858 - 0.491354i	0.618626
-0.375858 + 0.491354i	0.618626
-0.039871 - 0.568075i	0.569472
-0.039871 + 0.568075i	0.569472
-0.437927 - 0.261902i	0.510267
-0.437927 + 0.261902i	0.510267
0.318551 - 0.196799i	0.374439
0.318551 + 0.196799i	0.374439
-0.275073	0.275073

Source-Calculated by author



Source-Plotted by author

Figure 21-Unit circle

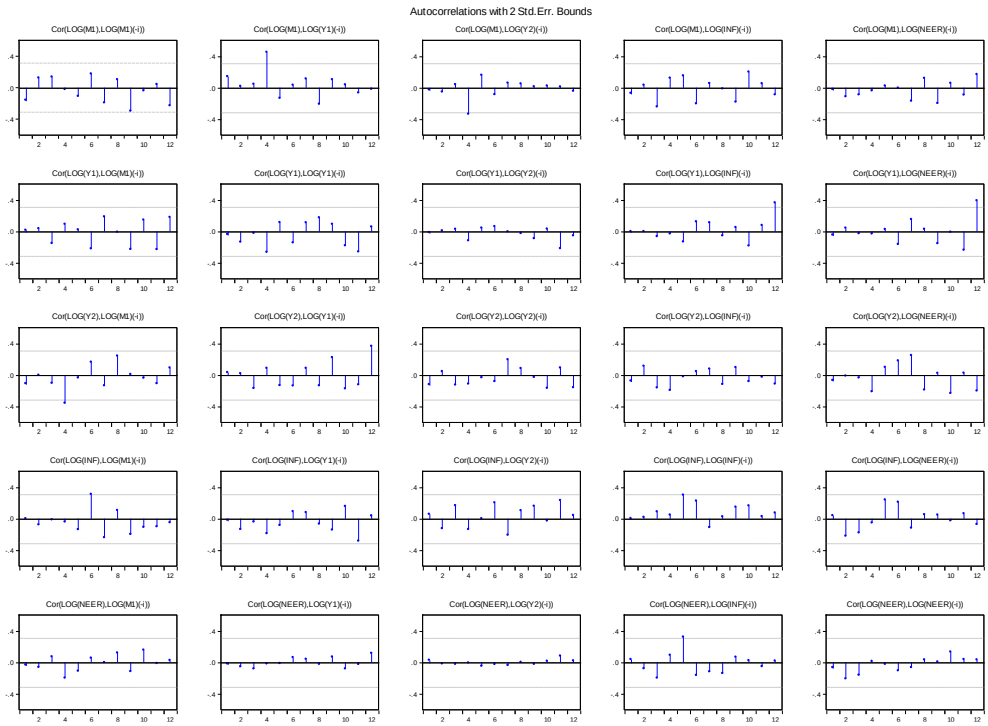


Figure 22: AC and PAC

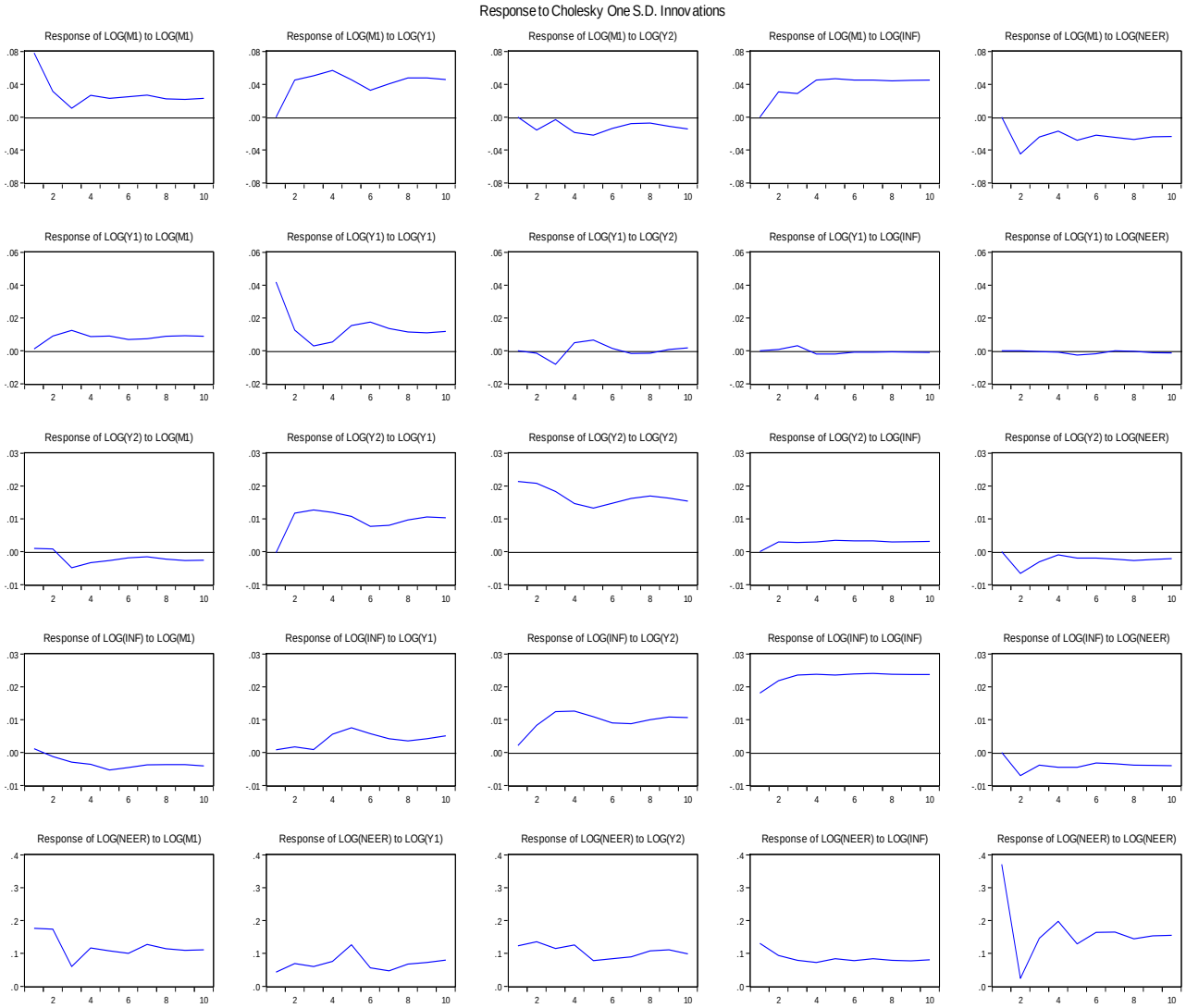


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Figure 23: Impulse Response Functions

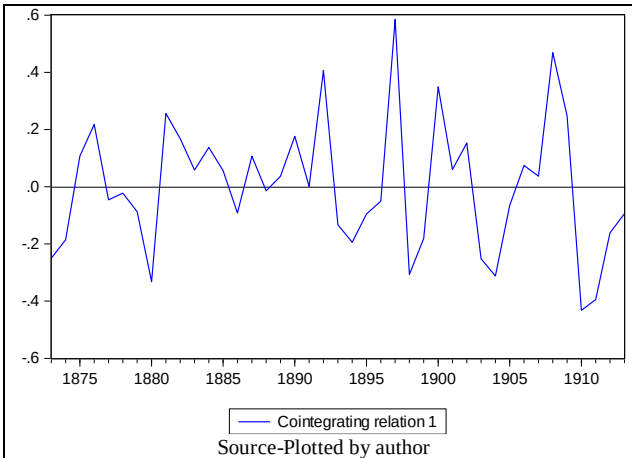

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Figure 24: Cointegrating equation

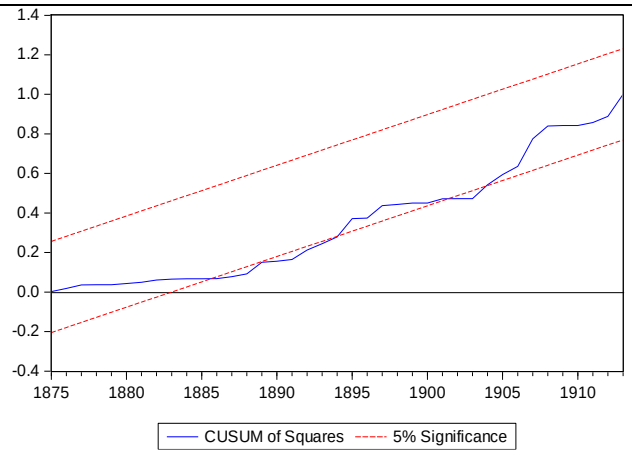

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Figure 25: Stability test

Table 8. Short run causality

Causalities from	To	Chi-square(2)	Probability	Accepted /rejected
UK's GDP	India's GDP	5.456	0.06	Rejected for no causality
India's import from UK	UK's GDP	5.1079	0.077	Rejected for no causality
UK's GDP	UK inflation	6.636	0.036	Rejected for no causality

Source-Calculated by author

Conclusion

The paper concludes that India's export to England from 1870 to 1913 increased by 0.707% per year and its share of total export decreased by 2.98% per annum. The trend line is cubic in nature which was supported by H.P. Filter model containing peak and trough. It contains one upward structural break in 1903.The ARIMA (1, 0, 0) model of export is stationary and stable. Indian import from Britain during gold standard catapulted by 2.0% per annum and import share had fell down by 3.16% per year significantly. The trend line is cubic and its peak and trough are supported by H.P. Filter model. Two upward structural breaks had been found in 1880 and 1904 respectively. ARIMA (4, 1, 2) model of Indo-import trade was found stable and stationary. The cyclical trends of India's export to UK has one peak but cycle consists of many peaks and troughs. Similarly, India's import from UK has many cycles of downswings and upswings but cyclical trend consists of two peaks and troughs. India's export to Britain, India's GDP, UK's GDP, CPI of Britain and NEER of India revealed one cointegrating equation where VECM is stable and nonstationary. There were long run causalities from India's GDP, UK's GDP, India's NEER and UK's CPI to Indo-UK export from 1870 to 1913. Similarly, India's import from Britain, India's GDP, British GDP, India's NEER and British CPI contain one cointegrating equation where VECM showed stable and nonstationary. But there were long run causalities from India's GDP and UK's GDP, India's NEER and British CPI to India's import from Britain during the said period. Even, there was short run causality from India's import from UK to UK's GDP.

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