Are Devaluations Contractionary? Evidence from Panel Cointegration

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ABSTRACT

Earlier studies that investigated the relation between exchange rate and domestic output employed panel data. In this paper we improve upon the traditional approaches of the existing econometric literature on contractionary devaluation or depreciation by applying panel unit root and panel cointegration techniques to annual data from 42 countries (18 OECD and 24 non-OECD). After confirming the existence of unit roots in all variables of the model as well as cointegration among all variables, results from different specifications of the model revealed that in the long-run, devaluations are contractionary in non-OECD countries regardless of model specification. However, for OECD countries the results were sensitive to model specification.

1. INTRODUCTION

DEVALUATION CAN BE A CATALYST in the process of real economic adjustment to various shocks. This is precisely the motivation for the devaluation frequently included among the central elements of stabilisation programs. Indeed, devaluation has been prescribed and used increasingly as a stabilisation device in developing countries, as part of International Monetary Fund orthodox adjustment programs. The conventional treatment is based upon the proposition that devaluation improves competitiveness, boosts exports and switches demand towards domestically produced goods, ultimately expanding the production of tradables. In addition, countries that undergo real depreciations are believed to have better chances in the journey toward more open economies and sustained growth, because a more depreciated exchange rate will likely prevent destabilising financial crises, such as occurred in Mexico during 1982 and 1995.

However, the proposition that devaluations are genuinely expansionary has encountered serious challenges from theoretical studies as well as historical facts, according to which devaluations are contractionary. In point of fact, stabilisation packages that include a devaluation component, have been criticised by an ever-growing body of literature that considers the exchange rate a questionable instrument of economic policy, particularly in developing countries. If, instead, devaluations are contractionary, policymakers will be at an impasse when trying to foster output growth while at the same time improving the balance-of-payments position. The theoretical likelihood that devaluations could be contractionary was, in many instances, supported by actual experience. Several authors observed output declines in the aftermath of devaluations and pointed out that the beneficial relative price adjustment generated by devaluations may come at a high price — namely recession. A vast body of research has made its way into the literature under the subject heading of contractionary devaluation. Theoretical research argues for contractionary devaluation by concentrating on the aggregate demand and aggregate supply model. The most important reasons for a devaluation to cause a contraction of *aggregate demand* include:

(1) Redistribution of income towards economic entities with a high marginal propensity to save (Diaz-Alejandro, 1963; Cooper, 1971a; and Krugman and Taylor, 1978). Devaluation typically boosts profits in export and import-competing industries as it leads to higher relative prices for traded goods. When this increased price level leads to lower real wages, national spending is likely to shrink since the marginal propensity to save from profits exceeds that from wages.

(2) A decline in investment (Branson, 1986; Buffie, 1986a, 1986b and van Wijnbergen, 1986). Often, new investment consists largely of imported capital goods that need to be supplemented with domestic resources and investment. Under these circumstances, a depreciation that reduces imported capital by raising its cost, also reduces domestic investment that was supposed to supplement the imported capital. In turn, reduced investment depresses aggregate demand.

(3) Increased debt and debt service payments in local currency (Cooper, 1971b; Gylfason and Risager, 1984 and van Wijnbergen, 1986). Devaluation will invariably increase the debt service burden of a country that has accumulated external loans denominated in foreign currency. This heavier burden drains off resources that could be used in spending and production, resulting in reduced aggregate output.

(4) Reduction in real wealth or real balances (Bruno, 1979; Gylfason and Schmid, 1983; Hanson, 1983 and Gylfason and Radetzki, 1991). Under given initial nominal money balances and wealth, a higher price level ensuing from devaluation reduces real cash balances and real wealth. A fall in expenditure will be needed in order to restore real balances.

(5) Low government marginal propensity to spend out of tax revenue under ad valorem taxes on trade (Krugman and Taylor, 1978). Initially, devaluation is bound to increase the domestic currency value of imports while their volume remains unchanged. This increased domestic currency value of trade causes trade *ad valorem* taxes (tariff revenue), and particularly those on imports, to rise. As a result, there will be a redistribution of income from the private sector to the government. Because the latter is believed to have a marginal propensity to save that is close to unity in the short run, that leaves government spending unchanged, aggregate demand will contract due to decrease in private consumption.

(6) Real income declines if the trade balance is initially in deficit (Cooper, 1971c and Krugman and Taylor, 1978). When the trade balance is in deficit, real income at home tends to fall as imported goods become more expensive, and foreign currency out-payments overwhelm in-payments.

