J-Curve Dynamics and the Marshall-Lerner Condition: Evidence from Azerbaijan

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Abstract

This paper seeks empirical evidence for the J-curve and the Marshal-Lerner condition for Azerbaijan. The results suggest that a real depreciation of the Azerbaijani Manat would cause a decline in the balance of trade in the short-run and an increase in the long-run. When including the prices of exports and imports into the analysis, the robustness test shows that the terms of trade ratio diminishes following the devaluation and does not return to its pre-depreciation level in the long-run, while the balance of trade continues to improve. This points at the presence of an underlying volume effect as the key driver of the trade balance growth. Overall, the results of this study suggest a fulfillment of the Marshall-Lerner condition criteria, indicate the existence of the J-curve, and the price and volume effects.

Keywords: Marshall-Lerner condition, Azerbaijan, J-curve, real depreciation, Manat, export and import price.

JEL Codes: F31, F41

1. Introduction

Standard economic theory suggests that a real devaluation of the domestic currency can potentially improve the trade balance. A change in the exchange rates has two effects on the flow of trade – price effect and volume effect. The price effect implies that a currency depreciation will cause imports to be more expensive and exports to appear cheaper in the short run for the domestic buyers. The balance of trade may deteriorate in the short run due to the time required for the exports and imports to adjust to the new exchange rate. Krueger (1983) has claimed that there are certain goods which have already been purchased or ordered at the time of the devaluation, and the short run is dominated by the completion of old contractual obligations. As the volume of trade begins to respond to the depreciation, it is believed that the so-called "volume effect" of currency devaluation will reverse the trade balance movement and eventually improve it. Dornbusch and Krugman (1976) argued that there would be a perverse negative response of the trade balance to currency depreciation, followed by a larger export elasticity that would improve the balance in the long run. The phenomenon of the domination of the volume effect over the price effect in the long run is the Marshall-Lerner condition. If plotted over time, the trade response graph yields a J-resembling line, thus the J-curve terminology.

Conventionally, the J-curve estimation has been estimated using time-series econometrics. In particular, the traditional Johansen approach to co-integration and error correction modeling (ECM) has been widely used. Gupta-Kapoor and Ramakrishnan (1999) estimated the J-curve for Japan employing the Johansen-Juselius method. Bahmani-Oskooee an Alse (1994) studied the relationship between the trade balances and the real effective exchange rate (REER) for many countries using the error correction methodology. Halicioglu (2008) examined the Turkish J-curve with the Pesaran's autoregressive-distributed lag model (ARDL). The Engel-Granger approach has also been used by various researchers. The majority of studies have employed aggregated data. Beginning with Rose and Yellen (1989), however, there has been a rise in disaggregated, or bilateral, estimation. Some of the more recent J-curve studies include Onafowora (2003), Hacker and Hatemi (2004), Narayan (2004), Moura and Da Silva (2005), Bahmani-Oskooee *et al*. (2006). For a thorough literature review, consult Bahmani-Oskooee and Ratha (2004) who provide a very extensive analysis on the J-curve literature from 37 articles for the 1973-2003 period.

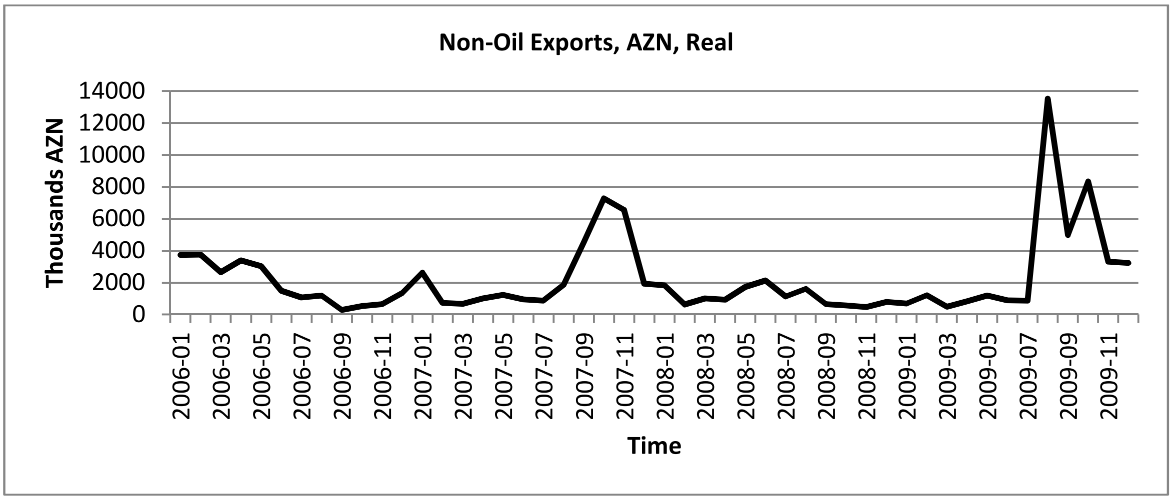
The main motivation for undertaking this research study is that no empirical work on the Azerbaijani J-curve has been done before. The case of Azerbaijan is particularly interesting because the country experienced an export-driven economic boom in the mid-late 2000s when the nation was growing at a double-digit rate. The national currency, manat, was steadily appreciating during the late 2000s while oil-dominated exports were rising at the same time. For this very reason only the non-oil segment of the country's total exports will be examined, since the oil component, which puts exogenous pressure on the domestic currency to appreciate, would have an exactly opposite, or inverse, relationship with the exchange rate. Overall, establishing a relationship between the Azerbaijani trade balance and the Manat would carry practical significance for the nation's conduct of monetary policy, as well as shed light on the peculiar events of the past half-decade.

