The J-Curve in Transition Economies: An Application of the ARDL Model

Salah A. Nusair

Department of Economics and Finance

Gulf University for Science and Technology

The J-Curve in Transition Economies: An Application of the ARDL Model

Abstract

This article tests for the J-curve phenomenon for seventeen transition economies using monthly data over the period January 1991 - January 2012. The method used is the conditional autoregressive distributed lag (ARDL) bounds testing approach to cointegration and error correction modeling of Pesaran et al. (2001). The method is used to examine the short-run and long-run relationships between the trade balance and the real effective exchange rate. The results suggest evidence of cointegration in all the cases. The short-run coefficient estimates suggest that there are significant positive and negative coefficients in most cases, implying that currency depreciation has short-run effects. However, these short-run effects follow the J-curve pattern only in Slovenia. These short-run effects last into the long-run only in the cases of Armenia, Georgia and Ukraine. This suggests that the J-curve phenomenon is supported for only Armenia, Georgia and Ukraine.

Keywords: J-curve; transition economies; real effective exchange rate; ARDL model; cointegration

JEL classification: F31, F41, F10

1. Introduction

The management of the exchange rate is a critical issue for economic policy, especially in transition economies. Of considerable importance to policymakers is the relationship between the exchange rate and the trade balance. In particular, policymakers are concerned about this relationship because exchange rate fluctuations are likely to change the demands for exports and imports thus, affecting the trade balance, gross domestic product, and eventually economic growth.

Economies in transition are economies which are changing from centrally planned economies into market-driven economies. The transition process started in most countries in the late 1980s and early 1990s. During this transition process, the economies faced many challenges as they moved from one system to another. These challenges are summarized by the International Monetary Funds (IMF) as the main ingredients of the transition process and include:[1]

[1] Source: http://www.imf.org/external/np/exr/ib/2000/110300.htm

- *Liberalization: the process of allowing most prices to be determined in free markets and lowering trade barriers that had shut off contact with the price structure of the world's market economies.*
- *Macroeconomic stabilization: primarily the process through which inflation is brought under control and lowered over time, after the initial burst of high inflation that follows from liberalization and the release of pent-up demand. This process requires discipline over the government budget and the growth of money and credit (that is, discipline in fiscal and monetary policy) and progress toward sustainable balance of payments.*
- *Restructuring and privatization: the processes of creating a viable financial sector and reforming the enterprises in these economies to render them capable of producing goods that could be sold in free markets and of transferring their ownership into private hands.*
- *Legal and institutional reforms: These are needed to redefine the role of the state in these economies, establish the rule of law, and introduce appropriate competition policies.*

Transition economies have undergone a period of rapid structural changes spurred by shifts in relative prices due to the liberalization process (Falk *et al*., 1996). With this process, trade barriers are lowered so as to increase trade flows and production patterns are rebuilt to become more in line with the region's comparative advantage (Falk *et al*., 1996). An important aspect of these economies is that they are relatively small, open economies, depending on exports to promote economic growth. Thus, changes and developments in their exchange rates may adversely affect their trade flows (exports and imports) and hence, economic growth and eventually, their efforts in catching-up with the European Union (EU) countries, especially for countries hoping to join the EU (Bahmani-Oskooee and Kutan, 2009).

An important stylized fact regarding the development of the exchange rates in transition economies is there initial undervaluation, misalignment and appreciation due to the transition process (Bahmani-Oskooee and Kutan, 2009). In particular, the transition process started with liberalization of markets to allow prices to be market-determined. The liberalization process was initially accompanied by very high inflation rates and real depreciation of the currencies for most of the transition economies (Papazoglou and Pentecost, 2004; Taylor and Sarno, 2001). Prior to the transition process, currencies of the transition economies were believed to be strongly over-valued and substantial currency devaluation was considered to be a necessary pre-condition to support liberalization of markets and to bring domestic prices closer to the world prices (Halpern and Wyplosz, 1997). The initial depreciation was then followed by a significant, continuing secular real appreciation (Taylor and Sarno, 2001). This behavior is clearly visible in figure 1, which shows the plots for the real effective exchange rates over the sample period examined.

[INSER FIGURE 1 HERE]

Thus, most transition economies began their transition with a sharp nominal and real depreciation of their currencies followed by real appreciation as domestic inflation exceeded subsequent nominal depreciation over the course of the transition (Brada, 1998). This trend appreciation was documented and explained by Halpern and Wyplosz (1997). Whereas for some currencies the substantial real appreciation may be partly explained as a return of the currencies to their equilibrium values following the initial depreciation, for other currencies, the continuing real appreciation of their currencies may be related to real factors as a consequence of the liberalization process. According to Halpern and Wyplosz, this trend appreciation could be due to efficiency gains and rising productivity stemming from structural reforms. This trend appreciation caused by real factors is the well-known Balassa-Samuelson effect, which states that fast-growing economies experience real currency appreciation. However, real appreciation could also be due to nominal shocks, such as fiscal and monetary policies (Barlow, 2003). At the early stage of the transition, the economies faced high and volatile inflation rates. Consequently, the economies were forced to manage their exchange rates to control inflation and to achieve domestic price stability. Therefore, interventions in exchange markets were regular and aimed at preventing or slowing down the real appreciation of the currencies (Sideris, 2006). However, at a later stage, achieving competitiveness as measured by the real exchange rate played an important role, especially for countries hoping to join the EU. Of particular importance to trade flows and competitiveness is high volatility of exchange rates. To achieve competitiveness, some countries undertook a series of official devaluations, others switched to more flexible exchange rate policies, and others established independent central banks (Bahmani-Oskooee and Kutan, 2009; Kočenda and Valachy, 2005).

Accordingly, and given the peculiar situation of their economies and the limited number of studies, examining the relationship between the exchange rate and the trade balance is a critical issue to policymakers in transition economies and hence, provides an interesting case to study. Therefore, the objective of this paper is to fill an important gap in the literature by examining the short-run and long-run effects of a real depreciation on the trade balance in 17 transition economies using the bounds testing approach to cointegration and error correction modeling of Pesaran et al. (2001). The economies are Central and East European (CEE) countries (Bulgaria, Croatia, Czech Republic, Macedonia, Hungary, Poland, Romania, Slovakia, and Slovenia), the Baltic countries (Estonia, Latvia, and Lithuania), the Commonwealth of Independent States (CIS) countries (Armenia, Georgia, Russia, and Ukraine), and China in Asia. The study uses monthly data over the period January 1991-January 2012, collected from the IMF's International Financial Statistics Online database and the Eurostat. The choice of the countries as well as the start and end dates of the sample period is based upon data availability. The data include the real effective exchange rate defined such that a decrease reflects a real depreciation of the domestic currency. The trade balance defined as the ratio of exports to imports (X/M).[2] Both exports and imports are expressed in domestic currency terms. Industrial production index is used as a measure of income. For foreign industrial production, we use the index of the EU15 comprised the following 15 countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and United Kingdom. All variables are expressed in logarithmetic forms.

The remainder of this article is organized as follows. Section two presents the theory and methodology. Section three provides literature review. Section four reports the results and Section five concludes.

2. Theory and methodology

Theoretically, changes in the exchange rate have two basic effects on the trade balance: price and volume effects. While domestic currency depreciation/devaluation increases the price of imports in domestic currency terms, it decreases the price of exports in foreign currency terms. As a result, depreciation will make imports more expensive in domestic currency terms and exports less expensive in foreign currency terms. Consequently, the price effect of currency depreciation can lead to an increase in

[2] A number of studies use this definition for the trade balance, see, for example, Magee (1973), Flemingham (1988), Marwah and Klein (1996), Baharumshah (2001), Bahmani-Oskooee and Tatchawan (2001), Bahmani-Oskooee and Goswami (2003), Hacker and Hatemi-J (2003). Other studies use the inverse of this definition, that is (M/X), see for example, Bahmani-Oskooee and Alse (1994), Bahmani-Oskooee and Brooks (1999), LaI and Lowinger (2002), Bahmani-Oskooee and Kutan (1999). It is argued that the reason for using X/M or M/X is to make the measure of trade balance unit free (Bahmani-Oskooee, 1991).

the volume of exports and a decrease in the volume of imports. However, the existence of export and import contracts that are usually made several months in advance implies that price effects will work faster than volume effects following currency depreciation (LaI and Lowinger, 2002).

Accordingly, there is a popular belief in the international economics literature that the relationship between the exchange rate and the trade balance differs between the short-run and long-run. In particular, it is widely believed that the immediate effect of currency depreciation is to lower the trade balance, but this is reversed in the long-run. In other words, following currency depreciation, the trade balance is expected to deteriorate in the short-run before it improves in the long-run, thus; producing a tilted J shape. This J shape is the popular J-curve phenomenon advanced by Magee (1973), which describes the time path of the trade balance in response to currency depreciation. This suggests that improvement in the trade balance takes place only with a delay, which describes the time lag that producers and consumers will take to adjust to the new prices. Junz and Rhomberg (1973) identify five lags between currency depreciation and its ultimate impact on the trade balance. These lags are recognition lag, decision lag, delivery lag, replacement lag and production lag.[3]

The rationale behind the J-curve is embedded in the elasticities approach to the balance of payments adjustment which focuses on the fact that the price elasticities of demand for exports and imports may be expected to change over time. In particular, these price elasticities are expected to be low in the short-run following the exchange rate change, and higher in the long-run. The low elasticities in the short-run may attributed to the existence of trade contracts that are signed several months in advance. These contracts need some time to be fulfilled, therefore, volumes of exports and imports will be less responsive to price changes in the short-run. However, with the passage of time these volumes will become more responsive to price changes as trade contracts expire and both consumers and producers adjust to price changes.