(7) Increased interest rates (Bruno, 1979 and van Wijnbergen, 1986). As devaluation is passed on in domestic prices and wages, a reduction in the real volume of bank credit and the monetary base occurs. Often, a lower real volume of bank credit for the private sector implies that firms will resort to the curb (parallel) market for funds, where the interest rate will have to rise and reduce aggregate demand through traditional mechanisms.

(8) Foreign profits increase (Barbone and Rivera-Batiz, 1987). The short run redistribution of income from wages to profits may turn out to be even more contractionary under foreign ownership of capital. Thus a portion of the increased profits will leak to the rest of the world.

Devaluations may also reduce *aggregate supply* via three main channels:

(1) The price of imported inputs increases (Bruno, 1979; Gylfason and Schmid, 1983; Hanson, 1983; Gylfason and Risager, 1984; Islam, 1984; Gylfason and Radetzki, 1991; Branson, 1986; Solimano, 1986 and van Wijnbergen, 1986). If final goods prices are somewhat sticky, the price of imported inputs in terms of domestic final goods will increase following devaluation. Increased production costs will then clearly reduce supply.

(2) Wage indexation based on price levels [Hanson, 1983; Gylfason and Risager, 1984; Islam, 1984; Gylfason and Radetzki, 1991; Branson, 1986; Edwards, 1986b. Solimano, 1986 and van Wijnbergen, 1986). Increased prices for tradables caused by devaluation may lead labor to demand higher wages in an attempt to restore the initial standard of living. Such an increase in wages could produce adverse supply effects and partially nullify the positive effects of devaluation.

(3) Working capital grows costlier as real balances decline (Bruno, 1979 and Wijnbergen, 1986). If devaluation increases the demand for money,

interest rates will climb, making working capital more costly and discouraging production.

Consideration of the above channels makes the threat of contractionary devaluations real. Many developing countries that have experienced severe balance of payments crises as a result of their over-valued currencies, have often resisted devaluation as an adjustment instrument mainly because of two reservations: (i) uncertainty about the influence of exchange rates on import demand, export supply, and domestic expenditures; (ii) impending negative side effects on output growth, employment, inflation, net international reserves, as well as real wages and income distribution. It is with regard to this resistance that Cooper (1971c) observes that changes in finance ministers often seem to follow devaluations.

Because of a lack of long time series data, most econometric studies that have tried to assess the impact of devaluation on output, have either relied upon cross-sectional data or panel data. For any country for which long time-series data have become available, researchers have engaged in country-specific studies. For example, Rogers and Wang (1995), Santaella and Vela (1996), Copelman and Werner (1996) and Kamin and Rogers (1997) all estimate a VAR model for Mexico and all find that depreciation of the real or nominal exchange rate results in decline in aggregate output. Rodriguez and Diaz Gazani (1995) in a VAR for Peru and Hoffmaister and Végh (1996) for Uruguay arrive at similar conclusions. In a case study for Korea, Bahmani-Oskooee and Rhee (1997) introduce Johansen's cointegration and error-correction technique into the literature. Relying on data over the period 1971-1994, they show that depreciations have been expansionary in Korea and that their positive effects appear only after three quarters.

Another study by Bahmani-Oskooee (1998) tackles a different time horizon than that treated by the existing literature — the long run effects of devaluation. Quarterly data on real as well as nominal effective exchange rates for 23 LDCs were used in a cointegration framework to examine the presence of a long-run association between output and effective exchange rates. He validates the hypothesis of neutral devaluations with respect to output in the long run. Finally, Upadhyaya (1999) applies cointegration and error-correction modeling techniques to data drawn from six Asian countries and finds that while in Pakistan and Thailand devaluation is contractionary, in India, Sri Lanka, Malaysia, and the Philippines it has no long-run effects.

As for cross-sectional studies, Sheehey (1986) analyses the short run effects of unanticipated inflation, exchange rates and business cycles on output growth. Based on cross-section data for 16 industrial Latin American countries, he finds support for the contractionary devaluation hypothesis. Morley (1992) conducts a cross-section study on 28 LDCs from 1974. His findings conform to the view that devaluations have a contractionary effect on total output over a two-year period.

We choose to pay particular attention to panel data contributions to the literature, because we utilise a panel data approach in our estimation. One of the most prominent early econometric studies is the one by Edwards (1986a). He estimates a model of real output behaviour based on data from 12 developing countries over the period 1965-80. His least squares dummy variable model indicates that monetary surprises and government spending are expansionary, whereas devaluations appear to be neutral in the long run. Devaluations tend to reduce output in the first year, but this effect is completely offset during the second year. Khan (1988) uses a similar approach by including policy variables and terms of trade disturbances in a panel framework covering 67 countries over period 1973-1986. The exchange rate variable is found to be insignificant.

