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INCREASE IN LABOUR PRODUCTIVITY IN THE CONTEXT OF FDI INFLOWS INTO THE AUTOMOTIVE INDUSTRY OF VISEGRAD GROUP MEMBER STATES

The goal of the paper is to analyze the impact of foreign direct investment inflows into the automotive industry of the Visegrad Group on labour productivity. Since the 1990s Central Europe has obtained a massive amount of FDI with a large share of automotive industry in it. Automotive FDI inflow is closely associated with the transfer of technology into the V4 industry. Using statistical analysis we conclude that automotive FDI inflow to the V4 countries increases labour productivity of the industry under study.

Keywords: *the Visegrad group; automotive industry; foreign direct investments; labour productivity; transfer of technologies; division of labour.*

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ПІДВИЩЕННЯ ПРОДУКТИВНОСТІ ПРАЦІ У КОНТЕКСТІ ПРИПЛИВУ ПІІ ДО ГАЛУЗІ АВТОМОБІЛЕБУДУВАННЯ: ЗА ДАНИМИ КРАЇН ВИШЕГРАДСЬКОЇ ГРУПИ

У статті проаналізовано вплив прямого іноземного інвестування у галузь автомобілебудування у Вишеградській групі на продуктивність праці у досліджуваній сфері. Починаючи з 1990-их рр. у Центральній Європі спостерігається посилений приплив ПІІ, левова доля якого припадає на автомобілебудування. Притік ПІІ саме в цю галузь безпосередньо пов'язаний з трансфером технологій у країни Вишеградської четвірки. Статистичний аналіз дозволяє дійти висновку, що приплив ПІІ в автомобілебудування підвищує продуктивність праці.

Ключові слова: *Вишеградська група; автомобілебудування; пряме іноземне інвестування; продуктивність праці; трансфер технологій; поділ праці.*

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ПОВЫШЕНИЕ ПРОДУКТИВНОСТИ ТРУДА В КОНТЕКСТЕ ПРИТОКА ПИИ В ОТРАСЛЬ АВТОМОБИЛЕСТРОЕНИЯ: ПО ДАННЫМ СТРАН ВЫШЕГРАДСКОЙ ГРУППЫ

В статье проанализировано влияние прямого иностранного инвестирования на отрасль автомобилестроения в Вышеградской группе на продуктивность труда в исследуемой сфере. Начиная с 1990-ых гг. в Центральной Европе наблюдается усиление притока ПИИ, львиная доля которого приходится на автомобилестроение. Приток ПИИ именно в эту отрасль напрямую связан с трансфером технологий в страны Вышеградской четвёрки. Статистический анализ позволяет сделать вывод о том, что приток ПИИ в автомобилестроение повышает продуктивность труда.

Ключевые слова: *Вышеградская группа; автомобилестроение; прямое иностранное инвестирование; продуктивность труда; трансфер технологий; разделение труда.*

Problem statement. Foreign direct investment (FDI) brought many changes to the region of Central Europe. Gradual growth of FDI inflows in the last two decades has led to the emergence and expansion of new industries, often not present in these countries before. A good example is the automotive industry, which belongs today in Central Europe to the principal industries. Automotive industry development has

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brought many well-documented benefits to Central Europe – growth in industrial production, employment and export. This is confirmed, for example, by T. Dudas (2013), who notes that the impact of automotive FDI significantly decreased unemployment in some regions of Slovakia and the industry has become the major employer in this region. However, there are some other benefits that have not yet been examined sufficiently empirically in the V4 region.

The aim of this article is to ***examine one of these less-documented positive effects of FDI inflows – the impact of inflows on labour productivity in the countries of the Visegrad grouping*** (the V4). We chose the already mentioned automotive industry for our analysis. Our selection of this industry was influenced by two important factors. Firstly, it is the sector almost exclusively built through FDI, which reinforces the relevance of our research. Secondly, it is the sector which is an essential pillar of the economy in each of the V4 countries.

