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Is the J-Curve Effect Observable for Small North European Economies?

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Abstract

The present study tests for the J-curve for five North European countries—Belgium, Denmark, The Netherlands, Norway, and Sweden—using generalized impulse response functions. The results provide empirical support for the J-curve. Each country has an impulse response function generated from a vector error-correction model that suggests that after a depreciation, there will be a dip in the export-import ratio within the first half-year after the depreciation. The long-run export-import ratio appears to be higher than the low point of this early dip in almost all cases. Also, in most cases, the export-import ratio appears in many periods after the depreciation to be converging from below to a higher long-run equilibrium.

The relationship between the exchange rate and the current account is an issue of fundamental importance for macroeconomic policymakers. These policymakers are often concerned about avoiding a highly negative or highly positive current account since they wish to avoid the problems associated with inoptimal intertemporal trade situations. They are also interested in the current account since movements in it are reflected in national income. To the extent that these policymakers can influence the exchange rate, they would naturally be interested in how the use of that influence would affect the current account.

How the exchange rate affects the current account, or the trade balance to be more specific, is an issue with a long history in economics. Formally, the answer to this inquiry is based on whether a currency depreciation results in a sufficient increase in export volume and decrease in import volume (the volume effect) to overcome the increase in import prices (the import value effect).[1] If so, the trade balance rises as a result. In contrast, if the value effect is stronger than the volume effect, the trade balance diminishes. The above condition is often discussed in terms of elasticities; if the price elasticities of import and export demand in absolute terms are sufficiently high (low), then the trade balance will rise (fall) in response to currency depreciation.[2]

This issue is complicated by the fact that the price elasticities for import and export demand may be expected to change over time, resulting in the J-curve. The J-curve is a J-shaped time path of the trade balance in response to depreciation, i.e., after such an exchange rate change, the trade balance initially falls and then slowly rises, perhaps to a higher level than initially. This situation arises because import and export demand elasticities may be expected to be low initially after the exchange rate change, and higher after some time. A number of reasons could lead to the low initial elasticities. For example, it takes some time for old export and import orders to be fulfilled, and it may take some time to change input patterns in production.

The purpose of the current paper is to examine the validity of the J-curve for five small North European countries: Sweden, Norway, Denmark, Belgium, and The Netherlands. We employ a vector error-correction model to analyze the relationships between the following variables: the export-to-import ratio, the real exchange rate, domestic output or industrial production, and foreign output or industrial production. The analysis is performed in three ways: (1) with aggregate trade data on a quarterly basis (by "aggregate trade" we mean a country's trade with the rest of the world), (2) with aggregate trade data on a monthly basis, and (3) with bilateral trade data with respect to Germany (a major trading partner of all these countries) on a monthly basis. The second way is performed for all countries, but the first and third only for some countries. The smallness of these countries makes them heavily reliant upon trade and particularly sensitive to variations in trade. Their smallness also allows us to potentially take advantage of the fact that we may not expect a feedback from small country economic conditions to world GDP. Otherwise, the similar geographical situation of these countries allows for a more efficient data collection process.

Previous studies have had varying success at showing the existence of the J-curve. Rose and Yellen (1989) found no statistically reliable indications of a J-curve for the US bilateral trade with respect to the G-7 countries or for aggregate US trade. Initial testing for cointegration among their variables generally indicated none. Rose (1990) likewise found no evidence for the J-curve among some developing countries using a similar methodology. Bahmani-Oskooee and Alse (1994) considered the relationship between the import-to-export ratio and the real effective exchange rate for nineteen developed countries and twenty-two developing countries using 1971:I to 1990:IV data. In only six cases did they find evidence of cointegration—Brazil, Costa Rica, Ireland, The Netherlands, Singapore, and Turkey.[3] The data from all of these countries indicated that depreciations result in trade balance increases in the long run, except the opposite was true in the Irish case. Using an error-correction model these authors also determined that for Costa Rica, Ireland, The Netherlands, and Turkey, a depreciation results in short-run trade balance deterioration. Therefore, only for these four countries, out of forty-one studied, did they find evidence supporting the J-curve. Hsing and Savvides (1996) tested whether the trade balances of Korea and Taiwan show the J-curve effect. They examined the trade balances of each of these countries with respect to Japan, with respect to the US, and with respect to the world overall. Their estimated results generally failed to show the existence of a J-curve effect when using an unrestricted distributed lag model. However, they found some evidence for the J-curve when using the polynomial distributed lag model, most notably in the case of Korea-US trade.