[3] The recognition lag is the time needed for the markets to realize that competitiveness conditions have changed. The decision lag occurs due to the time necessary to establish new business connections and orders. This entails building up new supplier-customer relationships that both parties are reluctant to break. The delivery lag involves the necessary time to deliver the orders after which payments are undertaken and the trade flow published. The replacement lag accounts for the replacement of inventories, outdated equipment to wear out or to be drawn down before being replaced. The production lag is the time needed to undertake modifications in supply capacities and supply patterns (Stuċka, 2004, page 9).

Empirically, the effects of currency depreciation on the trade balance are usually examined by the Marshall-Lerner condition (MLC). Countries with deficits in their trade balance are generally advised to devalue their currencies so as to improve their trade balance by making their exports less expensive in foreign currencies terms and their imports more expensive in domestic currency terms. However, the success of the devaluation depends on whether the MLC condition is satisfied. In general, for a devaluation to improve the trade balance, the MLC states that the sum of price elasticities of demand for exports and imports exceeds unity.

Theoretically, the relationship between the exchange rate and the trade balance is investigated by assuming that the domestic economy produces exportable and importable goods that are used for consumption (Dornbusch, 1980; Rose, 1990). Given this, the trade balance in domestic currency terms can be written as

$$TB = (P)(X) - (E)(P^*)(M) \qquad (1)$$

Where TB is the trade balance, $X(M)$ is the volume of exports (imports), P is the domestic price of exports in domestic currency terms, P^* is the foreign price of imports in foreign currency terms, and E is the nominal exchange rate defined as domestic currency units per one unit of the foreign currency. Moreover, the export and import demand equations can be expressed as functions of the real exchange rate, domestic and foreign income as follows

$$X = f(Q, Y^*), M = f(Q, Y) \qquad (2)$$

Where $Q = (E)(P/P^*)$ is the real exchange rate defined such that an increase in Q represents real domestic currency appreciation. Then, following the work of Rose and Yellen (1989) and Rose (1990), a country's trade balance is based on a reduced form function that depends directly on the real exchange rate, domestic and foreign incomes

$$TB = f(Q, Y, Y^*) \qquad (3)$$

To examine the relationship between the trade balance and the exchange rate, the following model is used

$$tb_{it} = \beta_{0i} + \beta_{1i}q_{it} + \beta_{2i}y_{it} + \beta_{3i}y_{it}^* + \varepsilon_{it} \qquad (4)$$

Where small case letters denote variables in logarithmetic forms. tb_{it} is the bilateral trade balance for country i with respect to the foreign country, q_{it} is the real effective exchange rate of country i, $y_{it}(y_{it}^{*})$ is the domestic (foreign) industrial production index, and ε_{it} is a random error term. The real effective exchange rate is defined such that a decrease implies real depreciation of the domestic currency.

Economic theory suggests that the volume of exports to a foreign country ought to increase when foreign income increases, and vice versa. Similarly, volume of imports from a foreign country ought to increase as domestic income rises, and vice versa. This implies that the coefficient of domestic income (β_{2i}) is expected to be negative and the coefficient of foreign income (β_{3i}) is expected to be positive. However, β_{2i} can be positive and β_{3i} can be negative if the increase in income is due to an increase in the production of import-substitute goods (Bahmani-Oskooee, 1986). The coefficient of real exchange rate (β_{1i}) could be positive or negative. If positive, it implies that a lower real exchange rate (real depreciation) would deteriorate the trade balance, but if negative, a decrease in the real exchange rate would improve the trade balance. However, according to the J-curve hypothesis, a decrease in the real exchange rate initially deteriorates the trade balance because the depreciation initially reduces the demand for the home country's exports but increases its demand for imports (Narayan, 2006). But, with the passage of time, export and import volumes adjust to price changes and the trade balance improves. Therefore, the coefficient of real exchange rate (β_{1i}) is expected to be negative. In particular, if the J-curve hypothesis holds in the data, β_{1i} would be positive in the short-run but negative in the long-run. In other words, a negative estimate for β_{1i} implies that the MLC holds, but a positive value will suggest the violation of the MLC (Bahmani-Oskooee and Wang, 2006).

Equation (4) in its present form only gives the long-run relationship among the variables because equation (4) is a long-run relationship. Since the J-curve is a short-run phenomenon, it is necessary to incorporate the short-run dynamics into the estimation. This is usually done by specifying equation (4) in an error-correction format. One popular specification is the univariate Engle and Granger (1987) representation. Another approach is the multivariate cointegration procedure of Johansen (1988) and

Johansen and Juselius (1990). However, these approaches have been subject to some criticism in the literature. For instance, the Engle and Granger procedure is based on the Augmented Dickey-Fuller unit root test, which is known to lack power in short samples and in the presence of structural breaks (see, for example, Froot and Rogoff, 1994; Perron, 1989). In addition, this procedure requires determining the dependent variable and determining the order of integration among the variables. Although the multivariate procedure of Johansen does not require determining the dependent variable, it requires pre-testing for unit root among the variables and requires all variables to be integrated of order one. Recently, Pesaran *et al.* (2001) developed a single cointegration and error correction approach, known as the bounds testing approach. According to this approach, equation (4) is estimated as a conditional autoregressive distributed lag (ARDL) model.

The advantage of using the ARDL model is that yields valid results regardless of whether the underlying variables are integrated of order one, zero, or a combination of both (Pesaran *et al.*, 2001). Enders (2004) argues that "it is possible to find equilibrium relationships among groups of variables that are integrated of different orders." Similarly, Asteriou and Hall (2007) also explains that in cases where a mix of $I(0)$, $I(1)$ and $I(2)$ variables are present in the model, cointegrating relationships might exist. Therefore, the ARDL testing approach has the advantage that the existence of a long-run relationship among a set of variables can be tested without any prior knowledge about the order of integration of the individual variables, which avoids problems associated with unit roots pre-testing. Other advantages of using this approach include that both the dependent variable and independent variables can be introduced in the model with lags. In particular, the word "autoregressive" refers to lags in the dependent variable, indicating that past values of the variable are allowed to determine its current value. The word "distributed" refers to lags in the explanatory variables, suggesting that the dependence of the dependent variable on the independent variables may or may not be instantaneous depending on the theoretical considerations. In other words, changes in economic variables may or may not lead to immediate changes in other variables. Hence, the response in economic variables may take place only with lags. Moreover, evidence shows that the ARDL estimators have desirable small sample properties and they effectively correct for potential endogeneity of the explanatory variables (see Pesaran and Shin, 1999, and Caporale and Pittis, 1999, 2004). In addition, the test remains valid for testing the existence of a long-run relationship under fractional integration and near unit root processes (Pesaran and Pesaran, 1997). Therefore, the ARDL model is considered appropriate to examine to the relationship between the exchange rate and the trade balance. To carry out bound test of Pesaran *et al.* (2001), equation (4) is estimated as a conditional autoregressive distributed lag (ARDL) model as follows

$$\Delta tb_{it} = \alpha_{0i} + \sum_{j=1}^{k} \alpha_{1ij} \Delta tb_{it-j} + \sum_{j=0}^{p} \alpha_{2ij} \Delta q_{it-j} + \sum_{j=0}^{q} \alpha_{3ij} \Delta y_{it-j} + \sum_{j=0}^{m} \alpha_{4ij} \Delta y^*_{it-j} + \alpha_{5i} tb_{it-1} + \alpha_{6i} q_{it-1} + \alpha_{7i} y_{it-1} + \alpha_{8i} y^*_{it-1} + v_{it} \quad (5)$$

The bounds testing approach involves testing the null hypothesis of no-cointegration or no long-run relationship ($\alpha_{5i} = \alpha_{6i} = \alpha_{7i} = \alpha_{8i} = 0$) against the alternative of cointegration ($\alpha_{5i} \neq \alpha_{6i} \neq \alpha_{7i} \neq \alpha_{8i} \neq 0$). Pesaran *et al.* (2001) propose an $F - test$ for these hypotheses, which has a non-standard distribution and takes into account the stationarity properties of the variables and, hence does not require pre-testing for unit root. Pesaran *et al.* (2001) compute two sets of critical values for any significance level. One set (lower values) assumes all variables are $I(0)$ and the other set (upper values) assumes that all variables are $I(1)$. This provides a band covering all possible classifications of the variables into $I(0)$ and $I(1)$ or even fractionally integrated variables. If the calculated test statistic is above the upper critical bounds value, then the null hypothesis is rejected and the variables are co-integrated. If the test statistic is below the lower critical bounds value, then the null hypothesis is not rejected and the variables are not co-integrated. If the test statistic falls within the bounds, then the test becomes inconclusive and no decision regarding cointegration can be made. If variables are cointegrated, then the short-run effect of depreciation is given by the sign and significance of α_{2ij}. In particular, the J-curve hypothesis is supported if α_{2ij} is positive for the first few lags followed by negative values. The long-run effect is given by the size and significance of α_{6i} normalized on α_{5i}.

Specification (5) is used to examine the short-run and long-run effects of currency depreciation in 17 economies in transition. The data include the real effective exchange, the domestic and foreign industrial production index as a proxy for income.

3. Literature Review

Empirical research on the relationship between the exchange rate and the trade balance has produced mixed results. Bahmani-Oskooee and Ratha (2004) provide a literature review for the J-curve related empirical papers. The authors classify the empirical studies into two groups: studies using aggregate trade data and studies using bilateral trade data. They argue that studies using aggregate trade data, such as Bahmani-Oskooee (1985), Himarios (1989), Bahmani-Oskooee (1991), Bahmani-Oskooee and Alse (1994), Demirden and Pastine (1995) and Brada *et al*. (1997) suffer from *"aggregation bias problem"*. These studies provide at best mixed results and not much evidence is found either in the short-run (the J-curve effect) or in the long-run. On the other hand, studies using bilateral trade data, such as Rose and Yellen (1989), Marwah and Klein (1996), Bahmani-Oskooee and Brooks (1999) and Bahmani-Oskooee and Goswami (2003) find favorable long-run effects of currency depreciation on the trade balance, but no strong support for the J-curve effect has been found.

