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Working Paper

Silesian University in Opava
School of Business Administration in Karvina
Institute of Interdisciplinary Research

Working Papers in Interdisciplinary Economics and Business Research

Assessing the Exchange Rate Sensitivity of Bilateral Agricultural Trade in Visegrad Countries

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August 2016

Working Papers in Interdisciplinary Economics and Business Research

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Citation

ŠIMÁKOVÁ, J., 2016. Assessing the Exchange Rate Sensitivity of Bilateral Agricultural Trade in Visegrad Countries. *Working Paper in Interdisciplinary Economics and Business Research no. 33.* Silesian University in Opava, School of Business Administration in Karviná.

Abstract

Jana Šimáková: **Assessing the Exchange Rate Sensitivity of Bilateral Agricultural Trade in Visegrad Countries**

This paper examines short-term and long-term effects of exchange rate changes on bilateral agricultural foreign trade in the Visegrad countries. Johansen cointegration test is employed to analyze the long-term relationship and VEC model to explore the short-term effects of exchange rate. Dataset covers period 1999 - 2014. Agricultural product groups are based on the SITC classification. Results show only some agricultural sectors significantly connected with exchange rate movements in the long-term. Effects of currency depreciation are ambiguous and cannot be generalized across the analyzed product categories but increasing in particular trade balances after currency depreciation dominates its decreasing.

Key words

exchange rate; agricultural sector; trade balance; cointegration; Visegrad

JEL: F14, F31, Q17

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Acknowledgement

Publication of this paper was supported by the Ministry of Education, Youth and Sports within the Institutional Support for Long-term Development of a Research Organization in 2016. The support is gratefully acknowledged.

Introduction

Agricultural and food production is one of the traditional industries of the economies of Visegrad Group (V4) and despite the volume of this whole production was significantly reduced in recent years, the value of trade activities had been constantly growing (Bielik, 2010). During the last two decades, agricultural trade in V4 countries passed through a series of changes that influenced its shape and character. The V4 agricultural trade development was influenced especially by successful transformation from centrally planned economy to market economy; by entrance of Czechia to the EU; and according to Horská et al. (2011), globalization and integration processes has played the important role as well. After the transformation of economies, the importance of agricultural trade within the individual V4 country gradually declined. The share of agricultural export in the total export fell, in the case of all of the V4 countries, below 10% (Svatoš and Smutka, 2012).

The transition process and membership in the EU caused changes also in territorial structure of agricultural trade. V4 countries changed their trade orientation especially towards the trade with other member states, which means an EU share of over 75% of its total trade (Svatoš and Smutka, 2012). After joining the EU and the trade liberalization, the V4 agriculture also faced an inflow of cheaper agri-food production from abroad. Insufficient domestic sales and low, respectively unstable purchase prices are solved many times by decreasing or complete termination of unprofitable agricultural production. One of the macroeconomic policy instruments is exchange rate, which can influence the price competitiveness of international traded products. Policies prescriptions have generally assumed that currency depreciation stimulates exports and curtail imports, while currency appreciation is detrimental to exports and encourage imports. Domestic currency depreciation (devaluation in fixed currency regimes) increases the price of imports in domestic currency terms, which means more expensive imports. Simultaneously it decreases the price of exports in foreign currency terms, in other words, exports become cheaper. Given the above, price effect of currency depreciation can increase the volume of exports and decrease the volume of imports (Gupta-Kapoor and Ramakrishnan, 1999). Based on this presumption, this paper considers exchange rate as an instrument which plays a critical role in profitability of both export-oriented and import-competing agriculture and can affect the agricultural trade balance.

The aim of this paper is to examine the short-term and long-term effects of exchange rate changes on bilateral agricultural foreign trade in the Visegrad countries. Data used in this study cover period from 1999:Q1 to 2014:Q3 and are based on the SITC classification. To distinguish the long term effects from the short term ones, authors apply the J-curve theory which says that currency depreciation improves the trade balance only from long run perspective; in the short run it even worsens the trade balance before improving it (Bahmani-Oskooee and Ratha, 2004). In the study is employed a Johansen cointegration test to analyse the long term relationship between variables. Short run effects are explored by estimating the vector error correction model.

