

Economic Efficiency in Transition: The Case of Ukraine

Anatoliy G. Goncharuk

Although a market economy is by definition more effective than a centrally planned economy, various countries in transition have faced the problem of economic inefficiency. The aim of this paper is to develop a comprehensive measure of economic efficiency using the production function framework and estimate it for the Ukraine economy. There exist namely a vast amount of indicators that support our hypothesis on the diminishing efficiency of the Ukraine economy in the last years. Our in-depth analysis shows that the diminishing efficiency is a consequence of ineffective investments and innovations as well as of an increasing intensity of materials use.

Key Words: economic efficiency, productivity, factors, labour, capital

JEL Classification: O47, C3

Introduction

The transition from an administrative-command economy to a market economy raises many theoretical problems unknown earlier, since this transition is an absolutely new historical process. And one of the key problems of the former administrative-command economy that consequently led to transition was the declining economic efficiency of these economies.

The centrally planned economy practically divested itself of scientific and technological progress, thereby there were no effective motives for progress at a workman and enterprise level. Especially this concerned the industries that produced goods aimed for final consumption, such as agricultural and food-producing industries. The administrative-command economy was based on bulky and planned distribution of scarce resources characterized by: domination of heavy industry and the defense establishment, with inability to respond dynamically and adequately to consumer needs, slow-moving production apparatus and constantly accumulated pervasive disproportions in production. Besides, inactivity of the economy was accompanied by professional inactivity of

Anatoliy G. Goncharuk is Assistant Professor at the Department of Management, Odessa National Polytechnic University, Ukraine

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the labour force, and the essential system of employees dismissal, re-training and reeducation could not be built. Increasing crisis in the socialist economies was not accompanied by liquidation of low-effective and obsolete enterprises, there was no flow of capital towards more effective industries, and enterprises didn't create motives for renovation of production as is usually the case in developed market economies. In the centrally planned economy in comparison with the market economy the lesser part of GDP was directed to personal consumption and the vast amount was addressed to social objects.

Thereby the administrative-command system was not able to provide high economic and social efficiency of the economy in comparison with a market one. Therefore the transition process to a market economy model in terms of efficiency of the economy could be considered as an advanced process.

At the same time, transition to market economy was accompanied by a drop in efficiency indicators practically in all cases. Among the specialties of that decline one may accentuate following major ones:

1. change in labour productivity is inevitable under structural transformation, liquidation of inefficient manufacturing, creation and increase of apparent unemployment, changes in social needs in goods and services;
2. growth of energy and material intensity of the economy by reason of cancellation of government subsidies and price liberalization;
3. growth of social inequality by reason of cancellation of many state social guarantees and increase of capitalization of the economy.

However, while in countries implementing radical market reforms (Poland, Slovenia, Hungary etc.) this decline was uncontinuous (2–3 years) and then came hasty and persistent growth, there were fluctuations of labour productivity dynamics in countries with gradual reform (Bulgaria, Romania) or continued decline in countries with inconsistent reform (Russia, Ukraine etc.).

The most pervasive and durable bust of economic efficiency was observed in Ukraine where during the first 9 years of transition the labour productivity declined twice as much. Despite the certain success of that country during the last few years in economic growth, monetary and currency stability, expansion of external trade and investments, increase of household incomes and savings, there are a lot of factors that restrain high-efficient growth of the Ukrainian economy and constrain the level

and rate of that growth. This paper is dedicated to analyses of those factors and to the estimation of the actual level and dynamics of economic efficiency of the Ukraine economy.

Definitions and Methodology

There exist different definitions of economic efficiency and frameworks for estimation of its basic indexes. The most common are described below.

Economical efficiency was defined by the Italian scientist V. Pareto as a state when the needs of all society members are satisfied as fully as possible, with given limited resources (Kuznetsova and Osadchaya 1993). That state is called Pareto efficiency or Pareto optimality. According to Pareto theory resources allocation in perfect competition conditions is effective. In perfect competition economy all benefits are produced (production efficiency) and allocated (consumption efficiency) effectively. Besides, the combination of produced benefits cannot be changed for improvement of consumer positions (exchange efficiency) (Vidyapin 1999).

