

AN EMPIRICAL SECTOR-SPECIFIC GRAVITY MODEL FOR HUNGARIAN INTERNATIONAL TRADE

Jana Šimáková¹, Daniel Stavárek¹

¹ Department of Finance and Accounting, School of Business Administration in Karvina, Silesian University in Opava, Univerzitní náměstí 1934/3, 733 40 Karviná, Czech Republic

Abstract

ŠIMÁKOVÁ JANA, STAVÁREK DANIEL. 2015. An Empirical Sector-Specific Gravity Model for Hungarian International Trade. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 63(6): 2145–2150.

This paper contributes to the economic literature on the impact of exchange rate volatility on Hungary's foreign trade. Basic gravity model shows that trade volume between a pair of countries is an increasing function of their sizes (GDP) and a decreasing function of the distance between them. Additional factors included in extended model are population, dummy for common border and proxy for exchange rate volatility. The measure of exchange rate volatility is estimated by GARCH model. This paper explores relationship between trade and exchange rate uncertainty using quarterly data over the period 1999:1 – 2014:3. In order to obtain the objective result, we use the panel data regression for 10 sectors of Hungarian international trade based on SITC classification and six major trading partners (Austria, Germany, France, United Kingdom, Italy and Poland). The significant parameters obtained from panel regression demonstrate that bilateral exchange rate volatility leads to a decrease in Hungary's foreign trade.

Keywords: exchange rate volatility, international trade, gravity model

INTRODUCTION

In the current world economic development, the effects of exchange rate uncertainty on macroeconomic variables, including international trade can hardly be ignored. Either theoretically or empirically, there exists almost no consensus on the effects of exchange rate uncertainty related to its impact on international trade.

While early theoretical studies using partial equilibrium analysis under risk aversion suggested a negative link between trade and exchange rate uncertainty (e.g. Ethier, 1973; Clark, 1973), more recent studies find that the link can be also positive or ambiguous depending on a variety of factors (e.g. Auboin and Ruta, 2013). Some later studies justified mixed results by including market conditions associated with derivative assets and the alternative of foreign direct investment into the models (e.g. Franke, 1991; Viaene and de Vries, 1992; Sercu and Vanhulle, 1992) and some recent studies evidenced this conclusion by taking into the account

the structure of the foreign trade in given country (e.g. Bahmani-Oskooee and Hajilee, 2013; Bahmani-Oskooee *et al.*, 2013).

The trade policy changes in the first half of the 20th century triggered widening in the number of theoretical models concerning the international trade. One of the most important and empirically most successful models is the gravity model of trade, which is at the center of our analysis. Since the seminal work of Tinbergen (1962), basic gravity model has been widely used to explain the volume of trade between two countries or regions. By linking trade flows directly with economic size of countries and inversely with trade costs, usually proxied by geographical distance between them as an indicator of transport costs, the gravity model points some insights in the pattern of international trade and production. Leamer and Levinsohn (1995) have argued that the gravity model has produced some of the clearest and most robust findings in empirical economics.

The aim of this paper is to estimate the effect of Hungarian forint volatility on international trade. For this purpose we follow the recent trend in decomposition of foreign trade to specific sectors on one hand and use the extended gravity equation as a representation of an empirically stable relationship between the size of economies, distance between them and realized trade volume on the other hand. This paper explores relationship between trade and exchange rate uncertainty over the period 1999–2014. In order to obtain the objective result, we use the panel data regression for 10 sectors of Hungarian foreign trade based on SITC classification.

Hungary's strategic position in Europe and its relative lack of natural resources makes this economy dependent on foreign trade. Hungary is a very open country with openness almost 160% in 2014. This contribution thus provides further evidence of the impact of exchange rate uncertainty on trade flows within the post-communist country after its total economic transformation. Market reforms liberalized prices and trade. Another aspect of this transformation was change of the exchange rate regime from fixation of the forint against a basket of currencies to the currency floating. In addition, Hungary is an interesting subject to study, as foreign trade serves the important channel of its economic integration within the European Union.

Review of Relevant Literature

As the name of the model suggests, the gravity model of trade derives from the law of universal gravitation formulated in 1687 by Isaac Newton, in which the size of the gravitational interaction is proportional to the multiplication of the weight of the two interacting objects and is inversely proportional to the square of their distance (Postenyi, 2014). The idea for using the gravity models to analyze international trade date back to Tinbergen (1962), Pöyhönen (1963) and Linnemann (1966). Following their works the basic gravity model tries to explain the volume of trade between two countries or regions by their economic size and distance.