In this paper, when dealing with aggregate trade data, we follow in the tradition of Gupta-Kapoor and Ramakrishnan (1999) and Lal and Lowinger (2001), who utilized vector error correction models to relate the import-to-export ratio to domestic GDP, world GDP, and the effective exchange rate (real or nominal). They examined the impulse response function showing how the import-to-export ratio reacts to changes in the effective exchange rate. Using 1975:I to 1996:IV data, Gupta-Kapoor and Ramakrishnan found indications of a J-curve for Japan. Lal and Lowinger examined the existence of the J-curve for seven East Asian countries—Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, and Thailand—using 1980 to 1998 quarterly data. They found J-curve relations in their impulse response functions for all countries except Japan, which failed to have the sign for the estimated error correction coefficient necessary for a non-explosive series and long-run equilibrium.

Considering the success of these last two studies in discovering J-curve relations, it is interesting to see if the J-curve would also be found if we used similar techniques on the small North European economies of this study. All of the countries in our study were also studied in the Bahmani-Oskooee and Alse (1994) study, and only one, The Netherlands, succeeded in showing signs of a J-curve in their study, as the rest were thrown out due to lack of cointegration. The cointegration problem of that earlier study is not a major concern, however, since five of the six East Asian countries that showed the J-curve effect in Lal and Lowinger (2001) had also failed the cointegration test of Bahmani-Oskooee and Alse (but not in the Lal and Lowinger study).

One innovation that we have in this paper methodologically is that we consider two types of data—quarterly as is done in the previously mentioned studies, and monthly. We consider monthly data since that part of the J-curve for which the value effect is stronger than the volume effect may be observable only at the monthly level. Also some of the dynamics may more appropriately fit with monthly data. The drawback of using monthly data is that it requires a proxy for domestic and worldwide GDP. For the monthly data, we use the country industrial production indices in that role.

A second methodological innovation is that we deal with a world output measure that is more appropriately weighted for trade than what we find in the studies by Gupta-Kapoor and Ramakrishnan (1999) and Lal and Lowinger (2001). This will be described more in the next section. Third, we allow for world output to act exogenously in our estimates if the data indicate it is weakly exogenous. A fourth methodological innovation is that we make use of generalized impulse response functions as developed by Pesaran and Shin (1998). Unlike the traditional impulse response functions, generalized impulse response functions do not require orthogonalization of shocks and are invariant to the ordering of the variables in the model.

The paper will be organized as follows. In the following section we present a theoretical basis for the J-curve phenomenon. After that we present a section on the empirical model and a section on the data that we use. We finish the paper with a section that presents our results and a final section that provides some concluding remarks.

1. Theoretical basis for the J-curve

To shed further light on the J-curve effect, the traditional explanation of the J-curve is presented below. In general, the trade balance TB may be written as follows

$$TB = PX_Q - EP^* M_Q, \tag{1}$$

Where X_Q is the quantity exported of a composite export good, M_Q is the quantity imported of a composite import good, P is the price per unit of the composite export good in domestic currency, P^* is the price per unit of the composite import good in foreign currency, and E is the exchange rate, defined as domestic currency per unit of foreign currency. The quantity exported should be negatively related to its price in foreign currency, P/E, and the quantity imported should be negatively related to its price in domestic currency, EP^*, due to the law of demand in both cases. Export and import quantities are also typically dependent upon domestic and foreign economic conditions. This issue shall be taken into account in the empirical model but will be ignored here for simplicity. Therefore we can write functions for X_Q and M_Q as follows:

$$X_Q = X_Q(P/E), \quad X'_Q < 0 \tag{2}$$

$$M_Q = M_Q(EP^*), \quad M'_Q < 0.^4 \tag{3}$$

When there is a depreciation (E rises), the quantity exported rises and the quantity imported drops, both of which will cause the trade balance to increase. This is referred to as the volume effect. On the other hand a depreciation makes each unit of import more expensive, which has a negative effect on the trade balance. This may be referred to as the import value effect.[5] Traditional J-curve theory claims that initially the import value effect is stronger than the volume effect, as quantities exported and imported are slow to adjust to exchange rate changes. This slow reaction in export and import quantities can come about for various reasons: (1) recognition lag (awareness in the market of the changed competitive conditions may take a while), (2) decision lag (establishment of new orders and business connections may take a while), (3) delivery lag (payment for old orders based on old prices may take a while until delivery), (4) replacement lag (replacement of used inventories or out-dated equipment may take a while), and (5) production lag (changes in supply capacities and supply patterns may take a while, due to it taking time for suppliers to be convinced that the changed conditions are sufficiently large and long-lasting to justify the changes) (Junz and Rhomberg, 1973). Over time, the volume effect becomes stronger, and may (with a traditional J-curve) overcome the import value effect. Thus the trade balance drops in response to depreciation, and then rises in reaction to the strengthening volume effect.

