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MÁRIA LACKÓ

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Labour Research Department, Institute of Economics, Hungarian Academy of Sciences
Department of Human Resources, Budapest University of Economics

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Author: Mária LACKÓ, senior research fellow of Institute of Economics, Hungarian Academy of Sciences. Address: H–1112, Budapest, Budaörsi út 45. Phone/fax: (43) 22-36-71-313 (c/o János Gács); E-mail: gacs@iiasa.ac.at

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DO POWER CONSUMPTION DATA TELL THE STORY? – ELECTRICITY INTENSITY AND HIDDEN ECONOMY IN POST-SOCIALIST COUNTRIES[1]

MÁRIA LACKÓ

The paper disputes the frequently presented and quoted statement that in post-socialist economies data on power consumption are better indicators for aggregate output changes than data on official GDP. Attempt is made to show that the variation of electricity intensities in post-socialist countries does not necessarily reflect the growth of the hidden parts of the economy. Statistical and econometric analysis of data for 18 post-socialist economies show that in this region, the differences in measured and registered structural changes are more important factors explaining the differences in the changes of electricity intensity than the changing size of the unofficial economy.

Introduction

The hidden economy is universal, it is present in any economic system, in developed market economies, in the socialist/post-socialist countries and in developing economies. In spite of such a universality the direct causes of the hidden economies in the different systems are different.

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In the **developed market economies** the main factors affecting the hidden economy are: high tax-rates, the burden of regulation by the state, varying possibilities of employment for the labor in the official economy and low tax-morality.

In the **developing countries** the causes are the same, though their weights are different: the determinant is the lack of opportunities for the agents to participate in the official business and labor market.

The causes of emergence and perpetuation of the hidden economy in **socialist economies** were entirely different from those in market economies. In fact, the habitual factors of market economies could not be significant in the socialist environment because of the extreme narrow scope of formal taxation and the full employment of the labor force. Major factors triggering the expansion of the hidden economy in socialist countries were the pressure of permanent shortages, the negligible size of the legal private economy, the low level of services provided by the sate, and the lack of competition (*Kornai*, [1992]).

In the **post-socialist system**, a gradual restructuring of the factors that trigger the hidden activities takes place: the factors that had been characteristic of the socialist system lose importance, while those characterizing the market system gain ground. Major new developments, like disappearance of shortages, the emergence of competition, a gradually expanding market of services, and the growing role of the legal private economy (*Kornai* [1995]) all lead to the disappearance of the earlier causes of hidden economy and give way to the traditional causes present in market economies like the gains of tax evasion, and of the black labor of unemployed and other inactive people.

In the course of gradual restructuring also the financial discipline an tax discipline develop slowly.

"In the socialist system discipline was enforced by the bureaucracy itself, many times with arbitrary and brutal means" (*Kornai* [1993], p. 326.).

Distrust and indifference towards the state characterized the behavior of the citizens. In the early 1990s, in the course of the transition process the means of enforcement have gradually changed to those of the constitutional state. However, to establish trust in the state takes much longer time than changing the regulatory system. (*Kornai* [1992], [1993]). As a consequence of economic liberalization and continuing distrust in the state the scale of hidden activities economy has grown fast in these economies.

In the literature of transition the size of the hidden economy has got a prominent place, and that for several reasons: first, the size of the hidden economy has far reaching consequences for the actual, as opposed to registered, rate of output decline, and second, the pervasiveness of hidden activities greatly determines the size of the missing revenues from the government budget in the times when stabilization endeavor seeks all possible sources of budgetary revenues.

Once as student and later as colleague and friend of *János Kornai* I got acquainted with the characteristic features of socialist and the post-socialist economies under his guidance. One of the general principles that I learned from him during these 28 years was that for the description, analysis and understanding of the economic phenomena measurement is indispensable, even in the case of arcane concepts such as the hidden economy.

The measurement of the size of hidden economy has not been solved in any economic system, let alone for the post-socialist economies. Many estimations methods have been established and applied that have produced results that support, complement, but many times contradict to each other. A consensus about the reliable and acceptable approaches is far from being established.

In this study I deal with such methods of estimation of the hidden economy which rely to a great extent on aggregate electricity consumption data. The application of these methods has got widespread, and its results frequently cited in the transition literature. Following the presentation of the method devised by *Dobozi* and *Pohl* [1995] and *Kaufmann* [1995], I show why these

methods are inappropriate for measuring the hidden economy in the post-socialist economies. At the end of the paper, as an alternative, I briefly present my own model which is based (partly) on the development of the residential electricity consumption instead of aggregate electricity consumption.

1. The method of Dobozi and Pohl to measure the change of size of the hidden economy

In 1995, two supplementary papers were published in the newsletter Transition with talkative titles: Real Output Decline in Transition Economies – Forget GDP, Try Power Consumption Data! (*Dobozi* and *Pohl*, [1995]); and Electricity Consumption and Output Decline – An Update (*Dobozi* [1995]).