The gravity model is a key tool for researchers interested in the effects of trade-related policies. It provides a convenient testing base on which to assess the trade impacts of different additional variables included in the model. Although the gravity model is seems to be an appropriate platform for applied international trade researchers, its use does not come without some potential pitfalls.

Following the initial works based more on the intuition, the theoretical foundations of gravity equations explaining international trade flows have been widely discussed and developed. These foundations mainly base on theories of international trade. Subsequent studies have shown that, far from being a purely econometric tool without a theoretical basis, gravity models can arise out of a range of trade theories. In particular, Bergstrand (1989) confirmed that a gravity model is in

accordance of model of trade based on monopolistic competition. In this model, identical countries trade differentiated goods because consumers have a preference for variety. Models with monopolistic competition overcome the undesirable feature of Armington models whereby goods are differentiated by location of production by assumption. Firm location is endogenously determined and countries are specialized in the production of different sets of goods. Deardorff (1998) contributes that the gravity model can arise from a traditional factor-proportions explanation of trade. Eaton and Kortum (2002) derive a gravity-type equation from a Ricardian type of model, and Helpman *et al.* (2008) and Chaney (2008) obtained it from a theoretical model of international trade in differentiated goods with firm heterogeneity.

The impact of exchange rate volatility on Hungarian foreign trade was investigated mostly by other techniques than the gravity model. Ozturk and Kalyoncu (2009) investigated empirically the impact of exchange rate volatility on the trade flows of six countries over the quarterly period of 1980–2005. The impact of a volatility term on trade is examined by using an Engle-Granger residual-based cointegrating technique. The major results show that increases in the volatility of the real exchange rate, approximating exchange-rate uncertainty, exert a significant negative effect on trade for South Korea, Pakistan, Poland and South Africa but positive effect for Turkey and Hungary in the long run.

This conclusion is in opposite to findings of previous studies which confirmed indirect relationship between exchange rate volatility and international trade (e.g. Gotur, 1985; Bailey *et al.*, 1987; Chou, 2000). In addition, Tomanová (2013) analyzed impact of exchange rate volatility on the export performance of Central and Eastern European countries. Volatility's impact on export performance is estimated on bilateral export flows of Czech Republic, Slovakia, Hungary and Poland to euro area by using monthly time series data, over the period 1999:01 to 2013:3. For the volatility measurement, G/ARCH models were used. Autoregressive distributed lag and error-correction approach were used to examine the impact of exchange rate volatility on the exports. The results suggest no significant relationship among the exchange rate volatility and export performance in Central European Economies, impact of exchange rate volatility turns out to be ambiguous.

The gravity model approach to this issue in Hungary was realized in Šimáková (2014). This paper employed extended trade gravity model approach which included variables of GDP, population, distance, dummies for common border; membership in EU and proxy for exchange rate volatility. The volatility was estimated by standard deviation. The model was performed on quarterly data of total foreign trade over the period 1997:1–2012:2 and included 11 trading partners. The results

suggest that nominal exchange rate volatility of Hungarian forint has a significant negative effect on bilateral trade over the sample period (2%).

The empirical literature examining the effect of exchange rate volatility on sectoral trade in Hungary is even rarer. One study was made by Fogarasi (2011). His paper considered question of the effect of exchange rate volatility on international trade flows of transition economies in Central Europe by studying the case of Hungarian agricultural exports to their export destination countries between 1999 and 2008. Based on a gravity model that controls for other factors likely to determine bilateral trade, the results show that nominal exchange rate volatility has had a significant positive effect on agricultural trade over this period.

METHODOLOGY AND DATA

The considerations about theoretical foundations of the gravity model for analyzing international trade flows do not generate a proper and unique specification of the gravity equation used in empirical work. In the basic form of the gravity model, it is assumed that the amount of trade between two countries increases with their size measured by their national incomes and decreases with the cost of transport between them, measured by the distance between their economic centers (Tinbergen, 1962).

