IS THERE A J-CURVE IN NIGERIAN AGRICULTURAL SECTOR?

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Abstract

The paper empirically tests the existence of the J-curve hypothesis using Nigerian sectoral data. The hypothesis asserts that adjustment to a disturbance in payments is not instantaneous since a certain period of time would have to elapse before variation in the exchange-rate can restore equilibrium in the trade balance. In this study the J-curve hypothesis was tested using data on the Nigerian agricultural sector. The analyzed model is a multiplier-based framework which imposes an Almon lag structure on the exchange rate regimes The empirical results indicate that the J-curve does not exist in Nigerian agricultural sector precisely in the long-run since the pattern of lag between the exchange rate depreciation and the trade balance resembles more of an asymmetric S-shape of a horizontal S.

Key words: J-curve, Nigeria, agriculture sector, S-curve, exchange rate

INTRODUCTION

One hypothesis often observed in the literature on international trade is that a country's current account *worsens* immediately after a real currency depreciation/devaluation and begins to improve after some time. This phenomenon is also dubbed the *J-curve*[1], to denote the time path of the trade balance for example, which initially decreases (deteriorates) and subsequently increases (improves) to a level higher than the one prior to the devaluation, Gandoloe (2002). Technically speaking, this short-run sharp deterioration of the trade balance is a reaction to depreciation. The reason for this sharp deterioration that follows the devaluation is that most import and export orders are placed several months in advance and are such predetermined by the previous contracts which would still be in force. Succinctly put, the J-curve occurs due to sticky domestic currency prices of exports, which are subject to medium term contracts.

The J-curve hypothesis has been empirically investigated in several studies. Some of these studies introduce adjustment lags to explain the phenomenon; and precisely by distinguishing various stages that underline the devaluation. According to Magee (1973) who first introduced the J-curve concept, these stages could be referred to as the *currency-contract period*, the *pass-through* period, and the *quantity-adjustment* period. The *currency-contract* period is the short period of time which follows ostensibly after the devaluation exercise. This short period is the immediate era that characterizes the exchange-rate variation associated with the devaluation given that there are previously made contracts before the variation occurs. The "perverse valuation" worsens the initial trade balance as domestic currency prices of imports rise. The *pass-through* period on the other hand is also a short period which corresponds to the era of contracts agreed upon immediately after the exchange rate has varied. It is the time period that follows exchange rate variation by which prices can change but with unchanged quantities due to rigidities of demand and supply of exports and imports, Gandoleo (2002). This stage may be viewed as the trough in-between the two points of inflexion (currency-contract and quantity-adjustment periods). The balance during this stage gradually improves as demand elasticities of exports and imports approach their long-run values. The *quantity-adjustment* period is the era long enough by which both prices and quantities can change. This is also predicated on the condition that should suitable conditions of the elasticities be fulfilled, then the balance of trade ought to improve following the Marshal-Lerner condition[2]. These dynamic analyses in the transition process from the old to the new equilibrium with different speed of adjustments are complex and are characterized by coefficients of the exchange rate lags. Technically, speaking the pass-through period which lies between the other periods can be likened to lie between two points of inflexion. The pass-through period starts at the point of negative turn and ends at the point of a positive turn.

The empirical literature is replete with mixed results on the J-curve hypothesis (see for example Wood, 1991; Jung and Doroodian, 1998; Bahmani-Oskooee and Brooks, 1999; Marwah and Klein, 1996; Bahmani-Oskooee and Rutha, 2007; Halicioglu, 2007). Some studies that have established the existence of J-curve effect are Lal and Lowinger (2002), Hacker and Abdulnasser (2003) and Stucka (2003); while Felmingham (1998), Rose and Yellen (1989), Gupta-Kapoor and

[1] The J-curve terminology was introduced in the late 1960s following the 1967 devaluation of the pound sterling that was followed by a trade deficit which ensured till 1970.

[2] The initial worsening of the trade balance before its eventual improvement is what is commonly described as the J-curve. The Marshall-Lerner condition asserts that for a small country, it the of import and export demand elasticities add up to more than unity, devaluation or depreciation could improve the trade balance in the long-run.

Ramakrishman (1999), Bahmani-Oskooee and Ratha (2004), Mehmet (2006) are some other examples that did not empirically find that real exchange rate has effect on trade balance.