The aim of this article is to examine empirically the following hypothesis: "The inflow of FDI in the automotive industry in the V4 region increases labour productivity in this industry". As already mentioned the sample includes the V4 countries – Czech Republic, Hungary, Poland and Slovakia. The period considered covers the years from 2002 to 2010. The selection of this period for a review was mainly influenced by the availability of comparable time series data; the range of 9 years is sufficient for statistical analysis. The data needed for empirical analysis were derived from the statistical office of the European Union (EUROSTAT), as well as from the OECD statistics.

Labour productivity figures for the category of production of motor vehicles, trailers and semi-trailers were derived from the EUROSTAT. At this time series it should be noted that since 2008 a new classification of economic activities, NACE Rev. 2 (NACE_R2) is used. In this classification production of motor vehicles, trailers and semi-trailers appears at the commodity level 29 (Manufacture of motor vehicles, trailers and semi-trailers). Before 2008, NACE Rev. 1.1 (NACE_R1) was used; in Slovakia OKEC (Statistical Classification of Economic Activities) Rev. 1.1. Under the old classification, the production of motor vehicles, trailers and semi-trailers appeared at the level 34 (Manufacture of motor vehicles, trailers and semi-trailers). The second time series for regression analysis is the FDI stock in the V4 countries. FDI stock is a more appropriate indicator for the analysis as the flow of FDI, since FDI flows are characterized by considerable fluctuations and do not reflect the real situation of investment in the sector and country, this means that it does not reflect the amount of investment with the real influence on the increase in labour productivity. The data on FDI are drawn from the OECD statistical database. We decided to use the data from this source on the grounds that it offers a sufficient and internationally comparable time series.

The literature review. The issue of the impact of FDI inflows on productivity growth in the domestic economy undergoes extensive analysis from both international and domestic point of view as well as from point of view of the Visegrad group, and to that fact occurs the same amount of positive as well as negative reviews. The following section is devoted to the analysis of the issue at the international level, with the goal of highlighting and generalizing the findings of individual studies for subsequent application on the researched industry and region.

Smarzynska in her article "Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of spillovers through Backward Linkages" analyzes the issue of the relationship between FDI inflows and productivity growth of companies in a host economy on the example of Lithuania. The author concluded that the occurrence of spillover can be seen more at vertical level through feedback (cooperation of domestic and foreign companies at different levels of production) than at the horizontal level. Based on quantitative research, Smarzynska concluded that the 10% increase in foreign presence in the downstream industry induces 0.38% production increase of domestic companies (Smarzynska, 2002).

J. Haskel, S. Pereira and M. Slaughter also dedicated their article "Does Inward Foreign Direct Investment Boost the Productivity of Domestic Firms?" to the analysis of spillovers of productivity from FDI to domestic companies. They conducted the research at the level of industrial production (factories, production plants) in the UK in the period from 1973 to 1992 and concluded that there is a positive correlation between the growth of aggregate factor productivity of domestic plants and the activity growth in the share of foreign companies in the industry. Their calculations suggest that the 10% increase in foreign presence in the industry of the UK was reflected in the growth of productivity of domestic plants in the industry by about 0.5% (Haskel, Pereira and Slaughter, 2007).

M. Bijsterbosch and M. Kolasa in the article "FDI and productivity convergence in Central and Eastern Europe: an industry-level investigation" used data on the industrial level to research the relationship between productivity growth and the FDI inflow. They concentrated their analysis on whether the size of the benefits resulting from the FDI inflow depends on the absorptive capacity of a host country. The authors concluded, based on quantitative research, that there is a strong convergence effect in productivity at both country level and at industry level; productivity growth depends positively on the gap in productivity between the region and the euro area, while productivity convergence effect is particularly strong in the industry. The impact of FDI on productivity growth depends crucially on the absorptive capacity (Bijsterbosch and Kolasa, 2010).

The issue of productivity spillovers from foreign firms to domestic firms was also researched by M. Blomstrom and E. Wolff in the article "Multinational Corporations and Productivity Convergence in Mexico". Their research is based on the analysis of the impact of foreign companies activities (transnational corporations case) on the growth of labour productivity in Mexican industry in the period between 1965 and 1984. They examined to what extent the presence of foreign firms affected the productivity of domestic firms, and to what extent there is evident convergence between the level of productivity of Mexican industry and the US industry. The research results showed that the level of productivity of domestic firms in Mexico converged with productivity levels of foreign companies present in the country. It was also shown that both productivity growth of local companies and the pace of catching up with foreign companies in productivity was positively related to the degree of foreign ownership in the industry (Blomstrom and Wolff, 1989).