In these papers the authors, *Dobozi* and *Pohl* claim that in the post-socialist countries, especially in the case of countries of former Soviet Union (FSU) the statistically registered drop in GDP after 1989 exaggerates the actual decline, possibly by a very large margin. They state that in market economies, aggregate economic activity and electric power consumption usually move in lockstep (with an electricity-GDP elasticity close to one). Data for post-socialist countries do not show the same pattern, and the huge differences between the electric power consumption and GDP cannot be explained rationally across post-socialist countries but only by a rapid growth of the hidden economies. The papers of *Dobozi* and *Pohl* have not remained without effects: they have became returning motives of serious written analyses (*Transition Report* [1995], EBRD, for example) and of noted conferences dealing with post-socialist transition.

In the period 1989–1994, in Eastern European transition economies (with the possible exception of the Czech Republic) the cumulative decline in

power consumption closely matches the drop in GDP, yielding an electricity-GDP elasticity of about 1 (meaning that 1 percent GDP fall was associated with about 1 percent drop in electricity consumption). As *Dobozi* and *Pohl* write:"Even in those East-European countries where the economic structure and product lines changed drastically, as in Poland, the correlation between power use and economic activity remained fairly close." (*Dobozi* and *Pohl* [1995] p.10.)

In most FSU countries however, the reported output declines are completely inconsistent with the power consumption trends; thus, according to *Dobozi* and *Pohl*, the reliability of official statistics has to be seriously questioned. The gap between increasing electricity consumption and falling GDP can only be explained by gross underreporting of GDP. In the period 1989 and 1994, output downturn in Russia and Ukraine may have been inflated by official statistics more than twofold, in Azerbaijan as much as threefold, and in Georgia, Kazakhstan, Latvia and Moldova by 50 to 90 percent.

Several factors distort official statistics, such as:

– widespread underreporting of output in order to avoid high taxes,

– over-representation of large state-owned industrial enterprises that are undergoing major retrenchment, and

– shortcomings of data collection in capturing ever increasing private activities. (*Dobozi* [1995] p. 19.)

2. The Kaufmann-method

Based on the above considerations, *D. Kaufmann* [1995] already reported some concrete calculations concerning how, with what speed and to what size the hidden economy grew in the Ukraine between 1989 and 1994.

"To measure overall economic activity in an economy, electric power consumption is usually the single-best physical indicator of economic activity. Overall economic activity and electricity consumption have been empirically observed throughout the world to move in lockstep – with an electricity/GDP elasticity close to one (*Dobozi* and *Pohl* [1995]). For the specific case of economies in transition a careful consideration of all special features (very low electricity prices, with gradual adjustment upward; untapped efficiency improvement potential; and restructuring towards less electricity intensive activities) suggests that on balance electricity efficiency per unit of overall GDP may increase somewhat overtime (i.e. there may be less than unitary elasticity during the transition). While still being a good proxy, this means that the changes in electricity consumption may to some extent underestimate the changes in overall GDP.

On the basis of the substraction of the two variables measuring overall and official GDP, respectively, we can arrive an estimate of the unofficial economy. If the estimate of changes of overall GDP, approximated by the rate of change of electric power consumption, is somewhat underestimated, it means that the unofficial economy will also be somewhat underestimated. Consequently, this estimate of the unofficial economy (derived by subtracting the proxy for the overall economy from official GDP, if biased, is likely to be a conservative estimate." (*Kaufmann* [1995] p.1.)

As a starting point of estimating the size of the unofficial economy in Ukraine *Kaufmann* uses the results of the well-known Berkeley-Duke research on the Second Economy of the USSR (*Alexeev* at al., [1987]) conducted during the late 1980's. These estimates roughly range between 8% and 16% of the total economic activity. Thus, for purposes of his calculation, *Kaufmann* uses the midpoint estimate of 12%, assuming that this share of all the economic activities had been unofficial in 1989.

The next step in his calculation is to derive the figures for the overall GDP proxy, based on overall electricity consumption. He also computes the growth indices of official GDP.

The figures in *Table 1* are Kaufmann's proxy variables for the calculations on the overall and official GDP, respectively. They incorporate the baseline 1989 estimate for the unofficial economy of 12%. *Table 2* presents Kaufmann's calculations on the evolution of the Ukrainian unofficial economy during the period 1989–1994 in index numbers, starting with 12.0 in 1989 (since base index is 100.0 for the overall economy). The first and third rows come from the calculations in *Table 1*, while the second row (unofficial economy) is the difference between the third and first rows.

From *Table 2* it can be seen that

– by 1994 the unofficial economy tripled, while the official economy contracted to less than half the size it was in 1989;

– the decline in overall economy since 1989 was one-quarter, which while significant, is still less than half the decline derived from official statistics. The decline in the official economy was mitigated by the rapid growth in the unofficial economy during the period.

On the basis of *Table 2* Kaufmann calculates the relative shares of the official and unofficial economies. According to *Table 3*, by 1994 the estimated share of the unofficial economy in the overall Ukrainian economy was 48.1%. Kaufmann adds that this result is consistent with micro-survey estimates.

The above described estimation method of the unofficial economy is very simple, and appealing. However, as *Dobozi* and *Pohl* confess themselves, there are people who are skeptic towards this method: "Although our article was generally welcomed as being on the right track to obtain more reliable – and certainly low-cost – estimates of the extent of output retrenchment during the systemic transition, some skeptics argued that while power consumption and economic activity tend to move in tandem in market economies, it may not be relevant for transition economies that are experiencing rapid and massive structural changes. Many argue, that the increase in electricity consumption may reflect structural movement toward

higher electricity intensity in GDP." (*Dobozi* [1995] p.19.)