However the economy that according to Pareto is effective isn't socially effective, whereas an optimal resources allocation leads to formation of social inequality and, in order to smooth it, the social economic policy of the government is engaged. Therefore the Pareto efficiency conception cannot be applied to the majority of factual situations where political arrangements improve the estate of one group of people at the expense of another.

Moreover, according to Pareto, the motion from state monopoly to free competition during the transition process means a gain of economic efficiency. It was immediately noticed in the introduction that this process is accompanied by a drop in economic efficiency in the majority of transition countries. So it refutes Pareto's conception of transition economy.

When speaking about economic efficiency one should emphasize also the analytical conception of operational efficiency developed by Farrell (1957) that divides economic efficiency into technical and allocative components (multipliers). Technical production efficiency reflects an ability to derive a maximal output from a given set of the factors of production. Allocative efficiency (efficiency of allocation or 'Pareto efficiency') reflects an ability to use resources in optimal combination considering their relative cost and applied production technology. The economy may be called technically inefficient if it uses overmuch resources to produce

output goods. In terms of allocation, the economy is inefficient if it uses a nonoptimal combination of resources to produce output goods.

The following definition of economic efficiency was used as the basis for given research. Economic efficiency is obtaining the maximum output under minimum production factors input. It defines efficiency of the total economy.

The following measures of using particular factors of production (i. e. labour, capital) are often used for estimation of economic efficiency: labour productivity, capital productivity ratio, materials-output ratio etc. The other common indicator of the efficiency that measures the impact of more than one factor is the multifactor productivity, that is defined as the ratio of total output goods with respect to input resources (total costs). Practically, multifactor productivity considers the influences of two factors – labour and capital (*The Economist* 2004). Formally multifactor productivity A can be recorded in the following way:

$$A = \frac{F}{F(K, L)}, \quad (1)$$

where Y denotes total output goods (base index of output), $F(K, L)$ is production function and denotes the average rate of labour capital input (K) and labour input (L).

A can be seen as an aggregate indicator of economic efficiency in contradistinction from particular indicators like average labour productivity (y) or average capital productivity (g). Furthermore A can be denoted as the average from y and g (with expedient measure). Assuming that $F(K, L) = K^\alpha L^{1-\alpha}$ is a production function of Cobb-Douglas then:

$$A = g^\alpha y^{1-\alpha}, \quad (2)$$

where A already denotes the weighted geometrical average of y and g . That means that the base index of A must be set between the base indexes of y and g with the same base. The ratings of the ratio between capital and labour received from the data from the national accounts system, are most commonly used as the weights α and $\alpha - 1$, the estimates of output elasticity dependent on two factors. Standard practice presumes a setting of the estimation of factor rates via expert evaluation on the level of 0.3 and 0.7 correspondingly for capital and labour (OECD 2001; Dolinskaya 2002; Voskoboynikov 2003; Bessonov 2004; Jongen 2004). The given parameters values of production function (2) have a key role in formation of the efficiency to labour factor and are very near to the values obtained by P. Douglas in the 1920's. At once during the last few decades the role

of labour in formation of output goods declined essentially as a result of industrialization and the rising degree of mechanization and automation process. Indeed, under the existing technology level, when the role of person in various branches consists just in control for machine running, it is impossible to speak about the domination of the labour factor in the economy. As evidence, one may adduce the empirical values of production function parameters obtained from statistics data of the Soviet economy for the period 1960–1985 and the amount for labour and capital correspondingly 0.5382 and 0.4618 (Granberg 1988).

Besides, the approach described above is imperfect more because it overlooks the rest of the key production factors – inventory and entrepreneurship. The last is the fourth factor of production whose content consists in the most effective rearrangement of all other factors for the purpose of production of goods and services. In the present conditions, the process innovations, pioneer products, organization innovations etc. are necessary features of entrepreneurship. Relative economic efficiency denotes a choice of such a combination of all production factors existing in limited volumes that permits the results to be achieved with the least costs by using business, production and management know-how.

Being exclusive from consideration of all factors but labour and fixed capital, the two-factor production function is grounded by scientists on the following: labour and capital are the results of production processes at the previous stages where capital assets and labour force were also used, therefore all factors can be reduced to those two factors (Chetyrkin and Klas 1986). However, inventory is also a primary production factor that should be taken into consideration especially in the case of economies that do not possess any ample funds of raw materials by own resource production and are reluctant to import those in quantities for production needs. Therefore there exists the necessity to develop a comprehensive measure of economic efficiency that considers the influences of all basic factors and is not limited only to labour and capital.