Another study by Edwards, (1989b), derives a testable reduced form equation from a macroeconomic model and uses panel data regressions on 12 developing countries for the period 1965-84. Consistent with his previous conclusions, Edwards finds that devaluations are contractionary in the short-run. They remain neutral, however, for the long run only in two out of seven regressions. In none of the seven specifications do the coefficients of the lagged exchange rate turn out to be significant. Kamin and Klau (1998) examine a dataset of pooled annual observations from 27 countries. They tackle the long-run effects of devaluation, while including external shocks and considering regional grouping. They fail to find support for the contractionary devaluation hypothesis in the long run, or that contractionary devaluations are only a developing country phenomenon.

Nunnenkamp and Schweickert (1990) conduct a pooled time-series cross-sectional analysis on a sample of 48 countries over the period 1982-1987. They maintain that the pessimism about the negative impact of devaluations on output growth rates is unjustified. Moreover they examine group-specific effects and conclude that in the short run, contractionary devaluations seem more likely for exporters of manufactures, while expansionary devaluations are more possible for exporters of agricultural products. Finally, Agenor (1991) examines a pooled sample of 23 developing countries, and considers the deviation of actual from expected changes in the real exchange rate, foreign income, the money supply and government spending. He asserts that unexpected real exchange rate depreciation is expansionary, while anticipated real depreciations have an irreversible contractionary effect.[2]

The panel studies reviewed above have a deficiency in that they have used non-stationary data, thus standard econometric results may not be valid unless the variables in each panel model are cointegrated. Before estimating a panel model, one has to establish the integrating properties of each variable, as well as cointegrating properties of all variables together in the panel cointegrating space. Two studies have applied panel unit- root and panel cointegration tests in this part of the literature, Chou and Chao (2001) employed annual data over the period 1966-1998 across five Asian economies

(Indonesia, South Korea, Malaysia, the Philippines and Thailand) and showed that real output and the real exchange rate are both non-stationary. The panel cointegration tests revealed that the two variables are not cointegrated, implying that there is no long-run relationship between real output and the real exchange rate in Asian countries. Similarly, Christopoulos (2004) considered annual data over the period 1968-1999 across 11 Asian countries (India, Indonesia, South Korea, Malaysia, Myanmar, Nepal, Pakistan, the Philippines, Singapore, Sri Lanka, and Thailand) to show that, again, real output and the real exchange rate both have unit roots in a panel framework, although they are found to be cointegrated in the long-run. The estimated model provided empirical support for contractionary devaluation in the long-run.

Therefore, it is the purpose of this paper to add to these later panel studies by applying recent developments in panel unit-root testing and panel cointegration techniques. Our study differs from the last two studies above in a few ways. First, they considered a model that included only the real exchange rate and real output without any other policy variable in the model. Thus the panel cointegration tests could suffer from omitted variables. Second, they included the real bilateral exchange rate in their analysis. A country's currency could depreciate against one currency and appreciate against another one. A measure to capture variation in the overall value of a country's currency is the nominal effective exchange rate which we employ in our analysis in this paper. Finally, they applied the tests to data from Asian countries only. To be more comprehensive, we pool data across 18 developed countries (DCs) as one group and 24 less developed countries (LDCs) as another group, making this the most comprehensive study. To this end, in Section II we outline a model and explain the methods. In Section III we present the empirical results. Finally, a summary is provided in Section IV. Data definitions and sources are cited in an appendix.

2. The model and methodology

Our model is based upon the panel data model used by Edwards (1986a, 1989b). Edwards' model took the following form:

$$\log Y = a_0 + a_1 \log E + a_2 \log M + a_3 \log G + u \tag{1}$$

where Y is real *GDP*, E is the nominal effective exchange rate, M is a measure of the money stock and G represents government demand for non-tradables. Therefore a_1 measures the elasticity of real *GDP* with respect to the nominal exchange rate and is our main object of estimation; a_2 represents the elasticity of real GDP with respect to changes in the real money stock and is expected to have a positive sign; lastly, a_3 captures the effect of fiscal policy on output and is also expected to carry a positive sign. Note that since the exchange rate has been defined as units of foreign currency per unit of domestic currency, a negative coefficient for the exchange rate would imply that devaluations are expansionary. Since the model will be estimated using data from the current float, changes in *E* really reflect a depreciation rather than devaluation. However, the two terms are used interchangeably and include small as well as large changes in *E*.