Under the impact of criticism, in his recent calculations with his co-authors (*Johnson, Kaufmann* and *Shleifer* [1997]), Kaufmann eases the strict assumption of unit elasticity. According to his new concept he assumes an elasticity of 0.9 for Eastern-European countries, 1 for the Baltic countries and 1.15 for CIS countries. With this modification, he and his co-authors use his method described above for estimating the hidden economy already for 17 countries. His results are presented in *Table 4.*

The author of this paper keeps belonging to the skeptics, despite the fact that she agrees with the approach that uses indicators of electricity consumption for the estimation of the share of hidden economy in GDP. In fact, in an other paper she also worked out an estimation method for this purpose, a method that is suitable for international comparison, and which extensively makes use of the indicators of electricity consumption.

My skepticism derives from several factors. One cannot avoid asking: how is it possible that, according to the calculations of *Kaufmann,* the hidden economy didn't grow in Romania or Uzbekistan during the years of transition, while in other countries the size of hidden activities seems to grow rapidly? It is also surprising that in 1994 and 1995 the ratio of the hidden economy to GDP is much smaller in Slovakia than in the Czech Republic. Likewise, this ratio also seems to be too low in Poland if compared to other reform countries, and to anecdotal evidence.

The second kind of doubt derives from the examination of Finland's case. In the early 1990s, Finland, just like the East European economies,and to some extent due to similar factors experienced a significant fall of the GDP.

Between 1990 and 1993 in Finland the GDP decreased by 13.6%, while electricity consumption, far from decreasing, increased by 5.5%.

The growth of electricity intensity in Finland in 1990–1993 was 22%, not much less than the average of the 18 post-socialist countries in 1989–1994, 32%, but far larger than the average of the East European and Baltic

countries in 1989–1994, 8.3%. Do the similarities suggest that just like in the transition economies Finland's growth of electricity intensity can also be explained by the sudden jump of the hidden economy? To see whether this can be true, let's carry out the same calculation for Finland that Kaufmann did for Ukraine. The initial share of the unofficial economy which is relevant for 1990 (10.0%), was taken from my own estimation (*Lackó* [1996]).

According to this calculation, the share of the hidden economy in Finland would increase from 10% to 27% in three years, i.e. its relative size would fast triple! We get a similarly surprising and unrealistic result if the starting share is 5% instead of 11%. In that case the share of the hidden economy in 1993 would be 23%, which would mean an even more radical change, since the result would be more than for times the size of the starting value.

The results cited above are astonishing and, given all the general knowledge about Finland, cannot be true. The above calculation was presented in order to show that the method by which the results were derived is rather debatable.

In fact, the growth of electricity intensity in Finland is connected with the normal effects of recessions rather than the expansion of the unofficial economy: in recessions electricity consumption decreases not as much as the GDP because the fixed (overhead) electricity use, does not contract in proportion with the drop in general capacity utilization.

This effect is also mentioned by *Dobozi* and *Pohl* when they discuss electricity intensity of countries in transition, however, they add: "It is plausible to assume that the consumption-increasing effect of this factor was largely offset by the combined impact of higher electricity tariffs and shifts in the output mix away from heavy industry." (*Dobozi* and *Pohl* [1995] p.18.)

In the following I will show that in the 18 post-socialist countries under investigation it is mainly the differences in the size of structural changes of the economy that determine the differences in changes of electricity intensity.

3. Analysis of changes in electricity intensity in 18 post-socialist countries in the period 1989–1994

It is obvious that at times of recession, due to smaller than usual capacity utilization, electricity intensity grows, as we saw in Finland's case. In post-socialist countries, however, additional factors are also present. According to OECD experts (Electricity in European Economies in Transition. *OECD [*1994]), in individual countries of East Europe, but particularly in FSU countries since 1990 the industrial sector has largely maintained its level of energy consumption, despite the fact that industrial production, in value-added terms, has fallen substantially. Reasons for this included the following:

(a) – the share of industrial output represented by energy intensive basic industries, including energy-industry, has actually increased;

(b) – inefficient plants have not been closed, but instead have operated at lower partload efficiencies. According to *Roxburgh* and *Shapiro* [1996] in Russia, because of the Excess Wages Tax, which actually is an employment subsidy, unemployment is internal to the enterprise: this gives a strong incentive for the firm to retain excess workers on low wages rather than making them redundant. This kind of tax influences not only state-owned firms but also privatized ones, moreover, it was found, that privatized firms made fewer workers redundant than state owned companies (*Standing* [1994]). According to the calculation made by *D. Kaufmann* [1995] , the rate of the hidden unemployment in Ukraine is 35 %. Internal unemployment most probably lead to higher electricity intensity in the industry that if it would be external one.

(c) – electricity price rises have been limited in real terms, and nominal price adjustments have often been accompanied by consumers' refusals to pay;

(d) – little or no investments have been made in new plants to improve

electricity efficiency;

(e) – the decision-makers' ability to evaluate the energy use implications of their investment choices is lacking. Under the centralized economic system, decision on investments into fixed assets were based primarily on the available production capacity and plan targets for physical output, with little emphasis on productivity or efficiency. This legacy has produced industrial enterprise managers largely unfamiliar with cost accounting procedures.

