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## **A LINK BETWEEN INNOVATION PERFORMANCE AND INWARD FOREIGN DIRECT INVESTMENTS: A CASE OF SLOVAKIA**

### **Abstract:**

There are plenty of studies analysing foreign direct investment flows in connection with other factors, however not so many of them take into consideration also effects on innovation performance of a particular country. The present study investigates a link between macro-level innovation performance and inward foreign direct investments in conditions of Slovakia. The results of regression analysis covering the period between 2003-2017 showed that innovation performance measured by gross expenditures on research and development is negatively influenced by foreign direct investment inflows, especially by greenfield investment projects allocated in Slovakia. This negative effect is even more significant on lagged level, namely one year after the investment allocation.

### **Keywords:**

innovation performance, inward foreign direct investment, greenfield investment, mergers and acquisitions

**JEL Classification:** F21, F41, O30

## Introduction

Economies substantially differ in their innovation performance and emerging and transforming countries are trying to catch up with developed countries within technological and scientific development. In the empirical literature there has been a huge debate regarding drivers of innovation progress of the countries (e.g. Furman, Porter, Stern, 2002; Krammer, 2009; Carayannis, Grigoroudis, 2014). Important role in this regard is attributed to the foreign direct investment flows (e.g. Ramzi, Salah, 2018) especially from the open perspective point of view. It is generally believed that openness to foreign investments promotes international diffusion of technology (Gong, Keller, 2003). There are plenty of studies dealing with firm-level transfer of know-how and technology to domestic firms resulting from foreign direct investments (see e.g. Falk, 2005; Khachoo, Sharma, 2016).

However, in the center of our interest is to examine the relationship between inward foreign direct investment (hereinafter also “FDI”) and the innovation performance on the macro-level. Despite plenty of studies with mixed results conducted worldwide, single-country studies dealing with this issue in conditions of the Central European countries are rather scarce. Moreover, only a few studies discuss separately the effect of cross-border mergers and acquisitions (hereinafter also “M&As”) and greenfield investment projects as the types of FDI on innovation performance. The importance of conceptual distinction between the two types was highlighted especially by Davies et al. (2018) who state that greenfield investments are relatively more reliant on knowledge produced at the country of origin. On the other hand, M&As are more responsive to barriers between the origin and destination countries, including geographical and cultural barriers.

The aim of the present study is to investigate a link between macro-level innovation performance and inward foreign direct investments in conditions of Slovakia in the period of 2003-2017. Our study compares the effect of cross-border M&As and greenfield investments because based on the previous empirical findings it is reasonable to assume that distinct types of inward FDI influence the innovation performance differently. The rest of the paper is organized as follows: part 2 presents literature review on the studied topic, part 3 introduces data and methodology, part 4 brings own empirical results and their discussion followed by conclusion.

## 1 Literature Review

In the empirical literature there is a continuous debate about the underlying drivers of the national innovation performance. While prior studies had focused on a closed-system approach (country level factors), the open-system approach considers also other variables beyond a country’s boundary (Wu et al., 2017). The rapidly rising level of economic integration fostered by market openness to FDI makes the traditional approach to national innovation with the focus on a closed-

system analysis less relevant (Gong, Keller, 2003). Hence, in the following review we focus on the studies on performance – foreign direct investment flows relationship conducted on the aggregated level.

One of the first studies that took into account the effect of foreign direct investment flows also on the technology diffusion was a study by Borensztein et al. (1998) that utilized data on FDI flows from industrial countries to 69 developing countries and concluded that FDI is an important vehicle for the transfer of technology, contributing relatively more to growth than domestic investment. However, the higher productivity of FDI holds only when the host country has a minimum threshold stock of human capital. Thus, FDI contributes to economic growth only when a sufficient absorptive capability of the advanced technologies is available in the host economy. Similar results regarding the necessity to reach a minimum human capital threshold level in order to benefit from the technology transfer of US multinational enterprises was detected also by Xu (2000). In more details, Liu and Buck (2007) state that foreign R&D activities by multinational enterprises in a host country significantly affect the innovation performance on a local level only when absorptive ability is taken into account. They indicate that both international technology spill over sources and indigenous efforts jointly determine the innovation performance of local high-tech sectors.

