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Trade Elasticities and Marshall - Lerner Conditions for Nepal

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Abstract

Nepal's trade deficit is increasing due to high volume of imports and very small share of export to foreign trade. Share of export to total trade is continuously decreasing for long period of time and its growth is disproportionate with the trade partners. Having fixed exchange rate with Indian currency, Nepalese international trade is highly dominated by trade with India (64.6 percent of export and 64.7 percent of import in FY 2018/19). Government policies aim to diversify the trade and promote export. Despite continuous depreciation of Nepalese rupee, Nepal's export could not increase as desired. This paper estimates trade elasticities with major trade partners of Nepal, India and other countries to examine the applicability of Marshall-Lerner condition. The findings reflect that Marshall-Lerner condition is satisfied in Nepalese case.

1. Introduction

In the economic theory, devaluation and depreciation of exchange rate of a country will have three types of effects to the domestic economy. Firstly, it will make import costlier and real volume of import will decrease, second, exports increase being cheaper in the international market and lastly country will earn less of foreign exchange from same amount of export amount. The total trade effect of devaluation depends upon the income and price effects and respective export and import elasticities. To improve the trade balance from devaluation or depreciation, Marshall-Lerner condition states that the sum of export and import elasticities should be more than unity.

2. Statement of Problem

Nepal continuously faces currency depreciation for a long period of time but improvement in trade balance has not been realized. Moreover, in BoP account, the portion of the trade deficit is too large and BoP deficit is largely covered by the remittance income. Budget deficit coupled with trade deficit could catch up by the deficit circle in the economy. Hence, the fundamental question is why consecutive depreciation has not improved the trade balance.

3. Review of Literature

A number of studies have been conducted by researchers to verify the Marshall-Lerner condition mainly in country specific studies and show mixed results. The studies estimate the trade elasticities for bilateral trade and for international trade with group of other countries also. Some other studies are focused on regional trade perspective. A generalized gamma distributed lag model was estimated by Noland (1989) for Japanese case and the evidence supports long lags on responses for price changes. Most of the studies used Johensen's cointegration tests, stationary tests, autoregressive distributed lag, Dynamic Ordinary

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Least Square (DOLS) procedure to estimate the long-run structure. For example, Reinhart (1995), Bahmani-Oskooee and Niroommand (1998) and Caporale and Chui (1999) used similar methodology for different countries and produced consistent results. Using ordinary least square (OLS) method to estimate the import and export demand functions Loot (2011), shows that devaluation/depreciation does not improve the trade balance. Shahzad et al (2017) analyzed Marshall- Lerner condition for South Asia region using random effects model, Hausman Specification test and Breusch-Pagan test using panel data and find that the Marshall- Lerner condition does not hold. Hooper et al., 2000 examined trade elasticity of G-7 countries and found less response of devaluation on trade. Moura & Silva, (2005) estimated both linear and nonlinear impulse response functions and show that the condition holds true. Turkay (2014) and Caporale et al. (2015) found Marshall-Lerner condition holds only in the long run for Turkey and Kenya respectively. Study by Rose (1991) shows contrasting result for five OECD countries in the short run. Cambazoglu & Gunes (2016) also found similar non-response of the devaluation effect for Turkey. Summary of the more review of studies is exhibited in table 1.1.

Table 1.1: Summary of Literature Review

Study by	Data Used	Model and Tests	Result
Brooks (1999)	1973-1996	ADF and KPSS tests, Johansen-Juselius FIML estimation, CUSUM and CUSUMSQ stability tests, Bilateral	Existence of M-L condition
Ahearn (2002)	1973-	Cointegration and ECM, for four South East Asian Countries	Existence of M-L condition for Philippines and Malaysia
Mohammad & Hussain (2010)	1970-2008	Augmented Dickey-Fuller test, Johansen-Juselius cointegration, impulse response function	Existence of M-L condition
Eita (2013)	1991-2011	cointegrated vector autoregression model	Existence of M-L condition
Bano et al. (2014)	1980-2010	ADF stationarity test and cointegration test	Existence of M-L condition
Bahmani et al. (2013)		ARDL approach	Non- Existence of M-L condition
Sek & Har (2014)	1980-2012	Modified least square method,	Non- Existence of M-L condition
Panda & Reddy (2016)	1987-2014	Bound test, ARDL and ECM	Non- Existence of M-L condition
Pandey (2013)	1993-2011	KPSS test, vector error correction model	Existence of M-L condition