As indicated in the introductory section, unlike previous panel studies, in order to avoid spurious results we first examine the cointegrating properties of the variables involved. Because the data are cast in a panel framework, the application of panel unit root tests and panel cointegration tests are required. The presence of cointegration would signal that there is a long-run equilibrium relationship between these variables. Once cointegration is established, the next step is to estimate (1) using appropriate panel techniques.

Panel cointegration tests are in essence an application of the Engle-Granger (1987) cointegration analysis. As indicated by Engle and Granger a set of variables, integrated of order *d*, can be considered cointegrated if the residuals from the regression of one variable on the others are integrated of an order less than *d*. Naturally, even in a panel framework, the investigation of a long run relationship begins with stationarity tests for all the variables involved. *Panel unit root* tests have been developed on the same principles that underlie the conventional ADF (Augmented Dickey Fuller) test. Their most prized feature perhaps is the degree of homogeneity that they allow. For example, while a test by Levin and Lin (1992) allowed for heterogeneity of the intercepts across members of the panel, a more recent test by Im, Pesaran, and Shin (2003) allows for heterogeneity in intercepts as well as in the slope coefficients. The Im, Pesaran, and Shin test is based on the following equation:

$$\Delta y_{it} = \mu_i + \beta_i y_{i,t-1} + \sum_{k=1}^{p_i} \theta_{i,k} \Delta y_{i,t-k} + \gamma_i t + \varepsilon_{it} \tag{2}$$

where $i = 1, 2, \ldots, N$ and $t = 1,2,\ldots,T$.

The null hypothesis is $\beta_i = 0$, for all i's, while the alternative hypothesis is $\beta_i < 0$. The Im, Pesaran, and Shin statistic is, in principle, an average of the individual ADF statistics computed as:

$$\bar{t} = \frac{1}{N} \sum_{i=1}^{N} \frac{\hat{\beta}_i}{\hat{\sigma}_{\hat{\beta}_i}} \tag{3}$$

In a further step, the above *t*-bar statistic is standardised so that it converges to a standard normal distribution, as *N* grows very large. The computation of this type of statistic, as well as the determination of the order of integration for each variable, completes the first phase of testing for cointegration.

Our test for panel cointegration is based on Pedroni (1995, 1997). Unlike the other panel cointegration tests developed to date, Pedroni has constructed a framework that allows testing for cointegration of homogeneous and heterogeneous panels with *multiple* regressors. Here, we work with two such statistics whose construction and usage is detailed below.

Following Pedroni (1999), consider the following model:

$$y_{it} = a_i + \beta_{it} + \gamma_{1i}x_{1i,t} + \gamma_{2i}x_{2i,t} + \ldots + \gamma_{Mi}x_{Mi,t} + e_{i,t} \tag{4}$$

for $i = 1, 2, \ldots, N$ cross-sections; $t = 1,2,\ldots,T$ observations; and $m = 1,2,\ldots,M$ regressors.

In the above equation, a_i represents the fixed effect or the individual-specific effect that is allowed to vary across individual cross-sectional units. At the same time, the slope coefficients gmi and the time effect β_i are modelled heterogeneously just like the intercept terms. The two statistics developed by Pedroni and adopted in this study differ in that the first is considered to be a within-dimension statistic or panel *t*-statistic, while the second is a between-dimension statistic or group *t*-statistic. Their labels are based on the way the autoregressive coefficients are manipulated to arrive at the final statistic. While the panel-*t* is constructed from estimators that pool the autoregressive coefficient across different individuals for unit root tests on the estimated residuals, the group-*t* is built on estimators that merely average the individually estimated coefficients for each *i*. As explained by Bahmani-Oskooee *et al.* (2002, p. 399) the null hypothesis is the same for both tests. However, while in the Panel-*t* test the alternative hypothesis presumes that the stationary autoregressive parameter to be homogenous, the Group-*t* test presumes it to be heterogeneous.

In constructing these statistics we need to take the following steps:

1. Upon the inclusion of all appropriate fixed effects, time trends, or common time dummies, compute the residuals $\hat{e}_{i,t}$ from the panel regression (4).

