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Estimating the Size and Growth of Unrecorded Economic Activity in Transition Countries: A Re-evaluation of Electric Consumption Method Estimates and their Implications

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Abstract

It is widely acknowledged that underground (unrecorded) economic activities play a major role in transition economies. Evaluations of the success and failure of the transition experience should therefore be based on total economic activity [TEA], namely, the sum of recorded and unrecorded economic activity. Substantive conclusions concerning the effects of unrecorded activities on the transition process as well as investigations of the causes and consequences of unrecorded activities have to date, relied extensively on estimates of unrecorded income based on variants of the electric consumption method [ECM] during the first half of the transition process. We first attempt to replicate these estimates employing improved data series. We then go on to extend and update alternative versions of the ECM estimates of unrecorded income for twenty five transition countries for the period 1989-2001. These new estimates enable us to examine the sensitivity of the results to alternative specifying assumptions, particularly, initial conditions. We find that our updated ECM estimates of the size of the unrecorded sector are not only highly sensitive to initial conditions, but they produce negative estimates of unrecorded income for many transition countries. Our findings are also compared to the new national accounting procedures that attempt to estimate exhaustive measures of the "non-observed economy". Our disturbing results call into question many of the substantive conclusions reached by other scholars who relied on earlier ECM estimates to draw inferences about the transition process as well as the causes and consequences of underground economies in transition. In short, while we conclude that ECM estimates of the size of the unrecorded economy are unreliable, it is still possible to use the growth rate of the unrecorded sector to make important inferences about the transition process by examining the dynamic relationship between recorded and unrecorded sectors. The extension of our data base to cover the entire transition period will hopefully result in new investigations employing panel data rather than the more traditional method of applying simple cross country test procedures.

Key words: underground, unreported, unrecorded, unobserved, hidden, informal, non-observed, shadow economy, transition economies.
JEL 017, O40 O5, D78, H2, H26, P20.

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During the early years of transition from planned to market economies, it became abundantly clear that any analysis of the transition required knowledge of the critical role played by the unrecorded (unobserved) economies of Central and Eastern Europe (CEE) and the former Soviet republics (FSU). Individual scholars and international agencies (Dobozi and Pohl, 1995; Kaufmann and Kaliberda, 1996; Johnson et al., 1997; Johnson et al., 1998) employed the electric consumption method (ECM) to obtain estimates of the size and growth of "unrecorded income" (Feige, 1990). These estimates were then used to examine the causes and consequences of what is often called the underground economy.

The purpose of this paper is to reexamine ECM estimates of unrecorded income in order to determine their sensitivity to alternative initial conditions and alternative specifications of "ceteris paribus" assumptions. We first attempt to replicate earlier results with more recent data and also update estimates of unrecorded income to the year 2001 for twenty five transition countries. We then modify the estimates to account for those structural changes in transition economies countries that are likely to affect the relationship between electric consumption and total economic activity (TEA). Our aim is to provide an improved temporal-cross country data base on the evolution of (TEA) [recorded plus unrecorded income] during the transition decade. These macro method estimates of unrecorded income are then compared to estimates of unrecorded income obtained from newly developed national accounting procedures (OECD, 2002) which attempt to produce "exhaustive" estimates of GDP.

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The passing of a decade of transition experience has brought forth many efforts: (EBRD, 1999; 2001; World Bank, 2002; IMF, 2000; Berg et al., 1999; Campos and Coricelli, 2002; Havrylyshyn, 2001) to characterize the growth performance of transition countries and to use "stylized facts" based on observed GDP growth, to evaluate the impact of initial conditions, institutions, and alternative policies on the dynamics of the transition process. These studies rely exclusively on the growth of recorded GDP to assess developments during the transition decade although most include at least a passing reference acknowledging the difficulties of basing transition analysis on measured GDP.[1] The failure of these studies to incorporate estimates of unrecorded economic activity in the analysis of the transition decade can be explained both by the acknowledged difficulties of obtaining reliable estimates of a phenomenon whose raison d'Ltre is to defy detection and the fact that the most recent unrecorded income estimates (Eilat and Zinnes, 2002) only span the period 1990-1997.

Our new estimates of unrecorded income will permit a re-examination of the robustness of substantive results based exclusively on recorded GDP, as well as those based on earlier and more limited ECM estimates of unrecorded income. We find that published estimates of unrecorded income for the period 1990-1997 are in error and that the substantive results based on these estimates are not robust in light of attempted replications. The extension of our data base to twenty five transition countries covering the period 1990-2001, permits hypothesis testing based on cross-country time series panel data rather than the more limited cross country analysis employed in earlier research.

[1] For example, Fisher, (2002) states: "In the transition countries of Central and Eastern Europe, the Baltics, Russia and the other countries of the former Soviet Union, output fell by more than 40 percent on average. There are well known reasons to believe these data exaggerate the real output loss…" Havrylyshyn, (2002) asserts, "growth of output and the attendant improvement in the well being of the populace is, arguably, the key purpose of changing the system". He then acknowledges that " data in this section use the official GDP measure, excluding what many have demonstrated is a large underground economy".(p.56). Berg et al., (1999) state: "we use official GDP numbers…which suffer from considerable, well-known measurement problems and in particular are widely believed to overstate initial output decline by inadequately capturing newly emerging activities. However, the only practical alternative-output estimates based on electricity consumption- seem even more problematic for the purposes of panel regression, quite apart from the fact that these estimates are not available for all countries in our sample." p. 19-20.

To anticipate our major results, we find that updated ECM estimates of the type reported by (Kaufmann and Kaliberda, 1996; Johnson et al., 1997; Friedman et al., 2000) produce disturbing negative estimates of the size of the unrecorded income for a number of transition countries, calling into question the reliability of substantive results which rely on these estimates. We find similar problems in our efforts to replicate and extend the "modified" electric consumption method (MECM) introduced by Eilat and Zinnes (2002). We attempt to correct for these problems by employing more recent data sources and more reliable estimates of the pre-transition size of the unrecorded sector in the FSU countries (Alexeev and Pyle, 2003). Nevertheless, we still obtain negative estimates for the size of the unrecorded economy for a number of countries. We conclude that hypothesis testing should be based on rates of growth of total economic activity. We also find that the unrecorded sector serves as a buffer for the recorded sector, with the substitution effect dominating the income effect.

Conceptual Framework

More than two decades have passed since Feige (1980) urged the economics profession to "entertain a fundamental distinction, between the "observed" and the "unobserved" sectors of the economic system."[2] Feige (1990) further elaborated a taxonomic framework, based on the new institutional approach to economic development that defined clear distinctions between the illegal economy, the unreported economy, the

[2] This unpublished paper was presented at the American Economics Association meetings. I take the liberty of quoting at length:

"The observed sector of the economy consists of those economic activities that are regularly caught in the net of our official statistical accounting mechanism. It is this observed sector that furnishes us with our perceptions of the fundamental facts of economic life. Not only does it function as the basic for generating the questions that the economics profession seeks to answer,; it also provides the fodder for our forecasting industry, our empirical tests, and our policy prescriptions. Thus any major systematic discrepancy between our observations of macroeconomic life and actual macroeconomic activity serves to generate misguided questions, to produce erroneous answers, and perhaps most damagingly, to disseminate systematically false information among citizens and policy makers alike. Their actions in turn, based on biased information, may well serve to de-stabilize actual economic activity.

The unobserved sector, being the complement of the observed sector, consists of those activities (legal or illegal, market or non-market, monetary or barter) that escape the purview of our current societal measurement apparatus. It is my conjecture that this hitherto unnoticed sector is of substantial magnitude and more importantly, that it has been growing relative to the observed sector. And if it is the case that unobserved activities have grown relative to observed activities, then this phenomenon has major implications for macroeconomic stabilization, allocative efficiency, and income distribution." (p.3-4).

unrecorded economy and the informal economy. The criterion for distinguishing between these unobserved economies is based upon the particular institutional rules violated by different forms of unobserved behavior. All estimates in the current paper refer to the "unrecorded economy", namely, those activities that should be, but are not fully included (measured) in the national accounts, according to the international standards as defined in the 1993 System of National account (SNA).[3] These unrecorded economic activities are of particular relevance to transition economies that have undergone a shift from planned to market oriented economic systems and have also made a key transition in statistical practice, switching from the Material Product System of accounting to the SNA accounting standard. A summary measure of the unrecorded economy is the amount of "unrecorded income", namely, "the amount of income that should (under existing rules and conventions) be recorded in national accounting systems (e.g. national income and product accounts) but is not." (Feige, 1990). We refer to the recorded economy as comprising all those economic activities that are in fact included in the published national accounts measure of economic activity (measured output).