Linnemann (1966) included population as an additional variable for the size of the country and its economy in the gravity model. This model is sometimes called the augmented gravity model and can be formulated in equation (1):

$$X_{df} = \delta \frac{Y_d^{\beta_1} Y_f^{\beta_2} POP_d^{\beta_3} POP_f^{\beta_4}}{D_{df}^{\theta}}, \quad (1)$$

where δ , $\beta_{1(2, 3, 4)}$ and θ are the parameters of the modified equation, X_{df} is the bilateral trade between domestic country d and its foreign partner f , $Y_{d(f)}$ is income of respective country and $POP_{d(f)}$ is its population. D_{df} is the distance between two analyzed countries.

There is supposed the direct relationship between foreign trade and income as the exporter country indicates high level of production which increases the amount of exportable goods. Furthermore, high income in the importer country indicates higher level of import because higher income causes higher demand; therefore, the coefficient is expected to have a positive sign. The coefficient of population is supposed to be positive as well but some estimation can reveal theoretically justified indirect relationship with foreign trade. This is due the fact that big country can either export more than small countries due to economies of scale but either less when the absorption effect prevails and the country consumes what it produced resulting in fewer products to be exported (Martinez-Zarzoso, 2003).

The expected sign of the distance coefficient is negative as distance is a relatively good approximation of trade costs, the time elapsed during shipment, and various transaction and communication costs which are not easy to measure directly (Head, 2003). According to Arvas (2008), the distance can be a considered not only as a proxy for transport costs and an indicator of the time elapsed during shipment; it can be even correlated with the cost of searching for trading opportunities and considered as a proxy for culture differences connected to different consumer patterns.

The gravity equation is frequently extended to incorporate other factors that stimulate or reduce bilateral trade flows. Additional variables may be necessary depending on the purpose of the analysis. For the purpose of this paper, we incorporate exchange rate volatility and the existence of a common border into the model. Exchange rate is widely used as an explanatory variable, especially in panel analyses with long time periods.

There is no doubt about the theoretical explanation of relationship between exchange rate and trade turnover (see Clark, 1973; Hooper and Kolhagen, 1978), but as is evident from the review of the empirical research conducted in support of theoretical models', considerations provides ambiguous evidence on this issue. One can illustrate this lack of consensus by the conclusions formulated in Taglioni (2002) or Ozturk (2006), which hold that if the presumed adverse effect of exchange rate volatility on trade flows exists, it is certainly not large. This finding is shared by Rajan (2004), but he discovered that the exchange rate volatility is more likely to reduce international trade if the research focuses on bilateral trade instead of aggregate trade.

Regarding methodology, we follow Tichý (2007) and Baldwin *et al.* (2005) and employ the following extended gravity equation (2):

$$\ln X_{p,df} = \alpha + \beta_1 \ln Y_d + \beta_2 Y_f + \beta_3 \ln POP_d + \beta_4 \ln POP_f + \beta_5 \ln D_{df} + \beta_6 \ln V(ER)_f + \beta_7 \ln CB_{df} + u_{ij}, \quad (2)$$

where dummy variable CB_{df} represents a common border (it equals 1 if the trading partner shares a common border with a domestic country and 0 if not), $V(ER)_f$ is the exchange rate volatility, α and β_k are the unknown parameters of the model, and u_{ij} is the error term. X_p represents the total trade turnover between the pair of countries in an individual product group.

To measure the exchange rate volatility, we used GARCH model in following form (3):

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^m \alpha_i \epsilon_{t-i}^2 + \sum_{j=1}^s \beta_j \sigma_{t-j}^2, \quad (3)$$

where σ_t^2 is the conditional variance, parameter $\alpha_0 > 0$ and the constraints $\alpha_i \geq 0$, $\beta_j \geq 0$ are needed to ensure σ_t^2 is positive (Campbell *et al.*, 1997). The variance of

the disturbance term for each period is modelled as a function of the errors in the previous periods.

As Arvas (2008) states, standard gravity models usually employ cross-sectional data to estimate trade patterns in a given year, or averaged data. We employ a panel data regression to avoid the risk of choosing an unrepresentative year and to monitor unobservable individual effects between trading partners. This can provide additional insight into trading relationships. In addition, the use of panel data is particularly suggested for estimating the relationship between international trade and exchange rate volatility.