2. Compute the residuals $\hat{c}_{i,t}$ of the following differenced regression:

$$\Delta y_{it} = b_{1i}\Delta x_{1i,t} + b_{2i}\Delta x_{2i,t} + \ldots + b_{Mi}\Delta x_{Mi,t} + c_{i,t}$$

3. Compute $\hat{L}^2_{11i}$, representing the long run variance of $\hat{c}_{i,t}$ as follows:

$$\hat{L}^2_{11i} = \frac{1}{T}\sum_{t=1}^{T}\hat{c}^2_{i,t} + \frac{2}{T}\sum_{\ell=1}^{k_i}\left(1 - \frac{\ell}{k_i + 1}\right)\sum_{t=\ell+1}^{T}\hat{c}_{i,t}\hat{c}_{i,t-\ell}$$

4. Save the residuals of the ADF test for $\hat{e}_{i,t}$ as $\hat{u}_{i,t}$ and compute the following variances for these residuals:

$$\hat{s}_i^2 = \frac{1}{T}\sum_{t=1}^{T}\hat{u}^2_{i,t} \qquad \text{and} \qquad \tilde{s}^2_{N,T} = \frac{1}{N}\sum_{t=1}^{T}\hat{s}_i^2$$

As a last step, construct the final statistics:

$$Panel-t=\left[\hat{s}_{N,T}^{2}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\hat{e}_{i,t-1}^{2}\right]^{-1/2}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\hat{e}_{i,t-1}\Delta\hat{e}_{i,t}$$

$$Group-t=N^{-1/2}\sum_{i=1}^{N}\left[\sum_{t=1}^{T}\hat{s}_{i}^{2}\hat{e}_{i,t-1}^{2}\right]^{-1/2}\sum_{t=1}^{T}\hat{e}_{i,t-1}\Delta\hat{e}_{i,t}$$

The above two statistics are standardised as: $\dfrac{\chi_{N,T}-\mu\sqrt{N}}{v} \Rightarrow N(0,1)$

where $\chi_{N,T}$ represents either of the above two statistics, while μ and ν are respectively mean and variance adjustment terms.

The null of no cointegration is then tested, based on the standard normal statistic just described. Under the alternative hypothesis, these two statistics diverge to negative infinity. Hence the left tail of the normal distribution is employed to reject the null. More details about the critical values or the approximate standardisation can be found in Pedroni (1999).

3. Empirical results

Using annual data from 42 countries that span the period from 1988 to 1997, we report the results of the panel unit roots for each variable. Since the sample includes OECD and Non-OECD countries, we carry out all the tests for OECD and Non-OECD countries separately as well.[3] Since data for non-OECD but not for OECD countries could be extended to 2002, we also carry out the tests for the extended period for non-OECD countries.[4] The results are reported in table 1.

Table 1: Panel Unit Root Test Results (IPS Statistic)

	variable			
	Log Y	*Log E*	*Log M*	*Log G*
All 42 Countries (1979-1997)	8.69	-0.13	2.55	1.46
OECD Countries (1979-1997)	5.90	-0.84	0.57	-1.30
Non-OECD Countries (1979-1997)	6.38	2.13	2.88	3.06
Non-OECD Countries (1979-2002)	4.62	0.99	0.41	2.55

It is clear from table 1 that the calculated statistic for each variable and for each group is greater than the critical value of -1.96 from the standard *t*-table, indicating that the null hypothesis of non-stationarity cannot be rejected. Next we calculate the Panel-ADF and Group-ADF statistics for cointegration among the variables of equation (1) and report the results in table 2.

Table 2: Panel cointegration test results

	All Countries	OECD	Non-OECD (1979-1997)	Non-OECD (1979-2002)
Panel ADF Stat. (Standard Case)	-1.74	-3.59	-8.36	-0.20
Group ADF Stat. (Standard Case)	-5.79	-22.62	-28.85	-5.32
Panel ADF Stat. (Heterogeneous Case)	-3.98	-10.43	-11.18	-0.36
Group ADF Stat. (Heterogeneous Case)	-14.34	-46.30	-79.23	-15.0

Except for three cases, it appears that the calculated ADF statistics are much less than the critical value of -1.96 from the standard *t*-table, indicating that the null of non-stationary residuals in equation (1) is rejected or all variables are cointegrated.

Cointegration, however, does not provide information about the sign and size of coefficients in the model. To determine whether currency depreciation is contractionary, we need to estimate (1). When variables are cointegrated, the Ordinary Least Squares (OLS) method applied to the pooled data yields consistent and efficient coefficient estimates. However, to perform sensitivity analysis, we estimate the model using four different techniques. In Case 1, we apply OLS to the panel data. In Case 2, we take into consideration country-specific factors by including country dummy variables. The supposition here is that each cross-sectional unit and each time period are characterised by their own special intercept (Kmenta, 1986, page 630). In Case 3, we assume that residuals within each time period are correlated and estimate a so called random-effect model by OLS or by Maximum Likelihood Estimation (Case 4). The results for each case and for each group are reported in table 3.