The focus of this paper is to establish a connection between the trade dynamics of Azerbaijan with the Euro zone (Euro-17) during the 2006:01-2009:12 time interval. The expectation is that there exists a long-run relationship between the trade balance of Azerbaijan, which is represented as the difference between the Azerbaijani exports to the Euro zone and the imports from the Euro zone, and the real bilateral exchange rate (RFX). A traditional trade balance model will be estimated with two equations, for exports and for imports, via the Johansen approach and a Vector Error Correction Model (VECM). Preliminary unit-root tests will be performed, and the results will be presented. The co-integration equations will present the long-run relationship between exports, imports, and the exchange rate. It is expected, for the Marshall-Lerner condition to hold, that the sum of export and import elasticity's from these two equations will exceed 1. In the end, an Impulse Response Function (IRF) will show the short-run movement of the trade balance in response to the exchange rate innovations, yielding a J-curve demonstration.

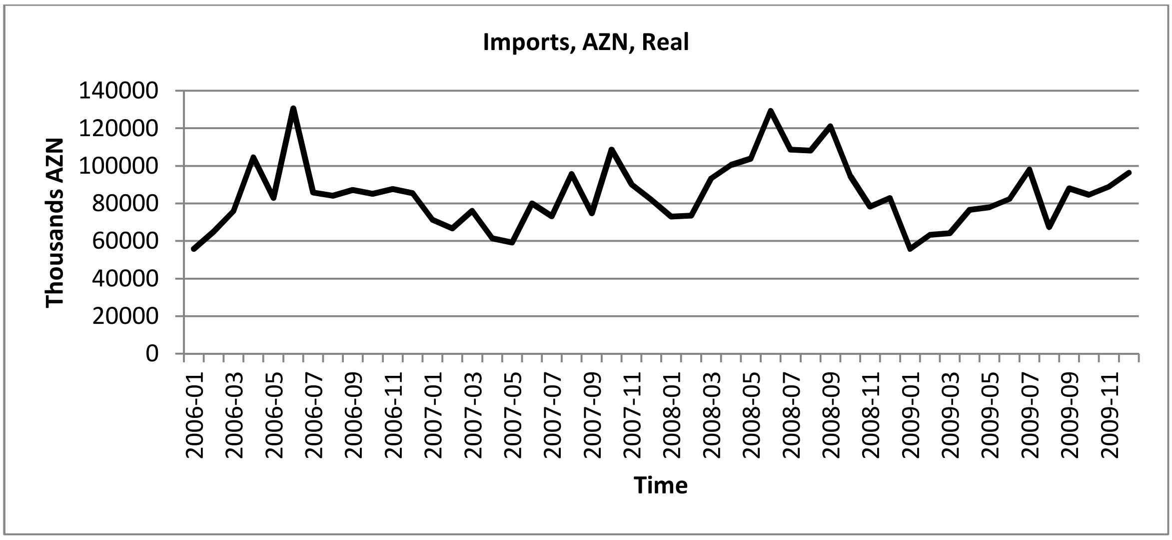
The remainder of the paper is organized as follows. Section 2 describes the data used in the study. Section 3 presents the model and methodology. Section 4 discusses the empirical results. Finally, Section 5 concludes.

