Can Foreign Direct Investment Promote Exports in Slovakia?

Zheng-Zheng LI – Chi-Wei SU** – Ran TAO*** – Oana-Ramona LOBONŢ*****

Abstract

In this paper, we investigate whether the knowledge capital model (Carr Markusen and Maskus, 2001) is satisfied in Slovakia by applying the bootstrap rolling window subsample test to examine the causal relationship between foreign direct investment (FDI) and exports (EX). This method provides more accurate evidence of a connection between these two variables considering structural changes. The empirical results show a positive correlation between FDI and EX and support the vertical FDI in the knowledge capital model in most sample periods. Specifically, when FDI is rising, EX increase accordingly, and vice versa. In addition, FDI exerted a negative effect on EX in 2011, which is attributable to the relative state of the situation at home and abroad. The findings illustrate that FDI and EX benefit from the free economic institution reforms and inexpensive resources. Therefore, the Slovakian government should improve tax reforms and maintain the stability of legislation to achieve mutual promotion between FDI and EX.

Keywords: *foreign direct investment, exports, bootstrap rolling window, EU accession*

JEL Classification: C32, F14, F21

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Introduction

This study examines the bidirectional relationship between foreign direct investment (FDI) and exports (EX) in Slovakia. The growth of multinational sales has outpaced the notable expansion of trade among globalized world economies. Consequently, the trade literature has sought to consider the mode of foreign market access (Helpman, Melitz and Yeaple, 2003). The previously mentioned study also recognizes that countries can serve foreign buyers through a variety of channels: they can export their products to international customers or serve them through foreign subsidiaries by engaging in FDI and contract with foreign countries to produce and sell their products. FDI has been a subject of interest for a long time. This attention has been renewed in Central and Eastern Europe (CEE) in recent years for the following reasons. First, the collapse of state socialism in CEE helped to open the region to foreign capital and FDI (Pavlinek, 1998). FDI has commonly been viewed as crucial not only to effective industrial restructuring in the region (Papp, 1996) but also to the overall success of the transition to a capitalist economy (Michalak, 1993).

Furthermore, the CEE region has a well-educated, skilled, and relatively inexpensive labor force given its productivity level, and it is located close to the prosperous Western European economies, thus possessing considerable market potential (Pavlinek, 1998). Finally, especially in Slovakia, it is proposed that FDI contributes to the increase in EX performance; this effect occurs when export-oriented FDI is recognized (Szkorupová, 2014). FDI is considered an essential component of EX and even of national development strategies for transition countries. Thus, the relationship between FDI and EX needs to be reexamined, and it would be useful for Slovak authority to implement advantageous incentive policies.

Slovakia is one of the fastest growing economies in Europe and the 2nd fastest[1] in the Eurozone (EC, 2012). During the transformation period, Slovakia, as an investment destination, has gradually increased in importance due to its economic reforms. Slovakia successfully transformed from a centrally planned economy to a market-driven economy. Specifically, through a series of deregulation and liberalization approaches to trade, several privatization processes are nearly complete. Combined with the privatization of the banking sector, the inflow of foreign investment has significantly increased. Slovakia is an attractive country for foreign investors considering its low wages, low tax rates and well-educated labor force (Carstensen and Toubalb, 2004). Slovakia is a small economy in the process of catching up to more advanced countries, and entry into the EU

[1] In 2011 and 2012, Slovakia was the 2nd fastest growing Eurozone member after Estonia.

brought about a considerable change in the economic framework. Specifically, with borrowing costs decreasing and the exchange rate risk disappearing, the growth prospects for the economy have improved (Huefner and Koske, 2008). That is, the EU accession reduced the barriers for borrowers (Backé and Wójcik, 2008; Huefner and Koske, 2008). Therefore, the development of FDI flowing into Slovakia has had an upward trend. FDI inflow grew more than 600% from 2000 and cumulatively reached an all-time high of USD 17.3 billion in 2006, or approximately USD 22,000 per capita by the end of 2008 (Hošková, 2001). The country was referred to as the "Tatra Tiger"[2] before the 2008 global financial crisis. Since then, Slovakia has undergone a successful restructuring process; therefore, export industries have received special support. Most importantly, the automobile industry has become the largest exporting industry in Slovakia (Broeck, Mehrez and Guscina, 2012).

According to the traditional Heckscher-Ohlin-Samuelson theory, Heckscher (1919), Ohlin (1933) and Samuelson (1949) suggest that international trade and FDI are substitutes for the ability of labor and capital to move freely between countries without transportation costs. The implication is that international trade requires an indirect exchange of production factors among countries (Liu, Wang and Wei, 2001). Mundell (1957) elaborates on the relationship between FDI and international trade with the prevalence of tariffs; trade barriers lead to changes in foreign investment, and vice versa. He also argues that the international mobility of the factors of production, including FDI, may be a substitute for international trade, assuming that production functions are identical across countries. However, Kojima (1973) claims that if the mobility of factors moves toward a country with a shortage, then FDI may have a positive impact on trade. The debate about causality in the relationship between inward FDI and EX from a host country is one aspect of a more general argument.