It is now widely accepted that "the lack of exhaustive coverage of GDP results in severe shortcoming both for the users and for the producers of national accounts" (Bloem and Shrestha, 2000, p.3). Among these are biased growth rates, and misleading information concerning the levels of macroeconomic aggregates and structural changes in the economy. These in turn, can lead to erroneous conclusions concerning the determinants of economic development and to misguided policies based on incorrect information about what is actually transpiring in the economy.

Recently, a consortium of national and international agencies adopted the foregoing conceptual framework and produced a handbook for measuring the Non-Observed Economy (OECD, 2002), which sets out to present a "systematic strategy for achieving exhaustive estimates of gross national product" taking specific account of "activities that are missing from the basic data used to compile the national accounts

[3] The literature on the unobserved economy continues to suffer from a plethora of vague terms including: black, clandestine, grey, hidden, second, shadow, and subterranean that we avoid in this paper. We retain the more precise notions of unreported, unrecorded, illegal, informal, and household production for own final use as described in Feige (1990). These concepts are also employed as key definitions in the handbook for measuring the Non-Observed Economy, (OECD, 2002) which seeks to "identify and promote international best practice."

because they are underground, illegal, informal, household production for final use, or due to deficiencies in the basic data collection system." The handbook refers to these activities as "non-observed" and they "comprise the non-observed economy" (NOE). The handbook is a technical document that sets out procedures for estimating the various components of the non-observed economy, which are, then to be included in an exhaustive measure of GDP. Once included, the estimated imputations are referred to as "the measurement of NOE."[4] We shall employ the term "imputed unrecorded income" (IUI) to describe the estimate of "non-observed" activity that is now to be included in the national accounts. The amount of IUI in many transition economies is already a sizable fraction of measured output.[5] Eurostat (Stapel, 2000) has now adopted these new procedures and their use is expected to spread as more countries undertake efforts to obtain exhaustive (comprehensive) measures of economic activity.

As countries impute a growing fraction of GDP as IUI, the national accounting community must be held to the highest standards of consistency and transparency. By consistency we mean that great care must be taken so that every major revision in the published accounts must be made comparable with earlier published data in order not to distort perceptions of changes in total output and its composition over time. In order to assure transparency, every published national account aggregate must be accompanied by full documentation describing the amount of the aggregate accounted for by IUI and the exact assumptions employed to obtain the IUI estimate. Moreover, in the age of computers, it should be possible for consumers of national account information to simulate alternative GDP scenarios by changing some of the key assumptions employed in the estimation of IUI. Without stringent safeguards for consistency and transparency, national accountants risk, that by delving into the murky area of the unobserved economy in the interests of pursuing exhaustiveness, they may be confronted with growing skepticism that the accounts have become more subjective and opaque, and thereby more potentially vulnerable to political manipulation. This observation is particularly salient for the transition countries whose national accounts have been manipulated in the past.

[4] The measurement of NOE includes imputations that were unrecorded 1) for statistical reasons, including, lack of response, registers not kept up to date, subjects not registered; 2) for economic reasons including underreporting and unregistered subjects; 3) the informal sector; 4) illegal activities and 5) other forms of non-exhaustiveness of GDP.

[5] See Mel'ota and Gregory (2001), and Dean (2002).

The highest standards of consistency and transparency will be necessary if this highly worthy and difficult effort to make the accounts exhaustive is to prove successful and credible.

Transition countries are particularly vulnerable to unobserved activities arising from loosened state controls as well as tax and regulation incentives for firms and individuals to avoid registration, or otherwise underreport income-producing activities. These problems are most severe in the FSU countries but also affect the CEE countries as they seek accession to the European Union (EU). Despite major efforts to improve the quality and exhaustiveness of national accounting systems, it is widely recognized that current statistical practice still fails to incorporate a wide range of unobserved activities. As we await the much-anticipated improvement in the exhaustiveness of national accounts, it becomes all the more important to pursue macro-economic modeling estimates of the dynamic evolution of the unobserved economies of FSU and CEE countries as an independent check on the veracity of new SNA measures of IUI.

Electric Consumption Methods

Simple Unit and Variable Elasticity Models

To date, data limitations have confined the use of macro-economic modeling estimates of unobserved activities in transition countries to those based on variants of the electric consumption methodology (ECM), most prominently, Kaufmann and Kaliberda (1996); Johnson et al. (1997); Eilat and Zinnes (2002). These estimates, covering the period 1990-1995,[6] have been widely cited (Friedman et al., 2000; May et al., 2002) and employed, to measure the impacts of initial conditions, taxes, regulation and corruption in transition countries. The more popular monetary methods proposed by Feige (1979, 1986, 1989) and Tanzi (1980, 1983) have not, to date, been successfully applied to transition countries since they require knowledge of the total amount of cash used as a medium of exchange in unrecorded activities. In transition countries, currency substitution (the substitution of foreign currency for domestic currency as a medium of exchange) results

[6] In their most recent paper, Eilat and Zinnes (2000) include estimates for the years 1996-97 based on the modified electric consumption method (MECM).

in unofficial or de facto dollarization (Feige, 2003). Since foreign currency is widely thought to be employed for under taking unrecorded transactions, we must await monetary estimates of unrecorded income that include estimates foreign currencies in circulation in these countries (Feige, 2002).

Among the ECM estimates employed in the literature, the simplest, assumes that electric consumption is the single best indicator of total economic activity (TEA) and that the elasticity of electric consumption with respect to GDP is unity. Thus the difference between the growth rate of electric consumption (a proxy for the growth in TEA) and the growth rate of measured GDP yields an approximation to the growth rate of unrecorded income. Kaufmann and Kaliberda (1996) and Johnson et al. (1997) employ a slightly less restrictive approach. Recognizing that some countries are more energy efficient than others, they employ different elasticity assumptions for different country groups as displayed in Table 1.

Table 1: Assumed Output Elasticity of Electric Consumption

Central and Eastern Europe "Energy efficient"	Baltic Countries "Energy neutral"	Former Soviet Union "Energy inefficient"
0.9	1.0	1.15

All ECM models require an estimate of the initial share of unrecorded income in TEA.[7] Table 2a (column 1), displays the initial 1989 starting values assumed for FSU countries by Kaufmann and Kaliberda (1996) and Johnson et al. (1997). Column 3 represents more recent improved starting values generated by Alexeev and Pyle (2003) based on Soviet émigrés survey data for the FSU countries and the forth column displays the starting values for 1990 employed by Eilat and Zinnes (2002). The next two columns display what we shall use as the "low" and "high" start values in our efforts to update the ECM results for the FSU countries. The final column reports the results of a recent study by Kim (2003) which estimates the size of household unrecorded income derived from

[7] The same requirement exists for the estimation of latent variable models such as the Multiple Indicator Multiple Cause (MIMIC) models (Giles and Tedds, 2002). It should be noted that MIMIC models do not produce estimates of unrecorded income, but rather estimates of the fiscal concept, "unreported" income. The latter should not be confused with the former.

unpublished Soviet family budget surveys. Kim's findings are of interest because they confirm the Alexeev-Pyle contention that the unrecorded economy showed considerable variation across the different FSU republics.

Table 2a: Estimates of Initial Starting Values of Unrecorded Income (% TEA)

FSU Countries

FSU	Kaufmann /Kaliberda; Johnson et al. 1989	Alexeev / Pyle 1989	Eilat / Zinnes 1990	Feige/ Urban Low Values 1989	Feige / Urban High Values 1989	Kim 1989
The Baltics						
Estonia	12.0	22.1	19.9	12.0	22.1	1.5
Latvia	12.0	22.1	12.8	12.0	22.1	1.8
Lithuania	12.0	22.1	11.3	12.0	22.1	5.1
Western FSU						
Belarus	12.0	28.6	15.4	12.0	28.6	3.3
Moldova	12.0	28.6	18.1	12.0	28.6	8.2
Russian Federation	12.0	18.0	14.7	12.0	18.0	3.4
Ukraine	12.0	25.3	16.3	12.0	25.3	6.6
The Caucasus						
Armenia	NA	NA	23.4	12.0	32.8	8.6
Azerbaijan	12.0	32.8	21.9	12.0	32.8	9.8
Georgia	12.0	32.8	24.9	12.0	32.8	11.3
Central Asia						
Kazakhstan	12.0	32.8	17.0	12.0	32.8	5.0
Kyrgyz Republic	NA	NA	17.0	12.0	32.8	10.6
Tajikistan	NA	NA	17.0	12.0	32.8	9.7
Turkmenistan	NA	NA	17.0	12.0	32.8	10.0
Uzbekistan	12.0	32.8	11.4	12.0	32.8	10.7

However, as noted in Table 2, the two studies diverge significantly with respect to the critical question concerning the initial share of unrecorded income in TEA at the

beginning of the transition period.[8] We shall employ the Johnson et al. (1997) initial values for our initial lower bound simulations because these results have been so often cited in the literature. It should however be noted that if Kim's (2003) estimates are closer to the correct values, the negative results reported below are only strengthened. Similar information on initial values for the CEE countries are displayed in Table 2b with the final column displaying the starting values employed for our estimates.