2. Data

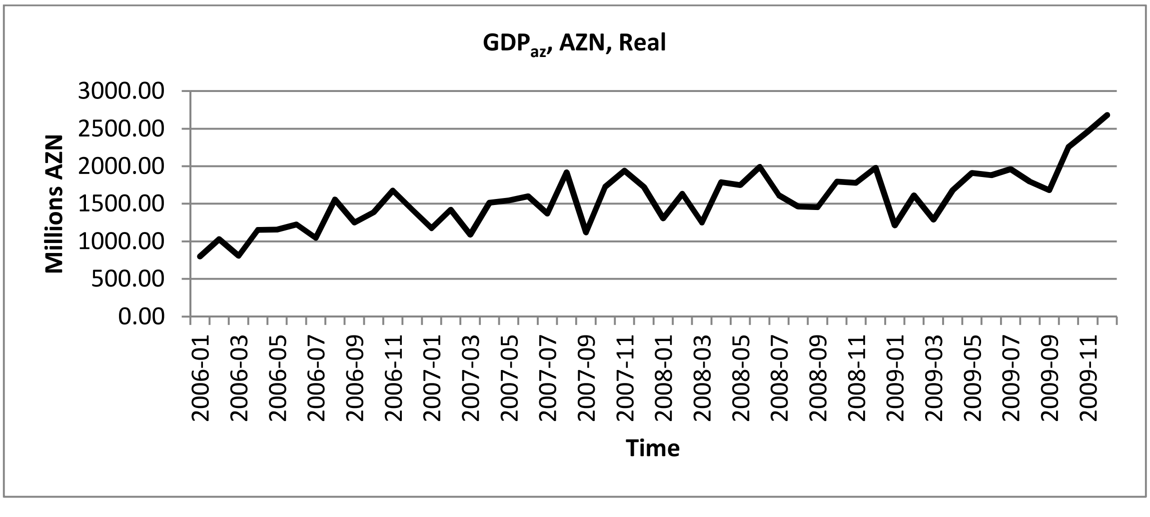
There are 5 primary variables in the model described in this study: exports (X), imports (IM), real bilateral exchange rate (RFX), domestic demand (Y_{az}), and foreign demand (Y_{eur}). Exports are Azerbaijan's non-oil exports to the Eurozone denominated in Manats. The graph below represents the over-time trend of the variable:

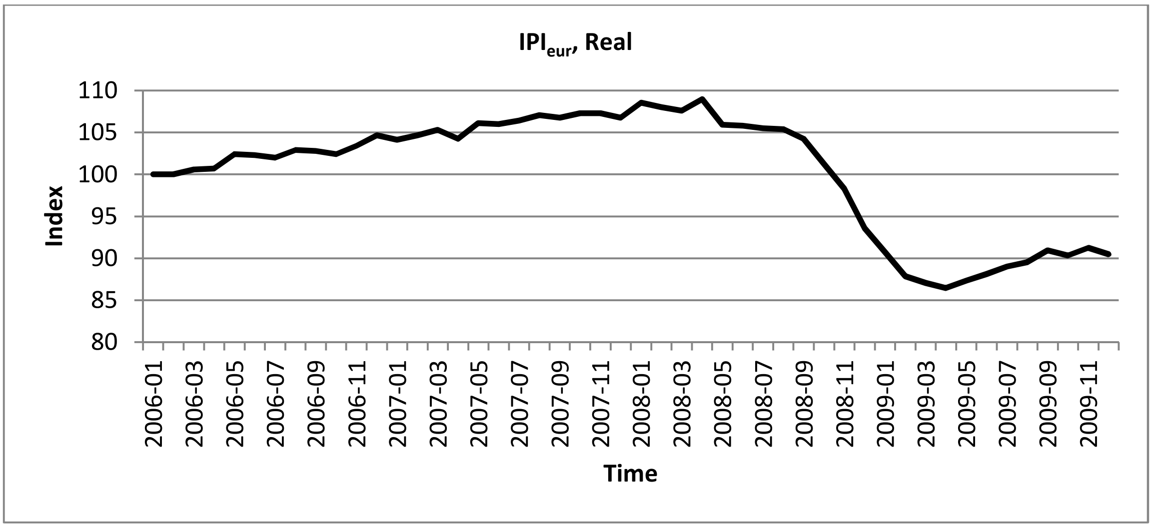


Imports are Azerbaijan's total bilateral imports from the Eurozone denominated in Manats. Again, the dynamics of the variable can be best observed in a graph:

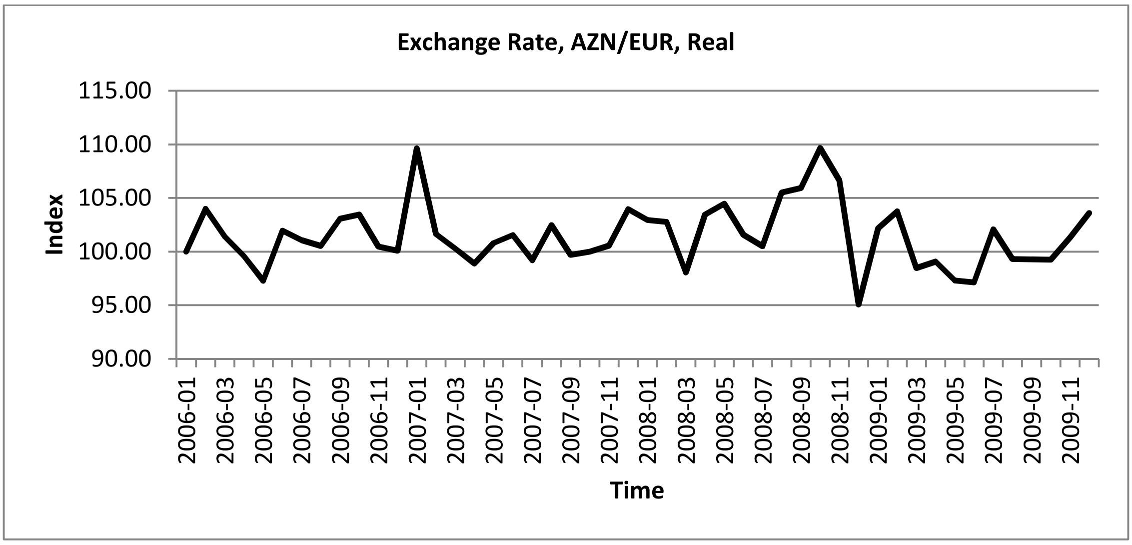


The model examined in this paper is about functions of demand, domestic and foreign. Based on the approaches from literature, economic reason, and availability of data, real Gross Domestic Product (Y_{az}) has been taken as a proxy for domestic – Azerbaijani – demand. It seems that real GDP is the most suitable, and also obtainable, proxy for the gross demand of a single country. Foreign demand is approximated by the Industrial Production Index (IPI) of the Eurozone (Y_{eur}). Given the nature of the trading partner, which is a composite of 15+ countries, a weighted and indexed proxy is required for demand approximation. Several literature examples have suggested using the IPI for bilateral estimation with a complex partner (Gupta-Kapoor and Ramakrishnan, 1999). Below are the graphical representations of Y_{az} and Y_{eur} changes over time. Values for the Eurozone's IPI have been reindexed, assigning 100 for January 2006 (first month in series):





The exchange rate in this study is the real bilateral exchange rate of Manat for Euro (AZN/EUR). It is said to be bilateral since it is Vis-à-vis one partner. With such definition, an increase in the exchange rate's value represents a real depreciation of the currency, since more Manats can now be exchanged for the same amount of Euros. The exchange rate has been accounted for inflation; it's adjusted by the consumer price index quotient. The numbers have been normalized by assigning 100 to the January 2006 value (first month in series). Below is the graph of the over time variation in the exchange rate:



The numbers for exports and imports were taken from the Institute for Fiscal Studies (IFS). Real GDP of Azerbaijan and the real bilateral exchange rate were taken from the Central Bank of Azerbaijan statistical database. Eurozone's IPI comes from EUROSTAT. All the variables are real, and in a monthly format. The share of the Eurozone accounts for approximately 50% of Azerbaijan's aggregate foreign trade.

3. Methodology

The trade balance model employed in this study is estimated by the following long-run – co-integrating – reduced form equations:

$$\ln(X_t) = \alpha_0 + \beta_x(RFX_t) + \beta_{eur}(\ln Y_{eur}) + \varepsilon_t \qquad (1)$$

$$\ln(IM_t) = \alpha_0 + \beta_{im}(RFX_t) + \beta_{az}(\ln Y_{az}) + \varepsilon_t \qquad (2)$$

where, ln is the natural logarithm, X and IM are the values of non-oil exports and imports respectively, RFX is the real bilateral exchange rate, Y_{eur} is the Industrial Production Index of the Eurozone, Y_{az} is the real GDP of Azerbaijan, and ε_t is the error term. Based on the above definitions, an increase in the value of RFX would mean a depreciation of the manat. It is *a priori* expected that the signs of export and import elasticity's (β_x and β_{im}) will be positive and negative respectively. A positive sign for the foreign or domestic production coefficient (Y_{eur} and Y_{az}) would mean that Azerbaijani exports, or imports, are demand driven. The Marshall-Lerner condition will hold if the sum of the export and import elasticity's exceeds 1.