All time series used for estimation are on a quarterly frequency and cover the period from 1999:1 to 2014:3. The data of GDP, bilateral exchange rates, population, import and export flows were obtained from Eurostat. The data on the distance between Hungary and its trading partners were taken from the GeoDist database. The bilateral distances are measured using city-level data. The capital city is considered to be the economic center in all trading countries included in the estimations. GDP of each respective country is set in index form to make it unit free (Bahmani-Oskooee, 1991).

The product groups used in estimations are determined on the basis of SITC classification:

- T0: Food and live animals;
- T1: Beverages and tobacco;
- T2: Crude materials, inedible, except fuels;
- T3: Mineral fuels, lubricants and related materials;
- T4: Animal and vegetable oils, fats and waxes;

T5: Chemicals and related products;

T6: Manufactured goods;

T7: Machinery and transport equipment;

T8: Miscellaneous manufactured articles; and

T9: Commodities and transactions not classified elsewhere in the SITC.

Tab. I shows the average share of individual product categories on Hungary's total international trade during the period 1999–2014. Tab. I also includes percentage changes of the product groups' shares from 1999 to 2014. The highest share of total trade turnover falls into product categories T7 and T6. Their shares in sum represents more than 50%. In addition, in the share of product category T7 can be observable increasing in time.

RESULTS

The geographical pattern of foreign trade shows Hungary considerably oriented towards European Union. In the empirical estimation, we work with the six largest trading partners of Hungary: Austria (AT), Germany (DE), France (FR), United Kingdom (GB), Italy (IT) and Poland (PL).

In empirical testing was performed logarithmic transformation to reduce skewedness and heteroscedasticity and to stabilize variability. In this study is applied the least squares method for panel data in the extended gravity model estimation. The dependent variable in the model is the total trade turnover between Hungary and its selected trading partners within individual product

I: Commodity structure of Hungary's international trade (in %, 1999–2014)

	T0	T1	T2	T3	T4	T5	T6	T7	T8	T9
Share	9.67	0.56	4.97	10.05	0.86	9.66	21.13	34.37	7.80	0.92
Change	23.39	128.54	-52.86	-30.33	103.73	-27.88	-28.77	24.63	113.75	-30.31

Source: Author's calculation

II: Estimated coefficients of gravity model

	TT	T0	T1	T2	T3	T4	T5	T6	T7	T8	T9
Y_d	0.11	0.16	1.13	-0.06	0.11	0.23	-0.13	0.11	0.16	0.01	-0.47
	***	***	***				***	***	***		
Y_f	0.25	0.30	0.16	0.58	0.51	0.62	0.24	0.14	0.41	0.30	-0.04
	***	***		**			**	***	***	***	
POP_d	1.24	3.02	-0.95	1.33	-0.56	1.29	-0.23	0.40	-0.48	-1.18	-1.7
	**	**					*	***			
POP_f	-1.85	0.62	-0.41	0.59	-1.13	0.33	-0.51	-2.71	1.13	-1.04	-0.86
			*							**	
$V(ER)_f$	-0.19	0.00	-0.01	-0.01	-0.00	-0.00	-0.01	-0.00	-0.00	-0.00	-0.00
	**			**	**		***	***			
D_{df}	-0.00	-0.00	0.00	-0.00	0.00	-0.01	0.00	0.00	-0.00	-0.00	-0.16
	*			**							
CB_{df}	-0.00	0.00	0.00	-0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02
							**				

Note: ***, **, * denote significance level at the 1%, 5% and 10% level, respectively

Source: Author's calculation

groups. We have included 6 cross-sections (trading partners) and 63 periods (quarterly data between 1999:1 and 2014:3). The results of the estimation are summarized in Tab. II.

Considering Hungary's total trade with major partners, we can observe highly significant parameters which are in accordance with economic theory. Despite, results are more ambiguous when we disaggregate data into particular sectors. Significant parameters of domestic and foreign income (except T5 product group) revealed positive effect on foreign trade. Notably, the estimated influence of the domestic effect seems to be generally larger than the effect of foreign income. The effect of population on particular trade

turnovers are mixed and cannot be generalized. The theoretical foundation for positive as well as negative coefficients can be found in study of Martinez-Zarzoso (2003). Despite the significant direction of relationship between distance between economic centers and common border are in accordance with economic theory, estimated parameters are small, almost without no effect on Hungary's trade turnover. Regarding the effect of exchange rate volatility, our results are similar to results of Šimáková (2014) as the significant parameters demonstrate that bilateral exchange rate volatility leads to a decrease in trade of product groups TT, T2, T3, T5 and T6.