ECM estimates have been used to test a variety of hypotheses concerning the transition. It is therefore useful to replicate, update, and extend the coverage of all ECM estimates to all twenty five transition countries employing the most recent and reliable

Table 2b: Estimates of Initial Starting Values of Unrecorded Income (% TEA)

CEE	**Kaufmann / Kaliberda; Johnson et al. - 1989**	**Alexeev / Pyle 1989**	**Eilat / Zinnes 1990**	**Feige / Urban Values**
EU Border Countries				
Croatia	NA	NA	22.8	22.8*
Czech Republic	6.0	NA	6.7	6.0
Hungary	27.0	NA	27.0	27.0
Poland	15.7	NA	19.6	15.7
Slovak Republic	6.0	NA	6.0	6.0
Slovenia	NA	NA	22.8	22.8*
The Balkans				
Albania	NA	NA	NA	23.4
Bulgaria	22.8	NA	25.1	25.1
Macedonia	NA	NA	22.8	22.8*
Romania	22.3	NA	22.3	22.3

* For Croatia, Slovenia and Macedonia we employ the Eilat/Zinnes starting values for the base year. For the other CEE countries we use the Johnson et al. (1997) start values and for Albania we take the average start value for the Balkans

[8] Kim acknowledges that if survey participants "were less willing to provide information on their informal economy activities than those in the surveys of Soviet émigrés, one would expect (his results) to provide lower estimates of the size of the Soviet informal economy".

data sources.[9] Figure A1 (in Appendix A) displays our new time series estimates based on the most recent data sources employing the standard ECM elasticity assumptions for both "low" and "high" initial starting values for the FSU countries. Figure A2 (in Appendix A) shows the corresponding updated estimates for the CEE countries. Where applicable, we compare our new estimates to those originally published by Johnson et al. (1997) and examine the sensitivity of the results to alternative "low" and "high" initial starting values.

Our attempt to replicate the (Johnson et al., 1997) estimates published in their Table 1 (p.183) [10] was not entirely successful, since we employed revised data series that were not available to them at the time of their writing. In several cases, both the levels and temporal patterns of the updated estimates for the period 1989-1995 are sufficiently different from the Johnson et al. (1997) published results to call into question the veracity of their substantive findings. Moreover, when the ECM estimates are updated to 2001 using Johnson et al. initial values (ECM-Low Start values), we find the implausible result that for some years the shares of the unrecorded economy become negative for the following countries: Armenia, Belarus, Estonia, Kazakhstan, Latvia, Lithuania, Turkmenistan, Poland, Romania, and Slovak Republic.[11]

When the ECM model is re-estimated using the higher initial starting values suggested by the Alexeev and Pyle (2003) for the FSU countries, the results (ECM-H) are improved in so far as the previously obtained negative estimates of the unrecorded sector for the FSU countries: Belarus, Estonia, Kazakhstan, Latvia, Lithuania, and Turkmenistan now become positive. With the exception of Armenia, all the remaining negative estimates are for CEE countries, suggesting that the initial values of the unrecorded economies of these countries may also have been seriously unstated. However Kim's (2003) findings suggest this is unlikely to be the case. We are left with the uncomfortable surmise that the simple ECM models do not give reliable estimates of

[9] GDP growth rates are obtained from the European Bank for Reconstruction and Development (EBRD) [EBRD, 2002: Table 3a] and net energy consumption growth rates are calculated from data provided by the Department of Energy [DOE, 2003 Table 6.2].

[10] These are the same data employed by Freidman et al. (2000).

[11] It should be noted that when the same replications are attempted using the unit elastic assumptions, the estimates for Moldova are also negative for 2001.Had we employed the lower initial values suggested by Kim (2003) we would have found even poorer results, that is a larger number of negative values for the share of unrecorded income.

the size of the unrecorded sector. However, the models are still useful for determining the inter-temporal path of unrecorded activity in different countries. Hence, using the growth rates of the unrecorded sector rather than their size provides the best hope for testing substantive hypotheses. In order to further investigate the robustness of ECM results to alternative specifying assumptions, we turn to the modified electric consumption method (MECM) proposed by Eilat and Zinnes (2002).

The Modified Electric Consumption Approach

The simple ECM approach suffers from a number of widely acknowledged (Eilat and Zinnes, 2002) weaknesses. A variety of unrecorded activities may not require large amounts of electricity and/or may use other energy sources. Moreover, the efficiency of energy use changes over time due to different rates of technical progress, changes in industrialization and of course, changes in energy prices. Johnson et al. (1997) attempted to deal with these issues by the simple expedient of employing different electricity/output elasticities for different countries. Eilat and Zinnes (2002) propose a more direct approach. In order to account for changes in the price of electricity as well as changes in the composition of output and efficiency in energy usage, they modify the simple ECM methodology by attempting to filter out the specific effects of these other variables on the change in electric consumption.

Following their notation, they first attempted to filter out the effects of various factors that may effect the change in electric consumption ($\Delta Elec_t$) other than a change in total economic activity (TEA). This is accomplished by first regressing ($\Delta Elec_t$) on the percentage change in electricity prices ($\Delta Eprice_t$), the percentage point change of industry share of GDP denoted by ($\Delta IndGdp_t$) and the percentage point change of the share of the private sector in GDP ($\Delta PrvGdp_t$).[12] Their reported regression results (p. 1253) are as follows:

$$(1)\ \Delta Elec_t = \underset{(3.25)}{0.032} \underset{(-2.79)}{-0.25} \times \Delta Eprice_t + \underset{(2.46)}{0.05} \times \Delta IndGdp_t - \underset{(1.62)}{0.0018} \times \Delta PrvGdp_t$$

[12] Their data set consists of panel observations for the period 1994-1997, omitting observations for which the annual change in electricity consumption exceeded 10%.

Adj R^2=0.26

Having accounted for these other influences on $(\,)Elec_t$) they proceed to calculate:

(2) $(\,)Elec_t^{resid}$) = $(\,)Elec_t$) + 0.25 x $(\,)Eprice_t$) - 0.05 x $(\,)IndGdp_t$) + 0.0018 x $(\,)PrvGdp_t$)

where, $(\,)Elec_t^{resid}$) represents the residual change in electricity that is assumed to vary directly with changes in total economic activity. They therefore estimate the change in total economic activity $(\,)TEA$) from the residual estimated in equation 2,[13] and estimate the relative size of the unrecorded economy by subtracting the observed change in official GDP.

Our attempts to replicate the Eilat/Zinnes reported results employing their original data produced the following regression equation:

(3) $(\,)Elec_t$) =0.035 -0.026 x $(\,)Eprice_t$) +0.005 x $(\,)IndGdp_t$) -0.0022 x $(\,)PrvGdp_t$)
(3.63) (-2.97) (2.44) (-1.94)

Adj.R^2= .29

Comparing our attempted replication (Equation 3) with their published result, (Equation 1) we find important differences in the size of the estimated coefficients for $(\,)Eprice_t$) and $(\,)IndGdp_t$). Fortunately these discrepancies were resolved through private correspondence, which confirmed that their published results contained typographical errors. The equation estimates which Eilat and Zinnes actually used in their calculations of unrecorded income were in fact very close to those we have estimated and reported in our Equation 3. We therefore use our Equation 3 coefficients and the corresponding revised Equation 2 (with corrected parameters) to estimate the corrected values of $(\,)Elec_t^{resid}$), and the corresponding estimates of the change in TEA. We can then derive the revised share of unrecorded income in TEA.

[13] For the years 1990-1994 they used the Johnson et al. variable elasticity assumptions. For the years, 1995-97, they used a unitary elasticity for all countries since their filtered series for these years already made the adjustments that Johnson et al. were compensating for with the ECM approach that uses different elasticities for different country groups.