Departing from the Cobb-Douglas production function with constant returns to scale (scale effect) and adding to that the missing, in our view, factors of production, the following production function was obtained:

$$Y_t = AL^{\alpha_1} K^{\alpha_2} M^{\alpha_3} E^{\alpha_4}, \quad (3)$$

where Y_t is total output (GDP), A is total factor productivity, L , K , M , E are the factors of production, correspondingly, employment (labour), fixed capital stock (means of labour), material resources store (subjects

of labour) and injection to innovations (entrepreneurship). a_1, a_2, a_3, a_4 are parameters of function, and define elasticity of output by particular input resources.

The parameters a may be defined by rearrangement power equation (3) to linear form by taking the natural logarithm and applying the method of regression analysis. That linear form has the following view:

$$\ln(Y_t) = \ln(A) + a_1 \ln(L) + a_2 \ln(K) + a_3 \ln(M) + a_4 \ln(E). \quad (4)$$

Variable A in equation (3) is standard residual and indicates the return (output) from all used basic factors of production. That is, A is in fact a comprehensive measure of economic efficiency of the economy. Re-denoting the given measure as EE after ordinary transformation, the following formula was derived for comprehensive measure of economic efficiency:

$$EE = y^{b_1} g^{b_2} m^{b_3} e^{b_4}, \quad (5)$$

where y is the average efficiency of use of the direct labour (labour productivity), g is average efficiency of application of the means of labour (fixed capital productivity or output-capital ratio), m is average efficiency of application of the subjects of labour (output-materials ratio), e is average efficiency of application of the accomplishment of entrepreneurial innovations (output – innovations cost ratio), b_1, b_2, b_3, b_4 are dynamic parameters of function defined by the following formulas:

$$b_1 = \log_y \frac{Y^{\frac{1}{4}}}{L^{a_1}}, \quad b_2 = \log_g \frac{Y^{\frac{1}{4}}}{K^{a_2}}, \quad b_3 = \log_m \frac{Y^{\frac{1}{4}}}{M^{a_3}}, \quad b_4 = \log_e \frac{Y^{\frac{1}{4}}}{E^{a_4}}.$$

It is rational to use the ratios (indexes) and not the absolute values as benchmark data since factors may have various dimensions during the construction of production functions. Accordingly benchmark data about resources input, efficiency of resources application and production output must be performed as time series of corresponding economic indexes. Thereby the dynamics of economic efficiency may be measured by following index:

$$I_{ee} = I_y^{b_1} \cdot I_g^{b_2} \cdot I_m^{b_3} \cdot I_e^{b_4}, \quad (6)$$

where I_g, I_y, I_m, I_e are correspondingly indexes of average fixed capital productivity, labour productivity, output-materials ratio and output – innovations cost ratio.

The presented equation (6) is in substance a four-factor production function and averaging function, namely the dynamics of economic efficiency is a certain average value of the dynamics of efficiency of use of

direct labour, means of labour, subjects of labour and accomplishment of entrepreneurial innovations.

Estimates of the Parameters

Practical application of the equations described above requires a real estimate of factor costs and corresponding parameters of specified functions.

The estimate of employment level, particularly in a period of economic depression in Ukraine, encounters the problems of underemployment and latent unemployment. The high percent of registered employment that was observed during all the transformation period is bound up with the impossibility of dismissal of part of the disengaged payroll in the layoff process. That led to reduction of workweek and workday duration, expansion of employees on administrative leave and part-time employed, thus leading to the underemployment gain. Therefore we will use actual working hours instead of the number of employees to estimate a real value of direct labour costs and hourly output per employee for an estimate of labour productivity.

The measure of fixed capital stock collides with the problem of adequate estimate of value of fixed capital that is really used in business activity. As noticed by R. Solow, capital in stock doesn't mean capital in work (Solow 1957). The estimate of fixed capital unadjusted for wear and for unused share is kept out from measurement of the real efficiency of its usage. When fixed capital in stock in a period of economic depression is standing, the estimate of fixed capital depends on utilization rate. Moreover, balance sheet value estimation of the fixed capital during the transformation period in Ukraine did not correspond to its market value, which has never been precisely estimated, because of inadequate indexation, especially during the hyperinflation period. As a result, it was the distorted amortization system that did not reflect a real usage of fixed capital in the production process.