CONCLUSION

This paper contributes to the economic literature on the impact of exchange rate volatility on Hungary's foreign trade. For this purpose we followed the recent trend in decomposition of foreign trade to specific sectors on one hand and used the extended gravity equation as a representation of an empirically stable relationship between the size of economies, distance between them and realized trade volume, on the other hand. The volatility of bilateral exchange rates was incorporated into model as estimation of GARCH model.

Generally is assumed, that higher exchange rate volatility leads to higher transaction costs for traders and is followed by decrease of foreign trade. The significant parameters of estimation is in accordance to this statement and demonstrate that bilateral exchange rate volatility leads to a decrease in trade of crude materials, mineral fuels, lubricants, animal and vegetable oils, chemicals and manufactured goods. These sectors represents almost half of the total Hungary's foreign trade.

Usually, international trade tends to be a driver of the economy in countries neighboring with economies with open trade regimes, with high presence of multinational companies and large volume of re-exports. Foreign trade is an integral part of the total development growth and national growth of an economy of Hungary as well. In summary, the results based on disaggregated data clearly demonstrate that the increasing of exchange rate volatility reduces Hungary's foreign trade turnover. Therefore, economic instruments and active policy aimed at reducing exchange rate volatility would stimulate improvement of Hungary's trade.

Acknowledgement

Publication of this paper was supported by the Student Grant System of Silesian University [project SGS/7/2013].

REFERENCES

- ARVAS, A. M. 2008. Does Real Exchange rate Matter for Emerging Markets' International Trade? A Gravity Model Approach for Turkey. In: *Proceedings of First International Conference on Management and Economics*. Tirana: Epoka University Research and Application Center, 77–96.
- AUBOIN, M. and RUTA, M. 2013. The Relationship between Exchange Rates and International Trade: A Literature Review. *World Trade Review*, 12(3): 577–605.
- BAHMANI-OSKOOEE, M. 1991. Is there a Long-Run Relation between the Trade Balance and the Real Effective Exchange Rate of LDCs? *Economics Letters*, 36(4): 403–407.
- BAHMANI-OSKOOEE, M. and HAJILEE, M. 2013. Impact of Exchange-Rate Variability on Commodity Trade between U.S. and Germany. *Empirica*, 40(2): 287–324.
- BAHMANI-OSKOOEE, M. HARVEY, H. and HEGERTY, S. W. 2013. Exchange-Rate Variability and U.S.-French Trade Flows: Evidence from Industry Data. *Empirica*, 40(4): 685–719.
- BAILEY, M. J., TAVLAS, G. S. and ULAN, M. 1987. The Impact of Exchange Rate Volatility on Export Growth: Some Theoretical Considerations and Empirical Results. *Journal of Policy Modeling*, 9(1): 225–243.
- BALDWIN, R., SKUDELNY, F. and TAGLIONI, D. 2005. Trade Effects of the Euro, Evidence from Sectoral Data. Frankfurt am Main: European Central Bank. [Online]. Available at: <https://www.ecb.europa.eu/pub/pdf/scpwpwps/ecbwp446.pdf>. [Accessed: 2014, February 1].