Previous studies have focused mainly on developed countries and some developing countries in Asia, thus leaving economies in transition with no or very few studies. Bahmani-Oskooee and Kutan (2009) examine the short-run effect (the J-curve hypothesis) and the long-run effect (improvement in the trade balance) for 11 Eastern European countries (Bulgaria, Croatia, Cyprus, the Czech Republic, Hungary, Poland, Romania, Russia, Slovakia, Turkey and Ukraine) using bilateral monthly data over the period January 1990-June 2005 and the bound testing approach to cointegration and error correction modeling of Pesaran et al. (2001). While the authors find evidence of cointegration in all the cases, they find empirical support for the J-curve hypothesis in only Bulgaria, Croatia and Russia. Bahmani-Oskooee and Wang (2006) examine the trade balance between China and 13 of its major trading partners, using bilateral quarterly data over the period 1983Q1-2002Q1. The authors examine the short-run and long-run effects of real depreciation of the renminbi on China's trade balance using the bound test of Pesaran *et al.* (2001).

Their results reveal that a real depreciation has significant short-run effects, but does not follow the J-curve path. Moreover, they find that this depreciation has no long-run effect in most cases. Narayan (2006) examines China's trade balance with the U.S using monthly data over the period November 1979-September 2002. Using the bound test of Pesaran *et al.* (2001), the author finds that a real depreciation improves China's trade balance both in the short-run and long-run, therefore finds no evidence of the J-curve. Hacker and Hatemi-J (2004) examine the short-run and long-run effects of currency depreciation on the trade balance between the Czech Republic, Hungary, and Poland with respect to Germany, using bilateral monthly data over the period August 1993-July 2002. Using Johansen cointegration procedure, they find evidence of a positive long-run relationship between the trade balance and the exchange rate for all three countries. However, they find evidence of the J-curve effect in the Czech Republic and Poland, but not in Hungary.[4]

This paper differs from the previous studies examining the relationship between the exchange rate and the trade balance in transition economies in the following aspects. First, except for Bahmani-Oskooee and Kutan (2009), whereas these studies examine the relationship between the exchange rate and the trade balance for one or three countries, this paper examines the relationship for seventeen transition economies from the CEE, CIS, the Baltic and Asia. Second, the paper uses recent and relatively long sample from January 1991 to January 2012. Third, the paper examines the short-run and long-run effects of depreciation on the trade balance using the bounds testing approach to cointegration and error correction modeling of Pesaran *et al.* (2001).

Although Bahmani-Oskooee and Kutan (2009) examine the relationship between the exchange rate and the trade balance for 11 countries, there are two issues concerning their work, however. Their sample ended on June 2005 and contained only 11 transition economies. With more years of data, it is quite interesting to re-examine the dynamics behavior of the trade balance for transition economies and to add

[4] Égert and Morales-Zumaquero (2008) examine the impact of changes in exchange rate regimes and exchange rate volatility on exports performance ten in Central and Eastern European transition economies. They find that foreign exchange volatility can hurt exports performance and that the impacts of volatility and regime changes on exports vary across sectors and countries. Kemme and Teng (200) examine the impact of exchange rate misalignments in Poland on export growth and find that misalignments tend to reduce export growth.

more countries. In addition, Bahmani-Oskooee and Kutan use for the foreign income the industrial production index of the OECD countries. This index may not be a good proxy for foreign income for their sample countries because some of the countries in the sample are members in OECD (for example, Czech Republic, Hungary, Poland and Turkey are members in OECD). Therefore, instead of using the industrial production index of the OECD countries, this paper uses the industrial production index of the EU15, which does not include the production of any of the countries in our sample.

4. The Results

The ARDL model in specification (5) is estimated for seventeen economies in transition using monthly data over the period January 1991 – January 2012. The first step in the estimation procedure is justifying the inclusion of the lagged level variables in specification (5). This is done by carrying out an $F-test$ for the null hypothesis of no-cointegration ($\alpha_{5i} = \alpha_{6i} = \alpha_{7i} = \alpha_{8i} = 0$) against the alternative of cointegration ($\alpha_{5i} \neq \alpha_{6i} \neq \alpha_{7i} \neq \alpha_{8i} \neq 0$). However, as noted by Bahmani-Oskooee and Wang (2006) and demonstrated by Bahmani-Oskooee and Brooks (1999) and Bahmani-Oskooee and Goswami (2003), the $F-test$ is sensitive to number of lags imposed on the first-differenced variables in specification (5). To check this we impose a fixed number of lags (two, four, six, eight, ten and twelve lags) on each first-differenced variable and then carry out the $F-test$. The results, reported in table1, are indeed sensitive to the number of lags. For example, at the 10% percent significance level and the lag length is set at two, the results suggest evidence of cointegration for all but Poland and Armenia. In contrast, when the lag length is set at twelve, the results suggest evidence of cointegration in only two cases: Lithuania and Croatia. However, these results can be justified as the number of lags is being imposed randomly without using some information criterion to select the optimum number of lags. Therefore, we impose a maximum of 12 lags on each first-differenced variable and then employ Schwarz Information Criterion (SIC) and Akaike Information Criterion (AIC) procedures to select the optimum number of lags. Then, the $F-test$ is carried out at the optimum number of lags. The results, reported in table2, are indeed sensitive to the number of lags. At the 10% percent significance level the results using SIC suggest evidence of cointegration for eleven countries (Latvia, Lithuania, Bulgaria, Macedonia, Hungary, Slovakia, Slovenia, Georgia, Ukraine, Russia and China). Conversely, using AIC shows evidence of cointegration for only five countries (Estonia, Latvia, Lithuania, Hungary and Slovakia). In this paper, we use SIC to select the optimum number of lags in the ARDL model because Pesaran and Shin (1999) show, using Monte Carlo experiments, that though the ARDL-AIC and ARDL-SIC have quite similar small-sample properties, the ARDL-SIC performs slightly better in the majority of the experiments. They suggest that this may be due to the fact that SIC is a consistent model selection criterion whereas AIC is not. Hence, the SIC can be described as being more parsimonious with the lag length selection and is a consistent model selection criteria (Pesaran and Shin 1999).

[INSERT TABLE 1 HERE]

[INSERT TABLE 2 HERE]

Thus, using SIC shows evidence of cointegration for eleven out of the seventeen countries as the $F-test$ statistic is larger than its upper bound critical value at the 10% significance level. The results for Estonia, Croatia, Czech Republic, Poland, Romania, Armenia and Russia suggest that the variables are either not cointegrated (the $F-test$ statistic lower than its lower bound critical value) or no decision can be made (the $F-test$ statistic lies within the bounds). However, an alternative way to establish cointegration in specification (5) is to use the long-run estimates $(\alpha_{5i}, \alpha_{6i}, \alpha_{7i}, \alpha_{8i})$ to form an error correction term (ECM_{t-1}) and then to replace the linear combination of the lagged-level variables in specification (5) by ECM_{t-1}. Then, the model is re-estimated again using the optimum number of lags on each first-differenced variable. A negative and significant coefficient obtained for ECM_{t-1} will support cointegration among the variables (Pesaran *et al.*, 2001). The results of estimating the coefficient for ECM_{t-1} are reported in table 3, and show that it is negative and significant in all the cases, thus supporting cointegration among the variables in all the cases.

[INSERT TABLE 3 HERE]

Table 3 also presents the estimates of the short-run and long-run coefficients. As far as the J-curve phenomenon is concerned, we report only the short-run coefficient estimates for the real effective exchange rate. The J-curve phenomenon is supported if α_{2ij} is positive for the first few lags followed by negative values; that is, a decrease in the real effective exchange rate (real depreciation in the domestic currency) lowers (worsens) the trade balance. Only in the case of Slovenia the J-curve phenomenon is supported where a positive coefficient is followed by a negative one, with all coefficients significant at the 1% significance level. For the rest of the countries, there is no specific pattern for the J-curve phenomenon. Note that although we find support for J-curve for only one country, there are significant positive and negative coefficients in most cases, implying that currency depreciation in these countries has short-run effects.

In four cases (Armenia, Georgia, Russia and Ukraine), our findings suggest that a real depreciation leads to an initial improvement in the bilateral trade balance. A possible explanation is that these countries' exports are very sensitive to fluctuations in the real exchange rate because of their high competition in the international goods markets. Interestingly, these countries belong to the Commonwealth Independent States (CIS),[5] whose exports are mainly mineral products, chemicals, transport equipment, machinery, clothing, food products, software, computer and electronic products, metals and precious stones. These products are vulnerable to world market fluctuations. Therefore, when there is a real depreciation, the competitiveness of these countries' exports in the international goods markets increases. This high competition makes the price elasticity of demand for exports very high, which can make the export volume effect following a real depreciation dominate the price effect. Therefore, the trade balance improves rather worsens in the short-run.