1. Review of Relevant Literature

J-curve theory is the traditional instrument to analyze the dynamic effect of exchange rate changes on trade balance. J-curve theoretical basis comes from the Marshall-Lerner condition, which states that the sum of export and import demand elasticity has to be at least one and then the currency depreciation has a positive impact on the trade balance (Auboin and Ruta,

2012). Usually, Marshall-Lerner condition is not met in the short run, goods tend to be inelastic and depreciation deteriorates the trade balance initially. In long run consumers can adjust to the new prices, volume effect is generally believed to dominate the price effect and trade balance will be improved. Short run effect of currency depreciation and related J-curve phenomenon was first advanced by Magee (1973), who pointed that short run deterioration and long run improvement of trade balance after depreciation resemble the letter J.

Literature concerning the J-curve issue tends to fall into one of the following three categories: studies using aggregate trade data; studies employing disaggregate trade data at bilateral level; and recent studies using disaggregate trade data at commodity level. The first type of studies concentrates on the use of aggregate export and import data between a country and the rest of the world in assessing the effectiveness of currency devaluation (e.g. Felmingham, 1988). These studies have to employ the effective exchange rate, what can be misleading when country´s currency appreciate against one currency and simultaneously depreciate against another currency (Bahmani-Oskooee and Brooks, 1999). The weighted averaging will therefore smooth out the effective exchange rate fluctuations, yielding an insignificant link between the effective exchange rate and the trade balance. Therefore, many other studies employ bilateral exchange rates and bilateral trade balance data between a country and its major trading partners (Bahmani-Oskooee and Ratha, 2004). There has been a growing body of literature arguing that the second-generation study may still suffer from the aggregation bias problem, as significant exchange rate impacts with some commodities could be more than offset by insignificant exchange rate effects with others, thereby resulting in an insignificant exchange rate impact and vice versa. Therefore, the newest studies disaggregate data to industry level (e.g. Bahmani-Oskooee and Hegerty, 2011).

In the agricultural trade literature, most studies have mainly concentrated on the effect of changes in exchange rate on agricultural export volume and/or prices (e.g. Gardner, 1981; Bradshaw and Orden, 1990). Limited studies have been made to investigate the impact of exchange rate on the agricultural trade balance. Among studies applying the J-curve estimation can be found paper by Yazici (2006). He investigated whether the J-curve hypothesis holds in Turkish agricultural sector. Based on the data covering the period from 1986 to 1998, the results indicate that, following devaluation, agricultural trade balance initially improves, then worsens, and then improves again. This pattern shows that J-curve effect does not exist in Turkish agricultural sector. Another important finding is that devaluation worsens the trade balance of the sector in the long run. Douglason Godwin (2009) empirically tested the existence of the J-curve hypothesis using Nigerian agricultural data. The hypothesis asserts that adjustment to a disturbance in payments is not instantaneous since a certain period of time would have to elapse before variation in the exchange-rate can restore equilibrium in the trade balance. The analysed model is a multiplier based framework which imposes an Almon lag structure on the exchange rate regimes. The empirical results indicate that the J-curve does not exist in Nigerian agricultural sector precisely in the long-run since the pattern of lag between the exchange rate depreciation and the trade balance resembles more of an asymmetric S-shape of a horizontal S. Yazdani and Shajari (2009) published study, where the impact of macroeconomic indicators of Iran and its 20 trading partners on Iran's agricultural trade balance had been investigated. The ARDL approach was applied during the period of 1960 - 2005. They found out that real exchange rate had the positive impact on trade balance indicating that the depreciation improves trade balance.

Although many studies on the J-curve effect have been published, few of them focus on Central and Eastern European countries. Bahmani-Oskooee and Kutan (2009) is the most

comprehensive study of the J-curve phenomenon in emerging Europe. Based on data from 12 countries covering the period 1990-2005, they found empirical support for the J-curve effect in Bulgaria, Croatia and Russia. By contrast, no evidence of the J-curve effect was revealed for the V4 countries. More recently, Nusair (2013) applied a similar methodology of autoregressive distributed lag (ARDL) cointegration and a corresponding error correction model on data from 17 emerging and transitioning countries over the period 1991-2012. In empirical estimations, an aggregate trade balance data and effective exchange rates are used. Although the J-curve effect was present in Armenia, Georgia and Ukraine, the V4 economies remained free of the J-curve effect. Šimáková and Stavárek (2012) applied J-curve approach to aggregated data of Slovakia for the period 1997-2010 using effective exchange rate and the overall trade balance. Simulation of shock in exchange rate development provided by using of impulse - response function demonstrates the inverse J-curve, therefore the depreciation leads to immediate improvement without worsening the long-term trade balance of Slovakia below its initial value.