According to various scientists (Griliches and Jorgenson 1967; Costello 1993) the problem of fixed capital utilization record and its inadequate estimate may be solved by application of the data about power use as an indicator of fixed capital utilization rate. However that necessarily would lead to overestimating capacity utilization and we could not estimate the real fixed capital stock if it considers the significant scope of the hidden sector of the economy.

Thereby the obtainment estimate of real fixed capital stock under dis-

TABLE 1 Estimates of regression model parameters for equation (6)

Multiple correlation coefficient	$R = 0.9721$
Coefficient of determination	$R^2 = 0.9450$
F-statistics	$F = 30.089$
Number of Observations	$N = 12$
t-statistics	3.087; 2.723; 3.143; 2.278

Source: Own calculations.

torted systems of balance sheet value estimation and depreciation, the impossibility of estimating a real utilization rate and absence of any data about market value, is impossible. In that situation it seems apposite to apply an amount of annual fixed asset formation (in comparable prices), which generally are realized purposely for use in the production process, as an evaluation of capital value dynamics. In connection with that, we define corresponding assumptions about full utilization and application of invested fixed capital in production of GDP.

There are annual data about material costs in the economy (in comparable prices) used as a material resources store applied in production of GDP.

The value of injection to innovations is defined as the amount of funding of research-and-development activities on the domestic entrepreneur's account.

All following estimations are based on the data about the state of the official sector of the Ukrainian economy received from International Labour Organization, State Statistic Committee of Ukraine, Ministry of the Economy of Ukraine and other official sources.

To define the parameters of function (6), namely the elasticities of GDP by particular measures of resources costs, multiple regression analysis by annual data was carried out (chain indexes of figures in comparable type), consequently for years 1991–2003 the following equation was obtained:

$$Y_t = L^{0.428} K^{0.212} M^{0.160} E^{0.201}. \quad (7)$$

Since the amount of factors elasticities approximately equals 1 (accurately 1.001) hence the scale effect is practically absent and the obtained function (7) may be considered as linear homogeneous.

The parameters of the obtained model are reported in table 1. They denote its high accuracy and closely related variables. According to those the dynamics of real GDP at 95% is defined by the dynamics of four

TABLE 2 Estimates of regression model parameters for equation (8)

Multiple correlation coefficient	$R = 0.9951$
Coefficient of determination	$R^2 = 0.9901$
F-statistics	$F = 150.637$
Number of Observations	$N = 11$
t-statistics	2.583; 2.293; 2.745; 2.622

Source: Own calculations.

factors – working time, fixed asset formation, material costs and entrepreneurial innovations. The unimportance of parameter A and its proximity to 1 indicates that the average productivity of all factors practically didn't fluctuate for the total considered period.

The elasticity of economic growth by working time, as it turned out, is the most (0.428) that is the evidence of the determinative influence of the human factor on economic dynamics in Ukraine. This is below the value (0.4618) calculated for the Soviet economy for 1960–1985 years (Granberg 1988) and indicate an increasing influences of other factors on GDP dynamics. The obtained value of elasticity of output growth by labour for Ukraine in comparison with the corresponding parameter of production function for most developed capitalistic countries in the post-war period (1950–1977), is lesser than in USA (0.447) and Great Britain (0.506) and more than in the less developed Japan economy (0.397) in that period (Chetyrkin and Klas 1986). The similar comparison with the countries which carried out transition successfully, denotes low enough value of the elasticity of output with respect to labour in Ukraine: in Slovenia this parameter amounts 0.507 (Novak 2003), in Czech Republic that amounts 0.58 (Dupaigne and Henin 2002), in Poland it is equal 0.66 (Kolasa and Żółkiewski 2004).

