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A Panel Data Analysis to Evaluate the Effect of Currency Devaluation on Major Export Items

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Abstract

Many countries devaluate their own currencies on the basis of assumption that promoting export is an important aspect in economic growth. This paper uses 25 years' (1987 to 2011) panel data for 33 such countries with their major export items to empirically examine whether devaluation of these countries currency matter for change in exports for major items by using different econometrics techniques. Results find that devaluation of the currencies cause export to decrease rather than to increase. Thus countries should follow appropriate policy for currency appreciation than currency depreciation for export promotion.

Key Words: Panel data, Fixed effect, White robust standard error, Currency devaluation.

I. Introduction

It is usually believed that the policies that encourage exports have a positive impact on economic growth. The export oriented industries have higher marginal product of labor and as a result they pay higher wages than other sectors, whereas an important component of the relative price of exports which matters for sectoral allocation, largely depend on the level of real exchange rate. The real exchange rate broadly depends on government decision of devaluation of currency, which is a major economic and political agenda. Different countries needed to devalue their currency for a variety of reasons, including correction of price distortion to get right price so that market can function properly, which increases competitiveness in the international markets. As a result, it would be possible to decrease foreign trade deficit and improve the balance of payments, and above all, to achieve a feasible economic growth.

This paper aims at assessing the effect of rapid devaluation of countries currencies' on major export items of 33 selected countries (see appendix). These selected countries had devaluated their currencies due to other exogenous shock on currency rather than export. This analysis will answer the question whether the currency devaluation affects the export growth or not. To do this different econometric techniques for panel data analysis have been used.

The relationship between currency devaluation and export growth has been investigated by different researchers having no consensus among their findings. The role of exports is vital in economic growth and especially the real exchange rate in export promotion features prominently in literature on development and globalization (Rodrik[1], Haddad and Pancaro[2]). Servén[3] shows that the volatility of exchange rates has a negative impact on growth, investment and on exports of goods. However, Freund and Martha[4] find large sustained depreciations of the real exchange rate, implying improvements in competitiveness. In some of their specifications they find that low levels of exchange rate volatility and high levels of trade openness significantly increase export. Edward[5] claimed that devaluations had a negative effect on output in the short-run while they were neutral in the long-run using pooled time series cross section data for 12 countries. This result was supported by Upadhyaya et.al.[6] from the study of currency depreciation[1] using panel data on Asian countries. While, Conoly, Schmid and Rosenweig[7] found a positive relationship between currency devaluation and export growth.

Eilat and Einav[8] argue that the exchange rate matters more for exports and growth in advanced economies. In the context of developing country, in contrast, the real exchange rate is likely to matter less, while political risk is more important for competitiveness in service sectors like tourism. In contrast, Goswami, Gupta, Mattoo and Saez[9] have found few differences in the determinants of services exports when they attempt to estimate the effect of currency devaluation on export separately for advanced and developing economies. The results from Eichengreen and Gupta[10,11] confirm the importance of the real exchange rate for export growth. In addition, they find that the effect of the real exchange rate is even stronger for exports of services than exports of merchandise. It is especially large for exports of modern services, as opposed to traditional varieties. The evidence for differential effects between advanced and developing countries, in contrast, is weaker. Still, this suggests that as developing countries shift from exporting primarily commodities and merchandise to exporting traditional and modern services, appropriate policies toward the real exchange rate became even more important.

The above mentioned studies were carried out by considering either panel data or time series over specific period of some region or some selected countries while they did not consider the cases of rapid change in currency exchange rate, which was a frequently used policy tool under both IMF-regulated and independent stabilization programs for those countries. This research address this gap in literature as this study is considering all countries where currencies were devaluated during the last twenty years. The

[1] Currency depreciation/devaluation is the loss of value of a country's currency with respect to one or more foreign reference currencies (e.g. USD, EURO). Its opposite, an increase of value of a currency, is currency appreciation.

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study will also consider the main export items of different countries to evaluate the effect of the rapid devaluation of the currency during the last twenty five years.