Slow exchange rate pass-through complicates the story further. Suppose that frictions to international trade are sufficient to allow deviations from purchasing power parity, at least in the short run. In reaction to exchange rate changes, producers may not immediately change the foreign currency price on products they sell in a foreign country. This the producers may do because, for example, they do not wish to pass a lot of exchange rate volatility to their customers. In the extreme, this implies that when there is a depreciation, P/E and EP^* do not change. That means P increases and P^* decreases by the same percentage as E increases. The result given in Equations (1)–(3) is that X_Q and M_Q remain unchanged, as does the value of imports EP^*M_Q, but the value of exports PX_Q rises. Therefore, in the short run, we may observe in response to depreciation an increase in the trade balance.

In actuality, however, we should not expect to find in the short run perfect lack of pass-through as in this example, or the other extreme of perfectly complete pass-through. Industries will tend to vary in their degree of pass-through. Therefore, in the short run, we have two opposing forces in response to depreciation: the higher domestic currency value of imports for a given P^* puts downward pressure on the trade balance whereas slow pass-through puts upward pressure on the trade balance. Given the import value effect becomes permanent and the slow pass-through is not, we may still observe over the short-run period the trade balance dropping after an initial mild drop or after an initial mild rise. As time progresses further, the export and import volume changes put further upward pressure on the trade balance, but slow exchange rate pass-through could also further slow the adjustment of export and import quantities.

An entirely different justification for the J-curve can be found in the response of capital movements to productivity changes, as discussed in Backus, Kehoe, and Kydland (1994). Suppose a country experiences a productivity improvement. That results in a terms-of-trade deterioration for that country as its export price falls, and depreciation ensues. The productivity improvement also pulls in investment from abroad, so the country has downward pressure on its trade balance corresponding to the upward pressure on its capital account. Over time the boom in investment diminishes, so we should see the trade balance edging upwards again.

2. The empirical model

The primary relation we are interested in with this study is that between the trade balance and the real exchange rate (the real effective exchange rate or a real bilateral exchange rate). Rather than consider the usual definition of trade balance, exports minus imports, we instead look at the ratio of exports to imports. This ratio has been used in its inverse form in other empirical studies (Bahmani-Oskooee and Alse, 1994; Gupta-Kapoor and Ramakrishnan, 1999; Lal and Lowinger, 2001) and has the convenient property that it can be logged regardless of whether there is a trade surplus or not, unlike exports minus imports.

The trade balance is, of course, affected by other factors besides the real exchange rate. Most important is the size of domestic and foreign economies, as represented by national income or GDP. Textbook presentations of the affect of the size of domestic and foreign economies on trade usually emphasize demand effects: a rise in domestic national income causes a decrease in the trade balance due to higher imports, and a rise in foreign national income causes an increase in the trade balance due to higher exports (Krugman and Obstfeld, 2001). However, the size of the domestic and foreign economies can also represent supply capacities, and thereby the textbook relations may be reversed: an increase in domestic GDP may cause an increase in the trade balance due to higher exports, while an increase in foreign GDP may cause a decrease in the trade balance due to higher imports.

Due to the importance of domestic and foreign outputs to trade, we include them as our variables of interest, along with the export-to-import ratio and the real exchange rate. This is in line with Gupta-Kapoor and Ramakrishnan (1999) and Lal and Lowinger (2001).[6] As in those studies, we are interested in including feedback effects among the variables in our estimation of the effect of exchange rate movements on trade. Therefore we are interested in estimating the interactions between all four variables. The discussion of our empirical model below is based on using aggregate trade data with quarterly basis. As a result, we use the real effective exchange rate for the real exchange rate and a weighted world output measure since we are dealing with aggregate trade, and we use GDP rather than industrial production for an output measure because the quarterly frequency allows it. Modifications to use aggregate trade on a monthly basis, or bilateral data with respect to Germany on a monthly basis, are discussed subsequently.

We are interested in the linear interaction between the four variables logged to take advantage of elasticity interpretations: the logged export to import ratio, $\ln(X/M)$; the logged real effective exchange rate $\ln(REER)$, logged domestic real output, $\ln Y$; and the trade-weighted average of logged foreign output, $W \ln Y^*$. The last variable is defined as follows. Suppose Y_{ft} is the output of foreign country f at time t and α_f is a weight based upon the amount of trade between the domestic country and the foreign country, where $f \in F =$ the set of foreign countries for which data are available. The trade-weighted average of logged foreign output at time t would then be