The most recent studies, among other Filippetti et al. (2017) analysed the impact of internationalization (including inward FDI) on the innovation performance of 40 countries and found a negative association between inward FDI and patenting in countries with low absorptive capacity where FDI may displace local infant activities and stunt further development of related local knowledge. Wu et al. (2017) investigated 80 countries and showed that international patenting activities vary across countries. They also found that inward foreign direct investment significantly contributes to emerging countries' (including Central European countries') ability to produce cutting-edge technologies, but this effect does not exist for leading innovator countries. Another study by Pradhan et al. (2017) using panel data from 32 high-income OECD countries showed existence of several bi-directional causality relations including relationships between foreign direct investment and innovation measured through several indicators. Authors at the same time conclude that there is bi-directional causality between economic growth and innovation in the long run in the presence of other variables among other FDI, no matter which one measure of innovation is using. A contradictory effect of inward FDI on national innovative capacity was detected by Andrijauskiene and Dumciuviene (2019). Inward FDI supports a country's national innovative capacity by encouraging the employment in knowledge-intensive sectors and having a positive effect on trademark and design applications, while no significant effect on patents was shown. Thus, the nature of innovation measure seems to matter.

The above mentioned studies evaluated the influence of FDI on innovation performance in general, without special distinguishing between M&A and greenfield investment projects. However, Davies et al. (2018) compared the two types of FDI theoretically and empirically and concluded that with greenfield investment the foreign investor develops proprietary assets (e.g. intellectual property, advanced technologies, unique product varieties, etc.) in the country of origin that are then transferred to the host country. In contrast, acquirer performing M&A identifies target asset in the host country and then integrates that with the parent company's global activities.

Hence, it is reasonable to predict that due to transfer of proprietary assets from origin country to the host country the innovation performance of the reporting host country shall be more significantly and positively influenced by greenfield investments in comparison to M&As.

This prediction can be supported by the results of the study by Stiebale (2016) that indicate a considerable increase in post-acquisition innovation in the acquirer's country, while innovation in the target's country tends to decline. The asymmetry of effects between acquiring and target firms increases with pre-acquisition differences in knowledge stocks, indicating a relocation of innovative activities towards more efficient usage within multinational firms. Chang, et al. (2013) also confirmed negative impact on domestic innovation not only in case of cross-border M&As but also in case of remaining inward direct investment, so inward FDI in total were found to be negatively correlated with domestic patents. On the other hand, within empirical literature can be found also evidence that cross-border M&As might spur innovative activity due to technology transfer or improved market access (e.g. Guadalupe et al., 2012). Similarly, using affiliate data, Bertrand et al. (2012) find evidence that acquired affiliates have a higher level of sequential R&D intensity than greenfield affiliates.

To sum up, there is no empirical consensus on an existence and nature of relationship between inward FDI and national innovation performance. At the same time, there is a limited number of studies focusing on influence of different types of inward FDI on innovation, and even less conducted specifically in conditions of some of Central European countries. Hence, a single-country studies can enrich the existing literature.

## **2 Data and Methodology**

A present single-country study on an influence of inward FDI and their types on innovation performance is conducted in conditions of Slovakia over a period from 2003 till 2017. As a key dependent variable innovation performance is considered. However, innovation performance is not easily measurable concept. Traditionally, there are several types of measures (see e.g. Filippetti et al., 2017). In this regard, Hagedoorn and Cloudt (2003) note that there is no generally accepted indicator of innovative performance or a common set of indicators. The study established a composite construct based on four indicators (i.e. R&D inputs, patent counts, patent citations and new product announcements) that clearly catches a latent variable „innovative performance“. However, the findings also showed the strong statistical overlap among these indicators and future research might also consider using any of these indicators to measure the innovative performance.

In the broader sense we can distinguish input innovation measures, mostly including R&D expenditures, or number of research staff (used e.g. in studies by Zemlinerová, 2012; Pradhan et al. 2017; Andrijauskiene and Dumciuviene, 2019) and output measures such as number of patents, trademarks and industrial designs (used e.g. in studies by Filippetti et al., 2017; Pradhan et al. 2017; Andrijauskiene and Dumciuviene, 2019). There are also some composite indicators designed to evaluate the national innovation performance. Probably the best known is the European Innovation Scoreboard (EIS) that provides a comparative assessment of the research and innovation performance of the EU Member States and selected third countries. The EIS is published by the European Commission since 2007. The EIS measurement framework

distinguishes between four main types of indicators and ten innovation dimensions, capturing in total 27 different indicators. However, for the calculation of normalised scores, data have been used for an eight-year period. With different normalised scores, also the summary innovation index for the year is different within the different EIS reports, thus results among different EIS reports should not be compared.