S. Djankov and B. Hoekman dealt with the impact of FDI on the aggregate factor productivity in Czech economy in their article titled "Foreign Investment and Productivity Growth in Czech Enterprises". The authors conducted their research

based on data collection from Czech companies in the period 1992–1997 along with the analysis of databases containing financial and ownership information on the companies. They arrived to demonstrating the hierarchy in which the average productivity growth of production factors has the highest intensity in the companies established on the basis of FDI, while the intensity decreased in different forms of cooperation until the companies with purely domestic capital. The aggregate factor productivity is considered an indirect measure of technology transfer. From the technological point of view in examining the impact of foreign investors on domestic companies, domestic companies show the lack of capacity and ability to absorb occurred technological spillovers from foreign companies (Djankov and Hoekman, 1999).

All previous analyses demonstrate through research of individual economies (industries) positive correlation between FDI inflows and productivity growth in a domestic economy. While examining the issue, many pitfalls are found in many cases, including, for example, the lack of available data, causing not completely clear confirmation whether the total productivity growth is due to productivity spillover from foreign companies directly to individual domestic companies with lower productivity or the presence of highly productive foreign companies in the economy induces better productivity for the whole economy averaging less productive domestic companies and more productive foreign companies.

Determination of the problem subject to analysis. Increasing labour productivity is not only a tool to increase efficiency and competitiveness of companies, but has a far greater impact on increasing the economic well-being in a particular state. Labour productivity is also related to many other economic indicators, such as economic growth, competitiveness and the living standard of inhabitants in the economy. Labour productivity growth will be automatically reflected in the growth of labour costs – wage growth, which directly affects the growth of living standards of the population. Labour productivity growth in one sector has also a spillover effect[3] on other sectors, resulting in labour productivity growth in them too. This phenomenon can be potentially dangerous for the economy in such a case, if growth rates of labour cost driven by labour productivity growth reduced the investment attractiveness of the country, and it would deter foreign investors from their intentions to invest in the economy, or investors could start withdrawing their existing investment into other countries with a more favorable ratio of productivity and labour costs.

Labour productivity is a key measure of economic performance. The country's economic growth may be due to either increase in employment, or effective labour of employed (increased labour productivity). According to the OECD terminology, labour productivity (for a particular country) equals to the ratio between the volume of output (gross domestic product or gross value added) and the volume of inputs used (total hours worked or total employment). The ratio to calculate labour productivity reflects the efficiency of inputs, which are used in the economy to produce products or services.

The means of labour productivity growth (as well as the overall productivity in a sector) are the inflow of new technologies, know-how, new production methods etc.

[3] It is a certain kind of positive externality, transfer of benefits from one area to another.

Along with the continuous increase in human capital, these factors create the basis for the growth of the overall labour productivity, growth of the productivity of production factors and ultimately the growth of the entire economy.

A large number of the above effects comes into the economies of the V4 region in FDI from foreign automakers. The share of the automotive production sector for FDI in the industry is in Czech Republic – 25%, Hungary – 23% and 11% in Slovakia (Dachs, 2012)[4]. Due to the fact that in this region there is only one quasi-domestic automaker clearly internationally – Skoda (which also falls under the German company Volkswagen), it is possible to observe the occurrence of spillovers in productivity, particularly at vertical levels within subcontracting relationships.

The empirical analysis of the FDI impact on labour productivity in the automotive industry. Here we statistically verify the impact of FDI inflows in the automotive industry of the V4 region on increase labour productivity in the automotive sector. This fact will be verified through the tools of econometric analysis; we specify the relationship between the stock of FDI in the automotive industry and labour productivity growth in the same industry.

An increase in labour productivity is a natural phenomenon, associated with the inflow of advanced production technologies into the economy, which are carried out by the FDI. Automotive sector is particularly vulnerable to this effect given the high degree of production automation in this sector. The level of production, however, requires a quality workforce, on one hand, qualified professionals to control the production technology and on the other, in terms of work efficiency within a smaller finishing and partial works to be manually done by labour force. In both cases labour productivity is reflected.