$$W \ln Y_t^* = \sum_F \alpha_f \ln(Y_{ft}). \tag{4}$$

We avoid the alternative formulation used by Kapoor and Ramakrishnan (1999) and Lal and Lowinger (2001), where the summing and logging are reversed, i.e., $\ln(\sum_F \alpha_f Y_{ft})$, because it defeats the purpose of weighting by degree of trade. Suppose, for example, that the country of interest (the "domestic country") has an equal amount of trade with a small neighboring country and a large distant country that has much more output than the small neighboring country. With its linear relation to other logged variables, our measure implies that a 1% change in the output of either foreign country will have the same percentage effect on the other variables of interest. If $\ln(\sum_F \alpha_f Y_{ft})$ is used instead, then the percentage impact on other variables from a 1% change in the large distant country's output would be assumed to be equivalent to the percentage impact of a much larger percentage change in the small neighboring country's output. In general, estimates of elasticities using $\ln(\sum_F \alpha_f Y_{ft})$ will tend to be overly based on output variations of large economies. Note, however, that this conclusion is true only if the outputs of the various economies are measured in absolute magnitudes, not as indices. If indices are used, then our measure and the alternative one should provide very similar results.

We wish to consider the linear relations between the four variables $\ln(X/M)$, $\ln(REER)$, $\ln Y$, and $W \ln Y^*$ through a vector error correction (VEC) model of the following form:

$$\Delta Z_t = \eta + \alpha\beta' Z_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta Z_{t-i} + \varepsilon_t, \tag{5}$$

where

$Z_t = (\ln(X/M)_t, \ln(REER)_t, \ln Y_t, W \ln Y_t^*)'$ at time t,
$\eta =$ the deterministic components vector,
$\alpha =$ the speed-of-adjustment parameters matrix,
$\beta' =$ the matrix of cointegrating vectors,
$\Gamma_i =$ the matrix of coefficients,
$i =$ the lag order,
$k =$ the maximum lag order, and
$\varepsilon_t =$ the error-terms vector at time t.

Following the suggestions by Hatemi-J (2001), the lag order k is chosen carefully by application of the multivariate Schwarz (1978) and Hannan and Quinn (1979) criteria (SC and HQ respectively), the multivariate likelihood ratio test (LR), and a combination of multivariate diagnostic tests. We first estimate SC and HQ criteria. If two different lag orders are obtained we use the LR test to choose one of these lag orders. Finally we apply a series of diagnostic tests to make sure that the underlying statistical assumptions (i.e., no autocorrelations, constant variance, and normal distribution of errors) are fulfilled. If any of these assumptions is not fulfilled, we add more lags until better diagnostic results are obtained. We then determine the order of integration for each of the variables, applying Johansen's (1996) multivariate unit root tests. Multivariate tests apply the whole information in a system consisting of several variables, resulting in more efficiency in the estimated results.

If the integration orders indicate that the variables could be cointegrated, we continue with the Johansen and Juselius (1990) maximum likelihood procedure to test for cointegration. If the variables are cointegrated, we test for weak exogeneity of $W \ln Y^*$ with respect to the other variables using the Johansen (1992) maximum likelihood method. We do this because we are dealing with small domestic countries and $W \ln Y^*$ may therefore be considered exogenous, although a small country may be able to affect the output of another small country with which it heavily trades. If $W \ln Y^*$ cannot be rejected to be weakly exogenous, then we restrict the parameters within the system so that other variables cannot effect $W \ln Y^*$. Such restriction is meant to provide us with better estimates of the other parameters in the system. If $W \ln Y^*$ is found not to be weakly exogenous, no such restriction is put into place.

We follow the procedure outlined in Johansen (1988, 1991) and Johansen and Juselius (1990) to estimate the vector error correction model. To look at the possibility of the J-curve effect, we examine the generalized impulse response function (Pesaran and Shin, 1998) of $\ln(X/M)$ with respect to a one standard deviation change in $\ln(REER)$. The advantage of this procedure is that it is not sensitive to the order in which the variables are entering the model.

Our analysis for aggregate trade on a monthly basis differs from that for aggregate trade on a quarterly basis by (1) the different frequency, and (2) having industrial production used for country output (as a proxy) rather than GDP due to data availability. Our analysis for bilateral trade with Germany differs from that for aggregate trade on a quarterly basis by (1) using the bilateral export and import values rather than the aggregate ones, (2) using the real bilateral exchange rate with Germany rather than the real effective exchange rate, (3) using monthly data and again having industrial production used for country output (as a proxy) rather than GDP, and (4) using the log of Germany's industrial production index instead of $W \ln Y^*$.

3. Data

The data used for this study come primarily from the *International Statistical Yearbook* computer database compiled by DSI Data Service and Information. Within this database, the data we use comes from the IMF's *International Financial Statistics* (*IFS*) and the OECD's *Main Economic Indicators* (*MEI*).