Due to our effort to cover as long period as possible and to maintain data consistency over time, we do not use composite indicator in our analysis. For the purpose of our study we measured innovation performance through input indicator publish on a current yearly basis, namely gross expenditures on R&D (GERD) that are calculated on a national level and include total expenditures on R&D activities within the organizations operating in Slovakia in all sectors. They include capital and current expenditures. The primary data on gross expenditures on R&D were taken from *Yearbooks of Science and Technology* published annually by Statistical Office of the Slovak republic.

Independent variables considered as potential determinants of innovation performance are inward FDI and their major types. As a source of the data, the FDI/TNC database of UNCTAD is used. Data on FDI flows are constructed on a net basis (capital transactions' credits less debits between direct investors and their foreign affiliates). FDI flows with a negative sign indicate that at least one of the three components of FDI (equity capital, reinvested earnings or intra-company loans) is negative and not offset by positive amounts of the remaining components.

Different types of inward foreign direct investments (*Inward FDI*), namely cross-border mergers and acquisitions (*M&A*) and greenfield investment projects (*Greenfield*) allocated in Slovakia are analysed separately as potential drivers of innovation performance measured by gross expenditures on R&D (*GERD*). Table 1 presents simple statistics of studied variables followed by correlation matrix showing Pearson and Spearman correlation coefficients among all pairs of studied variables (table 2).

**Table 1: Simple statistics of studied variables**

Variable	Mean	Std Dev	Median	Minimum	Maximum
<b>Inward FDI</b>	2341	2014	2976	-604.08009	5803
<b>M&amp;A</b>	116.34600	168.02298	66.41000	-2.36300	541.24000
<b>Greenfield</b>	3950	2489	3340	1093	9255
<b>GERD</b>	463.36667	220.53359	416.4000	231.2000	927.3000

*Source: own processing*

**Table 2: Correlation matrix**

	<b>Inward FDI</b>	<b>M&amp;A</b>	<b>Greenfield</b>	<b>GERD</b>
<b>Inward FDI</b>	1	0.00843	0.60099**	-0.63026**
<b>M&amp;A</b>	0.33601	1	-0.02750	-0.23631
<b>Greenfield</b>	0.60714**	0.13405	1	-0.54870**

<b>GERD</b>	-0.61786**	-0.58088**	-0.61429**	1
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*Note: The asterisks denote the statistical significance of coefficients on a level of 10% (\*), 5% (\*\*), and 1% (\*\*\*), based on p-values. The Spearman's rank correlation coefficients are below the diagonal, while the Pearson's correlation coefficients are above the diagonal.*