One recent study on the effect of real exchange rate on trade balance is by Mehmet (2006) who examined the J-curve effect in the agricultural sector of Turkey. The analysis was conducted using Bahmani-Oskooee model which extended Krueger's (1983) multiplier-based model. The model imposed a lag structure on the exchange rate and also incorporated additional determinants like world income, world money and domestic money. The findings based on the quarterly data that covered the period from 1986 (I) to 1998 (III), revealed that following devaluation, Turkey's agricultural trade balance initially improves then worsens, and then improves again. This implies that J-curve effect does not exist in Turkish agricultural sector. Other previous studies like Bahmani-Oskooee and Alse (1994) using data of 41 developed and developing countries, tested for the existence of cointegration and the J-curve effect by applying the Engle-Granger two-step procedure. The results revealed that trade balance and real effective exchange rate are cointegrated for fourteen countries and some evidence of the J-curve effect exist for the set of countries whose trade balance and exchange rate are cointegrated. The implication of these studies is that the debate on the J-curve effect is still unsettled.[3]

In Nigeria, previous studies carried out on the external sector generally (e.g. Olisadebe, 1995; Egwaikhide, 1995; Egwaikhide, Chete and Falokun, 1994; Komolafe, 1996; Odusola and Akinlo, 1995; Orubu, 1988; Omotor and Jike, 2005; Omotor, 2008) and particularly on agricultural exports (e.g. Kwanashie, Ajilima and Garba, 1997; Omotor and Orubu, 2007) did neither address the theoretical issues nor the empirical evidence of the J-curve hypothesis. In order to bridge this knowledge-gap, this paper therefore modestly investigates the J-curve effect in Nigerian agricultural sector by examining how agricultural sector responds to changes in the exchange rate. The paper also performed the Granger causality test which allows for rejection or otherwise of the hypothesis that exchange rate does not Granger cause trade balance of Nigerian agricultural sector.

The expected results will not only espouse us to a better understanding of the impact of exchange rate changes on agricultural trade balance especially of Nigeria. Furthermore, they will also assist in policy design and targeting within the sector. Policy makers can use such empirical findings to (should exchange rate Granger causes agricultural trade balance or otherwise) forecast the current account and trade balance of Nigeria and by extension make exchange rate a good indicator for monetary and exchange rate policies. The rest of the paper is organized into three sections.

[3] For a comprehensive survey of the literature on the J-curve, see Bahmani-Oskooee and Ratha (2004).

MATERIALS AND METHODS

In formulating a trade balance model that establishes a direct link between the trade balance and the exchange rate dynamics, the Bahmani-Oskooee (2005) model which extends Krueger's (1983) and amplified by Mehmet (2006) is closely followed. The model is a multiplier-based framework which imposes an *Almon* lag structure on the exchange rate regimes. Other determinants included in the model are world income, world money and domestic money. The model takes the following form.

$$TB_t = a_0 + a_1 Y_t + a_2 YW_t + a_3 M_t + a_4 MW_t + \sum_{i=0}^{n} \{\beta_i (E/P)_{t-1}\} + u_t \quad (1)$$

where TBt is the agricultural trade balance defined as the ratio of imports to exports[4], Yt is domestic income, YWt is world income, Mt is the level of domestic high-powered money, MWt is level of the rest of the world high powered money, E/P is the exchange rate variable and Ut is the disturbance term. All variables are expressed in real terms.

As far as the sign expectations in equation (1) are concerned, there are no priori expectations for the parameters since they are purely empirical. For example, it is expected that the coefficient of the domestic income be negative because a rise in Nigeria's national income will lead to an increase in imports, thus causing deterioration in agricultural trade balance. However, increased domestic income could also lead to an improvement in the trade balance of Nigeria, if domestic production of importables rises faster than consumption, which retards imports volume, Magee (1973) and Mehmet (2005). It thus implies that, a1 could be negative or positive depending on whether demand side factors dominate supply side or vice versa. With respect to the sign of the domestic money coefficient, it is expected to have a negative sign. Increased domestic high-powered money may be perceived as an increase in net wealth and consequently increased spending, including imports; increased imports worsen the trade balance. However, as argued by Miles (1979) and cited in Mehmet (2006: 320), the negative derivative may not hold due to the following reasons: a) money may constitute a small fraction of the total wealth; b) money may not be perceived as net wealth, and c) increased wealth may not generate significant rise in expenditure. In pertinence to world income and world high-powered money, their coefficients are expected to have signs contrary to their domestic counterparts. Finally, one expects the coefficient attached to the real exchange rate (if it is not dynamized) to be positive if real depreciation is to increase exports and lower imports (assuming the Marshall-Lerner condition is satisfied). However, in the short-run, the J-curve hypothesis is expected to be negative. These

[4] This measure of trade balance has been applied in other studies e.g. Ardalani and Bahmani-Oskooee (2007: 2).

mix presumptions further justify the inconclusive theoretical relationship between the exchange rate and the trade balance and the need for more empirical tests.

The data set covers the period 1970–2006 for Nigeria. All the data used are originally derived from the Central Bank of Nigeria [8] and International Monetary Fund-International Financial Statistics (2007). For constructed variables, the real net trade balance of Nigeria's agricultural sector is obtained by taking the difference of agricultural exports and the imports and deflating it by GDP deflator. The data on nominal GDP deflators are price levels and all form African Development Bank.