The growing FDI trend in the automotive industry of the V4 region can be traced in Table 1, which shows the status of FDI in the automotive industry. Of these states Czech Republic has the largest volume of FDI, which also corresponds with the largest number of cars produced in this region.

FDI stock in the automotive industry is a more appropriate indicator to express the relationship between FDI and labour productivity, whereas the flow of FDI is highly volatile and does not reflect the actual amount of FDI in the country, which determines the increase in labour productivity. Table 2 expresses labour productivity in the automotive industry of the V4, which is in terms of gross value added per employee.

Previous two tables are input data to express the relationship between the two variables. The growing trend is recognized in all the countries; the most unequivocal is the trend in Hungary and the least – in Slovakia. This trend is always compared to the 45 degree line, which expresses the ideal state of dependency. Penultimate character shows the situation of each country affected by the crisis (2009).

In the next section, we move to the specific procedure of regression analysis and interpretation of various stages of the analysis. Baseline regression equation for the implementation of panel data has the following formula:

$$PP_{it} = \alpha + \beta PZI_{it} + u_{it}. \quad (1)$$

[4] The year of the data is not stated, but the document was published in May 2012, so it can be assumed that this data belongs to the previous year – 2011.

Table 1. **Evolution of FDI in the automotive industry in the region V4,** *mln USD*

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
CZ	1705,22	2140,906	3953,771	4273,45	5452,641	7377,152	10166,765	9745,339	10459,25	9620,053
HU	2508,663	3358,003	4705,955	5926,051	5676,031	7410,622	9439,077	5600,057	4801,415	3665,106
PL	1991,4	2213,9	3307,1	5687,3	5594,7	6990,8	9421,7	6715	8385,2	8654,8
SR	126,484	-27,95	565,697	1229,641	1920,877	2964,494	3460,08	4293,595	3280,507	3391,235

Source: the OECD statistics.

Table 2. **Labour productivity in the V4 region in the production of motor vehicles, trailers and semi-trailers as a share of gross value added per employee,** *ths EUR*

	2002	2003	2004	2005	2006	2007	2008	2009	2010
CZ	21.9	23.6	25.1	27.8	32.5	35.4	29	29.3	37.1
HU	33.8	36.6	39.1	41.3	43.4	48.2	47.3	33.2	43.9
PL	19.6	21	25.9	28.3	28.8	29.3	33.5	26	29.7
SR	22.4	25.2	23.7	24.5	26.9	37.9	22.5	23	31.3

Source: own elaboration based on the Eurostat online database.

Labour productivity in the automotive industry as a dependent variable in our analysis is expressed as PP_{it} and FDI in the automotive industry as an independent variable is expressed as PZI_{it}. α is a constant threshold and u_{it} mean random errors, the index i represents the individual V4 countries and t index time series from 2002 to 2010.