Figures A3 and A4 (Appendix A) respectively report the Eilat/Zinnes original estimated shares (labeled EZ) of the unrecorded economy for the FSU and CEE countries, as well as our replication and extension (FUEZ) of their results to the year 2001, using revised data applied to their corrected MECM model.

As was the case with our attempt to replicate and extend the Johnson et al. results, we find that for several countries, our replications with new data do not track their original published results. Moreover, we discover the same problem as found with the Johnson et al. replications, namely, that the Eilat/Zinnes MECM approach yields implausible negative shares for the following countries in some years: Belarus, Kazakhstan, Lithuania, and Turkmenistan.

In an attempt to remedy this problem, we first attempted to re-estimate the Eilat/Zinnes (equation 3) to include all twenty five transition countries for the period 1995-2001.[14] Both the full data set, and the more limited data set excluding all observations for electric consumption changes in excess of 10% (their procedure), yielded poor results in so far as none of the parameters of their included variables were significantly different from zero at the 95% confidence level.

Our final attempt to improve the MECM model along the lines suggested by Eilat and Zinnes was to relax their implicit restriction that the constant terms for all countries were identical. Permitting separate constant terms for each country, and applying a GLS estimation procedure produced the results tabulated in Table B1 of the Appendix B. The variables $(\,)\mathrm{IndGdp}_t$) and $(\,)\mathrm{PrvGdp}_t$) were excluded from the analysis after various alternative specifications indicated that these variables were statistically insignificant and only the change in electricity price $(\,)\mathrm{Eprice}_t$) was included in the final regression. Given these new estimates, we again followed the Eilat/Zinnes methodology to calculate both the estimated change in total economic activity and correspondingly, the implied estimates of the share of unrecorded income in TEA. Our new estimated shares (labeled FUGLS) are displayed in Figure A3 (Appendix A) for the FSU countries employing the higher initial values suggested by Alexeev/Pyle (2003) and similarly in Figure A4 (Appendix A) for the CEE countries employing the initial values displayed in column 4 of Table 2B above. The time paths of the unrecorded shares estimated by our GLS

[14] Recall that their data set only included the years 1995-1997.

procedure generally follow a similar pattern to those based on the original MECM model, suggesting that we have captured at least the spirit of their MECM approach. Moreover, by incorporating the initial values suggested by Alexeev and Pyle for the FSU countries, we eliminate all negative values of the share of unrecorded income in TEA. We still however find negative results for the following CEE countries: Poland, Romania and the Slovak Republic.

Overview of ECM Results

Average Size

Tables B2a and B2b (Appendix B) respectively display the estimated average size of the unrecorded economy in the FSU and CEE countries obtained by the four ECM methods discussed above. It is apparent from Table B2a for the FSU countries that the ECM-H and the FUGLS estimates are very similar, owing to the fact that both sets of estimates employ the higher initial values suggested by the Alexeev/Pyle study which puts the ECM estimates in their best light. We conclude that initial values (which are disputed in the literature) rather than the particular method used to adjust for differences in energy efficiency appear to most significantly affect the estimates of the size of unrecorded income. The largest unrecorded economies appear to be in the Kyrgyz Republic, Tajikistan, Azerbaijan and Georgia, while the smallest unrecorded sectors are in the Slovak Republic, Poland, and Romania.

It is interesting to compare the size of the unrecorded economy estimated by the ECM models with completely independent estimates of imputed unrecorded income (IUI) estimated by the newly established OECD (2002) handbook procedures. Table 3 displays the average percentage share of the unrecorded economy (IUI/TEA) as estimated by the OECD procedures for those transition countries and for those time periods for which they are available with comparable estimates for the same periods estimated by the two ECM methods employing the Alexeev-Pyle initial values. With the exception of Armenia and Kazakhstan for which the estimates are roughly similar, the estimated sizes derived from the ECM models significantly exceed those produced by the new OECD methods. Had we employed the starting values suggested by Kim (2003), our calculated averages would

be closer to those obtained by the NIPA methodology; however, many more estimates of the size of the unrecorded sector would then become negative.

Table 3: Comparison of National Accounts and ECM Estimates of Unrecorded Income

	Period	Average IUI/TEA NIPA	Average Yu/TEA ECM-H	Average Yu/TEA FUGLS
FSU				
Armenia	1997-1999	20.1	19.7	26.0
Belarus	1999	10.7	22.2	21.2
Estonia	1997	10.2	32.4	33.6
Georgia	1997-1999	20.4	55.7	55.7
Kazakhstan	1999	18.9	20.5	16.2
Kyrgyz Republic	1997-1998	12.1	64.4	65.2
Lithuania	1998	15.2	20.5	20.6
Moldova	1997-1998	15.7	58.9	58.0
Russian Federation	1997-1998	17.5	44.0	44.2
Ukraine	1999	16.7	57.1	56.6
Uzbekistan	1998	12.3	31.0	34.5
CEE				
Albania	1996-2000	31.4	60.5	59.3
Croatia	1998-1999	7.83	24.1	22.8

Our preliminary assessment of these results suggests the estimates of the size of the unrecorded sector produced by ECM models are not reliable. We form this judgment not only because of their general lack of conformity with the newly produced OECD estimates, but more importantly, by our findings of negative unrecorded economies for a number of the transition countries and the sensitivity of the estimated sizes to the poorly established initial values that are required to produce the ECM results. This is not however, a council of despair, since these macro approaches may still shed light on the more important question concerning the growth of the unrecorded sector and its relationship to the growth of the recorded sector during the transition process. It is to these issues that we now turn.

The Evolution of Total Economic Activity

One of the central issues in transition economics is to determine the evolution of total economic activity during the transition period. It is often observed that the key indicator of economic growth, namely the growth rate of recorded GDP may be a misleading indicator of total economic activity if the unobserved economy is growing at a different rate that than of the recorded economy.

Table 4a Comparison of Recorded Growth, Growth of the Unrecorded Economy and the Rate of Growth of Total Economic Activity: FSU- 1989-2001

FSU	Average Growth Recorded GDP	Average Growth Unrecorded Economy	Average Growth Total Economic Activity
The Baltics			
Estonia	-0.9	-6.1	-2.3
Latvia	-1.8	-8.9	-3.6
Lithuania	-2.7	-8.0	-4.1
MEAN FOR GROUP:	-1.8	-7.7	-3.3
Western FSU			
Belarus	-0.5	-12.5	-3.2
Moldova	-7.4	-2.8	-7.9
Russian Federation	-3.6	5.7	-1.5
Ukraine	-6.1	3.2	-3.0
MEAN FOR GROUP:	-4.4	-1.6	-3.9
The Caucasus			
Armenia	-1.3	-12.7	-4.5
Azerbaijan	-3.7	3.7	-1.1
Georgia	-6.5	-0.3	-4.8
MEAN FOR GROUP:	-3.8	-3.1	-3.5
Central Asia			
Kazakhstan	-1.7	-12.5	-4.4
Kyrgyz Republic	-2.9	8.7	1.8
Tajikistan	-4.9	3.6	-2.0
Turkmenistan	-1.1	2.8	-2.1
Uzbekistan	0.3	0.2	0.0
MEAN FOR GROUP:	-2.1	0.6	-1.3
MEAN FOR FSU:	-3.0	-2.4	-2.8

Tables 4a and 4b respectively present our ECM-H estimates for the FSU and CEE countries of the average growth rate of recorded GDP (Yo), the growth rate of the unrecorded economy (Yu) and the growth rate of total economic activity (TEA) during the decade of transition. The tables reveal that the recorded GDP growth rates appear to be a poor and inconsistent estimate of the development of total economic activity. For some countries this is good news. In Russia, Ukraine, Azerbaijan, Georgia, Kyrgyz Republic, Tajikistan, Uzbekistan, Croatia, Czech Republic, Slovenia Albania, and Macedonia, TEA either grew more or declined less than would be indicated by official GDP statistics.

Table 4b : Comparison of Recorded Growth, Growth of the Unrecorded Economy and the Rate of Growth of Total Economic Activity: CEE- 1989-2001

CEE	Average Growth Recorded GDP	Average Growth Unrecorded Economy	Average Growth Total Economic Activity
EU Border Countries			
Croatia	-0.7	3.7	-0.2
Czech Republic	0.4	10.5	0.7
Hungary	0.8	-4.4	-0.4
Poland	2.2	-78.0	-0.7
Slovak Republic	0.7	-2.3	-1.2
Slovenia	2.0	16.2	3.8
MEAN FOR GROUP:	0.9	-9.0	0.3
The Balkans			
Albania	1.5	15.7	6.7
Bulgaria	-2.0	-3.8	-2.7
Macedonia	-1.5	6.7	0.8
Romania	-1.5	-247.5	-4.2
MEAN FOR GROUP:	-0.9	-57.2	0.2
MEAN FOR CEE:	0.2	-28.3	0.3

The bad news comes for the Baltic states, Belarus, Moldova, Armenia, Kazakhstan, Turkmenistan, Hungary, Poland, Slovak Republic, Bulgaria, and Romania, countries in

which TEA performed more poorly than was reflected in official GDP statistics. In short, the results confirm the conjecture that published GDP statistics may give a misleading impression of the true rates of overall economic growth in transition countries.