Having established evidence of cointegration among the variables in all the cases and established that currency depreciation has short-run effects in most of the cases, we next turn to the estimates of the long-run coefficients and to determine whether the short-run effects last into the long-run. The long-run effects of a currency depreciation is given by the size and significance of α_{6i}. In particular, for a currency

[5] The CIS includes Azerbaijan, Armenia, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Turkmenistan, Uzbekistan and Ukraine

depreciation to improve the trade balance in the long-run, the long-run coefficient estimates for the real effective exchange rate (α_{6i}) should be negative and significant. The results, reported in table 3, show that the coefficient estimates are negative and significant for only three countries: Armenia, Georgia and Ukraine. This suggests that currency depreciation in Armenia, Georgia and Ukraine improves the trade balance in the long-run. Thus, based on our results and given the definition of the J-curve of Rose and Yellen (1989), which is short-run deterioration followed by long-run improvement, we find support for the J-curve phenomenon only in Armenia, Georgia and Ukraine. This implies that the short-run effects of currency depreciation on the trade balance are found to last into the long-run in the cases of only Armenia, Georgia and Ukraine. Our findings are contrary to those of Bahmani-Oskooee and Kutan (2009) who find support for the J-curve for Bulgaria, Croatia and Russia. However, a possible explanation could be the different number of lags in the ARDL model. Whereas this paper employ SIC and to select the optimum number of lags, Bahmani-Oskooee and Kutan (2009) use AIC.

The results for Estonia, Latvia, Lithuania, Romania and Slovakia show that the long-run coefficient estimates are positive and significant, implying that depreciation has a negative effect on the trade balance. For the remaining countries, the long-run coefficient estimates are not statistically significant, indicating that the real exchange rate does not play a significant role in the bilateral trade balance in these countries in the long-run. Thus, for the countries where the long-run coefficient estimates are positive or insignificant, real depreciation does not have a favorable long-run impact on the trade balance. A possible explanation for this is that the MLC may be violated in these countries; that is, demand curves for exports and imports are inelastic thus, causing volumes of exports and imports not to adjust adequately to changes in the real effective exchange rate. Another possible explanation is that these countries are prone to inflationary effects of devaluation (Bahmani-Oskooee and Wang, 2006). Thus, even if in the short-run devaluation or depreciation improves the trade balance, inflationary effects of devaluation could offset this improvement in the long-run by hurting exports and increasing imports. This happens when devaluation improves the trade balance in the short-run, causing the demand for domestic goods and services to increase and hence, prices. The increase in prices will make domestic goods and services expensive, which can decrease exports and increase imports and therefore, worsens the trade balance.

Table 3 also reports the long-run coefficient estimates for domestic and foreign incomes. The coefficient estimate for domestic (foreign) income is expected to be negative (positive); that is, an increase in domestic (foreign) income is expected to increase the demand for imports (exports), and thus the domestic trade balance with corresponding country will deteriorate (improve). However, this relationship can be reversed if the increase in income is due to an increase in the production of import-substitute goods (Bahmani-Oskooee, 1986). For instance, an increase in domestic (foreign) income can induce an increase in the supply of all goods including the tradable goods (import-substitute goods) of the domestic (foreign) country. Thus, an increase in income can lead to a decrease in imports. The results in table 2 show that the income coefficients for Hungary, Poland and Armenia are positive and significant; implying an increase in domestic income improves the trade balance. This suggests that as these economies grow, they produce more import-substitute goods, leading to a decrease in their imports and hence the trade balance improves. On other hand, the world (EU15) income carries negative and significant estimates for Estonia, Latvia, Lithuania, Bulgaria, Croatia, Romania and China. This suggests that for these countries as the EU15 income increases, the member countries of the EU15 import less from these countries. Again, this suggests that as EU15 member countries grow, they produce more import-substitute goods thus, importing less from their trading partners. Only in the case of Armenia the coefficient estimate on the EU15 income is statistically positive, implying that an increase in the EU15 income leads to an increase in Armenia's exports and hence improves its trade balance. Overall, the finding that income coefficients are statistically significant suggests that the level of economic activity in these countries plays an important role in managing their trade balance. For example, the results for Hungary, Poland and Armenia suggest that any income–increasing policy may help reduce imports as the countries produce more import-substitute goods and hence, improve their trade balance.

As mentioned above, the error correction terms(ECM_{t-1}) are negative and statistically significant in all the cases, which ensures cointegration among the variables and that long-run equilibrium is attainable.

In particular, ECM_{t-1} measures the speed at which the bilateral trade balance adjusts to changes in the explanatory variables before converging to its long-run equilibrium. That is, ECM_{t-1} measures the speed of adjustment to equilibrium. For example, the average speed of adjustment coefficient in the Baltic countries is -0.21, implying that 21% of this periods' deviations from the long-run equilibrium are corrected in the next period.

Finding evidence of cointegration among the variables does not necessarily imply that the estimated coefficients are stable. Therefore, stability tests of Brown *et al.* (1975); known as the cumulative sum of recursive residuals ($CUSUM$) and the cumulative sum of squares of recursive residuals ($CUSUMQ$) are used. The tests are applied to the residuals in model (5) to test the stability of both short-run and long-run coefficient estimates. Figure 2 shows the plots of the $CUSUM$ and $CUSUMQ$ tests and table 3 provides a summary for the results. Whereas the $CUSUM$ test detects systematic changes in the estimated regression coefficients, the $CUSUMQ$ test captures sudden shifts in the regression coefficients. The figure presents conflicting results. While the $CUSUM$ test shows parameter stability in all but Hungary, Georgia and China, the $CUSUMQ$ shows instability in the parameters of the trade balance in all but Estonia, Bulgaria, Macedonia, Slovenia and Russia.

5. Summary and Conclusion

It is argued in the international economics literature that the relationship between the exchange rate and the trade balance differs between the short-run and long-run. In particular, it is widely believed that the immediate effect of currency depreciation or devaluation is to lower the trade balance, but this is reversed in the long-run; thus, producing the J-curve phenomenon. This phenomenon is used to describe the short-run and long run response of the trade balance to currency depreciation or depreciation.

This article has attempted to investigate the J-curve phenomenon for 17 transition economies using monthly data over the period January 1991 – January 2012. The single cointegration approach of Pesaran et al. (2001), known as the ARDL bounds test, was employed to investigate the short-run and long-run response of the trade balance to real currency depreciation. Using the ARDL bounds test, we find evidence of cointegration among the variables in eleven cases out of the seventeen countries. Together with this result, the significant and negative error correction term (ECM_{t-1}) found in all the cases confirms the existence of cointegration in all the cases.

The short-run coefficient estimates suggest that there are significant positive and negative coefficients in most cases, implying that currency depreciation in these countries has short-run effects. However, these short-run effects follow the J-curve pattern only in Slovenia. These short-run effects last into the long-run only in the cases of Armenia, Georgia and Ukraine. Thus, and given the definition of the J-curve, that is, short-run deterioration followed by long-run improvement in the trade balance, we find support for the J-curve phenomenon only in the cases of Armenia, Georgia and Ukraine. For the rest of countries where the long-run coefficient estimates are positive or insignificant, real depreciation does not have a favorable long-run impact on the trade balance.

Our findings that the exchange rate has no long-run positive effect on the trade balance in the transition countries under study (except in the cases of Armenia, Georgia and Ukraine) have important policy implications. As mentioned earlier, these economies are relatively small, open economies, depending on exports to promote economic growth. Therefore, and according to our findings that depreciation has no long-run positive effect on the trade balance, these economies may not use exchange rate policy to increase exports and promote economic growth in the long-run. Thus, transition economies trying to catch-up with the EU and hoping to join the EU may need to consider other policy channels (such as fiscal and monetary policies) to achieve economic growth required to catch-up with EU.[6] [7]

We also find that the long-run coefficient estimates for domestic and foreign incomes are statistically significant in most cases, suggesting that the level of economic activity in these countries plays an important role in managing their trade balance. For example, the results for Hungary, Poland and Armenia

[6] It should be noted that Estonia, Latvia, Lithuania, Czech Republic, Hungary, Poland, Slovakia and Slovenia have joined the EU in 2004, and Bulgaria and Romania have joined the EU in 2007. The rest of the countries in our sample have not yet joined the EU. Of course, China is not expected to join the EU.

[7] Our conclusion is similar to Bahmani-Oskooee and Kutan's (2009) who examined the J-curve phenomenon for 11 transition economies and found support for the J-curve for only Bulgaria, Croatia and Russia. Accordingly, the authors concluded that the exchange rate policy may not be used to promote large trade balance surplus and hence economic growth.

suggest that any income–increasing policy may help reduce imports as the countries produce more import-substitute goods and hence, improve their trade balance.

References

Asteriou D., Stephen G. (2007). Applied Econometrics: A Modern Approach using E-Views and Microfit, New York: Palgrave MacMillan.

Baharumshah A. (2001). The effect of exchange rate on bilateral trade balance: new evidence from Malaysia and Thailand. Asian Economic Journal 15: 291-312.

Bahmani-Oskooee M. (1985). Devaluation and the J-curve: some evidence from LDCs'. Review of Economics and statistics 67(3): 500-4.

Bahmani-Oskooee M. (1986). Determinants of international trade flows: the case of developing countries. Journal of Developments Economics 20: 107-23.

Bahmani-Oskooee M. (1991). Is there a long-run relationship between the trade balance and the real effective exchange rate of LDCs? Economics Letters 36(4): 403-7.

Bahmani-Oskooee M., Alse J. (1994). Short-run versus long-run effects of devaluation: error correction modeling and cointegration. Eastern Economic Journal 20(4): 453-64.

Bahmani-Oskooee M. Brooks T. (1999). Bilateral J-curve between US and her trading partners. *Weltwirtschaftliches Archiv* 135(1): 156-65.

Bahmani-Oskooee M., Goswami G. (2003). A disaggregated approach to test the J-curve phenomenon: Japan versus her trading partners. Journal of Economics and Finance 27(1): 102-13.

Bahmani-Oskooee M., Ratha A. (2004). The J-curve: a literature review. Applied Economics 36: 1377-1398.

Bahmani-Oskooee M., Gelan A. (2006). Black market exchange rate and productivity bias hypothesis. Economic Letters 91: 243-9.

Bahmani-Oskooee M., Wang Y. (2006). The J curve: China versus her trading partners. Bulletin of Economic Research 58(4): 323-343.