An additional major source of data for bilateral trade analysis was *Ecowin*, a database that collects data from many sources, but the relevant ones for us are Statistics Norway, Statistics Sweden, Germany's Federal Statistical Office, and Hanson & Partners AB. We collected quarterly data for three countries—The Netherlands (1977:I to 2000:III), Norway (1978:I to 2000:III), and Sweden (1975:I to 2000:III). We collected monthly data 1976:1 to 1999:12 for aggregate trade analysis for five countries—Belgium, Denmark, The Netherlands, Norway, and Sweden. For the consideration of bilateral trade flows with respect to Germany, we collected monthly data for Norway and Sweden (1991:01 to 2000:12 in both cases), the only two countries out of the five considered that have not entered into monetary union or fixed exchange rates with the German currency.[7] We limit ourselves to the post-reunification period for Germany to avoid the problem of data incompatibility over time, but that short time period immediately limits us to using monthly data, as there is an insufficient amount of quarterly data for this period. Overall then, we have ten cases for analysis: (1) three with aggregate trade data on a quarterly basis, (2) five with aggregate trade data on a monthly basis, and (3) two with bilateral trade data with respect to Germany on a monthly basis. Some of the data we wished to use for these ten cases were only available seasonally adjusted, so we collected all data as seasonally adjusted, or when that was not possible, we collected data and seasonally adjusted it ourselves for consistency using a Census X-11 multiplicative process.

For the export-to-import ratio we collected the values of the exports and imports of goods, in domestic currency terms, from *MEI* (for aggregate trade data) or *Ecowin* (for bilateral trade data) and performed the necessary division operation. We collected real effective exchange rate data (base year 1995) from *MEI*. This variable is calculated by finding geometric averages of nominal exchange rate index variations and deflating by geometric averages of variations in consumer price indices. The averaging is based upon weights that vary according to 28 countries (OECD and East Asian) and 31 geographic markets. We invert the *MEI* real effective exchange rate variable so that our variable $REER$ is in terms of domestic currency per foreign currency, i.e., a rise in our variable represents a real depreciation of the domestic currency against the world, indicating a gain in competitiveness. The real exchange rate for each bilateral trade analysis is computed by using the domestic (Norwegian or Swedish) nominal exchange rates with Germany (domestic currency per deutschemark) and multiplying by the German consumer price index and dividing by the domestic consumer price index. These consumer price indexes and bilateral exchange rates were collected from *Ecowin*.

For domestic real output and foreign real output the data used differed depending on whether we were dealing with quarterly or monthly data. The data for foreign real output also differs whether we are analyzing aggregate trade or bilateral trade. With the quarterly data, we compiled purchasing power parity (PPP) adjusted real GDPs for fifteen OECD countries 1975:I to 2000:III using nominal GDP data from both *MEI* and *IFS*, PPP rates from the OECD Web site, and the US CPI from *MEI*.[8] These countries were Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, The Netherlands, Norway, Spain, Sweden, the UK and the USA.[9] For each domestic country we consider on a quarterly basis (The Netherlands, Norway, and Sweden) we can thus use fourteen other national GDPs to calculate the average logged foreign GDP measure, $W \ln(Y^*)$. This measure is calculated based upon the formula in Equation (4), where Y_{ft} is the PPP adjusted real GDP of country f in quarter t, and F is the set of fourteen available countries. The trade weights are calculated as

$$\alpha_f = \frac{X_f + M_f}{\sum_F (X_f + M_f)}, \tag{6}$$

where, X_f is the domestic country's value of exports to country f and M_f is the domestic country's value of imports from country f. The values for X_f and M_f are 1995 values from the IMF's *Direction of Trade Statistics, 1999*. For the domestic logged real GDP measure, $\ln Y$, we do not use the PPP adjustment; domestic real GDP we measure in domestic currency based on domestic GDP deflation. These data come from *MEI* for Norway and The Netherlands, and from the *SCB Tidseriedatabas* (*Statistics Sweden Time Series Database*) for Sweden.

GDP is not available on a monthly basis, so for our monthly data we use the industrial production indexes. The computation of the monthly $\ln Y$ measure is simply the log of the domestic industrial production index, collected from *IFS*. For the monthly aggregate trade cases we use the industrial production indexes of seventeen OECD countries (adding Greece and Ireland to the list of fifteen countries used in the quarterly data) from *IFS* to provide our measures of domestic and foreign economy sizes. For these cases we compute the monthly $W \ln Y^*$ measure with Equations (4) and (6) in similar fashion as is done for the quarterly data, with the only differences being that Y_f is the industrial production index of country f and the set F includes sixteen countries (seventeen minus the one domestic country). For bilateral trade analysis, we use the log of the German industrial production index (collected from *Ecowin*) instead of $W \ln Y^*$.