Based on this list of specific factors that determine electricity use in post-socialist economies we may assume that it is the rate at which structural changes take place in the individual post-socialist countries that will mostly explain the differences in the growth of electricity intensity across these economies. In the following I investigate this problem with the help of a cross-sectional examination of 18 post-socialist countries. Already at this point I would like to emphasize that I don't exclude the possibility, that also the growth of the hidden economy influences the growth of electricity intensity. I only claim that the method initiated by *Dobozi, Pohl* and *Kaufmann* is not the right one to apply for the periods and the economies that these authors wanted to use their method for.

In my analysis three different indicators of structural change are defined:

1. The change in the share of industry in the production of GDP between 1989 and 1994: ind (measured in percentage point)
2. The difference between the decrease of electricity consumption in industry and the decrease of total electricity consumption in 1989–1993: d (percentage point)
3. The maximal rate of unemployment between 1989 and 1994: u (percent)

We assume that the larger structural changes took place in a particular economy, i.e. the faster the dismantling of industries of socialist type was carried out, the less growth in electricity intensity occurred. More precisely:

– the more the value added of the industrial branches decreases compared to the official GDP, the less growth in electricity intensity occurs,

– the more the electricity consumption in industrial branches decreases in comparison to total electricity consumption, the more pronounced shift occurs from highly electricity intensive branches to branches with less electricity intensity, and therefore the less the electricity intensity of the economy grows;

– the higher the rate of unemployment, which is to a high degree structural unemployment, the larger structural changes happened in respect with the dismantling of industry of socialist type and therefore the slower the rise of electricity intensity in the economy.

Table 5 shows the average size of the individual structural indicators for the different groups of countries. In the last column the average change in electricity intensity is presented. The table shows that for the East-Central European countries each indicator of structural change is 1.6 - 2 times as large as the average indicator of the full sample of 18 countries, the indicators of the Baltic Countries are similar to the total average, while the indicators of the countries of Commonwealth of Independent States are half as large as the average indicators. In the last column of the table, it can also be noticed that in line with our assumption the bigger the structural change, the less is the growth of electricity intensity.

The regularity which is suggested by the interrelations of the country group averages, i.e. that the development of electricity consumption is significantly influenced by the scale of structural changes, is now subjected to a more exact econometric analysis. Let's look first at the correlation between the indicators of the individual countries.

From *Table 6* we can see that there is a close positive relationship between the change of electricity consumption and the change of the official GDP. We find also an interesting relation between two indicators of structural change: the larger the decrease of the share of industrial branches within the official GDP, the larger the rate of unemployment.

The table also shows an important correlation between the change of the official GDP and the structural indicator measured by the electricity consumption: the less the electricity consumption in industrial branches decreases in comparison with total electricity consumption, in other words the smaller the structural change in this field, the larger fall is experienced in the official GDP. We have to be careful with the interpretation of this result. If electricity consumption in the industrial branches contained an increasing share of unregistered elements compared to that contained in total electricity consumption, then it would give sufficient explanation for a larger decline in the official GDP. In this case the growth in total electricity intensity would indeed be caused by the growth of the hidden economy. However this assumption is most probably not well founded: if the electricity consumption due to non-registered production is in the industrial branches large and growing then at least the same would apply to the total electricity consumption, since trade and service activities are much easier to keep unregistered.

From *Table 6* it is evident that the growth of electricity intensity is correlated with the measure of structural changes related to electricity consumption in industry: the less the decrease in electricity consumption in the industrial branches compared to total electricity consumption, the more the electricity intensity increases.

4. Econometric analysis

In the following we formulate our hypothesis in an equation and attempt at verifying it with a cross-section econometric estimation.

Equation (1) expresses our already sketched hypothesis, that in addition to the changes of the official GDP, it is the scale of the three kinds of structural changes that determine total electricity consumption. With this, of course, we do not state that the growth of unofficial economy doesn't

influence electricity consumption or the growth of total GDP. We only state that the difference between the shifts in electricity consumption and the change of the official GDP is not that mystic and hidden, and it shows a strong relation to the scale of structural changes.

The equation is as follows:

$$de_i = d_1\, dgdp_i + d_2\, ind_i + d_3\, d_i + d_4\, u_i + d_5 \qquad (1)$$

$$d_1>0 \quad d_2>0 \quad d_3>0 \quad d_4<0$$

where

de_i: the change in electricity consumption between 1989 and 1994

$dgdp_i$: the change of the official GDP between 1989 and 1994

ind_i: the change of the share of industry in the production of GDP between 1989 and 1994

u_i: the maximal rate of unemployment between 1989 and 1994

d_i: the difference between the change of electricity consumption in the industrial branches and the change in total electricity consumption, 1898-1993

i: country indicator. The countries are: Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia, Estonia, Latvia, Lithuania, Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Moldova, Russia, Ukraine, Uzbekistan.