4. Marshall Lerner Condition

To Know the effect of exchange rate devaluation/depreciation on trade balance, four important elasticities should be evaluated (Heller, 1974):

-Elasticity of demand to import (δ_{IM})

-Elasticity of demand for export (δ_{EX})

-Elasticity of supply of import (σ_{IM})

-Elasticity of supply of export (σ_{EX})

Lets assume constant elasticity of demand and supply curves for output,

$$Q = CP^{\in} \quad \text{..... (i)}$$

Where, Q = Output, C = constant, P = Price and P is price and $\in$ is coefficient

$P_{EX} = r^{-\delta_{EX}/(\delta_{EX}+\sigma_{EX})}$, then the relevant demand and supply curves for export and import will be,

$$Q_{EX}^{S} = EX_0.(P_{EX})^{\sigma_{EX}} \quad \text{..... (ii)}$$

$$Q_{EX}^{D} = EX_0.(P_{EX}.\mathrm{r})^{\delta_{EX}} \quad \text{.....(iii)}$$

$$Q_{IM}^{S} = IM_0.(P_{IM}.\mathrm{r})^{\sigma_{IM}} \quad \text{.....(iv)}$$

$$Q_{IM}^{D} = IM_0.(P_{IM})^{-\sigma_{IM}} \quad \text{..... (v)}$$

Equation (ii) shows export supply curve for the country and equation (iv) shows export supply curve of rest of the world while equation (iii) shows import demand curve for rest of the world and equation (v) shows import demand curve of the country.

Taking log on both sides of (ii) and (iii) equations,

$$\log Q_{EX}^{S} = \log EX_0 + \sigma_{EX} \log P_{EX} \quad \text{..... (vi)}$$

$$\log Q_{EX}^{D} = \log EX_0 - \delta_{EX} \log P_{EX} - \delta_{EX} \log \mathrm{r} \quad \text{..... (vii)}$$

For equilibrium,

$$Q_{EX}^{S} = Q_{EX}^{D}$$

So that , $(\delta_{EX} + \sigma_{EX}) \log P_{EX} = -\delta_{EX} \log r$ ..... (viii)

Taking antilog we obtain,

$$P_{EX} = r^{-\delta_{EX}/(\delta_{EX}+\sigma_{EX})}$$

Substituting this value of PEX in equation (ii), we get,

$$EX_0 r^{-\delta_{EX}(\sigma_{Ex}+1)/(\delta_{Ex}+\sigma_{EX})} - IM_0 r^{\sigma_{IM}(\delta_{IM}-1)/(\delta_{IM}+\sigma_{IM})} Q_{EX} = EX_0 r^{-\delta_{EX}\sigma_{EX}(\delta_{EX}+\sigma_{EX})} \quad \text{…….. (ix)}$$

Similarly,

$$P_{IM} = r^{-\delta_{IM}/(\delta_{IM}+\sigma_{IM})} \text{ and}$$

$$Q_{IM} = EX_0 r^{\delta_{IM}\sigma_{IM}(\delta_{IM}+\sigma_{IM})}$$

Now, trade balance in terms of domestic currency is defined as,

B = QEx. PEX- QIM. PIM

$$= EX_0 r^{-\delta_{EX}(\sigma_{Ex}+1)/(\delta_{Ex}+\sigma_{EX})} - IM_0 r^{\sigma_{IM}(\delta_{IM}-1)/(\delta_{IM}+\sigma_{IM})} \quad \text{.....(x)}$$

Differentiating with respect to r, we get,

$$\frac{dB}{dr} = -\left[EX_0 \frac{\delta_{EX}(\sigma_{EX}+1)}{\delta_{EX}+\sigma_{EX}} + IM_0 \frac{\sigma_{IM}(\delta_{IM}-1)}{\delta_{IM}+\sigma_{IM}} \right] \quad \text{…….. (xi)}$$

This shows effects of exchange rate change on trade balance in terms of domestic currency. The expression in terms of foreign currency will be,

$$\frac{dB}{dr} = -\left[EX_0 \frac{\sigma_{EX}(\delta_{EX}-1)}{\delta_{EX}+\sigma_{EX}} + IM_0 \frac{\delta_{IM}(\sigma_{IM}-1)}{\delta_{IM}+\sigma_{IM}} \right] \quad \text{…….. (xii)}$$

The means devaluation will show positive change in balance of trade defined as export less import.