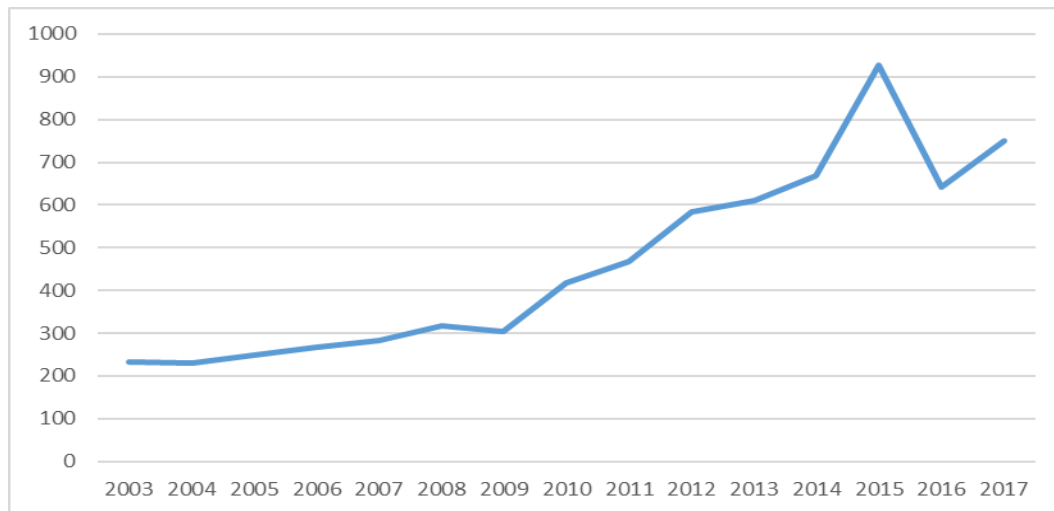
*Source: own processing*

The values of Pearson correlation coefficients show negative statistically significant relationship between innovation performance and total volume of inward FDI as well as volume of greenfield investment projects. Moreover, Spearman rank correlation coefficients prove even stronger statistically significant relationships between innovation performance and other studied variables including volume of cross-border mergers and acquisitions that indicates existence of rather non-linear relationships between dependent and independent variables.

Influence of inward FDI and their types on innovation performance is analysed more deeply by regression analysis using OLS technique. Two linear regression models are constructed. In the model (1) the dependent variable – GERD is supposed to be influenced by volume of inward FDI, value of cross-border M&A by economy of seller, e.i. Slovakia and by value of announced greenfield projects allocated in Slovakia. In the model (2) we regress the 1-year lagged volume of GERD against a series of inward FDI variables. We thus take into account the possible delay in the innovation activities after allocation of the foreign investment, as suggested e.g. by Wang, (2010) or Wu et al. (2017). The regular diagnostic tests, including normality, heteroscedasticity and collinearity tests, are performed to analyse validity of the models.

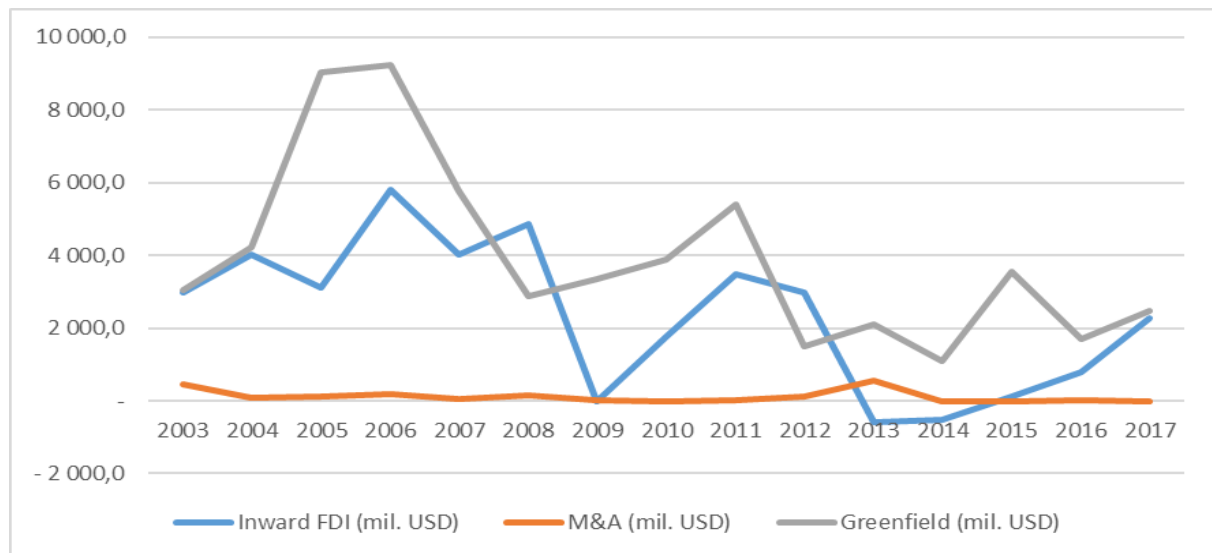
### 3 Results and Discussion

The development of the dependent variable within the observed period is shown in the figure 1. It is obvious that the innovation performance of Slovakia has increased gradually, with the exception of the 2009 crisis year. However, in the last few years higher volatility of the volume of gross expenditures on R&D is obvious. According to the information contained in European Innovation Scoreboard report (2019) Slovakia belongs to the group of moderate innovators that includes 14 Member States where innovation performance is between 50% and 90% of the EU average. Besides Slovakia, to this group of countries belong also Croatia, Cyprus, Czechia, Greece, Hungary, Italy, Latvia, Lithuania, Malta, Poland, Portugal, Slovenia, and Spain. The strongest innovation dimensions in case of Slovakia are sales impacts and employment impacts. On the other hand, finance and support, intellectual assets and attractive research systems are the weakest innovation dimensions.