Some studies confirmed the existence of some characteristics associated with the J-curve effect on a bilateral basis. Hacker and Hatemi (2004) tested the J-curve for Czechia, Hungary and Poland in their bilateral trade with Germany. They came to the conclusion that trade balance deteriorates within a few months after depreciation and then rises to a long-run equilibrium value higher than the initial one. The J-curve effect in bilateral trade between Czechia and Germany was also empirically confirmed by Šimáková (2012b), who applied a traditional methodology comprised of Johansen's cointegration and error correction model. Moreover, Šimáková (2012b) also found the J-curve in Czechia's trade with Poland. Šimáková (2012a) further analyzed the effect of exchange rate changes on bilateral trade flows between the Slovak Republic and its seven main trading partners. J-curve effect was demonstrated in the case of trade with Hungary and partly with the Czech Republic. Šimáková (2013) analyzes the bilateral trade flows of Hungary and confirms the J-curve in the case of trade with UK.

On the contrary, Hsing (2009) examined the J-curve for the bilateral trade of six CEE countries, including V4 and the USA, and found no evidence of this effect in any of the analyzed states. This inconsistency can be related to the relatively insignificant share of the USA in the international trade of the CEE countries. Šimáková (2014) discusses problems arising from the use of aggregated data and in the case of Slovakia demonstrates the effect of the distortion of the results caused by the aggregation of data. While at the aggregate level during the period 1997-2013 is revealed an inverse J-curve, effects on bilateral level are ambiguous and for trade with Hungary even demonstrate their conformity with the effect of a classic J-curve.

A product-level studies have so far been applied to the Czech Republic during 1993-2013 and for Poland in the period 1997-2013. Šimáková and Stavárek (2015) confirm by Johansen cointegration test the presence of long-term relationship with the exchange rates for almost all the sub-trade balance of the Czech Republic and demonstrate beneficial effects of depreciation on the agricultural products. Vector error correction model in this case does not show almost any statistically significant relationships and agri-food trade remain free f J-curve effect. Šimáková (2014) demonstrates the same conclusions for the case of Poland.

In summary, the existing empirical literature on the J-curve phenomenon concerning the V4 countries and its international trade is very limited. Results of the few previously published studies indicate almost no evidence for the J-curve effect. In addition, none of them is made in third-generation way for the particular agricultural sector. As compared to other papers, this study uses the most recent available data on international trade on the commodity level

to avoid the aggregation bias problem which can influence the results. Therefore, this study substantially contributes to scientific discussion in this field and fills the gap in literature about bilateral agricultural trade.

2. Model and Data Specification

This study employs a reduced form of trade balance model to analyze the long-run effects of changes in exchange rate on the trade balance. They use a trade model in which trade balance is expressed as a function of exchange rate and the domestic and foreign income. The Johansen cointegration procedure is applied to avoid the main criticism of early studies, whose results could suffer from spurious regression problem because of non-stationary data. For empirical analysis of agricultural trade, the model is specified as follows (1):

$$lnTB_{p,t} = \alpha + \beta lnY_{d,t} + \gamma lnY_{f,t} + \lambda lnER_{f,t} + \varepsilon_t \quad (1)$$

where TB_p is a measure of the trade balance in time period t defined as the ratio of exports of the individual V4 country to country *f* over the V4 country imports from country *f* in a selected product group. Y_d is measure of the domestic income (GDP) set in index form to make it unit free; Y_f is the income of trading partner *f* and ER_f is the bilateral exchange rate. The exchange rate is defined in a manner that an increase reflects a depreciation of the domestic currency. ε_t represents an error term. Since an increase in foreign income Y_f is expected to increase the exports to respective country, an estimate of γ is expected to be positive. Contrary, since an increase in domestic income Y_d is assumed to increase the imports, an estimate of β is expected to be negative. Finally, the parameter λ is expected to be positive as the trade balance of respective industry should improve due to domestic currency depreciation.