Empirical studies on the causal relationships between FDI and EX are abundant but contradictory. Head, Ries and Spencer (2004) verify that there is a negative partial correlation between exports and FDI in their investigation of Japanese manufacturers, and they conclude that the two variables are substitutes. In contrast, the United Nations Conference on Trade and Development (UNCTAD, 2002) illustrates that an increase in the quantity of inward FDI boosts EX in host countries by means of the accumulation of capital, the introduction of new technology, and improvements in management experience and marketing strategies. Albuquerque, Loayza and Servén (2005) argue that larger inflows of FDI will

[2] "Tatra Tiger" is a nickname that refers to the economy of Slovakia in period 2002 – 2007 and after 2010, following the ascendance of a right-wing coalition in September 2002, which engaged in a program of liberal economic reforms.

lead to a higher volume of trade as well as other benefits, such as increased rates of total factor productivity growth. Iqbal, Shaikh and Shar (2010) confirm the positive effect of FDI on EX and economic growth in Pakistan. Furthermore, Pacheco-Lopez (2005) finds a bidirectional relationship between FDI and EX in Mexico. Aizenman and Noy (2006) show that the feedback effects between trade and FDI are stronger in developing countries than in industrialized countries, which indicates that the bulk of the FDI to developing countries has been vertical. Pramadhani, Bissoondeeal and Driffield (2007) show that there are indeed causal links among FDI, trade and their sensitivity to growth effects in Indonesia. Prasanna (2010) finds a significantly positive impact of FDI inflows on export performance in India.

As for European emerging countries, Jun and Singh (1996) explore six CEE countries and manifest that FDI and exports are unrelated. Furthermore, their opinion is strengthened by Fabry (2001), who investigates the relationships among FDI, economic growth, and exports in CEE countries. Damijan, Kostevc and Rojec (2013) show that FDI has significantly contributed to export restructuring in CEE countries. However, the effects of FDI are heterogeneous across countries. While more advanced core CEE countries succeeded in boosting exports in higher-end technology industries, noncore CEE countries stayed with export specialization in lower-end technology industries. Bajgar and Javorcik (2016) suggest that FDI inflows have facilitated export upgrading by Romanian firms. Ciani and Imbruno (2017) investigate how inward FDI affects export performance in Bulgaria and find that export spillovers from FDI via horizontal, forward and backward linkages generate heterogeneous effects across several components of export revenues. Positive forward spillovers from FDI onto export revenues can occur and are associated with an increase in quantity without any change in price.

Hošková (2001) proposes that the impact of foreign investors established in Slovakia on the trade balance is significant considering the small market, which indicates how successful these investors have been in meeting the objective of pro-export orientation. Sochulakova and Igazova (2013) believe that FDI has an impact on lowering the unemployment rate as it enables the opening of new positions and promotes economic growth. For the small and open Slovakian economy, FDI is a key resource for new technologies and knowledge; it is a tool for opening new jobs. FDI means access to international markets and the improvement of the economic situation in the country. Zysk and Śmiech (2014) point out that Slovakia is a country where FDI is the strongest determinant of foreign trade. A smaller impact of FDI on bilateral exchange is recorded for Poland and the Czech Republic.

However, the previous literature has its shortcomings. Zhang and Song (2002) find that increased levels of FDI positively affect manufacturing export performance. However, the authors do not consider the total amount of EX. Although most researchers analyze the relationships between FDI and economic growth or EX and economic growth (Pramadhani, Bissoondeeal and Driffield, 2007; Jayachandran and Seilan, 2010; Acaravci and Ozturk, 2012), they neglect the interaction between FDI and EX.

Acaravci and Ozturk (2012), Ferencikova (2012) and Szkorupová (2014) reveal that foreign investors have contributed significantly to the Slovakian economic boom; however, they do not empirically confirm the causal relationship between FDI and EX. Most importantly, the current methodologies include panel causality tests (Falk and Hake, 2008), vector autoregressive (VAR) models (Pelinescu and Radulescu, 2009), and vector error correction models (VECM) (Szkorupová, 2014). However, the results from the full-sample data may be inaccurate because they ignore structural changes, including external shocks and modifications in the economic structure (Balcilar and Ozdemir, 2013).

This paper presents a significant contribution to the literature by considering the time variation in the causal links between FDI and EX. The bootstrap rolling-window method is better than most conventional mathematical approaches, which cannot identify full-sample relationships, especially the subsample relationships within the time series, and cannot reveal how such relationships vary over time. This issue can be addressed by allowing the causal link between the two series to be time-varying rather than using full-sample data that assume that a single causal relationship applies to every period.

In this paper, we test for causality on the rolling subsample, allowing us to consider structural changes in the sample and the evolution of the causality throughout subperiods rather than simply testing for causality in the full sample, which assumes a permanent causal relationship. The empirical results show that in several subsamples, a positive causal relationship of FDI and EX (unidirectional or bidirectional) exists. However, in a special period, these two variables show the opposite correlation. This finding is not in line with the knowledge capital model developed by (Carr, Markusen and Maskus, 2001), which means that FDI could hinder EX in some periods.

This paper is structured as follows. Section 1 introduces the knowledge--capital model. Section 2 sheds light on the methodology of the bootstrap rolling-window causality test. Section 3 describes the data. Section 4 explains the empirical results and offers corresponding policy implications. Last section concludes the study.

1. Knowledge-Capital Model

The knowledge capital model (Carr, Markusen and Maskus, 2001) was developed from lateral direct investment theory (Markusen, 1984) and vertical direct investment theory (Helpman, 1984). Markusen and Maskus (2002) further improve this model. Vertical direct investment theory means that companies assign different stages of production to various countries that have comparative advantages. This theory argues that the fundamental motivation of enterprises is to make use of international differences in factor endowments. Therefore, this type of FDI is also known as efficiency-seeking FDI. Lateral direct investment theory means that companies produce and sell the same products in multiple countries at the same time. This type of FDI is also known as market-seeking FDI since its ultimate goal is to produce and sell products in the host country but not the international market. However, the paradox is that lateral and vertical direct investment theory are incompatible, but they coexist. To solve this problem, Carr, Markusen and Maskus (2001) build the knowledge capital model by unifying these two theories under the premise of allowing for the existence of different factor intensities between headquarter services and actual production activities. In this model, the various knowledge assets created by the headquarters of the multinational corporation include research and development, management, marketing and finance. The knowledge capital has three properties: fragmentation, skilled-labor intensity, and jointness.