**Figure 1: Development of gross expenditures on R&D (in mil. Euros)**

Source: Yearbooks of Science and Technology

The following figure 2 shows development of inward foreign direct investments and their types, namely cross-border mergers and acquisitions and greenfield investments. Volume of cross-border mergers and acquisitions is calculated on a net basis as follows: sales of companies in the host economy to foreign entities (-) sales of foreign affiliates in the host economy. The data cover only those deals that involved an acquisition of an equity stake of more than 10%. Data refer to the net sales by the economy of the immediate acquired company, i. e. the Slovak economy. Data on greenfield investments refer to estimated amounts of capital investment in millions of dollars.

**Figure 2: Types of inward FDI in Slovakia (in mil. USD)**

Source: FDI/TNC database of UNCTAD

The total volume of inward foreign direct investments in Slovakia was in the observed period most significantly influenced by greenfield projects located to the Slovak republic. On the other hand, the volume of cross-border M&As was significantly lower and developed more constantly. In regard to the relation between M&As and greenfield investments Davies et al. (2018) state that while the developed countries receive the majority of M&As, developing countries host the bulk of greenfield investments. It seems that in case of Slovakia the catching-up process with Western economies is still ongoing. Hence, it is important to identify the role of different types of inward FDI in influencing innovation performance of the country.

The regression analysis was conducted in order to examine the impact of inward FDI and their types on the national innovation performance. The results of the model (1) that examines contemporaneous effect of inward FDI and thus takes into account values of all the studied variables in the same year are shown within the table 3.

**Table 3: Model (1) - Dependent variable: GERD (year  $t$ ), independent variables (year  $t$ )**

	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-ratio</i>	<i>p-value</i>	
const	715,587	94,6317	7,562	<0,0001	***
M&A	-0,315099	0,280082	-1,125	0,2845	
Greenfield	-0,0246525	0,0236553	-1,042	0,3197	
Inward FDI	-0,0504920	0,0292300	-1,727	0,1120	

R-squared	0.499962	Adjusted R-squared	0.363588
F(12, 12)	3.666108	P-value(F)	0.047311
White's test for heteroskedasticity		p-value	0.325
Test for normality		p-value	0.414
Durbin-Watson test	1.490268	p-value	0.103
RESET test for specification		p-value	0.912
VIF			no collinearity problem

The first model shows no statistically significant impact of any of the variables describing FDI inflows on the innovation performance in the year of merger or acquisition or realization of greenfield investment. We have further predicted that the effect of the received inward FDI by reporting economy on its innovation performance could be lagged due to the possible delay in the innovation activities implemented by the incoming foreign investor. Hence, model (2) with 1-year lag (e.g. similarly as in the study by Wang, 2010) was constructed. Within the model (2a) we considered all the independent variables as possible determinants of innovation performance. The results are shown in the table 4.

**Table 4: Model (2a) - Dependent variable: GERD (year  $t$ ), independent variables (year  $t-1$ )**

	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-ratio</i>	<i>p-value</i>	
const	756,826	84,9833	8,906	<0,0001	***
M&A	-0,296648	0,244209	-1,215	0,2524	
Greenfield	-0,0259561	0,0206339	-1,258	0,2370	



Inward FDI	-0,0574455	0,0251182	-2,287	0,0452	**
R-squared	0.639156	Adjusted R-squared	0.530903		
F(12, 12)	5.904279	P-value(F)	0.013840		
White's test for heteroskedasticity		p-value	0.885		
Test for normality		p-value	0.791		
Durbin-Watson test	1.212705	p-value	0.357		
RESET test for specification		p-value	0.445		
VIF			no collinearity problem		

The model (2a) showed negative statistically significant lagged effect of the total volume of FDI inflows on the volume of gross expenditures on R&D. Similar results were previously obtained e.g. by Chang, et al. (2013). However, we have found no statistically significant effect of the particular types of inward FDI on innovation. Whereas the focus of our interest is specifically to examine the impact of the types of inward FDI, we have constructed one more additional reduced model, only with cross-border M&As and greenfield investments as independent variables. The results of reduced model (2b) are shown in the table 5.