Figures A5 and A6 (Appendix A) reveal the evolution of total economic activity in all transition countries as the sum of the recorded and unrecorded income. As can be seen from the graphs, the temporal pattern of unrecorded and recorded activity was quite different depending on the country studied.

The Relationship between the Recorded and the Unrecorded Economy

The relationship between the recorded and unrecorded economy remains a critical empirical issue that affects the interpretation of official statistics and therefore policy decisions. A priori, the relationship is ambiguous, since a decline in the reported economy could induce individuals to shift into the unrecorded economy reflecting a conventional substitution effect. However, to the extent that a reduction in recorded income also leads to a reduction in the demand for unrecorded income, the income effect works in the opposite direction. If the income effect dominates the substitution effect, we would observe the two economies being positively correlated over time. Conversely, if the substitution effect dominates the income effect we would expect to find an inverse relationship between the two economies.

This issue is of particular salience for those countries which have experienced dramatic declines in recorded incomes during the transition period. If the substitution effect dominates the income effect, total economic activity would have declined by less than recorded economic activity due to the buffering effect of the unrecorded economy. Eilat and Zinnes (2002) report the interesting finding that the substitution effect clearly dominates the income effect but that the strength of the net effect depends upon whether recorded income is rising or falling. We test this finding with a panel regression over all countries for the entire period 1989-2001 employing both the ECM and MECM results. The estimated equation takes the form:

4) $Yu = \$_o + \$_1 Yo + \$_2 Yo \times D + ,$

where Yu represents the unrecorded economy, Yo the recorded economy and D is a dummy variable equal to 1 when Yo is increasing and zero otherwise. The equations are estimated by GLS and the result for the ECM-H estimate of Yu is:

5) $Yu = 50.6 - .38\ Yo - .05\ Yo \times D$ N=318, Adj R^2 =.87
(36.5) (-16.1) (-4.1)

The corresponding MECM equation employing the FUGLS estimate of Yu is:

6) $Yu = 47.6 - .34\ Yo - .05\ Yo \times D$ N=298, Adj R^2 =.85
(31.4) (-13.1) (-4.1)

Our findings confirm the Eilat/Zinnes result that the unrecorded and recorded economies are negatively related, suggesting that the substitution effect dominates the income effect. Eilat/Zinnes report that a $1 fall in recorded income is associated with a 31 cent increase in the unrecorded economy and that a one dollar increase in recorded GDP is associated with a 25 cent decline in unrecorded income. Our new estimates suggest that a one dollar decline in the recorded sector is associated with a 34–38 cent increase in the unrecorded sector and that a one dollar increase in the recorded sector is associated with a 39-43 cent decrease in the unrecorded. We conclude that the unrecorded economy acts as a buffer that dampens declines in the recorded sector of the transition economies. However, in contrast to the Eilat/Zinnes conclusion that the unrecorded sector displays hysteresis, we find that a recovery in the recorded sector of transition economies brings about a considerable shift out of the unrecorded sector.

Summary and Conclusions

Estimates of the unrecorded economy for the period 1990-1997 employing electric consumption methods have been widely employed to study the causes and consequences of underground activities. Since our perspectives on the successes and failures of the transition are largely based on evidence derived from the reported economy, it is useful to examine how our assessments may change when viewed through the broader lens of total economic activity (recorded plus unrecorded income). To this end, we attempt to first replicate earlier ECM based estimates of unrecorded income by employing more recent revised data series. We then go on to update the earlier estimates

to 2001 and examine the robustness of the results to alternative specifying assumptions. We find that various versions of the ECM estimates produce disturbing negative results for the size of the unrecorded economy in many transition countries, and moreover, that the estimated size of the unrecorded economy is highly sensitive to initial starting values. Since the empirical values of these initial conditions are strongly contested in the literature, the reliability of estimates of the size of the unrecorded sector must be seriously questioned. As such, many of the substantive conclusions reached by other scholars employing these estimates must also be called into question. Indeed, our own preliminary attempts to replicate some of these substantive conclusions suggest that they are not robust.

We do however believe that while the size of unrecorded economy produced by these methods is unreliable, it is still be possible the gain considerable insights into the dynamics of the transition process by focusing future attention on growth rates of the unrecorded sector. By extending our current data base to the year 2001, we provide a richer empirical basis for performing panel data tests of various hypotheses concerning both the causes and consequences of unrecorded activities. Moreover, we believe that all studies of the transition process should be viewed through the lens of total economic activity, rather than simply by examining the growth of recorded income.

Several other recent improvements in our knowledge base are likely to contribute to a greater understanding of the role of unrecorded activities on the dynamics of the transition process. The recent publication and wider adoption of the new national accounting procedures that attempt to produce exhaustive estimates of GDP will certainly provide additional information on the growth of unrecorded activities. Moreover, recent research (Feige, 2003) documenting the vast amounts of foreign currencies in circulation in transition countries enables researchers to now correctly employ monetary-macro methods to estimate the size and growth of the unrecorded economy during the transition period. These new estimates should permit a re-examination of the various hypotheses concerning the causes and consequences of unrecorded activities. More fundamentally, we shall soon be in a position to deepen and extend our current understanding of the impact of initial conditions, institutional arrangements and alternative policies on the

successes and failures of the transition process by viewing its dynamics from the broadened perspective of total economic activity.