The knowledge-capital model assumes the existence of two homogeneous goods (X and Y), two countries (U and V), and two types of homogeneous factors (unskilled labor (L) and skilled labor (S)). Good Y is labor-intensive and produced under constant returns to scale in a competitive industry. Good X is skilled labor-intensive overall, displays increasing returns to scale and is subject to Cournot competition with free entry and exit. In terms of this good's headquarter services and plants, facilities may be geographically separated, and a firm may have plants in one or both countries (Carr, Markusen and Maskus, 2001). The process of corporate decision-making follows the two-stage game. In the first stage, a corporation decides the headquarter location, number of factories and type of FDI. In the second stage, the organization decides the output based on the homogeneous product Cournot competition model. Different characteristics of knowledge capital determine the type of multinational companies. Corporations select a different business model based on the various situations in the market.

This theory hypothesizes that the relationship between FDI and EX depends on the property of FDI. If FDI is a lateral direct investment in the host country, then the primary motivation of FDI is to meet the domestic demand, and it will have adverse effects on the host country's exports. If FDI is a vertical direct

investment in the host country, then the main motivation of FDI is to the product by utilizing the host country's comparative advantage to meet the international market demand, which will have positive effects on the host country's exports. Suppose various countries (C_1, C_2, …, C_n) and two types of production factors that include unskilled labor (L) and skilled labor (S) exist. The only difference among these countries is the intensity of the production factors (I) that are uniformly distributed in the interval of [0, 1]. If $I > 0.5$, then country C_i is capital-intensive, and if $I < 0.5$, country C_i (i $\in$ [1, n]) is labor-intensive. This study supposes that inward FDI has existed in each country since the existence of trade barriers. Exports are not always the best choice for a multinational corporation since the tariff costs of exports may be higher than the cost of directly investing in the host country. Each country has two types of FDI: vertical direct investment and lateral direct investment (Carr, Markusen and Maskus, 2001). If the amount of the vertical direct investment is greater, then $I < 0.5$, which indicates that a majority of FDI is motivated to utilize the host country's comparative advantage (cheap labor resources); as a result, FDI in country C_i has positive effects on its exports. If the amount of the lateral investment is greater and $I > 0.5$, then C_i is a skilled-intensive country, which indicates that the majority of FDI is motivated to meet the domestic market demand; as a result, FDI in country C_i has no significant positive effects on its exports. According to the knowledge-capital model, the bidirectional relationship between FDI and EX can be constructed for country C_i as follows.

$$FDI = \begin{cases} FDI \rightarrow EX & If \;\; I < 0.5 \\ FDI \nrightarrow EX & If \;\; I > 0.5 \end{cases} \tag{1}$$

2. Methodology

2.1. Bootstrap Full-sample Causality Test

According to Sims et al. (1990), statistics such as the likelihood ratio (LR) and Lagrange multiplier (LM)[3] may not have standard asymptotic distributions because structural changes always exist in a time series and the VAR model (Sims, Stock and Watson, 1990; Toda and Phillips, 1993; 1994). Toda and Yamamoto (1995) propose a modified Wald test that acquires a standard asymptotic distribution by computing an augmented VAR model with $I(1)$ variables.

[3] LR tests have been proven to have better performance when testing a causality relationship (Shukur and Mantalos, 2000). The LM test is the foundation for parameter constancy against the alternative hypothesis that the parameters follow a random-walk process (Balcilar, Gupta an Miller, 2014).

However, this test fails in small- and medium-sized samples under Monte Carlo simulations. Shukur and Mantolos (2000) indicate that as a result of using the residual-based bootstrap (*RB*) method, critical values in power and size are significantly improved. Moreover, several studies have confirmed the effectiveness of this method without considering whether the two variables are cointegrated (Mantalos and Shukur, 1998; Shukur and Mantalos, 2000; Balcilar, Ozdemir and Arslanturk, 2010). Shukur and Mantalos (2000) prove that the *RB* method is particularly appropriate for standard asymptotic tests and for the power and size properties in small-sample corrected *LR* tests. Thus, we choose the *RB*-based modified *LR* statistic. We consider the VAR process as follows:

$$y_t = \varphi_0 + \varphi_1 y_{t-1} + \ldots \varphi_p y_{t-p} + \varepsilon_t,\ t = 1,\ 2,\ \ldots,\ T \tag{2}$$

where $\varepsilon_t = (\varepsilon_{FDI,t},\ \varepsilon_{EX,t})'$ follows a zero mean, independent, white noise process with a nonsingular covariance matrix, and optimal lag length p can be obtained from the Schwarz information criterion (SIC). By splitting it into two subvectors, $y_t = (y_{FDI,t},\ y_{EX,t})'$, the above equation can thus be written as follows:

$$\begin{bmatrix} y_{FDI,t} \\ y_{EX,t} \end{bmatrix} = \begin{bmatrix} \varphi_{10} \\ \varphi_{20} \end{bmatrix} + \begin{bmatrix} \varphi_{FDI,FDI}(L) & \varphi_{FDI,EX}(L) \\ \varphi_{EX,FDI}(L) & \varphi_{EX,EX}(L) \end{bmatrix} \begin{bmatrix} y_{FDI,t} \\ y_{EX,t} \end{bmatrix} + \begin{bmatrix} \varepsilon_{FDI,t} \\ \varepsilon_{EX,t} \end{bmatrix} \tag{3}$$

where $y_{FDI,t}$ is the FDI, and $y_{EX,t}$ is the EX. $\varphi_{ij}(L) = \sum_{k=1}^{p+1} \varphi_{ij,k} L^k$, where L is the lag operator ($L^k x_t = x_{t-k}$).