Note that, as indicated before, if a decrease in E or nominal depreciation is to result in a decrease in output (Y), we would expect a positive coefficient for the Ln E variable which supports contractionary devaluation. From Table 3 we gather that except for cases 1 and 3 in the OECD sample, in all remaining cases Ln E carries a positive and significant coefficient. While in the case of OECD the impact of depreciation on domestic production is sensitive to model specification, in the case of non-OECD countries this is not the case. For the latter group, devaluation seems to be contractionary for all specifications and for both sample period. Our finding of devaluations being contractionary in the long-run (in the results for non-OECD countries) contradicts Edwards (1986a), who found that devaluations produce contractionary effects during the first year but turn expansionary in the following year; therefore, being neutral over long run. The difference should be attributed to the panel cointegration technique, which assures us that once cointegration is confirmed, a long-run relationship among the variables of concerned could be estimated.[5]

Table 3: Estimates of cointegrating vectors normalised on output

	Coefficient estimates of			
	Ln *E*	Ln *M*	Ln *G*	Adj. R^2
All 42 Countries				
Case 1	0.01 (1.30)	0.03 (7.18)	-0.01 (1.62)	0.06
Case 2	0.12 (11.2)	0.13 (16.9)	0.31 (17.3)	0.62
Case 3	0.09 (8.42)	0.14 (18.0)	0.04 (4.13)	0.52
Case 4	0.12 (11.5)	0.14 (17.7)	0.27 (14.6)	-
OECD Countries				
Case 1	-0.07 (3.46)	0.02 (4.94)	-0.01 (0.80)	0.09
Case 2	0.17 (9.09)	0.18 (12.6)	0.22 (4.97)	0.75
Case 3	-0.05 (2.10)	0.09 (11.1)	-0.01 (0.27)	0.59
Case 4	0.17 (9.12)	0.19 (15.4)	0.13 (3.10)	-
Non OECD Countries				
Case 1	0.04 (3.38)	0.06 (7.73)	-0.02 (3.48)	0.10
Case 2	0.11 (8.09)	0.13 (12.2)	0.32 (13.7)	0.60
Case 3	0.10 (6.64)	0.15 (12.6)	0.05 (3.55)	0.49
Case 4	0.11 (8.19)	0.13 (12.6)	0.28 (11.8)	-
Non OECD Countries (1979-2002)				
Case 1	0.07 (5.16)	0.06 (10.4)	0.01 (1.73)	0.19
Case 2	0.13 (13.1)	0.14 (16.9)	0.36 (16.8)	0.75
Case 3	0.16 (14.0)	0.19 (23.7)	0.06 (5.36)	0.66
Case 4	0.14 (13.5)	0.14 (17.5)	0.33 (14.7)	-

Note: Numbers inside the parentheses are the absolute values of the *t*-ratio.

4. Summary and conclusions

Currency devaluation or depreciation is said to stimulate aggregate demand by increasing its net export component. On the other hand, due to an increase in the cost of imported inputs (subsequent to devaluation), it is said to decrease aggregate supply. Thus, depending upon the extent of the shift in aggregate demand and aggregate supply, devaluation could result in a decrease or an increase in domestic production.

Most of the earlier studies estimated contractionary or expansionary effects of devaluations by employing panel data. With recent advances in panel unit root testing and panel cointegration, they suffer from a spurious regression problem that can now be corrected for. Thus, it is necessary to determine the integrating properties of each variable and the cointegrating properties of all variables in the model.

In this paper we borrow a reduced form model of output determination from the literature, in order to assess the impact of devaluation on domestic production. We improve upon the traditional approaches of the existing econometric literature on contractionary devaluation, by employing panel unit root and panel cointegration techniques. The data used are annual from 42 countries (18 OECD and 24 non-OECD) over the period 1988-97, for all countries as well as an extended period of 1988-2002 for non-OECD countries. We believe that using data from the most recent decade will render our conclusions more useful for policy analysis, as well as avoiding the regime shifts that come with longer time series. After confirming the existence of unit roots in all variables of the model, as well as cointegration among all variables, results from different specifications of the model revealed that in the long-run, devaluations are contractionary. This finding was confirmed in all model specifications for non-OECD countries as compared to OECD countries.

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APPENDIX

All data were extracted from the International Financial Statistics (IFS) of the International Monetary Fund, in CD-ROM format. The dataset contains information for 42 countries and spans the period from 1988 to 1997 with yearly observations. The following countries were included based on data availability:

OECD Countries: Australia, Austria, Belgium, Denmark, Finland, France, Greece, Iceland, Italy, Netherlands, New Zealand, Norway, Portugal, Sweden, Switzerland, United Kingdom, United States.