As a brief theoretical note, a partial derivative of the balance of trade with respect to the exchange rate would show a direct impact of the depreciation. However, a one-time movement in the exchange rate will affect not only the trade balance, exports, or imports, but also the future exchange rate, which in turn will carry an additional effect on the trade aggregates, etc. It is important to account for these feedback effects to estimate the trade balance model correctly. Therefore, an econometric method of vector auto regressions (VAR), not a conventional OLS, should be employed. A VAR model and an impulse response function would take the feedback effects into account.

In the preliminary stage, a set of unit-root tests must be carried out to ensure that at least two of the variables in each of the two long-run equations has a unit root. It's foremost important for a model to carry sound economic relevance, and not merely to satisfy specific econometric properties. Should a variable have a unit root in the level form, stationary is obtained usually by first-differencing. Such variable is said to be I(1) in first differences. Co-integration, a key element of this process, is established if the variables are individually I(1), or at least two or more of them are. See Hansen and Juselius (1995:1) for a thorough description of the co-integration procedure.

Further, a VAR in the level form is estimated for the export and for the import equations separately. The VAR in this paper is in the following format:

$$Z_t=A_1Z_{t-1} + A_2Z_{t-2} + \ldots + A_pZ_{t-p} + BX_t + e_t \qquad (3)$$

where, Z is a vector of n non-stationary variables, X – vector of deterministic variables; e – vector of innovations.

The preliminary VARs are required to check the correct number of lags in the model, to ensure that there is no autocorrelation in the error terms, and that the residuals follow the pattern of a normal distribution. With the right number of lags, a Johansen Co-integration test is performed to determine the number of co-integrating equations. A Vector Error Correction Model (VECM) is then estimated with the previously obtained number of lags, which will present the long-run co integration forms for the export and for the import equations. For this paper, the following VECM specification is used:

$$\Delta Z_t=\mu_t + \sum_j\gamma_j\Delta Z_{t-j} + \prod X_{t-1} + u_t \qquad (4)$$

where, Zt is a vector of endogenous variables, μ_t – deterministic component, γ_j – matrix of coefficients, $\prod=\alpha\beta'$, where α is the parameter of speed adjustment, and β' is the vector of co integration, u_t – matrix of residuals.

Finally, IRFs of the exports and imports will demonstrate the short-run dynamics of the two aggregates, while an IRF on the trade balance (X-IM) will capture the J-curve phenomenon.

4. Empirical Results

Unit Root Tests

On each variable in the model the Augmented Dickey Fuller, the Phillips-Perron, and the KPSS unit root tests were performed. The Akaike Info Criterion was chosen for lag selection. The results of the tests are presented below in Table 1.

Table 1: Unit Root Test Results

Variable|Test	Augmented DF (P-values)	Phillips-Perron (P-values)	KPSS (LM-Statistic)	Conclusion
lnX	Level: 0.0884 First Dif.: 0.0001	Level: 0.0696 First Dif.: 0.000	Level: 0.4889 First Dif.: 0.1410	I(1)
lnIM	Level: 0.1290 First Dif.: 0.0000	Level: 0.2150 First Dif.: 0.000	Level: 0.5488 First Dif.: 0.1557	I(1)
RFX	Level: 0.000 First Dif.: 0.0000	Level: 0.000 First Dif.: 0.000	Level: 0.1006 First Dif.: 0.0308	I(0)
lnY_{az}	Level: 0.4359 First Dif.: 0.0000	Level: 0.0001 First Dif.: 0.000	Level: 0.1623 First Dif.: 0.0799	I(1)
lnY_{eur}	Level: 0.3161 First Dif.: 0.0068	Level: 0.7513 First Dif.: 0.0020	Level: 0.1936 First Dif.: 0.2239	I(1)

Based on the unit root tests' results, it is clear that each of the two demand equations has at least two I(1) variables. Therefore, the Johansen approach to estimation is applicable.