We tested the null hypothesis that FDI does not Granger cause EX by imposing the restriction where $\varphi_{12,k} = 0$, $k = 1,\ 2,\ 3,\ \ldots,\ s$. The null hypothesis that EX does not Granger cause FDI can be similarly tested. Thus, if the null hypothesis is rejected, EX Granger causes FDI significantly.

2.2. Parameter Stability Test

One of the assumptions for the full sample test in VAR model is the parameters are constant. This assumption may be wrong if structural changes are shown in the underlying full-sample time series, and the causal links become unstable (Balcilar and Ozdemir, 2013). Thus, we test the stability of parameters both in the short-run and in the long-run. We examine the stability of the short-term parameters by using the Sup-*F*, Mean-*F* and Exp-*F* tests (Andrews 1993; Ploberger, 1994). These tests can be utilized to investigate the parameter stability in short-run. We also use the *Lc* test from Nyblom (1989) and Hansen (2002) to examine whether parameters are stable in the long-run. These tests are calculated

from the sequence of *LR* statistics, which test the stability of parameters versus the alternative of a single structural break at an unknown point. Andrews (1993) notes that statistics require 15 percent trimming from both ends of the sample to test the stability of the parameters in the short-run. Thus, the fraction of the sample in (0.15; 0.85) is needed.

2.3. Subsample Rolling-window Estimation

This paper applies rolling-window bootstrap estimation to solve the parameter nonconstancy and avoid pretest bias (Balcilar, Ozdemir and Arslanturk, 2010). There are two obvious benefits to using the rolling estimation. First, the causal relationship between two series can change with varying times in the rolling-window method. Second, because of the existence of structural changes, a rolling technique is unstable in different subsamples. The rolling-window method relies on fixed-size subsamples sequentially rolling from the beginning to the end of the full sample (Balcilar, Ozdemir and Arslanturk, 2010). In this regard, supposing the rolling window includes T observations, instead of estimating one causality test, we have a $T - s$ sequence of causality tests to estimate, that is, $\tau - s + 1$, $\tau - s$, ..., T for $\tau = s, s + 1, ..., T$, with a fixed rolling-window s observation. Every subsample can be estimated, and the *RB*-based modified *LR* test can ensure the accuracy of the results. The time-varying causality between FDI and EX can be intuitively noted by computing the bootstrap p-values of this estimation. We utilize the rolling method to obtain a large number of estimations; their average ($N_b^{-1}\sum_{21,k}^{p}\hat{\phi}_{21,k}^{*}$, $N_b^{-1}\sum_{12,k}^{p}\hat{\phi}_{12,k}^{*}$) is defined as the impact of FDI and EX, which are the explained variables. Additionally, N_b^{-1} is the repetitions using the bootstrap,[4] and both $\hat{\varphi}_{21,k}^{*}$ and $\hat{\varphi}_{12,k}^{*}$ are rolling estimates from the VAR models. With a confidence interval of 90%, the lower and upper limits equal the 5th and 95th quantiles of each $\hat{\varphi}_{21,k}^{*}$ and $\hat{\varphi}_{12,k}^{*}$, respectively (Balcilar, Ozdemir and Arslanturk, 2010).

In the rolling-window estimation, there are two conflicting objectives, the first of which is the precision of the model estimates, and the second of which is the representativeness of the method over the subsample periods. The window size influences the accuracy of the estimations and the number of observations. A large window with more observations can promote accuracy, but it also reduces the representativeness because of heterogeneity. However, a small window size could improve the representativeness and reduce the accuracy. Therefore,

[4] In this study, the bootstrap estimates and bootstrap p-values are based on $N_b^{-1} = 2000$.

we must choose a proper window size to ensure both accuracy and representativeness. Pesaran and Timmerman (2005) confirm that the optimal window size under structural change depends on the persistence and size of the break considering the structural change, which is according to the square root mean square error. Their Monte Carlo simulations indicate that the bias in autoregressive (*AR*) parameters is minimized with a window size of approximately 10 – 20 when there are frequent breaks (Balcilar, Ozdemir and Arslanturk, 2010). A large window size may ensure the accuracy of the parameter estimates, but a window size that is too large will increase the risk of including some of these multiple shifts in the window sample claims for a smaller window size.

3. Data

We assess the causality between net FDI inflow and EX using the quarterly data in Slovakia for the period of 1995Q1 to 2014Q2. Inward foreign direct investment defines the FDI that inflows to this country. Export represents the export of goods and services at regular prices (Szkorupová, 2014). We use data on the macrolevel according to the studies of Kristjánsdóttir (2010), Choi (2016) and Li et al. (2017). Kristjánsdóttir (2010) employs a knowledge-capital model and the accumulated stock of inward FDI to determine how FDI in a small open economy compares with that of larger countries. Choi (2016) uses a balanced panel of 57 countries over the period 1999 – 2010 based on the knowledge--capital model framework. The data on the dependent variables are annual flow data for aggregate FDI and FDI in the manufacturing and service sectors from Korea to host countries. Li et al. (2017) test the causal relationship between FDI and exports in China using macro monthly data. Our data are collected from EUROSTAT and the central bank of the Slovak Republic and are adjusted to eliminate seasonal factors.