EMPIRICAL RESULTS

In order to test for the existence and effect of the J-curve, equation (1) was estimated sequentially. Firstly, the determination of the lag length of the exchange rate via Aikaike Information Criterion (AIC) and the Shwartz Information Criterion (SIC). Both criteria reported an appropriate lag length of 9 series. Secondly, sequential F-test criterion in the determination of the degree of the polynomial (given the imposition of Almon lag structure) found it to be 2. Based on these two analyses, equation (1) was estimated. The estimated results are shown in Table 1.

As can be observed from Table 1, it is established that the literature on the J-curve was supported by the coefficients of exchange rate (current and lags) up to the fourth lag; that is, negative (contemporaneous sign) sign followed by positive signs from the sixth to the eight lag. The results of Table 1 thus show that the exchange rate coefficients were initially negative, then positive, and then negative and positive again. This implies that the Nigerian agricultural trade balance first worsens, then improves, worsens, and then improves again (at the nineth lag, it worsens again). This behaviour other than the nineth lag resembles an S-curve which is reminiscent of an earlier work on the J-curve, Backus, Kehoe and Kydland (1994: 84). Thus, this behaviour presupposes that the J-curve does not exist in Nigerian agricultural sector as some of the empirical studies suggest (for example, Mehmet, 2006 for Turkey.

As further observed from Table 1, the sum of coefficients of the exchange rate variables is negative (–2.51). This connotes that devaluation worsens the Nigerian agricultural trade balance in the long-run. Consequent upon this, it can also be expressed unequivocally that the Marshall-Lerner condition (see note 2) is not absolutely established.

Concentrating on the coefficients of the other variables in the model, domestic income for instance is positively signed and weakly significant statistically at 11 percent

Tab. 1: Estimation of results of trade balance of Nigerian agricultural sector (TBt)

	Coefficient	*t*-statistic
Exchange rate current	76 30415	(1 205249)
Lag 1	0.030861	0.0152984
Lag 2	0.101637	0.482860
Lag 3	0.100390	0.484757
Lag 4	0.217306	1.041980
Lag 5	–0.111241	–0.554500
Lag 6	0.424397	1.819970
Lag 7	0.155906	0.398924
Lag 8	0.078963	0.203958
Lag 9	–0.301924	–1.257160
Sum of lags	–2.511	
Y_t	2.466612	1.686005
YW_t	5.99	1.419732
M_t	0.933007	3.692302
MW_t	–7.923005	–2.528503

Diagnostic Tests:
(a) Adjusted R-Squared = 0.806983; (b) Durbin-Watson = 2.124926; (c) Normality (Jarque-Bera) = [0.598107];
(d) Serial correlation = [0.59]; (e) ARCH = [0. 75]

Tab. 2: Pairwise Granger causality tests

Null Hypothesis:	Obs	F-Statistic	Probability
LREXR does not Granger Cause LTB	35	0.22453	0.80022
LTB does not Granger Cause LREXR		0.59028	0.56048

level. The positive sign of the domestic income coefficient contrary to expectation signifies that increased domestic income improved trade balance of Nigerian agricultural sector. The world income level coefficient though positively signed as a priori expected, it is neither statistically significant nor did it report a contrary sign to its domestic counterpart. Money both at domestic and world level are statistically significant at 5% level. Domestic money is positively signed. The positive relationship between domestic money and the trade balance of the Nigerian agricultural sector denotes that increased domestic money did not increase agricultural imports and so, may not have retarded agricultural trade balance. The world money is negatively signed and thus contrary to its domestic counterpart as expected 'a priori'. The negative sign of world money underscores the low level of agricultural exports from developing countries including Nigeria.

The results of the diagnostic tests are reported in Panel B of Table 1. The results signify that estimation of equation (1) passes all the reported battery of tests. The estimated model is normally distributed and not serially correlated.

In Table 2, the causality test result in the spirit of Granger is presented. The test statistic indicates neither unidirectional nor bi-directional relationship between exchange rate and agricultural trade balance on Nigeria.

CONCLUSION

The J-curve describes the lag between exchange rate depreciation and the improvement in the trade balance. In this study the J-curve hypothesis was tested using data on the Nigerian agricultural sector. The empirical results indicate that the J-curve does not exist in Nigerian agricultural sector precisely in the long-run since the pattern of lag between the exchange rate depreciation and the trade balance resembles more of an asymmetric S-shape of a horizontal S (scrupulously an S-curve). The study also revealed the weak strength of Nigerian agricultural exports relative to world money. The causality test result signify that contemporaneous exchange rate devaluation does not Granger cause Nigerian agricultural trade balance. Summarily, it can be concluded with some caution that the S-curve seem to be a fairly phenomenon that describes more of the Nigerian agricultural sector relatively to exchange rate devaluation or depreciation than the J-curve.

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