Bahmani-Oskooee M., Kutan A. (2009). The J-curve in the emerging economies of Eastern Europe. Applied Economics 41: 2523-2532.

Bahmani-Oskooee M., Tatchawan K. (2001). Bilateral J-curve between Thailand and her trading partners. Journal of Economic Development 26: 101-9

Brada J. C. (1998). Introduction: exchange rates, capital flows, and commercial policies in transition economies. Journal of Comparative Economics 26: 6113-620.

Brada J., Kutan A., Zhou S. (1997). Exchange rate policy and outward orientation in developing countries: the Turkish experience. Journal of Development Studies 33(5): 675-92.

Barlow D. (2003). Purchasing power parity in three transition economies. Economics of Planning 36: 201-221.

Brown R., Durbin J., Evans, J. (1975). Techniques for testing the constancy of regression relations over time. Journal of Royal Statistical Society 37: 149-63.

Caporale G., Pittis N. (2004). Estimator Choice and the Fisher's Paradox: A Monte Carlo Study. Econometric Reviews 23(1): 25-52.

Caporale G., Pittis N. (1999). Efficient estimation of cointegrating vectors and testing for causality in vector autoregressions. Journal of Economic Surveys 13: 1-35.

Demirden T., Pastine I. (1995). Flexible exchange rate and the J-curve. Economic Letters 48(3-4): 373-377.

Dornbusch R. (1980). Open Economy Macroeconomics. Basic Books, New York.

Égert B., Morales-Zumaquero A. (2008). Exchange Rate Regimes, Foreign Exchange Volatility, and Export Performance in Central and Eastern Europe: Just another Blur Project? Review of Development Economics 12(3): 577-593.

Enders W. (2004). Applied Econometric Time Series. John Wiley & Sons, Inc., USA.

Engle R., Granger C. (1987). Cointegration and error correction representation: estimation and testing. Econometrica 55: 251-76.

Falk M., Raiser M., Brauer F. (1996). Making sense of the J-curve: Capital utilization, output, and total factor productivity in Polish industry 1990 – 1993. Kiel Institute of World Economics Diisternbrooker Weg 120, D 24100 Kiel Department IV. Kiel Working Paper No. 723.

Flemingham B. (1988). Where is the Australian J-curve? Bulletin of Economic Research 40(1): 43-56.

Hacker R., Hatemi-J A. (2004). The effect of exchange rate changes on trade balances in the short and long run: evidence from German trade with transitional Central European economies. Economics of Transition 12(4): 777-799.

Froot K., Rogoff K. (1994). Perspectives on PPP and long run real exchange rates. NBER working paper No. 4952.

Halpern L., Wyplosz C. (1997). Equilibrium exchange rates in transition economies. IMF Staff Papers 44: 430-461.

Himarios D. (1989). Do devaluations improve the trade balance? The evidence revisited. Economic Inquiry 27(1): 143-68.

Johansen S. (1988). Statistical analysis of cointegration vectors. Journal of economic dynamics and controls 12: 231-254.

Johansen S., Juselius K. (1990). Maximum likelihood estimation and inferences on cointegration with application to the demand for money. Oxford Bulletin of Economics and Statistics 52: 169-210

Junz H., Rhomberg R. (1973). Price Competitiveness in Export Trade among Industrial Countries. American Economic Review 63: 412-418.

Kemme D., Teng W. (2000). Determinants of the real exchange rate, misalignment and implications for growth in Poland. Economic System 24: 171-205.

Kočenda E., Valachy J. (2005). Exchange rate volatility before and after regime switch: a new measure and new evidence from transition. CERGE-EI Working paper.

Krugman P., Baldwin R. (1987). The persistence of the U.S. trade deficit. Brooking Papers on Economic Activity 1: 1-43.

LaI A., Lowinger T. (2002). Nominal effective exchange rate and trade balance adjustment in South Asia countries. Journal of Asian Economics 13: 371-383.

Magee S. (1973). Currency contracts, pass through, and devaluation. Brookings Papers of Economic Activity 1: 303-325.

Marwah K., Klein L. (1996). Estimation of J-curves: United States and Canada. Canadian Journal of Economics 29(3): 523-39.

Narayan P. (2006). Examining the relationship between trade balance and exchange rate: the case of China's trade with the USA. Applied Economics Letters 13: 507-510.

Papazoglou C., Pentecost E. J. (2004). The dynamic adjustment of a transition economy in the early stages of transformation. Journal of Macroeconomics 26, 547-561.

Perron P. (1989). The Great Crash, the Oil Price Shock, and the Unit Root Hypothesis. Econometrica 57: 1361-1401.

Pesaran H., Pesaran B. (1997). *Working with Microfit*, Camfit Data Limited.

Pesaran M., Shin Y., Smith R. (2001). Bound testing approaches to the analysis of level relationship. Journal of Applied Economics 16: 289-326.

Pesaran H., Shin Y. (1999). An autoregressive distributed lag modeling approach to cointegration analysis. *Econometrics and economic theory in 20th century: theRagnar Frisch centennial symposium,* eds. S. Strom, Cambridge University Press, Cambridge.

Rose A. (1990). Exchange rates and the trade balance: some evidence from developing countries. Economic Letters 3(34): 271-275.

Rose A., Yellen J. (1989). Is there a J-curve? Journal of Monetary Economics 24: 53-68.

Sideris, D. (2006). Purchasing power parity in economies in transition: evidence from Central and East European countries. Applied Financial Economics 16: 135-143.

Stućka T. (2004). The effects of exchange rate change on the trade balance in Croatia. International Monetary Funds (IMF) Working Paper WP/04/65.

Taylor M. P., Sarno L. (2001). Real exchange rate dynamics in transition economies: A nonlinear analysis. Studies in Nonlinear Dynamics and Econometrics, Quarterly Journal 5(3), the MIT Press.

Wilson P., Tat K. (2001). Exchange rates and the trade balance: the case of Singapore 1970 to 1996. Journal of Asian Economics 12: 47-63.

Table 1: The results of the $F-test$ at different lags

Country	Sample period	2 lags	4 lags	6 lags	8 lags	10 lags	12 lags
Baltic countries							
Estonia	1994:01-2010:12	4.171[c]	2.270[a]	2.551[a]	2.893[b]	1.947[a]	2.261[a]
Latvia	1995:01-2012:01	5.308[c]	4.732[c]	3.998[c]	3.353[b]	4.133[c]	3.091[b]
Lithuania	1994:01-2012:01	4.687[c]	3.436[b]	4.113[c]	6.196[c]	4.485[c]	5.299[c]
CEEs							
Bulgaria	1995:01-2011:12	8.778[c]	5.045[c]	4.571[c]	2.895[b]	3.647[b]	2.978[b]
Croatia	1992:01-2012:01	8.463[c]	4.295[c]	4.162[c]	4.077[c]	4.711[c]	6.541[c]
Czech Republic	1993:01-2012:01	8.308[c]	4.44[c]	3.111[b]	2.218[a]	2.863[b]	2.724[b]
Macedonia	1993:12-2012:01	9.489[c]	7.57[c]	3.258[b]	3.183[b]	2.960[b]	2.861[b]
Hungary	1991:01-2011:12	4.215[c]	3.543[c]	4.479[c]	2.303[a]	4.622[c]	3.014[b]
Poland	1991:01-2011:12	2.532[b]	2.243[a]	3.167[b]	2.917[b]	2.563[b]	1.878[a]
Romania	1991:11-2012:01	11.741[c]	4.225[c]	2.204[a]	2.581[b]	2.898[b]	1.079[a]
Slovakia	1993:01-2008:12	7.798[c]	4.157[c]	3.816[c]	2.455[b]	2.163[a]	1.890[a]
Slovenia	1994:01-2007:02	7.295[c]	4.722[c]	4.250[c]	3.095[b]	2.513[b]	1.746[a]
CISs							
Armenia	1996:01-2012:01	2.727[b]	2.826[b]	2.895[b]	1.963[a]	1.206[a]	0.947[a]
Georgia	1995:10-2012:01	5.879[c]	3.254[b]	2.015[a]	1.466[a]	0.713[a]	0.717[a]
Russia	1995:01-2012:01	4.031[c]	2.668[b]	2.729[b]	2.505[b]	1.437[a]	1.417[a]
Ukraine	1994:01-2012:01	7.312[c]	6.561[c]	6.109[c]	3.298[b]	1.531[a]	1.603[a]
Asia							
China	1991:01-2012:01	6.713[c]	4.642[c]	4.068[c]	4.528[c]	3.004[b]	2.461[a]

[a] indicates that the test statistic lies below the 10% lower bound,[b] that it falls within the 10% bounds, and [c] that it lies above the 10% upper bound. The null hypothesis of no-cointegration is rejected when the test statistic is above the upper bound. The null hypothesis is not rejected when the test statistic is below the lower bound. If the test statistic falls within the bounds, then the test becomes inconclusive and no decision regarding cointegration can be made. The upper (lower) critical value of the $F-test\ statistic$ at the 10 percent significance level is 3.52 (2.45) when there are four variables, and 3.77 (2.72) when there are three variables (Pesaran et al., 2001, table CI, case III, page 300). In seven cases (Estonia, Latvia, Lithuania, Bulgaria, Georgia, Ukraine and China), industrial production index was either not available or available but for only a very short period of time. Therefore, in these cases, income proxy was not used and hence, the analysis is carried out using only three variables (the trade balance, the real effective exchange rate and foreign industrial production index).