Parallel analysis was carried out on the basis of base indexes (1992=1) that gave rather different results for parameters of production function:

$$Y_t = 0.929L^{0.383}K^{0.292}M^{0.190}E^{0.061}. \quad (8)$$

According to the parameters described in table 2, the obtained regression equation (8) is valid. Those denote that independent variables included there define Ukrainian GDP dynamics on 99%. The given function in comparison with the function based on chain indexes, denotes the reduction of multifactor productivity that constrained GDP growth during the analyzed period in Ukraine. Moreover the magnitude of parameters by all four factors in the last equation (8) less than 1 (0.926)

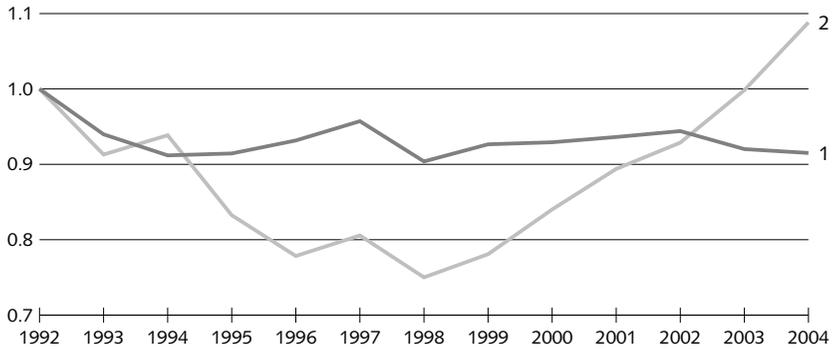


FIGURE 1 Basic dynamics of economic efficiency and labour productivity in Ukraine in years 1992–2004 (1 – growth rate of economic efficiency, 2 – growth rate of labour productivity)

indicates diseconomies of scale. Obviously the influence of production consolidation on the efficiency of the Ukrainian economy is negative. Evident is also a considerable increase of elasticity of output by capital (fixed capital and inventory investments) at the cost of drops of elasticities by labour and entrepreneurial innovations. Received low estimates of the elasticity of output with respect to labour for Ukraine (0.383) in comparison with the above mentioned developed and transition economies confirms the conclusion of Easterly and Fisher (1994) that the value of this parameter in the developed countries is greater than in developing countries.

Estimate of economic efficiency of the economy

The results of estimated production function (8) in comparison with dynamics of labour productivity (ratio of GDP to actual working hours by all employees of the economy) are shown in figure 1.

We can establish that the economic efficiency of the Ukrainian economy for the last 12 years declined – towards the end of 2004 it was approximately at the level of 1995. The tendencies of its increase in 1996–1997 and 1999–2002 years were aborted. That may be explained by the following reasons:

1. the financial crisis in 1998 extremely negatively influenced economic efficiency of the Ukraine economy; in contradistinction to the 1993–1994 years period, the diminishing economic efficiency in 1998 was connected with a decline in productivity of all four production factors;

2. in 2003–2004, the falling of economic efficiency of the economy resulted from simultaneous decline in productivities of fixed capital investments, material resources and innovations.

The total falling of economic efficiency for all the analyzed period amounts to 8.5%.

Comparing both diagrams in figure 1, the following may be noted:

1. when in 1992, the falling of labour utilization efficiency accelerated the recession of overall economic efficiency of the economy, then in 1995–1996 the former already constrained the gain of the latter;
2. the similarity of dynamics of both measures in 1997–1998 indicates the essential role of labour in the composition of economic efficiency during those years;
3. the high growth rate of labour productivity in 1999–2002 compensated the falling of efficiency of other factors' use and largely supported a gain of overall economic efficiency of the economy;
4. during 2003–2004 the overall value of economic efficiency of the economy declined because of inefficient utilization of investments and innovations as well as an increase of intensity of materials use (materials-output ratio), nevertheless the growth rate of labour productivity speeded up.

Estimated dynamics show that fluctuations of a level of economic efficiency of the economy occurred in a narrow enough interval, considerably smaller than changes in the volumes of manufacture and labour productivity level. It is possible to explain this by smoothing and mutual compensative influence of four allocated factors on this dynamics. So, within significant falling values of one factor, others grew or changed slightly and on the contrary.