In order to test the short run relationship a short term dynamics are incorporated into the long run model. According to Hsing (2009) we apply the following error correction model (2):

$$\Delta lnTB_{p,t} = \alpha + \sum_{k=1}^{n} \omega_k \Delta lnTB_{t-k} + \sum_{k=1}^{n} \beta_k \Delta lnY_{d,t-k} + \sum_{k=1}^{n} \gamma_k \Delta lnY_{f,t-k} + \sum_{k=1}^{n} \lambda_k \Delta lnER_{f,t-k} + \vartheta_k EC_{t-1} + \varepsilon_t \quad (2)$$

where *EC* is the disequilibrium term and $\vartheta_k EC_{t-1}$ represents the error correction mechanism.

All time series used for estimation are in the quarterly frequency and cover the period from 1999:1 to 2014:3. Data for GDP and exchange rate are obtained from the OECD iLibrary statistical database in current prices. Data for imports and exports flows are obtained from the Eurostat. Development of total agricultural trade as a share on the total foreign trade turnover in the sample period can be seen in Figure 1. Estimated product groups representing the commodity structure of trade in agricultural sector are determined on the basis of SITC classification:

- T0: Food and live animals;
- T1: Beverages and tobacco;
- T4: Animal and vegetable oils, fats and waxes.

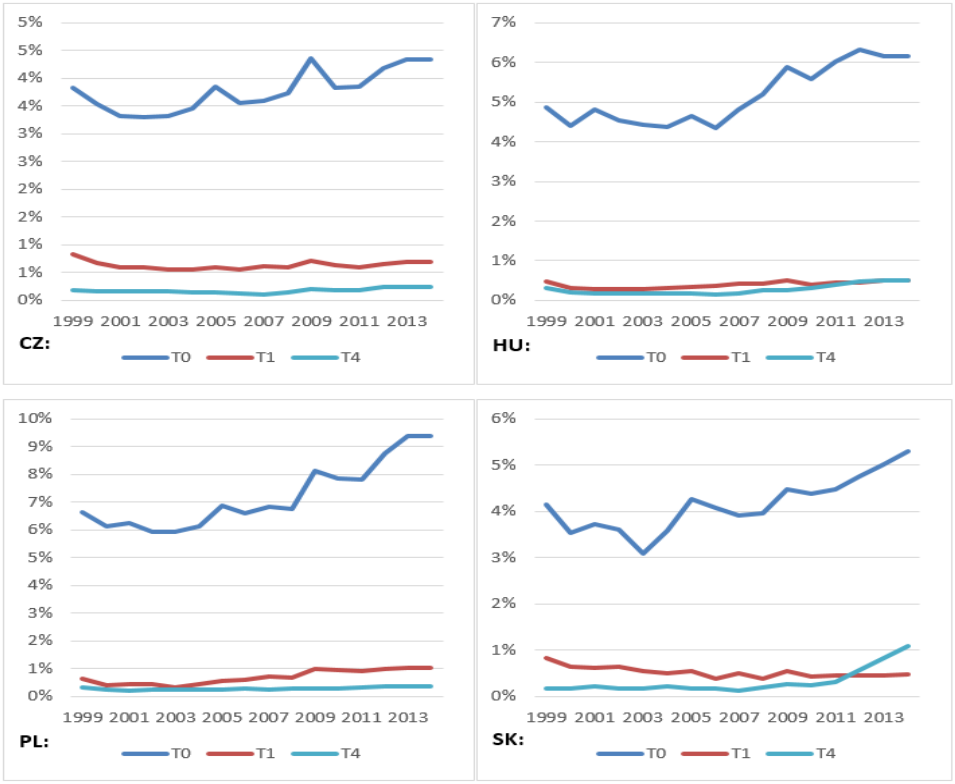

Fig. 1: Development of the agricultural trade in the V4 countries (1999 – 2014)
(Source: author's compilation)