Table 2: The results of the $F - test$ when optimal lags are selected by SIC and AIC

Country	Lags - SIC	$F - test$ - SIC	Lags - AIC	$F - test$ - AIC
Baltic countries				
Estonia	(3, 0, -, 0)	1.205 [a]	(11, 0, -, 0)	3.421 [b]
Latvia	(12, 0, -, 0)	7.124 [c]	(12, 1, -, 1)	7.649 [c]
Lithuania	(11, 0, -, 0)	7.128 [c]	(11, 0, -, 2)	6.109 [c]
CEEs				
Bulgaria	(5, 0, -, 0)	4.437 [c]	(12, 12, -, 7)	3.741 [b]
Croatia	(6, 0, 0, 0)	2.212 [a]	(6, 12, 2, 0)	1.974 [a]
Czech Republic	(11, 0, 0, 0)	1.144 [a]	(12, 5, 0, 0)	2.110 [a]
Macedonia	(1, 0, 0, 0)	12.034 [c]	(11, 0, 10, 3)	2.878 [b]
Hungary	(2, 0, 0, 0)	3.922 [c]	(12, 1, 11, 7)	5.181 [c]
Poland	(12, 0, 0, 0)	1.954 [a]	(12, 3, 5, 0)	2.178 [a]
Romania	(12, 0, 0, 0)	2.337 [a]	(12, 3, 4, 0)	3.046 [b]
Slovakia	(2, 0, 0, 0)	6.584 [c]	(2, 0, 6, 0)	6.904 [c]
Slovenia	(0, 1, 0, 0)	27.811 [c]	(11, 1, 1, 0)	3.403 [b]
CISs				
Armenia	(2, 0, 0, 0)	3.003 [b]	(2, 0, 3, 0)	3.104 [b]
Georgia	(2, 0, -,0)	6.851 [c]	(6, 0, -,0)	2.070 [a]
Russia	(1, 0, 0, 0)	3.705 [c]	(12, 10, 2, 0)	3.026 [b]
Ukraine	(1, 0, -,0)	12.745 [c]	(12,1 0, -,7)	1.123 [a]
Asia				
China	(1, 0, -, 0)	9.975 [c]	(12, 0, -, 9)	2.517 [a]

The numbers of lags on the first differenced variables are selected by setting a maximum number of 12 lags on each first differenced variable and then employing Schwarz Information Criterion (SIC) and Akaike Information Criterion (AIC) procedures to select the optimum lags. The order of the lags follows the specification in equation (5). For example, the first number is the number of lags on Δtb_{it-j}, the second is the number of lags on Δq_{it-j}, the third is the number of lags on Δy_{it-j}, and the fourth is the number of lags on Δy^{*}_{it-j}. – means that the variable is either not available or available for a very short period of time and, hence was not included in the analysis. The upper (lower) critical value of the $F - test\ statistic$ at the 10 percent significance level is 3.52 (2.45) when there are four variables, and 3.77 (2.72) when there are three variables (Pesaran et al., 2001, table CI, case III, page 300). The $F - test$ is carried out at the optimum lags. [a] indicates that the test statistic lies below the 10% lower bound,[b] that it falls within the 10% bounds, and [c] that it lies above the 10% upper bound.

Table 3: ARDL model estimates using SIC

	Short-run estimates		Long-run estimates				Diagnostics		
Country	Δq_t	Δq_{t-1}	$constant$	q_t	y_t	y_t^*	ECM_{t-l}	$CUSUM$	$CUSUMQ$
Baltic countries									
Estonia	0.250		-1.046	0.998	n.a	-0.856	-0.250	Stable	Stable
	(3.314)		(0.696)	(3.907)		(1.980)	(3.195)		
Latvia	0.300		1.736	1.298	n.a	-1.817	-0.232	Stable	Unstable
	(3.671)		(0.908)	(4.472)		(3.874)	(3.820)		
Lithuania	0.214		1.877	1.465	n.a	-1.995	-0.146	Stable	Unstable
	(4.559)		(0.643)	(2.596)		(2.107)	(2.387)		
CEEs									
Bulgaria	0.009		9.060	0.052	n.a	-2.104	-0.179	Stable	Stable
	(0.234)		(2.869)	(0.227)		(2.550)	(2.788)		
Croatia	-0.195		9.242	-0.896	1.047	-2.303	-0.218	Stable	Unstable
	(0.968)		(2.235)	(0.999)	(1.496)	(2.196	(2.705)		
Czech Republic	0.048		-2.815	0.269	0.322	0.022	-0.177	Stable	Unstable
	(0.904)		(1.548)	(0.887)	(0.964)	(0.046)	(2.423)		
Macedonia	0.063		-0.256	0.129	0.238	-0.418	-0.488	Stable	Stable
	(0.462)		(0.096)	(0.461)	(1.086)	(1.171)	(6.568)		
Hungary	-0.098		2.971	-0.330	0.575	-0.868	-0.273	Unstable	Unstable
	(1.132)		(1.091)	(1.084)	(2.420)	(1.495)	(5.238)		
Poland	-0.068		1.670	-0.711	0.591	-0.293	-0.096	Stable	Unstable
	(1.088)		(0.527)	(1.182)	(2.440)	(0.298)	(2.895)		
Romania	0.160		11.667	0.917	-0.373	-3.159	-0.175	Stable	Unstable
	(2.636)		(2.227)	(1.622)	(1.089)	(2.054)	(2.189)		
Slovakia	0.263		0.928	0.598	-0.369	-0.449	-0.440	Stable	Unstable
	(2.309)		(0.724)	(2.248)	(1.287)	(1.147)	(6.159)		
Slovenia	3.390	-2.544	-2.600	0.545	0.188	-0.190	-0.818	Stable	Stable
	(3.768)	(2.795)	(1.751)	(1.323)	(1.433)	(0.818)	(10.003)		
CISs									
Armenia	-0.728		-6.526	-2.095	0.237	3.107	-0.348	Stable	Unstable
	(3.772)		(1.639)	(6.186)	(2.004)	(3.704)	(4.595)		
Georgia	-0.291		3.989	-1.029	n.a	-0.076	-0.283	Unstable	Unstable
	(1.952)		(0.792)	(2.194)		(0.077)	(4.412)		
Russia	-0.838		-3.864	-0.410	-0.196	1.551	-0.199	Stable	Stable
	(4.138)		(1.210)	(1.084)	(0.387)	(2.388)	(3.414)		
Ukraine	-0.234		4.735	-0.617	n.a	-0.427	-0.380	Stable	Unstable
	(3.123)		(2.753)	(3.459)		(1.383)	(6.921)		
Asia									
China	-0.008		-2.275	-0.031	n.a	0.561	-0.261	Unstable	Unstable
	(0.124)		(1.734)	(0.123)		(2.053)	(4.799)		

$LM\ test$ is the Lagrange multiplier test of residual serial correlation. It is distributed as $\chi^2(12)$. $RESET\ test$ is Ramsey's test for function form. It is distributed as $\chi^2(1)$. ECM_{t-1} is the lagged error-correction term. A negative and significant ECM_{t-1} implies cointegration among the variables. $CUSUM$ is the cumulative sum of recursive residuals and $CUSUMQ$ is the cumulative sum of squares of recursive residuals. The $CUSUM$ and $CUSUMQ$ tests are used to test the residuals in equation (5) to determine the stability of the short-term and long-term coefficients. Numbers in parentheses are the absolute value of $t-ratios$. n.a means either a missing variable or was available for a very short period and hence was not included in the analysis.

Figure 1: real effective exchange rates (in logs)