4. Results

Based on the strategy mentioned before, the lag length in the VEC model is set to three for the aggregate trade analysis using monthly data for Belgium, The Netherlands, and Sweden. For Denmark and Norway, the optimal lag length is chosen to be two for the aggregate trade analysis using monthly data. For the quarterly data, the optimal lag length is chosen to be one for Norway and two for Sweden and The Netherlands. Lag orders for the bilateral cases are three for both Norway and Sweden. We use Johansen's multivariate procedure for testing unit roots. The results show that each variable is integrated of the first degree.

Next we tested for cointegration by using the Johansen and Juselius maximum likelihood approach. There is at least one cointegrating vector in each of the ten cases we are considering.[10] Given there is evidence of cointegration in all cases, we continue to estimate a VEC model in these cases. First, we determine if the logged foreign output variable is exogenous using the Johansen procedure. The estimated results show that it can be treated as exogenous for all of the three quarterly cases (The Netherlands, Norway, and Sweden) and for the aggregate-trade monthly cases of Denmark, The Netherlands and Norway. Likewise, the estimated results indicate that in the bilateral cases of Sweden and Norway, German industrial production can be treated as exogenous. For the aggregate trade analysis of Belgium and Sweden at monthly level, the null hypothesis that logged foreign output is exogenous is rejected at the conventional significance levels.

In all cases except the aggregate-trade monthly Swedish and Belgian ones and the bilateral trade cases, we restrict the VEC model so that the influence of other variables on the logged foreign output variable is zero, due to the results of the earlier exogeneity tests. We proceed to estimate the VEC model in all ten cases. Using the VEC model estimates, we trace out generalized impulse response functions to reflect the J-curve.

Figure 1 provides a graphical presentation of the impulse response functions for the quarterly and monthly aggregate trade cases. In each of the graphs in this figure, what is shown is the response of $\ln(X/M)$ over time to the innovation of a one standard deviation increase in $\ln(REER)$, i.e., a real depreciation. To support the J-curve, we should observe a fall in the export-import ratio at some point in the short run in reaction to the real depreciation, and then we should observe an increase in the export-import ratio over time.

As we can see in Figure 1, a short-run export-import ratio drop is observed in all cases. We see that in each of the monthly cases $\ln(X/M)$ drops at some point in the first three months to its lowest level. We similarly see that in each of the quarterly cases, $\ln(X/M)$ drops to its lowest level in either the first or second quarter.

The success at observing a rising export-import ratio over time depends on how we define this. If by this statement we just mean in the long-run the export-import ratio is higher than its short-run nadir mentioned in the previous paragraph, then we do observe this in seven of the eight cases. The exception is the quarterly Netherlands case, which appears supportive of the J-curve through the fourth quarter, but after that there is a collapse in the export-import ratio. On the other hand, if observing a rising export-import ratio over time means a positive slope to the impulse response function in the later periods, then we observe this in five of the eight cases. Again, the quarterly Netherlands case is an exception, along with the Swedish monthly and quarterly cases. The Swedish monthly case shows a collapse in the export-import ratio after the fourth month, but it is not as dramatic as in the quarterly Netherlands case. The Swedish quarterly case indicates constancy in the export-import ratio after the eighth or ninth quarter, which is lower than the third quarter peak.