Lets start from the initial situation of trade balance, i.e. EX0 = IM0 and assume that output can be expanded at constant cost and all buyers face given prices in international market so that supply elasticities are infinite i.e. $\sigma_{EX}\sigma_{IM} = \infty$. Then, the equation (xi) reduces to:

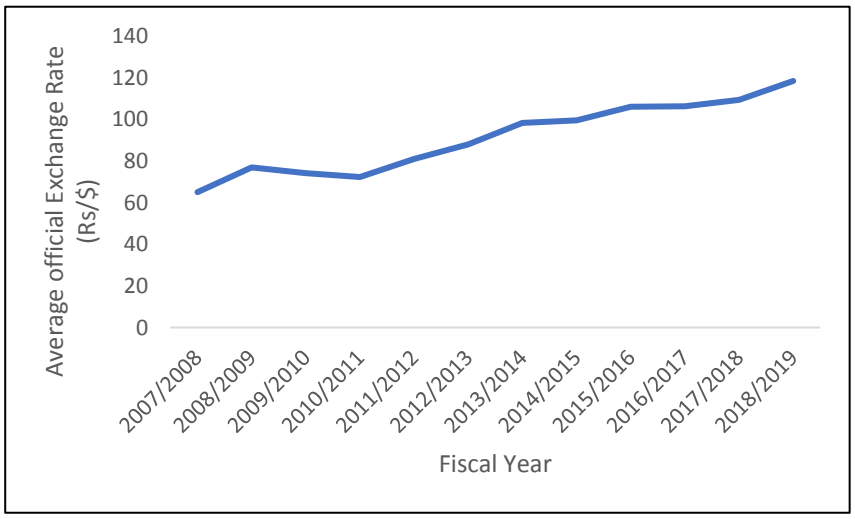
$$\frac{dB}{dr} = -\left[EX_0 \left(\delta_{EX} + \delta_{IM} - 1 \right) \right]$$

The precondition for the normal reaction of exchange rate change is that the sum of export and import elasticities should be greater than unity.

5. Exchange Rate

Nepal has pegged exchange rate system with Indian currency for long period of time. Since 1994, it has been fixed as 0.625 in term of IC and exchange rate movement with rest of the world moves as that of Indian currency. The nominal exchange rate with USD and other currencies continuously depreciates despite slight appreciation during 2008 financial crisis.

Figure 1.1: Official Exchange Rate (Dollar Term)



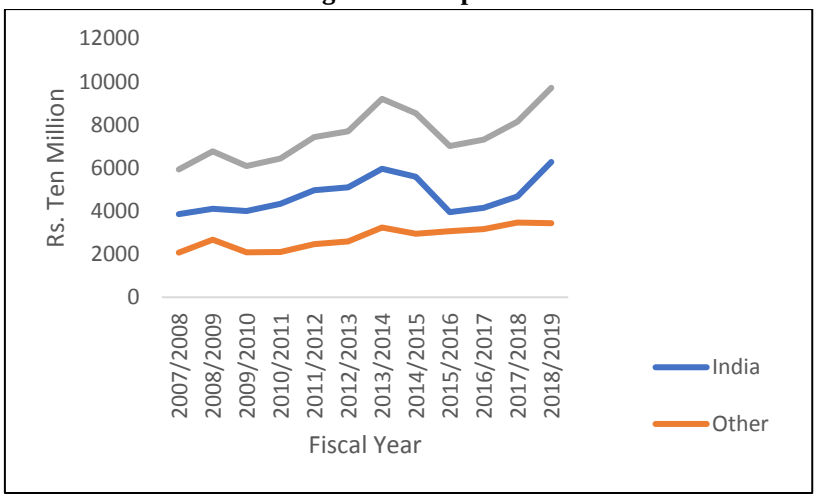
Source: Economic Survey (from 2007 to 2019), MoF

In the figure 1.1, the upside trend shows depreciation of Nepalese currency. Its depreciation rate is almost constant in recent years.

6. International Trade

Figure 1.2 portrays Nepal's export growth since 2007 which shows very low ratio to GDP (about three percent in 2018). It also shows that export to India is almost more than two third of total export in each year except from fiscal year 2015/2016 when there was blockade by Indian side.