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Appendix A: Figures

Figure A1: Share of Unrecorded Income –FSU Countries – Simple ECM Results

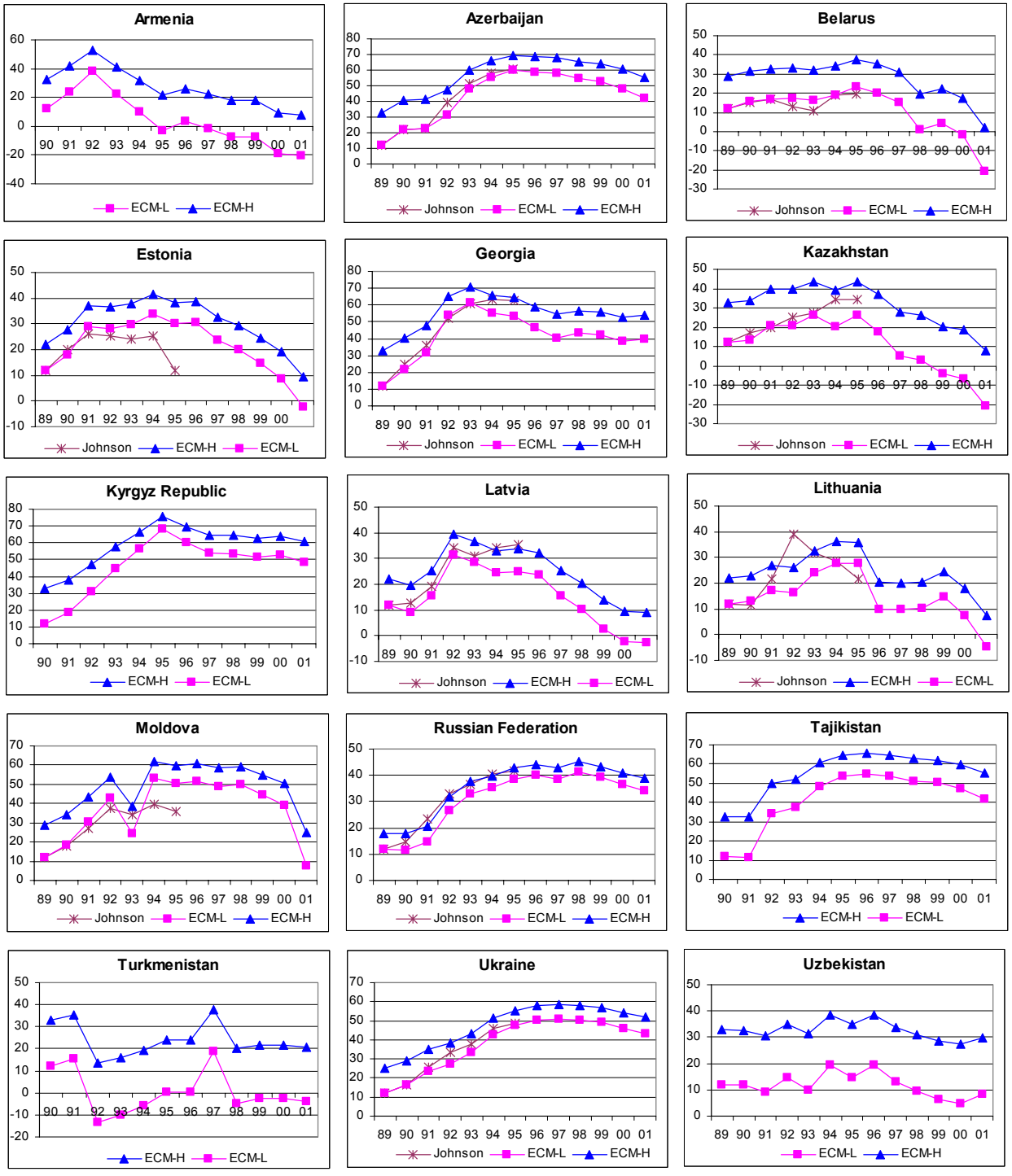


Figure A2: Share of Unrecorded Income –CEE Countries – Simple ECM Results

Figure A3: Share of Unrecorded Income –FSU Countries – MECM Results

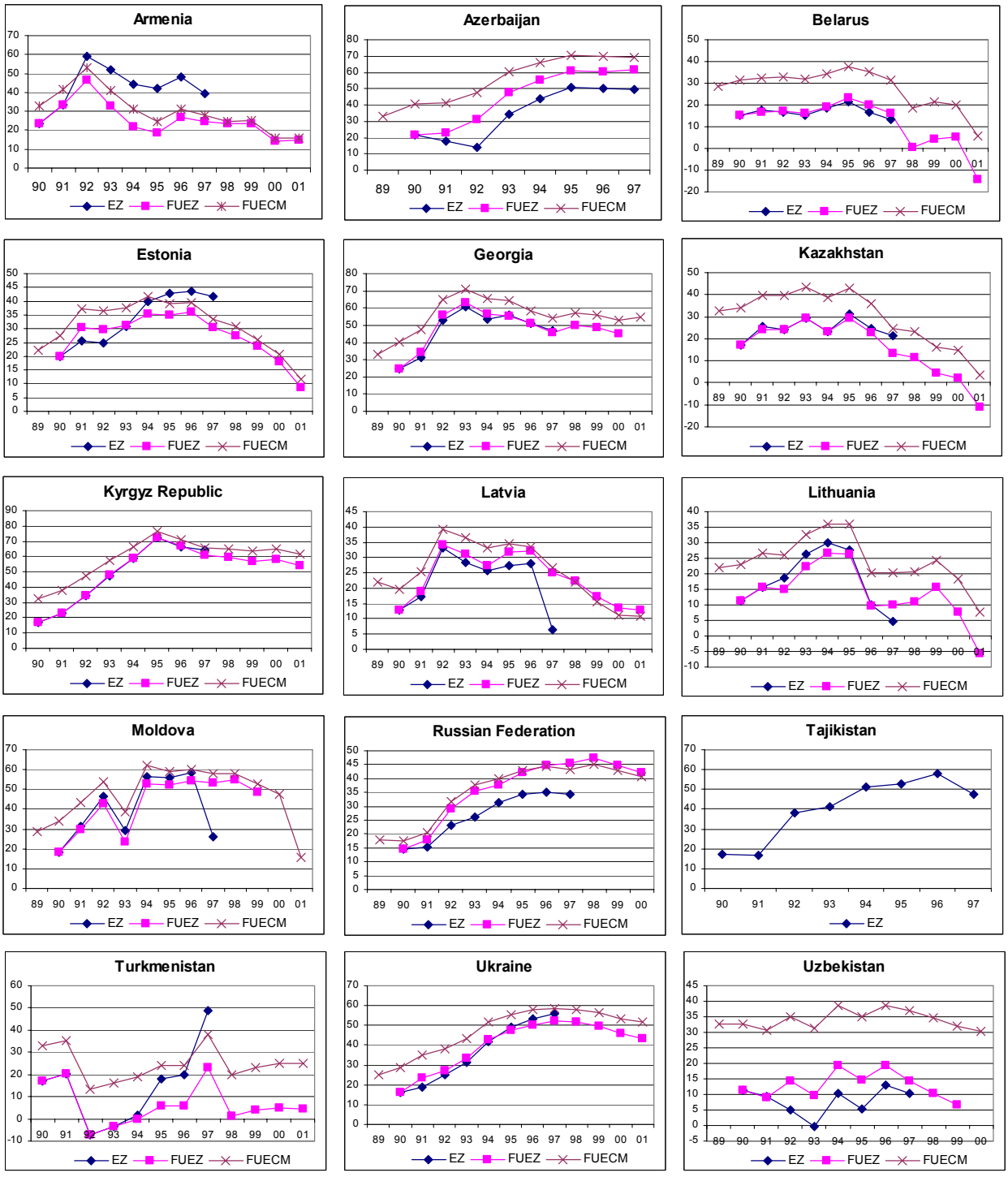


Figure A4 Share of Unrecorded Income –CEE Countries – MECM Results

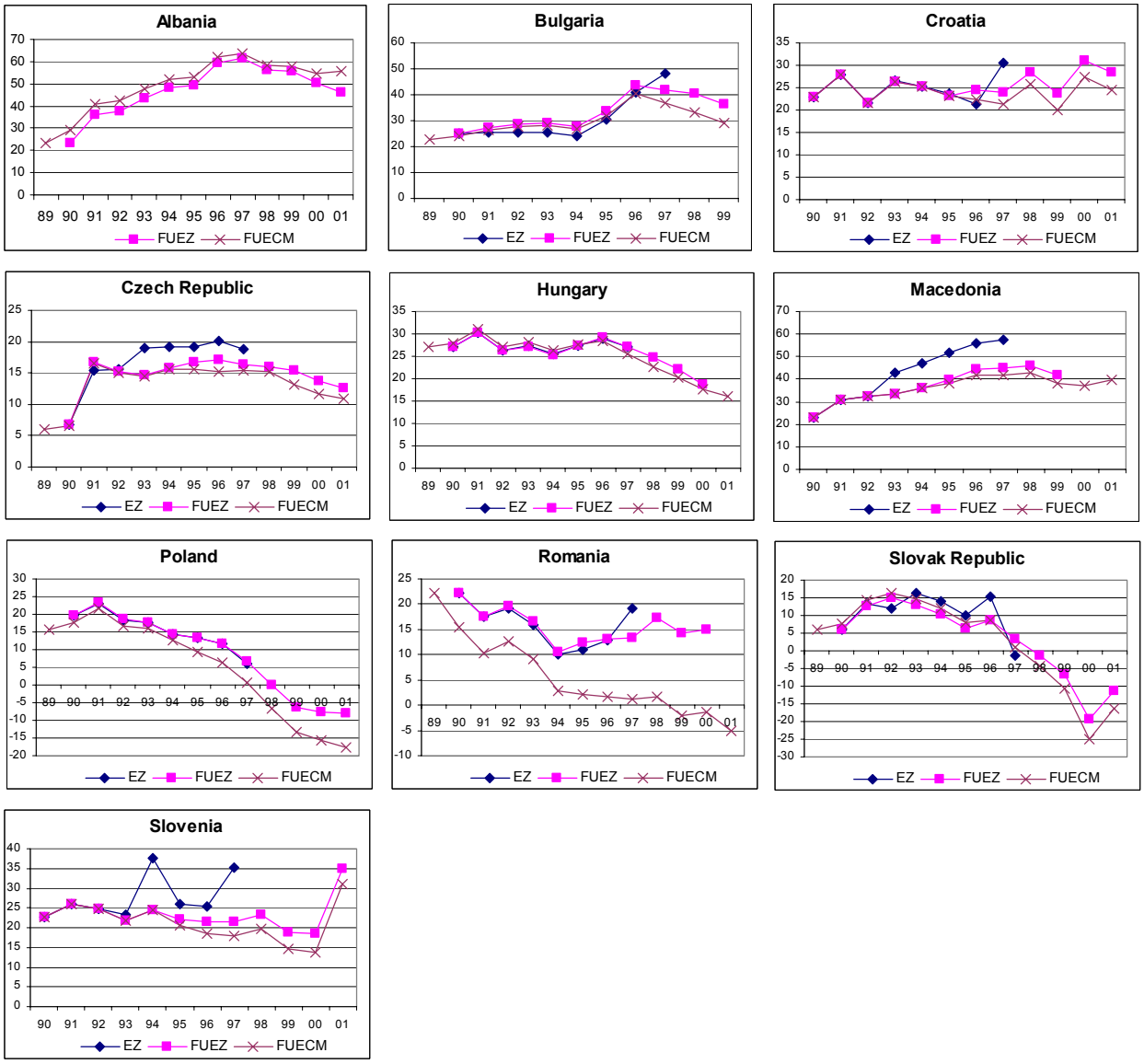


Figure A5: Evolution of Recorded and Unrecorded Economic Activity as Calculated by ECM-H Method – FSU Countries