II. Data

The countries which devalued their currencies during the last twenty years from 1991 to 2011 are considered. To have some export observations before the currency devaluation, time period of twenty five years has been considered. Thus the panel data set covers twenty five years over the period from 1987 to 2011 for countries that faced rapid devaluation of their currencies during the period and for which adequate data on exports are available. In total there are 33 such cases (list is in appendix) which are organized into country-year observations as unbalanced panel data[2] to analyze the exports growth of services measured in constant US dollar. The bilateral real exchange rate for one US dollar has been collected from the International Monetary Fund's *International Financial Statistics* (IFS) on the nominal exchange rate. All other data have been collected from the World Development Indicators of World Bank and export data have been collected from United Nation trade data.

The exports (EXP) of selected items (see appendix) represent the sum of value of those goods and services provided to the rest of the world. Data have been taken from United Nation trade data source which are measured in constant 2000 USD. The real exchange rate (RER) is defined as nominal exchange rate times the ratio of US price index to the domestic consumer price index where as the nominal exchange rate is the price of domestic currency in terms of the US dollar. Per capita income (PCI) is the gross national income divided by midyear population. Data are also measured in constant 2000 USD. Data are expressed in logarithm. Table 1 reports some descriptive statistics to get an overall idea about the data set. All the variables reported in Table1 are in logarithmic scale.

III. Econometric Modelling and Estimation

This paper aims to analyze the effect of currency devaluation on export growth. The regression equation contains the dependent variable as the export of selected items (Exp)whereas the independent variables include the real exchange rate (RER). Thus the first simple regression model is:

$$\text{LnExp} = \beta_0 + \beta_1 \ln RER + \varepsilon \quad (1)$$

With this benchmark model a control variable "log per capita income" is added along with the explanatory variable log of real exchange rate. Because per capita income is often used as average income, a measure of the wealth of the population of a nation, particularly in comparison to other nations, often used to measure a country's standard of living which influences the export. Also countries with lower Per Capita Income (PCI) have higher export trade because these countries have higher competitiveness in terms of price. Then as the final Pooled OLS model to capture the trend rate of growth over time i.e to control for the time- effect, the time dummy will be incorporated in the model. As the unbalanced panel data set contains 25 years, 24 time dummies are needed along with other explanatory variables. Then the model will be of the form:

$$\ln Exp = \beta_0 + \beta_1 \ln RER + \beta_2 \ln PCI + \sum_{t=1}^{24} \gamma_t D_t + \varepsilon \quad (2)$$

To use Pooled OLS for panel data, error terms should be free of entity fixed effects. As pooled OLS has many weaknesses to deal with panel data, later first difference method is used to get rid of the effect of any variable that is constant over time. Because countries exchange rate system (e.g. paged, floating, free float etc.), quality of institution (some institutions are in autarky), openness of trade have constant effect on Real Exchange Rate over time. In order to eliminate these constant effects and to capture the instantaneous effect of currency devaluation in that year, the following model has been used in the first difference estimate:

$$\ln Exp = \beta_0 + \beta_1 \ln RER + \beta_2 \ln PCI + \sum_{t=2}^{25} \gamma_t D_t + \varepsilon \quad \ldots\ldots\ldots\ldots\ldots (FD1)$$

If the random error term is serially uncorrelated fixed effect is more efficient than first differencing. Since the unobserved effects (e.g. exchange rate system, quality of institution, openness of trade) in the model are assumed to be serially uncorrelated with idiosyncratic errors and error term does not follow a random walk, the fixed effect estimator is used more than first difference estimator. Thus fixed effect model (which uses a transformation to remove the unobserved effect of constant prior to estimation) specified by equation FE1 has been used to compare which one works better.

$$\ln Exp = \beta_0 + \beta_1 \ln RER + \beta_2 \ln PCI + \sum_{t=2}^{25} \gamma_t D_t + \varepsilon \quad \ldots\ldots\ldots\ldots\ldots (FE1)$$

As exchange rate and trade has a systematic pattern of growth so it might be correlated with error term, thus to get rid of the endogeneity problem an instrumental variable for rapid change in currency value will be employed in the model and the model will be analyzed in two stage least squares method. The first difference in real exchange rate with a product of devaluation dummy will be employed as an instrument for rapid devaluation. i.e *diffRER.devdum* has been used as an instrument for logRER in the first stage.