**Table 5: Model (2b) - Dependent variable: GERD (year  $t$ ), independent variables (year  $t-1$ )**

	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-ratio</i>	<i>p-value</i>	
const	742,555	99,7285	7,446	<0,0001	***
M&A	-0,327743	0,286910	-1,142	0,2776	
Greenfield	-0,0547082	0,0192524	-2,842	0,0160	**
R-squared	0.450421	Adjusted R-squared	0.350497		
F(12, 12)	4.507658	P-value(F)	0.037168		
White's test for heteroskedasticity		p-value	0.546		
Test for normality		p-value	0.588		
Durbin-Watson test	0.893436	p-value	0.005		
RESET test for specification		p-value	0.163		
VIF			no collinearity problem		

The results of reduced model show that only greenfield investments allocated in Slovakia have negative and statistically significant lagged impact on innovation performance measured through gross expenditures on R&D. Thus, neither new investment projects allocated in Slovakia nor sales of Slovak companies to foreign investors are boosting contemporaneously or tardily innovation performance of Slovakia. Contrary to some previous findings (e.g. Guadalupe et al., 2012) we have not found any evidence regarding the positive international knowledge and technology transfer to the host country. Thus, it seems that the innovation activities in Slovakia are driven primarily by domestic investments. Similarly, Que and Zhang (2018) concluded that foreign venture capital-backed firms are less innovative than domestic venture capital-backed firms. However, these assumptions in case of Slovakia need further investigation.

Several reasons can be considered as explanations for our findings. No significant effect of inward FDI and any of their type in the year of their realization can be explained by allocating expenditures for initial activities, without effecting innovativeness. Subsequently, in case of greenfield investment projects, the transfer of knowledge from origin country is not evident even in the lagged period, possibly due to insufficient absorptive capacity of the host country, as it was pointed out e.g. by Filippetti et al. (2017). The authors generally expect that absorptive capacity has a positive modifying impact on the effects of internationalization on innovation through learning and knowledge acquisition. Hence, we can agree with Andrijauskiene and Dumciuviene (2019) that before putting efforts on receiving foreign investment, countries seeking to increase their innovation performance should firstly invest in domestic elements of absorptive capacity such as relevant human resources, physical infrastructure and R&D.

Within a future research it would be interesting to examine the effect of inward FDI on innovation performance in the longer terms, where potentially different significant relations can be detected. As it was proved by Zvezdanovič Lobanova et al. (2018) in case of effect of cross-border M&As on economic growth, it is negative and significant in the long-term perspective due to cost-saving and reduction or even relocation of production capacities to the countries with low-cost competitive advantages. For the same reasons, similar effects could be potentially revealed also in relation to innovation performance.

## **Conclusion**

This paper contributes to the existing discussion on the role played by the inward FDI and their types in influencing innovation performance on the national level, in case of single-country, namely Slovakia. Not only contemporaneous, however also lagged effects were considered. The results of regression analysis covering the period between 2003-2017 showed that innovation performance measured by gross expenditures on research and development is not influenced by inward FDI in the allocation year, however it is negatively influenced by FDI inflows, specifically by greenfield investment projects allocated in Slovakia in the lagged period, namely one year after the investment allocation. Surprisingly, no statistically significant effects of cross-border mergers and acquisitions were found in actual as well as lagged period.

Despite the general presumption that inward foreign direct investment through international diffusion of knowledge contribute to the country's ability to innovate, rather the opposite is true in case of Slovakia. Taking into account the possible moderating effect of domestic absorptive capacity it is recommended that policy makers should first consider development of intellectual capital and scientific infrastructure so that synergies can be created between foreign and local knowledge. From the factual content of foreign direct investment point of view, the structural changes toward attraction of innovation oriented investors seem to be desirable.

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