In *Table 7* the results of the econometric estimations are shown. The estimations were carried out with the ordinary least squares method, based on the cross-sectional data of 18 countries. The estimation was carried out in different variants (see *Table 7*). The signs of the parameters are mostly as expected, and the indicators of fitting are acceptable. In the course of the estimation, three dummy-variables were used for the countries Romania, Georgia and Uzbekistan. Beside the structural shifts across sectors that are taken into account in equation (1), Romania's special feature was the structural change that took place *within* the industry. In the mid-1980-s, Romania had by far the largest petrochemical sector in Eastern Europe. Between 1989 and 1992 this industrial branch virtually collapsed: its output decreased by 50 %. Due to the high electricity use in petrochemical industries this single specific development has contributed to the decline in Romania's

total electricity intensity to a large extent.(Electricity Policies of Romania, OECD 1993)

In the case of Uzbekistan it is also the heritage from the past that explains its outlier position.

During the Soviet era, Uzbekistan became the cotton-growing center of the former Soviet Union. The development of basic industries was neglected and the republic was among the least industrialized ones in the USSR (Ebel, 1997). Cotton accounts for 70 % of the country's exports, and 50% of its GDP. Exactly because of this reliance on a single commodity, Uzbekistan was barely struck by the transitional recession, and the country's electricity intensity did not grow either. The latter was also connected with the fact that Uzbekistan alone from all the republics of the former Soviet Union managed to increase its oil and gas production in the first years of transition. Therefore, currently has control over more energy sources capable of substituting for electricity, than before transition.

Georgia's special situation can be explained by the conflicts and wars in South-Ossetia and Abkhazia which lasted until 1994 and paralyzed the economy.

In estimation *A1* we haven't yet taken into account the differences in the scale of structural changes across the countries. According to the results obtained here a 1% decrease of GDP was accompanied on average by a 0.5% decrease in electricity consumption in the 18 post-socialist countries. In fact, this estimation does not help the analysis, it only describes the investigated event.

In estimations *B1, C1* and *D1* we included the three different structural indicators individually. In all three cases the sign of the structural parameter showed up as expected, however, the significance of the parameter in estimation C1 is not appropriate. The reason for this is the multicollinearity caused by the close negative correlation between the variables gdp_i and d_i. The fitting of the equation improved in all three cases in comparison to estimation *A1*, with the most spectacular improvement in the case of the indicator of the rate of unemployment (estimation *D1*).

The parameter of the rate of unemployment is significantly negative. The negative sign is as expected, since we assumed that larger unemployment indicates a larger scale of structural changes, which, ceteris paribus, reduces electricity consumption.

The assumption of a negative sign here is not, however, evident at all: we could have assumed and obtained a positive sign likewise due to the widely known close relationship of the size of the hidden economy and the level of unemployment. It is a tendency in developed market economies that the larger the rate of unemployment, the larger the size of the hidden economy.

This process in which the pool of the unemployed strengthens the activities in the hidden economy will most probably gradually become more pronounced in the Eastern European countries. Inactive members of the families start to participate intensively in the hidden economy, and through this, contribute to the increase of electricity consumption and intensity. This growth of electricity intensity is blurred by the effect of the structural changes, which is characterized by the reduction of the usual role of socialist heavy industry, and the subsequent cut in electricity intensity. According to our calculations, from the two effects in the period 1989–1994 , structural changes turned out to be more powerful: this is shown by the significantly negative parameter in equations *D1, E1* and *F1*.

In estimation *E1* we found some genuinely interesting results. If there was no difference between the 18 post-socialist countries' speed of structural change, then GDP and electricity consumption would really closely move together (value of parameter belonging to variable $dgdp_i$: 1.00).

In estimation *F1* all three structural indicators are presented. Here, due to the close negative relation between ind_i and u_i, multicollinearity arose.

Because of the multicollinearity between $dgdp_i$ and d_i equation (1) had to be reformulated and reestimated. The new function, equation (2), the dependent variable is the change of electricity intensity which is the function of the indicators of structural change.

$$dint_i = Q_1\, ind_i + Q_2\, d_i + Q_3\, u_i + Q_4 \qquad (2)$$

$$Q_1>0 \quad Q_2>0 \quad Q_3<0$$

where

$dint_i$: the change of electricity intensity between 1989 and 1994

We did a couple of estimations for equation (2), the results of which are shown in Table 8. In these estimations the parameters proved to be significant and got the expected signs (except that of the variable ind_i in estimation F2 because of multicollinearity). The most satisfactory result came out of estimation D2, where no multicollinearity distorted the estimated parameters.

From the results of estimation we can draw the conclusion that if there had not been a radical structural change in the official economy in Eastern Europe, then the growth of electricity intensity would have been larger, since the economic structure inherited from the past used a large amount of electricity even in the case when production was falling. We can formulate this also the opposite way: if there had been powerful structural changes in the official economy of the CIS countries, then the growth of electricity intensity would have been far less then experienced recently. Even within Eastern Europe differences can be seen in respect to structural changes in the official economy. For instance, in Slovakia structural changes, such as the cuts in the production of metallurgy and other heavy industries that were triggered by the shifts in demand, combined with the high unemployment caused the fast decline in the country's electricity intensity in 1993–1994. This was the reason for the larger decrease of electricity intensity in Slovakia than in the Czech Republic and not a smaller and more rapidly decreasing hidden economy, as implied by the estimation of *Kaufmann* and his co-authors (see *Table 4*).