- BERGSTRAND, J. H. 1989. The Generalized Gravity Equation, Monopolistic Competition, and the Factor-Proportions Theory in International Trade. *Review of Economics and Statistics*, 71(1): 143–153.
- CHANEY, T. 2008. Distorted Gravity: The Intensive and Extensive Margins of International Trade. *American Economic Review*, 98: 1707–1721.
- CHOU, W. L. 2000. Exchange Rate Variability and China's Exports. *Journal of Comparative Economics*, 28(1): 61–79.
- CLARK, P. 1973. Uncertainty, Exchange Rate Risk, and the Level of International Trade. *Western Economic Journal*, 11(3): 302–313.
- DEARDORFF, A. V. 1998. Determinants of Bilateral Trade: Does Gravity Work in a Neoclassical World? In: FRANKEL, A. J. (eds.), *The Regionalization of the World Economy*. Chicago: University of Chicago Press.
- ETHIER, W. 1998. Regionalism in a Multilateral World. *Journal of Political Economy*, 106: 1214–1245.
- FOGARASI, J. 2011. The Effect of Exchange Rate Volatility upon Foreign Trade of Hungarian Agricultural Products. *Studies in Agricultural Economics*, 113: 85–96.
- FRANKE, G. 1991. Exchange Rate Volatility and International Trading Strategy. *Journal of International Money and Finance*, 10(2): 292–307.
- GOTUR, P. 1985. Effects of Exchange Rate Volatility on Trade. *IMF Staff Papers*, 32: 475–512.
- HEAD, K. 2003. *Gravity for Beginners*. Vancouver: University of British Columbia.
- HELPMAN, E., MELITZ, M. J. and RUBINSTEIN, Y. 2008. Estimating Trade Flows: Trading Partners and Trading Volumes. *Quarterly Journal of Economics*, 123: 441–487.
- HOOPER, P. and KOHLHAGEN, S. 1978. The Effect of Exchange Rate Uncertainty on the Prices and Volume of International Trade. *Journal of International Economics*, 8(4): 483–511.
- EATON, J. and KORTUM, S. 2002. Technology, Geography, and Trade. *Econometrica*, 70(5): 1741–1780.
- LEAMER, E. E. and LEVINSOHN, J. 1995. International Trade Theory: the Evidence. In: GROSSMAN, G. M. and ROGO, K. (eds.), *Handbook of International Economics*. Amsterdam: Elsevier Science B.V.
- LINNEMANN, H. 1966. *An Econometric Study of International Trade Flows*. Amsterdam: NorthHolland.
- MARTINEZ-ZARZOSO, I. 2003. Gravity model: An Application to Trade between Regional Blocs. *Atlantic Economic Journal*, 31(2): 174–187.
- OZTURK, I. 2006. Exchange Rate Volatility and Trade: A Literature Survey. *International Journal of Applied Econometrics and Quantitative Studies*, 3(1): 85–102.
- OZTURK, I. and KALYONCU, H. 2009. Exchange Rate Volatility and Trade: An Empirical Investigation from Cross-country Comparison. *African Development Review*, 21(3): 499–513.
- POSTENYI, A. 2014. *Determinants of Foreign Trade of Hungary: Trade Theory and the Gravity Model*. [Online]. Available at: <http://doktori.econ.unideb.hu/download/pdf/kutatasiforum/2014jun/postenyi.andrea.pdf>. [Accessed: 2015, January 6].
- PÖYHÖNEN, P. A. 1963. Tentative Model for the Volume of Trade between Countries. *Weltwirtschaftliches Archiv*, 90: 93–100.
- RAJAN, R. 2004. *Exchange Rate Volatility and Trade Flows – Some New Evidences*. Washington D.C.: International Monetary Fund. [Online]. Available at: <https://www.imf.org/external/np/res/exrate/2004/eng/051904.pdf>. [Accessed: 2014, February 8].
- SERCU, P. and VANHULLE, C. 1992. Exchange Rate Volatility, International Trade, and the Value of Exporting Firm. *Journal of Banking and Finance*, 16(1): 152–182.
- ŠIMÁKOVÁ, J. 2014. Vplyv kurzovej volatility na obchodné toky Maďarska. In: *Hradecké ekonomické dny 2014*. Hradec Králové: Gaudeamus, 234–240.
- TAGLIONI, D. 2002. Exchange Rate Volatility as a Barrier to Trade: New Methodologies and Recent Evidences. *Economie Internationale*, 89(90): 227–259.
- TICHÝ, F. 2007. Impact of Accession to EMU on International Trade – Case of the Czech Republic. *Prague Economic Papers*, 4: 336–346.
- TINBERGEN, J. 1962. *Shaping the World Economy: Suggestions for an International Economic Policy*. New York: The Twentieth Century Fund.
- TOMANOVÁ, L. 2013. Volatility and the Foreign Trade in CEEC. In: *Proceedings of the First International Congress on Economics*. Ankara: Gazi University, 649–664.
- VIAENE, J. M. and VRIES, C. G. 1992. International Trade and Exchange Rate Volatility. *European Economic Review*, 36: 1311–1321.

Contact information

Jana Šimáková: simakova@opf.slu.cz
 Daniel Stavárek: stavarek@opf.slu.cz