Slovakia achieved macroeconomic stability though some market-oriented structural reforms after separating from Czechoslovakia. Slovakia is a post-communist country, and the development of FDI flowing into the country had an upward trend until the year 2000, but its volume and pace lagged far behind the needs of the economy and that of neighboring countries undergoing restructuring (Hošková, 2001). Slovakia joined the European Union in 2004 and the Eurozone in January 2009. Combined with earlier privatization and liberalization in the financial sector, EU accession reduced the barriers for international investors (Backé and Wójcik, 2008; Huefner and Koske, 2008), which boosted foreign investment and EX. Since the 2000s, Slovakia has been pursuing a policy of encouraging foreign investment, which is starting to gain in intensity. FDI inflow

has grown more than 600% since 2000 and cumulatively reached all-time highs of USD 17.3 billion in 2006 and approximately USD 22000 per capita by the end of 2008. Meanwhile, the series of tax reforms have reduced production costs, encouraging output and EX. Unsurprisingly, the global crisis and European debt crisis in 2008 reduced the worldwide supply of investment funds, particularly for emerging economies in the EU and Eurozone (Walch and Wörz, 2012). Consequently, foreign trade suffered a serious blow in 2009, when exports fell by 15% in Slovakia. The slump in the worldwide supply of investment funds affected FDI, while the decrease in EX is attributable to the reduction in foreign demand. Furthermore, Euro appreciation reduced the relative attractiveness of Slovakia as an investment location for export production, which decreased the level of FDI (Fidrmuc et al., 2013).

4. Empirical Results

The first step is to test the stationarity of FDI and EX. We use the ADF (Dickey and Fuller, 1981), PP (Phillips and Perron, 1988) and the KPSS (Kwiatkowski et al., 1992) unit root tests to certify stability. EX shows its stationarity in first--order difference series based on ADF, PP and KPSS nontrend unit root tests, while the original series of FDI is stationary (see Appendix Table A2). Therefore, we use FDI as the level and EX as the first difference in our analysis. We then test the conventional full-sample causality link between these two series by the VAR model. The bivariate VAR models are the FDI and EX, which are constructed as in Equation (3). Based on the Schwarz information criterion (SIC), the optimal lag lengths of FDI and EX are 2. We obtain the results in Table 1 by using full-sample causality results based on the *RB*-based modified *LR* causality tests. The null hypothesis is that EX does not Granger cause FDI, and vice versa, in the full sample. Based on the bootstrap *p*-values, FDI does not Granger cause EX, and vice versa. This finding contradicts most of the existing literature, which argues that a unidirectional or bidirectional causal link exists between FDI and EX. We consider whether structural changes lead to this conflict; thus, it is critical to reexamine the data and improve the methodology.

T a b l e 1

Full-Sample Granger Causality Tests

Tests	**H_0: FDI does not Granger cause EX**		**H_0: EX does not Granger cause FDI**	
	Statistics	*p*-values	Statistics	*p*-values
Bootstrap *LR* Test	0.524	0.340	0.787	0.500

Source: Caculated by R software.

Regarding the existence of structural changes, the full-sample causal relationship estimation with assumptions of parameter constancy and a single causality across the whole sample period are no longer persuasive; that is, the results are not convincing (Zeileis et al., 2005). When considering the structural changes, the parameters in the above VAR models that are estimated by full-sample FDI and EX will vary with time; the causal link between them becomes unstable. Therefore, there is a default presumption in a previous study that there are no structural changes in the time series (Balcilar and Ozdemir, 2013). Consequently, this paper tests for parameter stability and examines the structural changes. Thus, we apply the Sup-*F*, Mean-*F* and Exp-*F* tests provided by Andrews (1993) to assess the temporal parameter stability in the VAR models using FDI and EX. The *Lc* test proposed by Nyblom (1989) and Hansen (2002) is also used to test for all parameters in the overall VAR system. The corresponding results are reported in Table 2. The results of the Sup-*F* tests under the null hypothesis of parameter constancy against a one-time sharp shift in parameters are listed in the first row of the table. The results suggest that a one-time sharp shift exists in FDI, EX and the VAR system at the 1% level. The Mean-*F* and Exp-*F* tests under the null hypothesis that parameters follow a martingale process against the possibility that the parameters may evolve gradually are presented in the second and third rows, respectively. The results suggest that the equations of FDI, EX and the VAR system may vary with time. The *Lc* statistics test against the alternative that the parameters follow a random-walk process, as proposed by Granger (1996), which means that the parameters are nonconstant in the overall VAR models. Consequently, these results provide robust evidence that short-run instability exists in the parameters of the above VAR model using full-sample data. The *FM-OLS* statistics are conducted to evaluate the cointegration between the two variables; the Sup-*F*, Mean-*F*, Exp-*F*, and *Lc* tests are used to estimate the parameter stability in the long run. The results are summarized in Table 3.

T a b l e 2

Parameter Stability Tests

	EX Equation		**FDI Equation**		**VAR (1) System**	
	Statistics	Bootstrap *p*-value	Statistics	Bootstrap *p*-value	Statistics	Bootstrap *p*-value
Sup-F	48.788***	0.000	39.248***	0.000	41. 869***	0.000
Mean-F	15.590***	0.000	18.955***	0.000	14.296*	0.080
Exp-F	20.940***	0.000	16.071***	0.000	16.927***	0.000
L_c^b					2.65**	0.030

Notes: *, ** and *** denote significance at 10, 5 and 1 percent, respectively. Hansen-Nyblom parameter stability test for all parameters in the VAR (1) jointly.

Source: Caculated by R software.