At the end of our econometric analysis we return to the case of Finland to check the applicability of our results to this specific country. Our question is the following: How big is the difference between estimation and reality, if we estimate Finland's change of electricity intensity with the estimation results of equation (2) (i.e. with the parameters that were deducted from the analysis of 18 post-socialist economies) ?

During the recession of 1990–1993 in Finland the rate of unemployment increased with 14.3 percentage points, electricity consumption in the industrial branches increased by 3.6%, while total electricity consumption increased by 5.7%; accordingly the value of the variable d_i is -2.1. If we put these numbers into equation (2), and use the parameters produced by estimation D2, we get an estimation of 20.2% increase of electricity intensity for Finland. The real increase of electricity intensity was 22.3%; the difference between real and estimated change is a lot smaller than the margin of error of the estimated function. In our equation the growth of electricity intensity in Finland was explained by the various structural changes rather then by the explosive growth of the hidden economy.

Based on the results of the statistical analysis and the econometric estimations in sections 3 and 4 we feel that our hypothesis has been proved: it is the structural changes which take place in the countries with different speed, that is decisive in the development of electricity intensity. We don't exclude that the fast growth of the hidden economy does influence the growth of electricity intensity: we just state that from the usual aggregate data it is very hard to draw conclusions for the growth of the hidden economy.

5. Residential electricity and hidden economy – description of a new method

As already written in the Introduction, the hidden economy is present in any economic system. We may add here that in each economy hidden activities play a role in each sector of the economy, including the industry, trade and other services, even households.

In other papers of mine (*Lackó* [1995], [1996], [1998]) I analyzed the size of hidden activities present in households in a cross section of countries and used these results for the estimation of the volume of hidden activities on the national level. That model utilized the data of residential electricity consumption, a part of aggregate electricity consumption. In the following I

briefly summarize this model. The method helps to establish share of the hidden economy in different countries in a given period (I made calculations for 20 OECD economies and some post-socialist countries). It does not attempt to calculate the growth of the hidden economy, an in this respect it is not comparable with the *Dobozi–Pohl–Kaufmann* calculations. My model would be capable for the measurement of the growth too, but at this stage the unavailability of the necessary data prevents this exercise.

An advantage of the model based on residential electricity consumption is that it relies in meso-level analysis, i.e. the investigation of the behavior of households. This way it can ignore the substantial differences in the macro-structure of the different economies, and the impact shifts in this macro-structure on the electricity consumption, and through this, on the hidden economy.

The use of households as the level of analysis is beneficial also for another reason. One characteristic feature of economic transition in Eastern Europe is the mushrooming of small private business, which is set up practically in family-household framework. In this milieu this fast growing economic activity can easily operate mostly hidden from state registration.

The method is based on an econometrically tested model which uses data of developed market economies. Subsequently, the estimations of the size of the hidden economy in the socialist-post-socialist countries needed some modifications according to the specificity of this system.

The first premise for the model was that in each country a part of the household consumption of electricity is used in the hidden economy. We asserted that the electricity consumption of households in a country was determined not only by such visible factors as the size of the population, the level of development, the country's geographical location (climate and weather), the relative price of electricity, and access to other energy sources, but also by the extent of the hidden economy.

In the model the hidden economy is represented by three proxy variables: the tax/GDP ratio, the inactive/active labor ratio and the ratio of public social welfare expenditures to GDP. The first two proxies represent

well-known relationships: the higher these ratios the higher the share of the hidden economy. The third indicator is related to the enforcement of taxes: the higher the third ratio, the stronger efforts are made by the state to collect outstanding taxes.

The parameters of the model were estimated by a cross-section of the countries in different variants: (1) for 19 OECD countries in 1990, (2) for 19 OECD countries in 1989 and (3) through a panel data base made up of the data for 1989-1990. The estimated parameters were significant, the signs coincided with the expected ones. Accordingly, the results supported our assumptions about the determinants of household electricity consumption, including the impact of the hidden economy.

After the estimation of the parameters of the model residential electricity consumption could be decomposed to two parts with the help of which indicators were created for each country showing the per capita household consumption of electricity related to the hidden economy as a share of total per capita household electricity consumption. This calculation was carried out not only for 19 OECD countries but, following some necessary modification, also for some East-European countries (Hungary, Poland). The parameters obtained for the developed market economies were applied for these post-socialist economies to establish that part of household electricity consumption which was independent of the hidden economy. After subtracting this part of the consumption from the actual electricity consumption we got to the share of household electricity consumption used in the hidden economy in total household electricity consumption. As this sequence of calculations shows the proxies characterizing determinants of the hidden economy in developed market economies were not used here.

The results of this exercise aimed to determine the contribution of the hidden economy to GDP in the individual countries. However without the knowledge of how much GDP is produced by one unit of electricity in the hidden economy of each country the share of the hidden economy in the GDP can not be calculated. Since data for the per unit use of electricity in the hidden economy is unavailable an indirect conversion methods had to be

used.

This method was rather rudimentary: the results of one of the estimations known from the literature were taken (a calculation carried out for a single country for the early 1990s), and the other countries' data (their index of hidden economy expressed in terms of residential electricity consumption) were proportioned to this base country.