Table 2 reports pooled OLS, first difference and fixed effect regressions results. For each model the F-statistics indicates that parameter values are together significantly different from zero which implies that the set of explanatory variables used in the mode are relevant together to explain the dependent variable which is export here. The overall predictive powers of the models are quite satisfactory except

[2] An unbalanced panel data set is a panel data set where some data/observations are missing for some cross-sectional units in the sample period.

Table 1. Descriptive statistics for main concern variables

Variable	Obs	Mean	Std. Dev.	Min	Max
logexp	726	10.24552	.9132655	8.190241	12.20071
logRER	792	1.392945	1.684794	-7.770157	4.025973
logpci	691	3.209887	.6351194	2.002857	4.625063

From the above report it could be seen that all the variables have substantial variation within the variables.

for the first model. It is not surprising that naive model with only one variable explains only 3 % variations in export as export is not only determined by Real exchange rate but also many other factors. As a result when per capita income is included in the model the explanatory power increases substantially (between 58% and 85%). Time dummy variables are statistically highly significant for the longer distant period which means that exports growth gradually with time.

The coefficients of Log of Real Exchange Rate turns out to be negative and statistically significant at 5% level in most cases. Therefore, it could be said that devaluation reduces the export growth. Form the estimated result it could be said that after controlling for other observable factors 1% increase in Real Exchange rate (i.e 1% depreciation of currency) on average results in about 0.03% decrease in export which support the findings of Edward[5] and Kalyoncu et.al.[13] Although this finding is statistically significant but economically it is not a significant number. In spite of economic insignificance real exchange rate should be taken into consideration to improve the export growth.

Table 2. Results for Pooled OLS, First Difference and Fixed Effect Models

	Pooled OLS		First Difference	Fixed Effect
	Model 1	Model 2	FD1	FE1
lnRER	-0.099***	-0.028*	-0.026	-0.034***
	(0.02)	(0.015)	(0.018)	(0.007)
lnPCI		0.976***	1.17***	1.31***
		(0.03)	(0.04)	(0.057)
Constant	23.92***	16.18***	0.028***	13.71***
	(0.11)	(0.35)	(0.0051)	(0.41)
Time dummy	No	Yes	Yes	Yes
Obs	710	674	658	674
R-squared	0.03	0.58	0.63	0.85
P-value of F-stat	0.000	0.000	0.000	0.000
No. of countries			31	31

Note: White Robust Standard errors[3] are presented in brackets, *** p<0.01, ** p<0.05, * p<0.

Table 3. Results for Instrumental variable regression- Two stage regression

	First stage	Second stage
Dependent variable	RER	lnExport
lnRER		0.23*
		(0.1206)
lnPCI	-2.79***	1.49***
	(0.61)	(0.44)
RER*Devaluation Dummy	0.00066***	
	(0.0000386)	
Constant	0.101***	-.0042
	(0 .044)	(0.02)
Time dummy	Yes	Yes
No. of Observations	643	643
R-squared	0.17	
No. of countries	33	33

White Robust Standard errors in brackets, *** p<0.01, ** p<0.05, * p<0.1

[3] White Robust Standard error provides heteroskedasticity-consistent standard error estimates even when homoskedasticity assumption is violated (Freedman[12]).

From the first difference estimation, the effect of change in Real Exchange Rate on change in Export growth is not statistically significant even at 10% level but slightly higher than 10% level. In the fixed effect model the results have been reported in a way that emphasizes the need to interpret the estimates in light of the unobserved effects model. This model has been used to control explicitly for the unobserved, time-constant effects in constant term. Here most of the variables are statistically highly significant which support the previous result where as the estimates are more precise. Although the estimates in first difference and fixed effect are not very much different but the estimated standard errors are smaller in case of fixed effect. Thus fixed effect estimate might be considered as better result than first difference which is also supported by theory. In the case of fixed effect model as well as other models, robust standard error has been used; it is possible to use cluster error for which estimated standard errors 0.0333 and 0.11878 for co-efficients of lnRER and lnPCI respectively. These results are not presented in table because due to smaller number of countries the White robust standard error estimates are better than cluster estimates of standard error (Green[14]).