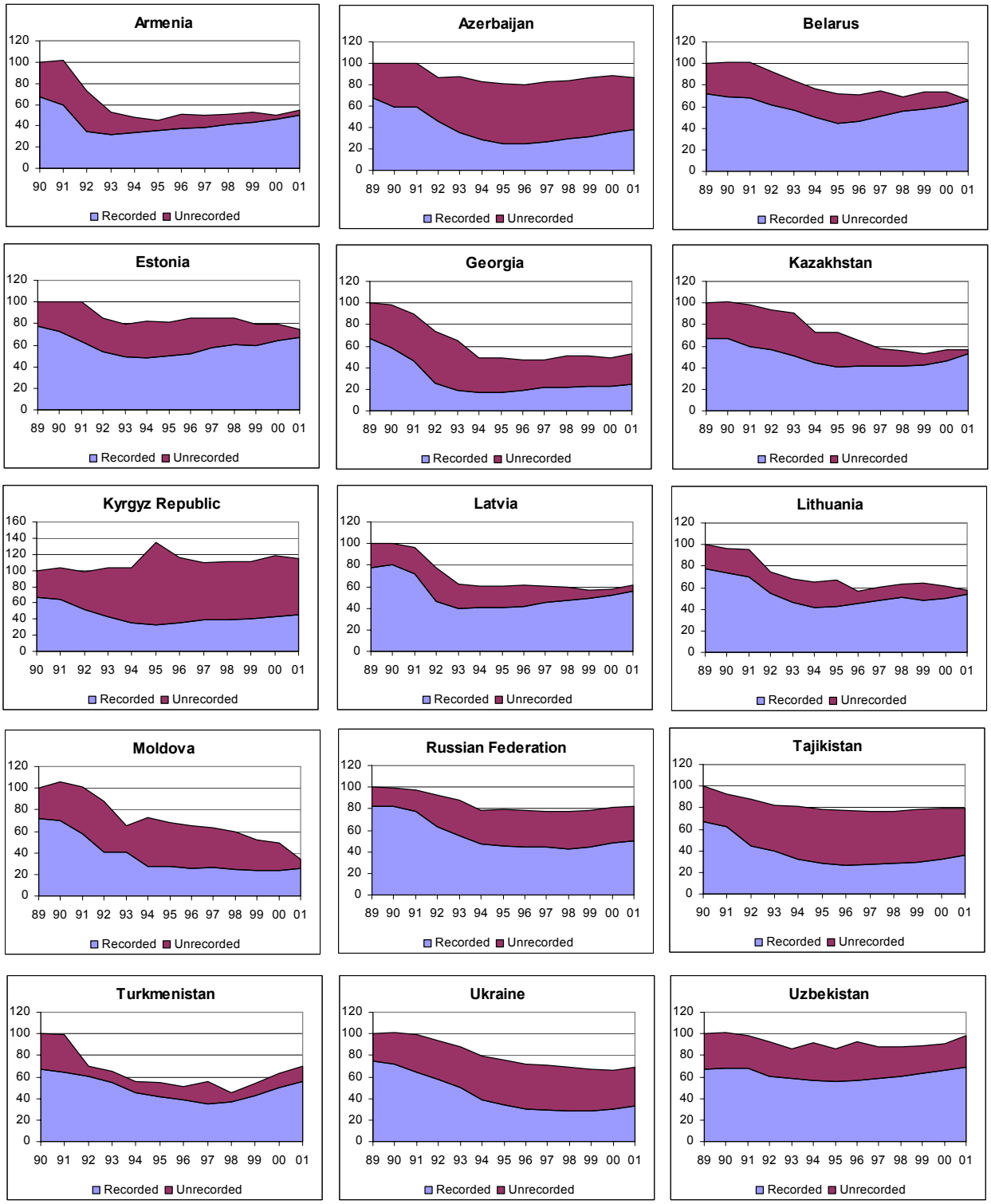
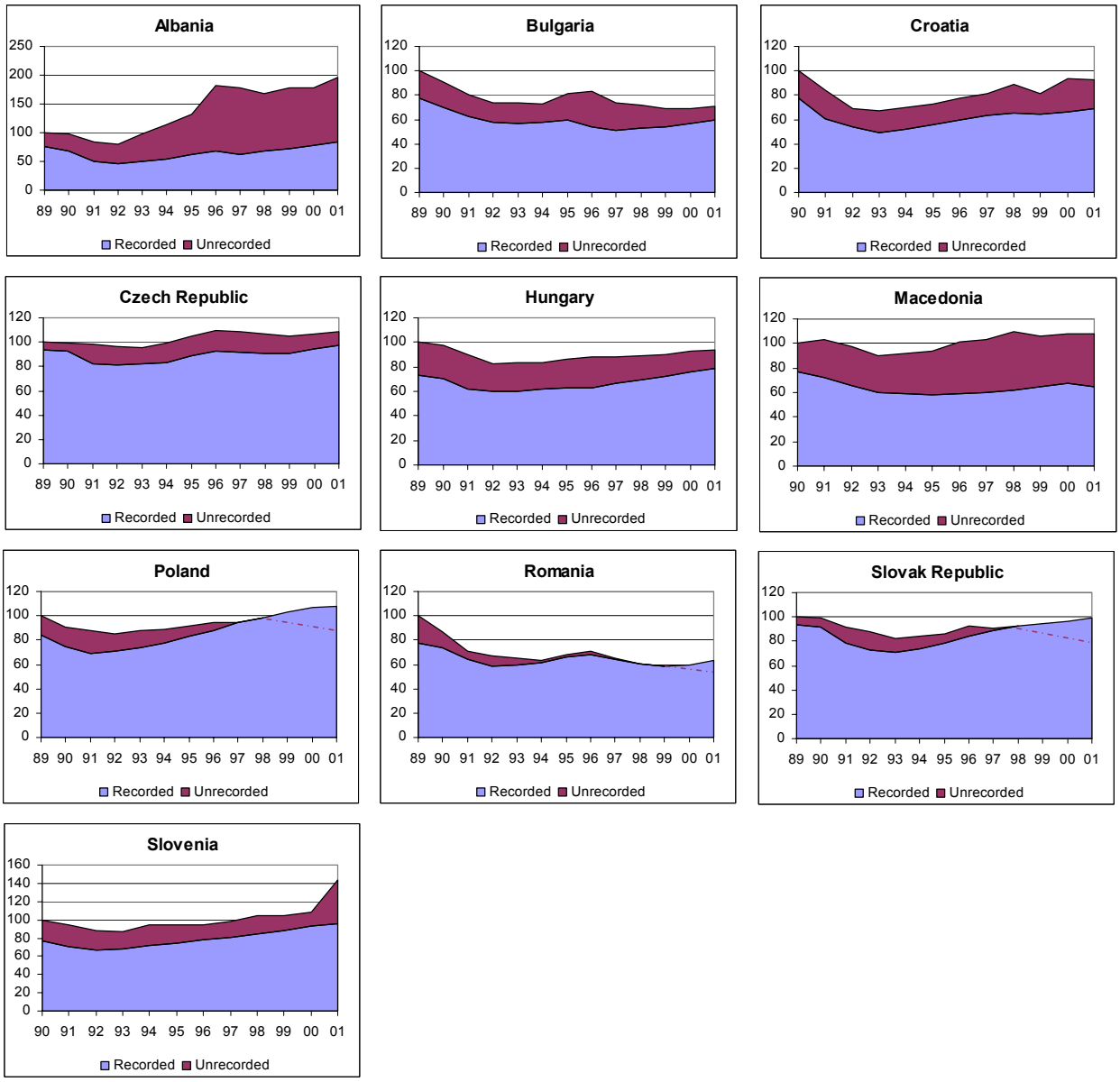