Non-OECD Countries: Belize, Burundi, Cameroon, Chile, Colombia, Costa Rica, Ivory Coast, Cyprus, Dominican Republic, Philippines, Saudi Arabia, Sierra Leone, Singapore, South Africa, St. Kitts And Nevis, St. Vincent & Grens., Togo, Trinidad And Tobago, Tunisia, Uganda, Uruguay, Venezuela, Zambia.

Variables:

Y = Real GDP. For each country it is expressed in index form with base year 1995.
E = Nominal Effective Exchange Rate. It is an index such that a decrease reflects depreciation of domestic currency and an increase reflects an appreciation.
M = Real money supply. M2 monetary figure is deflated by a GDP deflator (or CPI in its absence) to arrive at M. It is then set in index form.

G = Real government spending. Nominal figures are deflated by a price index (GDP deflator or CPI) to arrive at real figures. The real figures are then set in index form to make data homogenous across countries.

ENDNOTES

1. University of Wisconsin-Milwaukee (Bahmani-Oskooee) and University of Michigan-Dearborn (Miteza). E-mail: bahmani@uwm.edu The valuable comments of two anonymous referees are greatly appreciated. Any remaining errors, however, are ours.

2. In an attempt to assess the effects of devaluation on output, the literature has taken four different approaches: the 'before-after' approach; the 'control group' approach; the 'comparison-of-simulations' approach; and econometric modeling. For a comprehensive review of all four approaches, see Bahmani-Oskooee and Miteza (2003).

3. For a list of countries see the appendix.

4. The major restriction for not being able to extend the data for OECD countries beyond 1997 is that since many of them belong to euro-zone, their individual money supply figures in IFS stop in 1997.

5.N ote further that the long-run effects of fiscal and monetary variables are in line with our expectation in most cases, especially the real money supply (M) that carries a positive and highly significant coefficient in all cases.

REFERENCES

Agenor P-R (1991) 'Output, devaluation, and the real exchange rate in developing countries', *Weltwirtschaftliches Archiv*, 127, 18–41.

Bahmani-Oskooee M and Miteza I (2003) 'Are devaluations expansionary or contractionary: A survey article', *Economic Issues*, 8, 1-28.

Bahmani-Oskooee M and Rhee H-J (1997) 'Response of domestic production to depreciation in Korea: An application of Johansen's cointegration methodology', *International Economic Journal,* 11, 103-112.

Bahmani-Oskooee M (1998) 'Are devaluations contractionary in LDCs?', *Journal of Economic Development*, 23, 131-144.

Bahmani-Oskooee M, Miteza I and Nasir A B M (2002) 'The long-run relation between black market and official exchange rates: evidence from panel cointegration', *Economics Letters,* 76, 397-404.

Barbone L and Rivera-Batiz F (1987) 'Foreign capital and the contractionary impact of currency devaluation, with an application to Jamaica', *Journal of Development Economics*, 26, 1-15.

Branson W H (1986) 'Stabilization, stagflation, and investment incentives: The case of Kenya, 1979-1980 in Edwards S and Ahamed L (eds) *Economic Adjustment and exchange rates in developing countries*, Chicago.

Bruno M (1979) 'Stabilization and stagflation in a semi-industrialized economy' in Dornbusch R and Frenkel J A (eds) *International Economic Policy. Theory and Evidence*, Baltimore.

Buffie E F (1986a) 'Devaluations and imported inputs: The large economy case', *International Economic Review*, 27, 123-140.

Buffie E F (1986b) 'Devaluation, Investment and growth in LDCs', *Journal of Development Economics*, 20, 361-379.

Christopoulos D K (2004) 'Currency Devaluation and Output Growth: New Evidence from Panel Data Analysis', *Applied Economics Letters*, 11, 809-813.

Chou W L and Chao C C (2001) 'Are Currency Devaluations Effective? A Panel Unit Root Test', *Economics Letters*, 72, 19-25.

Cooper R N (1971a) 'Currency devaluation in developing countries' in Ranis G (ed) *Government and Economic Development*, New Haven: Yale University Press.

Cooper R N (1971b) 'Devaluation and aggregate demand in aid receiving countries' in Bhagwati J N et al (eds) *Trade Balance of Payments and Growth*, Amsterdam and New York: North-Holland.

Cooper R N (1971c) 'An assessment of currency devaluation in developing countries', *Essays in International Finance*, no. 86.

Copelman M and Werner A M (1996) 'The monetary transmission mechanism in Mexico', Working Paper, Federal Reserve Board.

Diaz-Alejandro C F (1963) 'A note on the impact of devaluation and the redistributive effects', *Journal of Political Economy,* 71, 577–580.