To see if the immediate effect of RER has different effect on export the change in logarithmic value of RER has been interacted with the devaluation year and the results have been presented in Table3. The estimated effect is statistically significant only at 10% level of significance (also the confidence interval contains zero value) when difference in real exchange rate times the devaluation has been used as an instrument for log of Real exchange rate although the instrument variable satisfies the relevance condition. The sign of the estimated co-efficient is positive in contrast to the earlier estimations. This might be due to that the instrument is not a sufficiently good instrument to capture the real change in Real Exchange rate due to exogenous shock. Also the explanatory power of first stage regression is very low (only 17%) which mean instrument has lower ability to explain the variation in the change in Real exchange rate. Therefore, the results from instrument variable regression might be considered as not good enough. Thus finally considering all the models it could be concluded that fixed effect model captures the effect more substantially to find the effect of devaluation of currency on export growth.

IV. Conclusion

The role of the real exchange rate on exports promotion that is in economic growth is prominent. As a result, this emphasizes the importance of a competitively valued exchange rate of a country's currency for promoting exports. The countries whose currency values are not stable have to devaluate their currency as a result of inadequate reserve of foreign currency for international trade. The analysis results suggest that devaluation causes reduction in export growth. This indicates that relying on undervalued exchange rate to encourage the exports of major export items does not only limit but also discourage the exports. In other words, economy benefits from exchange rate appreciation. Thus it might be concluded that countries should not frequently follow currency devaluation for the economic development of the country instead policy makers should follow real exchange rate appreciation for policy implementation.

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Appendix: List of Selected Countries and their Major Export Items

1. Algeria: petroleum and natural gas
2. Angola: crude oil, diamond, refined petroleum, coffee fish, timber and cotton
3. Argentina: soybean product, cereals, beef motor vehicle & parts and chemical & medicine
4. Bangladesh: textiles, apparel, readymade garments, ships, ceramic, fish, jute and leather

5. Belarus: machinery and equipment, mineral products, chemical and metals
6. Benin: crude oil, cotton, cotton, palm products and cocoa
7. Brazil: soybean, orange juice, cane& sugar, iron ors, crude oil and passengers vehicle
8. Bulgaria: non crude oil, copper, iron & steel, non-knit women& girls suits
9. Cambodia: knitted sweater, non-knitted women & girls suit, boys suit and knitted T-shirt
10. Cameroon: crude oil, wood, banana, aluminum and cocoa
11. China: computer, printer, machines part, cellophane, electronics and toys
12. Cote d'Ivore: lumber, uncoated paper, copper waste and scrap
13. Ethiopia: coffee, oil seeds& oleaginous fruits and aircraft engines
14. Haiti: knitted T-shirt, sweaters, boys suits and shirts
15. India: non-crude oil, iron ores, diamond, non-knitted women and girls suits and medicine
16. Indonesia: petroleum, gas, crude oil, coal and non-crude oil
17. Iran: crude oil, non-crude oil, petroleum and gas
18. Japan: passenger vehicle, electronic integrated circuit and motor vehicle parts
19. Kenya: cut flower and buds, tea, vegetables, coffee
20. South Korea :electronic integrated circuits, passenger vehicle, cell phone, non crude oil
21. Lebanon: jewelry, ferrous waste & scarp, diamond, fertilizer
22. Lithuania: non crude oil, furniture & parts, fertilizer, crude oil
23. Malaysia: electronic integrated circuit, computer, printer telephone, cell phone
24. Mali: cotton oil, seed, dates, items botanic
25. Mexico: crude oil, vehicle, TV receivers, motor vehicle parts
26. Niger: diamond, crude oil
27. Philippines: electronic integrated circuit, computer, printer
28. Russia: crude oil, non-crude oil, petroleum, aluminum, coal, nickel
29. Singapore: electronic integrated circuit, computer, printer, cell phone
30. Thailand: electronic parts, computer, printer rubber, truckers, telephone
31. Ukraine: semi finished product of iron & steel, non crude oil
32. United Kingdom: vehicle, crude oil, medicine, aircraft engine, computer
33. Zimbabwe: nickel, tobacco, ferroalloys, mattes, cotton, sugar.