The small variation of economic efficiency for the analyzed 12 years of transition to a market testifies to weak structural transformations, an inefficiency of carried out market reforms and technological backwardness of the Ukrainian economy which up till now is the most power-intensive country in the Europe. Such freezing of an inefficiency of economy was promoted by cheapness of the energy carriers received by Ukraine from abroad (from Russia, Turkmenistan and other countries), hard protectionism and a high degree of monopolization in the domestic market. Besides the high degree of corruption of authorities, the absence of an effective judicial-legal system, hard administrative and fiscal pressure upon economic subjects and other negative phenomena became the reason for

the 'shading' of a significant part of the national economy. As a rule, in a 'shadow' the most successful business left. As a result, there was created the paradoxical situation in the official sector of the economy at which the significant part (up to 50% and it is more) of enterprises was unprofitable, i. e. they were the potential bankrupts. And because of the absence of effective economic legislation and for a number of other reasons, such a situation in Ukraine was maintained during many years. Therefore the transition from command-administrative to a market economy was delayed in this country.

Thus, with liberalization of the the prices for energy carriers, demopolization and increase in the level of a competition in the domestic market, alleviation of the influence of the state on the business economic efficiency of official economy of Ukraine will grow and its 'shadow' component will be reduced.

Conclusions

The paper contains the results of analysis of the dynamics and factors of economic efficiency of the economy of Ukraine during the transition to a market economy. As was shown, it is necessary to apply comprehensive measures, those which take into consideration efficiency of utilization of all key factors of production under the estimate of value of economic efficiency of the economy.

Departing from the function of Cobb-Douglas with constant returns to scale after the range of transformation there was obtained the formula for four-factor productivity that set the dependence of the dynamics of economic efficiency from four basic factors – dynamics of labour productivity, fixed capital productivity, output-materials ratio and output-innovations cost ratio.

The four-factor production function was econometrically tested to estimate the parameters of the developed equation using the data about the official sector of the economy of Ukraine for 12 years of the transition process. The key results of that analysis showed the following:

The parameters of the production function that was built on chain indexes denote the high validity of the model and closely related variables. According to those the dynamics of real GDP in Ukraine at 95% is defined by dynamics of four factors – working time, fixed asset formation, material costs and entrepreneurial innovations. It is established that for all the investigated period the average productivity of all factors practically has not changed.

According to the parameters of a valid model of the production function constructed on the basis of basic indexes, the independent factors included into it on 99% define the dynamics of the GDP of Ukraine. In comparison with a function constructed on the basis of the chain indexes, the given function specifies decrease of four-factor productivity, which contained the growth of GDP in Ukraine in the analyzed period. The presence of diseconomies of scale is established, i. e. integration of manufacturing negatively influences the efficiency of the economy of Ukraine.

The estimate of parameters of the developed model of four-factor productivity denotes that economic efficiency of the economy is for the most part defined by labour utilization efficiency (working hours) while at the same time the influences of other factors (investments, materials cost, entrepreneurial innovations) on economic efficiency are also significant. At the same time, the value of the received parameter of the elasticity of output with respect to labour is considerably below in comparison with the developed and the other transition economies, and even with the USSR, which testifies that the economy of Ukraine is less developed.

Nevertheless high rates of economic growth and gain of labour productivity did occur in Ukraine during 2000–2004, the value of economic efficiency of the economy kept at quite a low level and even declined (in 2003–2004). This may be explained by ineffective investments and innovations as well as an increase of intensity of materials use in the Ukrainian economy.

Thus, it is not enough for maintaining a growth of economic efficiency of the economy only to have an increase of labour productivity. Cheap energy carriers (gas, oil), with which Ukraine during all the period of economic transformation was provided, did not promote modernization of the national economy and active implementation of energy saving innovations. They only froze the inefficient structure of the economy and technological backwardness of the country to which indicator it is possible to apply the highest in Europe consumption level of energy carriers on the unit of the GDP. This indicator names 'Energy use per PPP GDP', and in Ukraine it is higher even than in coldest and rich in minerals Russian Federation, and according with World Bank data it equals 0.57 kg of oil equivalent per constant (2000) US dollar of the GDP at PPP. That is 2.6 times higher than in Poland, 3 times higher than in Slovenia, 3.7 higher than in Great Britain and 6 times higher than in Hong Kong. As a result, with carrying out of liberalization of import prices of energy

carriers and growth of the world prices for them recently, the country on the threshold of 2005 and 2006 has closely collided with the danger of the crisis of efficiency. Therefore the real actions on fixed capital renovation, introduction of resources-saving technologies and effective innovations are necessary to increase the economic efficiency of the Ukrainian economy.

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