Figure A6: Evolution of Recorded and Unrecorded Economic Activity as Calculated by ECM-H Method – CEE Countries



APPENDIX B- Tables

Table B1: MECM GLS Estimates of $(\,)\mathrm{Elec}_t$) on $(\,)\mathrm{Eprice}_t$) –1995-2001

Dependent Variable: $(\,)\mathrm{Elec}_t$)
Method: GLS (Cross Section Weights)
Sample: 1995 2001
Included observations: 7
Number of cross-sections used: 24
Total panel (balanced) observations: 148

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$(\,)\mathrm{Eprice}_t$)	-0.018181	0.009102	-1.997476	0.0480
Fixed Effects				
_ALB--C	0.068606			
_ARM--C	0.031867			
_AZE--C	0.010385			
_BEL--C	-0.007708			
_BUG--C	-0.003996			
_CRO--C	0.039750			
_CZE--C	0.014144			
_EST--C	-0.010836			
_GEO--C	0.015030			
_HUN--C	0.017321			
_KAZ--C	-0.039518			
_KYR--C	0.028332			
_LAT--C	0.005866			
_LIT--C	-0.020634			
_MAC--C	0.022310			
_MOL--C	-0.111885			
_POL--C	0.004753			
_ROM--C	-0.006271			
_RUS--C	0.005349			
_SLK--C	0.004864			
_SLO--C	0.058856			
_TKM--C	0.176461			
_UKR--C	-0.008756			
_UZB--C	-0.019779			

Weighted Statistics			
R-squared	0.417635	Mean dependent var	0.013861
Adjusted R-squared	0.304003	S.D. dependent var	0.088833
S.E. of regression	0.074110	Sum squared resid	0.675552
Durbin-Watson stat	1.959678		

Unweighted Statistics			
R-squared	0.299274	Mean dependent var	0.006260
Adjusted R-squared	0.162547	S.D. dependent var	0.081434
S.E. of regression	0.074522	Sum squared resid	0.683082
Durbin-Watson stat	2.050075		

Table B2a: Average Size of the Unrecorded Economy as Calculated by Four ECM Models. FSU-1989-2001
Percent of Total Economic Activity [Yu/TEA x 100]

FSU	ECM-L		ECM-H		FUEZ		FUGLS	
	Period	Average Size **Yu/TEA**	Period	Average Size **Yu/TEA**	Period	Average Size **Yu/TEA**	Period	Average Size **Yu/TEA**
The Baltics								
Estonia	89-01	21.3	89-01	30.3	90-01	27.2	89-01	31.1
Latvia	89-01	14.9	89-01	24.6	90-01	23.3	89-01	25.4
Lithuania	89-01	14.3	89-01	24.1	90-01	13.8	89-01	24.2
MEAN FOR GROUP:		**16.8**		**26.3**		**21.4**		**26.9**
Western FSU								
Belarus	89-01	10.6	89-01	27.5	90-01	11.6	89-01	27.8
Moldova	89-01	36.4	89-01	48.4	90-99	43.0	89-01	47.0
Russian Federation	89-01	30.9	89-01	35.6	90-00	36.5	89-00	35.4
Ukraine	89-01	37.9	89-01	47.3	90-00	40.3	89-01	47.2
MEAN FOR GROUP:		**29.0**		**39.7**		**32.9**		**39.4**
The Caucasus								
Armenia	90-01	4.3	90-01	26.9	90-01	25.2	90-01	30.4
Azerbaijan	89-01	43.5	89-01	56.8	90-01	45.2	90-97	55.3
Georgia	89-01	41.5	89-01	55.3	90-00	48.3	89-01	55.4
MEAN FOR GROUP:		**29.8**		**46.4**		**39.6**		**47.0**
Central Asia								
Kazakhstan	89-01	10.3	89-01	31.5	90-01	15.8	89-01	29.9
Kyrgyz Republic	90-01	45.8	90-01	58.6	90-01	50.8	90-01	59.2
Tajikistan	90-01	41.3	90-00	55.2	90-01	na		na
Turkmenistan	90-01	0.3	90-01	23.9	90-00	6.3	90-00	24.6
Uzbekistan	89-01	11.9	89-01	32.7	90-99	12.9	89-00	34.0
MEAN FOR GROUP:		**21.9**		**40.4**		**21.5**		**36.9**
MEAN FOR FSU:		**24.3**		**38.6**		**28.6**		**37.6**

Table B2b: Average Size of the Unrecorded Economy as Calculated by Four ECM Models. CEE-1989-2001
Percent of Total Economic Activity [Yu/TEA x 100]

CEE	ECM-L		ECM-H		FUEZ		FUGLS	
	Period	Average Size **Yu/TEA**	Period	Average Size **Yu/TEA**	Period	Average Size **Yu/TEA**	Period	Average Size **Yu/TEA**
EU Border Countries								
Croatia	90-01	24.6	90-01	24.6	90-01	25.6	90-01	24.0
Czech Republic	89-01	13.2	89-01	13.2	90-01	14.7	89-01	13.2
Hungary	89-01	25.0	89-01	25.0	90-00	25.9	89-01	25.1
Poland	89-01	4.7	89-01	4.7	90-01	8.6	89-01	4.9
Slovak Republic	89-01	2.2	89-01	2.2	90-01	3.0	89-01	2.5
Slovenia	90-01	21.6	90-01	21.6	90-01	23.3	90-01	21.3
MEAN FOR GROUP:		**15.2**		**15.2**		**16.9**		**15.2**
The Balkans								
Albania	89-01	49.9	89-01	49.9	90-01	47.3	89-01	49.3
Bulgaria	89-01	23.8	89-01	23.8	90-99	33.4	89-99	29.6
Macedonia	90-01	36.4	90-01	36.4	90-99	37.2	90-01	36.2
Romania	89-01	4.8	89-01	4.7	90-00	15.6	89-01	5.5
MEAN FOR GROUP:		**28.7**		**28.7**		**33.4**		**30.2**
MEAN FOR CEE:		**20.6**		**20.6**		**23.5**		**21.2**

Table B3a: Comparison of Recorded Growth, Growth of the Unrecorded Economy and the Rate of Growth of Total Economic Activity: FSU- 1989-2001

	ECM-H		
FSU	Average Growth **Yo**	Average Growth **Yu**	Average Growth **TEA**
The Baltics			
Estonia	-0.9	-6.1	-2.3
Latvia	-1.8	-8.9	-3.6
Lithuania	-2.7	-8.0	-4.1
MEAN FOR GROUP:	**-1.8**	**-7.7**	**-3.3**
Western FSU			
Belarus	-0.5	-12.5	-3.2
Moldova	-7.4	-2.8	-7.9
Russian Federation	-3.6	5.7	-1.5
Ukraine	-6.1	3.2	-3.0
MEAN FOR GROUP:	**-4.4**	**-1.6**	**-3.9**
The Caucasus			
Armenia	-1.3	-12.7	-4.5
Azerbaijan	-3.7	3.7	-1.1
Georgia	-6.5	-0.3	-4.8
MEAN FOR GROUP:	**-3.8**	**-3.1**	**-3.5**
Central Asia			
Kazakhstan	-1.7	-12.5	-4.4
Kyrgyz Republic	-2.9	8.7	1.8
Tajikistan	-4.9	3.6	-2.0
Turkmenistan	-1.1	2.8	-2.1
Uzbekistan	0.3	0.2	0.0
MEAN FOR GROUP:	**-2.1**	**0.6**	**-1.3**
MEAN FOR FSU:	**-3.0**	**-2.4**	**-2.8**

Table B3b: Comparison of Recorded Growth, Growth of the Unrecorded Economy and the Rate of Growth of Total Economic Activity: CEE- 1989-2001

	ECM-H		
CEE	Average Growth **Yo**	Average Growth **Yu**	Average Growth **TEA**
EU Border Countries			
Croatia	-0.7	3.7	-0.2
Czech Republic	0.4	10.5	0.7
Hungary	0.8	-4.4	-0.4
Poland	2.2	-78.0	-0.7
Slovak Republic	0.7	-2.3	-1.2
Slovenia	2.0	16.2	3.8
MEAN FOR GROUP:	**0.9**	**-9.0**	**0.3**
The Balkans			
Albania	1.5	15.7	6.7
Bulgaria	-2.0	-3.8	-2.7
Macedonia	-1.5	6.7	0.8
Romania	-1.5	-247.5	-4.2
MEAN FOR GROUP:	**-0.9**	**-57.2**	**0.2**
MEAN FOR CEE:	**0.2**	**-28.3**	**0.3**

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