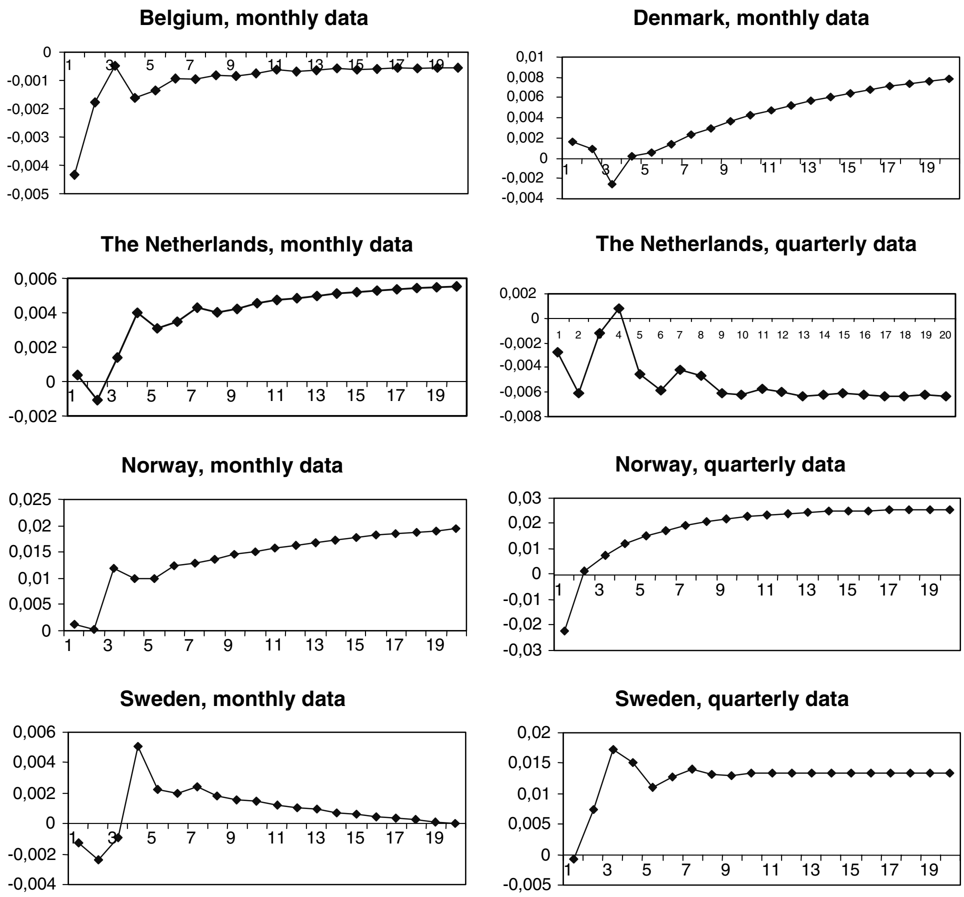

Figure 1. Generalized impulse response functions showing the effect of a one standard deviation depreciation in $\ln(REER)$ on $\ln(X/M)$, aggregate trade.

It is interesting to compare the nadir of the J-curve to that in other studies using impulse response functions from VEC models. In our results, the nadir occurs in seven of the cases in the first quarter, or first three months, and in the eighth case it occurs in the second quarter. In contrast, Lal and Lowinger (2001) found in their J-curves for six East Asian countries that the nadir occurred only twice in the second quarter, and in the other four cases the nadir was somewhere in the fourth to seventh quarters. Likewise, Gupta-Kapoor and Ramakrishnan (1999) found the nadir for their J-curve plot for Japan was in the fourth quarter. One may speculate why there appears to be a quicker upturn for the small North European economies. Perhaps it is due to better communication and lower transportation costs with other countries in the region, allowing the volume effect to make its presence felt sooner.

In five of eight cases the first response to a real depreciation is a decrease in the export-import ratio, with the other three cases showing the opposite. We conjecture that the occasional positive and slightly low negative initial responses in the export-import ratio are attributable to the struggle between the import value effect and slow exchange rate pass-through. Another interesting feature of these impulse response functions is that after the initial nadir of the J, there is very often a local peaking of the export-import ratio after one or two periods, for which the authors have no particular explanation.

The long-run response to real depreciation is also inconsistent across countries. We see that the export-import ratio increases in the long run for five cases—the monthly Denmark, Netherlands, and Norway cases, and the quarterly Norway and Sweden cases. In the monthly Belgium case, the export-import ratio converges to a small negative value. For The Netherlands and Sweden we see dramatic differences in the long-run responses to real depreciation in the quarterly and monthly cases. In The Netherlands, the long-run response is positive using monthly data but negative using quarterly. In contrast, Sweden's long-run convergence to a slight negative value using monthly data (by period 24, not shown in the diagram) does not match its convergence to a positive value using quarterly data. For the quarterly cases of Sweden and The Netherlands we also computed some impulse response functions based on industrial production rather than GDP. We did this to check whether the use of different output variables matters.[11] Our results, which are not presented here but are available on request from the authors, are that the impulse response functions do not change very much when using industrial production data rather than GDP. Therefore, given the difference in the monthly and quarterly impulse response functions for Sweden and The Netherlands, it appears that frequency is important in generating their impulse response functions. This may be due to important lag effects occurring at the monthly level that are not recognized using quarterly data.

Figure 2 presents the impulse response functions for Norway and Sweden from our bilateral trade analysis. We see in the Norwegian case that the impulse response function starts with early fluctuation and more frequent negative values than later, and then converges to a positive value. This appears supportive

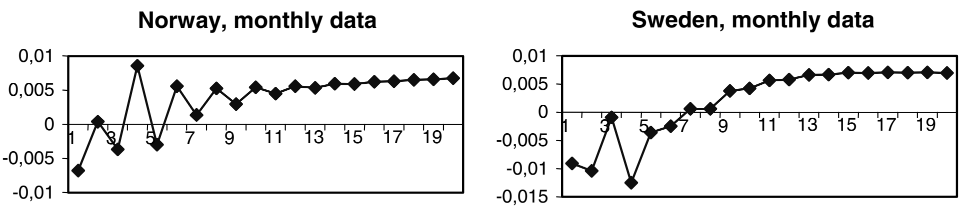

Figure 2. Generalized impulse response functions showing the effect of a one standard deviation depreciation in the log of the real bilateral exchange rate on the log of the bilateral export-to-import ratio, with respect to Germany.

