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Flexible exchange rates and the J-curve: An alternative approach[☆]

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Abstract

Estimates of the J-curve that do not explicitly account for feedback effects may give misleading results. In the absence of a structural model, a VAR approach is recommended to solve this problem.

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1. Introduction

A real exchange rate devaluation is typically assumed to lead to an improvement in the trade balance after a short period of deterioration. This is referred to as the 'J-curve' effect. Theory suggests that the short-run failure of the Marshall–Lerner condition is due to contract inflexibilities and hysteresis. Accurate empirical estimation of the J-curve is important for two reasons. It provides an indirect test of the Marshall–Lerner condition, and it provides information about the length and depth of a deterioration in the trade balance following a devaluation, which is critical to trade and exchange rate policy decisions.

Since the J-curve discussion was initiated during the fixed exchange rate period the empirical techniques that were developed to estimate the J-curve effect are well suited for that period. However, in a flexible exchange rate regime the dynamics of balance of trade and exchange rate determination are more complex. This paper presents an alternative empirical approach to translating the J-curve hypothesis into econometrics in a flexible exchange rate environment.

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Empirical work on the J-curve regresses the current trade balance on its own lags as well as on contemporaneous and lagged observations of the exchange rate, domestic income and foreign income. In a fixed exchange rate environment, the coefficients associated with the lagged exchange rates can be directly interpreted as the delayed effect of a devaluation on the trade balance. Earlier studies that found evidence in favor of the J-curve effect were criticized by Rose and Yellen (1989) for using non-stationary level data on income and exchange rates. In his further studies, Rose (1990, 1991) demonstrated that the J-curve is not detectable in stationary data from the OECD, a large set of developing countries, or the United States.

Variations on OLS estimation are particularly well suited for testing the J-curve in a fixed exchange rate environment. However, in a flexible exchange rate regime, changes in the exchange rate alter the balance of trade. These changes will, in turn, affect the exchange rate and other variables, such as income, which are likely candidates to influence the position of the trade balance. Feedback effects such as these cannot be captured in the OLS regression and therefore it is not possible to directly interpret the OLS coefficients on the lagged exchange rates as the delayed effect of the exchange rate on the balance of trade. These coefficients represent the partial derivative of the balance of trade with respect to the lagged exchange rate while the quantity of interest is the total derivative. In order to test the J-curve in a flexible exchange rate environment it is necessary to specify an econometric structure that explicitly deals with feedback effects.

2. Methodology and a simple empirical example

In order to allow for feedback effects between a set of key macroeconomic variables, we suggest Sims' (1980) vector-autoregression analysis. By explicitly endogenizing all variables, this model-free method gives considerable flexibility for unrestricted reduced forms to elicit the information contained in the data.

To demonstrate the importance of explicitly incorporating a method to measure feedback effects we provide a simple empirical example. The analysis is performed on quarterly US data from 1978 to 1993 covering the flexible exchange rate period. The trade balance, income, and exchange rate can be written in terms of their own lagged values and the lagged values of all other variables. Therefore, we estimate the following nth-order vector autoregression:

$$Z_t = \alpha + \sum_{i=1}^{n} \beta_i Z_{t-i} + \sum_{j=1}^{n} \gamma_j W_{t-j} + \mu_t , \tag{1}$$

where Z_t is a (3×1) vector of stochastic processes determining the trade balance B_t, real exchange rate X_t and domestic income Y_t. Foreign income W_t is assumed exogenous although endogenizing it does not significantly alter the results.

Stationarity is achieved by transforming the raw data from the IFS. The trade balance to GDP ratio is used for B_t. The percentage change in the real effective exchange rate (defined as the real dollar value of foreign currency), real GDP, and world income (approximated by trade-weighted real GDP for the rest of the G7) are used for the other variables.

The VAR requires independent estimation of equations for the determination of B_t, Y_t and

X_t. A two-year lag structure was chosen to facilitate comparison with the existing J-curve literature, which estimates an equation very much like the VAR balance of trade determination equation (shown in Table 1). The results reported for this equation are quite similar to the results typically reported in the literature. Given the short length and volatile nature of the series, it is not surprising that (as in previous work) very few of the coefficients are statistically significant. More importantly, the signs of the coefficients do not give any indication of a J-curve. In the absence of feedback effects, a J-curve would be associated with negative coefficients on short lags of the exchange rate, and positive coefficients on longer

Table 1
VAREST//Dependent variable is B
SMPL range: 1978.2–1993.2
Number of observations: 61