Table 3

Parameter Stability Tests in Long-run Relationship in Slovakia

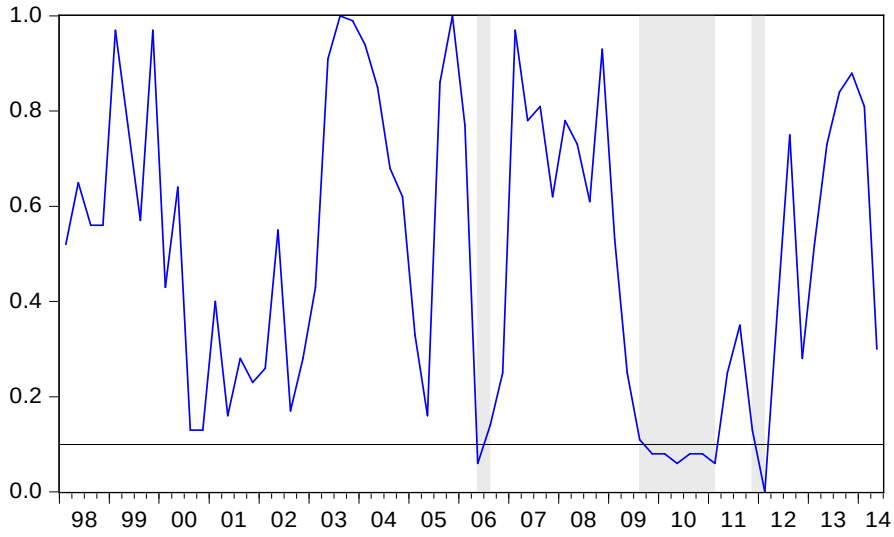
	Sup-*F*	Mean-*F*	Exp-*F*	L_c
FDI = α + β*EX	366.520***	158.482	179.864	7.589***
Bootstrap *p*-value	0.000	0.000	1.000	0.005

Notes: *** indicates significance at the 1 percent level.

Source: Caculated by R software.

Figure 1

Bootstrap *p*-values of Rolling Test Statistic Testing the Null that EX Does Not Granger Cause FDI



Source: Caculated by Eviews software.

In the subsample rolling-window causality test, we employ the *RB*-based modified *LR* causality tests to examine the causal link between FDI and EX. The null hypothesis of the tests is that EX do not Granger cause FDI, and vice versa. We can estimate the bootstrap *p*-values of *LR* statistics from the VAR models in Equation (3) by using the rolling subsample data with the 12-quarter[5] observations. This window size excludes the observations required for lags and, hence, is the actual number of observations in the VAR. In addition, the results are presented in the tests of the causal relationship between FDI and EX in Slovakia by

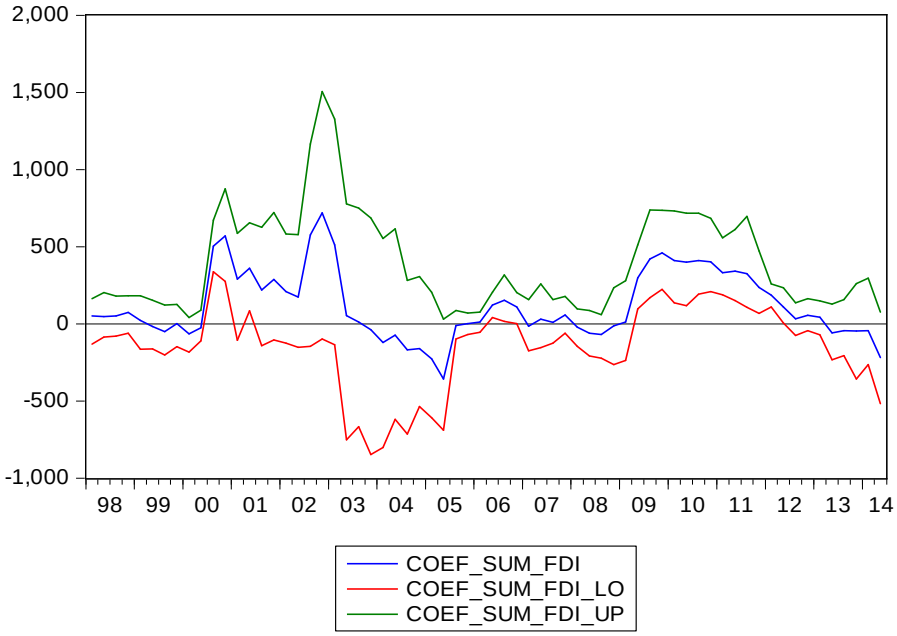
[5] No consistent criterion is available to determine the window size in the rolling-window test (Balcilar, Ozdemir and Arslanturk, 2010). Therefore, we conduct several iterations of the bootstrap rolling-window causality tests by employing different window sizes. Monte Carlo simulations indicate that the biases in AR parameters are minimized with a window size of approximately 10 – 20 (Balcilar, Ozdemir and Arslanturk, 2010). We then select different window sizes (e.g. 8, 12, 16 and 20 quarters), which produce similar results. We therefore select a 12-quarter window size, and the bootstrap technique employed in the rolling estimation allows for better precision.

the approach of the *RB*-based modified *LR* causality tests. Figure 1 shows the rolling bootstrap of the *p*-values of the *LR* statistics using FDI as the dependent variable in Slovakia. The null hypotheses can be rejected when the rolling bootstrap of the *p*-values is less than 10%. Intuitively, we can find that the null hypothesis is significantly rejected in several periods (2006Q2 – 2006Q3, 2009Q3 – 2011Q1 and 2011Q4 – 2012Q1).

Figure 2 presents more specific magnitudes of the impact using FDI as the dependent variable. Corresponding to Figure 1, we can see the rolling estimates of the magnitude of the effect that EX have on FDI from Figure 2.