Vector Auto Regressions

When constructing the VAR models, one lag was initially selected as the starting point of analysis. Following the lag structure test, however, the export demand VAR is continued with three lags, and the import demand VAR – with two. An autocorrelation test shows no problems with error autocorrelation. Similarly, the normality test affirms that all residuals are normally distributed. Generally, problems of autocorrelation and normality can be solved by adding more lags to the system. However, our analysis proceeds without any required interventions. Results of the autocorrelation and normality tests are not presented here for brevity and are available upon request.

Vector Error Correction Models

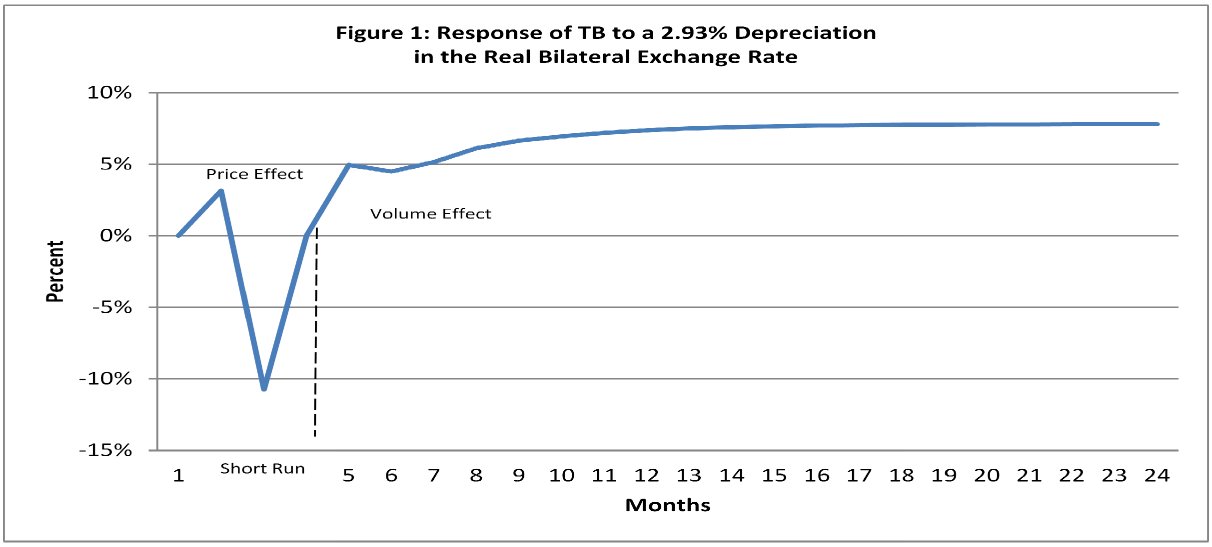
The Johansen co integration test is performed for both demand functions to reveal the number of long-run co-integrating equations. Each of the two functions has one co-integrating equation, which significantly eases the economic interpretation of the model. Further, the VEC model is estimated with the N-1 lags, where N is the number of lags in the respective preliminary VAR. Selection of deterministic elements is the following: intercept but no trend for the co-integrating equation, and no intercept for the VAR. The long-run equations are presented below:

$$\ln(X_t) = 101.57 + 1.465(RFX_t) + 11.467(\ln Y_{eur}) + \varepsilon_t \quad (5)$$

$$\ln(IM_t) = -.610 - 0.113(RFX_t) - 0.09(\ln Y_{az}) + \varepsilon_t \quad (6)$$

The proof of the Marshall-Lerner condition is thus straightforward: the sum of the export and import elasticities exceeds unity. Therefore, according to this model setup, a depreciation of Manat should improve the Azerbaijani trade balance in the long run. A combined effect of the trade balance response would be a 1.352% (1.465-0.113) improvement following a 100 basis point devaluation of the currency. The non-oil exports in Azerbaijan are significantly more sensitive to the exchange rate fluctuations than imports, as implied by the differential in the absolute values of the two elasticities. Furthermore, due to the high positive Y_{eur} coefficient, non-oil exports are said to be demand driven. Imports, on the other side, are evidently more supply dependent and demand independent, due to the very low Y_{az} coefficient. The sign of the coefficient is negative, while theory would predict it to be positive. However, the sign matters little if the value is close enough to zero, as is the case here.