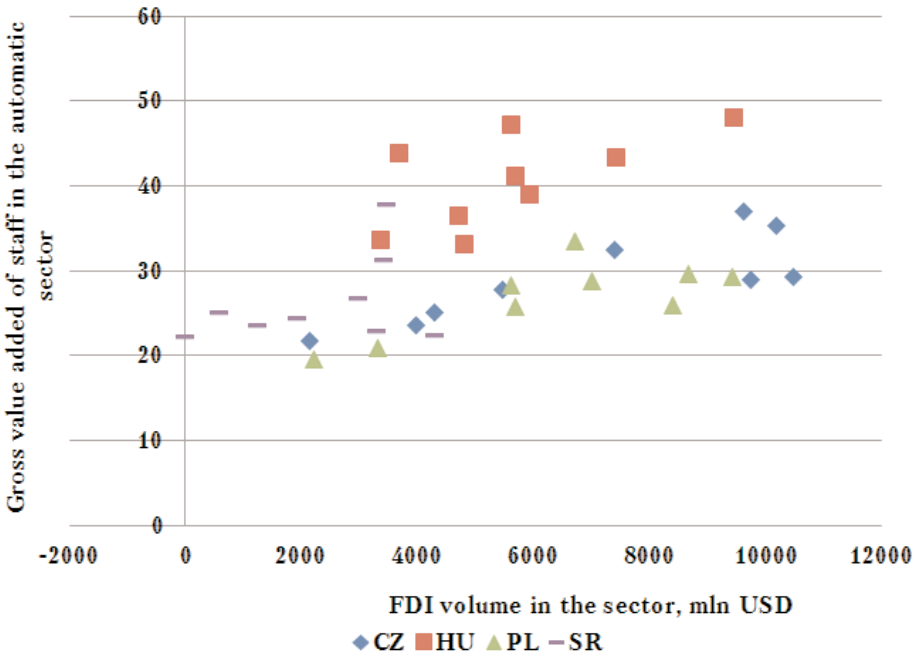

Figure 1. **The relationship between FDI and labour productivity in the automotive industry of the V4,** *own elaboration based on* the OECD and Eurostat online databases

There are 3 methods of statistical calculation of panel data analysis in econometric practice. Their usage depends on the properties of tested time series. This involves the following methods:

- The combined regression model (pool) using a matrix approach.
- Fixed effect model.
- Random effects model.

The combined regression model would in this case assume that individual states do not have unique characteristics when measuring and do not change in the time series under any rule. Therefore, the parameter α is a common constant to them. Conversely, the fixed effect model assumes that the states have unique characteristics (individual effects) in the measurement, which are not caused by random variations and do not change in time series. If the individual effects are unobservable but correlated with FDI stock, the solution is to include all effects into estimable conditional average α_i. Fixed effect α_i means a specific constant for each cross-sectional unit. Finally, *the random effects model assumes that states have unique characteristics (individual effects), which are due to random variations* and in the time series are constant

(do not change over the years). If the individual impacts on individual V4 countries are unobservable and uncorrelated with the stock of FDI, the solution is to connect the random component of the cross-sectional observation unit ε_*i* and random component specific to the cross-sectional unit *u_it*, which in addition to the initial assumption also assumes specific random component for each cross-sectional unit.

The next step of our analysis is the selection of a corresponding method, and for this matter we carry out auxiliary statistical tests. Individual tests and their resulting values in the next section show which method of the above three is the most suitable for processing our data.

Diagnostic use of each method implies the following. We assume a balanced panel with 4 cross-sectional units observed over 9 periods (years). Estimation of fixed effects allows different individual effects (i.e. different treshold constant α) for different cross-sectional units.

The combined regression model assumes that both the absolute element and all marginal coefficients in independent variables for all four states of the V4 are the same. Therefore, by joint F-test we verify the difference between cross-sectional units in order to see whether it is appropriate to use the combined regression model or fixed effect model. The outcome of the F-test in our case is the following:

$$F(3,31) = 28.2795 \text{ with a } p-\text{value of } 5.26495e-009. \quad (2)$$

Mean values of residues for cross-sectional units: Unit 1 = -4.2141; Unit 2 = 9.9703; Unit 3 = -4.5924; Unit 4 = -1.1638.

The results of this test indicate that the use of a combined regression model is inappropriate in this case, due to its great large differences in the mean of the four residues examined for cross-sectional units.

After excluding the combined regression model, the choice narrows to the use of a regression model with fixed effects or random effects model. To determine the final model, we carry out further testing of our data set – Breusch-Pagan test and Hausmann test.

Breusch-Pagan test is used to test the heteroscedasticity in the data set. In our case, the test evaluates whether it is appropriate to use the method of least squares or random effects model. The result of this test in this case is as follows:

$$LM = 68.5978 \text{ at } p = (prob(\chi^2(1)) > 68.5978) - 1.20737e-16. \quad (3)$$

Since the p-value in our case is less than 0.05, we reject the method of least squares, and for our analysis, we choose the random effects model. To ultimately confirm the appropriateness of the regression model with random effects, we carry out the Hausmann test. The results of this test are as follows:

$$H = 0.0972131 \text{ at } p = prob(\chi^2(1)) > 0.0972131 = 0.7552. \quad (4)$$

The key for us in this case is the p-value that greatly exceeds the chosen significance level of 0.05; therefore, we use the random effects model. Hausmann specification test thus ultimately confirms that the individual impacts on individual V4 countries are not correlated by explanatory variables of the whole panel, and therefore in the final specification of the FDI impact on labour productivity in the automotive sector we use the random effects model.