Variable	Coefficient	t-statistic	2-Tail significance
$X(-1)$	0.3802365	0.1886177	0.8518
$X(-2)$	0.7303199	0.3531187	0.7266
$X(-3)$	−0.3019429	−0.1613621	0.8730
$X(-4)$	2.2884537	1.2240888	0.2311
$X(-5)$	1.7296788	0.9048873	0.3732
$X(-6)$	−0.4012860	−0.2182487	0.8288
$X(-7)$	0.0572164	0.0304633	0.9759
$X(-8)$	3.3329538	1.8309004	0.0778
$B(-1)$	0.7311213	4.0770258	0.0003
$B(-2)$	−0.0412468	−0.1849967	0.8546
$B(-3)$	0.1813186	0.8054322	0.4274
$B(-4)$	0.3526264	1.6425072	0.1117
$B(-5)$	−0.2828094	−1.2873460	0.2085
$B(-6)$	−0.0339356	−0.1400133	0.8897
$B(-7)$	−0.1696184	−0.7423024	0.4641
$B(-8)$	0.3200428	1.8017129	0.0824
$Y(-1)$	−16.135762	−2.0370628	0.0512
$Y(-2)$	− 5.1881512	−0.6440462	0.5248
$Y(-3)$	6.7679569	0.7750810	0.4448
$Y(-4)$	− 5.2347233	−0.6139875	0.5442
$Y(-5)$	6.4806290	0.7223497	0.4761
$Y(-6)$	8.6421719	0.8502504	0.4024
$Y(-7)$	−10.519387	−0.9859780	0.3326
$Y(-8)$	11.690675	1.2500046	0.2216
$W(-1)$	0.9223746	0.0381758	0.9698
$W(-2)$	16.095471	0.6236449	0.5379
$W(-3)$	27.594245	1.1591805	0.2562
$W(-4)$	−24.588160	−0.9430244	0.3537
$W(-5)$	−32.960251	−1.1985662	0.2407
$W(-6)$	14.407352	0.5248931	0.6038
$W(-7)$	−17.143720	−0.6237124	0.5379
$W(-8)$	12.919981	0.5885714	0.5609
C	0.1180731	0.2456655	0.8077

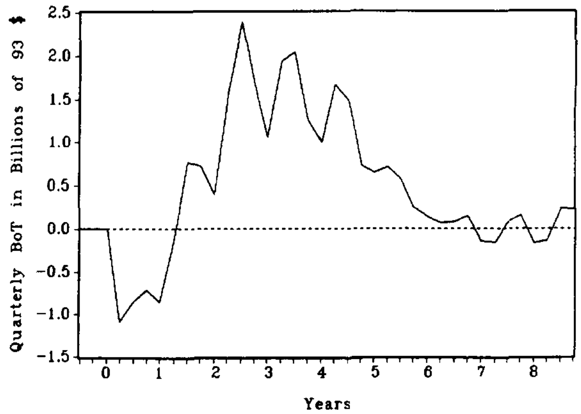

Fig. 1. Response of the trade balance to a one-time 2.5% depreciating shock.

lags. No such pattern emerges in the estimation. These coefficients represent the partial derivative of the balance of trade with respect to the lagged exchange rate.

However, when estimating the J-curve we are interested in the total derivative, which requires the estimation of feedback effects. These can be estimated by combining the estimate of the equation for balance of trade determination with the estimations of the equations for exchange rate and income determination. When this is done a different conclusion emerges. Fig. 1 presents the impulse response function for the balance of trade when the exchange rate is subjected to a one-time 2.5% depreciating shock. The result of this shock is a five-quarter negative response in the balance of trade[1] followed by a substantial and fairly long-lasting improvement in the balance of trade.

It is, of course, inappropriate and possibly misleading to put too much weight on such a simple empirical example. More detailed studies need to be undertaken before we can be confident about the existence and magnitude of a flexible exchange rate J-curve. However, this example demonstrates that feedback effects may be economically significant and can potentially alter the conclusions of empirical work.

3. Conclusion

This paper suggests an alternative approach to test the J-curve hypothesis. The OLS methodology and its variations, which are appropriate for the fixed exchange rate period, do not satisfy the theoretical need for explicitly incorporating feedback effects in the flexible exchange rate environment. Sims' VAR methodology, however, is particularly well suited to this purpose. Its reduced form approach provides a highly flexible estimation environment, which is essential in the absence of a well specified structural model. By explicitly endogeniz-

[1] This impulse response function implies that if the exchange rate is subjected to repeated depreciating shocks there would be a nine-quarter negative response in the balance of trade. This is quite similar to Mead's (1988) work with the Federal Reserve's Board of Trade Model where she uses a different technique to estimate feedback effects.

ing all variables it allows the indirect effects of exchange rate shocks on both the balance of trade and the exchange rate itself to be clearly seen in the respective impulse response functions. The simple example using US data provided in this paper demonstrates that the feedback effects may be economically significant. Therefore, explicitly incorporating these effects into future estimation is recommended.

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