The short-run dynamics of the price effect of the depreciation, as well as the output adjustment period is best visible in the combined IRF of the trade balance's response to the exchange rate innovations. The graph is presented below:



The graph suggests that the initial deterioration of the trade balance in response to a 2.93% depreciation in Manat is around 11%. The short-run effect, as indicated on the graph, lasts for about 4 months, or less than half a year. The figure is inconsistent with the conventional belief that the short-run adjustments should last for one year (Krugman, 1991:451). From month 5 onwards, the volume effect begins to set in. After approximately 1 full year, or 12 months, the trade balances reaches its long-run static condition at a 8% surplus. In theory, such rapid short-run adjustment is possible, and indeed in Azerbaijan it is common to consider one full calendar year as a sufficient adjustment period towards a long-run equilibrium. However, further analysis of the composition of the non-oil exports sector will still be necessary.

The J-curve manages to capture the response of the balance of trade to the combination of the price and volume effects. However, the two effects must be decomposed in order to demonstrate correctly the reason for the trade balance improvement in the medium-run. Either the ratio of the prices of exports to the prices of imports decreases and later returns to its pre-depreciation level, or the volume of exports grows as the price ratio stabilizes at its new below-zero equilibrium. In order to reveal the motor behind the J-curve dynamics, a new set of VEC models is built, now with two additional endogenous variables in P_x and P_{im}, which are the price indexes of non-oil exports and total imports. Thus, the new model with the trade prices takes the following theoretical format.

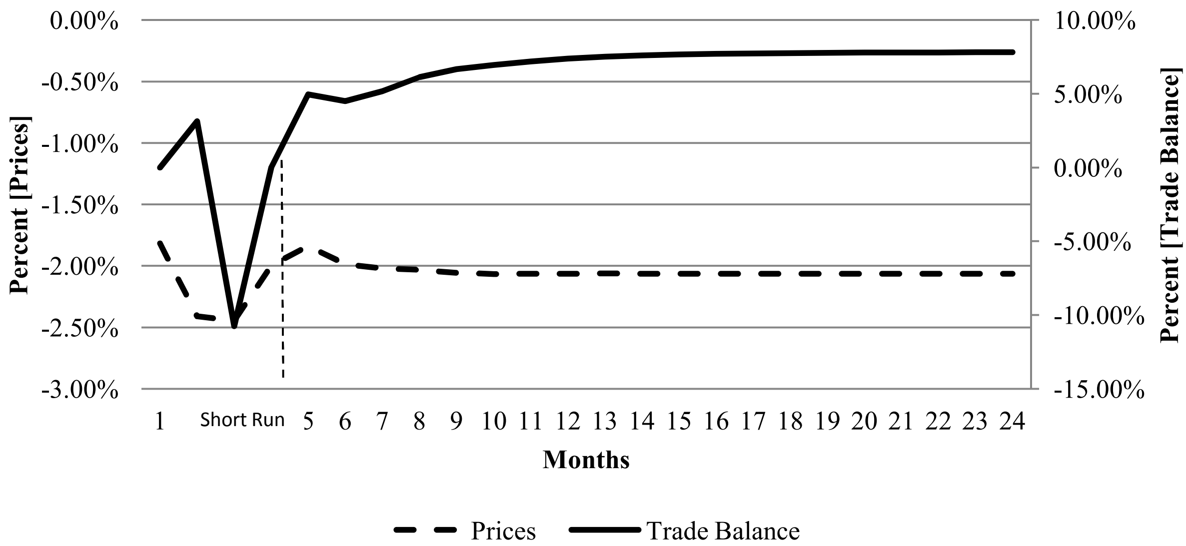
$$\ln(X_t) = \alpha_0 + \beta_x(RFX_t) + \beta_{eur}(\ln Y_{eur}) + \beta_{px}(\ln P_x) + \varepsilon_t \qquad (7)$$

$$\ln(IM_t) = \alpha_0 + \beta_{im}(RFX_t) + \beta_{pim}(\ln P_{im}) + \varepsilon_t \quad (8)$$

where P_x is the price of exports, P_{im} – price of imports, β_{px} and β_{pim} are the export and import price coefficients respectively.

There are no *a priori* sign expectations for the two price coefficients, since we do not know the long run behavior of prices and aim to find out exactly that. However, one expects the short run movement of the ratio of the two prices to be downwards. What happens from that point on is unknown. The combined IRF of the price indices' response to the exchange rate innovations, taken from the new VECMs, will shed light on the price-volume effect interplay. The IRF is presented below:

Figure 2: Response of Trade Balance and Trade Prices to a 2.93% Depreciation in the Real Bilateral Exchange Rate



In the graph above, the "prices" dashed series indicates a combined response from the exports and imports terms of trade ($P_x - P_{im}$). In the first 4 months, the trade prices and the overall balance of trade both diminish, indicating the presence of the price effect. By month 5, when the trade balance has fully recovered, the prices do not return to their pre-depreciation level, but fix at their long-run equilibrium of -2%. Meanwhile, the balance of trade continues to grow until it reaches a +8% surplus, suggesting that the quantity of non-oil exports rises in response to a cheaper Manat, due to the dominating volume effect.