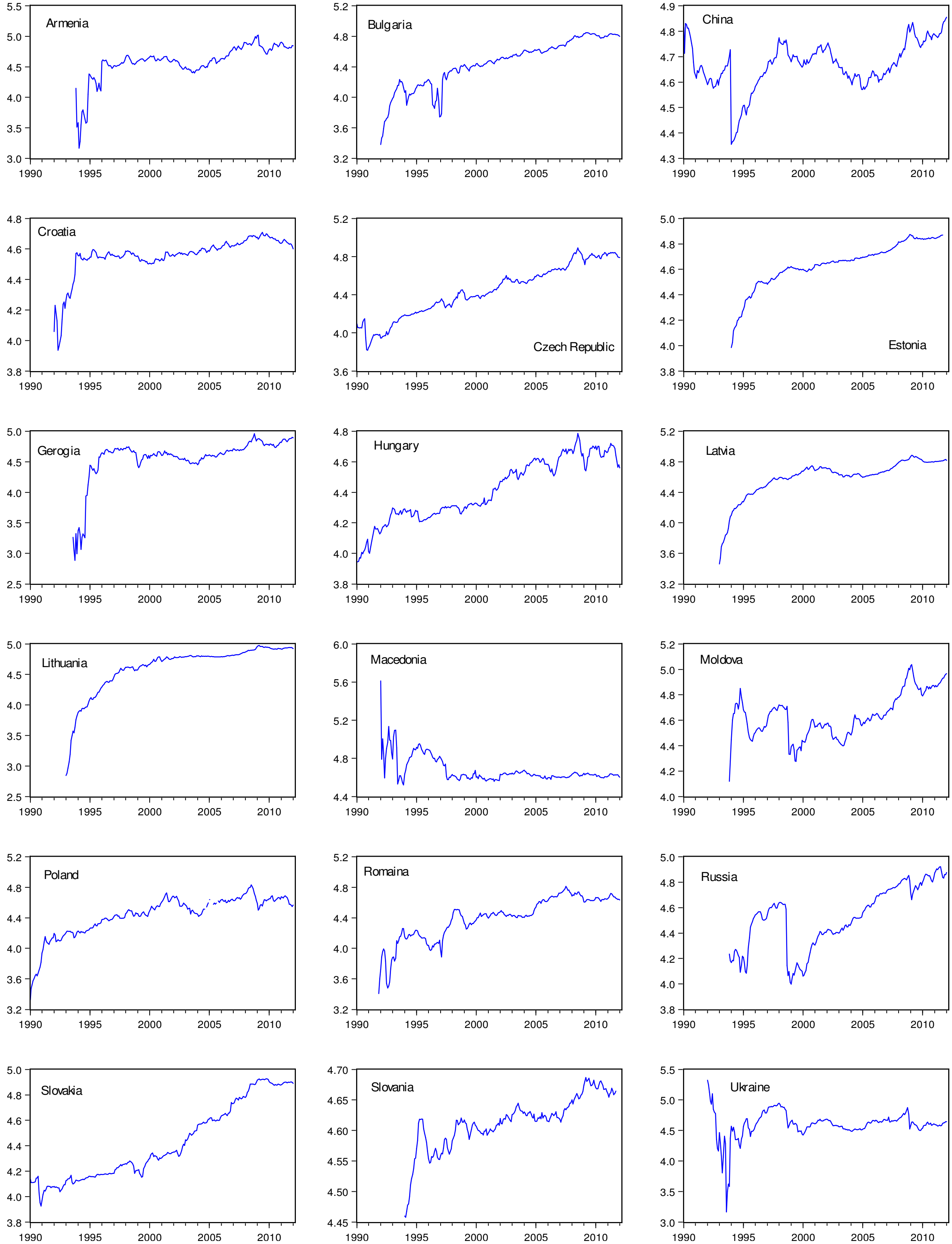
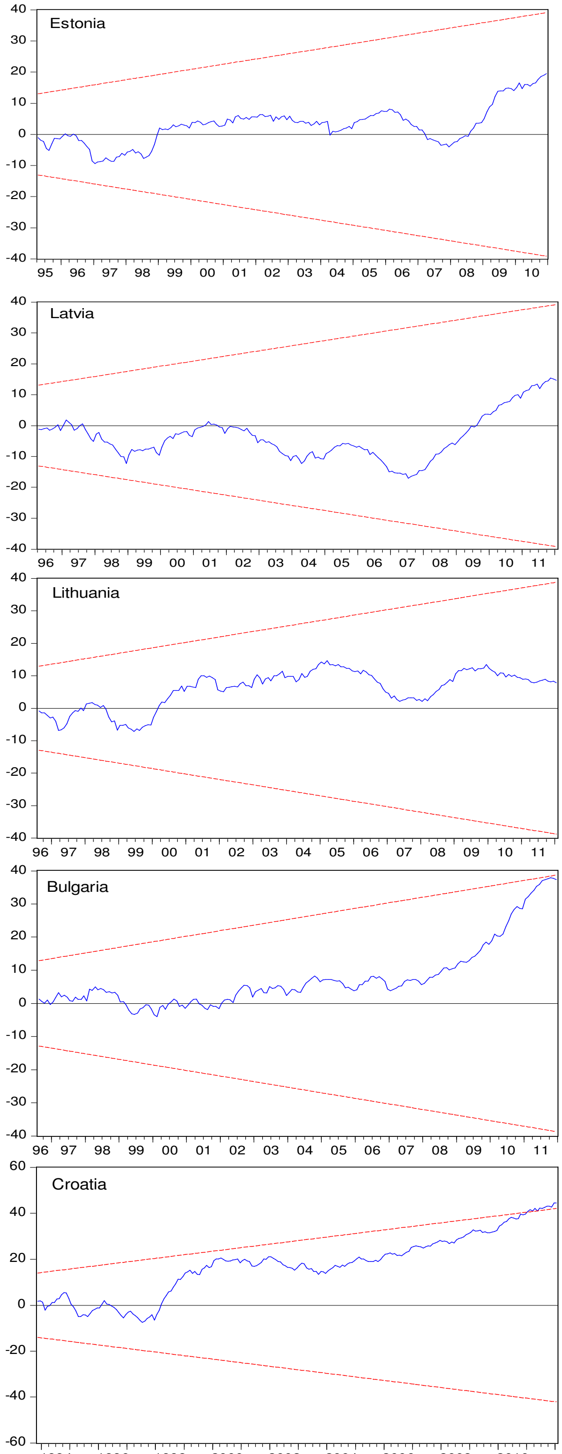
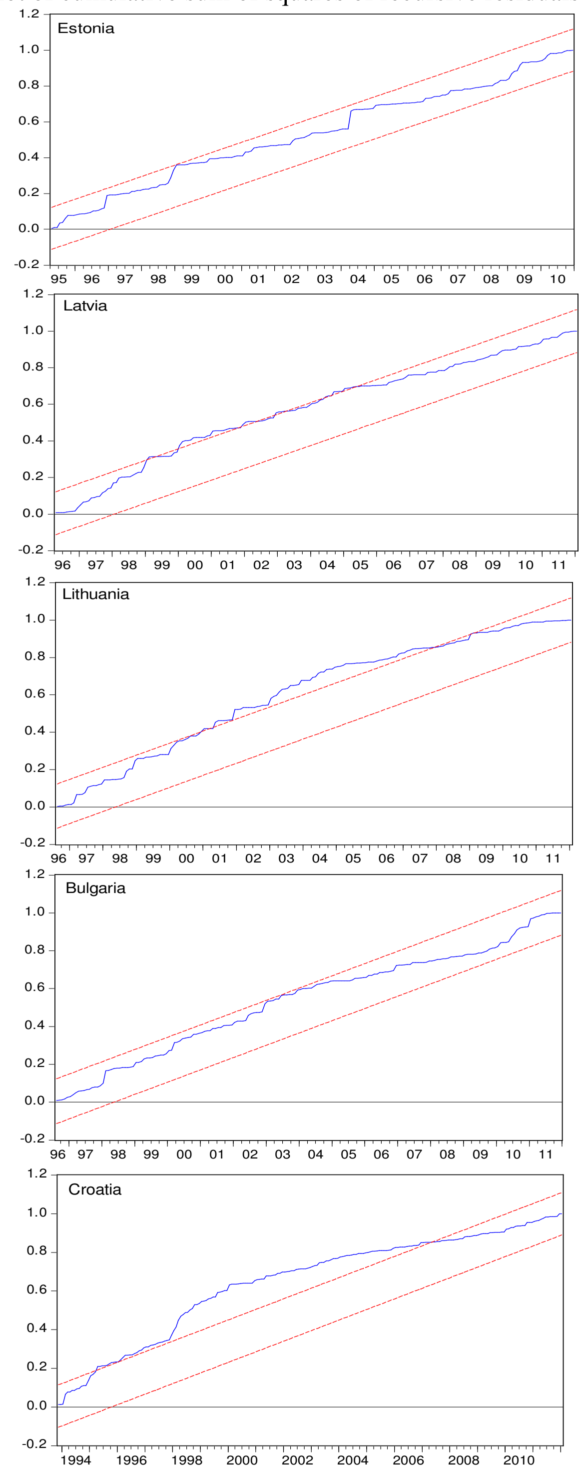


Figure 2: Test for stability of the short-run and the long-run coefficient estimates

Plot of cumulative sum of recursive residuals



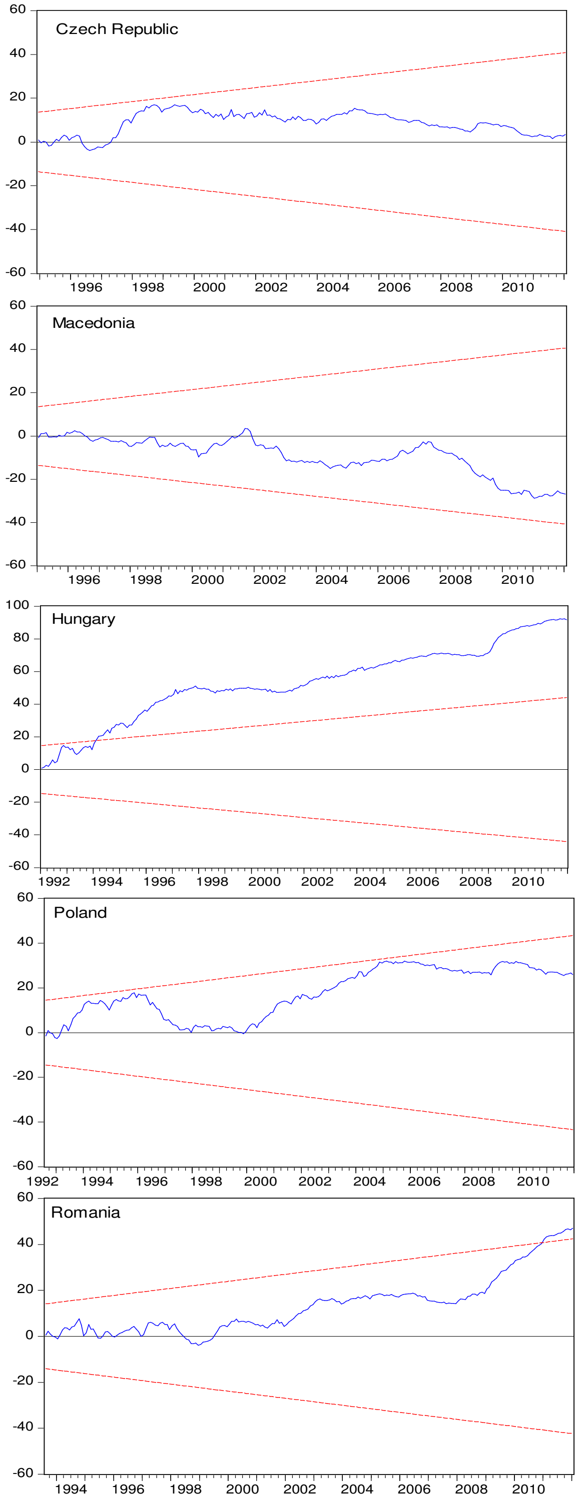
plot of cumulative sum of squares of recursive residuals



-------- is the 5% significance level critical bounds.