F i g u r e 2

Bootstrap Estimates of the Sum of the Rolling Window Coefficients for the Impact of EX on FDI



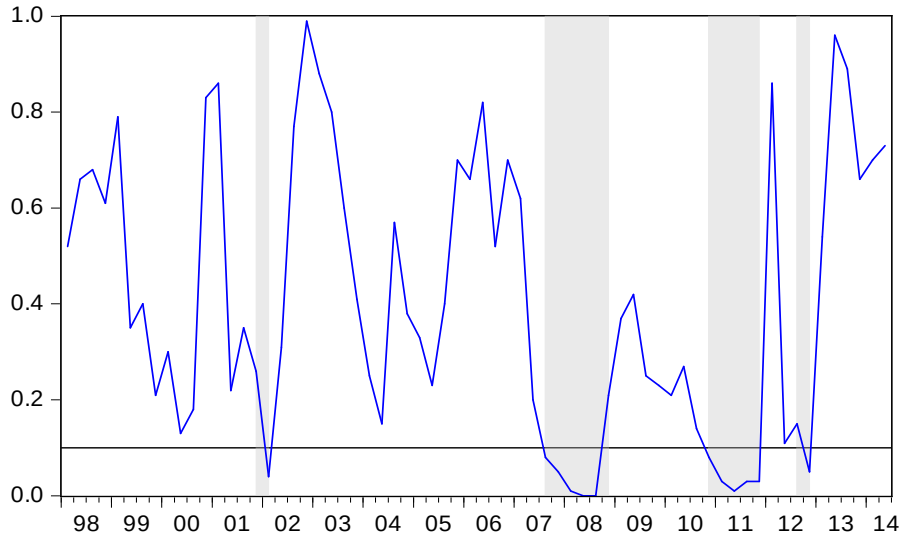
Source: Caculated by Eviews software.

In subsample 2006Q2 – 2006Q3, EX have a positive impact on FDI. The Slovakian government has implemented a series of tax reforms, including reducing personal income tax and corporate income tax and the adjustment of value added tax and consumption taxes. These tax reform policies promote the employment rate and efficiency (Moore, 2005), reducing production costs and increasing national output. Thus, the exports significantly increase and spur the rise in FDI. A long sub-period positive causality from 2009Q3 to 2011Q1 existed, when the global financial crisis occurs. The financial crisis worsened the international

financial markets due to liquidity problems and contagion effects, which have been enlarged by the European sovereign debt crisis (Fidrmuc et al., 2013). World-wide financial crises have different stages, but all reflect economic downturn (Moldovan et al., 2016), which could reduce global demands and hit foreign trade particularly hard. In 2009, exports fell by 15% in Slovakia, leading to a decrease in FDI. The accompanying debt crisis broke out in Greek and has prolonged economic depression. Furthermore, Slovakia's export-led growth strategy has vulnerability. The Slovakian economy has become strongly dependent on foreign demand, especially in European countries. For example, during this period, the drop in demand has been especially serious for automobiles, iron and steel, and building materials (Fidrmuc et al., 2013). The decrease in EX preceded the reduction in FDI, which contributed to the third causality relationship in the period 2011Q4 – 2012Q1.

F i g u r e 3

Bootstrap *p*-values of Rolling Test Statistic Testing the Null that FDI Does Not Granger Cause EX



Source: Caculated by Eviews software.

Figure 3 presents the rolling bootstrap *p*-values of the *LR* statistic with the null hypothesis that FDI does not Granger cause EX. We clearly find that the null hypothesis is significantly rejected in certain periods (2001Q4 – 2002Q1, 2007Q3 – 2008Q4, 2010Q4 – 2011Q4 and 2012Q3 – 2012Q4). Figure 4 reports the rolling estimates of the magnitude of the effect that FDI has on EX. Specifically, FDI exerts a positive effect on EX in most subperiods mentioned above, except 2010Q4 – 2011Q4. An active investment promotion policy, business

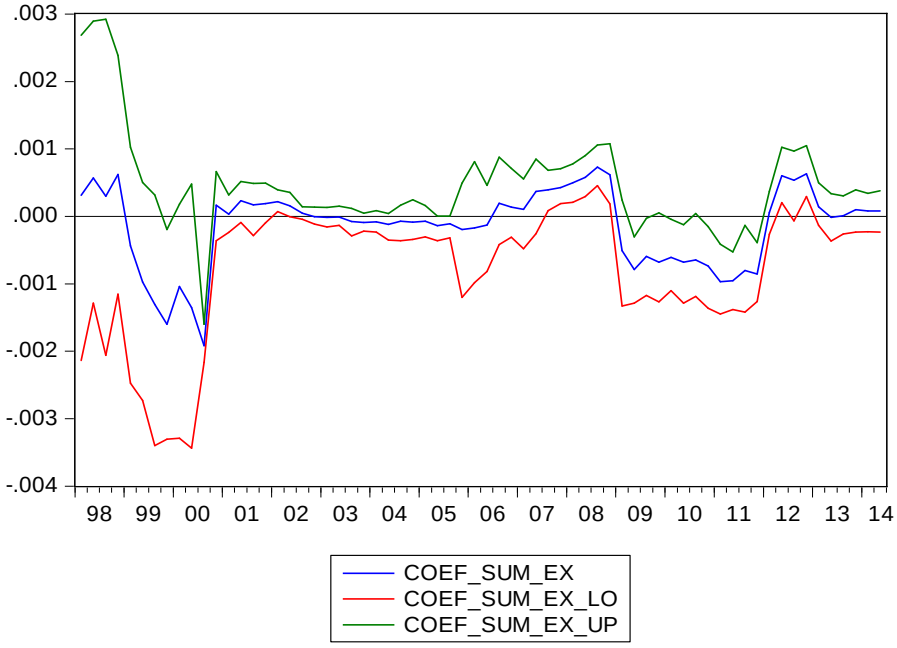
structural reforms, low corporate income taxes and the prospect of EU accession have contributed to a surge in inflows of FDI since the early 2000s (Fidrmuc et al., 2013). With these advantages, Slovakia has attracted a large number of foreign investments, which practically confirm the impact of FDI on the economy (Hošková, 2001). Then, the corresponding increase can be found in the exports. In the next three sample windows (2007Q3 – 2008Q4, 2010Q4 – 2011Q4 and 2012Q3 – 2012Q4) that exist in causal relationships, there are large fluctuations that occur during severe financial crises, including subprime crises and European debt crises. In 2007Q3 – 2008Q4, the global financial crisis reduced the worldwide supply of investment funds, especially in emerging economies in the EU and Eurozone (Walch and Wörz, 2012). Although the origin of the crisis was external, domestic demand suffered greatly. Specifically, credit standards were tightened, leading to an increase in borrowing costs. Meanwhile, income growth declined, while the labor market deterioration weighed on consumer confidence, and the bleak external outlook made firms revise their investment plans downward. Slovakia has gradually lost its advantages of inexpensive labor and land (Fidrmuc et al., 2013). In the post-financial crisis era (2010Q4 – 2011Q4), the causality presented a negative interaction. The early decision on Euro adoption may have ensured that Slovakia faced the financial crisis with lower vulnerabilities than other emerging CEE countries, avoiding a strong deleveraging episode. FDI inflows increased moderately as the real exchange rate appreciated. However, tight trade linkages with Germany and other Eurozone countries mean that growth shocks in those countries are transmitted to Slovakia via slower trade growth. Slovakia is especially sensitive to developments in Germany and in the Eurozone, on which it has nearly the highest trade dependence. The weak economic performance of the Eurozone resulted in declining shares of this region in exports from Slovakia (Fidrmuc et al., 2013). From 2012Q3 to 2012Q4, Euro appreciation vis-a-vis the CEE countries outside the Eurozone reduced the relative advantages of Slovakia as an investment destination for export production. Moreover, frequent changes in legislation imposed by new governments and an associated risk of regulatory uncertainty would divert investors from Slovakia to other emerging economies (Fidrmuc et al., 2013). The decline in EX follows the slump in FDI.