On average, between 2006 and 2009 the monthly non-oil exports of Azerbaijan have amounted to AZN 2.2 million. A 2.93% depreciation of the AZN would drive that value to approximately AZN 2.35 million within a year. This requires that domestic non-oil producers are able to adjust their manufacturing volumes on average by around AZN 100K per month in the first 6 months. In particular, if the volume effect is indeed present, then non-oil exports, in months 3 and 4 following the devaluation, must rise by AZN 233K and AZN 114K respectively. Such flexibility is possible if at least two factors are present. First, the exported products are technology non-intensive enough, and producers are able to adjust production numbers quickly without much trouble. Second, export demand must be to a significant extent price elastic, so that domestic exporters can realistically expect their exports, which are cheaper post-depreciation, to be successfully sold abroad.

With regards to the first factor, the largest non-oil-related export industries in Azerbaijan are edible fruit, animal products, sugars, floating structures, articles of iron and steel, plastics, and edible vegetables (ITC). Most of the names listed should have an elastic-enough supply side in the short-medium run to allow for a quick start of the volume readjustment.

The second factor requires medium-run demand elasticity with respect to a currency devaluation. In other words, foreign consumers must perform an effective switch of preferences from their domestic goods to foreign imports – Azerbaijani exports. Since it generally takes time for the public to evaluate consumption options and make an informed purchasing decision, demand is typically inelastic in the short-run. Thus the worsening of the trade balance. However, as demand elasticity grows with time, a key assumption behind the Marshall-Lerner condition, the balance of trade improves. As proven by the signs in the co-integrating equations presented earlier, Azerbaijani non-oil export demand is elastic in the long-run.

One of the assumptions of the J-curve theory is that the balance of trade is equal to zero at the time of the devaluation. Should a deficit or surplus exist, however, as is often the case with the majority of countries, the analysis gets more complicated. In particular, it is more difficult to deduce concrete policy-relevant alternatives for action. In principle, the intention to depreciate the currency in order to improve the current account has logic if the nation carries a significant trade deficit. Azerbaijan has been enjoying a trade surplus in the past years, when considering total exports. However, the non-oil component alone, which currently stands at around 5% of the total value of exports, does not balance out total imports. It's therefore difficult to extrapolate the results of this study, carried out only over the non-oil segment of Azerbaijani exports, to the general trade balance with the inclusion of the vast oil and gas industries.

Furthermore, there is an additional potential contemporaneous currency effect vis-à-vis the American dollar, in which the country's oil exports are traded. Depending on how the exchange rate fluctuations are managed, the domestic Manat can be converted to the Euro either directly or via the third currency, namely Dollar. A bilateral AZN/EUR depreciation could therefore potentially devalue the Manat with respect to the Dollar, implying an existence of additional influences on the foreign trade prices, and volumes, which could or could not reinforce the J-curve dynamic. It is thus desirable that future studies would consider an aggregated analysis with a pool of currencies, to capture the peculiarity of Azerbaijan's exchange rate management, in addition to the strictly bilateral approach presented in this paper.

5. Conclusion

This study has attempted to estimate the J-curve phenomenon for Azerbaijan through an analysis of the country's non-oil exports and total imports. The Johansen co-integration approach has been employed to measure the long-run responses of the balance of trade to currency depreciation, and an Impulse Response Function was built to analyze the short-run trade dynamics. The empirical results have indicated one long-run co-integrating equation, according to which a real devaluation causes a decrease in the trade balance in the short-run and an increase in the long-run. An additional set of models with the export and import prices was constructed to reveal the underlying reasons for the long-run improvement in the balance. The test has shown that the terms of trade ratio drops following the devaluation in parallel with the balance of trade worsening. The ratio does not return to its pre-depreciation level in the long-run, however, while the balance of trade continues to improve, suggesting an underlying presence of the volume effect. Overall, the results of this study suggest a fulfillment of the Marshall-Lerner condition criteria, indicate the existence of the J-curve pattern, as well as the price and volume effects. However, it’s necessary to augment this study with considerations for the oil-sector exports and the contemporaneous currency effects.

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