The results of our regression model confirmed the existence of a relationship between the amount of FDI in the automotive industry of the V4 and labour produc-

tivity growth in this sector. Dependence of labour productivity in the automotive industry from FDI in the sector based on our calculations reflects the following formula:

$$PP_{it} = 23.7548 + 0.00126486 \; x \; PZI_{it} + u_{it}. \quad (5)$$

Table 3.

Random effects model, using 36 observations includes 4 cross-sectional units The length of the time series = 9 Dependent variable: PP (labour productivity)				
	coeficient	*standard error*	*t-stat*	*p-value*
constant	23.7548	4.368	5.4384	< 0.00001***
FDI stock	0.00126486	0.000288679	4.3815	0.00011***

Mean value of dependent variable	30.49444	Standard error of dependent variable	7.596388
Sum of squares of residues	1754.767	Standard error of regression	7.080692
Logarithm of reliability	-121.0401	Akaike criterion	246.0802
Schwarz criterion	249.2472	Hannan-Quinn criterion	247.1856

Since the coefficient β in our case is a positive number, it confirms the positive relationship between the variables of interest. This means that in the studied sample of the V4 in the years 2002–2010, we managed to confirm empirically that the growth of FDI in the automotive industry leads to the growth of labour productivity in this sector.

Research results. Foreign direct investment can be regarded as the creator of some industries in Central Europe, including the automotive industry. Our primary research objective was to clarify, how they affect the inflow of FDI in the automotive industry in the V4 Group to increase labour productivity in the region. Through the study of various scientific articles related to the issue, we moved towards clarifying this fact for Central Europe. ***With the use of statistical methods processing time series of labour productivity in the automotive industry and FDI stock in the same industry, we confirmed our hypothesis, which we stated as "The inflow of FDI in the automotive industry in the V4 region increases labour productivity in this industry". Based on our research, we therefore confirm the correlation between the independent variable of FDI in the automotive industry and the dependent variable labour productivity in the same industry.*** In this context and based on our research findings, we incline to the authors, who also came to a similar conclusion. Among these authors, for example, are B. Smarzynska (confirmed the link between FDI growth and productivity growth in Lithuania), J. Haskel and S. Pereira (confirmed the link between aggregate factor productivity growth and FDI growth in the industry of the UK), M. Blomstrom and E. Wolff (productivity growth of domestic firms linked to the growth of foreign presence in Mexican industry) and M. Bijsterbosch and M. Kolasa (confirmed convergence between labour productivity and the inflow of FDI in Central and Eastern Europe).

With regard to the substance of the facts established, it should be noted that the given effect is logically resulting from the nature of production in the sector. Today car production is largely based on automated production, which increases productivity per employee. Physical work of employees within car production processes is mainly used in finishing work and fine tuning the car after work performed by a production line. Given the high division of labour, or implementation of various sub-activities of

various employees, there is an increase in workers performance, or their productivity. Large production capacity of automotive factories is reflected in labour productivity. In conclusion, we can confirm the fact of the increase in labour productivity in the automotive industry having a positive impact on the entire production sector of the countries in the V4 region.

Conclusion. In conclusion, we argue that although car industry brings to the region one of the most advanced and most modern forms of industrial production, from the qualitative point of view of increasing the level of individual economies this fact does not have deeper effects. The main positive effects of the car industry in the region are its quantitative economic effects and economic performance of the sector in each country. Positive contribution to the region from the qualitative point of view, would be expanding research and development activities of automakers in the V4 region. Through the integration of domestic workforce in the process, together with intensive cooperation of domestic professional training institutions, automakers and producers of components should be able to increase quality levels of each of the V4 economies and the process would lead to strengthening the knowledge economy.

Given the benefits of our research to practice, it is important to note that the qualitative benefits of the development of the sector in the region (or Slovakia) should not be overestimated. Automakers and their suppliers may be, from a certain point of view, taken in the economies of V4 as separate "islands" in the economy. On the other hand, it is worth highlighting that the size of investment that automakers and their suppliers have brought to the region is enormous, and the automotive industry, to some extent, made possible in the early stages of economic transformation after 1990 to start capital inflows into the region.

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