Figure 1.2: Exports



Source: Economic Survey (from 2007 to 2019), MoF

Export performance up to 1990 was more or less stagnating, and then it started to increase and reached to historical maximum of 13.6 percent in the year 2000 (Gyanwaly, 2017). After accession to WTO and

rapid liberalization Nepalese trade balance further deteriorated. Table 1.2 summarizes the import and export compared to GDP.

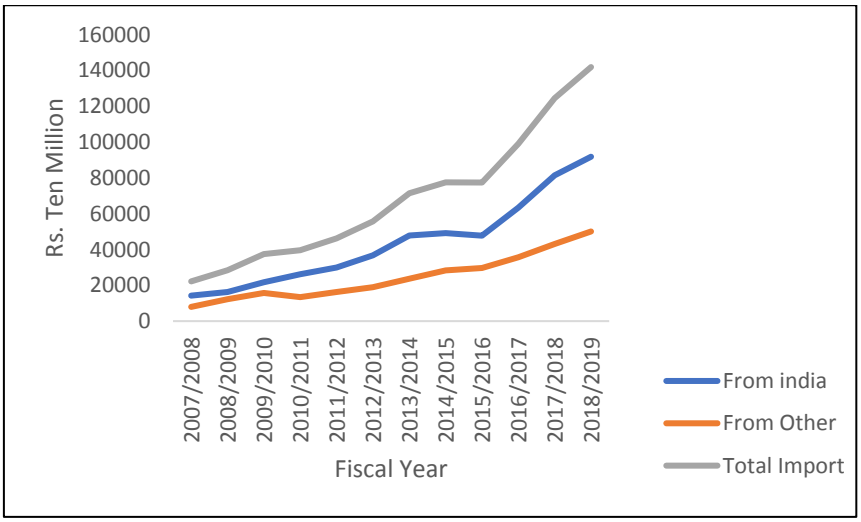
Table 1.2: Import and Export as percentage of GDP

Year	1975	1985	1990	1996	2006	2008	2014	2016*	2019*
Export	5.57	6.17	5.17	8.30	9.56	7.60	5.11	3.11	2.80
Import	11.37	17.42	18.38	31.10	27.57	28.47	39.70	34.33	40.94

Source: Gyanwaly, 2017[-] and *Economic Surveys of Nepal

Nepalese export is mainly determined by food items while import accounts more than 40 percent of GDP with larger share of manufacturing goods and machinery. Export to GDP ratio continuously declines after 2006 while import to GDP shows large rate of increment each year despite very small decline in fiscal year 2015/2016 due to disputes in border and blockade.

Figure 1.3: Imports



Source: Economic Survey (from 2007 to 2019), MoF

Huge gap between import and export led to widening growth of trade balance of Nepal. During ten year's period, trade deficit grows more than eight times and Nepalese external sector gets more volatile.

Nepal's export and import are highly dependent on Indian economy. On an average, 63 percent of total export and same percent of import takes place with India in last ten year's period. This reflects India dominated international trade of Nepal. But, both export and import do not show any trend with India and rest of the world when we compare as percent share.

Table 1.3: Nepal's International Trade (Rs. in million)

Fiscal Year	Export			Import			Trade Balance
	India	Other Countries	Total Export	From India	From Other Countries	Total Import	
2007/2008	3855.6	2071.1	5926.7	14237.7	7956.1	22193.8	-16267.1
2008/2009	4100.6	2669.2	6769.8	16243.8	12203.2	28447	-21677.2
2009/2010	3999.4	2083	6082.4	21711.4	15722.1	37433.5	-31351.1
2010/2011	4336	2097.8	6433.8	26192.5	13425	39617.5	-33183.7
2011/2012	4961	2464.5	7425.5	29939	16227.8	46166.8	-38741.3
2012/2013	5100	2591.8	7691.8	36703.1	18970.9	55674	-47982.2
2013/2014	5961.4	3237.8	9199.2	47794.7	23641.9	71436.6	-62237.4
2014/2015	5586.5	2945.5	8532	49165.6	28302.8	77468.4	-68936.4
2015/2016	3949.4	3062.4	7011.8	47721.3	29638.6	77359.9	-70348.1
2016/2017	4144.9	3159.9	7304.8	63367	35644.4	99011.4	-91706.6
2017/2018	4672	3464	8136	81410.2	43100.1	124510.3	-116374
2018/2019	6273.2	3437.8	9711	91790.9	50062.6	141853.5	-132143

Source: Economic Survey (from 2007 to 2019), MoF

Table 1.3 reflects that trade balance is always negative and widening in recent years making it almost half of the GDP.