of the existence of a J-curve. In comparison to the monthly data impulse response function for Norway in Figure 1, the value effect seems stronger and there is more early fluctuation. In the case of Sweden, the impulse response function starts with negative values immediately after a real depreciation, with some fluctuation, and then converges to a positive value. This again appears to support the J-curve hypothesis. This is more supportive of the traditional J-curve than in Figure 1 when we used aggregate trade for Sweden on a monthly basis, since here at least we see the convergence to a positive value.

5. Conclusions

In this paper, we have presented empirical evidence that appears rather supportive of the J-curve phenomenon for Belgium, Denmark, The Netherlands, Norway, and Sweden. In generating these results, careful consideration was made of optimal lag length and other time series properties of the data set. Using generalized impulse response functions derived from a vector error correction model, we investigate the phenomenon with respect to aggregate trade for each of these countries based on monthly data and, for the latter three countries, quarterly data. We also investigate the phenomenon with respect to bilateral trade with Germany for Norway and Sweden, giving us a total of ten cases. Each country has an impulse response function that suggests that after a depreciation, there will be a dip in the export-import ratio within the first half-year after the depreciation (although not necessarily to a lower level than initially). The long-run export-import ratio appears to be higher than the low point of this early dip in all but one case. Also, in seven of the ten cases, the export-import ratio appears in many periods after the depreciation to be converging from below to a higher long-run equilibrium.

What is likely to be of interest to policymakers is whether the early dip in the export-import ratio after a depreciation is sufficient to pull the export-import ratio below its initial level in the short run. In all but one of the ten cases, we do see this happening. Policymakers will naturally be interested in the long run effect of depreciation on the export-import ratio also. Here our results are less consistent, but in most cases (seven of ten) the export-import ratio improves.

Notes

1. In this paper, a distinction shall not be made between depreciation and devaluation, so the term depreciation will be used to refer to either. Likewise, appreciation will be used to refer to either appreciation or revaluation.
2. If the trade balance is equal to zero initially and there are infinite supply elasticities, “sufficiently high” means the Marshall-Lerner condition is met: the price elasticities (in absolute terms) of import and export demand sum to greater than one.
3. Mexico also had mixed indications cointegration (as did Turkey, actually), but they did not examine it further.
4. The above algebraic presentation is similar to that found in Caves, Frankel, and Jones (1999).
5. The terms “volume effect” and “value effect” are from Krugman and Obstfeld (2001).

6. Gupta-Kapoor and Ramakrishnan (1999) focused in their study on having all of their variables in nominal terms, however, so they dealt primarily with the nominal effective exchange rate rather than the real effective exchange rate. They also had some results using all real variables, but they did not present them in detail in their article.
7. Germany is the main trading partner for Sweden on both exports and imports. For Norway, Germany is the second-largest importer of Norwegian goods (behind the UK) and Germany is the second-largest exporter of goods to Norway (behind Sweden). We choose to focus on Norway's trade with Germany rather Norway's trade with the UK (the country with which Norway has the greatest value of exports plus imports) since Norway's trade with Germany is more balanced.
8. PPP conversion rates were available from the OECD only on an annual basis. Quarterly PPP conversion rates were imputed using the annual data along with data on quarterly ratios between non-seasonally adjusted US and domestic price indices, and then the resulting series was seasonally adjusted.
9. Data for quarterly nominal GDP values were not available for Denmark prior to 1987:I, The Netherlands prior to 1977:I, and Belgium prior to 1985:I. Quarterly values for these three countries' missing periods were imputed using yearly values from the year 2000 hardcopy version of the IMF's *International Financial Statistics* and regressions of how quarterly movements in these countries' GDP were related to such movements in the UK, Germany, and France. For Denmark we also used quarterly real GDP from the OECD's *Quarterly National Accounts* and a real value added deflator from *IFS* in imputing nominal values for 1977:I–1986:IV. The quarterly GDP values for Sweden go back only as far back as 1980 using *IFS* data, but this series was extended back to 1975:I using Swedish CPI and real GDP data from the *SCB Tidseriedatabas* (*Statistics Sweden Time Series Database*).
10. The results for unit roots, exogeneity, and cointegration are not reported to save space, but they are available upon request from authors.
11. The authors are thankful to an anonymous referee for his excellent selection.

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