3. Empirical Results

The bilateral analysis uses cross-border trade data between a particular country and its six major trading partners. The selection of partner countries represents at least 50 % of the total foreign trade turnover of each V4 country. Table 1 shows the major trading partners of the V4 countries. It can be seen that the V4 countries focus on the similar export markets and their regional similarity of consumer behavior translates also to their mutual trade. Approximately 25 % of V4 foreign trade is realized with Germany. Foreign trade of the V4 is so clearly influenced by German economic development, although it must be noted that the share is decreasing in time. Slovakia has one more significant partner, which is beyond the average of other observed trade – the Czech Republic. Bilateral trade between these two countries is based on the long-term economic ties. Even from the perspective of the Czech Republic, Slovakia is the second most important foreign market. In general, the V4 countries implement foreign trade thanks to barrier-free trade with EU countries (almost 80 % on average).

Tab. 1: Selection of V4 Trading Partners

V4 Country	Trading Partner					
CZ	AT	FR	DE	IT	PL	SK
HU	AT	FR	DE	GB	IT	PL
PL	CZ	FR	DE	IT	SK	GB
SK	AT	CZ	FR	DE	HU	PL

Source: author's compilation

Logarithmic transformation was performed to reduce skewness and heteroscedasticity and to stabilize variability. Integration of time series was determined using the augmented Dickey-Fuller test. The augmented Dickey-Fuller test for each individual time series confirmed the presence of unit roots, which is the basic precondition of cointegration between variables.

Since the choice of lag orders of the variables in the vector error correction model specification can have a significant effect on the inference drawn from the model, the appropriate lag length for each variable is sequentially determined. The optimal lags for each estimated trading partner within different product groups were determined on the basis of Schwarz information criterion. Results of the cointegration procedure can be seen in Table 2.

Tab.2: Number of Lags and Cointegration Equations.

		lag	*r*	*lag*	*r*	*lag*	*r*	*lag*	*r*	*lag*	*r*	*lag*	*r*
		AT		DE		FR		IT		PL		SK	
CZ	T0	4	1	2	1	2	1	2	2	2	2	2	1
	T1	4	1	2	0	2	1	2	0	2	1	2	1
	T4	4	0	2	0	4	0	2	0	2	0	2	0
		AT		DE		FR		GB		IT		PL	
HU	T0	2	0	4	2	2	1	2	1	4	1	4	1
	T1	4	1	5	1	2	1	4	0	4	1	4	1
	T4	5	0	5	2	5	0	4	0	4	0	4	0
		CZ		DE		FR		GB		IT		SK	
PL	T0	4	1	2	1	2	0	4	2	2	1	2	1
	T1	4	1	2	1	2	1	5	0	2	1	2	1
	T4	4	0	5	0	4	0	5	0	2	0	5	0
		AT		CZ		DE		FR		HU		PL	
SK	T0	4	1	2	1	2	1	2	2	2	2	2	1
	T1	4	1	2	1	2	1	2	1	2	1	2	1
	T4	5	0	5	0	4	0	5	0	2	0	2	0

Source: author's compilation

Product-level analysis pursues a common feature of no long-term relationships in the case of trade balance with animal and vegetable oils, fats and waxes (only exception is trade between Hungary and Germany). The lag structure range from 2 to 5 quarters. In general, higher lags are typical especially for trading partners Austria and United Kingdom. These trading flows are supposed to be purchased under long-term contracts, with longer adaptation to new price conditions. Although there are some product categories without proved cointegration, the product categories tending to the long term equilibrium significantly exceed them.

As a next step, it was proceeded the assessing of the long-term coefficient estimates for the models with evidence of a cointegrating relationship. Detailed results can be observed in Table 3. The theoretical expectations of the positive effect of foreign income and the exchange rate and the negative effect of domestic income on trade balance are not convincingly confirmed across the dataset.