7. Data and Methodology

To maintain the uniformity in information gathered, the required data have been taken from World Bank data source. Major trade partners with more than one percent of Nepal's international trade are considered in the study. The latest trade statistics from Trade and Export Promotion Centre reflect that Nepal has foreign trade of one percent or more with 15 countries: India, United States, Germany, Turkey, United Kingdom, China, France, Bangladesh, Italy, Japan, Canada, Australia, Netherlands, Vietnam and United Arab Emirates. Most of these countries are major partner of both export and import trade of Nepal.

Total import and export values in constant dollar term on 2010 have been taken for each of the countries. GNI for same base year have been compiled including Nepal. Import and export price index of Nepal are available from year 2001, thus this study covers 19 year's annual data from 2001 to 2018. All the data have been obtained from World Bank's data set www.worldbank.org.

Two equations have been estimated for the analysis: 1) Export Equation and 2) Import equation

$\log EX = \alpha_0 + \alpha_1 \log G + r + \epsilon$ …… (1)

$\log IM = \beta_0 + \beta_1 \log Gn + r + \mu$ …… …….(2)

Where, EX = Export, IM = Import, G = GNI of trade partners in constant 2010 value, r is real exchange rate, Gn is GNI of Nepal, $\alpha_{0,}\ _{\alpha 1,}\ \beta_0$ and β_1 are parameters, ϵ and μ are error terms.

8. Results and Discussion

Results from OLS regression show that GNP of other countries and real exchange rate as dependent variable can not jointly determine the export of Nepal, although exchange rate and F-statistics are significant. But Nepal's GNP and real exchange rate have highly significant influence over import. Breusch-Godfrey Serial Correlation LM Test results (Appendix 1 and Appendix 2) reject the presence of auto correlation in the model. Similarly, the White Heteroskedasticity test results show that both equations reflect homoscedasticity of the estimation. JB statistics reflect normal distribution of the residuals in both equations and ADF tests show that most of the data have unit root at level but they are found stationary at first difference. Johnson's cointegration results reject the existence of cointegration among variables with 3 lags (Appendix 3). As the unit root test show the possibility of cointegration of series of these variables in the long run relationship, Johansen maximum eigenvalue cointegration test with three lags has been carried out for both of the models. The results indicate no such long run association of the variables. As variables are not cointegrated, it can be concluded that there does not exist such a long run causality. Therefore, the estimation model qualify better on Variance Autoregressive Regression (VAR) model. The short run coefficients from VAR model reflect that coefficients are significant for two lags. Table1.4 and table1.5 show the results from VAR model.

Table 1.4: Export Equation (EX_t)

Variable	Coefficient	Std. Error	Z	p> lzl
gnitotal (Gt)	5.3573	1.6391	3.27	0.001
realexrate (rt)	1.0235	0.2534	4.04	0.000

Table 1.5: Import Equation (IM_t)

Variable	Coefficient	Std. Error	Z	p> lzl
gninepal (Gn_t)	-2.9559	1.1240	-2.63	0.009
realexrate (r_t)	0.4741	0.1731	2.74	0.006

Using these results, the cointegrating eigenvectors are computed as;

$EX_t + 5.3573\ G_t + 1.0235\ r_t$ (Export equation)

$IM_t - 2.9559\ Gn_t + 0.4741\ r_t$ (Import equation)

The Granger causality test confirm the validity of model. The results reject the null hypothesis of all lags of independent variables that do not cause dependent variable. To see the short run causality test, the outcomes of Granger causality test have been used.

Table 1.6: Granger Causality Wald Test for Export Equation

Equation	Excluded	Chi2	df	Prob>chi2
exportvalue	gnitotal	21.914	3	0.000
exportvalue	realexrate	28.063	3	0.000
exportvalue	ALL	45.546	3	0.000

Table 1.7: Granger Causality Wald Test for Import Equation

Equation	Excluded	Chi2	df	Prob>chi2
importvalue	gni nepal	64.765	3	0.000
importvalue	realexrate	38.171	3	0.000
importvalue	ALL	80.857	3	0.000

The null hypotheses that ' all the lags of independent variables do not cause dependent variable' in short run is rejected with 1 percent critical value.