Figure 2: Continued

Plot of cumulative sum of recursive residuals



plot of cumulative sum of squares of recursive residuals

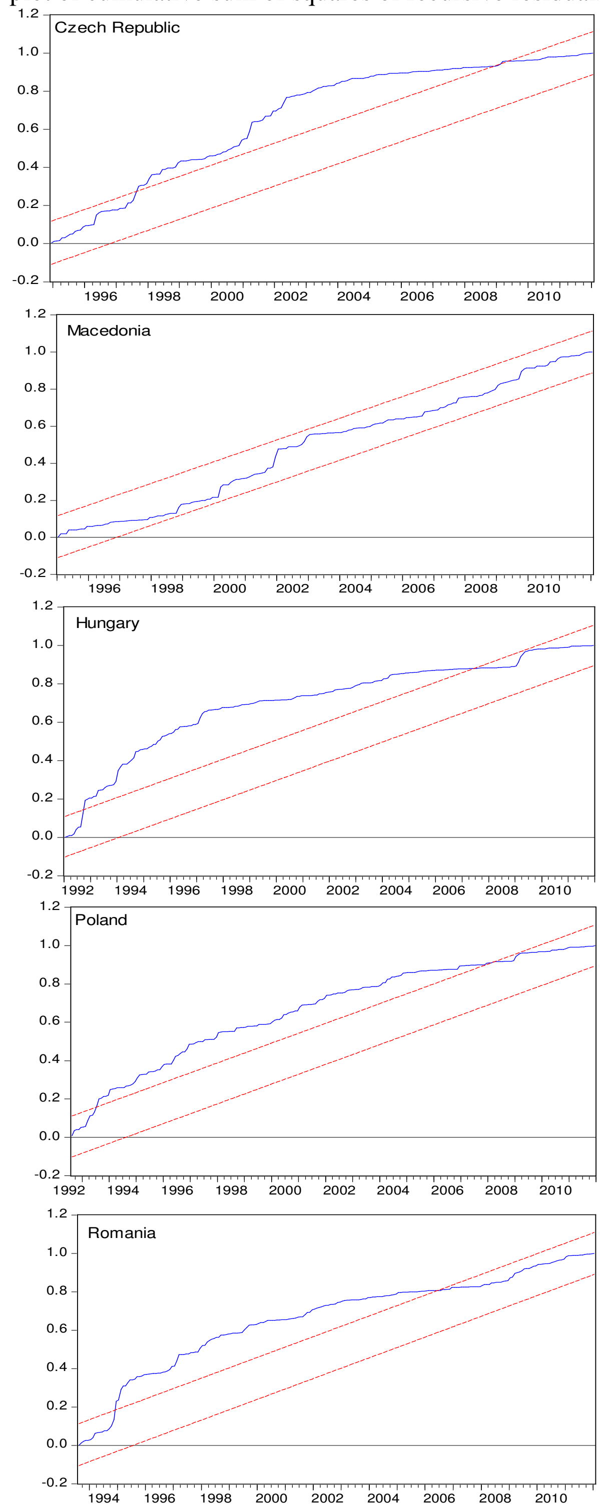
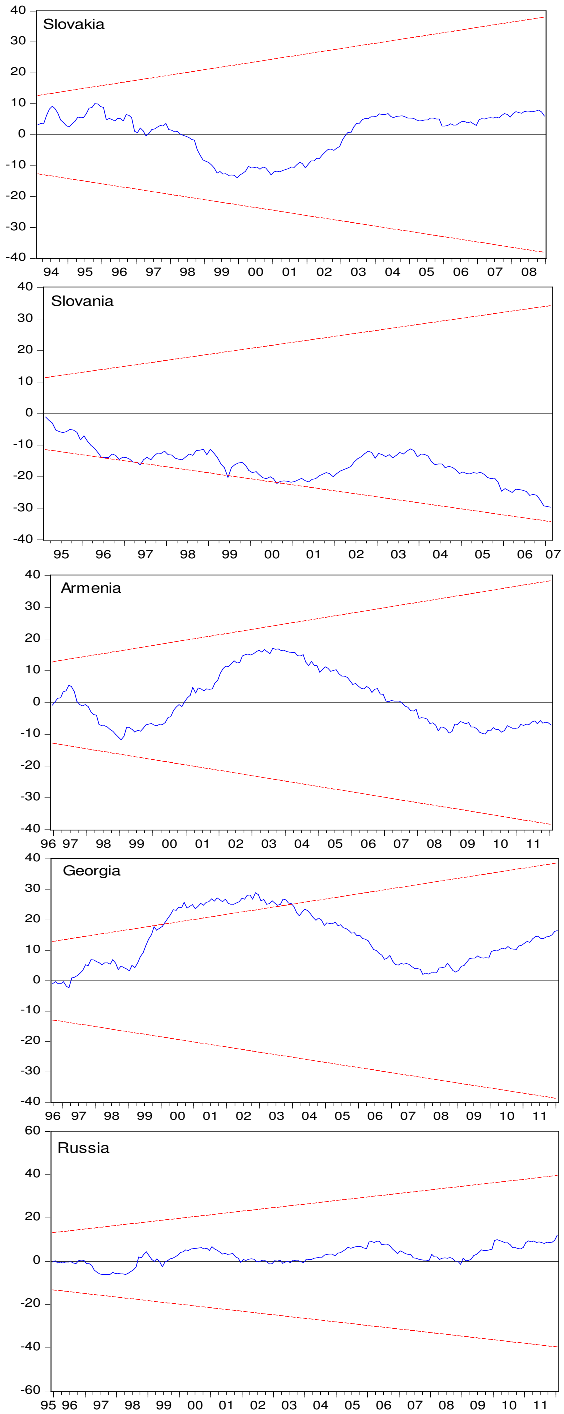


Figure 2: Continued

Plot of cumulative sum of recursive residuals



plot of cumulative sum of squares of recursive residuals

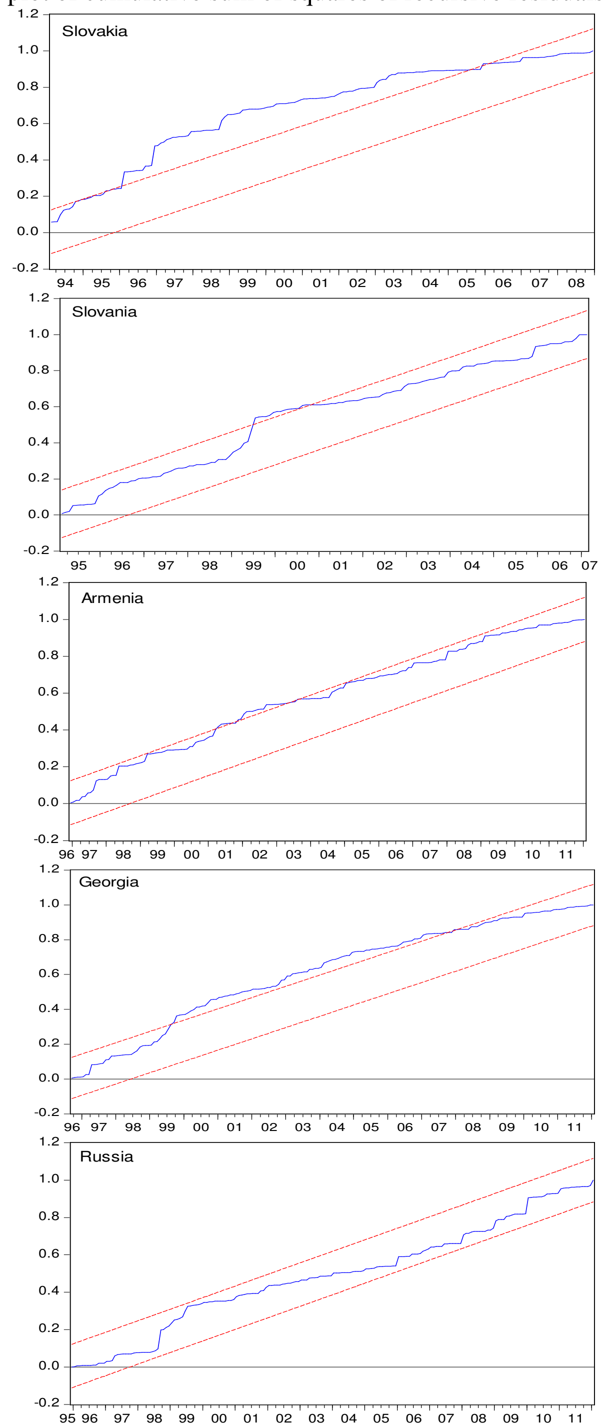
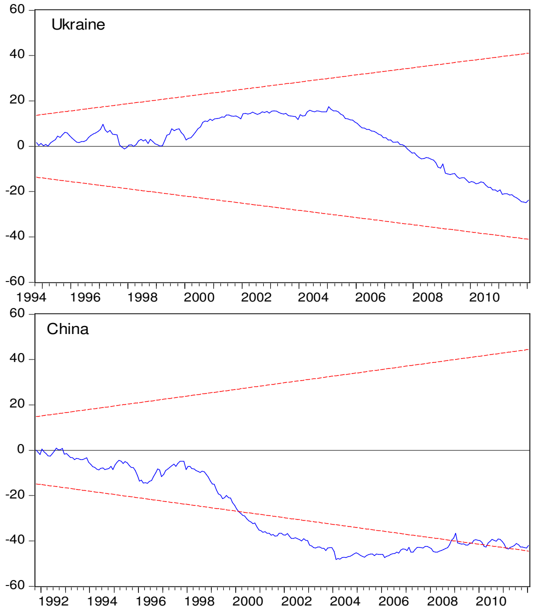


Figure 2: Continued

Plot of cumulative sum of recursive residuals



plot of cumulative sum of squares of recursive residuals