Thus, certain structural changes arise from important economic reforms and financial crisis, and the causal relationship between the FDI and EX has been proven unstable. In most fluctuation periods, we find a significant correlation between the two series. The results break through the knowledge-capital model (Carr, Markusen and Maskus, 2001), which verifies the negative correlation between FDI and EX. Specifically, in the subperiod of 2001Q4 – 2002Q1, a unidirectional

link between FDI to EX existed, which can be explained by the important role of market potential, low relative unit labor costs, skilled workforce and relative endowments in determining the flows of FDI into countries (Carstensen and Toubal, 2004). In this way, the rise in FDI promotes the whole economy, consequently the exports. From 2006Q2 to 2006Q3, a unidirectional link between EX to FDI existed. The tax reforms promoted the employment rate and efficiency (Moore, 2005). In addition, the EU accession in 2005 reduced trade barriers, which encouraged the increase in FDI. Between 2008 and 2012, the casual relationships between FDI and EX were either positive or negative, which can be explained by the relative state of the situation at home and abroad.

F i g u r e 4

Bootstrap Estimates of the Sum of the Rolling Window Coefficients for the Impact of FDI on EX



Source: Caculated by Eviews software.

Conclusion

This study employs the bootstrap Granger full-sample causality test and subsample rolling window to test the causal relationship between FDI and EX in Slovakia. We confirm that the results of the full-sample causality test are unreliable and that causal links between FDI and EX are unstable across the

full-sample data. Significant effects between the two series always exist around periods of large economic fluctuations. The empirical results show that FDI is vertical direct investment in most periods because the main foreign investors are companies from Germany, the Netherlands, France and Austria (Owczarczuk, 2013), and FDI in Slovakia has positive effects on its EX. The primary motivation of FDI is production by utilizing the host country's comparative advantage to meet the international market demand. However, the existence of a negative interaction contradicts the knowledge-capital model (Carr, Markusen and Maskus, 2001); that is, the rise in FDI will not improve EX. Generally, economic liberalization processes such as EU accession and tax reforms enhance the attraction for foreign investors. Combined with the market potential and low relative unit labor costs, both FDI and EX promoted each other before the crisis period. Nevertheless, the financial crisis severely affected FDI and EX since they are limited by the domestic market and overdependence on exports. Additionally, the comparative advantage of less expensive labor that foreign investors make use of in a country is not a permanent phenomenon. It is therefore important to broaden the domestic demands and strengthen other facets of comparative advantage, such as the skills and creative abilities of the workforce.

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Appendix

When evaluating VAR models, the *LM* autocorrelation test should also be taken into account. According to the Table A1, the null hypothesis is no series correlation. We can infer from that the null hypothesis is accepted for 5 lags, thereby the estimates are consistent.

Table A1

LM Autocorrelation Test

Lags	***LM*-stat**	**Prob**
1	0.177	0.996
2	3.884	0.422
3	1.837	0.766
4	3.809	0.433
5	3.574	0.467

Source: Caculated by Eviews software.

Table A2

Unit Root Tests Results

Variables	**ADF**		**PP**		**KPSS**	
	Trend	Non-trend	Trend	Non-trend	Trend	Non-trend
EX	–0.314(1)	–3.021(1)	0.114[3]	–2.545[3]	1.173 [6]***	0.127[6]*
FDI	–7.124(0)***	–7.128(0)***	–7.124[0]***	–7.128[0]***	0.366[3]	0.291[2]
ΔEX	–5.196(0)***	–5.225(0)***	–5.234[2]***	–5.258[2]***	0.059[3]	0.119[3]
ΔFDI	–8.189(3)***	–8.164(3)***	–39.977[2]***	–30.648[2]***	0.202[3]	0.291[3]

Note: *** and * denote the rejection of the null of unit root at 1% and 10% level of significance. The null hypothesis for KPSS is that the time series is stationary. The number in parentheses indicates the select lag order of the ADF model. Lags are chosen based on AIC. The number in brackets indicates the lag truncation for the Bartlett Kernel, as suggested by the Newey-West test (1987).

Source: Caculated by Eviews software.