From estimation of export and import equation, we can calculate various trade elasticities;

i.e. $\frac{\Delta EX}{\Delta r}$ =0.977, $\frac{\Delta IM}{\Delta r}$ = 2.123, $\frac{\Delta EX}{\Delta G}$ = 0.187, $\frac{\Delta IM}{\Delta Gn}$ = 0.34.

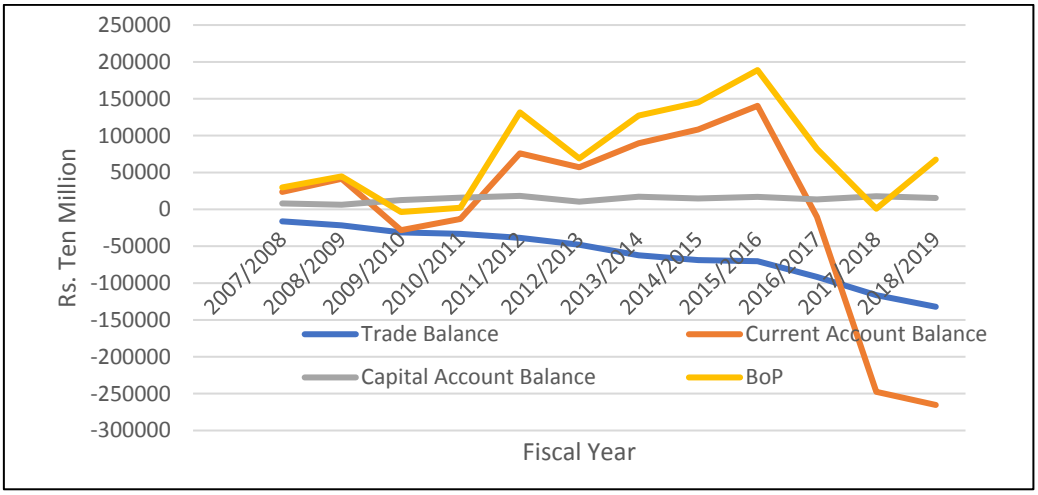
These information suggest us that one percent devaluation/depreciation in real exchange rate cause 0.98 percent rise in export and 2.12 percent rise in imports; and as the sum of elasticity coefficients is greater than unity, it satisfies the Marshall-Lerner condition. Moreover, one percent increase in Nepal's GNI leads to 0.34 percent increase in import while one percent increase in Nepal's trade partner's GNI would cause 0.19 percent increase in export. Therefore, Nepal's export elasticity reflects quite less response to its trade partner's income but import elasticity is relatively more elastic.

9. Marshall Lerner Condition, Fixed Exchange Rate Regime and Balance of Payment in Nepal

Marshall Lerner's condition is based on two important assumptions. First, it assumes that all buyers face given prices in the international markets and second output can be expanded at constant prices. The first assumption can be a realistic assumption in Nepalese case as price level in Nepal is mainly determined by import prices. Being small economy and lower production base, Nepal's production and exports are less influential to affect the prices in international trade. Although Marshall Lerner condition is validated from this study, Nepalese exports are relatively inelastic. This means, by devaluation of the currency we can not increase the export as desired. If we devaluate the currency by one percent, export will rise only by 0.98 percent. This fact supports to continue fixed exchange regime from international trade perspective.

In most of the countries, the balance of payment and trade balance show similar pattern where international trade of goods and services is relative larger. These two balances show different scenario in Nepalese case. On the one hand, trade balance is widening negative with still positive and growing balance of payment surplus.

Figure 1.4: Trade Balance, Current Account Balance, Capital Account Balance and Balance of Payment



Source: Derivation from Nepal Rastra Bank Annual Reports (2007-2019)

Figure 1.4 shows that there exists no systematic pattern between trade balance and balance of payment in Nepalese economy. Balance of payment is often surplus but shows no predictable pattern while trade deficit is increasing each year. Balance in capital account is in surplus each year since 2007 but it does not make any significant share in balance of payment current account balance and balance of payment move together.

10. Conclusion

This study examines the trade elasticities of Nepal with its fifteen major trade partners and the sum of trade elasticities validate the Marshall Lerner condition. This means devaluation will have normal reaction in Nepalese case. But export elasticity is relatively lower than import elasticity which shows that devaluation will affect import more than export. The long run relationship between the trade balance and balance of payment cannot be observed but balance of payment moves together with current account balance.