Edwards S (1986a) 'Are Devaluations Contractionary?', *The Review of Economics and Statistics*, 68, 501-508.

Edwards S (1986b) 'Terms of Trade, *Exchange Rates and Labor Markets Adjustment in Developing Countries*', NBER Working Paper No. 2110. Mass., Cambridge.

Edwards S (1989a) 'Exchange controls, devaluations, and real exchange rates: The Latin American Experience', *Economic Development and Cultural Change*, 37, 457-494.

Engle R F and Granger C W J (1987) 'Cointegration, Error Correction: Representation, Estimation, and Testing', *Econometrica*, 55, 251-276.

Gylfason T and Radetzki M (1991), 'Does devaluation make sense in the least developed countries?', *Economic Development and Cultural Change*, 40, 1-25.

Gylfason T and Risager O (1984) 'Does devaluation improve the current account?', *European Economic Review*, 25, 37-64.

Gylfason T and Schmid M (1983) 'Does devaluation cause stagflation?', *The Canadian Journal of Economics,* 25, 37-64.

Hanson J A (1983) 'Contractionary devaluation, substitution in production and consumption and the role of the labour market', *Journal of International Economics*, 14, 179-189.

Hoffmaister A W and Végh C A (1996) 'Disinflation and the recession-now-versus recession-later hypothesis: evidence from Uruguay', *IMF Staff Papers*, 43, 355-394.

Im K S, Pesaran M H and Shin Y (2003) 'Testing for unit roots in heterogeneous panels', *Journal of Econometrics*, 115, 53-74.

Islam S (1984) 'Devaluation, stabilization policies and the developing countries: A macroeconomic analysis', *Journal of Development Economics*, 14, 37-60.

Kamin S B and Klau M (1998) 'Some multi-country evidence on the effects of real exchange rates on output', Board of Governors of the Federal Reserve System International Finance Discussion Papers, Number 611.

Kamin S B and Rogers J H (1997) 'Output and the real exchange rate in developing countries: an application to Mexico', International Finance Discussion Paper No. 580, Board of Governors of the Federal Reserve System, Washington, D.C.

Khan M S (1988) 'The Macroeconomic Effects of Fund-Supported Adjustment Programs: An Empirical Assessment', IMF Working Paper, WP/88/113, Washington.

Kmenta J (1986) *Elements of Econometrics*, Macmillan Publishing Company, New York.

Krugman P and Taylor L (1978) 'Contractionary effects of devaluation', *Journal of International Economics,* 8, 445–456.

Levin A and Lin C F (1992) 'Unit root tests in panel data: asymptotic and finite sample properties', Department of Economics, University of California at San Diego, Discussion paper no. 92-93.

Morley S (1992) 'On the Effects of Devaluation During Stabilization Programs in LDCs,' *Review of Economics and Statistics*, LXXIV, 21-27.

Nunnenkamp P and Schweickert R (1990) 'Adjustment policies and economic growth in developing countries – Is devaluation contractionary?' *Weltwirtschaftliches Archiv*, 126, 474-493.

Pedroni P (1995) 'Panel cointegration: asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis', Indiana University Working Paper Number 95-013.

Pedroni P (1997) 'Panel cointegration: asymptotic and finite sample properties of pooled time series with an application to the PPP hypothesis: new results', Working paper, Indiana University.

Pedroni P (1999) 'Critical Values for Cointegration Tests in Heterogeneous Panels with Multiple Regressors', *Oxford Bulletin of Economics and Statistics*, 61, 653-670.

Rodriguez G H and Diaz Gazani G (1995) 'Fluctuaciones Macroeconomicas en la Economia Peruana. Working paper, Banco Central de Reserva del Peru.

Rogers J H and Wang P (1995) 'Output, inflation and stabilization in a small open economy: Evidence from Mexico,' *Journal of Development Economics*, 46, 271-293.

Santaella J A and Vela A E (1996). 'The 1987 Mexican disinflation program: An exchange rate-based stabilization?' *IMF Working Paper,* No. 24.

Sheehey E J (1986) 'Unanticipated inflation, devaluation and output in Latin America', *World Development,* 14, 665-671.

Solimano A (1986) 'Contractionary Devaluation in the Southern Cone: The Case of Chile' *Journal of Development Economics*, 23, 135-151.

Upadhyaya K P (1999) 'Currency Devaluation, Aggregate Output, and the Long Run: An Empirical Study', *Economics Letters,* 64, 197-202.

Van Wijnbergen S V (1986) 'Exchange Rate Management and Stabilization Policies in Developing Countries', *Journal of Development Economics*, 23, 227-247.