Table 9 summarizes the results of our estimations. According to the results of our investigations, in the early phase of transition, the size of the hidden economy in the investigated post-socialist countries (Hungary, Poland) is two times larger than in the average of developed market economies, and much larger than in that developed economy which has the largest hidden part (Spain, Greece, Ireland, Belgium, Italy).

6. Summary

This paper disputed the frequently presented and quoted statement, that in post-socialist economies data on power consumption are better indicators for aggregate output changes than official GDP. The development of electricity consumption is allegedly reflecting the combined growth of official and hidden economies and they tell the true story about decline of output in these countries between 1989 and 1994.

The authors *Dobozi, Pohl* and *Kaufmann* claim, that the statistical drop in GDP after 1989 in post-socialist countries, especially in the case of countries of former Soviet Union, exaggerates the actual decline, possibly by a very large margin. They take it for granted, that in market economies aggregate economic activity and electric power consumption usually move in lockstep (with an electricity-GDP elasticity close to one). Since the post-socialist countries do not show the same pattern, they claim that this feature can be explained rationally only by a rapid growth of the hidden (unofficial) economy.

Starting the discussion of the validity of this approach first the *Kaufmann* method was applied for Finland, a developed market economy that suffered an output decline in the early 1990s comparable to that in the post-socialist economies. The results was such an astonishing, unrealistic implicit growth of the hidden economy in Finland that had to lead to questioning the underlying assumptions of the *Dobozi–Pohl–Kaufmann* approach.

My paper attempts to show that the variation of electricity intensities in post-socialist countries does not necessarily reflect the growth of the hidden parts of the economy. Statistical and econometric analysis of data for 18 post-socialist economies show that the measured and registered structural changes are sufficient to explain the differences in the changes of electricity intensity in this region.

In the course of my investigations I have become convinced that using aggregate electricity consumption data and the assumption of constant electricity intensity is not the proper way to calculate the size or growth of the

hidden economy either in mature market economies or in economies in transition. I have become convinced, however, that other indices (like residential electricity consumption) and other assumptions lead to more satisfactory estimations of the size of the hidden economy in developed market economies and post-socialist countries, as it is showed in my earlier work (*Lackó* [1995], [1996], [1998]).

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Tables

Table 1

Changes in Electricity Consumption (as a proxy of Overall GDP) and Official GDP in Ukraine, 1989–1994

	1989	1990	1991	1992	1993	1994
Growth rate in Electricity Consumption		0	-2,2	-6,2	-7,8	-11,7
Electricity Consumption Index (1989 = 100)	100,0	100,0	97,8	91,7	84,6	74,7
Growth rate in Official GDP		-3,8	-13,4	-17,5	-14,9	-24,5
Official GDP Index (Index 1989 = 88)	88	84,5	73,2	60,4	51,4	38,8

Source: Kaufmann [1995]

Table 2

Evolution of the Official and Unofficial Economy in Ukraine 1989–1994, percent

	1989	1990	1991	1992	1993	1994
Official Economy Index	88	84,5	73,2	60,4	51,4	38,8
Unofficial Economy Index	12	15,5	24,6	31,3	33,2	35,9
Overall Economy Index	100	10,0	97,8	91,7	84,6	74,7

Source: Kaufmann [1995]

Table 3

Relative Shares of Official and Unofficial GDP in Ukraine 1989–1994, percent

	1989	1990	1991	1992	1993	1994
Official GDP	88	84,5	74,9	65,9	60,8	51,7
Unofficial GDP	12	15,5	25,1	34,1	39,2	48,1
Overall GDP	100	100,0	100,0	100,0	100,0	100,0

Source: Kaufmann [1995]

Table 4

Share of the unofficial economy in total GDP, 1989–95, selected transition economies (in percent)

	1989	1990	1991	1992	1993	1994	1995
Azerbaijan	12,0	21,9	22,7	39,2	51,2	58,0	60,6
Belarus	12,0	15,4	16,6	13,2	11,0	18,9	19,3
Bulgaria	22,8	25,1	23,9	25,0	29,9	29,1	36,2
Czech Republik	6,0	6,7	12,9	16,9	16,9	17,6	11,3
Estonia	12,0	19,9	26,2	25,4	24,1	25,1	11,8
Georgia	12,0	24,9	36,0	52,3	61,0	63,5	62,6
Hungary	27,0	28,0	32,9	30,6	28,5	27,7	29,0
Kazakhstan	12,0	17,0	19,7	24,9	27,2	34,1	34,3
Latvia	12,0	12,8	19,0	34,3	31,0	34,2	35,3
Lithuania	12,0	11,3	21,8	39,2	31,7	28,7	21,6
Moldova	12,0	18,1	27,1	37,3	34,0	39,7	35,7
Poland	15,7	19,6	23,5	19,7	18,5	15,2	12,6
Romania	22,3	13,7	15,7	18,0	16,4	17,4	19,1
Russia	12,0	14,7	23,5	32,8	36,7	40,3	41,6
Slovak Republic	6,0	7,7	15,1	17,6	16,2	14,6	5,8
Ukraine	12,0	16,3	25,6	33,6	38,0	45,7	48,9
Uzbekistan	12,0	11,4	7,8	11,7	10,1	9,5	6,5

Source: Johnson, Kaufmann and Shleifer[1997]