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Appendix 1

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.616227	Probability	0.236121
Obs*R-squared	3.584435	Probability	0.166590

Test Equation:

Dependent Variable: RESID

Method: Least Squares

Date: 09/21/20 Time: 20:28

Pre sample missing value lagged residuals set to zero.

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	0.597962	2.030662	0.294466	0.7731
GNI	-0.042603	0.153317	-0.277874	0.7855
EXRATE	-0.009687	0.115232	-0.084062	0.9343
RESID(-1)	0.050052	0.258805	0.193396	0.8496
RESID(-2)	-0.468267	0.261927	-1.787776	0.0971

R-squared	0.199135	Mean dependent var	-2.30E-15
Adjusted R-squared	-0.047285	S.D. dependent var	0.035610
S.E. of regression	0.036442	Akaike info criterion	-3.556049
Sum squared resid	0.017264	Schwarz criterion	-3.308724
Log likelihood	37.00444	F-statistic	0.808113
Durbin-Watson stat	1.612534	Prob(F-statistic)	0.541751

Appendix 2

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.904885	Probability	0.428616
Obs*R-squared	2.199619	Probability	0.332935

Test Equation:

Dependent Variable: RESID

Method: Least Squares

Date: 09/21/20 Time: 21:22

Pre sample missing value lagged residuals set to zero.

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	0.272876	0.909214	0.300123	0.7688
GNINEP	-0.025535	0.079564	-0.320940	0.7534
EXRATE	0.021690	0.134820	0.160880	0.8747
RESID(-1)	0.106037	0.287208	0.369201	0.7179
RESID(-2)	-0.385071	0.300842	-1.279978	0.2229

R-squared	0.122201	Mean dependent var	1.49E-15
Adjusted R-squared	-0.147891	S.D. dependent var	0.038973
S.E. of regression	0.041755	Akaike info criterion	-3.283858
Sum squared resid	0.022665	Schwarz criterion	-3.036532
Log likelihood	34.55472	F-statistic	0.452442
Durbin-Watson stat	1.606367	Prob(F-statistic)	0.769068

Appendix 3

Summary of ADF Test Statistics

Variable	Model	Test statistic	Critical value	Decision
Export	Only Intercept	-1.766	-2.63	Accept H_0: has unit root
	Intercept and trend	-3.148	-3.24	Accept H_0: has unit root
	No intercept/no term	0.08	-1.6	Accept H_0: has unit root
First Difference	Only Intercept	-4.497	-2.63	Reject H_0: No unit root
	Intercept and trend	-4.35	-3.24	Reject H_0: No unit root
	No intercept/no term	-4.54	-1.6	Reject H_0: No unit root
Import	Only Intercept	1.675	-2.63	Not valid
	Intercept and trend	-3.231	-3.24	Accept H_0: has unit root
	No intercept/no term	3.247	-1.6	Not Valid
First Difference	Only Intercept	-4.129	-2.63	Reject H_0: No unit root
	Intercept and trend	-4.547	-3.24	Reject H_0: No unit root
	No intercept/no term	-2.163	-1.6	Reject H_0: No unit root
GNI	Only Intercept	0.048	-2.63	Not valid
	Intercept and trend	-1.878	-3.24	Accept H_0: has unit root
	No intercept/no term	8.345	-1.6	Not valid
First Difference	Only Intercept	-3.402	-2.63	Reject H_0: No unit root
	Intercept and trend	-3.274	-3.24	Reject H_0: No unit root
	No intercept/no term	-1.043	-1.6	Accept H_0: has unit root
GNI Nepal	Only Intercept	0.205	-2.63	Not valid
	Intercept and trend	-2.095	-3.24	Accept H_0: has unit root
	No intercept/no term	20.045	-1.6	Not valid
First Difference	Only Intercept	-4.442	-2.63	Reject H_0: No unit root
	Intercept and trend	-4.236	-3.24	Reject H_0: No unit root
	No intercept/no term	-0.329	-1.6	Accept H_0: has unit root
Real Exchange Rate	Only Intercept	-0.823	-2.63	Accept H_0: has unit root
	Intercept and trend	-1.414	-3.24	Accept H_0: has unit root
	No intercept/no term	0.202	-1.6	Not Valid
First Difference	Only Intercept	-3.099	-2.63	Reject H_0: No unit root
	Intercept and trend	-3.603	-3.24	Reject H_0: No unit root
	No intercept/no term	-3.203	-1.6	Reject H_0: No unit root