As indicated before, the short-run effects of depreciation are reflected in the coefficient estimates obtained for the lagged value of the first differenced exchange rate variable. The J-curve approach allows us to distinguish the short-run effects from the long-run effects. The traditional J-curve is confirmed if the estimate of the coefficient for the exchange rate is significantly negative at lower lags and is followed by a significantly positive coefficient at longer lags. Simultaneously, the J-curve can be represented as negative short-run coefficients, followed by a positive long-run coefficient. In this study, only some short-term coefficients are statistically significant. The short-run significant negative coefficient followed by positive improvement can be found in T0 in trade of Czechia with Italy and Poland, and in T1 in trade

of Hungary with Italy. These trading flows jointly confirm the only examples of the J-curve pattern found in this paper. For other cases examined, the J-curve phenomenon is not supported by the estimated coefficients of exchange rates.

Tab. 3: Estimated Long-Run Coefficients of Trade Models

		Yd	*Yf*	*ER*	*Yd*	*Yf*	*ER*	*Yd*	*Yf*	*ER*	*Yd*	*Yf*	*ER*	*Yd*	*Yf*	*ER*	*Yd*	*Yf*	*ER*
		AT			DE			FR			IT			PL			SK		
CZ	T0	8.36	0.47	2.37	-4.14	2.05	-1.10	-1.62	3.79	-1.97		2.75	1.41		-0.39	2.63	-2.85	2.45	-0.53
	T1	-3.24	6.39	-1.51	x	x	x	-6.75	3.31	1.87	x	x	x	-0.07	0.90	0.65	0.53	0.12	0.74
	T4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
		AT			DE			FR			GB			IT			PL		
HU	T0	x	x	x		1.84	1.49	-4.42	6.18	-4.86	7.19	-11.44	1.23	-2.69	6.42	1.04	-1.11	0.10	1.42
	T1	1.48	-2.06	2.94	2.74	8.26	-0.24	-6.65	2.07	0.05	x	x	x	-5.58	10.37	1.19	-1.91	3.01	-1.50
	T4	x	x	x		3.62	4.19	x	x	x	x	x	x	x	x	x	x	x	x
		CZ			DE			FR			GB			IT			SK		
PL	T0	-0.23	0.87	0.73	0.40	-4.96	0.53	x	x	x	x	x	x	0.60	2.43	-1.21	x	x	x
	T1	-0.34	2.18	-1.51	0.22	1.55	0.82	8.13	-5.61	0.13	x	x	x	0.24	4.51	1.35	-0.92	0.84	-2.59
	T4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
		AT			CZ			DE			FR			HU			PL		
SK	T0	-0.40	-0.46	-0.32	-1.15	1.27	-0.90	-0.70	2.32	0.22		-2.97	-1.05		-5.63	0.29	-0.87	3.56	-0.45
	T1	-0.12	1.80	0.85	-0.73	3.12	0.42	1.33	1.43	-0.27	0.89	1.42	0.34	3.47	-0.09	-0.04	1.44	2.98	0.92
	T4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Source: author's compilation

Conclusion

The aim was to examine the short-term and long-term effects of exchange rate changes on bilateral agricultural foreign trade in the Visegrad countries. Special attention was given to assess the characteristics of the J-curve effect in different product groups and empirically identify whether V4 agricultural foreign trade could benefit from depreciation of domestic currency. The Johansen cointegration test and the vector error correction model were used for this purpose. The dataset used in this paper covers period from 1999:Q1 to 2014:Q3. Agricultural product groups were based on the SITC classification.

By relying on a relatively new approach of testing this relationship, this study shows that the long term relationship between particular trade balances and exchange rate can be found for product categories of food, live animals, beverages and tobacco. Animal and vegetable oils, fats and waxes are products without any cointegration. Effects of currency depreciation are ambiguous and cannot be generalized across the analyzed product categories but increasing in particular trade balances after currency depreciation dominates its decreasing. The theoretical short run assumptions were confirmed for Czechia in trade of food and live animals with Italy and Poland, and for Hungary in trade of beverages and tobacco with Italy. These trading flows jointly confirm the only examples of the J-curve pattern found in this paper. For other cases examined, the J-curve phenomenon is not supported by the estimated coefficients of exchange rates.

The effects of currency depreciation are less than ambiguous and cannot be generalized across the analyzed product categories but in the sample period, increasing in trade balances

after currency depreciation dominates its decreasing and exchange rate as a macroeconomic tool can represent an effective instrument of stimulating the agricultural foreign trade.

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