Table 5

Mean values of the indicators of structural change and electricity intensity by group of countries

	ind	**d**	**u**	**dint**
Central and Eastern Europe	-15,9	-18,1	12,3	1,005
Baltic Countries	-8,3	-9,3	4,7	1,237
Commonwealth of Independent States	-3,5	-7,0	2,6	1,550
Total	-8,4	-11,0	6,2	1,320

Source: own calculations

Table 6

Correlations among the indicators of the countries

	de_i	**$dgdp_i$**	**$dint_i$**	**ind_i**	**u_i**	**d_i**
de_i	1					
$dgdp_i$	0,81	1				
$dint_i$	-0,5	-0,84	1			
ind_i	0,23	0,13	0,15	1		
u_i	0,1	0,45	-0,38	-0,75	1	
d_i	-0,47	-0,72	0,66	0,32	-0,39	1

Note:
de_i – the change in electricity consumption between 1989 and 1994
$dgdp_i$ – the change of the official GDP between 1989 and 1994
$dint_i$ – the change of electricity intensity between 1989 and 1994
ind_i – the change of the rate of industry within the GDP
u_i – the maximal rate of unemployment between 1989 and 1994
d_i – the difference between the change of electricity consumption in the industrial branches and the change in the total electricity consumption (1989
i – country

Table 7

Results of estimation of equation (1)

Dependent variable: de_i

Independent variables	**(A1)**	**(B1)**	**(C1)**	**(D1)**	**(E1)**	**(F1)**
$dgdp_i$	0,531 (5,43)	0,6535 (6,06)	0,7052 (4,22)	0,8542 (10,23)	1,002 (11,56)	1,0209 (11,04)
ind_i		0,0047 (2,46)				-0,001 (0,70)
d_i			0,0043 (1,31)		0,00402 (2,72)	0,00433 (2,75)
$\ln u_i$				-0,0774 (5,65)	-0,0765 (6,92)	-0,084 (5,42)
Dummy variables						
Romania		-0,1405 (1,91)	-0,193 (2,31)	-0,1479 (3,18)	-0,1639 (4,32)	-0,1699 (4,27)
Georgia		0,044 (0,48)	-0,034 (0,35)	0,127 (2,04)	0,1556 (3,03)	0,1529 (2,90)
Uzbekistan		-0,0993 (1,23)	-0,052 (0,59)	-0,2973 (4,37)	-0,3221 (5,78)	-0,3344 (5,61)
constant	0,4055 (6,56)	0,3825 (7,84)	0,3643 (7,54)	0,3287 (7,84)	0,2839 (7,54)	0,2787 (7,11)
aR^2	0,627	0,76	0,69	0,902	0,936	0,933
F	29,57	11,84	8,43	32,28	42,5	34,83
Standard error of regression	0,0845	0,067	0,078	0,0434	0,035	0,036
Mean of dependent variable	0,7236	0,7236	0,7236	0,7236	0,7236	0,7236

Table 8

Results of estimation of equation (2)

Dependent variable: $dint_i$

Independent variables	**(A2)**	**(B2)**	**(C2)**	**(D2)**	**(E2)**	**(F2)**
ind_i	0,0163 (2,98)				0,0091 (2,08)	-0,027 (1,04)
d_i			0,022 (4,58)	0,0129 (5,59)	0,00433 (2,75)	0,0133 (5,71)
$\ln u_i$		-0,2102 (6,98)		-0,1559 (5,65)		-0,1735 (6,78)
Dummy variables						
Romania	-0,2538 (1,10)	-0,2195 (1,61)	-0,3832 (2,15)	-0,2419 (3,22)	-0,2887 (1,75)	-0,2548 (3,36)
Georgia	1,4102 (6,04)	1,3572 (10,05)	1,003 (5,52)	1,2067 (15,30)	1,1657 (6,48)	1,1801 (14,31)
Uzbekistan	-0,4621 (2,02)	-0,8237 (5,37)	-0,2323 (1,31)	-0,6511 (7,27)	-0,3389 (2,03)	-0,6657 (7,37)
constant	1,418 (20,52)	1,5706 (30,17)	1,5442 (21,90)	1,6442 (52,30)	1,5628 (24,68)	1,6498 (51,96)
aR^2	0,71	0,9	0,81	0,97	0,85	0,97
F	11,4	37,32	19,53	105,75	20,52	88,96
Standard error of regression	0,213	0,129	0,171	0,07	0,15	0,07
Mean of dependent variable	1,3189	1,3189	1,3189	1,3189	1,3189	1,3189

Table 9

The share of the hidden economy in percent of GDP

	1990	1991	1992	1993	1994
Poland	30,8	29,7	33,0	33,6	32,8
Hungary	26,7	32,4	34,8	32,8	31,0
Spain	22,9				
Greece	21,8				
Ireland	20,6				
Belgium	19,8				
Italy	19,6				
Demnark	16,9				
Austria	15,5				
Australia	15,1				
Germany	14,6				
Portugal	13,8				
Netherlands	13,4				
Finland	13,3				
Japan	13,2				
U.K.	13,1				
France	12,3				
Canada	11,7				
Sweden	11,0				
USA	10,5				
Switzerland	10,2				
Norway	9,3				

Source: Lackó [1998]